POSEIDON CRUISE 237/1

26th February - 16th March 1998
Viana do Castelo (Portugal) - Vigo (Spain)

Cruise Report

by

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Ocean Margin Exchange
OMEX Phase II-2

CONTENTS

Annex:

1. INTRODUCTION

During its second phase the **O**cean **M**argin **EX**change programme (OMEX II-2), funded by the European Commision, concentrates its investigations on the Iberian Margin, that form a comparative study to that during OMEX I at the Goban Spur (Celtic Sea). The Iberian Margin is particularly well suited for such a comparison of contrasting environments as it provides a number of features essential to investigate when aiming at a better understanding of exchange processes between the continental shelves and the adjacent deep sea basins. The Iberian Margin is characterised by a steep and narrow slope and it has a complex bottom topography which acts as a constraint to all exchange processes in the framework of ambient hydrography. Further, driven by the seasonal alternation of upwelling and non-upwelling conditions, it exhibits a pronounced seasonality of pelagic particle production, modification and sinking. This, in turn, delineates the spatial and temporal distributions of vertical particle fluxes from the upper ocean to greater depth as well as lateral fluxes along and across the continental slope.

In this framework, the POSEIDON cruise 237/1 aimed at contributing to a better description of plankton seasonality as a precondition for interpreting fluxes and to assess lateral gradients in the distribution of particulate matter. Hence, the cruise was primarily scheduled to deliver snap shot pictures of the distribution of production regimes under late winter/ early spring conditions and it was to focus on intermediate and bottom-near nepheloid layers which play a role immediating flux at the continental margin.

2. OBJECTIVES

The main objective of this cruise was to gather information on late winter/early spring non-upwelling conditions off NW Spain, and in detail:

- to obtain time-series recordings of sediment trap and current data to characterise fluxes of particulates at and across the continental margin. For this purpose two deep-sea moorings fitted with automated sediment traps and current meters had been deployed during a cruise with R/V PELAGIA in summer 1997. These were to be recovered, data and samples were to be collected, and the moorings were to be redeployed with the addition of *in situ* pumps.
- to trace intermediate and bottom-near nepheloid layers (INL and BNL) and to obtain samples for analysing particle concentration and composition. This will enable us to better assess the relative impact they exert on fluxes measured by sediment traps at the continental slope.
- to map the distribution of nutrients, mixed layer depth and particle composition, thus assessing prevailing export conditions
- to measure production rates of phytoplankton and bacteria and nutrient uptake rates to assess its variability in the WP2-Box
- to determine gradients in abundance and activity of micro-zooplankton in relation to community structure
- by sampling stable carbon isotopes (^{13}C) within the OMEX box and to contribute to a comprehensive dataset in conjunction with analyses obtained on previous cruises.

3. TIME SCHEDULE AND WORK CONDUCTED

R/V Poseidon left Viana do Castelo at 14:00h on 26th February 1998 during high tide and headed for a deep station at >3500m water depth in order to spool the ships' new CTD conductor cable and test the instruments on board. During the following 17 working days only three days were lost due to foul weather which was less than initially expected. Despite a persistent swell from the open Atlantic weather was in general favourable for work. Investigations were confined to the OMEX Box (Figure 1) and as far as possible the stations and transects determined to be of priority in WP2 during the Paris meeting were sampled. Cruise track and time allotted to the respective activities were designed to meet the requirements of the participating groups.

Recoveries and redeployment of two deep-sea moorings (IM 2 and IM 3 at 42° 37´N, 010° 01´W and 42°38´N, 009° 42´W) were a major objective of the cruise. Recovery took place on the 28th February and 1st March and was carried out most skilfully by the ship´s crew. Retrieved sediment trap samples and current meter data cover the period since July 1997 when these moorings had been deployed by RV PELAGIA. A near-complete set of trap samples and complete current meter recordings were obtained and after servicing the moorings were redeployed on March 1st, this time with the addition of 3 *in situ* pumps.

Intensive sampling of suspended particulate matter was conducted along the OMEX transects and along 2 slope-parallel transects at the 1500 m and 600 - 700 m bathymetric contours to determine the across- and along slope gradients in the concentration and composition of suspended particles. This data will contribute to the seasonal coverage of SPM around the mooring sites and complement the single-site data to be obtained for SPM from the *in situ* pumps on the moorings.

During cruise planning it was thought that a winter situation would be encountered in the investigation area with low phytoplankton production and biomass, winter nutrient values and deep mixing. This turned out not to be the case. Nutrients were depleted at almost all stations sampled, with values of < 1 µM NO_3 and SiO_4 within the upper mixed layer. Ammonium was present within the mixed layer at concentrations below 0.5 µM, with slightly elevated values at times between 50 and 80 m depth. Typical mixed layer depths of between 30 and 60 m were seen, with a broad fluorescence and particulate peak and the absence of a deep chl maximum. The situation we encountered therefore was one where spring growth had progressed and there was little across-or along-slope trend visible.

Daily bacterial and phytoplankton productivity measurements were conducted along the main OMEX transects N to S, with stations extending from the shelf to oceanic realms. Microzooplankton grazing experiments and samples for biomass determinations were also taken at these stations. A good data set will thus become available that is expected to contribute to the seasonal coverage of biomass and rate measurements within OMEX.

Work was terminated during late evening on the 15th March and R/V POSEIDON called into port of Vigo early the following morning. Swap tests kindly measured by the Instituto de Investigacions Marinas, Vigo, immediately on the 16th March documented that the ship was free of radioactive contamination. Unloading the vessel was efficient and completed by late afternoon the same day.

