RELATÓRIOS DE CAMPANHA

IBERIA-FORAMS
2012

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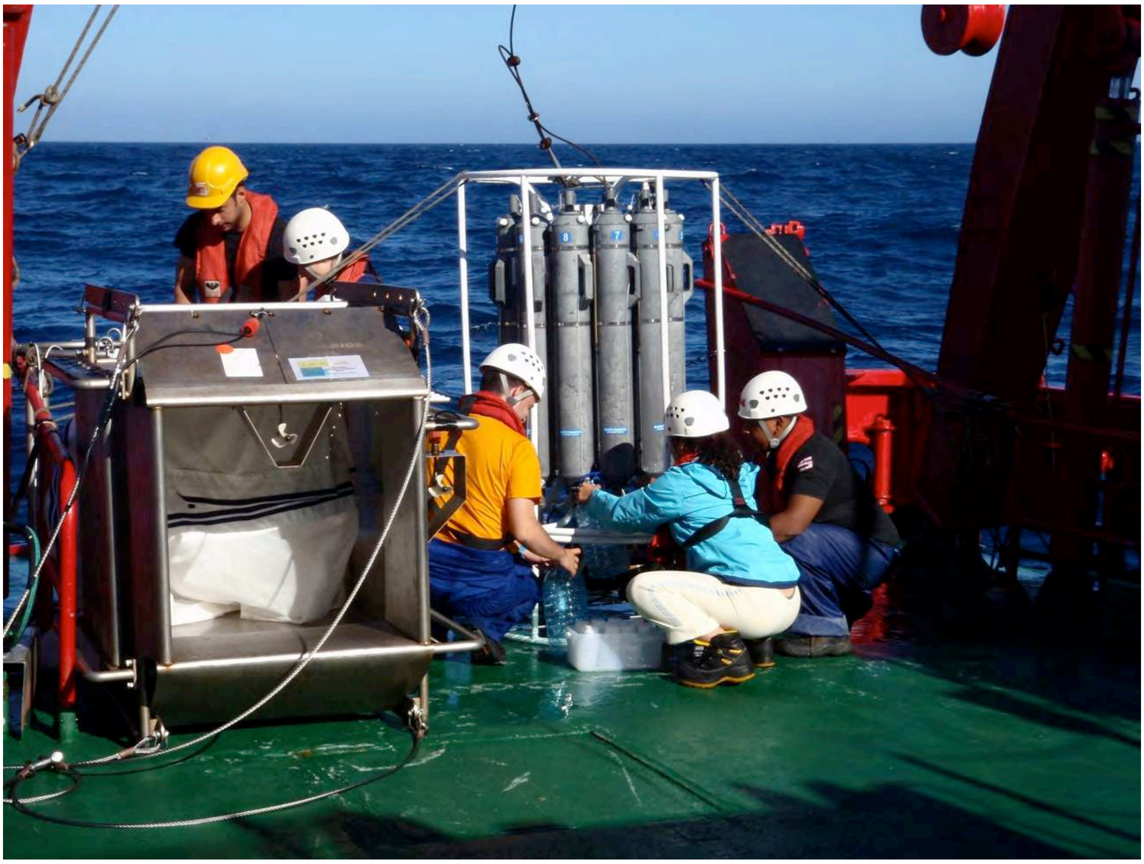
Eurofleets

EUROFLEETS Cruise Summary Report

IBERIA-FORAMS

R/V Garcia del Cid, Cruise Iberia-Forams

10.09.2012 – 16.09.2012
Vigo (Spain) – Huelva (Spain)



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2012

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IPMA Marine Geology Group Report No. 1/ 2012

Table of Content

1 Summary

The Iberia-Forams cruise on R/V Garcia del Cid started in Vigo (Spain) on September 10th, 2012 and ended in Huelva (Spain) in the morning of September 16th, 2012. Along the cruise track (Fig. 1.1) CTD profiles and seawater samples were collected at 12 stations. Multiple opening closing plankton net (Multi-Net) hauls for plankton ecology studies were performed at 10 of those stations. At stations 3, 5, 7, 9, 10, and 12 an additional Multi-Net haul was executed to retrieved planktonic foraminifers for molecular phylogeny studies.

Multi-sensor CTD profiles were done until close to the seafloor (depth range of 324 – 2559 m). Measured parameters include temperature, pressure, salinity, flourescence, oxygen content, and turbidity. The seawater samples, collected primarily for stable isotope analyses, cover the complete water column and sample all the water masses identified at the respective station. Thermocline and flourescence maxima depths encountered during the cruise were relative shallow and indicate that none of the stations sampled an upwelling event (Fig. 2.1b). Seawater samples from the upper 300 m were filtered to collect coccolithophorids. For all seawater samples the pH was determined as onboard measurement.

Fig. 1.1 Cruise track (until early afternoon of September 15th) and stations of R/V Garcia del Cid Cruise Iberia-Forams.

Multi-Net hauls covered water depths from 800 m upward, but at most stations the hauls were shallower (see section 7). The uppermost net always encompassed the flourescence maximum. Planktonic foraminifer abundances (as observed in the molecular phylogeny samples) are relative low and, in accordance with the prevailing hydrographic conditions, contain several subtropical species.

2 Research Programme/Objectives

The western Iberian margin is an eastern boundary upwelling system and during the upwelling season, i.e. May to late September/ early October, upwelling plumes and filaments can reach 200 km offshore (Sousa and Bricaud 1992; Haynes et al., 1993). Plankton studies in this region concentrated on the phytoplankton groups (coccolithophorids, diatoms; e.g., Abrantes and Moita, 1999), copopods or mero-zooplankton (Villa et al., 1997; Queiroga et al., 2005; Stehle et al., 2007). No data exists for planktonic foraminifers or pteropods and the samples collected during the cruise will finally provide one snapshot into their abundance and diversity during the upwelling season. We will also study the genetic diversity of some of the planktonic foraminifers as it is now known that many species have more than one genotype with the species *Globigerina bulloides* and *Neogloboquadrina pachyderma/ Neogloboquadrina incompta* having at least 7 genotypes (e.g., Darling and Wade, 2008).

Because we will collect more seawater than needed for the stable isotope studies water (see below) collected from the upper 300 m will be filtered for coccolithophorids. Furthermore, as a contribution to future studies on ocean acidification in the region we will measure the pH in all seawater samples.

Although planktonic foraminifers are an essential tool in paleoceanographic studies, we still rely on insights from sediment surface samples (e.g., Salgueiro et al., 2008), which integrate signals over a number of years and seasons, for interpreting data along the Iberian margin. So besides faunal and genetic diversity the planktonic foraminifer shells collected during the cruise will also be used for stable isotope analyses. Recent studies have shown that we need regional and species-specific calibrations for stable isotope or trace element data analysed in the carbonate of the foraminiferal shells (e.g., Mulitza et al., 2003; Wilke et al., 2009). For establishing a regional calibration a direct comparison between isotopic values measured in the seawater, in which the respective foraminifer species built its shell, with those analysed in the carbonate shell is essential. Consequently, seawater samples will be collected for stable isotope (δ^{18}O, δD, δ^{13}C-DIC) analyses from depths covering the complete water column but with special attention to the watermass structure in the upper 500 m.

Planned stations (Fig. 2.1a) are distributed along the western Iberian margin and include the re-occupation of the study site of the CALIBERIA project (Salgueiro et al., 2012) on the shelf edge off Vigo and of OVIDE 2010 transect stations 3 and 6 at 40.3°N. Additional stations shall collect data and samples at the positions of IODP Sites U1385 and U1387 (Expedition 339 Scientists, 2012) thereby allowing relating the water column data to the porewater and micropaleontological studies underway at these sites.

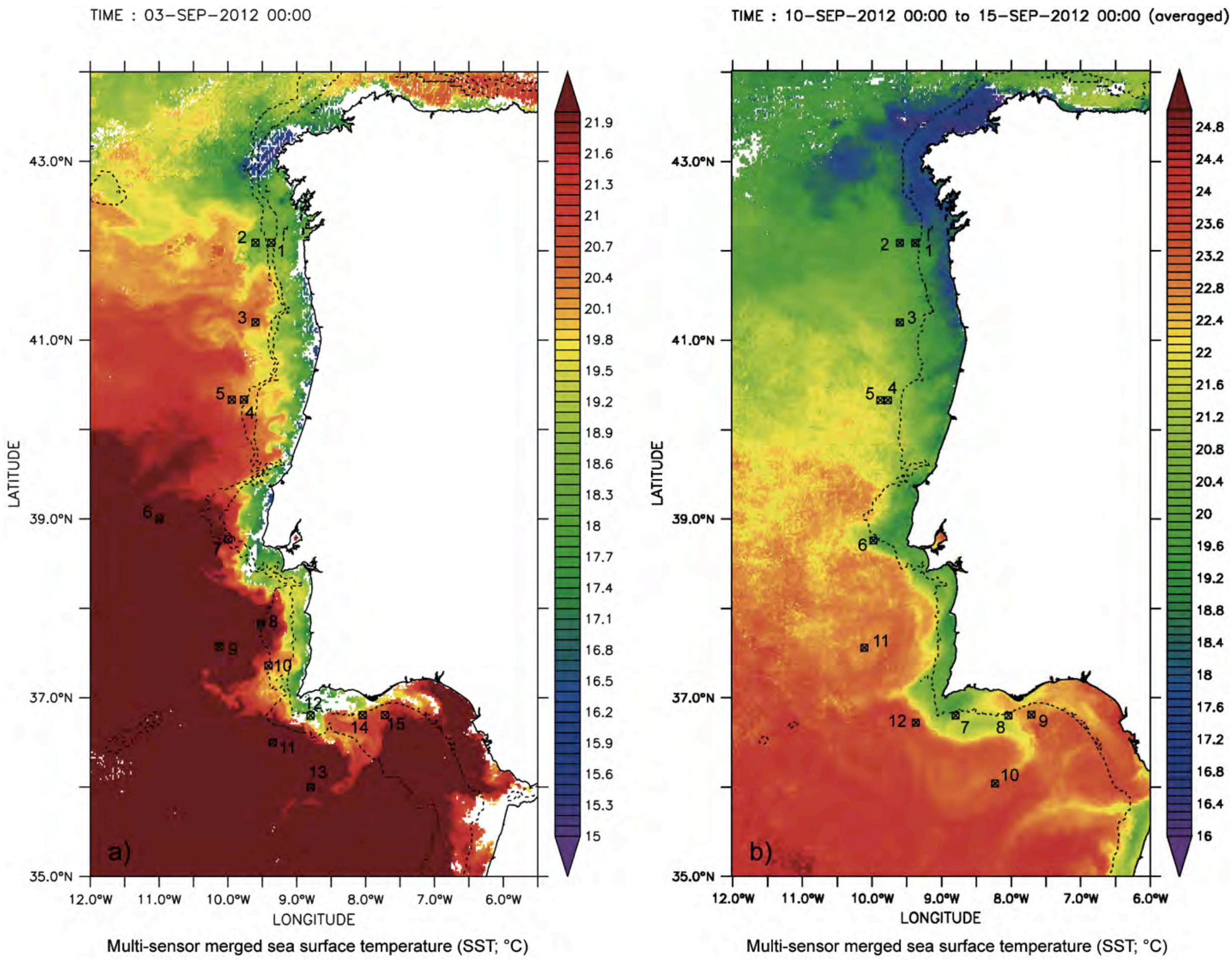

Fig. 2.1 Satellite sea surface temperature (SST) distribution in the working area prior to (a; 3rd September) and during the cruise (b; averaged for 10th – 15th September). Note the difference in SST scales for both maps. Black symbols and numbers indicate planned (a) and executed (b) stations. [Maps provided by Paulo Oliveira, IPMA]

3 Narrative of the Cruise

R/V Garcia del Cid left Vigo harbor on September 10th, 2012 just after 1 pm with a group of 7 scientists on board. Work at the first station began at 4:22 pm under an overcast sky and with an low amplitude swell. Station Iberia-Forams (Ib-F) 1 occupied the position of the station where monthly seawater samples were collected for the Portuguese-Spanish CALIBERIA project (Salgueiro et al., 2012). This station was also set as test station since most science party members had no previous experience with CTD/ Rosette or Multi-Net operations and sample collecting. Because of a communication problem during the first Multi-Net haul a second haul was necessary and we left the station at 8 pm. Ib-F station 2, located further offshore, was reached at 9:16 pm with rain showers and swell conditions similar to station Ib-F 1. The first CTD deployment had to be abandoned during the descend at 1200 m because of sensor problems (batteries need to be replaced). The second CTD/ Rosette deployment went down to 1757 m water depth. At this station a minimum of two Multi-Net hauls was planned. However, problems in retrieving the basket with the collector cups from the sea after the first haul led to all five plankton nets and one of the collector cups being damaged. Because the tears in the nets could not be repaired in a short time, allowing for additional hauls, the station was abandoned at 2:30 am on September 11th, 2012 with a southern course.

Work at station Ib-F 3 started on September 11th at 8:45 am with the CTD/ Rosette deployment. Sea conditions were good with only some low amplitude swell. The sky was overcast with the sun appearing in the afternoon. The CTD/Rosette was back on board at 10:20 am. Because the plankton nets needed to be repaired by attaching patches of mesh material by hand stitching (Fig. 3.1) prior to deployment, the first Multi-Net haul started only at 12:17 pm and collected material at five levels from 500 m upward. The first haul collected material for the molecular phylogeny study allowing as much time as possible for the microscope work under the relative stable sea conditions at station. For the second (ecology) Multi-Net haul the depth interval of the two deeper nets was changed to 600-400 and 400-200 m, respectively, while the upper nets samples the same depth intervals as the molecular phylogeny study haul. Work at station 3 was completed at 3:00 pm.

