BERICHTE
aus dem Fachbereich Geowissenschaften
der Universität Bremen

No. 130

G. Fischer, D. Bassek, J. Brüning, H. Dierssen, B. Dorschel, I. Flatter, A. Freesemann, M. Gabriel, B. Hönisch, R. Huber, C. Knaak, H. Kuhlmann, G. Mollenhauer, K. Pape, V. Ratmeyer, U. Rosiak, G. Ruhland, T. Wilkop

REPORT AND PRELIMINARY RESULTS OF METEOR-CRUISE M 41/4 SALVADOR DA BAHIA - LAS PALMAS, 18.5.-13.6.1998

Berichte, Fachbereich Geowissenschaften, Universität Bremen, No. 130
62 S., Bremen 1999
ISSN 0931-0800

The "Berichte aus dem Fachbereich Geowissenschaften" are produced at irregular intervals by the Department of Geosciences, Bremen University.

They serve for the publication of experimental works, Ph.D.-theses and scientific contributions made by members of the department.

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D 28334 BREMEN

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Fax: (49) 421 218-3116

Citation:

Fischer, G. et al.

Report and Preliminary Results of METEOR-Cruise M 41/4, Salvador da Bahia - Las Palmas,

18.5.-13.6.1998. Bremen 1999. Berichte, Fachbereich Geowissenschaften, Universität Bremen, No. 130, 62 p.

ISSN 0931-0800

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1. Participants

Name	Subject	Institution
Fischer, Gerhard	Chief Scientist	GeoB
Bassek, Dieter	Meteorology	DWD
Brüning, Jörg	Sedimentology	GeoB
Dierssen, Holger	Marine Chemistry	UBMCh
Dorschel, Boris	Marine Geology	GeoB
Flatter, Ines	Micropaleontology	GeoB
Freesemann, Angelika	Micropaleontology	GeoB
Gabriel, Margot	Marine Chemistry	UBMCh
Hönisch, Bärbel	Micropaleontology	GeoB
Huber, Robert	Sedimentology	GeoB
Koch, Egon	Journalist	-
Knaack, Christian	Meteorology	DWD
Kuhlmann, Holger	Marine Geology	GeoB
Mollenhauer, Gesine	Marine Geology	GeoB
Pape, Katja	Marine Chemistry	UBMCh
Ratmeyer, Volker	Marine Geology	GeoB
Rosiak, Uwe	Marine Geology	GeoB
Ruhland, Götz	Marine Geology	GeoB
Wilkop, Tomas	Marine Chemistry	UBMCh

Participating Institutions:

GeoB	Fachbereich 5 - Geowissenschaften Universität Bremen Klagenfurter Straße 28359 Bremen / FRG
UBMCh	Fachbereich 2 - Biologie/Chemie - Meereschemie - Universität Bremen Leobener Straße 28359 Bremen / FRG
DWD	Deutscher Wetterdienst Geschäftsfeld Seeschiffahrt Bernhard Nocht Straße 76 20359 Hamburg / FRG

2. Research Program

Marine Geology

The geological program of the cruise is the extension of investigations of pelagic sediments in the tropical-subtropical Atlantic in the frame of the special research project SFB 261. During earlier cruises, mainly of RV METEOR, sediment cores and surface sediments were recovered from almost all ocean areas of the southern and central Atlantic. During this cruise, surface sediment recovery will be carried out with a multicorer and a large box corer. Sediment sampling is planned at sediment trap sites in the western and eastern Equatorial Atlantic (equatorial upwelling and near-by mesotrophic-oligotrophic sites) and off West Africa at the edge of the coastal upwelling (Fig. 1). Sedimentological, micropaleontological and chemical characteristics which will be determined and compared to data derived from sediment traps.

Particle flux, stable isotopes and particle transport

Seasonal particle sedimentation will be monitored over several years in the western equatorial Atlantic and in the coastal upwelling area off NW Africa. For this purpose, three moorings with multi-sample sediment traps were installed on a SW-NE-transect during METEOR cruise 38/1; another mooring was deployed off Cape Blanc (CB) and will be redeployed during the cruise (Fig. 1). The three moorings in the western Atlantic are planned to be recovered and redeployed during METEOR cruise M47. Our objective is to receive long-term information about productivity and export flux in the equatorial and coastal upwelling areas. These results will be compared to data from oligotrophic sites (northern Brasil Basin, WAB; Fig. 1) and to a N-S transect in the eastern equatorial Atlantic (EA1-5).

The particles collected will be investigated for species composition of planktonic organisms and their stable isotope composition, trace element composition as well as for the composition of organic matter and terrigenous components. The aim is to identify

seasonal and interannual variations which play an important role for the formation and interpretation of sediments. The results provide a basis for the reconstruction of Late Quaternary current systems and productivity in the South Atlantic from sediment cores.