4. REPORTS OF THE WORKING GROUPS

4.1 FLUXES AS MEASURED BY MOORED SEDIMENT TRAPS

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A central aim of the OMEX project is to determine the flux of particles at the northern Iberian Margin and to interpret these fluxes in relation to the productivity and physical regime and compare them to the differing region at the Goban Spur. Two moorings were deployed along a transect at ca. 42°38'N at water depths of 1440 and 2250 m in August 1997, and were recovered during this cruise (positions in Figure 1). Mooring recovery was uneventful and thanks to the expert assistance of the crew all instruments were recovered with no damage. With the exception of the sediment trap in 1753 m on IM3 that malfunctioned due to corrosion and flooding of the motor, a full set of samples and complete record of current meter data were obtained. Pressure housings in one more trap showed severe corrosion at an earlier stage and had to be replaced. Further, an inclinometer attached to one of the traps had failed. Altogether 80 trap samples from 3 depth horizons were recovered and a comprehensive first data set is thus assured for investigating flux seasonality in this region. At a fist glance of the collection cups of the traps it was evident that flux was highly variable between adjacent sampling intervals, with some cups during the periods of upwelling and filament formation during August and September 1997 containing large amounts of green pigmented phytodetritus. Subsequent microscopic observations during picking in the laboratory have confirmed this impression. Samples are currently being manually picked and split prior to analyses and subsample distribution to other partners in OMEX. Mooring recovery will be in January 1999 on the METEOR. Details of the moorings are given in the Table 1 below.

Newly developed in situ pumps (manufactured by Baltec GmbH, Germany) were tested extensively and successfully on the ships' wire and were subsequently deployed on the moorings. The pumps are programmed to filter upto 50 l of seawater onto 47mm ∅ polycarbonate filters at pre-programmed intervals. The filters are then poisoned with mercuric chloride and stored watertight until recovery. 21 filters are contained in each pump and have been programmed to collect samples at the mid-time of each trap collection interval.

Table 1 : details of sediment trap moorings

Mooring	**Water depth**	**Position**	**Instrument depth**	**Instrument**
IM2	1500 m	42°38.5'N, 9°42.3'W	580 m	Sediment trap
			600 m	Current meter
			650 m	In situ pump
			1050 m	Sediment trap
			1070 m	Current meter
			1120 m	In situ pump
Mooring	**Water depth**	**Position**	**Instrument depth**	**Instrument**
IM3	2230 m	42°37.5'N, 10°01.5'W	570 m	Sediment trap
			590 m	Current meter
			645 m	In situ pump
			1050 m	Sediment trap
			1070 m	Current meter
			1750 m	Sediment trap
			1770 m	Current meter

4.2. WATER COLUMN INVENTORIES

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A) Nutrients

Information on dissolved inorganic nutrient concentrations is vital for assessing the potential for new production in a water body and for interpreting pelagic system characteristics encountered at a given time in a seasonal context. The POSEIDON cruise was scheduled for late winter/ early spring. Hence, data were to be obtained on whether spring autotrophic growth had taken place in these waters off the Iberian Margin already, possibly depleting nutrients within the euphotic zone or whether reserves were partly utilised only or even largely untouched.

A total of 188 analyses were carried out on board immediately after sampling by means of an autoanalyser for concentrations of Nitrite, Nitrate, Ortho-Phosphate, Silicic acid and, on most samples, also for Ammonium. Vertical profiles were taken from near-surface to 80-180 m depth at 18 stations (bold station numbers in Annex C) in conjunction with productivity casts early in the mornings. Further, on 16 transect stations concentrations at 10 m depth were determined to assess spatial heterogeneities in nutrient distributions. At the mooring positions water from depths of trap deployments was analysed for blank corrections for leached N and Si in trap samples.

Results evidence a biological post-spring situation prevailing within the OMEX Box during the cruise. Nitrate was largely depleted in the upper 40 m with values <1 µM throughout, in most cases even ranging between 0.5- 0.2 µM. The same distribution holds true for PO_4 and SiO_4 for which the range in the upper mixed layer was between < 0.1 µM and 0.2-<1 µM, respectively. The potential for an autotrophic biomass accumulation, hence, was minor to insignificant, and $Si0_4$ depletion certainly would not sustain any significant diatom accumulation. This is in line with on-board qualitative microscopical observations of 20 µm net hauls suggesting a well-developed microzooplankton community to be present and dinoflagellates playing a significant role within the autotrophs. Diatoms dominated the micro-autotrophic stock at selected stations, however, possibly showing a bloom had taken place in those waters before and that nutrient depletion may not have been ruling for a long period prior to the cruise.

B) Suspended Particulate Matter

Suspended particulate matter (SPM) recordings were made at a total of 75 stations from the surface to approx. 15 m above bottom. This was done using a 25 cm path length SEATECH transmissiometer to measure light attenuation that was attached to the CTD. Care was taken to ensure proper functioning by pre-deployment cleaning of windows and measurement of air blanks. The stations were distributed along the OMEX transects at the IM (see Figure 1) and along 2 slope-parallel transects at 1500 m and at 600 - 700 m water depths. A total of 250 depths within the surface mixed layer, mid-water particulate minimum and intermediate and benthic nepheloid layers were sampled using the CTD rosette and between 2 and 12 l filtered onto GF/F filters for the analyses of dry weight, carbonate, POC, PON, opal and $d^{15}N$. Samples will be analysed in the laboratory and provide excellent spatial coverage in particle composition gradients at the IM.

FIGURE 1 : CRUISE TRACK AND SAMPLING STATIONS

CRUISE TRACK NOT YET AVAILABLE.

4.3. MICROBIAL PRODUCTION AND NUTRIENT UPTAKE

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Aims:

To assess the spatial variability in phytoplankton and bacterial biomass and production processes at the Iberian shelf break between 42° and 43°N.

To determine rates of phytoplankton carbon fixation, and phosphate, nitrate and ammonium assimilation using radio- and stable isotope techniques. To determine rates of bacterial production using modifications of radioisotope methods.

