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CRUISE REPORT

CARBO-ACID

RV Ramón Margalef, SEA02_10

02.08.2022 - 11.08.2022,

Vigo (Spain) - Lisbon (Portugal)

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Carbo-Acid

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1 Summary

The CARBO-ACID research cruise (EUROFLEETS+ SEA02_10) was carried out on the RV Ramón Margalef between August 2nd and August 11st, with departing from Vigo – Spain and ending in Lisbon – Portugal. The main objective of this cruise was to collect data and samples to study the potential effects of ocean acidification on carbonate marine organisms (coccolithophores, pteropods, planktonic and benthic foraminifera, and corals) along the Iberian margin. With this objective, oceanographic data and water samples, plankton, cold-water corals and sediment samples were collected during an upwelling season, along two transects coinciding with the two persistent upwelling filaments off the Iberia Margin: the Cape Finisterra and the Cape Roca.

The cruise work was carried out as initially proposed, except for the long gravity cores (which were aiming to study the oceanographic conditions since the Last Glacial Maximum) because the ship did not have the required device onboard that allow to collect it. During the cruise we did a total of 7 stations, 4 stations along the Cape Finisterra transect (from W to E: CA3, CA2, CA7, CA8) and 3 stations at the Cape Roca (from W to E: CA6, CA5, CA4) transect (Fig. 1.1). At each station we usually started with a multibeam survey, a CTD and Rosette cast. These initial operations allowed to identify the different water masses present in this area, characterize their physical properties and to recover seawater samples at specific depth levels. The seawater samples were onboard subsampled, preserved in cold conditions or with chemicals and/ or filtered for several further analysis in the shore-based laboratories: DNA, chlorophyll, fitoplankton, coccolithophores, pH, alkalinity, stable isotopic composition, trace elements concentration and Suspend Particulate Matter. Subsequently to these operations, at each station, two vertical tows with a plankton multinet (with 5 nets) were done on the top 700 m of the water column to sample the planktonic communities of the different water depths. After this, sediment samples were recovered with a box-corer to study the past oceanographic conditions, between the pre-industrial Era and the Present, with multi-proxies used in paleoceanography and sedimentology. A total of 10 box-cores were recollected and each of them was onboard sub-sampled for DNA, enzymes and benthic foraminifera. Fifteen Shipek grab samples were recollected at the Fontanelas seamount (Estremadura Spur), station CA6, to characterize the sedimentary cover and to evaluate the presence of deep cold-water corals.

Preliminary results show that the stations CA7, CA8 and CA4, located close to the coast, as expected, are the most influenced by the coastal upwelling, exhibiting colder surface water, higher values of fluorescence, and more zooplankton content reflecting higher phyto-zooplankton concentrations, as typical of the upwelling waters. At station CA4 temperature was higher and fluorescence showed lower values, indicative of less phytoplankton, and interpreted as indicating a different upwelling source water from that upwelled further north. Based on the CTD data, the Cape Roca transect is more influenced by the subtropical East North Atlantic Central Water (ENACWst), while the Cape Finisterra transect is more under the influence of the subpolar branch (ENACWsp). Seafloor sediment samples showed significant differences between the stations. Along the northern transect (Cape Finisterra) the seafloor sediments show an increase in grain size from the offshore to the coast. The offshore stations CA3 and CA2 revealed finer grained sediments, CA8 were composed of coarser sand and the station CA7, the shallowest station 77 m, presented the sediment composed mainly of shell fragments and coarse grain sand. Along the southern transect (Cape Roca), the offshore station CA6 (Fontanelas seamount) has coarser sandy sediments with rock clasts and cold-water coral fragments, and the stations CA5 and CA4 with fine sand to muddy sediments. The detailed CA6 bathymetry allowed to verify the

existence of small plateaus on the slope of the Fontanelas seamount, where the fossil cold-water corals fragments were found, suggesting that this area is a very interesting system deserving further study with a ROV, and to characterize the corals fields and verify if there are live corals.

These recollected data and samples (Fig. 1.1) will allow not only to reconstruct the pH variability under different environmental conditions, but also to estimate the biogeochemical changes along the coastal ocean waters as the anthropogenic influence increases. These results will contribute to better understand and model the effects on the biota under the future expected oceans pH changes.

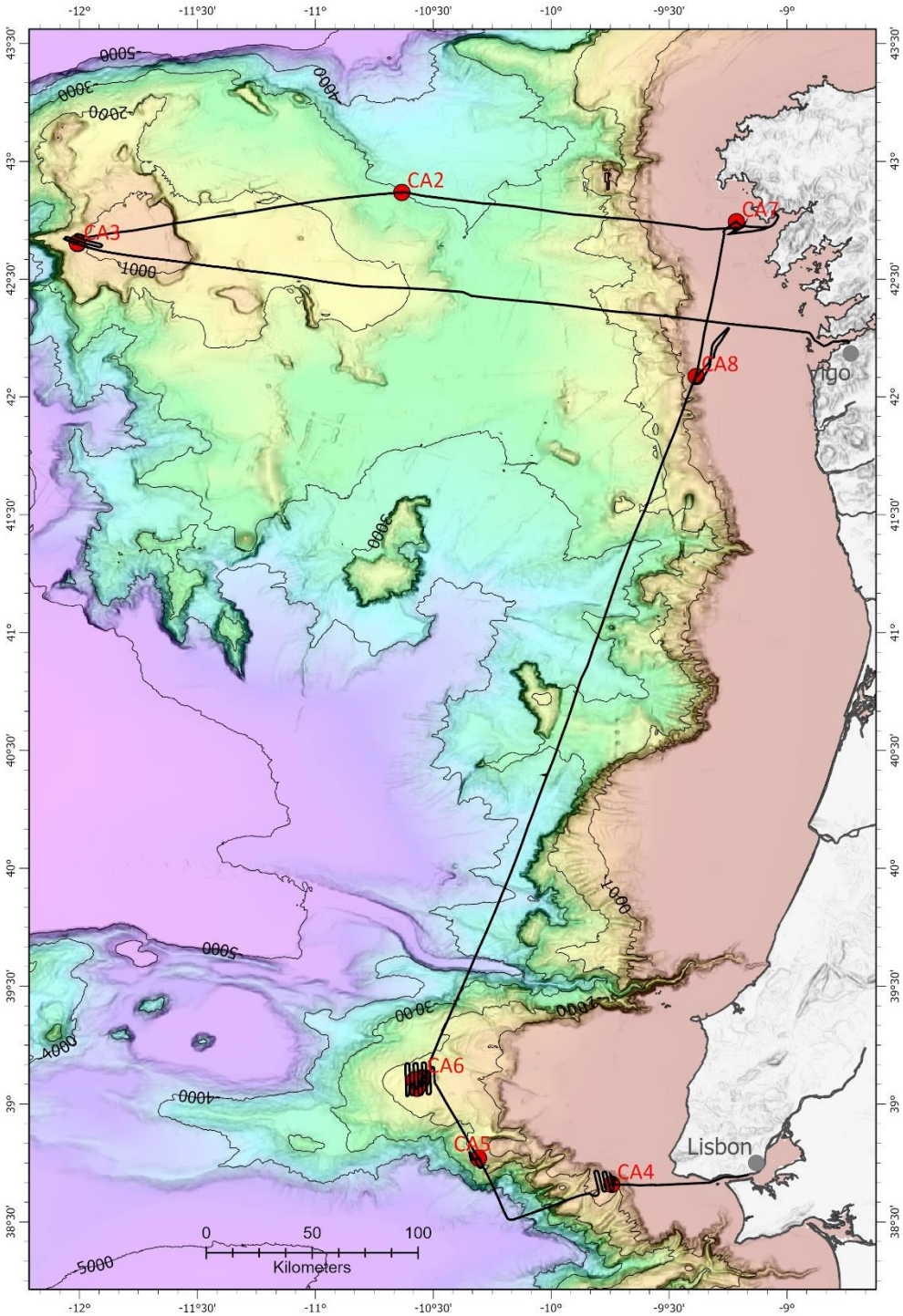

Fig. 1.1 Working area and shiptrack of RV Ramón Margalef during the CARBO-ACID Cruise. Bathymetry from EMODnet Bathymetry (2022).

2 Research Programme/Objectives

Since pre-industrial Era the atmospheric carbon dioxide (CO_2) concentrations increased from 280 parts per million volume (ppmv) to the present-day more than 418 ppmv (Dlugokencky and Tans, 2020), reaching the highest concentration experienced on Earth for the last 800 ky (Lüthi et al., 2008). If global emissions of CO_2 continue to rise at the same rate as between 2006 and 2015, the average pH of the ocean's surface water is predicted to fall by ~0.3 pH units by the end of this century (Bindoff et al. 2019). At coastal upwelling regions the ocean acidification can regionally be amplified by the combination of the high CO_2 concentrations in the upwelled waters with the high rates of primary production and respiration that strongly control seawater carbonate chemistry (e.g. Feely et al., 2008). This scenario can regionally potentiate dramatic impacts, some of them are already being observed in the marine biota, especially in carbonated organisms, e.g. diversity loss and reduction of the calcification rate (e.g. Bijma et al., 2013). To investigate the evolution of ocean acidification along the Iberian coastal upwelling system and to evaluate its impact on carbonated organisms (coccolithophores, pteropods, planktonic and benthic foraminifera, and corals), we carried this research cruise, where we collected data and samples (water, zooplankton, cold-water corals, and sediments) during an upwelling season, along two longitudinal transects that include two important upwelling filaments in the Iberian margin, the Cape Finisterra and Cape Roca filaments. This will allow us to investigate the effects of ocean acidification on the carbonate marine organisms: coccolithophores, pteropods, planktonic and benthic foraminifera, and cold-water corals in a mid-latitude region of the North Atlantic. Besides being a coastal upwelling system, where acidification if potentially amplified (by lower pH-upwelled waters and elevated primary production), the Iberian margin is a key region for paleoceanographic studies because its sediments record the climatic and oceanographic signals from high latitudes of both hemispheres, Greenland and Antarctica (Shackleton et al., 2000). Our results will improve the calibration of pH proxies and thus (past) pH reconstructions, allowing a comparison with the vast existing knowledge on the oceanographic history (paleoceanography) and calcifiers evolution (micropaleontology) on the Iberian margin, and to estimate the amplitude of future changes in the ocean in terms of CO_2 biogeochemistry and biota response.

3 Narrative of the Cruise

All the references to time (hours) given in the text and tables of this report are in UTC (Coordinated Universal Time) and recorded by us during the operations.

The group of 8 scientists that participated in the CARBO-ACID cruise arrived at the port of Vigo on August 1st 2022 at 18h. Then the luggage, material, and participants boarded at the RV Ramón Margalef. During that night all members of the scientific party began to unpack the material and set-up the laboratories. All researchers spent the night on the vessel.

DAY 1 (August 2nd 2022)

In the morning the scientific party continued to prepare the laboratories, while the technical members from IEO (*Instituto Español de Oceanografia*), CSIC (*Consejo Superior de Investigaciones Científicas*) and the RV Ramón Margalef Crew set-up and tested the gears. We had safety training, useful information's on the day-to-day routines on the life onboard. We also had a guided tour to the vessel. The RV Ramón Margalef left the Port of Vigo on August 2nd 2022 (12:33) and sailed in direction to station CA3. Due to the weather forecast that showed an increasing wind conditions and worst sea conditions moving from the offshore to the coast, we decided to start the operations at the most offshore oceanic station and from there moving to the more coastal stations. At the begging of the transit (14:31), still in the Ría de Vigo at a depth of 40 m (Lat. 42°12.96 N; Long. 8°50.48 W) the multinet was tested, without taking samples, operation to setup and to test all the system components. During transit, the members of the scientific party finalized the set-up of the laboratories and prepared the material for the sampling operations in the next day. Transit was done at maximum speed and therefore no multibeam was acquired.

DAY 2 (August 3rd 2022)

The multibeam data acquisition started at 03:48, as approaching the station CA3 when the water depth started to be within the operation range of the multibeam system, and finished at 9:02, when we arrived at station CA3 (Lat. 42°39.00 N, Long. 12°00.51 W) at 1100 m water depth. In station we started the sampling operations, first with the CTD/ rosette deployment at 9:11 down to 1075 m water depth, where were recovered seawater samples at 5 specific depths, followed of 2 multinet operations (required to have sufficient material for all the analysis) until 700 m water depth, 5 intervals of zooplankton recollection were done (CA3-M1 started at 11:25; CA3-M2 started at 13:32).

At 17:18 the first box-corer was deployed (Lat. 42°39.23 N, Long. 12°00.58 W) to collect sediments, but it was not conveniently closed and it collected an insufficient amount of sandy sediment, most of it washed out in the bottom of the box. The ship moved slightly from the station, and we tried a second box-corer that started at 18:32, we collected only 15 cm of sediment that was mixed while the equipment was retrieved onboard. In both box-corers, sub-sampling liners were not collected, only surface samples were recollected. After these two attempts we decided at 20:00 to do a complementary multibeam data acquisition at station CA3, where was carried out 4 parallel survey lines, and multibeam acquisition continued during the transit to station CA2. Immediately after the CTD/ rosette arrived on board at station CA3, in parallel with the other sampling

operations, part of the Scientific Party subsampled water for: pH, alkalinity, oxygen and carbon stable isotopic composition, trace elements, DNA, chlorophyll and phytoplankton content and composition, and Suspend Particulate Matter (Corg-POM, C and N isotopes). These subsamples of seawater were preserved in the fridge, filtered and/or poisoned. The seawater sampling, poisoning, and filtering took approximately 10 hours, finishing at 20:00. During the transit to CA2, the scientific party stored all samples and made sure that the sampling and filtration equipment was well secure.

DAY 3 (August 4th 2022)

The multibeam data acquisition finished at 4:57 because the water depth reached the limits of operation of the system. Transit was then carried out at 10 knots and we arrived at station CA2 at 6:10 (Lat. 42°05.26 N, Long. 10°37.94 W) at 2971 m water depth. We started, as in Station CA3, with CTD/ rosette deployment at 6:13 down to 2940 m water depth, where were recovered seawater samples at 6 specific depths, followed of 2 multinet operations, until 700 m water depth, where were collected 5 intervals of zooplankton (CA2-M1 started at 8:30; CA2-M2 started at 10:46). At 12: 34 the box-corer, was deployed slightly at same position at 2940 water depth, and 11 to 18 cm height of pelagic sediment was collected. The sediment in the box-corer was subsampled: first the surface samples were collected and after inserted 8 liners: 3 for DNA, 3 for Benthic Foraminifera (BF), and 2 for Geologic samples. The DNA and BF´s liners were subsampled onboard poisoned, and frozen. Due to bad weather conditions, strong wind and high swell that was expected to be worse during the night and reach the station CA1, it was decided to abandon the station CA2 and substitute the station CA1 for other station located at a new site, further south, close to the coast, called station CA7, where the wind conditions were more favourable. In parallel, immediately after CA2 CTD/ rosette arrived on board, proceeded the seawater subsampling, filtered and or poisoned during approximately 11.5 hours, until 19:30.

DAY 4 (August 5th 2022)

We arrived at station CA7 at 7:30 (Lat. 42°44.59 N, Long. 09°12.86 W) at 77 m water depth. In station we started first with CTD/ rosette deployment at 7:31 down to 65 m water depth, where were recovered seawater samples at 3 specific depths. After CTD/ rosette arrived on board, proceeded the seawater sub-sampling of seawater, poisoning or filtration was carried out. At same time, for logistical reasons and to optimize the sampling time, as the multinet was not yet ready, it was decided to carry out a box-corer first at 8:57. The sediment composed mainly of broken shells and sand, where was collected surface samples and 3 BF´s liners were subsampled onboard, poisoned with Bengal Rose, and frozen. Afterwards, we did 2 operations with a multinet until 65 m water depth, where only 2 intervals of zooplankton were collected, because this site was very shallow (CA7-M1 started at 10:54; CA7-M2 started at 11:30). As this station was shorted, we had some extra time and we decided to re-visited the CALIBERIA station (Salgueiro et al. 2020), our station CA8, before to go to Cape Roca transect. At station CA7 no multibeam was acquired.

At 15:28, we started the transit to station CA8 and the multibeam data acquisition, until 5:32 of next day (August 6th), surveying the area of station CA8 with one line of multibeam to characterize the seafloor topography.