Vertical particle concentration, size distribution and aggregate composition in the water column will be obtained with an in-situ camera system (ParCa II). The system utilizes a new CCD-based digital videocamera equipped with highly collimating strobelights. Digital images and sequences will be analyzed for particle size and shape, in order to retrieve data on the vertical distribution of suspended and sinking particulate matter (SPM) in the equatorial and subtropical Atlantic Ocean. One aim is to quantify the amounts of SPM at different water depths, another aim is to correlate particle distibutions with CTD-derived density discontiuities in the water column.

Micropaleontology

Dinoflagellates

The fourth leg aims at supplementing the calcareous dinoflagellate data set obtained during preceding cruises with information on environment factors such as temperature, salinity, nutrient- and light supply. For these purposes, the CTD and the spectral-radiometer will be used. Depending on the values of the measurements taken by these instruments, plankton samples will be taken with Niskin bottles from various depths of the upper water column at a number of stations. In addition, samples from the surface waters will be taken daily using the ship's membrane pump. This is aimed at isolating living individuals (especially the test forming *Thoracosphaera heimii*) for culturing experiments, after which the samples will be preserved for later investigations. Furthermore, it is planned to take sediment samples using the multicorer.

Coccolithophore communities

There is little known about the recent distribution of one of the most important groups of pelagic carbonat producing organisms. Therefore, during Leg M41/4, horizontal and vertical sampling profiles will be collected to investigate the composition of the

coccolithophorid communities in the water column. Surface water samples will be collected regularly during cruise time with the sea water pump to receive a continuous plankton profile. To record the vertical composition of the coccolithophorid communities in the upper water column, in particular at the trapping sites, water samples will be collected by Niskin bottles.

Trace element cycling

By participation in the sediment trap program of the Dept. of Geosciences at the University of Bremen, the Marine Chemistry Group will investigate the vertical transport of trace elements from the mixed layer until their burial in the sediments. Several productivity regions typical for the Eastern and Equatorial Atlantic are subject to this study. During M41/4, samples of suspended material will be obtained using in-situ-pumps supplemented by water sampling using GoFlo-bottles from the same stations. Comparison of both kinds of water column particles with the trace element composition of the sediment, and its relation to the vertical distribution of dissolved trace elements in the water column are expected to provide important clues on transport and sorption mechanisms as well as on the general geochemical behaviour of these elements in the ocean. Corresponding to previous results, during this cruise special attention will be paid to the consequences of the remineralization of carrier phases within the top 700 m and to the depth range of resuspension. The main focus is the sampling on transects across the equatorial West- and East-Atlantic.

For trace elements, profiles of dissolved (GoFlo-bottles) and suspended metals (using in-situ pumps with large diameter filters) will be obtained in the water column at the trap stations. On board ship, dissolved Al will be directly determined employing a fluorometric method. Determination of nutrients and oxygen will aid during interpretation. Several other dissolved metals will be separated from the sea water matrix and preconcentrated immediately on board by an automated procedure using complexating resins.

3. Narrative of the Cruise

RV Meteor departed from Salvador da Bahia (Brazil) on Monday, May 18, 1998 at 10:30 LT. Besides two meteorologists and one journalist, 16 scientists from the University of Bremen were on board. Four persons came from the Marine Chemistry group, all other were from the Geoscience Department.

After passing the 200 sm zone of Brazil, we started collecting plankton material from the ships' pumping systems to measure chlorophyll, study diatom/silicoflagellate, dinoflagellate and coccolithophore communities.. The acoustic systems HYDROSWEEP and PARASOUND were also started and tested for later application at the study sites (for multicorer sampling). On Thursday, May 21, we arrived at the first site WAB1 at 11°S in the central Brazil Basin. (Fig. 1). First, we carried out water sampling with the multinet and the rosette (HYDROBIOS) with 18 Niskin bottles. In the early morning, we recovered a 5500 m long mooring array with two sediment traps and a current meter completely. This mooring as well as all others recovered during this cruise were deployed with RV Meteor during the cruise M38-1. Everything had worked perfectly at site WAB1. Lateron, we redeployed a mooring with similar configuration (WAB2). We launched the multicorer with a Seabird SBE 19-CTD which is equipped with additional sensors for oxygen and chlorophyll fluorescence. We terminated the site collecting water and particles with the GoFlo-rosette and the in-situ pumps.