Experiments were performed on a daily basis at each of the stations listed in the annex. Water samples were collected from the CTD bottle rosette two hours before dawn from the euphotic zone (determined by mid-day profiles using a 2-p PAR sensor and SD) at depths corresponding to; 97, 55, 33, 20, 14, 7, 3 and 1% of surface irradiance. Following inoculation with the relevant tracers, incubations were made in an on-deck incubator. This consisted of a series of 8 tanks with spectrally corrected light screens, which permitted transmission of ambient irradiance in the range 97 -1%, and was maintained at surface seawater temperature with a continuous pumped supply from ca 5m. At night all tanks were covered with opaque lids to eliminate any effect of the ships lights. Incubations were terminated by fixation after 1 hour for bacterial production, and by filtration after 4 hours for phytoplankton nitrogen uptake and 24 hours for primary production and phytoplankton nutrient uptake.

Data will be available in preliminary form within 6 months and will be logged (within 12 months) at the British Oceanographic Data Centre (B.O.D.C.).

^{15}N - nitrate and ammonium uptake rates

Seawater was distributed from the CTD bottles into 0.62l polycarbonate bottles from each of the 8 depths sampled. $^{15}N\text{-}NO_3$ and $^{15}N\text{-}NH_4$ was added to triplicate samples from each depth at approximately 10% of the ambient concentration and incubated in the on-deck incubator for 24 hours. To estimate potential experimental artefacts of the 24 hr incubation (substrate depletion/ammonium regeneration) an additional 4 x 2 l of seawater was collected from 10m. This was distributed into polycarbonate bottles and innoculated with 2 x $^{15}N\text{-}NO_3$ and 2 x $^{15}N\text{-}NH_4$ at 10% of ambient concentration and incubated for approximately 4 hours. One bottle of each duplicate pair was incubated at 33% irradiance and the other in the dark. Particulate nitrogen concentration and atom% ^{15}N enrichment will be determined using continuous flow isotope-ratio mass spectrometry at the PML. Rates of nitrate and ammonium uptake will be determined from the combination of this data with dissolved nitrate and ammonium concentrations analysed onboard by Peter Fritsche - University of Kiel.

^{14}C - bicarbonate and ^{33}P - phosphate assimilation rates

Seawater was sampled from the same CTD bottles as ^{15}N uptake experiments. 8 x replicate 75ml bottles were filled from each depth sampled. Three light bottles and a dark control were innoculated with 1µCi of ^{14}C-sodium bicarbonate and further 3 light bottles and a dark control were innoculated with 1 µCi of ^{33}P-orthophosphate. Stock concentrations were checked daily by dispensing an aliquot into either a ^{14}C or ^{33}P absorbing scintillant. Radioisotope preparation, sample bottles and experimental procedures conformed to JGOFS level-1 protocols. Bottles were incubated for 24 hours in the same, simulated in-situ incubators as ^{15}N uptake experiments. Experiments were terminated by sequential filtration through 5, 2 and 0.2µm polycarbonate membrane filters. These were then dried overnight by desiccation. Samples will be analysed at the PML using a liquid scintillation counter.

Chlorophyll a concentration and phytoplankton species composition

Replicate subsamples from each water bottle used in the determination of uptake rates were taken for the determination of the total chlorophyll a concentration by spectrophotometry and the size-fractionated concentration by fluorometry. 1l of seawater was filtered through GF/F filters for analysis of the total concentration; 200ml were sequentially filtered through 5.0, 2.0 and 0.2 µm polycarbonate filters for the analysis of size fractions. Both sets of filters were stored frozen prior to analysis at the PML.

50ml water samples were taken at 10 and 20m from each pre-dawn CTD cast. These were fixed with Lugol's iodine and will be used for the determination of phytoplankton species composition and biomass by microscopy.

Production and biomass of heterotrophic bacteria

Bacterial activity was determined with two similar methods utilising the incorporation of radiolabelled substrates; the incorporation of ^{3}H-thymidine into nucleic acid and the incorporation of ^{3}H-leucine into protein. The former method gives a measure of replication rate and the latter of growth rate. The ratio of the two uptake rates provides an indication of the physiological condition of the bacterial population. 10 replicate subsamples were taken at each depth from the same pre-dawn CTD casts as primary productivity measurements. 4 replicates and a fixed control were incubated with 10nM ^{3}H-thymidine and a further 4 and a fixed control with 20nM ^{3}H-leucine. Incubations lasted between 1 and 1.5 hours and were conducted in the same on-deck incubators as primary production experiments. Incubations were terminated with the addition of trichloroacetic acid (TCA), centrifuged for 10 minutes at 14000 rpm, aspirated and washed with 5% TCA before a second centrifugation and aspiration. Uptake rates will be determined at PML using a liquid scintillation counter. Two additional incubations were completed with each substrate to confirm that the concentrations added were sufficient to saturate any naturally occurring thymidine or leucine.

Samples, fixed with 2% electron microscope grade glutaraldehyde were taken from every depth sampled and will be used to determine bacterial numbers and biomass using epifluorescence microscopy and image analysis.

4.4. MICROZOOPLANKTON HERBIVORY AND COMMUNITY STRUCTURE

Elaine Edwards
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Objectives

The specific aims of this project within OMEX II are to:
a) quantify the abundance, biomass and species composition of microzooplankton (20-200 mm) and heterotrophic nanoplankton (2-20 mm) of the surface mixed waters across the NW Iberian shelf
b) to quantify herbivorous interactions between microzooplankton and phytoplankton in surface waters.
The aim of the work on this cruise was to conduct microzooplankton grazing experiments and collect samples during ”typical winter conditions”.