Fig. 3.1 Iberia-Forams team members (from left to right: Blanca Ausin, Dave Bell, Andreia Rebotim) at work repairing the plankton nets.

Because of the delay already incurred during the cruise and to ensure that important stations on the southern margin could be sampled, work at station Ib-F 4 was limited to the CTD/Rosette cast. This station re-occupied the position of OVIDE 2010 transect station 3, for which the PI, Antje Voelker, has seawater samples for stable isotope studies. Re-occupation and sampling at this location will therefore allow an interannual comparison. Under calm sea conditions the CTD/Rosette cast started at 8:42 pm on

September 11th and ended at 9:40 pm. To save further time the position of the following station, Ib-F 5, was moved closer to shore therefore re-occupying OVIDE 2010 station 5 instead of station 6 as initially planned. At this station a full program with a CTD/ Rosette and two Multi-Net hauls was executed. As on the previous station sea conditions were good with a low amplitude swell. During the station work the ship drifted slowly southward with the current (see Station List; section 7). Station work started at 10:43 pm on September 11th with the CTD/ Rosette cast down to 2420 m. The ecology study Multi-Net haul sampled five levels between 700 m and the sea surface between 1:27 and 2:35 am on September 12th. The molecular phylogeny related Multi-Net haul sampled depths between 400 and 0 m between 3:12 and 3:47 am. The station work was completed at 4:02 am on September 12th and the ship moved southward in direction of planned station 7 because planned station 6 (Fig. 2.1a) is located too far offshore for safe working condition with R/V Garica del Cid, in particular since the forecast indicated increasing swell heights for the southwestern Iberian margin during the next two days.

Work at station Ib-F 6, located at the southern edge of the Estremadura promontory north of Lisbon, started at 2:00 pm on September 12th with sunny skies and low amplitude swell. After 4:00 pm, however, winds picked up with white caps becoming common and swell amplitude increasing. The CTD/ Rosette cast went down to 1217 m and was back on board at 3:06 pm. Because of the increased turbidity in the water column the winch cable suffered some contursions during the CTD/ Rosette cast. So to remove the contursions the winch cable needed to be unrolled and rolled up again interrupting the station work for 2 hours. During the work on the winch cable the ship drifted with the current southward. Because of the deteriorating sea conditions it was decided not to reposition the ship but to do the Multi-Net haul at the position where the work on the winch ended, i.e. about 3 minutes further to the south as the CTD/ Rosette cast. The Multi-Net haul sampled depths from 540 m upward between 5:07 and 6:13 pm. During the haul, the plankton net sampling the interval between 340 and 240 m suffered a big tear making this net unusable for future hauls. R/V Garcia del Cid left the station at 6:15 pm.

Because of the relative strong winds and a swell of more than 1.5 m height the planned order of stations had to be revised. High winds and swell were forecast for the Sines coast for the whole day of September 13th. The ship left station Ib-F 6 initially in direction of planned station 9, i.e. the position of IODP Site U1385 (Expedition 339 Scientists, 2012), but soon changed direction toward planned station 10, i.e. the position of IODP Site U1391 located closer to the coast (Fig. 1.1). In the early morning hours of September 13th it became, however, apparent that none of the Sines coast stations could be sampled and that station work would only be possible on the southern coast. The ship therefore moved to planned station 12 (Fig. 2.1a) on the Algarve shelf.

Work at station Ib-F 7 began on September 13th at 8:15 am under sunny skies. Some swell and a few white caps occurred but did not affect the station work. The CTD/ Rosette cast down to 410 m ended at 8:51 am when the equipment was back on deck. The first Multi-Net haul, now with only four nets and thus sampling only four intervals, collected material for the molecular phylogeny study for four depth intervals between

300 m and the surface between 9:20 am and 10:00 am. The second haul, performed between 10:20 and 10:56 am, collected material from the same levels as for the previous haul but this time for the ecology study. At 10:59 am R/V Garcia del Cid left the station on way to station Ib-F 8.

Station Ib-F 8 is located near the southwestern corner of the working area of the EUROFLEETS IMPACT proposal and cruise (PI M. Castro) allowing a comparison between the planktonic foraminifer species found in the plankton nets and the surface and subsurface sediments collected during the IMPACT cruise. The CTD/ Rosette cast down to 571 m was executed between 3:01 and 3:38 pm under warm and sunny skies. Sea conditions were good with low amplitude swell and only very few white caps. The Multi-Net haul started at 4:11 pm and ended at 4:55 pm. At 5:00 pm the ship left the station in direction of the last station along the Algarve shelf. Station Ib-F 9 was reached at 6:50 pm just after sunset. Sea conditions were similar as at station Ib-F 8, but the surface current was felt more strongly with the ship drifting eastward during hauls (the ship was repositioned after each haul). Station Ib-F 9 is positioned at the location of IODP Site U1387 (Expedition 339 Scientists, 2012). The CTD/ Rosette cast started at 6:57 pm and went down to 541 m. The first Multi-Net haul for collecting material for the genotype study between 360 m and the sea surface started at 8:00 pm and ended at 8:43 pm. The ecology-related haul was executed between 9:11 and 10:02 pm and started sampling material at 460 m depth. At 10:06 pm the ship left for the next station.

The position of Station Ib-F 10 was changed from the location of planned station 13 and moved eastward to reduce sailing time and gain shiptime to sample at least one station off the Sines coast. The position of station Ib-F 10 was reached at 3:35 am on September 14th. Under calm and warm sea and weather conditions the CTD/ Rosette cast started at 3:49 am and ended at 5:55 am. The cast reached a maximum water depth of 1924 m. The first Multi-Net hauls was aimed for the molecular phylogeny study and sampled between depths between 400 m and the sea surface between 6:20 and 7:05 am. The plankton net sampling the deeper interval became, however, unzipped, so that no sample was recovered. There was only few material caught in the deeper nets of this haul, so that it was decided to reduce the number of hauls for the ecological study to just one haul that would sample depths from 800 m upward. This second Multi-Net, the deepest one performed during the whole cruise, started at 7:26 am and ended at 8:50 am with the upper two nets sampling the same levels as the uppermost nets of the genotype haul. The ship left the station at 8:53 am in direction of the Sines coast.

Because of participants' travel arrangements made prior to the delay in the cruise's start and the last minute change in the arrival harbor, R/V Garcia del Cid had to arrive in Huelva by 8 am on Sunday, September 16th, as the latest. Within the remaining cruise time only two additional stations were feasible for sure. On the other hand, for the porewater study at IODP Site U1385 (planned station 9) that is performed by Iberia-Forams co-proponent David Hodell (UK) it was important to obtain data from this offshore station. So the decision was made to steam offshore to the position of IODP Site U1385 but to limit the work to the CTD/ Rosette cast. R/V Garcia del Cid arrived at Iberia-Forams Station 11 at 11:53 pm on September 14th. Under good sea conditions with a swell of 0.5 – 1m, no white caps and a sea surface temperature of 23.8°C the

CTD/ Rosette cast started at 11:55 pm on the 14th and ended at 2:38 am on the 15th. During the cast down to 2545 m and the subsequent upcast the ship drifted from the position of 37°34.10'N 10° 7.21'W to 37° 33.25'N 10° 6.41'W. At 2:39 am the ship left the station in a southeastward direction because it was decided locating the last station of the cruise offshore Cape São Vicente (see below) thereby abandoning sampling at the position of IODP Site U1391 (planned station 10; Fig 2.1a).

Because of the poor success so far in sampling upwelling phenomena and therefore collecting *Globigerina bulloides* specimens for the molecular phylogeny study the last station was positioned off Cape São Vicente where the satellite SST data from September 3rd (Fig. 2.1a) indicated colder temperature and therefore some upwelling. The Cape São Vicente region is a busy ship traffic area with regulated traffic lanes. The station was therefore positioned between the major lanes and thereby a bit further offshore than might have been ideal based on the SST data shown in Fig. 2.1b. Station work at Iberia-Forams station 12 started at 9:21 am on September 15th with the CTD/ Rosette cast down to 1032 m under sunny skies and swell conditions similar to the previous station. The first Multi-Net haul sampled depth from 400 m upward for the molecular phylogeny study. The second Multi-Net collected material from 550 m upward for the ecology study. The station work was completed at 12:48 pm on September 15th and R/V Garcia del Cid left in direction of Huelva. The ship docked in Huelva at 8 am on September 16th with the taxi picking up the Spanish cruise participants already waiting on the dock.

4 Preliminary Results

4.1 Water and Phytoplankton Sampling with CTD/Rosette

CTD measurements were performed with the UTM-CSIC's Seabird-CTD-system SBE 11 plus V5.1g down to about 10 m above the seafloor at each station. Data was recorded for the following parameters (sensor information given in brackets) during the down- and upcasts, respectively:

- Pressure [Digiquartz with TC 0814]
- Temperature [Temperature sensor 03P4553]
- Conductivity [Conductivity Sensor 043120]
- Oxygen [SBE 43 Sensor 0915]
- Flourescence [Flouro Seapoint Sensor]
- Turbidity [OBS Seapoint Turbidity Sensor]
- Beam transmission [Wet Labs C-Star CST-974 DR]
- PAR/ Irradiance [Biosperical Licor Chelsea Sensor 70160]

Water depth, salinity and density, calculated based on some of those parameters, were also part of the CTD output data.

The CTD system was mounted on a Rosette with 12 bottles of 10 liter capacity (see photo on cover). Water sampling was done during the upcast at levels defined based on the downcast CTD profiles (see depths of pH values in Figures 4.1 – 4.12; Annex 10.1). Water sample cover the various water masses and hydrographic conditions encountered at each station (see also comments in Annex 10.1).

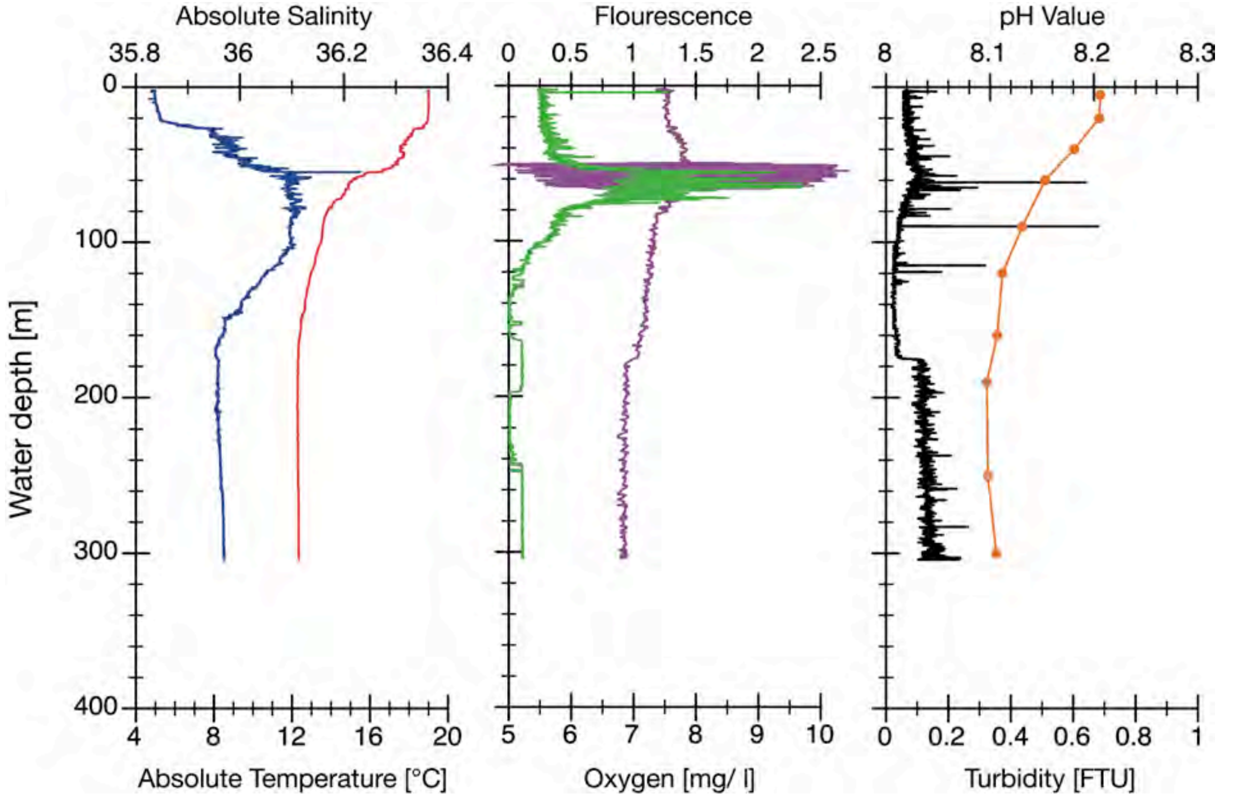

Fig. 4.1 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 1, i.e. the position where the CALIBERIA project collected monthly water column data and samples in 2011 and early 2012.

