**Megafauna, community respiration, phytopigments and bottom features off NW Spain.**

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## 1. INTRODUCTION

Export of shelf-derived organic matter (OM) near continental margins may add to the vertical rain of OM from local production over the slope. In such cases the continental rise and slope may act as (temporary) deposit centers of organic carbon and consequently become a site with augmented benthic mineralisation (e.g. $O_2$ respiration) and benthic biomass as was found to be the case on the US Atlantic and Pacific margins (Rowe *et al*, 1994, Jahnke *et al*, 1990). An extensive study of the biological and chemical processes occurring at the Celtic slope (SW Ireland) during the OMEX-1 project did not yield conclusive evidence for the presence of such depot centers (Omex-1, Final report).

During OMEX-2 which is carried out at the upwelling slope of NW Spain a more pronounced export of organic matter to deep waters is expected because of the enhanced primary production at the shelf. Earlier this has shown to be the case at the Pacific and West African coast, where upwelling is driven by the eastern boundary currents (Jahnke & Shimmield, 1995). In general benthic communities underneath upwelling systems seem to be more active in terms of respiration and richer in biomass than at comparable sites without upwelling (Sibuet *et al.* ,1993). The latter even holds for areas where adverse oxygen minima exist (Bett, 1995; Gage *et al.*, 1995). In a comparative study of the EUMELI sites, Sibuet *et al.* (1993) found that the numbers of megafauna organisms were more strongly enhanced underneath the upwelling site when compared to the oligotrophic abyssal plain than other categories of organisms. Also in other deep sea habitats without upwelling, a comparatively strong increase of megafauna was seen associated with an increase of the particle flux (Lampitt *et al.*, 1986; Sibuet *et al*, 1989). Thurston *et al.* (1994) argue that also the form in which the particles settles arrive at the sea floor (steady rain vs. drop) plays a role in the reaction of larger animals.

Large long living benthic animals form a time-integrated record of the local conditions. Their biomass will mirror the food availability, and the composition of the fauna will give an idea in which form this food is usually available. Therefore megafauna can be used for a relatively rapid assessment of gross differences within an area deploying a bottom trawl or sledge. Combining this with video imaging of the sea floor topography gives clues to the biologically relevant conditions near the seabed which are otherwise hard to obtain. During the OMEX-2 program we intend an extensive video-trawl survey of the sea floor and its inhabitants prior to local sampling and *in-situ* measurements in later stages. Besides the purpose of survey, the results (video & catch) will be used to arrive at a estimate for megafauna biomass. This quantity will, converted into C-respiration, be added to respiration by the macro and meiobenthos in order to arrive at a total estimate of the C demand by the metazoan community (see Heip *et al.*, in press). The survey will be followed by in-situ measurements of whole community respiration and (SCOC) and sediment organic matter quality.

## 2. PELAGIA CRUISE, 23 June - 14 July 1997

Sampling was planned along 3 transects (see below) i.e. one crossing the shelf and slope off La Coruna and ending on the abyssal plain. The objective of this transect was to compare the data with those of OMEX-I where similar depths were reached. A second transect was planned at latitude 42$^o$ 40'N ending at the Galicia Bank.

On each transect a seismic survey was made with a 3.5 Kc echosounder to locate suitable sampling locations. Once a potential track was selected, a short acoustic survey was made followed by a tow with the video-Agassiz trawl. The trawl is 3.5m wide with a net having a 1cm mesh-size. Two odometers are mounted on the trawl to measure the track length. A door in the trawl opening keeps pelagic animals out during lowering and hauling. The beam of the trawl carries a programmable video camera, which provides a view just in front of the trawl. The trawl was successfully operated at the12 stations that were visited. The animals caught in the net were identified, counted, and weighed. Selected species were dissected on board for the analysis of the RNA:DNA ratio (condition index) of their somatic tissue. At each trawling station, we made a CTD profile of the water column and simultaneously collected samples from the near-bottom water. Sediment samples were also collected with box- or multi-corer for the following analysis: macro- and meiofauna (NIOO, Yerseke), and phytopigments. Individual phytopigments (chlorophylls and carotenoids) in the near-bottom water and the surface sediment were analysed in the laboratory by means of HPLC (Wright *et al*, 1991). The results of the pigment analysis will be used to describe quality and origin of the phytodetritus.