Methods

Microzooplankton biomass studies
Water samples were collected from 10 litre water bottles on the CTD and were fixed as follows:
1) 250mls in 1% acid Lugols for the subsequent determination of total microzooplankton abundance, biomass and species composition. This will be carried out at PML using inverted microscopy and image analysis.
2) 30-50mls in 0.5% glutaraldehyde, dual-stained with DAPI and proflavine (final concentration 5 mg ml-1) and filtered onto 0.8mm black polycarbonate filters. The filters were mounted onto slides and frozen. Heterotrophic nanoplankton abundance and biomass will be determined from these samples by inverted fluorescence microscopy.

Grazing experiments

A total of 12 microzooplankton grazing experiments were carried out using the dilution technique described by Landry & Hassett in 119982 (Mar Biol 67: 283-288). Experimental water was collected pre-dawn from a depth of 10m. Half of this water was filtered through a 0.2 mm capsule filter which had been pre-rinsed in deionised water. The remaining water was pre-screened using a 200 mm mesh bag to exclude larger predators. A series of dilutions were made up by gently combining the screened water with the filtered in 2 litre polycarbonate bottles. All incubations were carried out over a 24 hour period in an ambient temperature-cooled deck incubator screened to the 33% light level. Sub-samples were taken at T0 and T24 from each bottle for the determination of chlorophyll concentration and community structure. All chlorophyll samples were extracted with 90% acetone and analysed on board by fluorometry. Preliminary results suggest that microzooplankton grazing was high with up to 75% of the phytoplankton population being turned over per day. Three examples of grazing experiment results are shown below.

Results

Pigments

In addition to microzooplankton samples, 2 litres of water were filtered onto 25mm GFFs. These were stored in liquid nitrogen until further analysis of pigment content using HPLC. This aim of this work within OMEX is to investigate the fluxes of chlorophyll and carotenoid pigment distribution, work carried out by Stuart Gibb and Denise Cummings at PML.

ANs

A series of AN net hauls were carried out. The AN was fitted with a 20 µm mesh net and allows the qualitative assessment of the larger rarer and less delicate of the microzooplankton such as the tintinnids, large heterotrophic dinoflagellates, sarcodines and metazoa, together with the larger phytoplankton cells. A number of AN samples were fixed in 4% buffered formaldehyde for Sonia Batten (SAHFOS) who will use the samples for the determination of the specific biomass of individual mesozooplankton taxa.

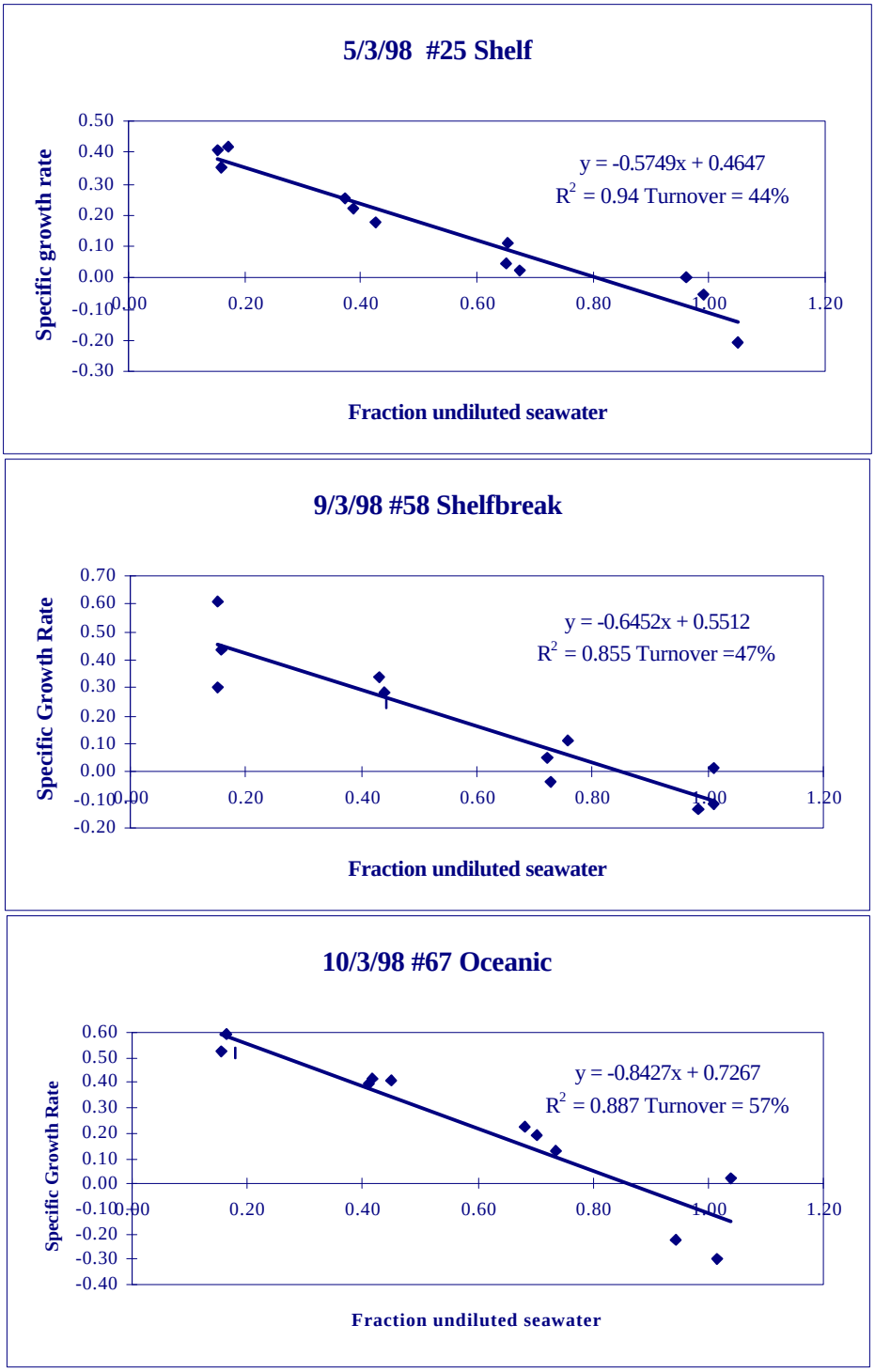

Figure 2: Examples of results obtained from microzooplankton grazing experiments carried out along the S-transect during March 191998. (Turnover = amount of chlorophyll turned over by the mirozooplankton day^{-1})

Table 2 : Full details of all samples collected.