We then proceeded to the NNE to site WA13/14 located at about 7°S/28°W. We started water sampling with a shallow serie of in-situ pumps and the GoFlo-rosette. After using the rosette with Niskin-bottles, we recovered a 5000 m long mooring and redeployed it shortly afterwards. The station work was terminated after 34 hours with light measurements (PAR), multinet sampling and, finally, a deep serie of in-situ pumps and the GoFlo-rosette. On Monday morning, we reached a former sediment trap sampling site at about 4°S/25°W. There, light measurements, water sampling with the GoFlo- and the Niskin-rosette was done and the in-situ pumps and the multinet were used. We continued our cruise track to the NNE to reach the sediment trap site WA12/15 close to

the equator at about 23°30.W. We there arrived on late Thuesday evening, May 26. During the night, we performed sampling of the water column with the multinet, the rosette, the in-situ pumps and GoFlo-collectors. Early in the morning of May 27, we recovered mooring WA12 completely. We obtained two complete sample series. After performing light measurements, we redeployed the mooring WA15. We completed station work with the multicorer equipped with the SBE19-CTD. In the afternoon, we left this site in southeastern direction to the Guinea Basin (about 800 nm). During this transect, we started sampling atmospheric dust from the Sahara with two special collectors on the first platform above the bridge of RV METEOR.

During former expeditions with RV METEOR, we deployed and recovered five moorings crossing the Guinea Basin in N-S direction at about 10°W. Except the southernmost site EA5 at about 3°S, we planned to perform water sampling at all other four sites (former EA1-4) during this cruise. The first site we studied was named EA4 during an earlier cruise and was located at 2°S/10°15.W. Upon arrival on late Saturday, May 30, we commenced with a first shallow serie of in-situ pumps and the GoFlo-rosette. The launching of the multinet and the rosette with Niskin-bottles followed during the night. Early in the morning, we performed light measurements. The station was completed with a second serie of in-situ pumps and the GoFlo-collectors which almost reached the deep sea floor at 4000 m. We then proceeded to the next site at 0°30.N/10°30.W which we reached on early Monday. We performed a similar sampling program than at site EA4 except that we did not launch a bottom-near serie of in-situ pumps and GoFlo-samplers. After sailing about 150 nm to the NNW, we arrived at the next site at 2°N/11°15.W. The sampling program there resembled the one of the southernmost site EA4 and was terminated after about 24 hours at about 1:00 L.T. on June 3. We proceeded to the northernmost site at 3°10.N/12°30.W. We launched the rosette, the instrument for light measurements, the in-situ pumps and the GoFlo-rosette and, finally, the multinet. After finishing these station works in the eastern equatorial Atlantic, RV METEOR continued the cruise to the NW to an earlier mooring site south of Cape Verde Islands (CV) where we arrived on Saturday, June 6. During this transect, we met the german research vessel POLARSTERN on June 4.

At site Cape Verde at 11°20.N/21°W, we performed light measurements, used the rosette, the in-situ pumps and the GoFlo-water collectors. We launched a video camera system for the first time down to a depth of about 4000 m. It collected pictures from larger particles every 10 m in the water column. Finally, we made two hawls with the multinet and completed station work on early Sunday morning. Then RV METEOR sailed to the north to a mooring site 200 nm off Cape Blanc (Mauretania). Shortly after departure from site Cape Verde, we switched off the ships' pumping systems due to arrival in the 200 nm zone of the Cape Verde Islands. The pumps were switched on again on early Thuesday, June 8.

We arrived at site Cape Blanc on Thuesday, June 9. After performing light measurements, we recovered the mooring CB8 equipped with two traps and one current meter. The upper trap had worked perfectly, the lower, unfortunately, not. The upper trap revealed a time series with unusually high fluxes and a strong seasonality. We continued with water sampling using the rosette with Niskin-bottles, the in-situ pumps and GoFlo-rosette. Lateron, the multicorer was used and the video camera was launched to about 1000m. Early in the morning, three hawls with the multinet were done. At 8:00 in the morning, we redeployed the mooring CB9. At last, we launched a bottom-near serie of in-situ pumps and the GoFlo-rosette.

We terminated station work at site Cape Blanc on Wednesday, June 10 at 21:30 UTC. Shortly afterwards, we switched off the ships' pumping systems because we reached the 200nm zone of Mauretania. We proceeded to Las Palmas, Gran Canaria (Spain) where we arrived at 7:00 L.T. on June 13, 1998.