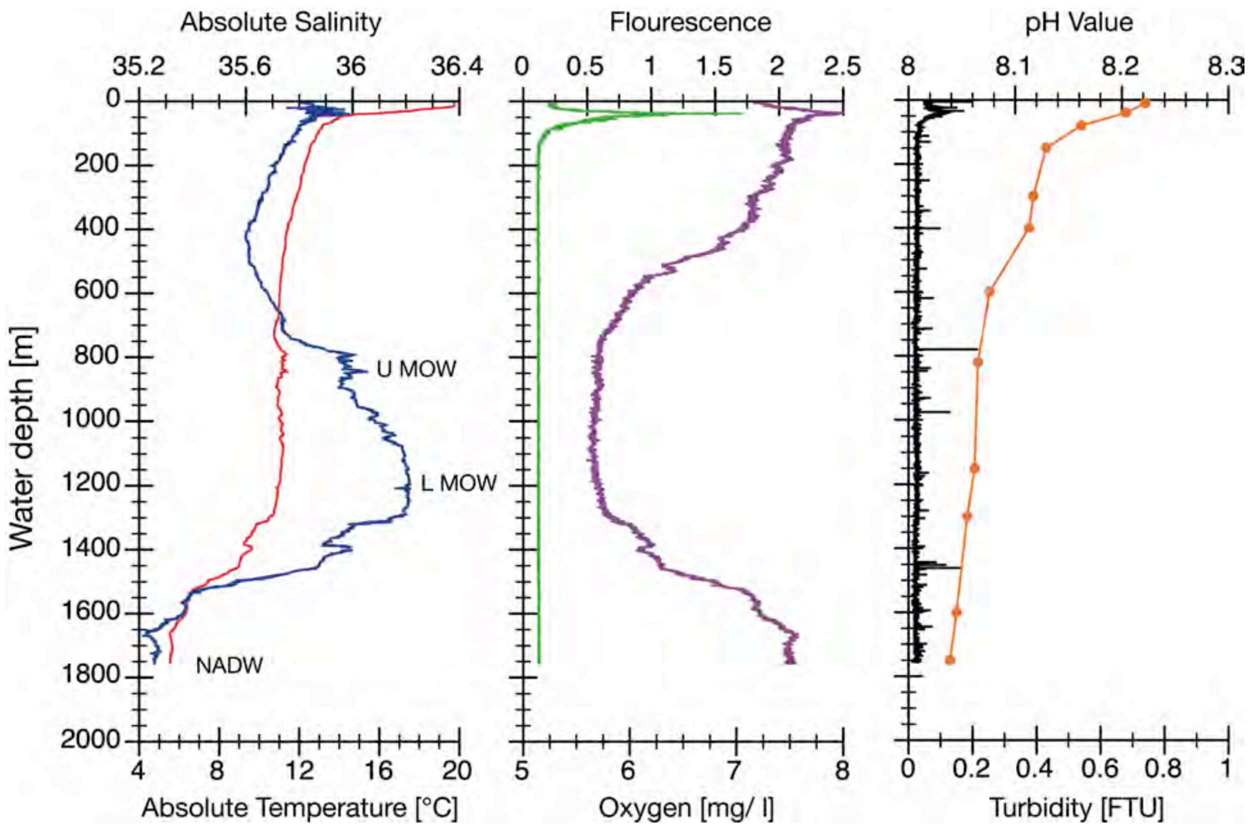

Fig. 4.2 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 2.

At all stations sampled during the Iberia-Forams cruise the flourescence maximum and the seasonal thermocline occurred within the upper 50 to 90 m (Fig. 4.1 – 4.12) indicating that none of the stations encountered upwelling conditions, in agreement with the satellite SST data (Fig. 2.1b). Temperatures in the upper water column were relatively warm in accordance with the absence of upwelling and with the observation that the North Atlantic was unusually warm during September 2012 (Fig. 4.13; NOAA-NCDC State of the Climate Global Analysis Report for September 2012 at http://www.ncdc.noaa.gov/sotc/global/2012/9). Subsurface temperature maxima below the seasonal thermocline at stations Ib-F 6 to 12 and potentially also the more northern stations might be related to North Atlantic Central Water (NACW) of the subtropical variety. Below this level, NACW of the subpolar variety, associated with a high oxygen content, is found with the related temperature minimum being located between 400 and 500 m, respectively, at most stations (Fig. 4.1 – 4.12).

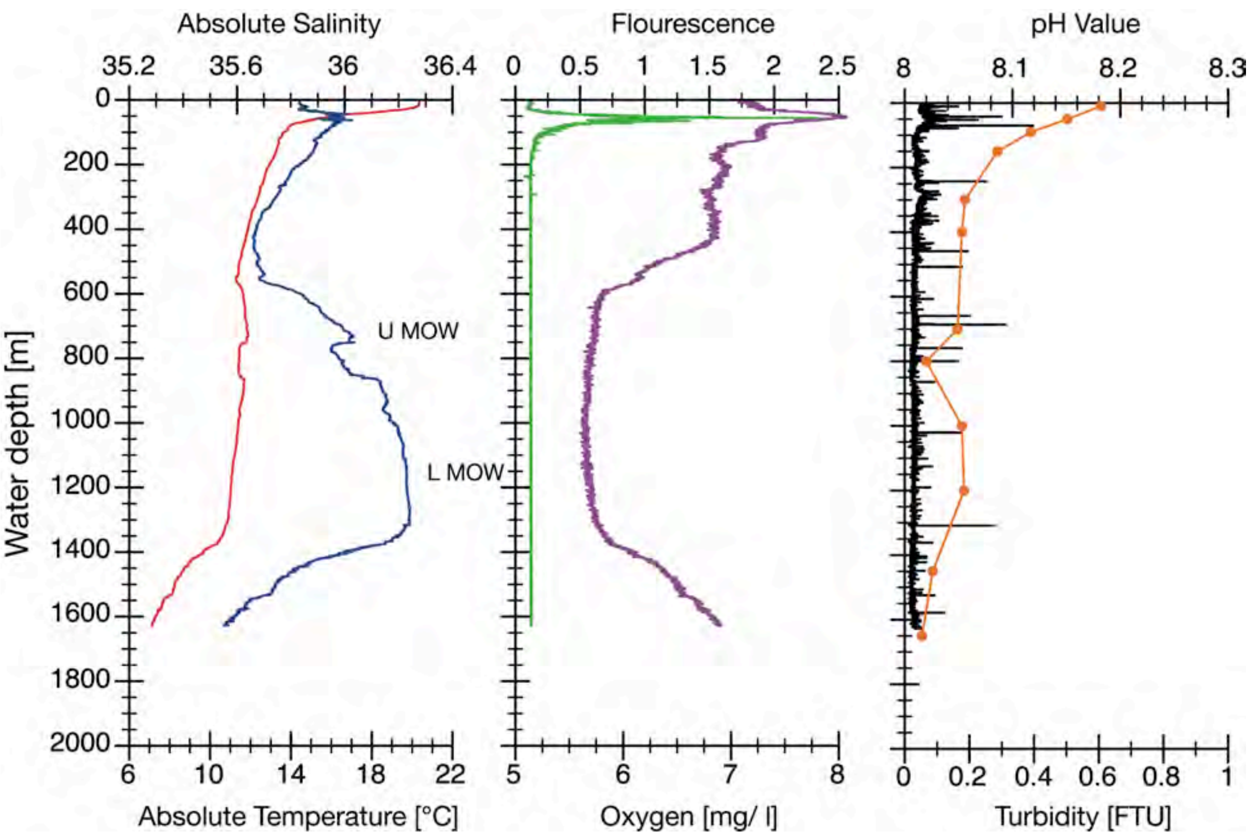

Fig. 4.3 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 3.

At the deeper stations, with the exception of Ib-F 10, the two cores (upper = U; lower = L) of the Mediterranean Outflow Water (MOW) can clearly be distinguished in the temperature and salinity profiles. Beneath the lower MOW core, the mixing zone between the MOW and the North Atlantic Deep Water (NADW) is visible in the profiles of stations Ib-F 2, 3, 5, 10, and 11. The presence of NADW at these deeper stations is clearly indicated by the decrease in temperature and salinity and the contemporary increase in oxygen content. The combined temperature minimum and oxygen maximum

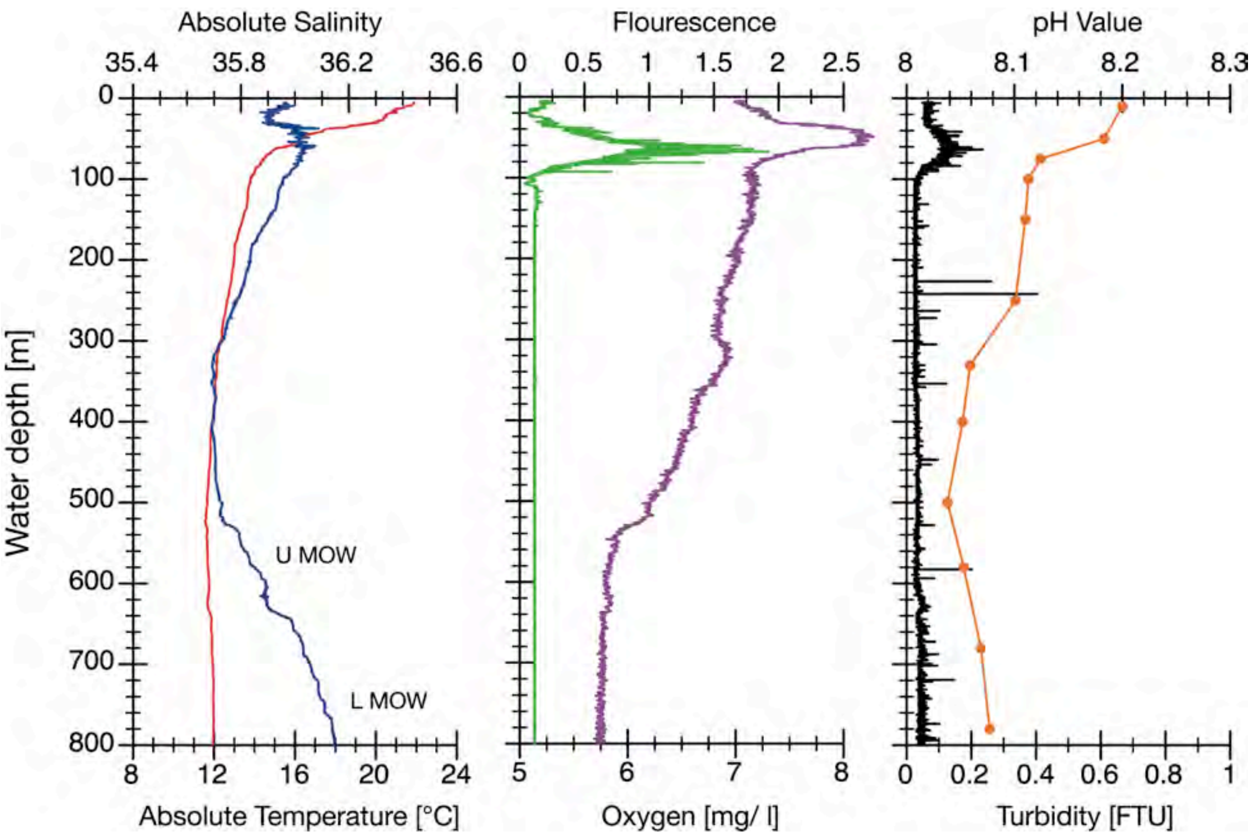

Fig. 4.4 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 4.

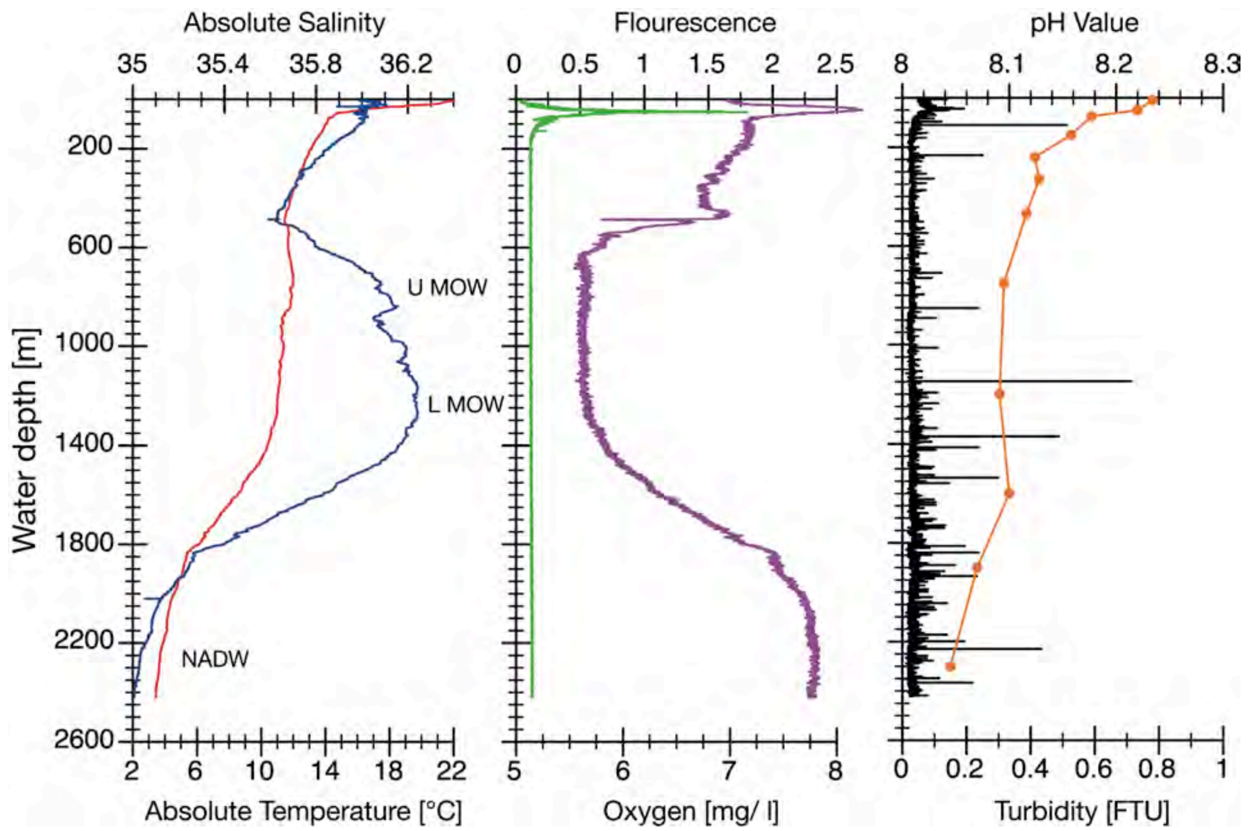

Fig. 4.5 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 5.

around 1660 m at station Ib-F 2 (Fig. 4.2) might be related to the presence of Labrador Sea Water.