Date	CTD Cast	Samples taken	Depths (m)
28/02/1998	2	Grazing expt 1	10
		Lugols	1, 10, 23, 30, 40, 60, 80, 120
		Glutaraldehyde	1, 23, 30, 40
		HPLC	1, 10, 23, 30, 40, 60, 80, 120
	AN	Formaldehyde	0-80
01/03/1998	5	Grazing expt 2	10
		Lugols	5, 10, 20, 30, 40, 60, 80
		Glutaraldehyde	5, 10, 20, 30, 40, 60
		HPLC	5, 10, 20, 30, 40, 60, 80
02/03/1998	8	Grazing expt 3	10
		Lugols	5, 10, 25, 30, 40, 60, 80
		Glutaraldehyde	5, 10, 25, 30, 40, 60, 80
		HPLC	5, 10, 25 ,30, 40, 60, 80
03/03/1998	17	HPLC	5, 10, 15, 20, 27,35
05/03/1998	25	Grazing expt 4	10
		Lugols	5, 10, 15, 27, 60, 80, 100
		Glutaraldehyde	5, 10, 15, 27, 60, 80
		HPLC	5, 10, 15, 27, 60, 80, 100
	AN	Formaldehyde	0-100
06/03/1998	37	Grazing expt 5	10
		Lugols	5, 10, 20, 35, 60, 80, 100
		Glutaraldehyde	5, 10, 20, 35, 60, 80
		HPLC	5, 10, 20, 35, 60, 80, 100
07/03/1998	44	Grazing expt 6	10
		Lugols	5, 10, 20, 35, 80, 120, 180
		Glutaraldehyde	5, 10, 20, 35, 80, 120
		HPLC	5, 10, 20, 35, 80, 120, 180
	AN	Formaldehyde	0-100
08/03/1998	51	Grazing expt 7	10
		Lugols	5, 10, 20, 35, 80, 120, 180
		Glutaraldehyde	5, 10, 20, 35, 80, 120
		HPLC	5, 10, 20, 35, 80, 120, 180

Date	CTD Cast	Samples taken	Depths (m)
09/03/1998	58	Grazing expt 8	10
		Lugols	5, 10, 20, 35, 80, 120, 150
		Glutaraldehyde	5, 10, 20, 35, 80, 120
		HPLC	5, 10, 20, 35, 80, 120, 150
	AN	Formaldehyde	0-100
10/03/1998	67	Grazing expt 9	10
		Lugols	5, 10, 20, 35,50, 80, 150
		Glutaraldehyde	5, 10, 20, 35,50, 80
		HPLC	5, 10, 20, 35,50, 80, 150
11/03/1998	71	Grazing expt 10	10
		Lugols	5, 10, 20, 35,50, 80, 150
		Glutaraldehyde	5, 10, 20, 35,50, 80
		HPLC	5, 10, 20, 35,50, 80, 150
12/03/1998	72	Grazing expt 11	10
		Lugols	5, 10, 20, 35,50, 80, 150
		Glutaraldehyde	5, 10, 20, 35,50, 80
		HPLC	5, 10, 20, 35,50, 80, 150
13/03/1998	72	Grazing expt 12	10
		Lugols	5, 10, 20, 35,50, 80, 130, 180
		Glutaraldehyde	5, 10, 20, 35,50, 80, 130
		HPLC	5, 10, 20, 35,50, 80, 130, 180

4.5. SAMPLING FOR CARBON ISOTOPES

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The ratio of $^{13}C/^{12}C$ in dissolved inorganic carbon in the upper ocean has been decreasing because of the production of fossil fuel CO_2 which is depleted in ^{13}C. Our investigation at the Goban Spur during OMEX I indicates that this anomaly in the $d^{13}C$ has penetrated as deep as about 2600 m there. The Iberian Margin is being investigated in detail as part of OMEX 2; and Poseidon 237 is the second in a series of collections that are being done in this area.

197 water samples for carbon isotope measurements were taken from 19 CTD hydrocasts (Table 3), and these samples were immediately poisoned with mercuric chloride solution. They have been returned to the Leibniz Laboratory of the University of Kiel, where the mass spectrometric measurements will be carried out.

Table 3 : Samples taken for ^{13}C measurements

Station	Depth (m)	Sample #		Station	Depth (m)	Sample #
42° 35.8 010°W 04.0'				42° 08.9 009°W 59.9'		
4	2405	1		65	2515	106
4	2000	2		65	2200	107
4	1700	3		65	2000	108
4	1400	4		65	1800	109
4	1100	5		65	1600	110
4	900	6		65	1400	111
4	650	7		65	1200	112
4	500	8		65	1000	113
4	200	9		65	800	114
				65	600	115
				65	400	116
				65	200	117
42° 09.0 009°W 44.1'				42° 09.0 010°W 18.0'		
23	2258	10		66	2750	118
23	2200	11		66	2600	119
23	2000	12		66	2400	120
23	1800	13		66	2200	121
23	1600	14		66	2000	122
23	1400	15		66	1800	123
23	1200	16		66	1600	124
23	1000	17		66	1400	125
23	800	18		66	1200	126
23	600	19		66	1000	127
23	400	20		66	800	128
23	200	21		66	600	129