DAY 5 (August 6th 2022)

We arrived at station CA8 at 6:05 (Lat. 42°05.26 N, Long. 09°23.12 W) at 343 m water depth. As usually, we started with CTD/ rosette deployment at 6:15 down to 320 m water depth, where were recovered seawater samples at 6 specific depths, followed the sub-sampling of seawater, filtration and or poisoning was carried out. In parallel we did 2 multinet operations, until 320 m water depth, where were collected 5 intervals of zooplankton (CA8-M1 started at 6:57; CA8-M2 started at 7:57). At 8:57 the box-corer, was deployed slightly at the same position (Lat. 42°04.54 N, Long. 09°23.56 W) at 343 m water depth. Box-corer allowed to collect 14 to 17 cm of sediment. Surface samples were collected, and 9 liners were inserted in the sediment box: 3 for DNA, 3 for BF, and 3 for Geologic samples. The DNA and BF´s liners were subsampled onboard, poisoned, and frozen. When finished the filtration and the subsampling of the sediments, we started the transit towards the 2nd transect, station CA6. Close to station CA6, and at an approximate depth of 2600 m, the multibeam data acquisition started at 21:26, until 5:52 of next day (August 7th).

DAY 6 (August 7th 2022)

We arrived at station CA6 at 6:02 (Lat. 39°06.64 N, Long. 10°32.90 W) at 1433 m water depth. We deployed the CTD/ rosette at 6:10 down to 1410 m water depth, where were recovered seawater samples at 6 specific depths, followed the seawater sub-sampling, filtration and or poisoning was carried out. In parallel we did 2 multinet operations, until 700 m water depth, where were collected 5 intervals of zooplankton (CA6-M1 started at 7:27; CA6-M2 started at 9:51). Between 11:31 and 16:32 the sediment sampling was performed by Shipek grab, in 5 operations slightly close to the station CA6 location. Only the first Shipek grab failed, because arrived open without material. In this station we employed the Shipek grab instead of the box-corer, because we were expecting coarse-sandy sediments at the seafloor or even rocky outcrops and corals.

The multibeam data acquisition started at 15:21, until 6:00 of next day (August 8th).

DAY 7 (August 8th 2022)

Still at station CA6, we performed another 10 Shipek grab samples, deployed through the Fontanelas Seamount between 6:06 and 14:42. Two, of the ten Shipek grab operations, were unsuccessful, arriving onboard only with water. At 15:04 the multibeam data acquisition restarted to finish the detailed bathymetric survey of the Fontanelas Seamount and the transit from station CA6 to station CA5 was carried out with multibeam survey, until 5:54 of next day (August 9th) allowing to image the seafloor at station CA5 with 2 survey lines.

DAY 8 (August 9th 2022)

We arrived at station CA5 at 5:59 (Lat. 38°46.19 N, Long. 10°18.53 W) at 1683 m water depth. As usually, we started with CTD/ rosette deployment at 6:03 down to 1663 m water depth, where were recovered seawater samples at 6 specific depths, followed by the sub-sampling of seawater, filtration and/ or poisoning. In parallel we did 2 multinet casts, until 700 m water depth, where were collected 5 intervals of zooplankton tows (CA5-

M1 started at 7:27; CA5-M2 started at 9:14). At 10:45 the box-corer, was deployed slightly at same position (Lat. 38°46.19 N, Long. 10°18.71 W) at 1684 m water depth. The box arrived full of sediment and surface samples were collected followed by 8 liners: 3 for DNA, 3 for BF, and 2 for Geology. At 13:24 we deployed the second box-corer (Lat. 38°46.19 N, Long. 11°18.52 W) at 1684 m water depth. The box arrived only with 15 cm of sediment. Surface samples were collected as also 7 liners: 3 for BF, and 4 for Geologic studies. The DNA and BF´s liners of both box-corers were subsampled onboard, poisoned, and frozen. After subsampling, cleaning and save the box of the box-corer, and once finished the seawater filtration, the transit to station CA4 started at 15:05 until 19:48. Multibeam data was acquired during this transit. After that, we continued to acquire multibeam data at station CA4, until 5: 34 of next day (August 10th).

DAY 9 (August 10th 2022)

We arrived at station CA4, the last station of the cruise, at 5:58 (Lat. 38°39.55 N, Long. 9°44.54 W), 584 m water depth. CTD/ rosette was deployed at 6:07 down to 560 m water depth, where were recovered seawater samples at 6 specific depths, followed by the sub-sampling of seawater, filtration and/ or poisoning. In parallel, we did 2 multinet operations, until 560 m water depth, where were collected 5 intervals of zooplankton tows (CA4-M1 started at 6:50; CA4-M2 started at 8:15). Between 10:32 and 14:12 the box-corer, was deployed 3 times at the same position. The first one, CA4-BC1 was unsuccessful. The second one, CA4-BC2, the pulley that supported the box-corer cable broke when the box-corer was arriving on the ship, fortunately the equipment was recovered and the pulley replaced, but the box with the sediment was intensely shaken and the surface of the sediment was very mixed. New operation attempted, CA4-BC3 that was carried out with success. The two last box-corers recovered approximately 35 cm sediment height in the box. In each one surface samples were collected (in CA4-BC2 only for DNA) and also 9 liners: CA4-BC2 - 3 for BF and 6 for Geologic samples; CA4-BC3 - 3 for DNA, 3 for BF, and 3 for Geologic samples. The DNA and BF´s liners of both operations were subsampled onboard, poisoned, and frozen. With the CA4-BC3 the station work was completed, and the RV Ramón Margalef left in direction to Port of Lisbon. Once the filtration and subsampling of the sediments finished, all equipment's/ material were washed and saved. The samples were better packed for the trip.

Scientific party began to pack the material and clean the laboratories.

DAY 10 (August 11st 2022)

The RV Ramón Margalef docked in Port of Lisbon at 8:30 on August 11st. Scientific party finished the packing and cleaning of the cabins. IPMA`s colleague arrived with the van and transported all the material, samples and the scientific team from the ship to IPMA. All Scientific party left from the ship at 14:00.

4 Preliminary Results

4.1 Underway Hydroacoustic (Multi-beam echosounding)

(V. Magalhaes, D. Pérez and L. Batista)

4.1.1 System Overview and Data Processing

Multibeam

RV Ramón Margalef had the Kongsberg EM710 hull-mounted multibeam echo sounder system available for bathymetric mapping of the seafloor during the campaign. The Kongsberg EM710 Multibeam echo sounder is a high-resolution shallow and intermediate water depth seabed mapping system, with a maximum operational depth range of 2800 m, a frequency band range from 40 to 100 kHz, with a maximum ping rate of 30 Hz and a swath coverage up to 140 degrees. The footprint of the beams has a 0.5 x 1° (along by across track respectively). In addition to the bathymetry data, the EM710 multi-beam echo sounder also records the amplitude of the backscattered signal. Further details can be found at https://www.eurofleets.eu/vessel/rv-ramon-margalef/ and https://www.ieo.es.

During the cruise, the EM710 multibeam echo sounder was run at the sampling sites, surveying the proposed sites with 1 to 8 parallel survey lines to obtain a mosaic of the interest area so that the seabed sampling operations could be safely conducted, avoiding any hard-grounds or rocky outcrops. Multibeam bathymetry was also acquired during the transits whenever the ship velocity was under 7 knots, the water depth was within the acquisition depth ranges of the system and the weather conditions allowed for the required navigation speed and an acceptable quality of the data. The quality of the acquired multibeam bathymetric data was very good. Multibeam backscatter was also acquired and onboard processed to produce seafloor acoustic backscatter maps of the sampling targets. Those provided important information about the seafloor geomorphology and physical properties, fundamental for the seafloor characterization prior to any of the seabed sampling operations. Therefore, backscatter mosaics were processed onboard, in general, prior to the seabed sampling operations. The data acquisition has failed during short periods from various causes (software hang-up, failures of the transmit/receiver unit due to hardware failure), however the onboard technicians were able to correct these failures and acquisition was always resumed. However, some data gaps occurred during the campaign: i) at station CA2 because the water depth exceed the operational range of the system; ii) at station CA7 data was not acquired due to time limitations and because the seafloor was sufficiently characterized using the EA600 sub-bottom profiler; iii) due to hardware failure data was not acquired during the transits from CA2 to CA7 and from CA7 to CA8; iv) during the transit from CA8 to CA6 no acquisition was not done due to time constrains and because de water depth exceed the operational ranges. Accurate sound velocity profiles to feed the multibeam data acquisition and processing were obtained at each station immediately before the acquisition using an SVP profiler or using the CTD data from the CTD/ rosette stations.

Multibeam data was logged in Kongsberg ***.all*** format. Data was processed onboard using the CARIS HIPS and SIPS software. The CARIS HIPS workflow included:

1. HIPS Vessel File and Project data structure definition;
2. Creating uncertainty models for the computation of TPU;
3. Conversion of raw data to HIPS format;

4. Sound Velocity Correction (applying sound velocity profiles to each station);
5. Applying tides correction;
6. Surface creation (e.g., CUBE);
7. Error detection and analysis of auxiliary sensor information (e.g., navigation, motion, etc.);
8. Using standard deviation and uncertainty surfaces for error recognition;
9. Processing multibeam swath;
10. Area-based cleaning using the Subset Editor;
11. IHO and surface-based data filtering;
12. QC and data visualization using 3D fly-through techniques;
13. Exporting data to 3rd party formats;
14. QC reports, presentation, and plotting.

Sub-Bottom Profiler (EA600)

The vessel is equipped with a hull mounted parametric sub-bottom profiler, the Kongsberg Topas PS18, however it was not functional during the CARBO-ACID cruise, and therefore the PS18 was not used during the entire campaign. Instead, the hydrographic profiler Kongsberg EA600 (operating at 200 kHz for shallow waters and 12 kHz at deeper waters) was employed, not only to guide the navigation and to characterize the seafloor nature at the station's sites, but it was also employed to monitor in real time the deployment of the sediment samplers (box-corer and shipek grab), the CTD/ rosette and the multinet. However, the data from the single beam EA600 was not digitally recorded during this campaign.

4.1.2. Multibeam Results

During this cruise, 237.6 nm of multibeam survey was acquired, corresponding to 2.80 GB of raw data and to a total area of 673.1 km^2 of seafloor coverage (Fig. 4.1).

Cape Finisterra Area (station CA3, CA2, CA7 and CA8)

In the northern area (Cape Finisterra or Galicia area) multibeam bathymetry (Fig. 4.2) was acquired during the transit when approaching to station CA3, at station CA3 and during the transit to CA2 (until the water depth was in the range of operation of the multibeam system). Multibeam was also acquired at stations CA8 (Fig. 4.2). Station CA2 was located bellow the limit of operation of the EM710 multibeam system and therefore this station was not surveyed. Station CA7, located at a very shallow water depth, was also not surveyed, not only due to limitations of time but also because it was sufficiently characterized using the EA600 sub-bottom profiler. During the transit from CA2 to CA7 and CA8 bathymetry data was not acquired due to a hardware failure of the acquisition system.

At station CA3 both bathymetry and backscatter imagery were acquired and processed to characterize the seafloor (Fig. 4.3) for sampling. Data suggested that despite the rough topography, at the proposed sampling site rock outcrops could be avoided and soft sediments could be sampled with box-corer.

At station CA8 (Fig. 4.2), bathymetry and backscatter data indicate a very smooth topography, most probably with fine to sandy sediments, as confirmed by sampling with box-corer (CA8-BC1).

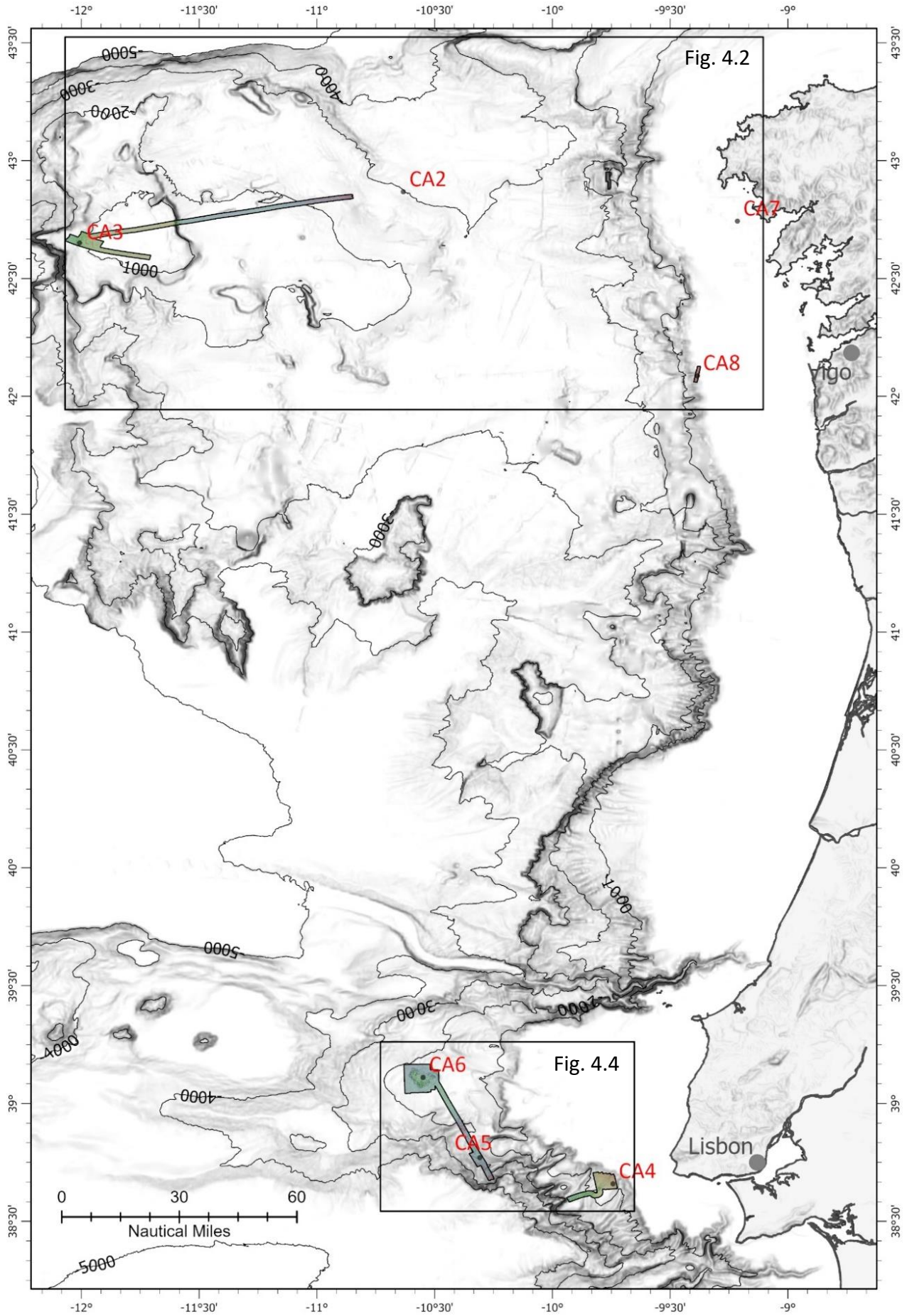

Fig. 4.1 Multibeam coverage acquired during the CARBO-ACID cruise.

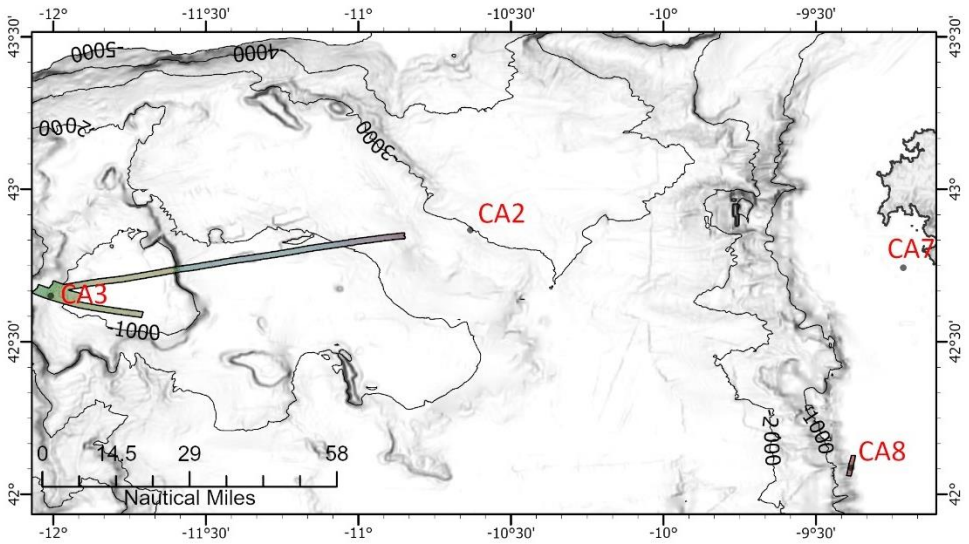

Fig. 4.2 Multibeam coverage acquired in the Cape Finisterra area.