Finally, we made a series of SCOC measurements in shipboard incubated and decompressed cores of 30 cm diameter under in-situ temperatures (Duineveld *et al*, 1997). Later cruises are scheduled to continue these studies with in-situ measurements of sediment community respiration (SCOC) using a new benthic lander system that compensates the loss of the former BOLAS lander

## 3. RESULTS

### 3.1. STATION LIST

Fig.1 shows the cruise track within the study area with the geographic position of the sampling stations depicted. Fig. 2 gives an impression of the depth profile along the two transects. The exact geographical positions with water-depth and date of sampling is given in Table 1.

### 3.2. VIDEO - MEGABENTHOS SURVEY

Following is a short account of the major features exposed by the video camera and the trawl catch.

**The C(-oruña) transect**: At the shallow shelf station C0 (180m), filter-feeding crinoids were very abundant. Surprisingly these crinoids were completely absent at the deeper station C4 (250m) situated just below the shelfbreak. It thus seems as if the shelf-break forms a marked border for this species. Filter-feeders appear to be most dense near the shelf-break but also deeper (C14, C17 and C36) they form the most important group visible on the video and in the net. We observed a remarkable alternation of species of filter-feeders down the slope starting with the crinoids at the shelfbreak (200m) followed by solitary corals (*Flabellum macandrewi*) at C14 (766m), deep water colonial corals (*Lophelia*) at C17 (1030m) and finally small colonial sea-anemones at C36 (1540m). At all stations down to 1800 m the seabed was covered with current ripples. The orientation of the ripple pattern was parallel with the depth contours. The video showed that both the corals (C14) and the sea-anemones (C36) lived in the depressions between ripples crests. At C36 the sea floor also formed terraces with short (40-50cm) steep edges at the off-shore side. Both features, the ripple marks and terraces, point to relatively high current speeds which are oriented perpendicular to the coast. At station C41 (2200m), filter-feeders do still occur but deposit-feeding sea-urchins (Irregularia) have gained numerical dominance. Both this station and the deeper one C59 (4900m) have a rather smooth seabed, with clear “Lebensspuren” like small mounds, pits and tracks, which are particulary abundant at C59. At station C59 on the abyssal plain, deposit-feeders (holothurians) are completely dominating. The video images from C59 gave the impression that the megabenthic fauna at this station was relatively rich compared to the Atlantic abyssal plain. The proximity of C59 to the steep slope and the continent could be a reason for the relative high biomass at this depth.

**The G(-alicia Bank) transect**: The area around the shelf-break (G0) looked similar as on the C (-oruñna) transect, i.e. crinoids are abundant above or at the shelf-break. Below the shelf break, crinoids are absent but filter-feeders remain relatively important in the form of small sea-pens (*Pennatula*). The steep continental slope did not allow sampling depths between 300 and 2000m. At the Galicia Bank this was only possible at the west-side of the Bank at 760m. Here, at station G100, the sediment looked coarse and consisted completely of pelagic foraminiferan shells. The colonial coral *Lophelia* is the most prominent megabenthic species on top of Galicia Bank. The video showed it to occur in patches which are more or less evenly distributed over the area. In the areas between these patches, we observed solitary corals (*Flabellum*). The video furthermore showed that the bottom topography on Galicia Bank was similar as at C36, namely current ripples and the same form of terraces. Between Galicia Bank and the coast of NW Spain, we trawled at 2300m depth (G56 and G30) on both sides of a deep (3000m) channel. Strikingly, the megafauna at each station is dominated by a single species of sea-cucumber though the species are different. A difference between G56 and G30 is the common appearance of small (1cm) swimming clams (Pectinidae) at the latter stations. In other aspects the stations are very much alike: on both we observed sparse Xenophyophoracea (too brittle to show up in the trawl-catch) and long filiform Gorgonaria. The most abundant animal in the short haul at G85 (1800m) was a tusk-shell (Dentaliidae). The bottom at all these three deep stations was rather smooth with few "Lebensspuren". Coring the sediments caused problems due to the compactness. Video images showed hardly any dust clouds when the heavy trawl-frame hit the bottom. All these aspects did us conclude that it is rather an erosive than a deposit area, with relative high currents.