Station	Depth (m)	Sample #
42° 09.0		
009°W 44.1'		
23	150	22
23	100	23
23	50	24
23	10	25
43° 00.0		
010°W 01.0		
44	2950	26
44	2800	27
44	2600	28
44	2400	29
44	2200	30
44	2000	31
44	1800	32
44	1600	33
44	1400	34
44	1200	35
44	1000	36
44	800	37
44	600	38
44	400	39
44	200	40
44	100	41
44	50	42
44	10	43
42° 09.0		
009°W 08.4'		
59	120	44
59	100	45
59	60	46
59	50	47
59	40	48
59	30	49
59	20	50
59	10	51
59	5	52
42° 09.0		
009°W 18.9'		
60	200	53
60	180	54
60	150	55
60	100	56
60	60	57
60	40	58
60	20	59
60	10	60

Station	Depth (m)	Sample #
42° 09.0		
010°W 18.0'		
66	400	130
66	200	131
42° 09.0		
010°W 18.0'		
67	2500	132
67	2300	133
67	2100	134
67	1900	135
67	1700	136
67	1500	137
67	1300	138
67	1100	139
67	900	140
67	700	141
67	500	142
67	300	143
67	100	144
67	50	145
67	25	146
42° 20.0		
010°W 00.0'		
68	2200	147
68	1600	148
68	1000	149
68	700	150
68	500	151
68	300	152
68	100	153
42° 19.9		
009°W 46.2'		
69	1975	154
69	1800	155
69	1500	156
69	1200	157
69	900	158
69	600	159
69	300	160

Station	Depth (m)	Sample #
42° 08.6		
009°W 26.2'		
61	574	61
61	500	62
61	450	63
61	400	64
61	350	65
61	300	66
61	250	67
61	200	68
61	150	69
61	100	70
61	50	71
61	10	72
42° 09.0		
009°W 28.0'		
62	1098	73
62	900	74
62	800	75
62	700	76
62	600	77
62	500	78
62	400	79
62	300	80
62	200	81
62	100	82
42° 09.0		
009°W 39.2'		
63	1976	83
63	1800	84
63	1600	85
63	1400	86
63	1200	87
63	1000	88
63	800	89
63	600	90
63	400	91
63	200	92
63	100	93
42° 09.0		
009°W 44.0'		
64	2230	94
64	2000	95
64	1800	96
64	1600	97
64	1400	98
64	1200	99
64	1000	100

Station	Depth (m)	Sample #
42° 29.9		
009°W 49.9'		
70	2100	161
70	1800	162
70	1500	163
70	1200	164
70	900	165
70	600	166
70	300	167
42° 39.9		
010°W 18.0'		
78	2500	168
78	2250	169
78	2000	170
78	1750	171
78	1500	172
78	1250	173
78	1000	174
78	500	175
78	100	176
42° 49.9		
010°W 00.1'		
80	1400	177
80	1100	178
80	800	179
80	500	180
80	300	181
80	100	182
80	50	183
42° 49.9		
009°W 45.9'		
81	1700	184
81	1400	185
81	1100	186
81	800	187
81	400	188
81	200	189
81	100	190
81	50	191

Station	Depth (m)	Sample #		Station	Depth (m)	Sample #
42° 09.0 009°W 44.0'				42° 49.9 009°W 38.0'		
64	800	101		82	800	192
64	600	102		82	600	193
64	400	103		82	400	194
64	200	104		82	200	195
64	100	105		82	100	196
				82	50	197

5. Acknowledgements

The master of R/V POSEIDON, Capitain Bruns, the officers and all crew are thanked for providing most efficient and safe conditions for our work and a very pleasant environment at the same. We could not have chosen better! Further, the whole cruise showed the clear advantages of conducting research on a medium-sized vessel where losses due to organisational friction can be kept to a minimum and efficiency is at its highest. Also, the interaction between the scientific parties on board was cheerful and rewarding throughout, which contributed to the overall success of this very cruise.

The European Commission is thanked for funding this sea-going work under the grant MAS3-CT97-0076.

ANNEX:

A) PARTICIPANTS AND INSTITUTIONS

Rolf Peinert (cruise leader)	Institut für Meereskunde, Kiel
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B) DEPLOYED INSTRUMENTS

- automated sediment traps (Baltec, Norderstedt, Germany) and current meters (Aanderaa, Bergen, Norway, some of which fitted with transmissiometers) were recovered and redeployed in two deep sea moorings at the continental margin.
- stand-alone pumps (Baltec, Norderstedt, Germany) were tested at various depths and thereafter deployed in both deep-sea moorings.
- a Neil Brown-CTD (Mark V) with attached back-scatter fluorometer/or transmissiometer and a 24 bottles rosette (General Oceanics) was used for obtaining vertical profiles of salinity, temperature, in vivo fluorescence/beam attenuation and for water sampling.
- a 20 µm mesh size Apstein plankton net was used to collect surface microplankton (vertical tows 100 - 0 m) for on-board qualitative microscopy.

C) LIST OF STATIONS AND INSTRUMENT DEPLOYMENTS

Instrument abbreviations: CTD = CTD fitted with 24 x 10 liter water bottle rosette;
AN = 20µm Apstein net; QM = Quantameter;
SAP = Stand-alone Pump; SD = Secchi disc

Bold station numbers: morning casts including nutrient analyses, production and standing stock assessments