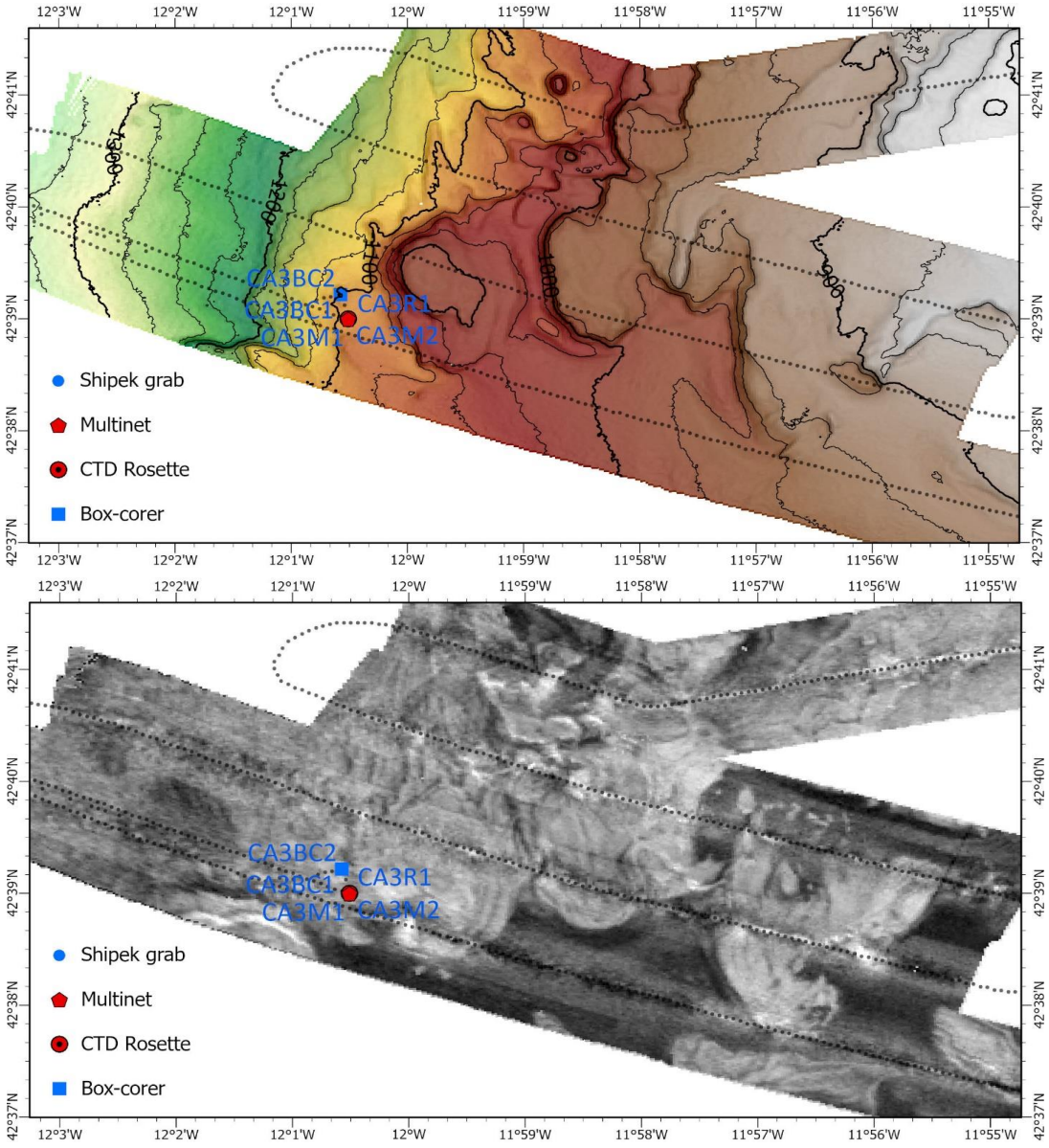

Fig. 4.3 Multibeam and backscatter coverage acquired at CA3 station.

Cape Roca Area (station CA6, CA5, and CA4)

In the Cape Roca or Estremadura Spur area, the station sites CA6, CA5 and CA4 were surveyed with multibeam and backscatter as also the transits between the stations, whenever the water depth was in the operation range of the multibeam system (Fig. 4.1 and Fig. 4.4).

Station CA6, located at the Fontanelas seamount, was surveyed with 8 parallel north-south acquisition lines, to totally image the seamount (Fig. 4.5). The bathymetry of the Fontanelas seamount showed a rough seafloor, with several conical features of stronger backscatter, toping a plateau. As bathymetry and backscatter data indicated a probable presence of hardgrounds, rocky outcrops and possibly coral/coral rubble, the seafloor sampling was done with a Shipek grab and not with a box-corer. Sampling results proved the estimated seafloor nature (see sampling results section) with a coarse sedimentary cover with abundant rocky outcrop fragments and occasional coral rubble. A profile of sampling stations was done along a SW-NE profile crossing the base of the Fontanelas seamount, the highest conical summit, and the plateau (Fig. 4.5).

Stations CA5 and CA4 were surveyed with, respectively, 2 and 5 parallel acquisition lines (Fig. 4.4). Bathymetry and backscatter data indicated a smooth and fine sedimentary cover suitable for sampling with box-corer.

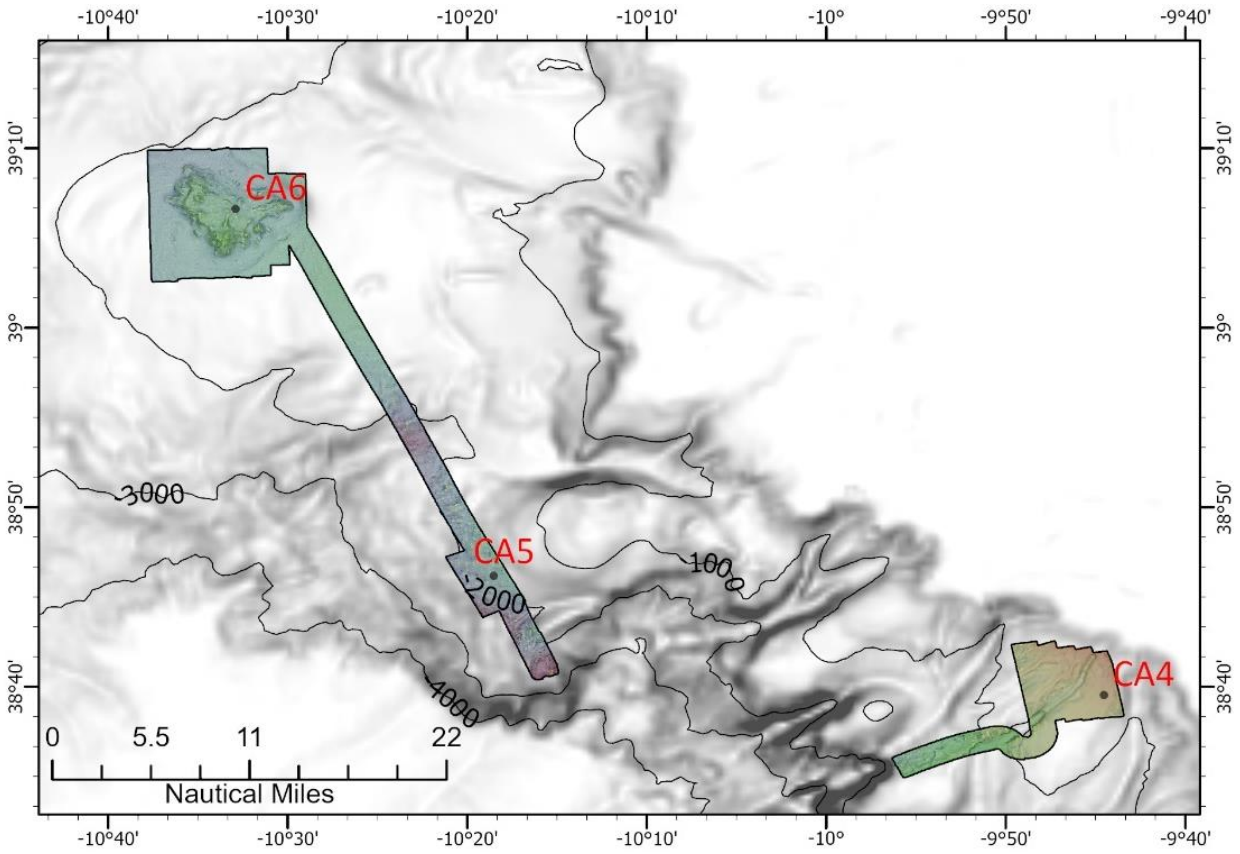

Fig. 4.4 Multibeam coverage acquired in the Cape Roca area.

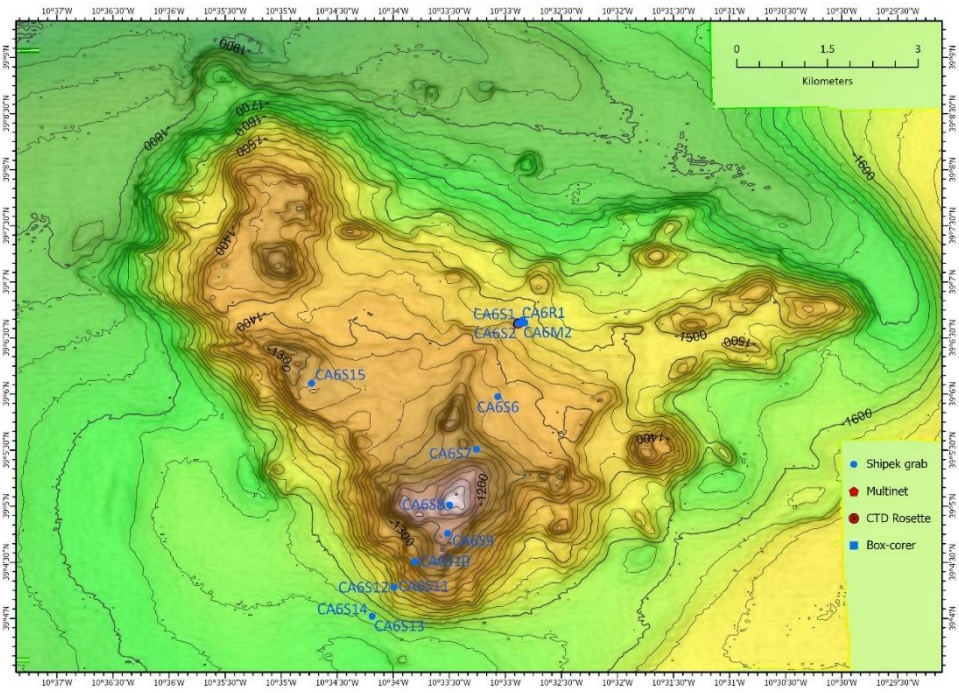

Fig. 4.5 Multibeam coverage acquired at the Fontanelas seamount (station CA6) in the Cape Roca area.

4.2 CTD/ rosette data and seawater sampling

4.2.1. Physical Oceanography: CTD Profiles

(F. Sousa, M. Otero, E. Salgueiro, V. Magalhães)

CTD measurements were performed with the Seabird-CTD-system 2x SBE 911 Plus mounted on a rosette (Fig. 4.6) from the *Instituto Español de Oceanografia* (IEO). Data was recorded with pressure, temperature, conductivity, oxygen, fluorescence and turbidity sensors. Water depth, potential temperature, salinity and sigma-theta (density) were calculated based on some of the above parameters.

Fig. 4.6 Seabird-CTD-system 2x SBE 911 Plus mounted on a rosette used in the CARBO-ACID cruise.

Preliminary results show good quality and consistency of the results (Fig. 4.7 and Fig. 4.8). All the CTD profiles allowed us to identify, in the upper layer, the seasonal thermocline and the fluorescence maximum between 25 m (station close to the coast, CA7) and 175 m (deep stations e.g. CA3). Along the water column, the presence of the Eastern North Atlantic Central Water (ENACW) could be identified in the layer 175-400 m. Then starts the influence of the warm, salty and low oxygen Mediterranean Outflow Water (MOW) until ~1200-1400 m, and for deeper layers, the Labrador Sea Water (LSW) and the North Atlantic Deep Water (NADW), showing a temperature and salinity decrease and an oxygen increase. The ENACW has a component with subtropical origin ($ENACW_{st}$: 18.58°C; 36.75) and a denser water with subpolar origin ($ENACW_{sp}$: 10.00°C; 35.40). The influence of $ENACW_{st}$ is very clear in station CA5 (off Cape Roca), and in station CA2 (off Cape Finisterra), with a more northern location, shows more influence of the $ENACW_{sp}$.

The presence of MOW in the station CA2 has its maximum in salinity at ~1000 m, showing an agreement with the data collected offshore Cape Finisterra, analysed by Prieto *et al.* (2013). In the southern station CA5 it is very clear the presence of the two cores of MOW: the upper core centred at ~800 m (MOW_{upper}) and the lower core at ~1200 m (MOW_{lower}). LSW and NADW are only observed at Cape Finisterra transect, in station CA2 (Fig. 4.7).

Stations CA7, CA8 and CA4, located close to the coast, are the most influenced by coastal upwelling, showing, as expected, colder surface water and higher values of fluorescence, reflecting higher phytoplankton concentrations, as typical of the upwelling regions (Fig. 4.8). At station CA4, the temperature shows higher values and lower fluorescence values, indicating less phytoplankton suggesting a different upwelling source (or stage) from that upwelled further north.

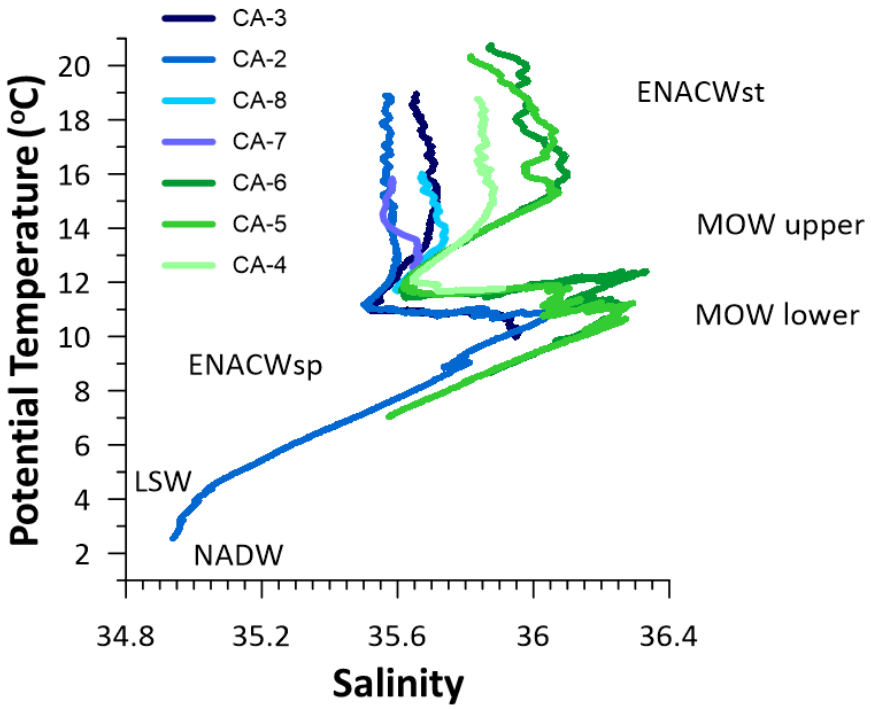

Fig. 4.7 Temperature-Salinity (T-S) profile data for seawater samples at all stations of the CARBO-ACID cruise: Cape Finisterra (blue colours); Cape Roca (green colours). ENACW(st, sp) – East North Atlantic Central Water (subtropical, subpolar); MOW – Mediterranean Outflow Water; LSW – Labrador Sea Water; NADW – North Atlantic Depth Water.