Increased trubidity, unrelated to the flourescence maximum and the associated plankton biomass, was observed at station Ib-F 1 in the bottom layer (lower 100 m; Fig. 4.1); at station Ib-F 6 below 200 m (Fig. 4.6); at station Ib-F 7 in the lower 100 m with a prominent peak above the seafloor (Fig. 4.7); at station Ib-F 8 thoughout the water column (Fig. 4.8); at station Ib-F 9 in the bottom layer above the seafloor (Fig. 4.9); and at station Ib-F 11 between 700 and 800 m (Fig. 4.11). The increased trubidity observed in the water column at station Ib-F 8 might be related to sediment mobilization caused by deep-sea trawling that is done in this region (two fishing boats were actively trawling in the region during the time of the station work). The trubidity peaks at stations Ib-F 9 and Ib-F 11 are related to sediment remobilization by the upper MOW core. The MOW is also contributing to the increased trubidity in the lower water column at station Ib-F 8 and might cause the bottom layer peak at station Ib-F 7.

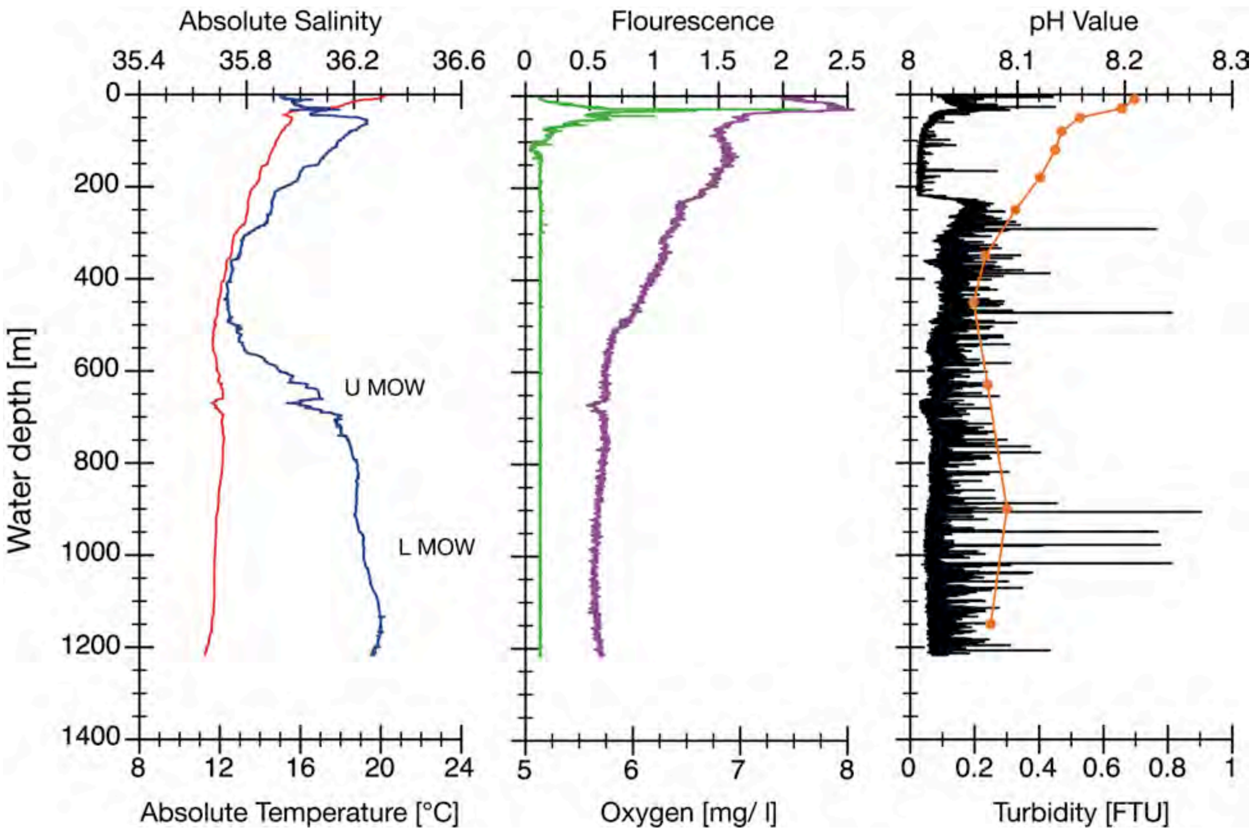

Fig. 4.6 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 6.

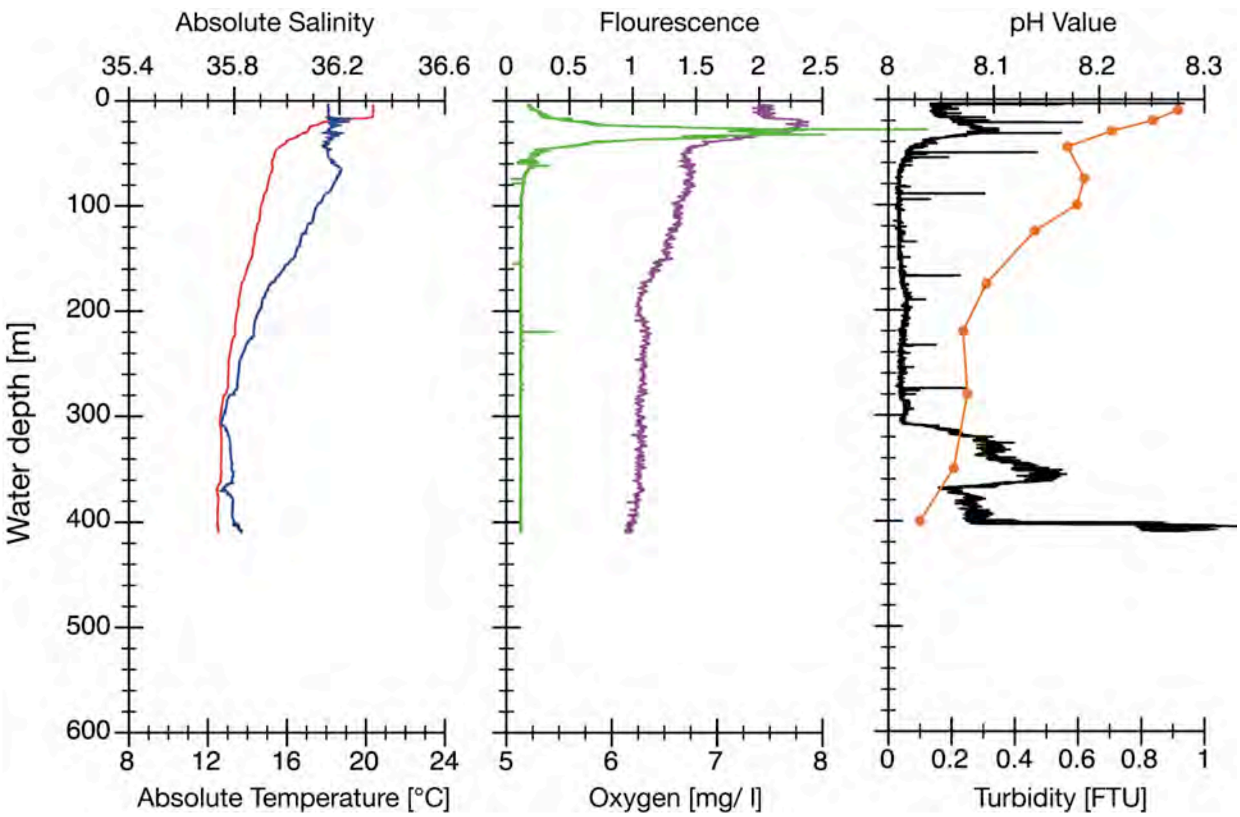

Fig. 4.7 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 7.

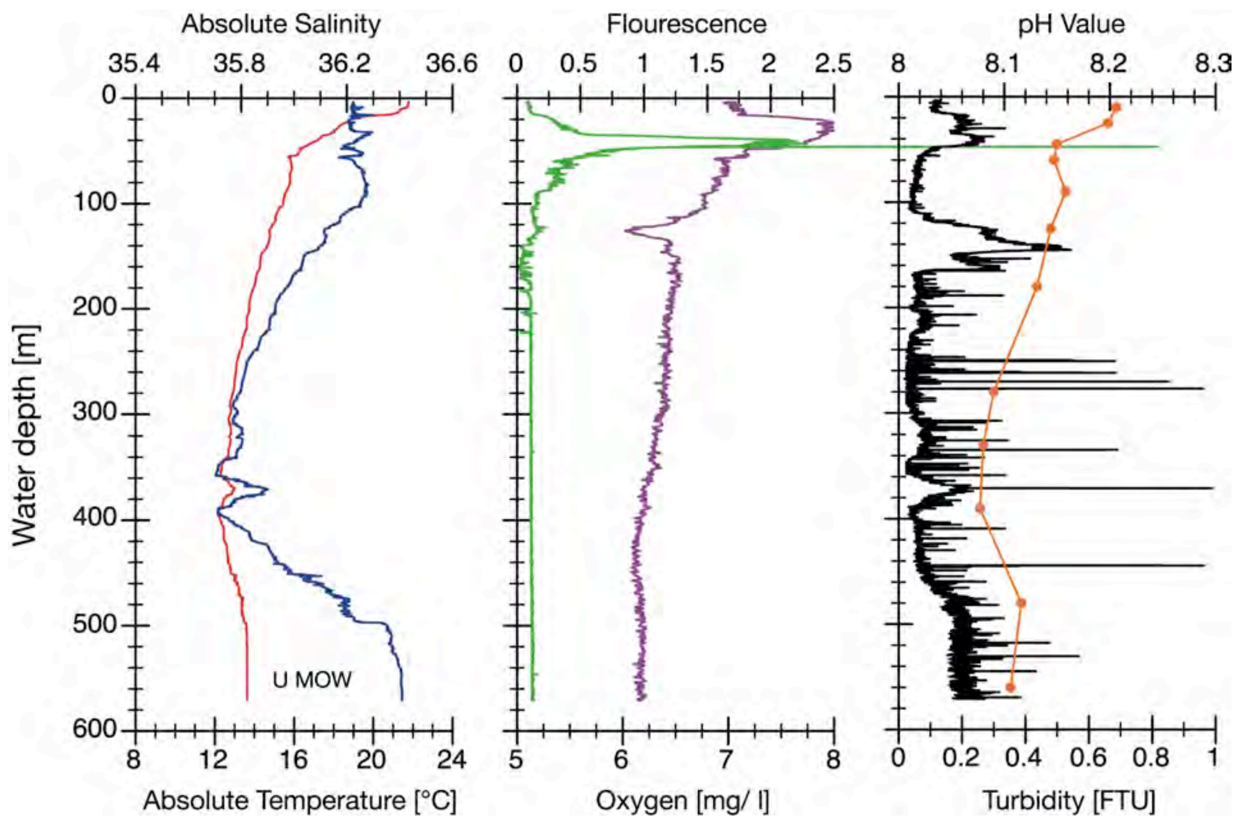

Fig. 4.8 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 8, i.e. the station near the EUROFLEETS IMPACT cruise working area.