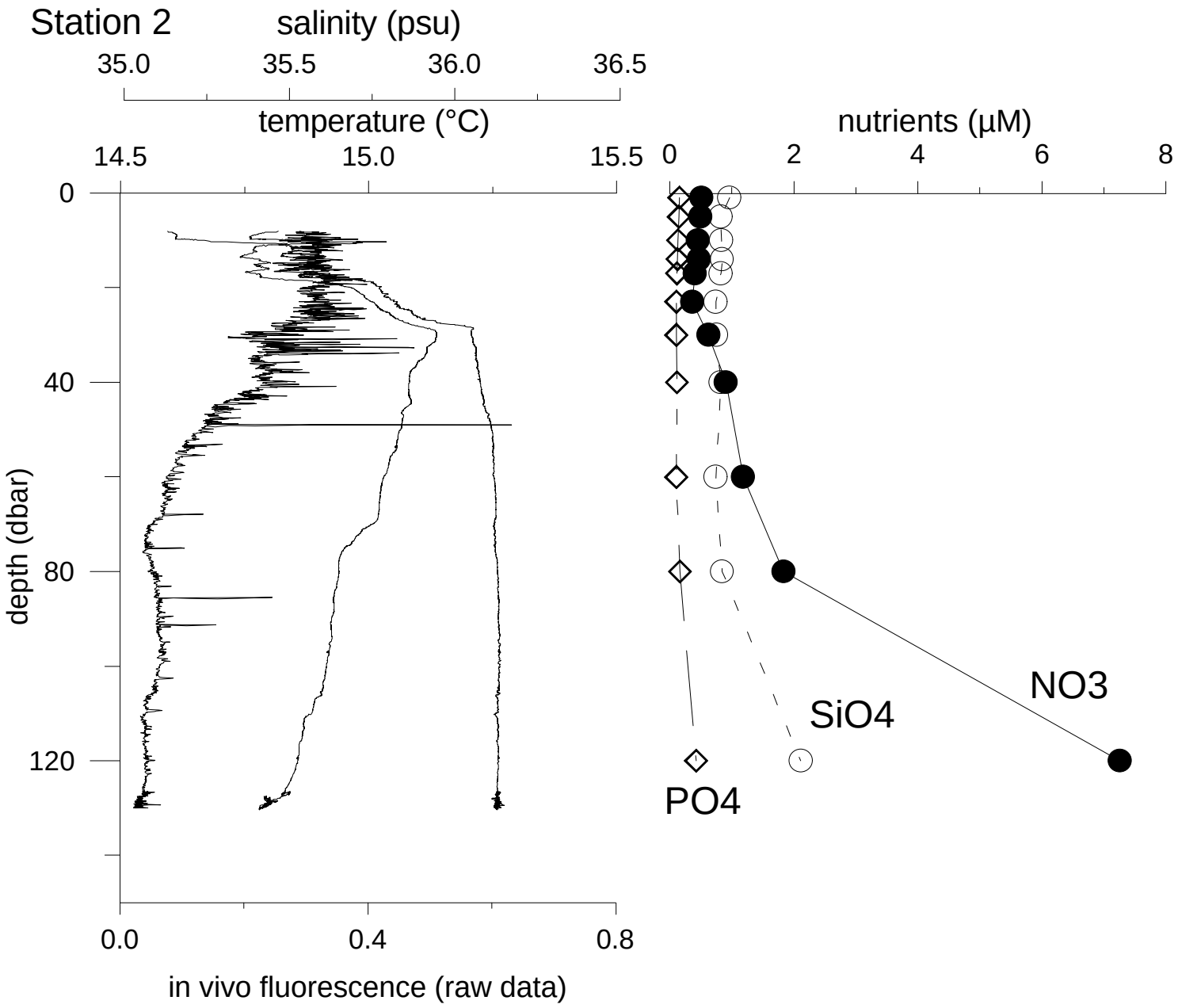
station	date	lat (N)	long (W)	water-depth (m)	start-time	instrument
1	27.2.1998	41° 36.9'	010° 17.9'	3222	8:37	CTD
		41° 35.8'	010° 18.6'	3238	11:30	AN
		41° 35.8'	010° 18.8'	3221	11:44	QM
		41° 35.6'	010° 19.3'	3251	13:08	CTD
		41° 37.2'	010° 17.7'	3218	23:05	SAP
2	28.2.1998	42° 36.8'	010° 01.5'	2215	5:23	CTD, AN
3		42° 37.4'	010° 01.7'	2272	8:25	recovery mooring IM 3
4		42° 35.8'	010° 04.0'	2429	12:30	CTD, SD
		42° 38.1'	010° 04.3'	2406	16:40	SAP
5	1.3.1998	42° 38.2'	009° 43.8'	1648	5:26	CTD, AN
6		42° 38.2'	009° 42.2'	1597	8:18	recovery mooring IM 2
7		42° 38.2'	009° 40.2'	1511	10:31	CTD, QM, SD
		42° 38.2'	009° 40.2'	1500	14:00	SAP
8	2.3.1998	42° 40.0'	009° 12.6'	100	5:23	CTD, AN
9		42° 40.1'	009° 12.5'	100	7:44	CTD
10		42° 40.1'	009° 22.2'	128	9:14	CTD
11		42° 40.0'	009° 29.9'	187	10:27	CTD