### 3.3. MEGAFAUNA BIOMASS AND FEEDING GUILDS

Total megafauna biomass (WW) as well as the biomass of the three principal feeding guilds are shown in Fig. 3. The biomass does not show a regularly decrease with increasing water depth. The pattern instead is more or less comparable to that found during OMEX-I over the Goban Spur (Duineveld *et al*, 1997), with a low value at the shallowest and deepest station (C0 and C59). The maximum biomass was found at C41 (2200m), where sea-urchins especially Echinothuridae are the dominant animals. The biomass values are mostly somewhat lower but still close to values found at the OMEX-I transect.
It is striking when looking at the feeding guilds, that deposit feeders are almost absent at the station (C36) where (deducing from the current ripples) the high bottom currents occur. Filter feeders in the form of the carnivorous solitary coral *Flabellum macandrewi* are important in biomass at station C14. At the stations C0 (Crinoidea), C14 (Lophelia) and C36 (Zoanthinaria) filter feeders are numerically conspicuous, but not important in biomass (Fig. 3).

### 3.4. SEDIMENT COMMUNITY OXYGEN CONSUMPTION - SHIPBOARD DATA

Table 2 shows the results of the SCOC deck incubations. The values are comparable to those measured at the OMEX-I transect over the Goban Spur (Duineveld *et al*, 1997). Outstanding is the high value at the deepest station C59 (4900m), which is three times as high as normal for an NE Atlantic abyssal station (see Lohse *et al*., in press). The fact that this station is situated just at the foot of the steep slope is the probable explanation for the high value. For the high value at station G30 is no duplo, and therefore this value has to be confirmed by measurements in 1998.

### 3.5. PHYTOPIGMENTS IN THE SEDIMENT

Phytopigments concentrations in the upper layer of the sediment are shown in Fig. 4. At the Coruña transect the two deepest stations (C41 and C59) not only have the highest phaeophorbide concentrations, but also the highest chlorophyll a concentrations, with a maximum at the deepest station C59 (4900m). At the Galicia transect the low values of phaeophorbides (chlorophyll a undetectable) at station G56 and G85, both situated in the channel between the continental slope and the Galicia Bank, are remarkable.

## 4. CONCLUSIONS

From this pilot study the following conclusions were drawn:
- It is a difficult area for bottom sampling the bottom (steep slope, hard bottom)
- A large area is influenced by strong currents
- Meganauna filter feeders form an important feature
- Cold water coral reefs (Lophelia) are present at the slope and at the Galicia Bank
- The megafauna biomass is comparable with the Goban Spur values
- Megafauna biomass reaches a maximum around 2000m depth
- Relative high SCOC values were found at the deepest stations
- The sediment of the deepest station (C59) had the highest phytopigment concentrations

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| STATION | DATE | DEPTH | Position |
|---|---|---|---|
| **C0** | 28-06-97 | 180 | 43 40.96 N 08 37.25 W |
| **C4** | 29-06-97 | 250 | 43 42.25 N 08 41.97 W |
| **C14** | 29/30-06-97 | 750 | 43 47.03 N 08 54.62 W |
| **C17** | 29/30-06-97 | 1030 | 43 48.31 N 08 58.39 W |
| **C36** | 01-07-97 | 1540 | 43 41.10 N 09 26.50 W |
| **C41** | 02/03-07-97 | 2200 | 43 45.37 N 09 33.00 W |
| **C59** | 04/05-07-97 | 4910 | 44 00.67 N 09 54.01 W |
| | | | |
| **G0** | 12-07-97 | 150 | 42 39.81 N 09 28.19 W |
| **G30** | 10/11-07-97 | 2630 | 42 40.16 N 10 09.80 W |
| **G56** | 09/10-07-97 | 2380 | 42 40.00 N 10 43.98 W |
| **G85** | 08-07-97 | 1800 | 42 40.74 N 11 24.21 W |
| **G100** | 07-07-97 | 760 | 42 44.93 N 11 44.17 W |

Table 1. Stations covered during the expedition, with date, depth and position.

| STATION | DATE | DEPTH | SCOC |
|---|---|---|---|
| **C0** | 28-06-97 | 180 | 176/161 |
| **C17** | 30-06-97 | 1030 | 148 |
| **C36** | 01-07-97 | 1540 | 44/45 |
| **C41** | 03-07-97 | 2200 | 77 |
| **C59** | 04-07-97 | 4900 | 73 |
| | | | |
| **G0** | 12-07-97 | 160 | 327/338 |
| **G30** | 11-07-97 | 2600 | 200 |
| **G56** | 10-07-97 | 2400 | 50/54 |
| **G100** | 07-07-97 | 800 | 49/36 |

Table 2. SCOC data from deck incubation measurements in $\mu$ mol. $m^{-2}.h^{-1}$.