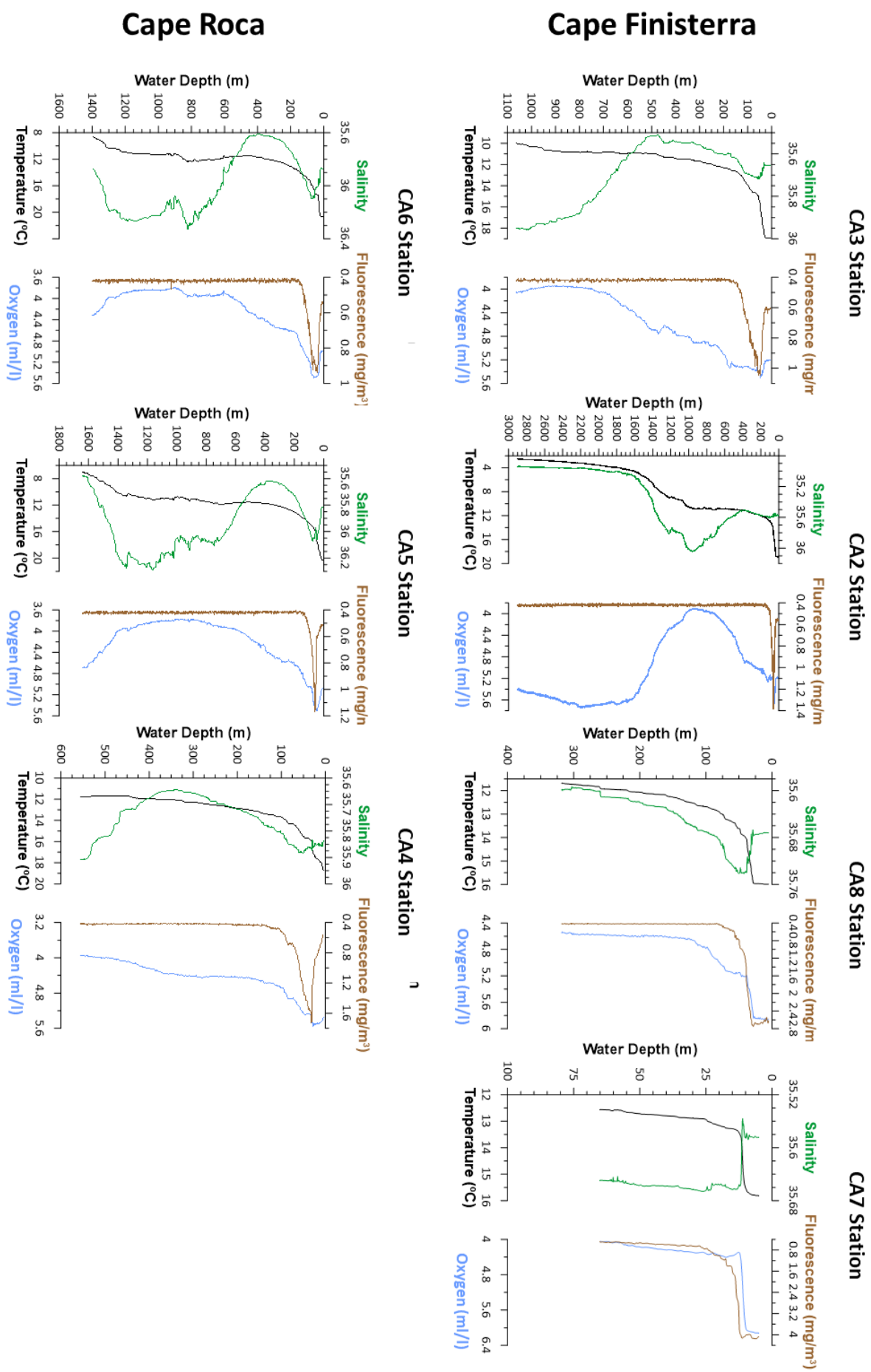

Fig. 4.8 CTD profile data for seawater samples at all stations of CARBO-ACID cruise: Temperature (black); Salinity (green); Fluorescence (brown); Oxygen (blue). Note the different scale by station.

4.2.2. Water column sampling with Rosette

(E. Salgueiro, L. Matos, A. Rebotim, F. Sousa, M. Schweizer, M. González-Martín)

Water column samples were collected with a rosette with 24 Niskin bottles of 12 L capacity, closed during the upcasts at selected levels, chosen based on the CTD downcast at the depth of the chlorophyll maximum (higher turbidity), bellow the transition of the seasonal thermocline / permanent thermocline, at different water masses, at the surface, at the bottom/deepest position, and whenever occur different hydrographic conditions. All the recollected seawater samples were subsampled onboard (Fig. 4.9), preserved in the cold or dark conditions, filtered and/ or chemical preserved for several analysis: nutrient content; Alk/DIC; stable isotopes; trace elements; fitoplankton; chlorophyll; coccolithophores; DNA; Suspend Particulate Matter (SPM). Before sampling the water from the Niskin rosette bottles, all the silicone tubes used for sub-sampling were cleaned with bleach and acid leached. A list of all collected and filtered seawater samples is given in Annex 10.1. At moment we are conducting the analytical work and waiting for the results for future publication.

Fig. 4.9 Left picture: L. Matos sampling seawater for stable isotopes; Right picture: M. González-Martín filtering seawater for Coccolithophorids.

Sampling for Nutrients content

At each station, 5 or 6 water depth levels were sampled, with exception of the shallow station CA7, located at 77 m water depth, where only 3 levels were sampled. Seawater samples for nutrients content were recollected directly from the Niskin bottles, into 50 ml plastic vials and immediately frozen at -20°C. After the cruise, the 38 samples were sent to IIM-CSIC, Vigo to be analysed.

Sampling for Alkalinity and Total CO_2

At each station, samples for alkalinity and for total CO_2 were collected at 5 or 6 depth levels: at the surface, at the deepest level, at all the different water masses, and whenever possible (when Niskin bottles were still available) duplicates were taken preferably at the surface and at the deepest level. Seawater sub-samples were recollected in 500 ml glass vials and immediately poisoned with 300 µl of concentrated Mercury Chloride ($HgCl_2$) solution. After glass vials were closed with a thin layer of grease on the stopper and twisted the stopper to squeeze the air out of the grease to make a good seal. The samples were stored in cold and dark room, but outside the refrigerator. After the cruise the 32 samples with duplicates were sent to LOCEAN/ Paris to be analysed.

Sampling for Stable Isotopes

At each station, 10 ml of seawater were collected in a glass vial for parallel measurements of $\delta^{18}O$/ δD, corresponding to the same water depth (Niskin bottle) where nutrient samples were collected. In a second glass vial 10 ml were collected for $\delta^{13}C$-DIC analysis. Each $\delta^{13}C$-DIC sample was poisoned with 20 µl of concentrated Mercury Chloride ($HgCl_2$) solution. Both glass vials were close with a crimp-seal and stored in the refrigerator. After the cruise all 76 samples were stored in the cold storage room of IPMA's Marine Geology Division until they were analysed.

Sampling and filtering for Trace Elements

In each station, at the same water depth where the nutrients and stable isotopes were collected (same Niskin bottles) samples for trace element analysis were collected. We collected the water in two 50 ml Falcon tubes (previously acid leached). After the water from each tube was filtered to other clean Falcon acid leached tube, through a Millipore sterile disposable vacuum filter unit, and acidified by adding 30 µl 16N HNO_3. After acidification, the 38 samples with duplicates, were stored in the refrigerator. After the cruise all samples were stored in the cold storage room of IPMA's Marine Geology Division until being analysed.

Sampling for Phytoplankton

Two phytoplankton samples were collected per station: one at the surface and another at the chlorophyll maximum depth, with the exception of the CA7 station, where we collected only the surface sample. We collected 250 ml of seawater directly from the rosette Niskin bottle into a glass bottle and then we poisoned the water with 25 drops of Lugol. The samples were stored on the ship in a dark and cold place, but not refrigerated. After the cruise the samples were sent to IIM-CSIC, Vigo to be analysed.

Sampling and Filtering for Chlorophyl

Approximately 2 L of seawater were collected at the surface and at the maximum chlorophyll depth in each station. The seawater from each depth level was filtered through GF/F of 25 mm diameter and with a pore size of 0.7 mm. Each filter was stored in flask and frozen -20°C. After the cruise the samples went to University of Lisbon for analysis.

Sampling and Filtering for Coccolithophorids

Approximately 5 L of seawater were collected from pre-selected rosette Niskin bottles that sampled depths in the uppermost 320 m of the water column, at all the stations. Between 3.0 and 4.9 L were filtered through cellulose sterile membrane filters of 47 mm diameter and with a pore size of 0.45 µm to collect coccolithophorids. Each filter was stored in plastic petri dishes and later-on, on land, dried in IPMA´s laboratory. All filters were sent to Salamanca University, and the data from these samples will be part of the PhD project of M. González-Martín.

Sampling and Filtering for DNA

Approximately 10 L of seawater was collected from pre-selected rosette Niskin bottles, with equivalent depths of the samples collected for nutrients, stable isotopes, and trace elements. From each depth, the water was filtered through three filters to obtain the same sample in triplicate, that is, approximately 3L of seawater were filtered per filter. The same coccolithophorid cellulose filters were used for the DNA filtration. Each filter was stored in plastic flasks and frozen at -80°C. After the cruise the samples were sent to University of Angers to be analysed.

Sampling and Filtering for SPM

At each level 30 L of seawater was collected from the pre-select levels (at surface, chlorophyll maximum and different water masses). To SPMc - flux calibration of optical and acoustic backscatter sensors, approximately 10 L were filtered using two filters (pre-weighed polycarbonate filters of 47 mm diameter and with a pore size of 0.40 µm) to obtain the same sample in duplicate. To SPM - analyse the POM and isotopes, approximately 20 L were filtered using two filters (pre-weighed and combusted GFF filters with 47 mm of diameter) to obtain the same sample in duplicate. Each filter was stored in plastic petri dishes and frozen at -20°C. After the cruise the samples went to NIOZ to be analysed.

4.3 Zooplankton Sampling with HYDRO-BIOS multi plankton sampler MultiNet

(A. Rebotim, E. Salgueiro, M. Otero, F. Sousa, V. Magalhães)

A HYDRO-BIOS multi plankton sampler MultiNet, type Midi with 50 x 50 cm opening frame (0.25 m^2), equipped with five nets (nets and cups with a 100 µm mesh size) was used to collect samples of planktonic organisms along the water column, by vertical hauls. Deployments were done vertically, with the ship in station, with winch speeds of 0.5 m/s during the downward cast and with a winch speed of 0.283 m/s (17 m/minute) during the upward cast (Fig. 4.10).

Fig. 4.10 During the CARBO-ACID cruise, samples of planktonic organisms were collected with a HYDRO-BIOS multi plankton sampler MultiNet, type Midi with five zooplankton nets, using vertical tows.

During this cruise, the levels to be sampled were chosen based on the temperature, salinity, and fluorescence profiles obtained during the downcast. These profiles allowed the selection of the intervals to be sampled, which corresponded, in general, the ones of: i) maximum fluorescence values, interpreted as indicating chlorophyll maximums, ii) thermocline, and iii) depth intervals showing significant salinity variations. During the downcast, after reaching the bottom depth, or 700 m depth (the maximum depth where planktonic foraminifera are expected to be living) we were waiting a minimum of 3 minutes to let the nets and the cups holder to settle and stabilize it's positioning in the water column, before slowly pulling it up to the surface. On the way up, the different nets were opened/closed sequentially at the predefined depths selected during the downcast. In Annex 10.2 is given the detailed depth intervals of the multinet tows.

Before lifting the net back on board, while the multinet device was still hanging in the air, each net was sprayed/washed down with seawater hose to wash the material stuck in the net down into the cups. The multinet device was then carefully lowered onto the deck. Each cup was removed from their respective plankton net and transferred into a 250 ml plastic bottles, using a squeeze bottle filled with previously filtered (with 100 μm mesh) seawater (Fig. 4.11). The plastic bottles containing the recovered Multinet samples were immediately freeze at -20°C and were kept freeze during all subsequent transport and also at the IPMA laboratory prior to being processed and analysed.

At Station CA5 Multinet M1, the cup nº 5, corresponding to the tow interval between 35 m and the sea-surface had it's net tear, then some zooplankton material could have been lost. After the CA7 station, the volume of seawater that was filtered in the subsequent multinet stations were not record because the flowmeter sensor installed on the multinet failed and could not be replaced.

Fig. 4.11 A MultiNet cup with the recollected zooplankton material being transfer into a 250 ml plastic bottle.

4.4 Sediments Sampling

(V. Magalhães, L. Matos, E. Salgueiro, M. Schweizer)

The sediment samples for sedimentology/ paleoceanography studies were collected with a box-corer (50x50x50 cm) and with a Shipek grab (20x20 cm, 630 cm^3). Aiming to collect longer, stratigraphically preserved sediment records, preference was given to the box-corer as sampling device. However, due to the sampling limitations of the box-corer, the Shipek grab was used in station CA6 located at the Fontanelas seamount, where the seafloor was expected to have coarser (sandy) sediments with rock clasts, with probable coral rubble or could even have rocky outcrops that could damage the box-corer. A detailed list of all the sediment sub-samples and their respective analytical work to be caried out at the on-shore lab is given in Annexes 10.3, 10.4 and 10.5.

4.4.1. Sediments and Corals Sampling with Shipek grab

At station CA6, at the Fontanelas seamount, the seafloor sampling was performed with a Shipek grab. A total of 12 Shipek deployments were successful, retrieving samples from the sea bottom ranging in water-depth from 1179 up to 1595 m. Overall, the several grabs collected sandy, foraminifera-rich sediments; with fossil cold-water coral fragments (incl. *Lophelia pertusa*, *Madrepora oculata,* possibly *Enallopsammia* sp., stylasterid or bamboo coral)*;* with several sponges; *Cidaris cidaris* and sea urchin spines; polychaete and serpulid tubes;

gastropod and pteropod shells; cirriped and bivalve shells (incl. possibly *Neopycnodonte* sp. fragments); and basaltic clasts of different sizes, most of them covered by Fe-Mn incrustations or coatings. Most of the coral fragments also show Fe-Mn coatings (Fig. 4.12).

In Annex 10.3 is given a detailed description of the recovered Shipek grab samples, listing the sub-samples that were taken and their respective proposed analysis to be done on shore. In Annex 10.4 is given a detailed list all sub-samples collected for DNA and Benthic Foraminifera Bengal Rose analysis (RB).

Fig. 4.12 Shipek grab being operated during the cruise (left) and recovered sample at station CA6.

4.4.2. Sediments Sampling with box-corer

A total of eight box-cores (Fig. 4.13) were successfully retrieved during the cruise, four of them along the northern transect off Cape Finisterra and four along the southern transect off Cape Roca. In the northern area, one box-core was done per sampling station. The content of each sampling varied greatly in both grain size and biogenic material. The two stations more offshore (CA3 and CA2) revealed finer-grain sediments (especially at CA2) and reduced bioclastic components. Sediments at CA8 were composed of coarser sand, populated by several polychaeta tubes in the sediment surface and gastropod shells at the box-core base. Living animals retrieved at CA8 included ten small ophiuroids and a polychaeta. Station CA7, due to its shallow setting (77 m), was significantly different from all other sampled stations, presenting sediment composed mainly of shell fragments and coarse-grains sand. Living biological components included a sea urchin.

In the southern study area, only the two stations closer to the coastline (CA4 and CA5) were sampled by box-coring. Each of these stations were sampled twice. At station CA6 the seafloor sampling was done instead with a Shipek grad due to the presence of rock clasts, coral fragments and the presence of large rocky outcrops. CA4 and CA5 box-cores presented sediment surfaces composed of fine sand to mud, containing several polychaeta tubes (Fig. 4.13). Also, pteropod shells were present in all the samples. The main difference found at CA4 was the presence of some black (volcanic) grains and a sediment layer composed of gastropod and bivalve shells at

~15-20 cm deep. Regarding living fauna, box-cores of stations CA5 also collected ophiuroids and a xenophyophore; while box-cores of station CA4 collected pelagic animals: a few small shrimps and isopods. In Annex 10.4 we present the detailed description of the recovered box-core samples at each station, the sub-samples taken and their respective proposed analysis to be done on shore.

Fig. 4.13 Box-corer (left) and sediment box with push liners being recollected (right).

Once the box-corer was on board and we could begin working on the samples, we aspirated the overlying water (being careful not to aspirate sediment), took photos of the surface sediment, described the surface sediment (e.g., grain size, structures, disturbance, presence of biogenic/ minerals) and finally we started sampling the sediment. At the stations, where we successfully collected box-cores, the surface samples were first subsampled, to study the actual oceanographic conditions, (DNA - industry, Foram DNA - Foraminifera DNA, benthic foraminifera Bengal Rose (RB), benthic fauna – benthos, and other geological samples), and then, to study past oceanographic conditions, the cores or liners for Foram DNA (triplicate), RB (triplicate), geological samples and when remaining samples for benthic macrofauna (benthos - triplicate) (Annex 10.4). The triplicate DNA (a, b, c) and RB (a, b, c) core liner were subsampled on board in 1 cm slices (Fig. 4.14).and to select specific levels for each analysis and frozen (-80°, Annex 10.5).