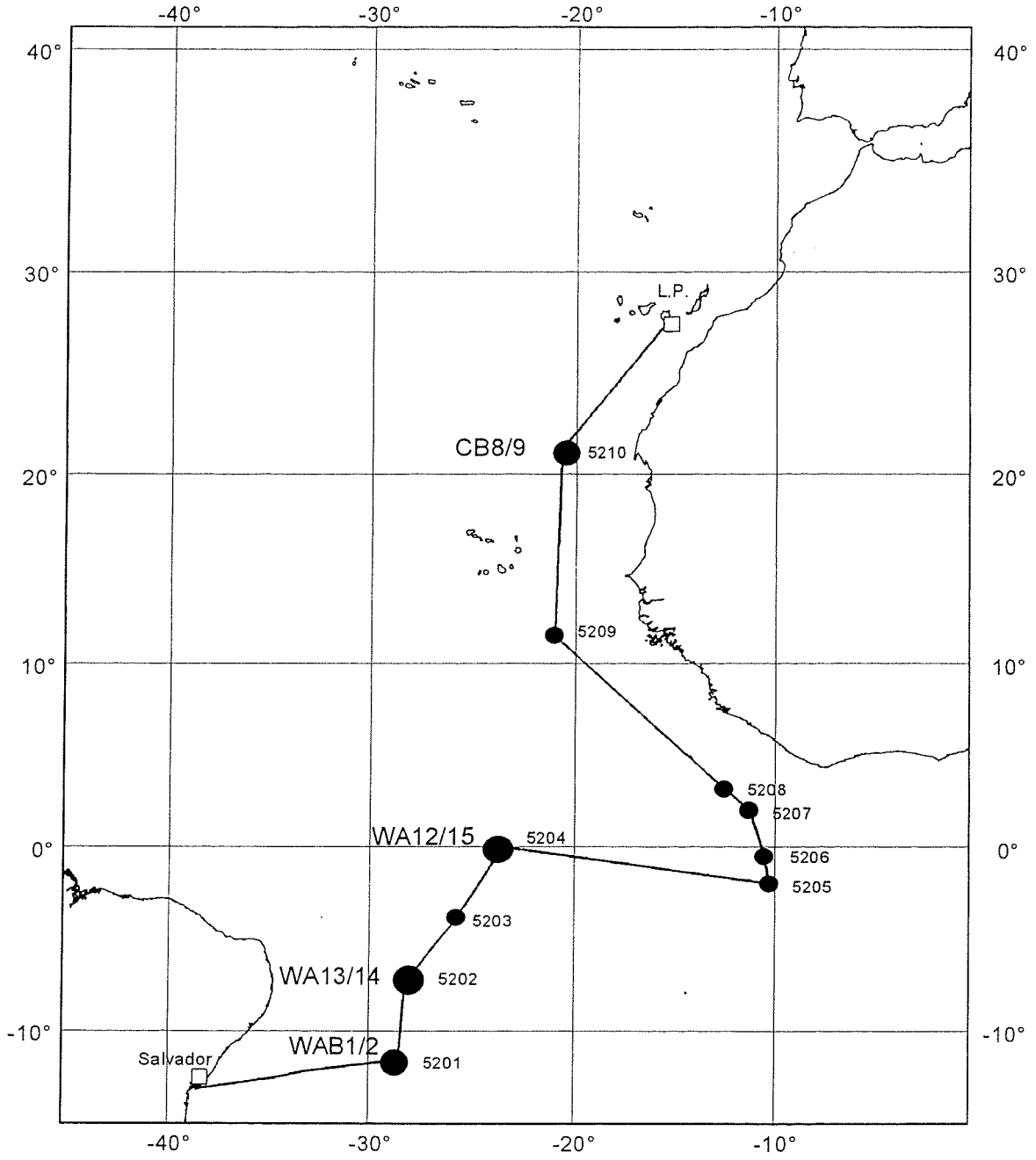

Fig. 1. Cruise track during RV METEOR Cruise M41-4. Sediment trap/current meter moorings are shown as large black dots (CB8/9, WA12/15, WA13/14 and WAB1/2). Stations are numbered (GeoB) and shown in small black dots.

4. Preliminary Results

4.1 . CTD-O_2-Chlorophyll-Fluorescence Probe
(V. Ratmeyer)

Nine CTD/O_2/Chl-a profiles were taken with a self-contained SBE 19 profiler equipped with a conductivity-temperature-depth probe plus oxygen sensor and a CHELSEA-fluorometer. All sensors were calibrated prior to the cruise by the manufacturer. The calibration coefficients from this calibration have been used to process the down-cast data on board shortly after data retrieval However, during most casts the oxygene values seem to be too high, with a positive drift of about 2 mg/l. Using a sampling rate of 2 samples/dbar, the CTD was deployed 70 m to 100 m above the bottom reaching multicorer, 20 to 50 m above the GoFlo-sampler, and 10 m above the ParCa II video system. Profiles with the CTD were taken between 1500 and 5500 m depth. The raw data were recovered on board and downcast standard plots were immediately produced to evaluate the stratification of the water column at all sampling sites. Four profiles are shown and described below as examples (Fig. 2a-d).

At the Cape Blanc site (Station GeoB 5210-7; Fig. 2a), a well mixed upper layer down to 120 m water depth causes low temperature and oxygen gradient at these depths. Chlorophyll concentrations are revealed from the CHELSEA fluorescence probe and show highest values up to 0.18 mg/l in the upper 80-100 m. Around 300 and 500 m, two 0.02 mg/l Chl-peaks appeared. A distinct oxygen minimum with values around 3 mg/l was observed between 500 m and 650 m water depth. Between 600 and 1000 m, a salinity minimum shows the almost northernmost influence of the AAIW. The NADW is found below 1600 m water depth, characterized by oxygen values around 6.5 mg/l and temperatures below 4°C.