station	Date	lat (N)	long (W)	water-depth (m)	start-time	instrument
12		42° 39.9'	009° 33.2'	521	11:55	CTD
13		42° 40.0'	009° 34.4'	730	13:58	CTD
14		42° 40.0'	009° 36.5'	19981	16:18	CTD
15		42° 40.1'	009° 43.4'	1628	18:52	CTD
16		42° 40.0'	009° 50.7'	1972	21:34	CTD
17	3.3.1998	42° 40.0'	009° 30.0'	190	4:42	CTD, AN
18		42° 30.0'	009° 16.7'	134	8:55	CTD
19		42° 30.0'	009° 21.5'	201	10:00	CTD
20		42° 29.9'	009° 25.6'	597	11:21	CTD
21		42° 30.0'	009° 26.3'	1038	12:41	CTD
22		42° 30.0'	009° 32.0'	1544	15:08	CTD
23	4.3.1998	42° 09.0'	009° 44.1'	2251	8:42	CTD
24		42° 09.0'	009° 28.0'	1081	12:48	CTD, QM, SD, SAP
25	5.3.1998	42° 09.0'	009° 03.0'	125	4:45	CTD, AN
26		42° 08.9'	009° 19.1'	215	7:51	CTD
27		42° 09.0'	009° 26.2'	51998	9:13	CTD
28		42° 05.0'	009° 25.3'	828	11:08	CTD, QM, SD
29		42° 09.0'	009° 28.0'	1085	13:05	CTD
30		42° 13.0'	009° 27.0'	641	14:42	CTD
31		42° 23.0'	009° 26.0'	19989	16:38	CTD
32		42° 29.9'	009° 26.5'	1053	18:32	CTD
33		42° 33.9'	009° 29.5'	1102	20:03	CTD
34		42° 42.4'	009° 35.4'	813	22:07	CTD
35		42° 49.9'	009° 37.0'	848	23:46	CTD
36	6.3.1998	42° 59.5'	009° 35.0'	958	1:37	CTD
37		43° 00.0'	009° 31.0'	204	4:40	CTD, AN
38		43° 00.0'	009° 32.8'	503	6:37	CTD
39		43° 00.0'	009° 33.2'	701	8:06	CTD
40		43° 00.0'	009° 34.6'	1150	8:04	CTD
41		42° 59.9'	009° 38.8'	1546	11:10	CTD
42		43° 00.0'	009° 42.8'	2366	12:48	CTD, QM, SD
43		42° 59.9'	009° 38.3'	1540	18:00	SAP
44	7.3.1998	43° 00.0'	010° 01.0'	3038	5:07	CTD, AN
45		42° 59.5'	009° 48.9'	2022	12:22	CTD, QM, SD
46		42° 57.5'	009° 49.0'	1520	14:43	CTD

station	Date	lat (N)	long (W)	water-depth (m)	start-time	instrument
47		42° 59.5'	009° 36.0'	1485	17:34	CTD
48		42° 56.0'	009° 39.9'	1236	19:57	CTD
49		42° 51.4'	009° 41.9'	1406	21:46	CTD
50		42° 46.0'	009° 41.3'	1383	23:42	CTD
51	8.3.1998	42° 42.0'	009° 39.5'	1532	1:20	5 CTD´s, AN
52		42° 37.0'	009° 38.5'	1450	6:53	CTD
53		42° 34.0'	009° 34.0'	1521	10:46	CTD
54		42° 33.0'	009° 30.5'	1100	12:31	CTD, QM, SD
55		42° 22.5'	009° 32.0'	1533	15:00	CTD
56		42° 18.5'	009° 34.0'	1483	16:40	CTD
57		42° 08.8'	009° 27.2'	869	19:11	SAP
58	9.3.1998	42° 09.0'	009° 28.0'	1053	4:45	CTD, AN
59		42° 09.0'	009° 08.4'	143	7:46	CTD
60		42° 09.0'	009° 18.9'	213	9:30	CTD
61		42° 08.6'	009° 26.2'	582	10:59	CTD
62		42° 09.0'	009° 28.0'	1101	12:11	CTD, QM, SD
63		42° 09.0'	009° 39.2'	119988	14:34	CTD
64		42° 09.0'	009° 44.0'	2243	16:36	CTD
65		42° 08.9'	009° 59.9'	2522	20:07	CTD
66	10.3.1998	42° 09.0'	010° 18.0'	2757	0:12	CTD
67		42° 09.0'	010° 18.0'	2756	4:42	CTD, AN
		42° 09.2'	010° 18.0'	2756		CTD
		42° 10.3'	010° 18.9'	2760		CTD QM, SD
68		42° 20.0'	010° 00.0'	2523	14:48	CTD
69		42° 19.9'	009° 46.2'	119985	18:08	CTD
70		42° 29.9'	009° 49.9'	2204	21:14	CTD
71	11.3.1998	42° 38.7'	009° 42.0'	1458	4:45	CTD, AN
72	12.3.1998	42° 36.9'	009°31.2'	530	6:47	CTD
73		42° 30.0'	009° 29.8'	190	17:48	CTD
74	13.3.1998	40° 40.0'	009° 30.0'	196	5:45	CTD, AN
75		42° 39.27'	009° 39.3'	1351	8:00	deployment mooring IM 2a
76		42° 39.47'	010° 01.89'	2245	14:02	deployment mooring IM 3a
77		42° 38.0'	010° 02.4'	2259	18:15	CTD
78		42° 40.0'	018° 18.0'	2791	23:24	CTD
79	14.3.1998	42° 49.9'	010° 17.8'	3081	10:35	CTD

station	Date	lat (N)	long (W)	water-depth (m)	start-time	instrument
80		42° 50.0'	010° 00.0'	2645	14:51	CTD
81		42° 49.9'	009° 45.9'	1950	18:22	CTD
82		42° 49.9'	009° 37.9'	974	21:20	CTD
83		42° 50.0'	009° 36.1'	678	22:58	CTD
84	15.3.1998	42° 50.0'	009° 30.0'	175	00:33	CTD
85		43° 00.0'	009° 33.0'	521	4:50	CTD, AN
86		42° 55.0'	009° 35.0'	368	7:13	CTD
87		42° 49.0'	009° 36.1'	475	8:38	CTD
88		42° 45.0'	009° 34.8'	452	10:48	CTD
89		42° 40.0'	009° 33.0'	417	12:15	CTD
90		42° 35.0'	009° 25.0'	184	14:15	CTD
91		42° 35.0'	009° 30.0'	627	15:06	CTD
92		42° 30.0'	009° 25.6'	596	16:56	CTD
93		42° 25.0'	009° 24.0'	594	18:28	CTD
94		42° 20.0'	009° 27.0'	538	19:58	CTD
95		42° 16.0'	009° 27.1'	494	21:17	CTD

D) Example for morning productivity stations: CTD, in vivo fluorescence profiles and nutrient concentrations



D) examples for transect stations (CTD and transmission) showing intermediate and bottom-near nepheloid layers