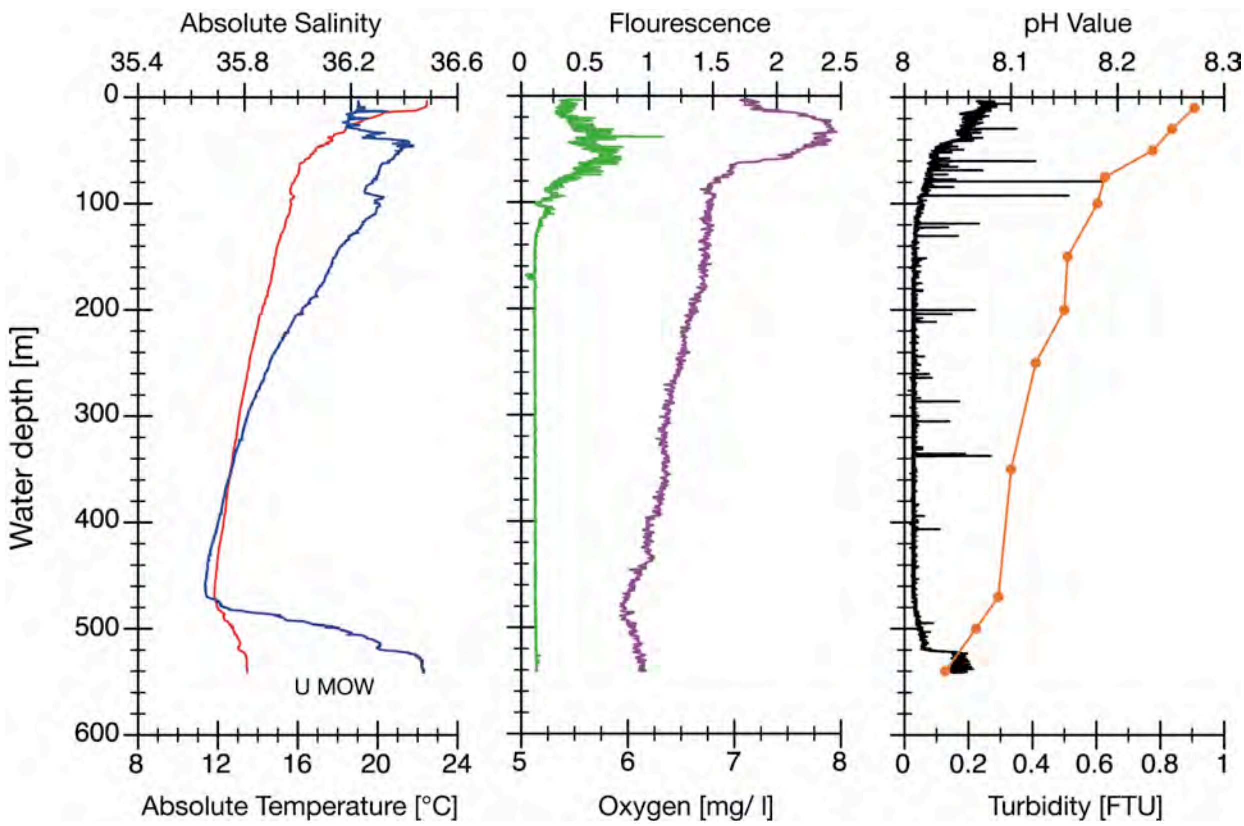

Fig. 4.9 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 9.

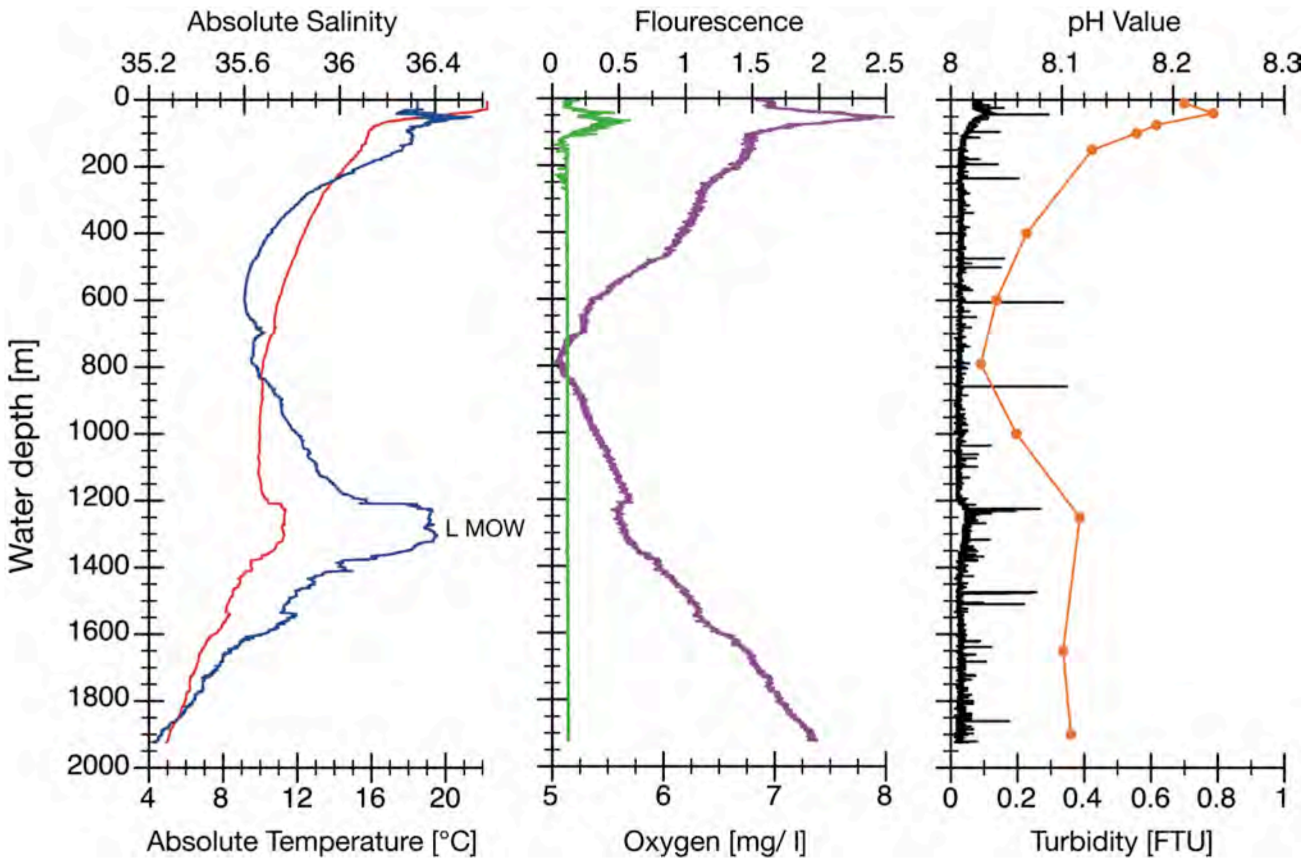

Fig. 4.10 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 10.

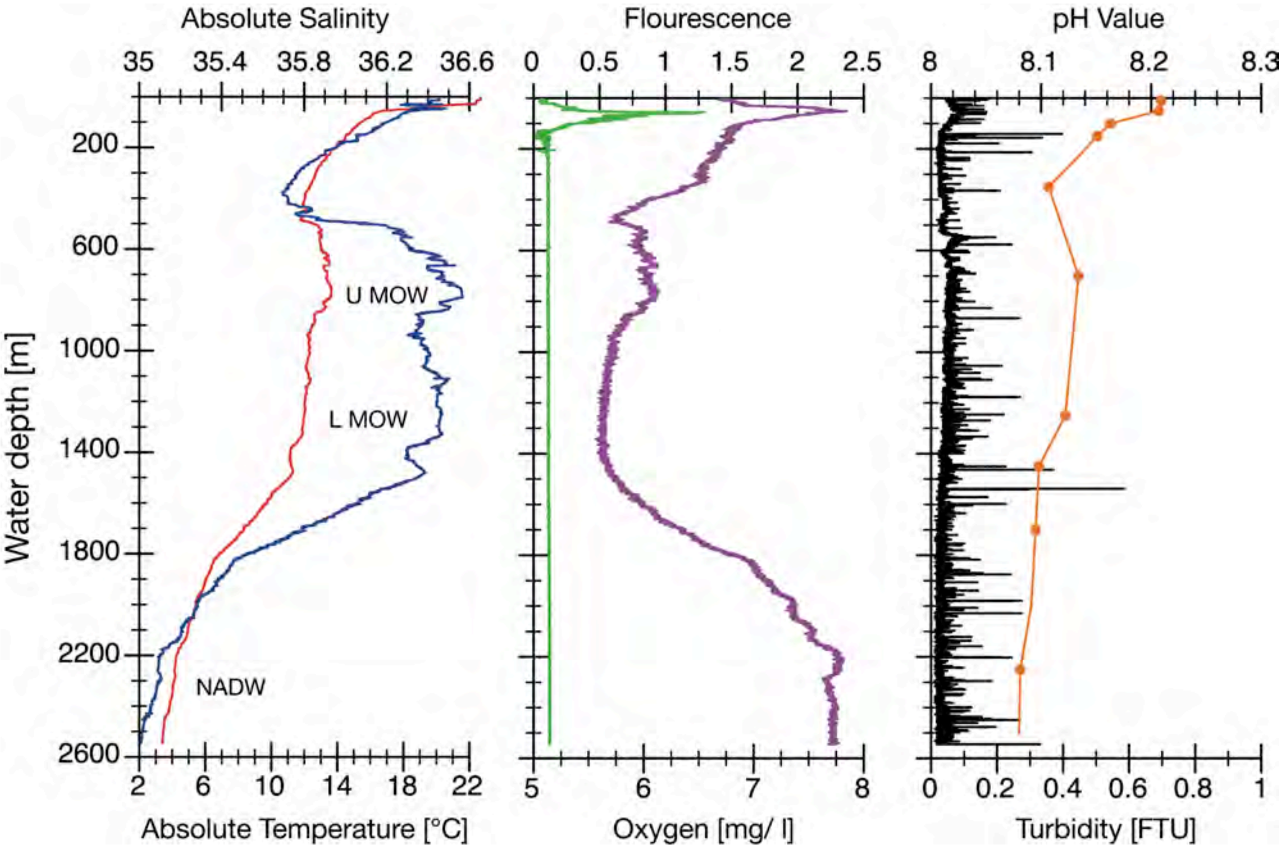

Fig. 4.11 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 11.

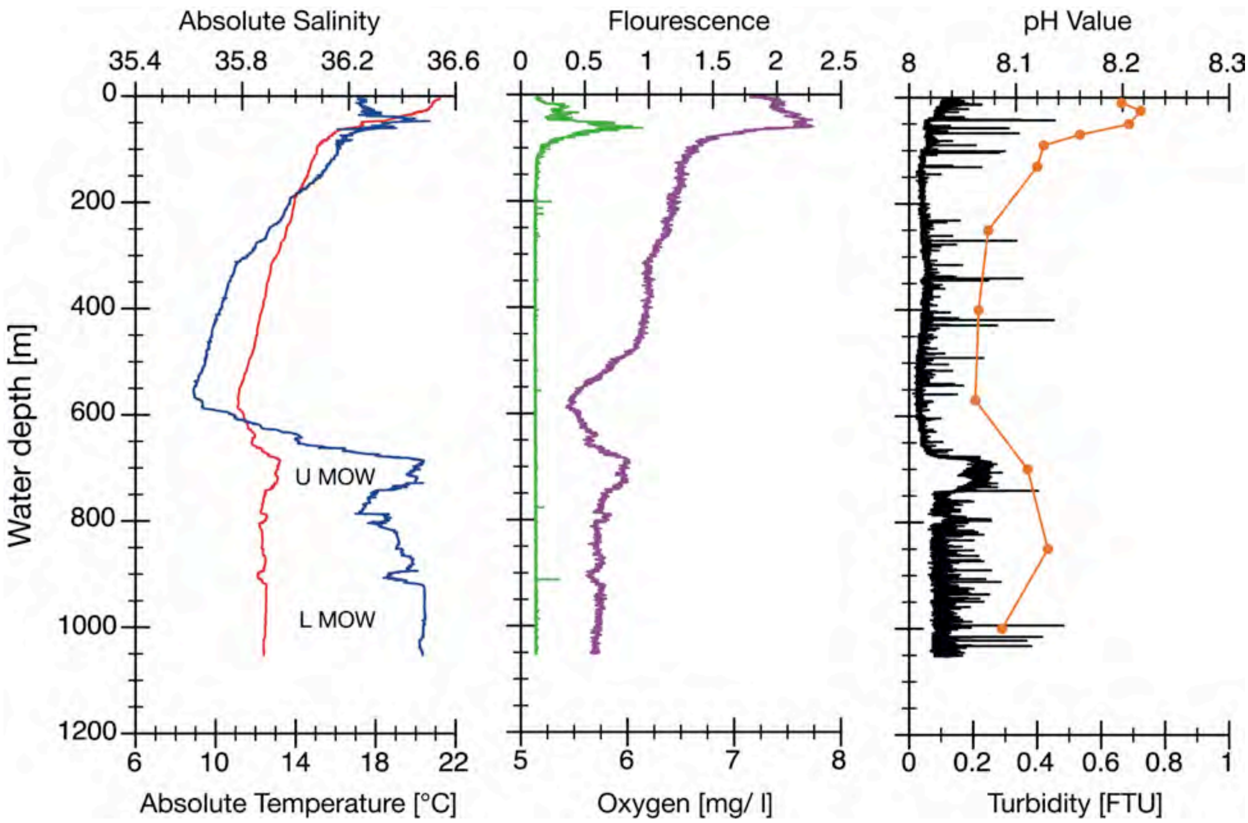

Fig. 4.12 CTD profile data –Temperature (red), Salinity (blue), Oxygen (purple), Flourescence (green), Turbidity (black)– and pH values (orange) for discrete seawater samples at station Ib-F 12.