The profile taken at the Cape Verde site (CV, GeoB 5209-6, Fig. 2b) shows a well developed mixed surface layer down to about 50 m waterdepth. The main thermocline is found below 80 m water depth where the highest chlorophyll concentrations occur (0.19 mg/l). Just below the thermocline around 100 m, an oxygen minimum of < 2 mg/l

was observed. A deeper oxygen minimum with values around 1.2 mg/l is located between 400 and 500 m water depth, concurrent with a chlorophyll maximum at 400 m with values around 0.03 mg/l. Relatively high Chl-values > 0.02 mg/l are found down to 1000 m water depth. Below 1600 m water depth, the North Atlantic Deep Water (NADW) can be found.

Around 10°W in the eastern equatorial upwelling area, a series of profiles from 2°N to 2°S shows the clear stratification of the water column with a distinct AAIW-signal between 500 and 1000 m depth. Surface chlorophyll values are highest on the equatorial site (GeoB 5206-2), however all sites show the same range of Chl-values between 0.03 and 0.01 mg/l between 200 and 1100 m depth. A distinct deep maximum could be found between 200 and 500 m depth at the southern site GeoB 5205-10 (Fig. 2c).

The western equatorial sites show a clearly deeper Chl-maximum and thermocline depth around 80 to 120 m compared to the eastern stations. In addition to the watermasses found in the eastern sites, the AABW was found below 4000 m depth, characterized by temperatures below 4° C. Chl-values appear to be lower below the thermocline (< 0.02 mg/l) when compared to the eastern sites. Lowest chlorophyll values were measured below 2000 m at the two southernmost stations GeoB 5202 and GeoB 5201. In the oligothrophic central Brasil Basin (GeoB 5201-8, Fig. 2d), the Chl-maximum at 200 m depth reaches only 0.12 mg/l. The surface layer here is characterized by water temperatures above 28° and salinities of 36‰ and higher.

Table. 1. List of CTD-O_2-chlorophyll-fluorescence profiles taken during M41-4.

Station GeoB	water depth (m)	profile depth (m)	attached to...
5201-8	5461	5461	MUC
5202-12	5585	5536	GOFLO
5203-5	5532	1450	GOFLO
5204-11	3701	1600	MUC
5205-10	3600	3521	GOFLO
5206-2	3916	1488	GOFLO
5207-8	4588	4529	GOFLO
5208-5	4541	200	GOFLO
5209-6	4966	4033	PARCA
5210-7	4150	4146	MUC

a.