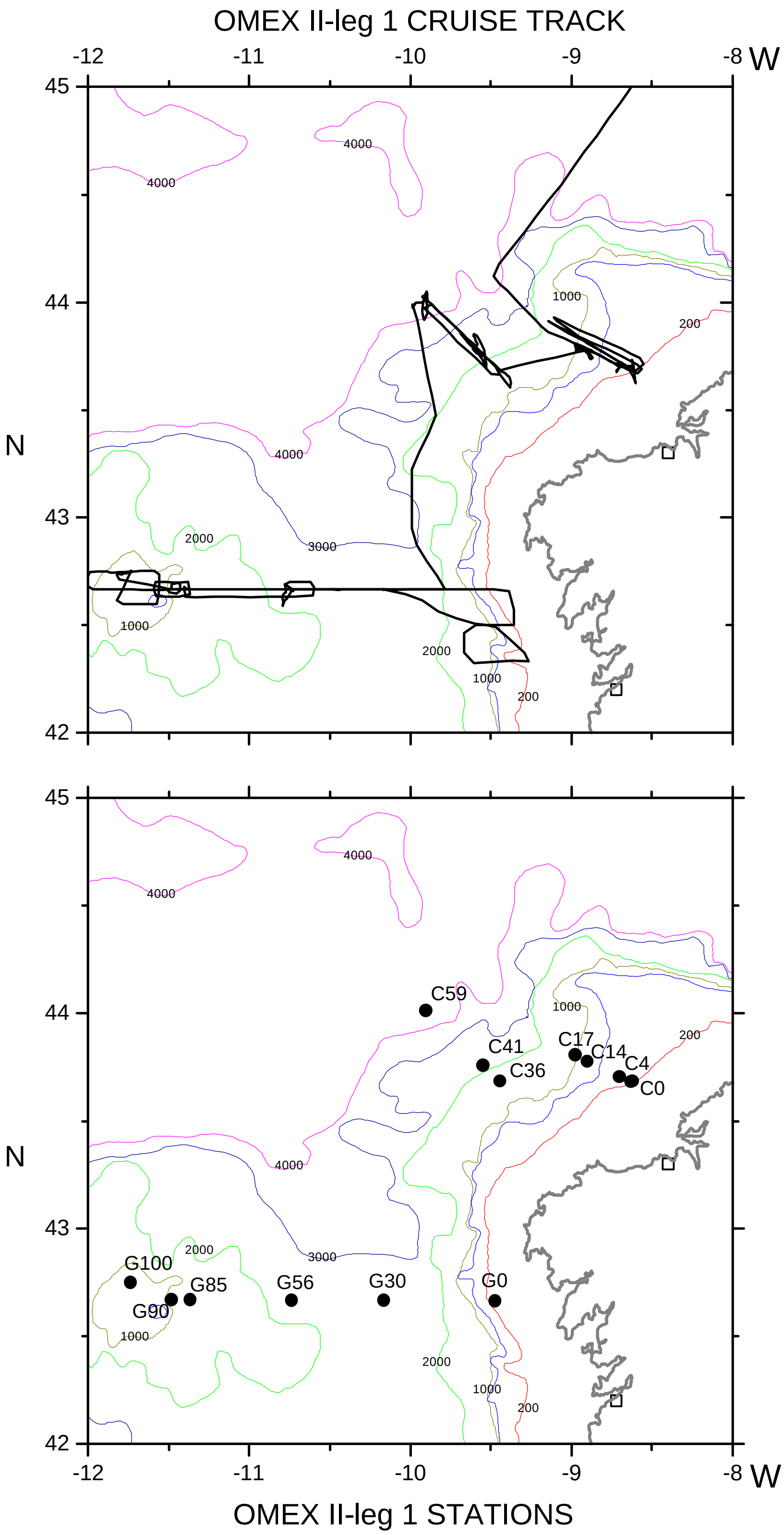
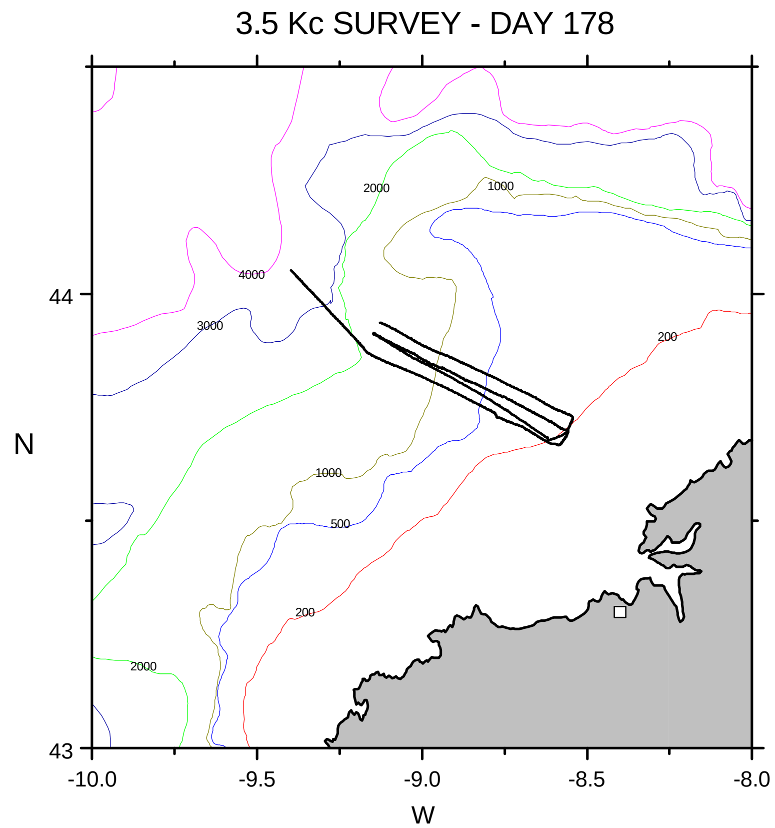