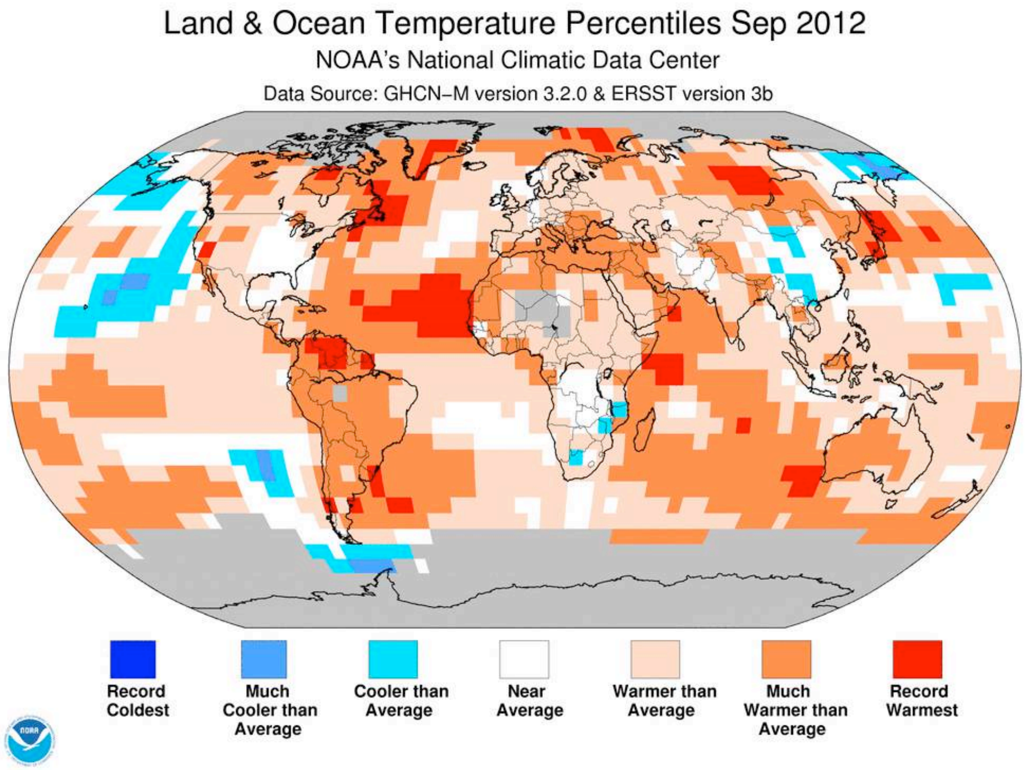

Fig. 4.13 Land and Ocean temperature anomalies during September 2012 presented as percentiles. Source: NOAA-NCDC State of the Climate Global Analysis Report for September 2012 at http://www.ncdc.noaa.gov/sotc/global/2012/9

4.1.1 Sampling for Stable Isotopes

From each Rosette bottle 10 cc of seawater were collected in a glass vial for parallel $\delta^{18}O$/ δD measurements. In a second glass vial 50 cc were collected for the $\delta^{13}C_{DIC}$ analysis. Each $\delta^{13}C_{DIC}$ sample was poisoned with 0.1 ml of concentrated Mercury Chloride solution and then stored in a Zarges box. During the cruise the $\delta^{18}O$/ δD samples were stored in the refrigirator to minimize evaporation. After the cruise all samples were stored in the cold storage room of IPMA's Marine Geology Group.

4.1.2 Filtering for Coccolithophorids

Approximately 5 liters of seawater were collected from selective Rosette bottles that sampled depths in the uppermost 300 m of the water column at all Iberia-Forams stations (Annex 10.3). Between 2.5 and 3.6 liters were filtered through mixed cellulose ester 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 (bottom and lid) and later-on on land dried in the respective laboratory (Ib-F 1 filters in Alfragide; all others in Salamanca).

4.1.3 pH Measurements

At all stations seawater was collected from each Rosette bottle for pH measurements. The seawater was filled into 250 ml plastic bottles whose lid was closed tightly right after filling. The bottles were brought into the wet lab where the pH measurements were done as soon as possible to minimize exchange with the air. For the pH measurement a WTW (Wissenschaftlich-Technische Werkstaetten GmbH) pH meter 3110 was used. The pH probe was calibrated with solutions of 4.01 and 7.00 and has an accuracy of ≤ 0.005 pH ± 1 digit. For measuring the pH value of a seawater sample the probe was inserted into the bottom half of each bottle and the value noted down when the reading was stabalized. For each sample two measurements were done (Annex 10.4). A third measurement was added, if the first two values differed significantly. Values plotted in Figures 4.1 to 4.12 are the mean of the respective measurements (Annex 10.4).

Measured pH values range from 8.027 to 8.275 with higher values generally observed in the upper water column. Highest surface water pH levels were found in the Gulf of Cadiz surface waters (stations Ib-F 7 and Ib-F 9). The measured surface water pH values are in the range of those observed near Bermuda and the Canary Islands (Bindoff et al., 2007) and in the Rockall Through (McGarth et al., 2012). Values measured in the NADW levels are, however, higher than those observed by McGarth et al. (2012) in their Rockall Trough timeseries.

4.2 Zooplankton Sampling with Hydrobios Multi-Net Plankton Sampler

A Hydrobios multiple opening closing net type Maxi (see photo on cover) was used to collect samples of planktonic organisms by vertical hauls (100-µm mesh size, 50 x 50 cm^2 opening; winch speed of 0.8 m/s). At stations Ib-F 1-3, 5 and 6 five depth intervals were sampled with the uppermost net sampling across the flourescence maximum (Annex 10.2). At station Ib-F 6 one of the plankton nets was damaged beyond repair. As consequence only four depth intervals could be sampled at the subsequent stations. Samples from Multi-Net hauls for the ecological study were preserved in formol and buffered with Hexamethylenetetramine for a pH value of 8.2. Residues from the plankton nets collected for the molecular phylogeny study were treated the same way.

Based on the catches in the plankton nets collected for the phylogeny study planktonic foraminifer abundances are relative low throughout. On the other hand, in accordance with the warm surface waters observed in the CTD data and Figure 2.1b, tropical species such as *Globigerinoides sacculifer* were observed as far north as 41°N (Iberia-Forams station 3).

4.2.1 Foraminifer Sampling for Molecular Phylogeny Study

Multi-Net hauls to collect specimens for the molecular phylogeny study were done at 6 stations (see Annex 10.2). The depth intervals for at least the uppermost two plankton nets were the same for the phylogenic as for the ecological Multi-Net haul.

Collection and shipboard preparation of the selected specimens followed the protocol established in Prof. Kate Darling’s laboratory. No specimens were collected from the plankton nets at Iberia-Forams station 9 (all samples preserved for ecological study) because the species did not differ from those collected at station Ib-F 7. The species and respective number of specimens collected at each station are listed below.

Station Iberia-Forams 3
- 10 crushed *Globorotalia scitula* (initially identified as *G. hirsuta*) preserved in DOC buffer and taken from 90-200 m depth.
- 9 whole *Globorotalia scitula* (initially identified as *G. hirsuta*) preserved in Urea buffer and taken from 90-200 m depth.
- 11 crushed *Neogloboquadrina pachyderma* right coiling (= *N. incompta*) preserved in DOC buffer and taken from 0-30 and 90-200 m depth, respectively.

Station Iberia-Forams 5
- 15 crushed *Globorotalia inflata* preserved in DOC buffer and taken from 100-200 m depth.
- 10 whole *Globorotalia inflata* preserved in Urea buffer and taken from 50-100 m depth.
- 10 crushed *Neogloboquadrina pachyderma* right coiling (= *N. incompta*) preserved in DOC buffer and taken from 0-200 m depth.
- 20 whole *Neogloboquadrina pachyderma* right coiling (= *N. incompta*) preserved in Urea buffer and taken from 0-200 m depth.

Station Iberia-Forams 7
- 10 crushed *Globigerinoides sacculifer* preserved in DOC buffer and taken from 0-100 m depth.
- 10 whole *Globigerinoides sacculifer* preserved in Urea buffer and taken from 0-100 m depth.
- 5 crushed *Orbulina universa* preserved in DOC buffer and taken from 0-100 m depth.
- 7 crushed *Globigerina bulloides* (small ones) preserved in DOC buffer and taken from 0-100 m depth.

Station Iberia-Forams 10
- 15 crushed *Globigerinoides sacculifer* preserved in DOC buffer and taken from 0-100 m depth.
- 15 whole *Globigerinoides sacculifer* preserved in Urea buffer and taken from 0-100 m depth.

Station Iberia-Forams 12
- 10 crushed *Globigerinoides ruber* pink preserved in DOC buffer and taken from 0-100 m depth.
- 11 whole *Globigerinoides ruber* pink preserved in Urea buffer and taken from 0-100 m depth.
- 15 crushed *Globigerina bulloides* preserved in DOC buffer and taken from 0-100 m depth.
- 15 whole *Globigerina bulloides* preserved in Urea buffer and taken from 0-100 m depth.
- 18 crushed *Orbulina universa* preserved in DOC buffer and taken from 0-100 m depth.

- 10 crushed *Globigerinoides sacculifer* preserved in DOC and taken from 0-100 m depth.
- 10 whole *Globigerinoides sacculifer* preserved in Urea buffer and taken from 0-100 m depth.

5 Data and Sample Storage

The CTD data will remain with the PI, Antje Voelker, until publication. After publication the data will be made available through one of the World Data Centers.

The seawater samples for stable isotope measurements, the Multi-Net samples for the ecological studies and the remaining material of the plankton net samples for the molecular phylogeny study are stored with the Marine Geology Group of IPMA in Lisbon. The seawater samples are the responsibility of Antje Voelker. The Multi-Net samples will be studied by Andreia Rebotim for her PhD thesis.

The planktonic foraminifer specimens collected for the molecular phylogeny study will be studied by Prof. Kate Darling at the University of Edinburgh.

The filters (for coccolithophorids) of station Ib-F 1, i.e. the location of the CALIBERIA project study site, are stored with the Marine Geology Group of IPMA. The filters from all the other stations will be prepared and studied (if they yield material) by Blanca Ausin Gonzalez at the University of Salamanca.

6 Participants

No.	Name	Gender	Affiliation	On-board tasks
1	Antje H. L. Voelker	F	MGG	Chief scientist; CTD profiling and sample depth selection
2	Andreia S. Rebotim	F	MGG	Seawater and Multi-Net sampling
3	Catarina D. Cavaleiro	F	MGG	Seawater and Multi-Net sampling
4	Warley Soares	M	MGG	Seawater and Multi-Net sampling
5	Blanca A. Gonzalez	F	USAL	Seawater and Multi-Net sampling
6	Eloy B. Cabarcos	M	USAL	Seawater and Multi-Net sampling
7	David B. Bell	M	UED	Multi-Net sampling; Phylogeny study
8	Andres G. Sotelo	M	UTM	Technician; CTD/Rosette & Multi-Net operations
9	Javier V. Rodriguez	M	UTM	Technician; CTD/Rosette & Multi-Net operations

MGG	Marine Geology Group, Portuguese Institute for the Ocean and Atmosphere (ipma), Lisbon, Portugal
USAL	Oceanic Geosciences Group (GGO), Department of Geology, University of Salamanca, Salamanca, Spain
UED	School of Geosciences, University of Edinburgh, Edinburgh, United Kingdom
UTM	Marine Technology Group, CSIC, Barcelona, Spain

7 Station List

Station No.	Date	Time*	Latitude	Longitude	Water Depth	Gear#	Remarks/Recovery
	2012	[UTC]	[°N]	[°W]	[m]		
Ib-F 1	10.09	16:21	42° 05.48'	9° 23.03'	324	CTD/ ROS	5, 20, 40, 60, 90, 120, 160, 190, 250, 300
Ib-F 1	10.09	18:20	42° 05.70'	9° 22.72'	317	MN	MN haul interrupted; commun. problem
Ib-F 1	10.09	19:20	42° 05.27'	9° 23.11'	354	MN	5-25, 25-50, 50-80, 80-180, 180-280
Ib-F 2	10.09	21:25	42° 05.37'	9° 35.81'	1792	CTD/ ROS	CTD profile interrupted; comm. problem
Ib-F 2	10.09	22:55	42° 05.94'	9° 35.58'	1757	CTD/ ROS	10, 40, 80, 150, 300, 400, 600, 820, 1150, 1300, 1600, 1750
Ib-F 2	11.09.	1:09	42° 05.51'	9° 35.85'	1810	MN	5-25, 25-80, 80-200, 200-300, 300-400
Ib-F 3	11.09.	8:50	41° 12.22'	9° 36.08'	1650	CTD/ ROS	10, 50, 90, 150, 300, 400, 700, 800, 1000, 1200, 1450, 1650
Ib-F 3	11.09.	12:17	41° 12.18'	9° 35.85'	1634	MN (G)	5-30, 30-90, 90-200, 200-300, 300-500
Ib-F 3	11.09.	13:49	41° 12.43'	9° 36.39'	1672	MN	5-30, 30-90, 90-200, 200-400, 400-600
Ib-F 4	11.09.	20:42	40° 20.06'	9° 45.90'	800	CTD/ ROS	10, 50, 75, 100, 150, 250, 330, 400, 500, 580, 680, 780
Ib-F 5	11.09.	22:43	40° 20.07'	9° 52.72'	2430	CTD/ ROS	10, 50, 75, 150, 240, 330, 470, 750, 1200, 1600, 1900, 2300
Ib-F 5	12.09.	1:27	40° 19.64'	9° 52.50'	2406	MN	5-100, 100-200, 200-300, 300-500, 500-700
Ib-F 5	12.09.	3:12	40° 18.68'	9° 53.01'	2786	MN (G)	5-50, 50-100, 100-200, 200-300, 300-400
Ib-F 6	12.09.	14:00	38° 45.88'	9° 59.07'	1247	CTD/ ROS	10, 30, 50, 80, 120, 180, 250, 350, 450, 630, 900, 1150
Ib-F 6	12.09.	17:07	38° 42.37'	10° 01.22'	970	MN	5-70, 70-140, 140-240, 240-340, 340-540
Ib-F 7	13.09.	8:19	36° 48.22'	8° 48.00'	423	CTD/ ROS	10, 20, 30, 45, 75, 100, 125, 175, 220, 280, 350, 400
Ib-F 7	13.09.	9:20	36° 48.07'	8° 47.59'	423	MN (G)	5-50, 50-100, 100-200, 200-300
Ib-F 7	13.09.	10:20	36° 47.54'	8° 47.61'	458	MN	5-50, 50-100, 100-200, 200-300
Ib-F 8	13.09.	15:01	36° 47.93'	8° 02.38'	552	CTD/ ROS	10, 25, 45, 60, 90, 125, 180, 280, 330, 390, 480, 560
Ib-F 8	13.09.	16:11	36° 48.16'	8° 02.24'	501	MN	5-60, 60-120, 120-240, 240-400
Ib-F 9	13.09.	18:57	36° 48.41'	7° 42.85'	555	CTD/ ROS	10, 30, 50, 75, 100, 150, 200, 250, 350, 470, 500, 540
Ib-F 9	13.09.	20:00	36° 48.29'	7° 41.92'	553	MN (G)	5-90, 90-180, 180-270, 270-360
Ib-F 9	13.09.	21:11	36° 48.06'	7° 42.64'	558	MN	5-90, 90-180, 180-300, 300-460
Ib-F 10	14.09.	3:49	36° 02.24'	8° 13.89'	1919	CTD/ ROS	10, 40, 75, 100, 150, 400, 600, 790, 1000, 1250, 1650, 1900
Ib-F 10	14.09.	6:20	36° 02.40'	8° 13.95'	1915	MN (G)	5-100, 100-200, 200-300, 300-400
Ib-F 10	14.09.	7:26	36° 02.57'	8° 14.01'	1913	MN	5-100, 100-200, 200-500, 500-800
Ib-F 11	15.09.	23:55	37° 33.67'	10° 06.81'	2559	CTD/ ROS	10, 50, 100, 150, 350, 700, 1250, 1450, 1700, 2000, 2250, 2500
Ib-F 12	15.09.	9:21	36° 43.03'	9° 21.90'	1062	CTD/ ROS	10, 25, 50, 70, 90, 130, 250, 400, 570, 700, 850, 1000
Ib-F 12	15.09.	10:57	36° 43.12'	9° 21.94'	1061	MN (G)	5-100, 100-200, 200-300, 300-400
Ib-F 12	15.09.	12:04	36° 43.37'	9° 22.21'	1050	MN	5-100, 100-200, 200-350, 350-550