Fig. 4.14 Core liner (recovered from the box-core) being subsampled on board for DNA and RB analysis.

5 Data and Sample Storage / Availability

All data and samples material not used in the analytical work are stored at the IPMA data storage and at the IPMA samples archive, being available through the cruise Principal Investigator (Emilia Salgueiro). All the on-board data is accessible, following the FAIR principles, through the EMODnet data portal and through the SeaDataNet SEANOE data portal, as described below:

Salgueiro, Emília; Magalhães, Vítor; Rebotim, Andreia; Matos, Lélia; Schweizer, Magali; Sousa, Fátima; González Martín, Maria; Batista, Luis (2022). Eurofleets+ CARBO-ACID cruise (SEA02_10) Datasets. SEANOE. https://doi.org/10.17882/96495.

Multibeam data sharing and data storage

All CARBO-ACID multibeam data was made available at the EMODnet Bathymetry after a quality control by the IPMA EMODnet data manager. The CARBO-ACID multibeam dataset ID at the EMODnet Bathymetry is: MB_CARBOACID2022 and the bathymetry grids at 30 or 50 m resolution can be downloaded at the EMODnet data portal. Raw data can be requested through the portal to the EMODnet national data holder (IPMA) or through the cruise Principal Investigator. The bathymetry data is also available, gridded at the SeaDataNet SEANOE data portal.

CTD data

The processed CTD data is available at the SeaDataNet SEANOE data portal. Raw data is available through the cruise Principal Investigator (Emilia Salgueiro).

Instrument: Seabird-CTD-system 2x SBE 911 Plus (s/n 09P27491-0670) installed on a 24 Niskin bottles rosette, always operated in station, vertical casts. Sensors: Conductivity - SBE 4C (s/n 90270-042688), Temperature - SBE 3plus (s/n 4169), Pressure - Max. prof. 6.885m. (s/n 0670), Fluorescence / Turbidity - WETLabs ECO-FL-NTU (s/n FLRTD-034), Dissolved oxygen - SBE 43 (s/n 90419-430270), Pomp - Max. prof. 10.500m SBE 5T (s/n 90160-053253).

Metadata and Data Processing: Raw data processed with Sea-Bird SBE Data Processing v7.26.7.1. Processing routines included: Data conversion, Data filtering, Alignment, Cell Thermal Mass, Loop, Derivative variables calculation, Bottle summary and ASCII output.

Variables: Date in Julian Day; Time [hours]; Time [minutes]; Time [seconds]; Depth [salt water, m], lat = 42.87; Pressure, Digiquartz [db]; Conductivity [S/m]; Salinity, Practical [PSU]; Specific Conductance [uS/cm]; Potential Temperature [ITS-90, deg C]; Potential Temperature Anomaly [ITS-90, deg]; Pressure Temperature [deg C]; Temperature [ITS-90, deg C]; Density [density, kg/m^3]; Density [sigma-theta, kg/m^3]; Average Sound Velocity [Chen-Millero, m/s]; Sound Velocity [Chen-Millero, m/s]; Sound Velocity [Delgrosso, m/s]; Sound Velocity [Wilson, m/s]; Thermosteric Anomaly [10^-8 * m^3/kg]; Turbidity, WET Labs ECO [NTU]; Fluorescence, WET Labs ECO-AFL/FL [mg/m^3]; Nitrogen Saturation [ml/l]; Oxygen raw, SBE 43 [V]; Oxygen, SBE 43 [ml/l]; Oxygen, SBE 43 [% saturation]; Oxygen Saturation, Garcia & Gordon [ml/l]; Oxygen Saturation, Weiss [ml/l]; Bottle Position in Carousel; Bottles Fired.

Multinet hydrographic data

The Multinet hydrographic raw data is available at the SeaDataNet SEANOE data portal.

Instrument and sensors: HYDRO-BIOS multi plankton sampler MultiNet, type Midi with 50 x 50 cm opening frame (0.25 m2), equipped with five nets (nets and cups with a 100 µm mesh size). Pressure sensor functional but, temperature, conductivity and flowmeter sensor (both flow in and flow out) were malfunctioning and therefore the temperature, conductivity and flow variables are not reliable.

Metadata: Data processed with OceanLab 3, the data acquisition software for HYDRO-BIOS Instruments.

Variables included: Time (hh:mm:ss), Number of net, pressure (dbar), Volume (m^3) only estimated values are available.

Seawater samples

After the cruise, the seawater samples for Nutrients and Phytoplankton content were sent to CSIC, Vigo to be analysed. The Alkalinity and Total CO_2 samples with duplicates were sent to LOCEAN/ Paris to be analysed. Chlorophyl filters were sent to University of Lisbon to be analysed. The SPM´s filters were sent to NIOZ to be analysed. DNA´s filters were sent to University of Angers to be analysed. Coccolithophorids´ filters were sent to Salamanca University to be analysed. This data will be part of the PhD project of M. González-Martín. The remaining water samples were stored in the cold storage room of IPMA's Marine Geology Division (IPMA-DivGM) for further analysis.

Zooplankton samples

All zooplankton samples were kept freeze at the IPMA-DivGM freeze room prior being processed and analysed.

Sediment samples

Foraminifera DNA and RB sediment samples were sent to University of Angers to be analysed. DNA - industry-samples were sent to ITQB for further analysis. The remaining water samples were stored in the cold storage room of IPMA's Marine Geology Division (IPMA-DivGM) for further sedimentological analysis and are available for other scientific projects.

6 Participants

6.1 On-board team

Fig. 6.1 CARBO-ACID on-board scientific team. From the bottom to the top: V. Magalhães; L. Matos; M. Schweizer; F. Sousa; A. Rebotim; M. González Martín; E. Salgueiro; D. Pérez.

Table 6.1 On-board participants.

No.	Name	Early career (Y/N)	Gender	Affiliation	On-board tasks
1	Emília Salgueiro*	N	F	IPMA	Co-chief scientist, CTD/ rosette work, multinet sampling; sediment sampling
2	Vítor Magalhães*	N	M	IPMA	Chief scientist, multibeam and sub-bottom profiling, CTD/ rosette work, sediment sampling
3	Andreia Rebotim*	Y	F	CCMAR	CTD/ rosette work, multinet sampling
4	Lélia Matos*	Y	F	CCMAR	CTD/ rosette work, sediment sampling
5	Magali Schweizer*	N	F	Angers Univ.	CTD/ rosette work, sediment sampling
6	Fátima Sousa*	N	F	MARE/ ARNET & DEGGE Lisbon Univ.	Rosette/CTD work

7	Luis Batista*	N	M	IPMA	Multibeam and sub-bottom profiling
8	Maria González Martín#	Y	F	Salamanca University	CTD-Rosette work
9	Manuel Medina Otero	N	M	UTM/CSIC	Multinet Technician /operator
10	Teodomiro Cardalda Lemiña	N	M	UTM/CSIC	Informatics Technician, EARS operator
11	Rebeca Reyes Fragueiro,	N	F	UTM/CSIC	Informatics Technician
12	Diego Pérez	N	M	UTM/CSIC	Multibeam Technician /operator

*Participants funded by EUROFLEETS+; #Participants not funded by EUROFLEETS+

6.2 On-shore team and analytical work to be carried out

Table 6.2 On-shore participants and respective tasks.

No.	Name	Early career (Y/N)	Gender	Affiliation	On-shore tasks
1	Fátima Abrantes	N	F	IPMA	Diatom expert
2	Paulo Oliveira	N	M	IPMA	Physical oceanography data/interpretation
3	José Abel Flores	N	M	Salamanca Univ.	Coccolitophore expert
4	Eric Douville	N	M	LSCE	Boron isotopes in corals
5	Elin Moe	N	F	ITQB	Proteins
6	Aline Mega	Y	F	IPMA/ CCMAR	PhD student, Foraminifera
7	Cristina Roque	N	F	IDL/ EMEPC	Multibeam data interpretation
8	Norbert Frank	N	M	Heidelberg Univ.	Cold-water corals
9	Furo Mienis	N	F	NIOZ	Suspended particulate matter
10	H. de Stigter	N	M	NIOZ	^{210}Pb cronology
11	Marcos Fontela	N	M	CCMAR/ Vigo Univ.	Chemical Oceanography data

12	Elin Moe	N	F	ITQB	Enzymes
13	Vanda Brotas	N	F	MARE/FCUL	Chlorophyll
14	Andreia Tracana	N	F	MARE/FCUL	Chlorophyll
15	Carmen Castro	N	F	IIM-CSIC, Vigo	Nutrients and phytoplankton
16	Maria Frojan	Y	F	IIM-CSIC, Vigo	Nutrients and phytoplankton
17	Jorge Arteaga	N	M	IPMA	Benthic macrofauna
18	Catia Bartilotti	N	F	IPMA	Benthic macrofauna

Table 6.3 Summary table with all the on-shore samples and analytical work to be carried out and the responsible team participant.

	Sample processing after the cruise	Team participant (Laboratory Institute responsible)
Water samples analysis	• Satellite and CTD oceanographic characterization	P. Oliveira (IPMA), E. Salgueiro F. Sousa, V. Magalhães (IPMA, FCUL, MARE)
	• Water chemistry (Alk, TC, pH)	E. Douville, L. Matos (Heidelberg Univ., IPMA)
	• Water isotopes (δ13C, δ18O, δD)	E. Salgueiro (IPMA, CCMAR)
	• Water trace elements	E. Salgueiro (IPMA, CCMAR)
	• Nutrient content/ total phytoplankton	C. Castro, M. Frojan (CSIC- Vigo)
	• chlorophyll	A. Tracana, V. Brotas (FCUL, MARE)
	• suspended particulate matter	F. Mienis, H. de Stigter (NIOZ)
	• Coccolitophore assemblages	M. González, J.-A. Flores (Sal. Univ)
	• DNA analysis	M. Schweizer (Angers Univ.)
Plankton analysis	• Pteropodes / Planktonic foraminifera assemblages	A. Rebotim (IPMA)
	• Planktonic foraminifera isotopes	A. Rebotim (IPMA)
	• Planktonic foraminifera trace elements (TE)	E. Salgueiro (IPMA)
	Multibeam data analysis	V. Magalhães, L. Batista, C. Roque (IPMA, IDL)
Sediment material	• Cold coral analysis (isotopes, trace elements)	N. Frank, E. Douville, L. Matos (Heidelberg Univ., LSCE, IPMA)
	• Pteropodes assemblages	A. Rebotim (IPMA)
	• Planktonic foraminifera (assembl., TE, isot.) / grain size analysis	E. Salgueiro, A. Mega (IPMA, CCMAR)
	• Coccolitophores assemblages	M. González, J. Flores (IPMA, Salamanca Univ.)
	• ^{210}Pb cronology	E. Salgueiro, H. de Stigter (IPMA/ NIOZ)
	• Marine diatoms assemblages / Total Organic Carbon	F. Abrantes (IPMA)
	• XRF, MSCL, X-Ray imagerie	V. Magalhães (IPMA)
	• Foraminifera DNA analysis	M. Schweizer (Angers Univ.)
	• DNA and enzymes	E. Moe (ITQB)
	• Benthic macrofauna	J. Arteaga, C. Bartilotti (IPMA)

7 Station List

Table 7.1 CARBO-ACID stations list and scientific operations.

Station No.	Date 2022	Time* [UTC]	Latitude [°N]	Longitude [°W]	Water depth [m]	Gear**	Remarks/Recovery***
CA3	03.8.	09:11	42°39.00	12°00.51	1100	ROS/CTD	CA3-R1: 1075, 251, 100, 51, 5 m
CA3	03.8.	11:25	42°39.00	12°00.51	1100	M	CA3-M1: 700-450, 450-200, 200-100, 100-40, 40-5 m
CA3	03.8.	13:32	42°39.00	12°00.51	1100	M	CA3-M2: 700-450, 450-200, 200-100, 100-40, 40-5 m
CA3	03.8.	17:18	42°39.23	12°00.58	1100	BC	CA3-BC1: BC did not close completely: no samples
CA3	03.8.	18:32	42°39.23	12°00.58	1098	BC	CA3-BC2: BC did not close completely: surface samples (no subsampling liners)
CA2	04.8.	06:13	42°52.03	10°37.94	2971	ROS/CTD	CA2-R1: 2940, 960, 250, 100, 60, 5 m
CA2	04.8.	08:30	42°52.03	10°37.94	2970	M	CA2-M1: 700-450, 450-200, 200-100, 100-50, 50-0 m
CA2	04.8.	10:46	42°52.03	10°37.94	2970	M	CA2-M2: 700-450, 450-200, 200-100, 100-50, 50-0 m
CA2	04.8.	12:34	42°52.03	10°37.94	2940	BC	CA2-BC1: surface and 8 linners (11-18 cm): 3 DNA, 3 Forams RB; 2 Geo
CA7	05.8.	07:31	42°44.59	09°12.86	77	ROS/CTD	CA7-R1: 65, 25, 5 m
CA7	05.8.	08:57	42°44.59	09°12.86	77	BC	CA7-BC1: surface and 3 liners (~15 cm): 3 Foram RB
CA7	05.8.	10:54	42°44.59	09°12.86	77	M	CA7-M1: 65-15, 15-1.5 m
CA7	05.8.	11:30	42°44.61	09°12.87	77	M	CA7-M2: 65-15, 15-1.5 m
CA8	06.8.	06:15	42°05.26	09°23.12	343	ROS/CTD	CA8-R1: 320, 100, 75, 50, 28, 5 m
CA8	06.8.	06:57	42°05.26	09°23.12	343	M	CA8-M1: 320-200, 200-100, 100-50, 50-30, 30-0 m
CA8	06.8.	07:56	42°05.26	09°23.12	343	M	CA8-M2: 320-200, 200-100, 100-50, 50-30, 30-0 m
CA8	06.8.	08:57	42°04.54	09°23.56	343	BC	CA8-BC1: surface and 9 liners (14-17 cm): 3 DNA, 3 Foram RB; 3 Geo
CA6	07.8.	06:10	39°06.64	10°32.90	1433	ROS/CTD	CA6-R1: 1410, 1150, 250, 100, 40, 5 m
CA6	07.8.	07:27	39°06.64	10°32.90	1433	M	CA6-M1: 700-450, 450-200, 200-100, 100-30, 30-5 m
CA6	07.8.	09:51	39°06.64	10°32.90	1433	M	CA6-M2: 700-450, 450-200, 200-100, 100-30, 30-5 m
CA6	07.8.	11:31	39°06.64	10°32.90	1433	S	CA6-S1: Arrived open: no material
CA6	07.8.	12:58	39°06.64	10°32.90	1433	S	CA6-S2: Arrived with material
CA6	07.8.	14:13	39°06.64	10°32.86	1440	S	CA6-S3: Arrived with material
CA6	07.8.	15:15	39°06.66	10°32.86	1442	S	CA6-S4: Arrived with material
CA6	07.8.	16:14	39°06.64	10°32.83	1443	S	CA6-S5: Arrived with material
CA6	08.8.	06:06	39°05.99	10°33.08	1356	S	CA6-S6: Arrived with material
CA6	08.8.	07:07	39°05.52	10°33.27	1230	S	CA6-S7: Arrived with material
CA6	08.8.	08:03	39°05.01	10°33.51	1097	S	CA6-S8: Arrived with material
CA6	08.8.	08:45	39°04.76	10°33.53	1179	S	CA6-S9: Arrived with material
CA6	08.8.	09:34	39°04.51	10°33.81	1245	S	CA6-S10: Arrived with material

CA6	08.8.	10:20	39°04.28	10°34.01	1392	S	CA6-S11: Arrived empty
CA6	08.8.	11:14	39°04.28	10°34.01	1397	S	CA6-S12: Arrived empty
CA6	08.8.	12:03	39°04.02	10°34.19	1594	S	CA6-S13: Arrived with material
CA6	08.8.	12:53	39°04.02	10°34.19	1595	S	CA6-S14: Arrived with material
CA6	08.8.	14:00	39°06.10	10°34.73	1304	S	CA6-S15: Arrived with material
CA5	09.8.	06:03	38°46.19	10°18.53	1683	ROS/CTD	CA5-R1: 1663, 1180, 250, 100, 60, 5 m
CA5	09.8.	07:27	38°46.19	10°18.52	1683	M	CA5-M1: 700-450, 450-200, 200-75, 75-35, 35-0 m
CA5	09.8.	09:14	38°46.19	10°18.53	1683	M	CA5-M2: 700-450, 450-200, 200-75, 75-35, 35-0 m
CA5	09.8.	10:45	38°46.19	10°18.71	1684	BC	CA5-BC1: surface and 8 liners (full BC): 3 DNA, 3 Foram RB; 2 Geo
CA5	09.8.	13:24	38°46.19	10°18.52	1684	BC	CA5-BC2: surface and 7 liners (~15 cm): 3 Foram RB; 4 Geo
CA4	10.8.	06:07	38°39.55	9°44.54	584	ROS/CTD	CA4-R1: 560, 250, 100, 75, 35, 5 m
CA4	10.8.	06:50	38°39.55	9°44.54	583	M	CA4-M1: 560-300, 300-200, 200-80, 80-30, 30-0 m
CA4	10.8.	08:17	38°39.55	9°44.54	584	M	CA4-M1: 560-300, 300-200, 200-80, 80-30, 30-0 m
CA4	10.8.	10:32	38°39.55	9°44.54	584	BC	CA4-BC1: Empty
CA4	10.8.	11:00	38°39.55	9°44.54	585	BC	CA4-BC2: surface and 9 liners (30-34 cm): 3 Foram RB; 6 Geo
CA4	10.8.	13:43	38°39.55	9°44.54	585	BC	CA4-BC3: surface and 9 liners (~35 cm): 3 DNA, 3 Foram RB; 3 Geo

* at start of descent;

**ROS/CTD: Seabird CTD mounted on Rosette with 24 bottles of 12L; M: HYDRO-BIOS Midi MultiNet with 5 nets; BC: Box-corer 50x50x50 cm; S: Shipek Grab;

***DNA: genotype material sub-sample; Foram RB: Benthic Foraminifera with Bengal Rose sub-sample; Geo: geologic material sub-sample.