Fig.1 Cruise Track and stations.



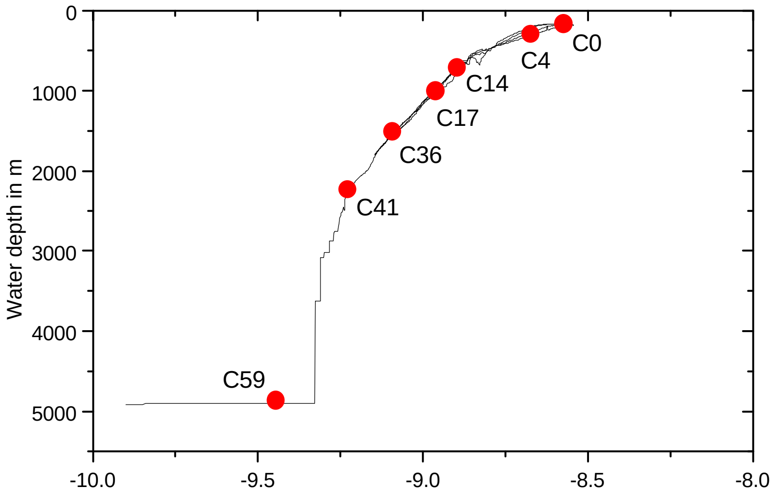




Fig. 2a. Depth profile along the “La Coruna” transect.