*: at start of descent
#: CTD/ ROS: Seabird CTD mounted on Rosette with 12 10-liters bottles; MN: Hydrobios Multi-Net; MN (G): Hydrobios Multi-Net haul for genotype material

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10 Annexes

10.1 Depths and comments for seawater stable isotope samples
10.2 Detailed Information for Multi-Net samples
10.3 Detailed Information for Plankton Filter Samples
10.4 Seawater pH Values

Annex 10.1: Depths and comments for seawater stable isotope samples

Station	Latitude (N)	Longitude (W)	Sample Depth [m]	δ^{18}O/D	δ^{13}C	Comment
Ib-F 1	42° 05.48'	9° 23.03'	5	y	y	
Ib-F 1			20	y	y	
Ib-F 1			40	y	y	
Ib-F 1			60	y	y	
Ib-F 1			90	y	y	
Ib-F 1			120	y	y	
Ib-F 1			160	y	y	
Ib-F 1			190	y	y	Change in oxygen concentration
Ib-F 1			250	y	y	
Ib-F 1			300	y	y	
Ib-F 2	42° 05.37'	9° 35.81'	10	y	y	
Ib-F 2			40	y	y	Flourescence maximum
Ib-F 2			80	y	y	Base thermocline
Ib-F 2			150	y	y	
Ib-F 2			300	y	y	
Ib-F 2			400	y	y	Salinity minimum
Ib-F 2			600	y	y	
Ib-F 2			820	y	y	upper MOW vein
Ib-F 2			1150	y	y	lower MOW vein
Ib-F 2			1300	y	y	LSW (?)
Ib-F 2			1600	y	y	NADW
Ib-F 2			1750	y	y	NADW
Ib-F 3	41° 12.22'	9° 36.08'	10	y	y	
Ib-F 3			50	y	y	Fourescence maximum
Ib-F 3			90	y	y	Base thermocline
Ib-F 3			150	y	y	Oxygen minimum
Ib-F 3			300	y	y	
Ib-F 3			400	y	y	Salinity minimum
Ib-F 3			700	y	y	upper MOW vein
Ib-F 3			800	y	y	Salinity minimum within MOW
Ib-F 3			1000	y	y	lower MOW vein
Ib-F 3			1200	y	y	lower MOW vein
Ib-F 3			1450	y	y	NADW
Ib-F 3			1650	y	y	NADW
Ib-F 4	40° 20.06'	9° 45.90'	10	y	y	
Ib-F 4			50	y	y	
Ib-F 4			75	y	y	near base thermocline, oxygen max.; base of flourescence maximum
Ib-F 4			100	y	y	
Ib-F 4			150	y	y	
Ib-F 4			250	y	y	
Ib-F 4			330	y	y	within subsurface oxygen maximum; lower salinity
Ib-F 4			400	y	y	NACW/ MOW mixing zone
Ib-F 4			500	y	y	NACW/ MOW mixing zone
Ib-F 4			580	y	y	MOW
Ib-F 4			680	y	y	MOW
Ib-F 4			780	y	y	MOW
Ib-F 5	40° 20.07'	9° 52.72'	10	y	y	
Ib-F 5			50	y	y	Flourescence maximum
Ib-F 5			75	y	y	Base thermocline
Ib-F 5			150	y	y	
Ib-F 5			240	y	y	
Ib-F 5			330	y	y	
Ib-F 5			470	y	y	Subsurface oxygen max.; Salinity min.
Ib-F 5			750	y	y	upper MOW vein
Ib-F 5			1200	y	y	lower MOW vein
Ib-F 5			1600	y	y	NADW

Station	Latitude (N)	Longitude (W)	Sample Depth [m]	δ^{18}O/D	δ^{13}C	Comment
Ib-F 5	40° 20.07'	9° 52.72'	1900	y	y	NADW
Ib-F 5			2300	y	y	NADW
Ib-F 6	38° 45.88'	9° 59.07'	10	y	y	
Ib-F 6			30	y	y	
Ib-F 6			50	y	y	within flourescence maximum
Ib-F 6			80	y	y	close to subsurface salinity maximum
Ib-F 6			120	y	y	close to subsurface oxygen maximum
Ib-F 6			180	y	y	
Ib-F 6			250	y	y	
Ib-F 6			350	y	y	
Ib-F 6			450	y	y	Salinity minimum
Ib-F 6			630	y	y	upper MOW vein
Ib-F 6			900	y	y	lower MOW vein
Ib-F 6			1150	y	y	lower MOW vein
Ib-F 7	36° 48.22'	8° 48.00'	10	y	y	
Ib-F 7			20	y	y	± base seasonal thermocline
Ib-F 7			30	y	y	within flourescence maximum
Ib-F 7			45	y	y	base thermocline; below flourescence and oxygen maximum
Ib-F 7			75	y	y	subsurface salinity maximum
Ib-F 7			100	y	y	
Ib-F 7			125	y	y	
Ib-F 7			175	y	y	subsurface oxygen minimum
Ib-F 7			220	y	y	narrow flourescence peak
Ib-F 7			280	y	y	
Ib-F 7			350	y	y	
Ib-F 7			400	y	y	
Ib-F 8	36° 47.93'	8° 02.38'	10	y	y	
Ib-F 8			25	y	y	± base of seasonal thermocline
Ib-F 8			45	y	y	fourescence maximum
Ib-F 8			60	y	y	near base of thermocline
Ib-F 8			90	y	y	subsurface salinity maximum
Ib-F 8			125	y	y	
Ib-F 8			180	y	y	
Ib-F 8			280	y	y	within salinity minimum layer
Ib-F 8			330	y	y	small salinity maximum
Ib-F 8			390	y	y	near base of salinity minimum layer
Ib-F 8			480	y	y	MOW
Ib-F 8			560	y	y	MOW
Ib-F 9	36° 48.41'	7° 42.85'	10	y	y	base seasonal thermocline
Ib-F 9			30	y	y	1st subsurface salinity minimum; upper half of flourescence peak
Ib-F 9			50	y	y	within flourescence peak; ± base thermocline
Ib-F 9			75	y	y	lower half of flourescence peak; below oxygen maximum
Ib-F 9			100	y	y	wihtin 2nd subsurface salinity maximum
Ib-F 9			150	y	y	close to upper boundary of salinity minimum water mass
Ib-F 9			200	y	y	
Ib-F 9			250	y	y	
Ib-F 9			350	y	y	
Ib-F 9			470	y	y	lower boundary of salinity minimum water mass
Ib-F 9			500	y	y	upper boundary of MOW
Ib-F 9			540	y	y	MOW
Ib-F 10	36° 02.24'	8° 13.89'	10	y	y	
Ib-F 10			40	y	y	upper boundary of thermocline and flourescence peak
Ib-F 10			75	y	y	base of oxygen maximum

Station	**Latitude (N)**	**Longitude (W)**	**Sample Depth [m]**	**δ^{18}O/D**	**δ^{13}C**	**Comment**
Ib-F 10	36° 02.24'	8° 13.89'	100	y	y	below thermocline and oxygen maximum
Ib-F 10			150	y	y	base of 2nd subsurface salinity maximum
Ib-F 10			400	y	y	middle of low salinity water mass
Ib-F 10			600	y	y	lower boundary of low salinity water mass
Ib-F 10			790	y	y	oxygen minimum
Ib-F 10			1000	y	y	MOW (diluted)
Ib-F 10			1250	y	y	lower MOW core
Ib-F 10			1650	y	y	below strong MOW/ NADW mixing zone
Ib-F 10			1900	y	y	NADW
Ib-F 11	37° 33.67'	10° 06.81'	10	y	y	
Ib-F 11			50	y	y	wihtin flourescence maximum
Ib-F 11			100	y	y	± base of thermocline, oxygen maximum and flourescence maximum
Ib-F 11			150	y	y	
Ib-F 11			350	y	y	salinity minimum water mass
Ib-F 11			700	y	y	upper MOW vein
Ib-F 11			1250	y	y	lower MOW vein
Ib-F 11			1450	y	y	lower boundary of lower MOW
Ib-F 11			1700	y	y	MOW/ NADW mixing zone
Ib-F 11			2000	y	y	
Ib-F 11			2250	y	y	NADW (highest oxygen level)
Ib-F 11			2500	y	y	NADW
Ib-F 12	36° 43.03'	9° 21.90'	10	y	y	
Ib-F 12			25	y	y	
Ib-F 12			50	y	y	± flourescence maximum
Ib-F 12			70	y	y	
Ib-F 12			90	y	y	± base thermocline
Ib-F 12			130	y	y	NACW subtropical
Ib-F 12			250	y	y	
Ib-F 12			400	y	y	low salinity water mass
Ib-F 12			570	y	y	oxygen minimum
Ib-F 12			700	y	y	upper MOW vein
Ib-F 12			850	y	y	upper salinity maximum in lower MOW vein
Ib-F 12			1000	y	y	lower MOW

Annex 10.2: Detailed Information for Multi-Net samples

Station	Latitude (N)	Longitude (W)	Sampling intervals [dbar]	Volume filtered [m³]	Cup mesh size [µm]	Net mesh size [µm]	Comments
Ib-F 1	42° 05.27'	9° 23.11'	5–25		64	100	
Ib-F 1			25-50	27	64	100	
Ib-F 1			50-80	35	64	100	
Ib-F 1			80-180	106	100	100	net has small tears/ holes
Ib-F 1			180-280		100	100	
Ib-F 2	42° 05.51'	9° 35.85'	5-25	11	64	100	tear in cup mesh
Ib-F 2			25-80	34	64	100	
Ib-F 2			80-200	96	64	100	
Ib-F 2			200-300	91	100	100	net run with holes
Ib-F 2			300-400	99	100	100	upper part of cup broken; no sample
Ib-F 3	41° 12.18'	9° 35.85'	5-30	ca. 8	64	100	
Ib-F 3			30-90	28	64	100	
Ib-F 3			90-200	73	64	100	
Ib-F 3			200-300	76	100	100	
Ib-F 3			300-500	140	100	100	
Ib-F 3	41° 12.43'	9° 36.39'	5-30	12	64	100	
Ib-F 3			30-90	46	100	100	
Ib-F 3			90-200	66	64	100	
Ib-F 3			200-400		100	100	
Ib-F 3			400-600	173	64	100	
Ib-F 5	40° 19.64'	9° 52.50'	5-100	55	100	100	thermocline; flourescence max.
Ib-F 5			100-200	85	100	100	
Ib-F 5			200-300	84	64	100	
Ib-F 5			300-500	154	64	100	salinity minimum water mass
Ib-F 5			500-700	162	64	100	
Ib-F 5	40° 18.68'	9° 53.01'	5–50	20	100	100	
Ib-F 5			50-100	36	100	100	
Ib-F 5			100-200	82	64	100	
Ib-F 5			200-300	80	64	100	
Ib-F 5			300-400	84	64	100	
Ib-F 6	38° 42.37'	10° 01.22'	5–70	69	100	100	
Ib-F 6			70-140	87	100	100	
Ib-F 6			140-240	145	64	100	
Ib-F 6			240-340	158	64	100	big tear in net near bottom; sample lost
Ib-F 6			340-540	260	64	100	two small holes in net
Ib-F 7	36° 48.07'	8° 47.59'	5–50	19	100	100	
Ib-F 7			50-100	28	100	100	
Ib-F 7			100-200	68	64	100	
Ib-F 7			200-300	71	64	100	
Ib-F 7	36° 47.54'	8° 47.61'	5–50	19	64	100	flourescence max.
Ib-F 7			50-100	35	64	100	
Ib-F 7			100-200	86	100	100	
Ib-F 7			200-300	89	100	100	
Ib-F 8	36° 48.16'	8° 02.24'	5-60	26	100	100	thermocline and fourescence max.
Ib-F 8			60-120	40	100	100	
Ib-F 8			120-240	96	64	100	samples over turbidity peak
Ib-F 8			240-400	127	64	100	