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Fig. 8.1 CARBO-ACID cruise participants.

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10 Annexes

Annex 10.1 Seawater subsampling collected and filtered

Annex 10.2 Detailed multinet sampling operations description

Annex 10.3 Detailed Shipek grab description

Annex 10.4 Detailed box-core description

Annex 10.5 Sediments sub-sampling for DNA and Benthic Foraminifera Bengal Rose samples

Annex 10.1 Seawater subsampling collected and filtered

CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3	**Station**	
03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	**Date**	
51	51	100	100	100	100	251	251	251	251	251	1075	1075	1075	1075	1075	**sample depth (mbsl)**	
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	**Rosette bottle no.**	
	4				3					2					x	**Nutrients** (50ml) depth	Seawater sampling
	4				3					2					x	**Alk/DIC** (500ml) depth code	
	4				3					2					x	**$\delta^{18}O$** (10ml) depth level	
	4				3					2					x	**$\delta^{13}C$** (10ml) depth level	
	4				3					2					x	**TE [x2]** (2x40ml) depth	
	1															**Phytopl.** (250ml) depth	
	2															**Chlorophyl** (filtered vol. L)	Seawater sampling and filtered
	3				4				4							**Coccos** (filtered vol. L)	
1.5				3				2.5						3		**DNA1** (filtered vol. L)	
				3				2.5						3		**DNA2** (filtered vol. L)	
3				3				2.5						3		**DNA3** (filtered vol. L)	
3.8										5					5	**SPMcal1** (filtered vol. L)	
									3.6				5			**SPMcal2** (filtered vol. L)	
							8.4					8.2				**SPM1** (filtered vol. L)	
						9.8					8.4					**SPM2** (filtered vol. L)	
																obs.	

CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA3	CA3	CA3	CA3	CA3	CA3	CA3	CA3
04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08	03.08
250	250	250	250	960	960	2940	2940	2940	2940	2940	5	5	5	5	5	51	51	51
11	10	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17
			3		2					1					5			
			3		2					1					5			
			3		2					1					5			
			3		2					1					5			
			3		2					1					5			
															2			
															2			
		3													3			
	2.8			3.2					2.9				1.5	1.5				1.5
	2.8			3.2					2.9					3				3
	2.8			3.2					2.9				3					
			4.69							5				4.4				
		3.5						4.8					4.8					4.48
9.2							10					9.6					9.3	
						10					9.25					10		

CA7	CA7	CA7	CA7	CA7	CA7	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2	CA2
05.08	05.08	05.08	05.08	05.08	05.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08	04.08
25	65	65	65	65	65	5	5	5	5	5	60	60	60	60	60	100	100	250
6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12
2					1					6					5		4	
2					1					6					5		4	
2					1					6					5		4	
2					1					6					5		4	
2					1					6					5		4	
										2					1			
2										1.8					1.6			
				3						3					3		3	
			2.8					1.5	1.5				1.5	1.5		2.9		
			2.8					1.5	1.5				1.5	1.5		2.9		
			2.8					1.5	1.5				1.5	1.5		2.9		
5					5				4.1					5				
				2.46				2.8					3.6					
		8					9.4					9.1						
	6.2					9.4					9.1							9

CA8	CA8	CA8	CA8	CA8	CA8	CA8	CA8	CA8	CA7	CA7	CA7	CA7	CA7	CA7	CA7	CA7	CA7	CA7	CA7	CA7
06.08	06.08	06.08	06.08	06.08	06.08	06.08	06.08	06.08	05.08	05.08	05.08	05.08	05.08	05.08	05.08	05.08	05.08	05.08	05.08	05.08
75	75	100	100	320	320	320	320	320	5	5	5	5	5	25	25	25	25	25	25	25
9	8	7	6	5	4	3	2	1	16	14	15	13	12	11	10	9	8	7		
	3		2					1					3							
			2					1A+1B					3							
	3		2					1					3							
	3		2					1					3							
	3		2					1					3							
													1							
	2		2				2						2							
	3		3				3					3						3		
3		3.1			1.4	1.4	1.4			2.7						1.5	1.5			
3		3.1			1.4	1.4	1.4			2.7						1.5	1.5			
3		3.1			1.4	1.4	1.4			2.7				2+2.4 6		1.5	1.5			
								5				2+2.4 2							5	
					4.3															
				9.3							8				10					
			9.4						7.4					9.9						

2 SPMcal filters used

2 SPMcal filters used

CA8	06.08	50	10	4		4	4	4							4.92				
CA8	06.08	50	11							1.9	3					4.55			
CA8	06.08	50	12									2.5	2.5	2.5					
CA8	06.08	50	13														9.5		
CA8	06.08	50	14															9.3	
CA8	06.08	28	15	5	3	5	5	5	1						3.7+1.42				2 SPMcal filters used
CA8	06.08	28	16							1.6	3					3.8+0.3			2 SPMcal filters used
CA8	06.08	28	17									3	3	3					
CA8	06.08	28	18														9.6		
CA8	06.08	28	19															9.34	
CA8	06.08	5	20	6	4A+4B	6	6	6	2						2+2				2 SPMcal filters used
CA8	06.08	5	21							1.5	3					2+2			2 SPMcal filters used
CA8	06.08	5	22									3	3	3					
CA8	06.08	5	23														8.9		
CA8	06.08	5	24															8.5	SPM2 filter set loose, filtering stopped
CA6	07.08	1410	1	1	1A+1B	1	1	1							3.9				
CA6	07.08	1410	2													4.9			
CA6	07.08	1410	3									3	3	3					
CA6	07.08	1410	4														8.8		

CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6	CA6
07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08	07.08
5	5	5	40	40	40	40	40	40	100	100	250	250	250	250	250	250	250	250	250	1150	1410
23	22	21	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5				
							5		4					3		2					
							4							3		2					
							5		4					3		2					
							5		4					3		2					
							1														
							1.8														
							3		3				3								
						1.5		3				3			3.1						
						1.5		3				3			3.1						
						1.5		3				3			3.1						
														4.4							
						5							5								
				9.6							9.4										
										9.9											
					9.2																

2 filters for Chl

CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA5	CA6
09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	09.08	07.08
60	60	60	60	100	100	100	250	250	250	250	1180	1180	1663	1663	1663	1663	1663	5
18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	24
			5			4				3		2					1	
			4							3A+3B		2					1A+1B	
			5			4				3		2					1	
			5			4				3		2					1	
			5			4				3		2					1	
			1															
			2															
			3			3				3								
		2.9			3.1				3.1		3.3					3		
		2.9			3.1				3.1		3.3					3		
		2.9			3.1				3.1		3.3					3		
	9.5							9.7							9.35			
9.1							8.5							9.7				9.4

CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA5	CA5	CA5	CA5	CA5	CA5
10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	09.08	09.08	09.08	09.08	09.08	09.08
75	75	100	100	100	250	250	250	250	560	560	560	560	5	5	5	5	5	60
13	12	11	10	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19
	4			3				2				1					6	
								2				1A+1B					5A+5B	
	4			3				2				1					6	
	4			3				2				1					6	
	4			3				2				1					6	
																	2	
																	2	
	4.7			4.9				4.7									3	
2.8			3				3.1				3					2.7		
2.8			3				3.1				3					2.7		
2.8			3				3.1				3					2.7		
						9.45				9.2					9.45			
					9.05				9.4					9				

CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4	CA4
10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08
5	5	5	5	5	5	5	5	35	35	35	35	35	35	35	35	35	35	75	
24	23	22	21	20	19	18	17	16	15	14									
				6					5										
				4A+4B					3										
				6					5										
				6					5										
				6					5										
				2					1										
				2					2										
				3					3										
			2.9					3											
			2.9					3											
			2.9					3											
		9.6					9.25												
	9.11					9.4													

Annex 10.2. Detailed multinet sampling operations description

Station	cast	Latitude (N)	Longitude (W)	Cup nº	Sampling intervals (mbsl) End	Start	Cup mesh size Net mesh size (µm)	Comments
CA3	M1	42°39.00'N	12°00.51'W	5	5	40	100	Descent velocity = 1 m/s at start, then at 30 m/min; Upward velocity = 20 m/min (0.333 m/s)
				4	40	100	100	
				3	100	200	100	
				2	200	450	100	
				1	450	700	100	
CA3	M2	42°39.00'N	12°00.51'W	5	5	40	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	40	100	100	
				3	100	200	100	
				2	200	450	100	
				1	450	700	100	
CA2	M1	42°52.03'N	10°37.94'W	5	0	50	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	50	100	100	
				3	100	200	100	
				2	200	450	100	
				1	450	700	100	
CA2	M2	42°52.03'N	10°37.94'W	5	0	50	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	50	100	100	
				3	100	200	100	
				2	200	450	100	
				1	450	700	100	
CA7	M1	42°44.59'N	9°12.86'W	2	1.5	15	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				1	15	65	100	
CA7	M2	42°44.59'N	9°12.86'W	2	1.5	15	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				1	15	65	100	
CA8	M1	42°05.26'N	9°23.12'W	5	0	30	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	30	50	100	
				3	50	100	100	
				2	100	200	100	
				1	200	320	100	
CA8	M2	42°05.26'N	9°23.12'W	5	0	30	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	30	50	100	
				3	50	100	100	
				2	100	200	100	
				1	200	320	100	
CA6	M1	39°06.64'N	10°32.90'W	5	5	30	100	Descent velocity = 1 m/s at start, then at 27 m/min (0.45 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	30	100	100	
				3	100	200	100	
				2	200	450	100	
				1	450	700	100	
CA6	M2	39°06.64'N	10°32.90'W	5	5	30	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	30	100	100	
				3	100	200	100	
				2	200	450	100	
				1	450	700	100	
CA5	M1	38°46.19'N	10°18.53'W	5	0	35	100	net from the cup was torn, most probably when washing with fresh water;

				4	35	75	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				3	75	200	100	
				2	200	450	100	
				1	450	700	100	
CA5	M2	38°46.19'N	10°18.53'W	5	0	35	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	35	75	100	
				3	75	200	100	
				2	200	450	100	
				1	450	700	100	
CA4	M1	38°39.549'N	9°44.543'W	5	0	30	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	30	80	100	
				3	80	200	100	
				2	200	300	100	
				1	300	560	100	
CA4	M2	38°39.549'N	9°44.543'W	5	0	30	100	Descent velocity = 1 m/s at start, then at 30 m/min (0.5 m/s); Upward velocity = 17 m/min (0.283 m/s)
				4	30	80	100	
				3	80	200	100	
				2	200	300	100	
				1	300	560	100	

Annex 10.3. Detailed Shipek grab description

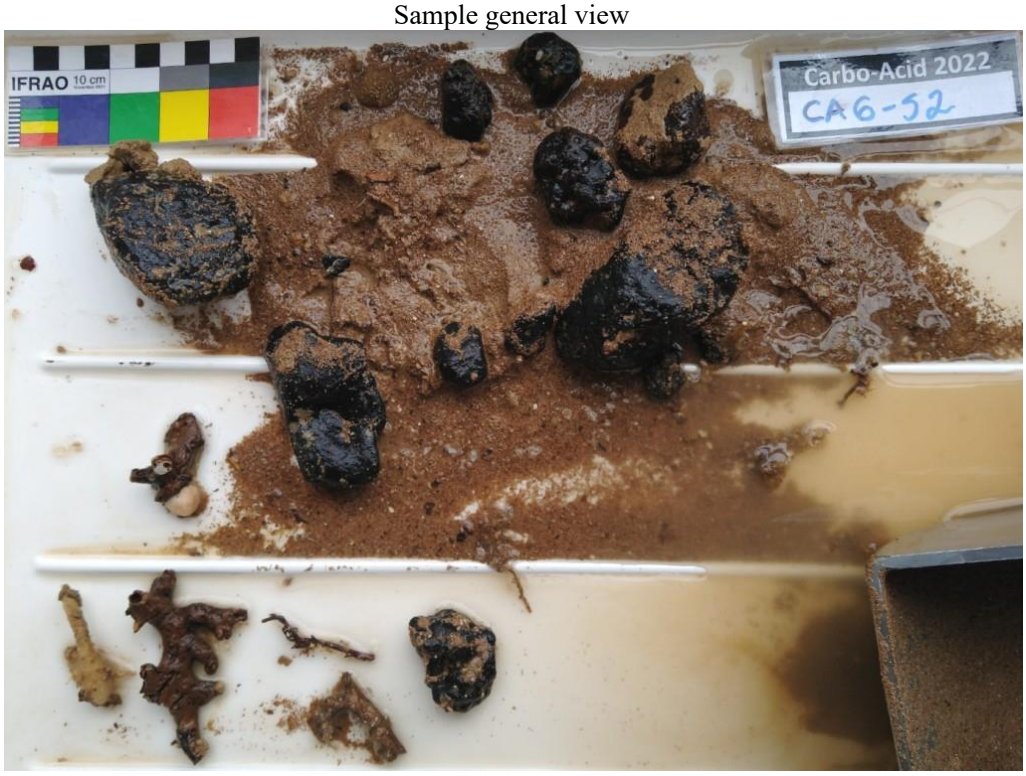
Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 07-08-2022	IPMA Access Number: 5987	**Station no.: CA6-S2**
Water depth: 1433 m	Latitude: 39º06.64' N	Longitude: 10º32.90' W

Samples collected:	*Sample description:*
Geologic samples: 4 Clasts 5 Coral fragments 6 Bioclasts (shells, etc) 7 Sieved sample: 4 mm > f > 100 µm *(frozen; incl. forams & pteropods)* *Other sampling:* 8 Foram RB (50 cc) 9 eDNA (50 cc)	Shipek spoon filled with light brown sandy sediment. Presence of basaltic clasts of around 10 cm (with Fe-Mn crust/coating), fossil cold-water coral fragments, several sponges, living polychaeta tubes, pteropod shells, serpulid tubes, forams, bivalve and cirriped shells.

Sample general view



RB= Bengal Rose

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 07-08-2022	IPMA Access Number: 5988	**Station no.: CA6-S3**
Water depth: 1440 m	Latitude: 39º06.64' N	Longitude: 10º32.86' W

Samples collected:	*Sample description:*
Geologic samples: 4 Clasts 5 Coral fragments 6 Sieved samples of 3 sizes: f > 4 mm 4 mm > f > 850 µm (stored frozen) 850 µm > f > 100 µm (stored frozen)	Sample composed of brown sand and small (2-6 cm) basaltic clasts, several pteropod shells, some sponges, small cold-water coral fragments (Scleractinia and maybe black coral fragments).

Sample general view

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 07-08-2022	IPMA Access Number: 5989	**Station no.: CA6-S4**
Water depth: 1442 m	Latitude: 39º06.66' N	Longitude: 10º32.86' W

Samples collected:	*Sample description:*
Geologic samples: 4 Clasts 5 Coral fragments 6 Sieved samples of 3 sizes: f > 4 mm (box) 4 mm > f > 850 µm (stored frozen) 7 850 µm > f > 100 µm (stored frozen)	Sample composed of olive brown sandy sediment with some small clasts and cold-water coral fragments, bivalve shell fragments and several pteropod shells.