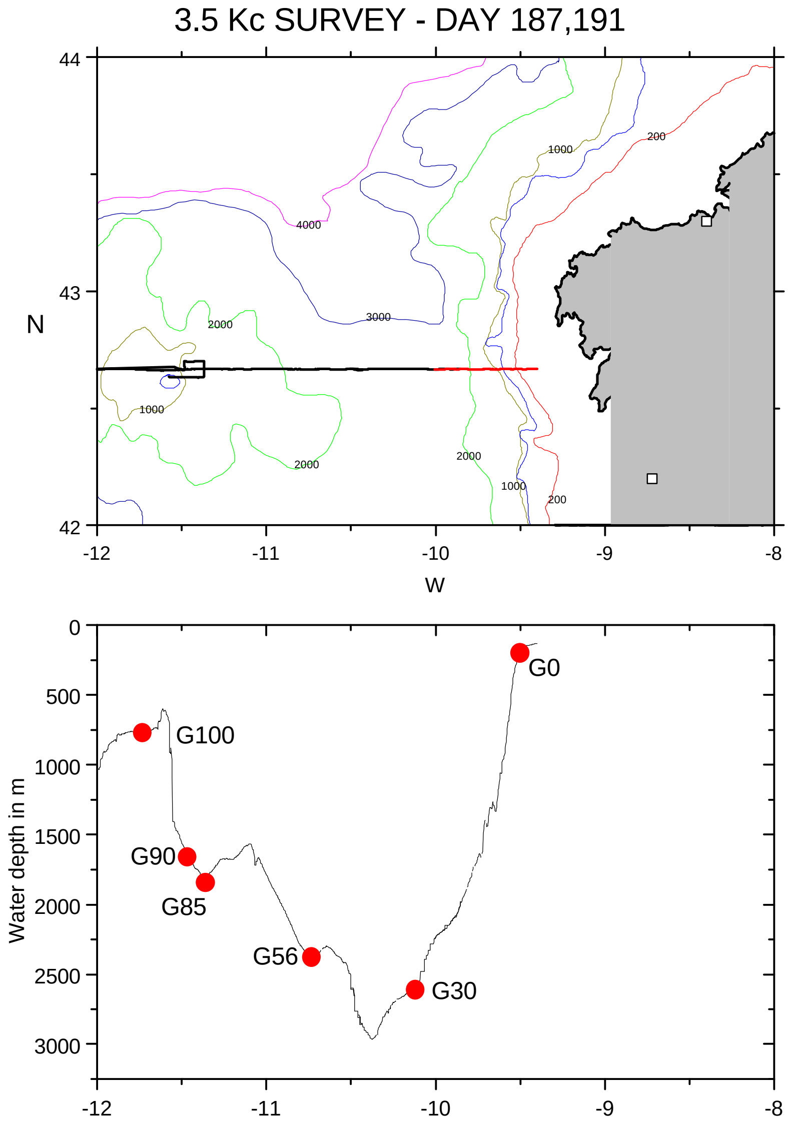
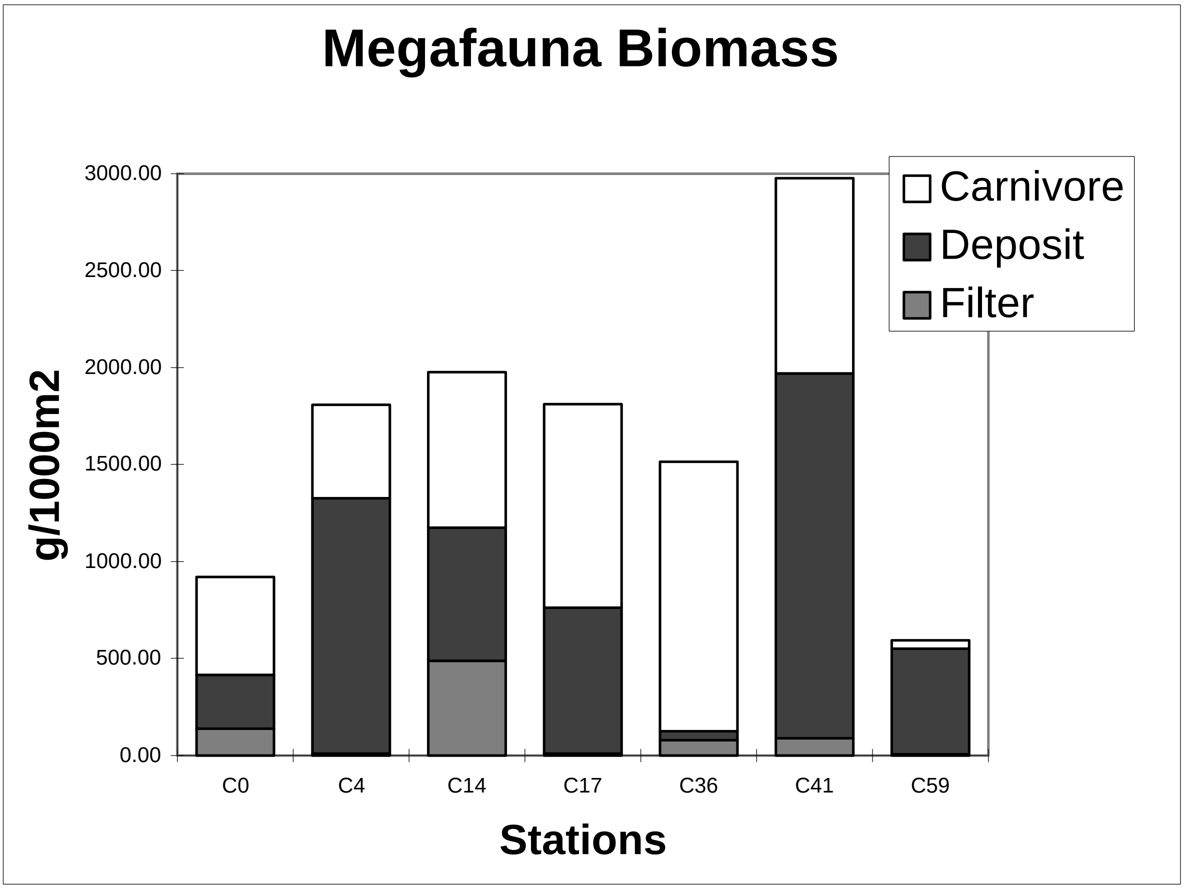