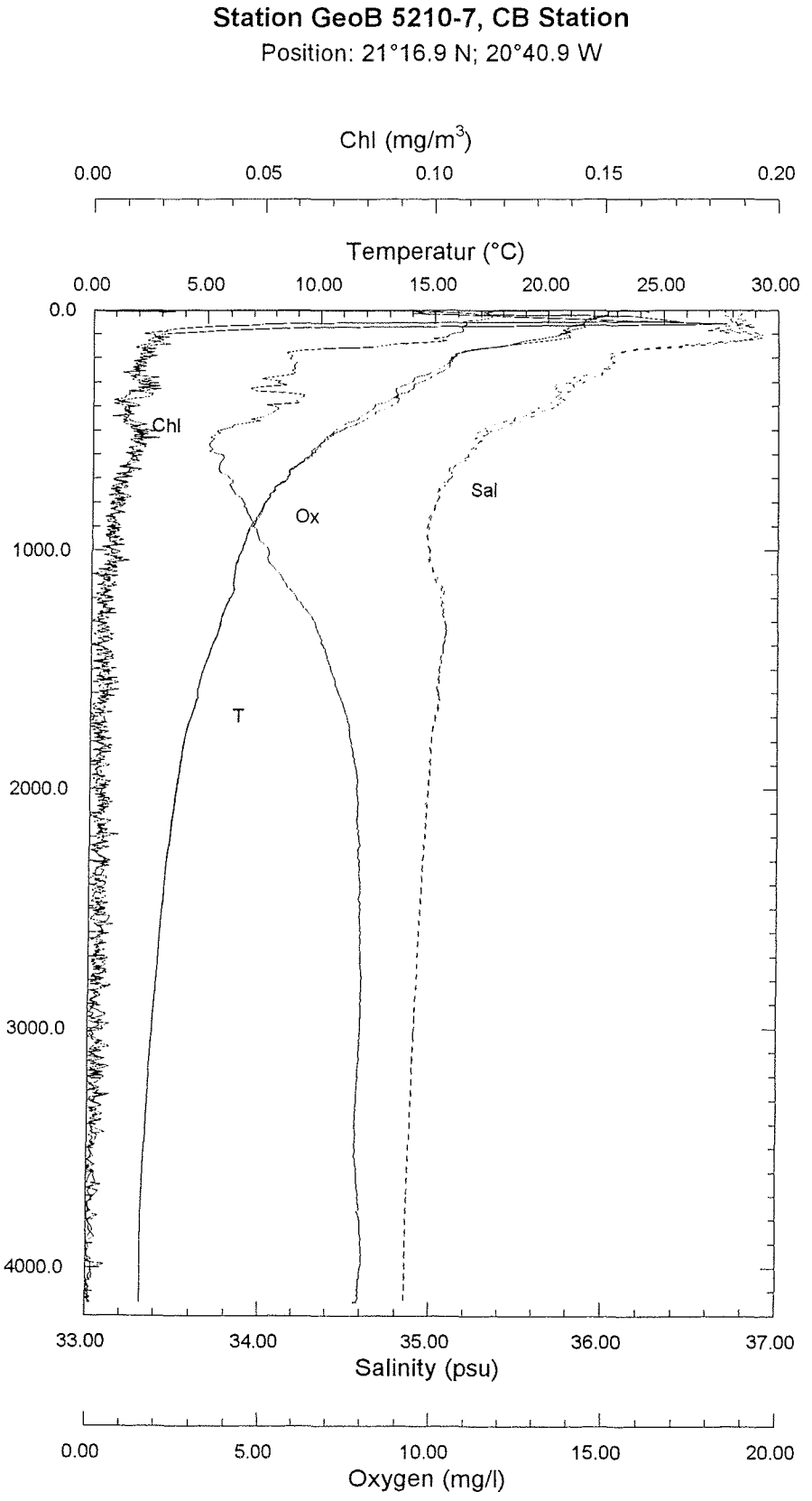

Fig. 2a. CTD-depth (m)-profile from site Cape Blanc (see Fig. 1).

b.