Sample general view

Sample details

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 07-08-2022	IPMA Access Number: 5990	**Station no.: CA6-S5**
Water depth: 1443 m	Latitude: 39º06.64' N	Longitude: 10º32.84' W

Samples collected:	*Sample description:*
Geologic samples: 4 Only one sample collected, stored frozen.	Small sample composed of little sandy sediment and some bioclasts (incl. pteropod shells).

PHOTOS
(no record available)

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 08-08-2022	IPMA Access Number: 5991	**Station no.: CA6-S6**
Water depth: 1356 m	Latitude: 39º05.99' N	Longitude: 10º33.08' W

Samples collected:	*Sample description:*
Geologic samples: 4 Coral and bigger shell fragments (box) 5 Sieved samples of 3 sizes: f > 4 mm (box) 4 mm > f > 850 µm 850 µm > f > 100 µm (stored frozen)	Small sample composed of homogeneous sand, bivalve shell fragments, pteropod shells, cold-water coral fragments (incl. *Lophelia pertusa* and bamboo corals). Bivalve shells could be *Neopycnodonte* sp. fragments.

Sample details

Sample general view

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 08-08-2022	IPMA Access Number: 5992	**Station no.: CA6-S7**
Water depth: 1230 m	Latitude: 39º05.52' N	Longitude: 10º33.27' W

Samples collected:	*Sample description:*
Geologic samples: 4 Coral, shell, and sea urchin fragments (box) 5 Sieved samples of 3 sizes: f > 4 mm (big box) 4 mm > f > 850 µm (box) 850 µm > f > 100 µm (stored frozen) *Other sampling:* 6 Foram RB (50 cc) 7 eDNA (50 cc)	Samples composed of sandy sediments with foraminifera and pteropod shells, bivalve (*Neopycnodonte*?) shell fragments, one *Cidaris cidaris* spine, sponges and one bigger cold-water coral fragment (possibly *Enallopsammia* sp.).

Sample general view

Sample details

RB= Bengal Rose

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 08-08-2022	IPMA Access Number: 5993	**Station no.: CA6-S8**
Water depth: 1097 m	Latitude: 39º05.01' N	Longitude: 10º33.51' W

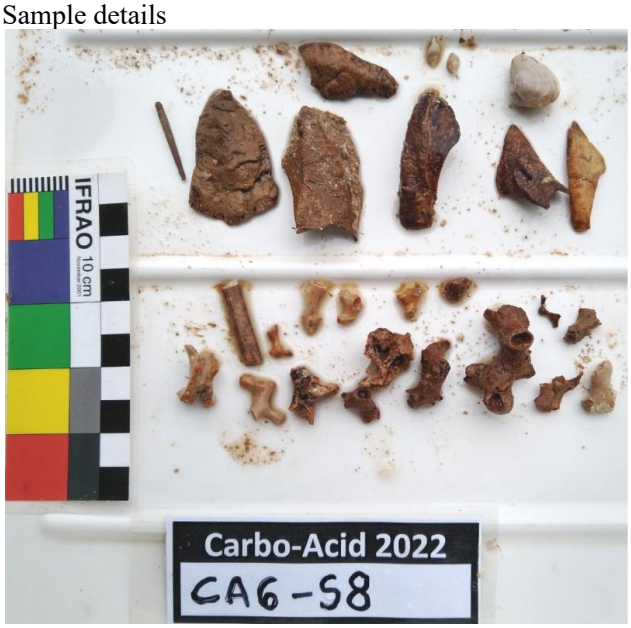
Samples collected:
Geologic samples:
4 Corals, shells fragments and spines (box)
5 Sieved samples of 3 sizes:
f > 4 mm (box)
4 mm > f > 850 µm (box)
850 µm > f > 100 µm (stored frozen)
Other sampling:
6 Foram RB (50 cc)
7 eDNA (50 cc)

Sample description:

Small sample composed of sandy sediments and a few cold-water coral fragments (*Lophelia*, *Madrepora* and stylasterid or bamboo corals), two gastropod and one complete bivalve shells, *Neopycnodonte* shell fragments and sea urchin spines.

Sample general view

Sample details



RB= Bengal Rose

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 08-08-2022	IPMA Access Number: 5994	**Station no.: CA6-S9**
Water depth: 1179 m	Latitude: 39º04.76' N	Longitude: 10º33.53' W

Samples collected:	*Sample description:*
Geologic samples: 4 Coral and shell fragments (box) 5 Sieved samples of 3 sizes: f > 4 mm (box) 4 mm > f > 850 µm (big box) 850 µm > f > 100 µm (stored frozen) *Other sampling:* 6 Foram RB (50 cc) 7 eDNA (50 cc)	Sample composed of sandy sediments with cold-water and shell fragments (incl. *Neopycnodonte* sp.), pteropod and gastropod shells.

Sample general view

Sample details

RB= Bengal Rose

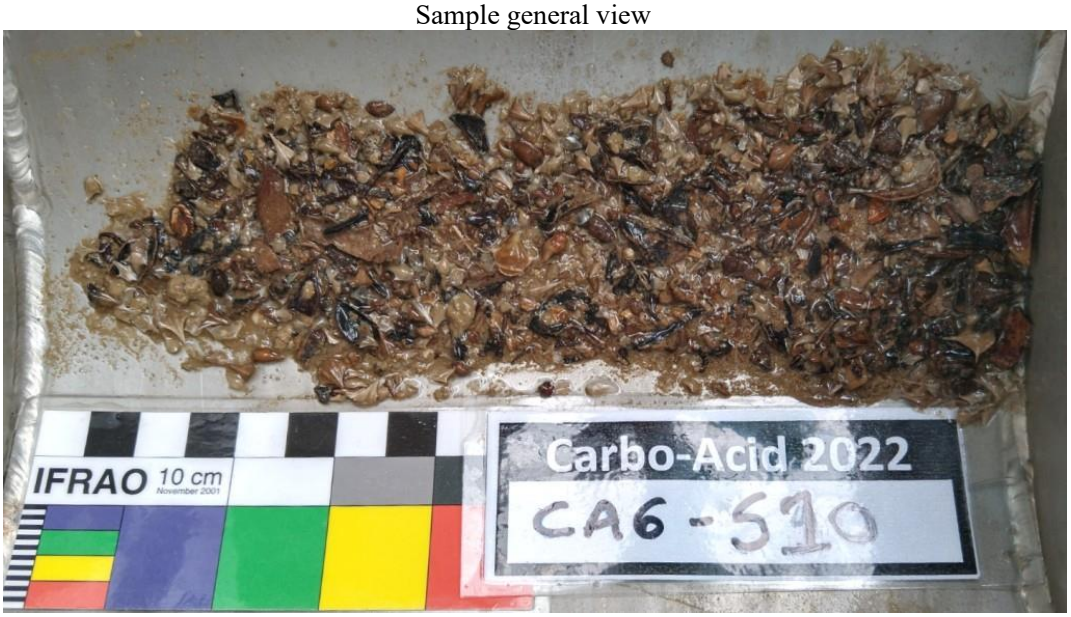
Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 08-08-2022	IPMA Access Number: 5995	**Station no.: CA6-S10**
Water depth: 1245 m	Latitude: 39º04.51' N	Longitude: 10º33.81' W

Samples collected:	*Sample description:*
Geologic samples: 4 Only one sample collected, stored frozen in a Falcon tube.	Very small sample collected, composed of sandy sediment and small coral and shell fragments. Presence of some gastropod and pteropod shells.

Sample general view



Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 08-08-2022	IPMA Access Number: 5998	**Station no.: CA6-S13**
Water depth: 1594 m	Latitude: 39º04.02' N	Longitude: 10º34.19' W

Samples collected:	*Sample description:*
Geologic samples: 4 Only one sample collected, stored frozen in a Falcon tube.	Very small sample composed of little sand (made of foraminifera shells), some shell fragments and small clasts. [comment: water depth possibly above Shipek sampling capacity, thus not recovering representative samples of the seafloor]

Sample general view

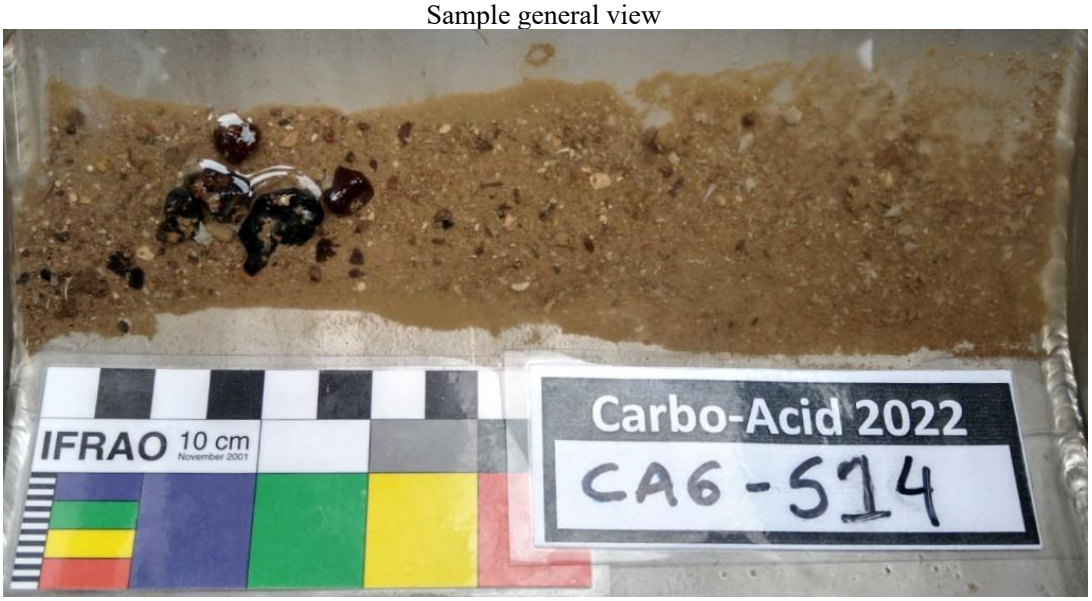
Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 08-08-2022	IPMA Access Number: 5999	**Station no.: CA6-S14**
Water depth: 1595 m	Latitude: 39º04.02' N	Longitude: 10º34.19' W

Samples collected:	*Sample description:*
Geologic samples: 4 Only one sample collected, stored frozen in a Falcon tube.	Very small sample composed of little sand (made of foraminifera shells) and small clasts. [comment: water depth possibly above Shipek sampling capacity, thus not recovering representative samples of the seafloor]

Sample general view



Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

SHIPEK GRAB DESCRIPTION

Date: 08-08-2022	IPMA Access Number: 6000	**Station no.: CA6-S15**
Water depth: 1304 m	Latitude: 39º06.10' N	Longitude: 10º34.73' W

Samples collected:	*Sample description:*
Geologic samples: 4 Only one sample collected, stored frozen in a Falcon tube.	Very small sample composed of little sand (made of foraminifera shells) and small fossil cold-water coral fragments (although they seemed freshly broken and with good aragonite preservation). [comment: water depth possibly above Shipek sampling capacity, thus not recovering representative samples of the seafloor]

Sample general view

Annex 10.4. Detailed box-core description

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

BOX-CORE DESCRIPTION

Date: 03-08-2022	IPMA Access Number: 5971	**Station no.: CA3-BC2**
Water depth: 1098 m	Latitude: 42º39.228' N	Longitude: 12º00.581' W

Surface Samples collected:

Geologic samples:
- Forams / Texture (100 cc)
- Diatoms / C.Org. (50 cc)
- Biogeochemistry (25 cc)
- Archive (100 cc)

Other sampling:
- Industry DNA (50 cc)
- eDNA (50 cc)
- foram RB (50 cc)
- Benthos grainsize box
- 3x bags of white ooze

Sub-sampled cores collected:

Liner	Liner Ø	Core name

RB= Bengal Rose

Sample description:

Top surface sediment probably not preserved (washed out while box-corer was taken onboard).
Surface composed of mostly sand and one black clast. Two other big (basaltic) clasts found at around 3-5 cm depth, together with patches of white sticky sediment (coccolithophore ooze?).

Sediment surface photo

Sampling photo

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

BOX-CORE DESCRIPTION

Date: 04-08-2022	IPMA Access Number: 5975	**Station no.: CA2-BC1**
Water depth: 2970 m	Latitude: 42º52.03' N	Longitude: 10º37.94' W

Surface Samples collected:

Geologic samples:
- Forams / Texture (100 cc)
- Diatoms / C.Org. (50 cc)
- Biogeochemistry (25 cc)
- Archive (100 cc)
- Small archive (25 cc)

Other sampling:
- Industry DNA (50 cc) 0-1 cm
- Industry DNA (50 cc) 1-2 cm

Sub-sampled cores collected:

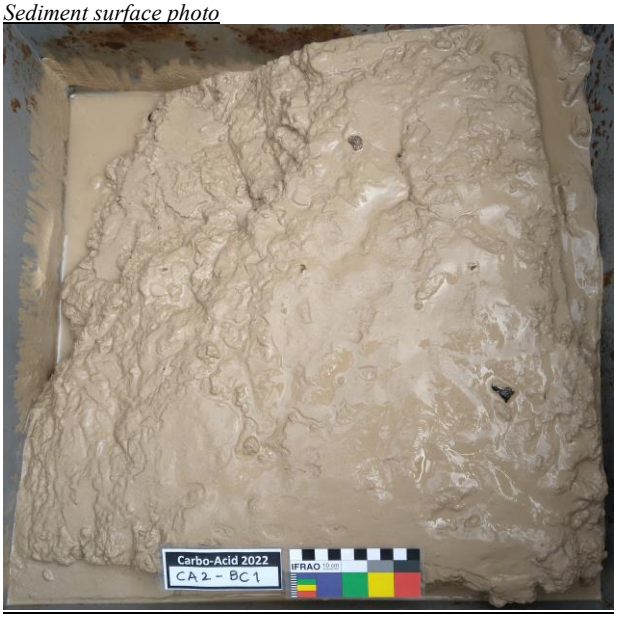
Liner	Liner Ø	Core name
1	11 cm	Foram DNA 1 *(0-1, 1-2, 4-5 cm)
2	11 cm	Foram DNA 2 *(0-1, 1-2, 4-5 cm)
3	11 cm	Foram DNA 3 *(0-1, 1-2, 4-5 cm)
4	11 cm	Foram RB 1 *(0-1 to 5-6 cm)
5	11 cm	Foram RB 2 *(0-1 to 5-6 cm)
6	11 cm	Foram RB 3 *(0-1 to 5-6 cm)
7	11 cm	Geo (MSCL, XRF)
8	11 cm	Geo Archive

RB= Bengal Rose
*sampled onboard

Sample description:

Incomplete box-core closure led to partial surface sediment loss while arriving onboard.
Surface sediment tilted but homogeneous and composed of light brown sandy mud. Recovery of 18 cm depth at box-corer maximal height.

Sediment surface photo



Sampling photo

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

BOX-CORE DESCRIPTION

Date: 05-08-2022	IPMA Access Number: 5977	**Station no.: CA7-BC1**
Water depth: 77 m	Latitude: 42º44.59' N	Longitude: 09º12.86' W

Surface Samples collected:

Geologic samples:
- Forams / Texture (100 cc)
- Archive Geo Box

Other sampling:
- Foram RB (50 cc)
- eDNA (50 cc)
- Benthos grainsize box

Sub-sampled cores collected:

Liner	Liner Ø	Core name
1	12.5 cm	Benthos 1 (~15 cm deep; obs.: collected with spatula into bag)
2	12.5 cm	Benthos 2 (~15 cm deep; obs.: collected with spatula into bag)
3	12.5 cm	Benthos 3 (~15 cm deep; obs.: collected with spatula into bag)
4		

RB= Bengal Rose

Sample description:

Sediment composed mainly of broken shells and coarse-grain sand. Presence of a sea urchin on top. 15 cm of maximal height of the collected box-core.