Fig. 2b Depth profile along the “Galicia Bank” transects.




Fig, 3 Megafaunal biomass in wet weights at the Coruña transect, with the proportion of the different feeding guilds indicated.

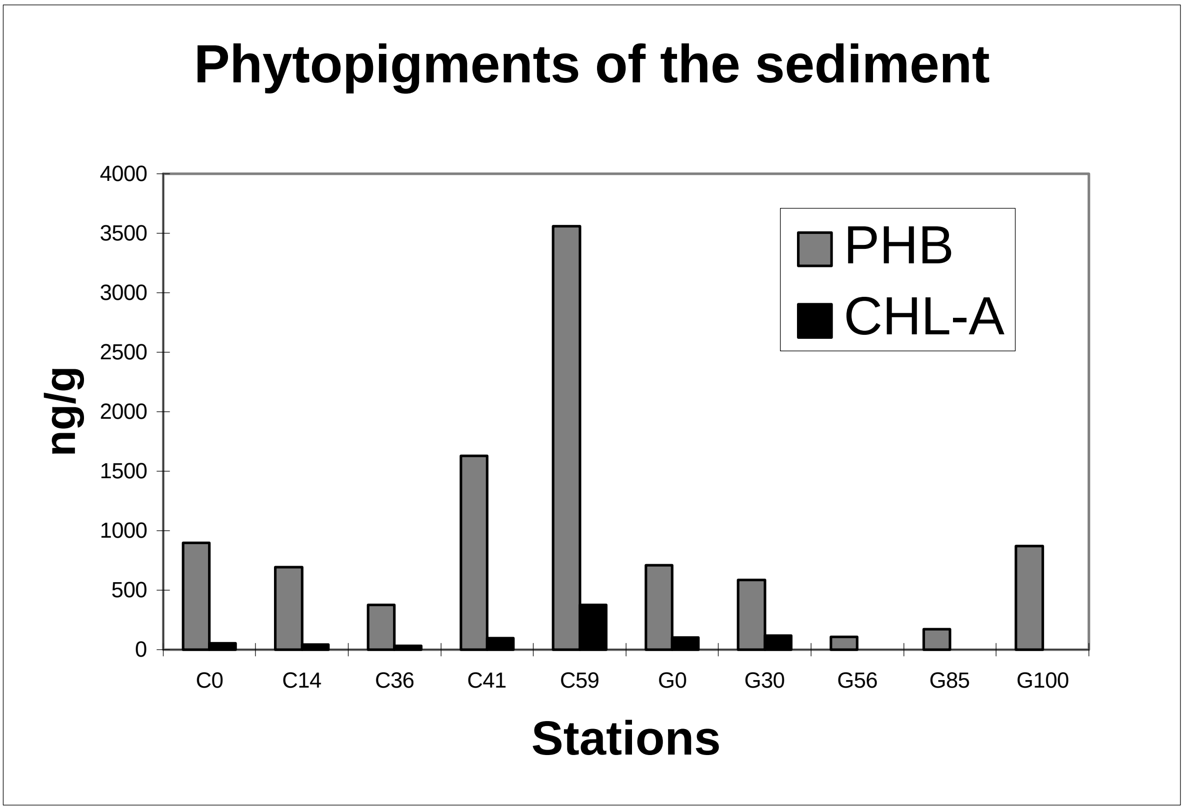



Fig. 4. Phytopigment concentrations in the surface sediment in ng/g. PHB = phaeophorbides, CHL-A = chlorophyll-a.