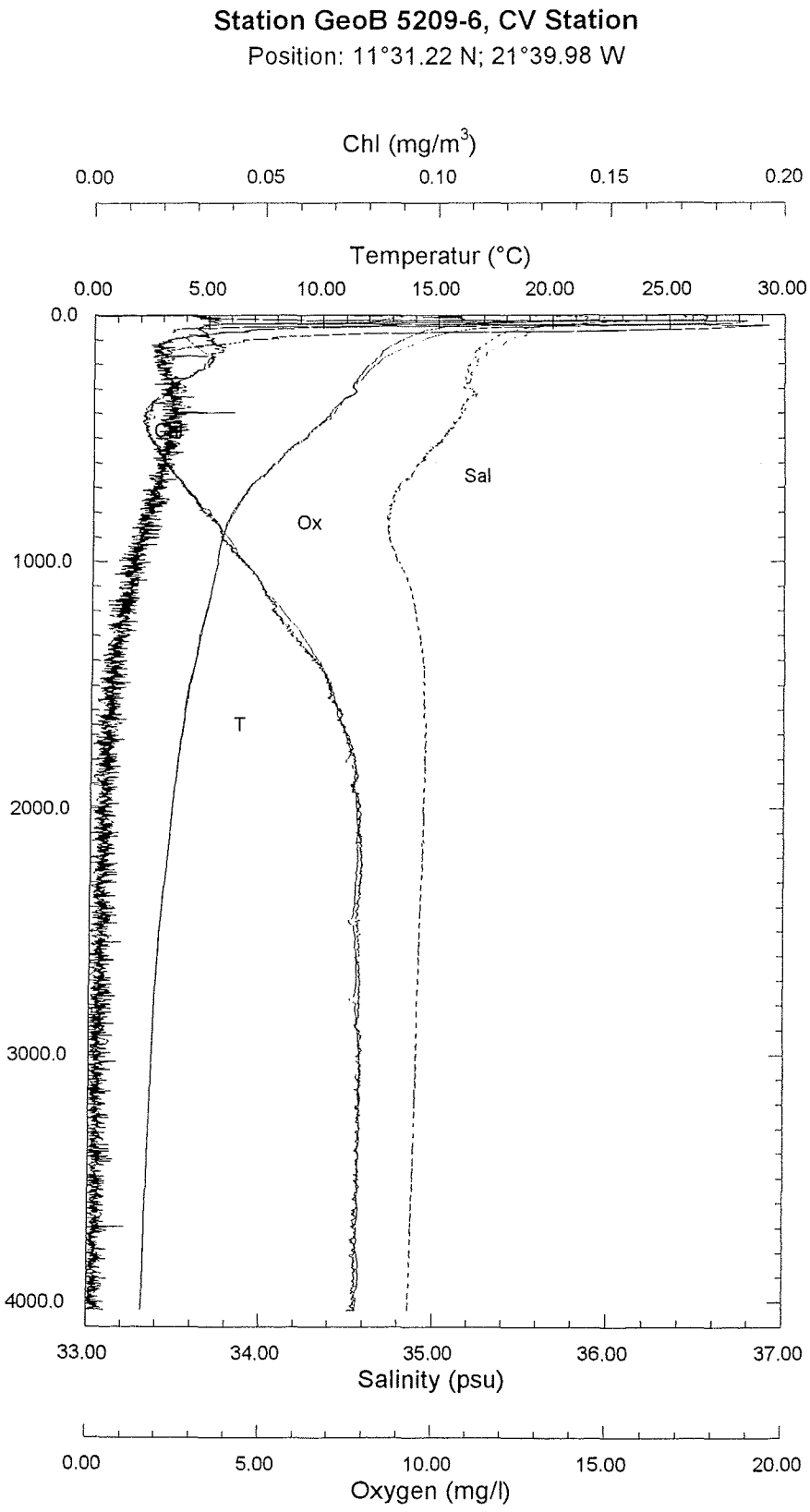

Fig. 2b. CTD-depth (m)-profile from site Cape Verde (see Fig. 1).

c.

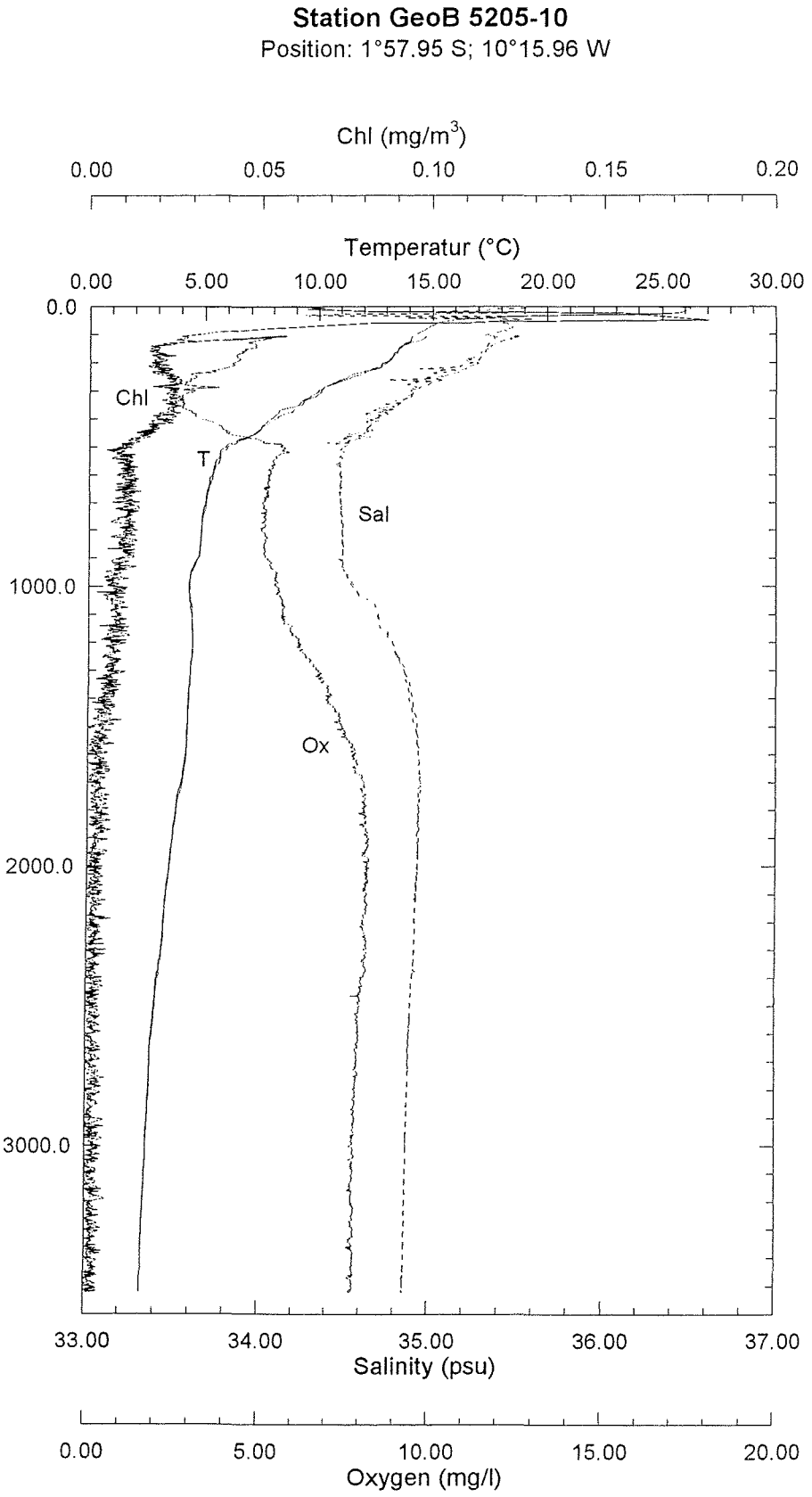

Fig. 2c. CTD-depth (m)-profile from the eastern Equatorial Atlantic upwelling area (see Fig. 1).

d.