Sediment surface photo

Sampling photo

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

BOX-CORE DESCRIPTION

Date: 06-08-2022	IPMA Access Number: 5983	**Station no.: CA8-BC1**
Water depth: 343 m	Latitude: 42º05.26' N	Longitude: 09º23.12' W

Surface Samples collected:

Geologic samples:
- Forams / Texture (100 cc)
- Diatoms / C.Org. (50 cc)
- Biogeochemistry (25 cc)
- 2x Archive (100 cc)

Other sampling:
- bag with clasts
- bag with gastropods

Sub-sampled cores collected:

Liner	Liner Ø	Core name
1	11 cm	Foram DNA 1 *(0-1, 1-2, 4-5 cm)
2	11 cm	Foram DNA 2 *(0-1, 1-2, 4-5 cm)
3	11 cm	Foram DNA 3 *(0-1, 1-2, 4-5 cm)
4	11 cm	Foram RB 1 *(0-1 to 5-6 cm)
5	11 cm	Foram RB 2 *(0-1 to 5-6 cm)
6	11 cm	Foram RB 3 *(0-1 to 5-6 cm)
7	11 cm	Geo 1 (MSCL, XRF)
8	11 cm	Geo 2
9	12.5 cm	Geo Archive

RB= Bengal Rose
*sampled onboard

Sample description:

Surface composed of olive brown sandy sediment. Presence of ~10 small ophiuroids, a polychaete and several smaller polychaete tubes. Approx. 14-17 cm of homogenous sediment recovered in the box-corer. Presence of gastropods at box-core base.

Sediment surface photo

Sampling photo

Boxcore side-view photo

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

BOX-CORE DESCRIPTION

Date: 09-08-2022	IPMA Access Number: 6004	**Station no.: CA5-BC1**
Water depth: 1684 m	Latitude: 38º46.19' N	Longitude: 10º18.71' W

Surface Samples collected:

Geologic samples:
- Forams / Texture (100 cc)
- Diatoms / C.Org. (50 cc)
- Biogeochemistry (25 cc)
- Archive (100 cc)
- Small archive (25 cc)

Other sampling:
- Industry DNA (50 cc)
- Sieved sample: f > 4 mm
- Sieved sample: 850 > f > 100 µm

Sub-sampled cores collected:

Liner	Liner Ø	Core name
1	11 cm	Foram DNA 1 *(0-1, 1-2, 4-5 cm)
2	11 cm	Foram DNA 2 *(0-1, 1-2, 4-5 cm)
3	11 cm	Foram DNA 3 *(0-1, 1-2, 4-5 cm)
4	11 cm	Foram RB 1 *(0-1 to 5-6 cm)
5	11 cm	Foram RB 2 *(0-1 to 5-6 cm)
6	11 cm	Foram RB 3 *(0-1 to 5-6 cm)
7	11 cm	Geo (5 cm compression)
8	11 cm	Geo Archive (5 cm compression)

RB= Bengal Rose
*sampled onboard

Sample description:

Tilted box-core with a surface of brown mud sediments, with pteropod shells and polychaete tubes.

Sediment surface photo

Sampling photo

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

BOX-CORE DESCRIPTION

Date: 09-08-2022	IPMA Access Number: 6005	**Station no.: CA5-BC2**
Water depth: 1684 m	Latitude: 38º46.19' N	Longitude: 10º18.52' W

Surface Samples collected:

Geologic samples:
- Forams / Texture (100 cc)
- Diatoms / C.Org. (50 cc)
- Biogeochemistry (25 cc)
- Archive (100 cc)

Other sampling:
- Foram RB (50 cc)
- eDNA (50 cc)
- Benthos grainsize box

Sub-sampled cores collected:

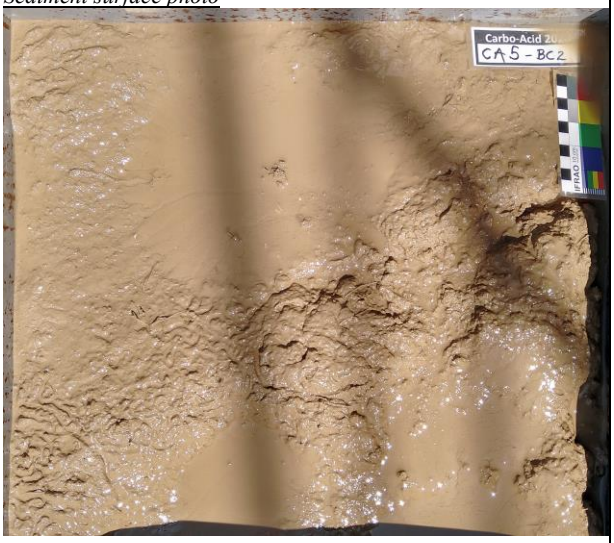
Liner	Liner Ø	Core name
1	12.5 cm	Geo 4 (5-6 cm compression)
2	11 cm	Geo 2 (5-6 cm compression)
3	11 cm	Geo 3 (5-6 cm compression)
4	11 cm	Benthos 1 (collected into bag)
5	11 cm	Benthos 2 (collected into bag)
6	11 cm	Benthos 3 (collected into bag)
7	11 cm	Geo 1 (5-6 cm compression) (MSCL, XRF)

RB= Bengal Rose

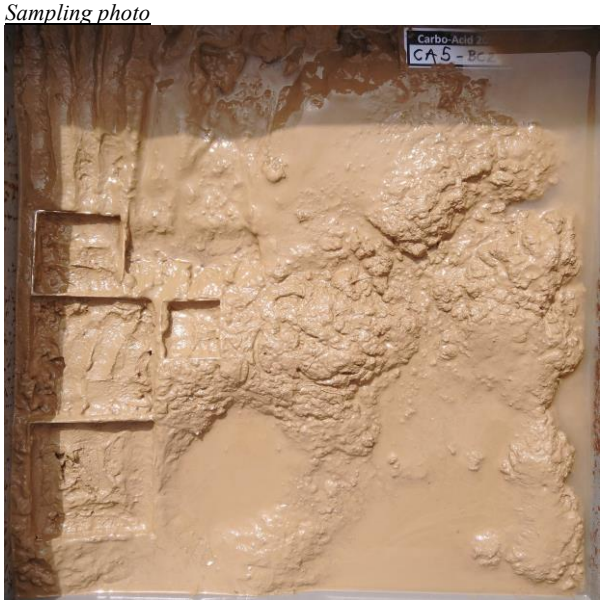
Sample description:

Surface composed of light brown muddy sediment with presence of polychaete tubes, ophiuroids, pteropod shells and a xenophiophore. Deeper sediment (> 15 cm deep) of olive brown colour.

Sediment surface photo



Sampling photo



Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

BOX-CORE DESCRIPTION

Date: 10-08-2022	IPMA Access Number: 6010	**Station no.: CA4-BC2**
Water depth: 585 m	Latitude: 38º39.549' N	Longitude: 09º44.543' W

Surface Samples collected:

Geologic samples:
-

Other sampling:
- Foram RB (50 cc)
- eDNA (50 cc)
- Benthos grainsize box
- bag with clasts
- bag with gastropods
- bag with shells
- bag with corals
- Sieved sample tube: f>850 µm
- Sieved sample tube: 850>f>100 µm

Sub-sampled cores collected:

Liner	Liner Ø	Core name
1	11 cm	Geo 1 (1-2 cm compression)
2	11 cm	Geo 2 (1-2 cm compression)
3	11 cm	Geo 3 (1-2 cm compression)
4	11 cm	Benthos 1 (collected into bag)
5	11 cm	Benthos 2 (collected into bag)
6	11 cm	Benthos 3 (collected into bag)
7	12.5 cm	Geo 4 (~1 cm compression)
8	12.5 cm	Geo 5 (~1 cm compression)
9	12.5 cm	Geo 6 (~1 cm compression)

RB= Bengal Rose

Sample description:

Due to technical problems box-core was tilted when placed onboard, likely washing out top surface sediment. Surface composed of brown muddy fine-sand sediment with polychaete tubes. Presence of few small shrimps. Box-core filled with sediment up to 30-34 cm deep.

Sediment surface photo

Sampling photo

Cruise: EUROFLEETS - Carbo-Acid
Vessel: RV Ramón Margalef

BOX-CORE DESCRIPTION

Date: 10-08-2022	IPMA Access Number: 6011	**Station no.: CA4-BC3**
Water depth: 585 m	Latitude: 38º39.549' N	Longitude: 09º44.544' W

Surface Samples collected:

Geologic samples:
- Forams / Texture (100 cc)
- Diatoms / C.Org. (50 cc)
- Biogeochemistry (25 cc)
- Archive (100 cc)

Other sampling:
- Industry DNA (50 cc)
- box with gastropod shells

Sub-sampled cores collected:

Liner	Liner Ø	Core name
1	11 cm	Foram DNA 1 *(0-1, 1-2, 4-5 cm)
2	11 cm	Foram DNA 2 *(0-1, 1-2, 4-5 cm)
3	11 cm	Foram DNA 3 *(0-1, 1-2, 4-5 cm)
4	11 cm	Foram RB 1 *(0-1 to 5-6 cm)
5	11 cm	Foram RB 2 *(0-1 to 5-6 cm)
6	11 cm	Foram RB 3 *(0-1 to 5-6 cm)
7	11 cm	Geo 1 (MSCL, XRF)
8	11 cm	Geo 2
9	11 cm	Geo 3

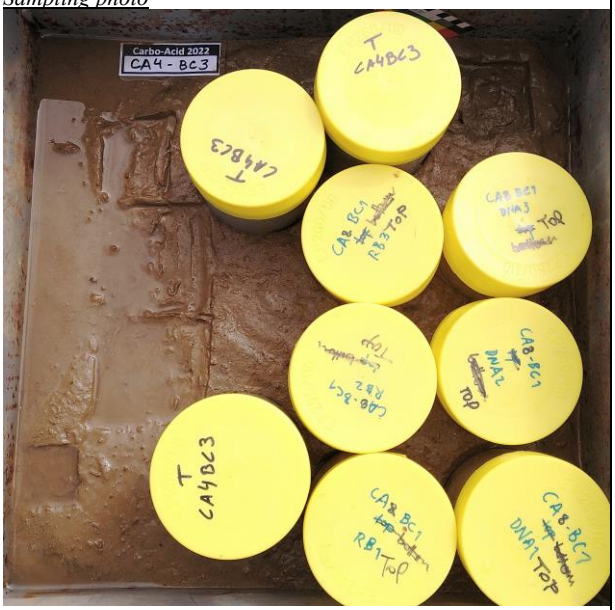
RB= Bengal Rose
*sampled onboard

Sample description:

Surface composed of light brown muddy fine sand sediment with polychaete tubes. Presence of some black (volcanic) grains. Presence of 2 isopods swimming in overlying water. At ~15-20 cm deep, layer with gastropods and shells. Total box-core depth of 35 cm.

Sediment surface photo

Sampling photo



Annex 10.5 Sediments sub-sampling for DNA and Benthic Foraminifera Bengal Rose samples

Site	Date of sampling	Water depth (m)	Device	Sediment depth	Replicates	Analyses	Label	Remarks
CA3	03/08/22	1100	BC2	surface	2	DNA	CA-3-BC2a/b DNA surf.	washed out
CA3	03/08/22	1100	BC2	surface	1	RB	CA-3-BC2c DNA surf.	
CA2	04/08/22	2970	BC1	0-1cm	3	DNA	CA-2-BC1a/b/c DNA 0-1cm	blond sticky mud, surf. + sandy
CA2	04/08/22	2970	BC1	1-2cm	3	DNA	CA-2-BC1a/b/c DNA 1-2cm	
CA2	04/08/22	2970	BC1	4-5cm	3	DNA	CA-2-BC1a/b/c DNA 4-5cm	
CA2	04/08/22	2970	BC1	0-1cm	3	RB	CA-2-BC1a/b/c RB 0-1cm	
CA2	04/08/22	2970	BC1	1-2cm	3	RB	CA-2-BC1a/b/c RB 1-2cm	
CA2	04/08/22	2970	BC1	2-3cm	3	RB	CA-2-BC1a/b/c RB 2-3cm	
CA2	04/08/22	2970	BC1	3-4cm	3	RB	CA-2-BC1a/b/c RB 3-4cm	
CA2	04/08/22	2970	BC1	4-5cm	3	RB	CA-2-BC1a/b/c RB 4-5cm	
CA2	04/08/22	2970	BC1	5-6cm	3	RB	CA-2-BC1a/b/c RB 5-6cm	
CA7	05/08/22	77	BC1	surface	2	DNA	CA-7-BC1a/b DNA surf.	shell debris
CA7	05/08/22	77	BC1	surface	1	RB	CA-7-BC1c DNA surf.	
CA8	06/08/22	343	BC1	0-1cm	3	DNA	CA-8-BC1a/b/c DNA 0-1cm	
CA8	06/08/22	343	BC1	1-2cm	3	DNA	CA-8-BC1a/b/c DNA 1-2cm	
CA8	06/08/22	343	BC1	4-5cm	3	DNA	CA-8-BC1a/b/c DNA 4-5cm	
CA8	06/08/22	343	BC1	0-1cm	3	RB	CA-8-BC1a/b/c RB 0-1cm	
CA8	06/08/22	343	BC1	1-2cm	3	RB	CA-8-BC1a/b/c RB 1-2cm	
CA8	06/08/22	343	BC1	2-3cm	3	RB	CA-8-BC1a/b/c RB 2-3cm	
CA8	06/08/22	343	BC1	3-4cm	3	RB	CA-8-BC1a/b/c RB 3-4cm	
CA8	06/08/22	343	BC1	4-5cm	3	RB	CA-8-BC1a/b/c RB 4-5cm	
CA8	06/08/22	343	BC1	5-6cm	3	RB	CA-8-BC1a/b/c RB 5-6cm	
CA6	07/08/22	1433	S2	surface	1	DNA	CA-2-S2 DNA surf.	
CA6	07/08/22	1433	S2	surface	1	RB	CA-2-S2 RB surf.	
CA6	07/08/22	1433	S2	1 coral+3 sponges		DNA	CA-2-S2	
CA6	08/08/22	1433	S7	surface	1	DNA	CA-2-S7 DNA surf.	
CA6	08/08/22	1433	S7	surface	1	RB	CA-2-S7 RB surf.	
CA6	08/08/22	1433	S8	surface	1	DNA	CA-2-S8 DNA surf.	
CA6	08/08/22	1433	S8	surface	1	RB	CA-2-S8 RB surf.	
CA6	08/08/22	1433	S9	surface	1	DNA	CA-2-S9 DNA surf.	
CA6	08/08/22	1433	S9	surface	1	RB	CA-2-S9 RB surf.	
CA5	09/08/22	1680	BC1	0-1cm	3	DNA	CA-5-BC1a/b/c DNA 0-1cm	
CA5	09/08/22	1680	BC1	1-2cm	3	DNA	CA-5-BC1a/b/c DNA 1-2cm	
CA5	09/08/22	1680	BC1	4-5cm	3	DNA	CA-5-BC1a/b/c DNA 4-5cm	

CA5	09/08/22	1680	BC1	0-1cm	3	RB	CA-5-BC1a/b/c RB 0-1cm	
CA5	09/08/22	1680	BC1	1-2cm	3	RB	CA-5-BC1a/b/c RB 1-2cm	
CA5	09/08/22	1680	BC1	2-3cm	3	RB	CA-5-BC1a/b/c RB 2-3cm	
CA5	09/08/22	1680	BC1	3-4cm	3	RB	CA-5-BC1a/b/c RB 3-4cm	
CA5	09/08/22	1680	BC1	4-5cm	3	RB	CA-5-BC1a/b/c RB 4-5cm	
CA5	09/08/22	1680	BC1	5-6cm	3	RB	CA-5-BC1a/b/c RB 5-6cm	
CA5	09/08/22	1680	BC2	surface	2	DNA	CA-5-BC2a/b DNA surf.	
CA5	09/08/22	1680	BC2	surface	1	RB	CA-5-BC2 RB surf.	
CA4	10/08/22	580	BC1	surface	1	DNA	CA-4-BC1 DNA surf.	surface flushed out
CA4	10/08/22	580	BC1	surface	1	RB	CA-4-BC1 RB surf.	
CA4	10/08/22	580	BC2	0-1cm	3	DNA	CA-4-BC2a/b/c DNA 0-1cm	
CA4	10/08/22	580	BC2	1-2cm	3	DNA	CA-4-BC2a/b/c DNA 1-2cm	
CA4	10/08/22	580	BC2	4-5cm	3	DNA	CA-4-BC2a/b/c DNA 4-5cm	
CA4	10/08/22	580	BC2	0-1cm	3	RB	CA-4-BC2a/b/c RB 0-1cm	
CA4	10/08/22	580	BC2	1-2cm	3	RB	CA-4-BC2a/b/c RB 1-2cm	
CA4	10/08/22	580	BC2	2-3cm	3	RB	CA-4-BC2a/b/c RB 2-3cm	
CA4	10/08/22	580	BC2	3-4cm	3	RB	CA-4-BC2a/b/c RB 3-4cm	
CA4	10/08/22	580	BC2	4-5cm	3	RB	CA-4-BC2a/b/c RB 4-5cm	
CA4	10/08/22	580	BC2	5-6cm	3	RB	CA-4-BC2a/b/c RB 5-6cm	