Station	**Latitude (N)**	**Longitude (W)**	**Sampling intervals [dbar]**	**Volume filtered [m³]**	**Cup mesh size [µm]**	**Net mesh size [µm]**	**Comments**
Ib-F 9	36° 48.29'	7° 41.92'	5–90	46	100	100	
Ib-F 9			90-180	67	100	100	
Ib-F 9			180-270	74	64	100	
Ib-F 9			270-360	82	64	100	
Ib-F 9	36° 48.06'	7° 42.64'	5–90	44	100	100	
Ib-F 9			90-180	56	100	100	
Ib-F 9			180-300	93	64	100	
Ib-F 9			300-460	140	64	100	
Ib-F 10	36° 02.40'	8° 13.95'	5–100	26	100	100	thermocline; flourescence max.
Ib-F 10			100-200	60	100	100	
Ib-F 10			200-300	68	64	100	
Ib-F 10			300-400	67	64	100	net became un-zipped; no sample
Ib-F 10	36° 02.57'	8° 14.01'	5–100	28	100	100	
Ib-F 10			100-200	43	100	100	
Ib-F 10			200-500	213	64	100	
Ib-F 10			500-800	254	64	100	
Ib-F 12	36° 43.12'	9° 21.94'	5–100	25	100	100	
Ib-F 12			100-200	63	100	100	
Ib-F 12			200-300	74	64	100	
Ib-F 12			300-400	87	64	100	
Ib-F 12	36° 43.37'	9° 22.21'	5–100	24	100	100	
Ib-F 12			100-200	40	100	100	
Ib-F 12			200-350	79	64	100	
Ib-F 12			350-550		64	100	

Annex 10.3: Detailed Information for Plankton Filter Samples

Station	Latitude (N)	Longitude (W)	Sample Depth [m]	Volume filtered [liters]
Ib-F 1	42° 05.48'	9° 23.03'	5	3
Ib-F 1			20	3.2
Ib-F 1			40	3
Ib-F 1			60	3.5
Ib-F 1			120	3.5
Ib-F 2	42° 05.37'	9° 35.81'	10	3
Ib-F 2			40	3
Ib-F 2			80	3
Ib-F 2			150	3.6
Ib-F 2			300	3.4
Ib-F 3	41° 12.22'	9° 36.08'	10	3
Ib-F 3			50	3
Ib-F 3			90	3.4
Ib-F 3			150	3.4
Ib-F 3			300	3.4
Ib-F 4	40° 20.06'	9° 45.90'	10	3
Ib-F 4			50	2.5
Ib-F 4			75	3
Ib-F 4			100	3.4
Ib-F 4			150	3.2
Ib-F 4			250	3
Ib-F 5	40° 20.07'	9° 52.72'	10	3
Ib-F 5			50	2.5
Ib-F 5			75	3
Ib-F 5			150	3
Ib-F 5			240	3
Ib-F 6	38° 45.88'	9° 59.07'	10	3
Ib-F 6			30	3
Ib-F 6			50	3
Ib-F 6			80	3
Ib-F 6			120	3
Ib-F 6			180	3.6
Ib-F 7	36° 48.22'	8° 48.00'	10	3
Ib-F 7			20	3
Ib-F 7			30	3
Ib-F 7			45	3
Ib-F 7			75	3
Ib-F 7			100	3.6
Ib-F 7			125	3.6
Ib-F 7			175	3.6
Ib-F 7			220	3.6
Ib-F 8	36° 47.93'	8° 02.38'	10	3
Ib-F 8			25	3
Ib-F 8			45	3
Ib-F 8			60	3.4
Ib-F 8			90	3.4
Ib-F 8			180	3
Ib-F 9	36° 48.41'	7° 42.85'	10	2.6
Ib-F 9			30	3
Ib-F 9			50	3
Ib-F 9			75	3
Ib-F 9			100	3.4
Ib-F 9			150	3.4
Ib-F 9			200	3.4
Ib-F 10	36° 02.24'	8° 13.89'	10	3
Ib-F 10			40	3
Ib-F 10			75	3.4

Station	Latitude (N)	Longitude (W)	Sample Depth [m]	Volume filtered [liters]
Ib-F 10			100	3.4
Ib-F 10			150	3.4
Ib-F 11	37° 33.67'	10° 06.81'	10	3
Ib-F 11			50	3
Ib-F 11			100	3.4
Ib-F 11			150	3.4
Ib-F 12	36° 43.03'	9° 21.90'	10	3
Ib-F 12			25	3
Ib-F 12			50	3.4
Ib-F 12			70	3.4
Ib-F 12			90	3.4
Ib-F 12			130	3
Ib-F 12			250	3.4

Annex 10.4: Seawater pH Values

Station	Sample Depth [m]	Value 1	Value 2	Value 3	Mean Value
Ib-F 1	5	8.209	8.203		8.206
Ib-F 1	20	8.205	8.205		8.205
Ib-F 1	40	8.185	8.176		8.181
Ib-F 1	60	8.152	8.153		8.153
Ib-F 1	90	8.129	8.133		8.131
Ib-F 1	120	8.101	8.122		8.112
Ib-F 1	160	8.113	8.100		8.107
Ib-F 1	190	8.097	8.097		8.097
Ib-F 1	250	8.093	8.102		8.098
Ib-F 1	300	8.110	8.102		8.106
Ib-F 2	10	8.221	8.222		8.222
Ib-F 2	40	8.205	8.202		8.204
Ib-F 2	80	8.162	8.162		8.162
Ib-F 2	150	8.130	8.128		8.129
Ib-F 2	300	8.122	8.112		8.117
Ib-F 2	400	8.107	8.119		8.113
Ib-F 2	600	8.062	8.082	8.085	8.076
Ib-F 2	820	8.062	8.068		8.065
Ib-F 2	1150	8.059	8.065		8.062
Ib-F 2	1300	8.054	8.056		8.055
Ib-F 2	1600	8.043	8.047		8.045
Ib-F 2	1750	8.036	8.041		8.039
Ib-F 3	10	8.183	8.180		8.182
Ib-F 3	50	8.150	8.152		8.151
Ib-F 3	90	8.118	8.115		8.117
Ib-F 3	150	8.084	8.088		8.086
Ib-F 3	300	8.058	8.054		8.056
Ib-F 3	400	8.053	8.052		8.053
Ib-F 3	700	8.050	8.047		8.049
Ib-F 3	800	8.019	8.021		8.020
Ib-F 3	1000	8.050	8.055		8.053
Ib-F 3	1200	8.053	8.057		8.055
Ib-F 3	1450	8.037	8.026	8.014	8.026
Ib-F 3	1650	8.017	8.014		8.016
Ib-F 4	10	8.198	8.202		8.200
Ib-F 4	50	8.182	8.184		8.183
Ib-F 4	75	8.125	8.122		8.124
Ib-F 4	100	8.112	8.113		8.113
Ib-F 4	150	8.111	8.108		8.110
Ib-F 4	250	8.100	8.102		8.101
Ib-F 4	330	8.060	8.058		8.059
Ib-F 4	400	8.050	8.054		8.052
Ib-F 4	500	8.040	8.036		8.038
Ib-F 4	580	8.055	8.050		8.053
Ib-F 4	680	8.070	8.067		8.069
Ib-F 4	780	8.077	8.077		8.077
Ib-F 5	10	8.229	8.238	8.235	8.234
Ib-F 5	50	8.221	8.219		8.220
Ib-F 5	75	8.169	8.182	8.179	8.177
Ib-F 5	150	8.159	8.156		8.158
Ib-F 5	240	8.120	8.128		8.124
Ib-F 5	330	8.129	8.127		8.128
Ib-F 5	470	8.119	8.113		8.116
Ib-F 5	750	8.096	8.093		8.095
Ib-F 5	1200	8.088	8.093		8.091
Ib-F 5	1600	8.097	8.103		8.100
Ib-F 5	1900	8.065	8.075		8.070
Ib-F 5	2300	8.032	8.058		8.045

Station	Sample Depth [m]	Value 1	Value 2	Value 3	Mean Value
Ib-F 6	10	8.210	8.208		8.209
Ib-F 6	30	8.195	8.199		8.197
Ib-F 6	50	8.157	8.159		8.158
Ib-F 6	80	8.140	8.142		8.141
Ib-F 6	120	8.138	8.132		8.135
Ib-F 6	180	8.122	8.120		8.121
Ib-F 6	250	8.096	8.099		8.098
Ib-F 6	350	8.063	8.073	8.074	8.070
Ib-F 6	450	8.060	8.058		8.059
Ib-F 6	630	8.072	8.071		8.072
Ib-F 6	900	8.091	8.088		8.090
Ib-F 6	1150	8.076	8.074		8.075
Ib-F 7	10	8.278	8.271		8.275
Ib-F 7	20	8.249	8.252		8.251
Ib-F 7	30	8.206	8.217		8.212
Ib-F 7	45	8.181	8.168	8.161	8.170
Ib-F 7	75	8.185	8.187		8.186
Ib-F 7	100	8.182	8.175		8.179
Ib-F 7	125	8.138	8.140		8.139
Ib-F 7	175	8.088	8.097		8.093
Ib-F 7	220	8.040	8.086	8.087	8.071
Ib-F 7	280	8.079	8.071		8.075
Ib-F 7	350	8.057	8.066		8.062
Ib-F 7	400	8.027	8.033		8.030
Ib-F 8	10	8.206	8.206		8.206
Ib-F 8	25	8.201	8.195		8.198
Ib-F 8	45	8.150	8.150		8.150
Ib-F 8	60	8.145	8.148		8.147
Ib-F 8	90	8.161	8.155		8.158
Ib-F 8	125	8.147	8.141		8.144
Ib-F 8	180	8.123	8.136	8.133	8.131
Ib-F 8	280	8.093	8.087		8.090
Ib-F 8	330	8.081	8.078		8.080
Ib-F 8	390	8.073	8.081		8.077
Ib-F 8	480	8.118	8.114		8.116
Ib-F 8	560	8.093	8.106	8.118	8.106
Ib-F 9	10	8.273	8.271		8.272
Ib-F 9	30	8.249	8.253		8.251
Ib-F 9	50	8.229	8.237		8.233
Ib-F 9	75	8.202	8.177	8.186	8.188
Ib-F 9	100	8.192	8.176	8.175	8.181
Ib-F 9	150	8.158	8.148		8.153
Ib-F 9	200	8.147	8.152		8.150
Ib-F 9	250	8.121	8.125		8.123
Ib-F 9	350	8.111	8.094	8.096	8.100
Ib-F 9	470	8.084	8.092		8.088
Ib-F 9	500	8.063	8.053	8.085	8.067
Ib-F 9	540	8.035	8.041		8.038
Ib-F 10	10	8.205	8.215		8.210
Ib-F 10	40	8.238	8.233		8.236
Ib-F 10	75	8.184	8.185		8.185
Ib-F 10	100	8.170	8.164		8.167
Ib-F 10	150	8.150	8.064	8.167	8.127
Ib-F 10	400	8.068	8.068		8.068
Ib-F 10	600	8.049	8.033	8.040	8.041
Ib-F 10	790	8.038	8.021	8.021	8.027
Ib-F 10	1000	8.090	8.041	8.047	8.059
Ib-F 10	1250	8.104	8.127	8.118	8.116
Ib-F 10	1650	8.106	8.096		8.101
Ib-F 10	1900	8.113	8.103		8.108
Ib-F 11	10	8.209	8.208		8.209
Ib-F 11	50	8.202	8.211		8.207
Ib-F 11	100	8.160	8.165		8.163

Station	**Sample Depth [m]**	**Value 1**	**Value 2**	**Value 3**	**Mean Value**
Ib-F 11	150	8.150	8.152		8.151
Ib-F 11	350	8.124	8.100	8.098	8.107
Ib-F 11	700	8.132	8.135		8.134
Ib-F 11	1250	8.121	8.123		8.122
Ib-F 11	1450	8.098	8.097		8.098
Ib-F 11	1700	8.096	8.093		8.095
Ib-F 11	2000	8.088	8.094		8.091
Ib-F 11	2250	8.081	8.080		8.081
Ib-F 11	2500	8.077	8.083		8.080
Ib-F 12	10	8.197	8.200		8.199
Ib-F 12	25	8.216	8.217		8.217
Ib-F 12	50	8.201	8.214	8.202	8.206
Ib-F 12	70	8.164	8.155		8.160
Ib-F 12	90	8.128	8.124		8.126
Ib-F 12	130	8.114	8.127	8.120	8.120
Ib-F 12	250	8.041	8.088	8.092	8.074
Ib-F 12	400	8.060	8.070		8.065
Ib-F 12	570	8.066	8.058		8.062
Ib-F 12	700	8.107	8.114		8.111
Ib-F 12	850	8.129	8.131		8.130
Ib-F 12	1000	8.077	8.090	8.093	8.087

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