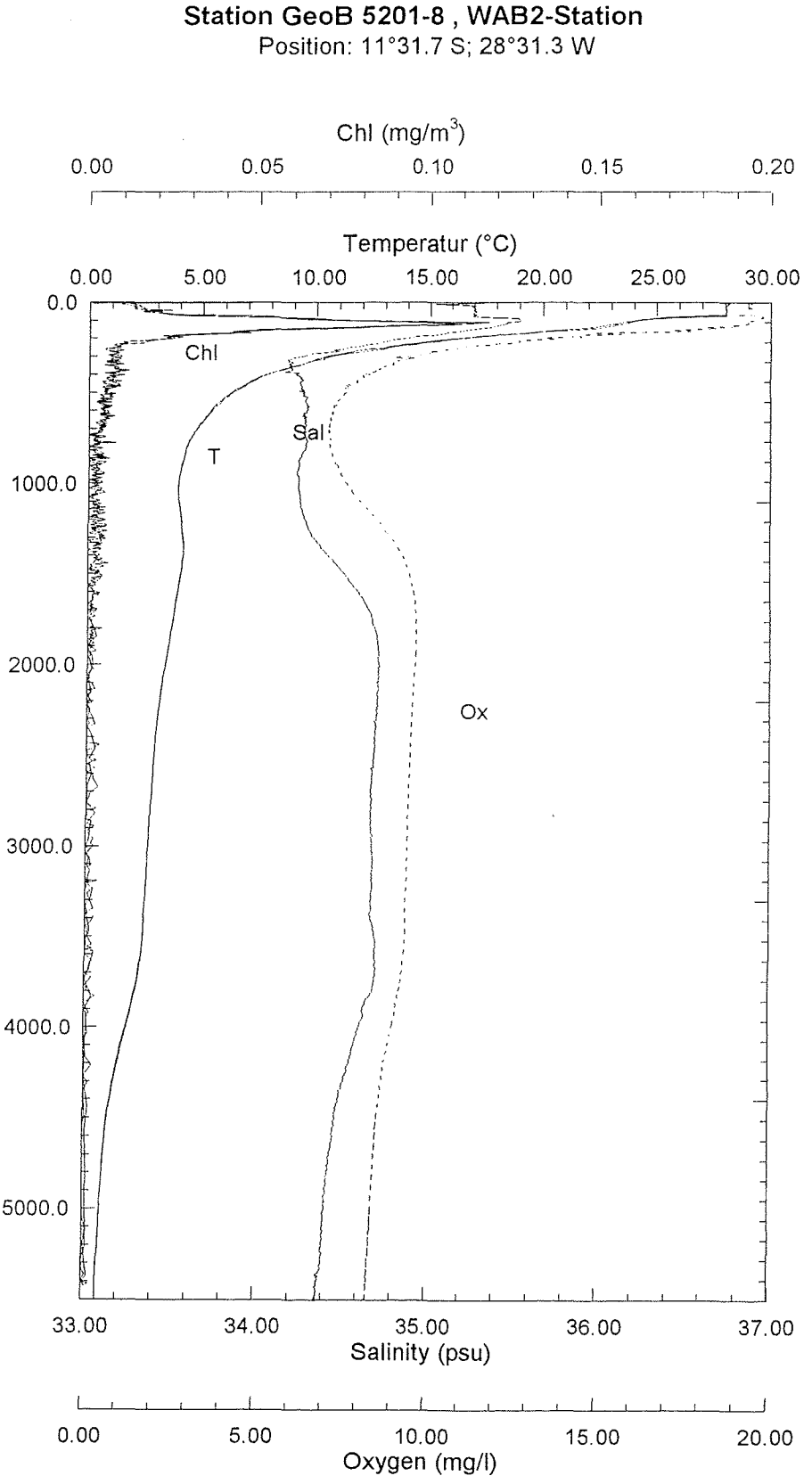

Fig. 2d. CTD-depth (m)-profile from the central Brasil Basin (see Fig. 1).

4.2. Marine Chemistry

(M. Gabriel, K. Pape, T. Wilkop, H. Dierssen)

A major key for understanding the biogeochemical cycling of chemical elements in the ocean are particle-water interaction processes. The main objectives during this cruise were to increase our knowledge about the control of trace element distribution in the water column which interact with biogenic and abiotic particles and to investigate how particle sedimentation in a high and low productivity region effects the vertical trace element distribution. The sampling strategy was to collect water samples and samples of suspended particulate material (SPM) from eleven stations (WAB2, WA12, WA4, WA15, EA4, EA3, EA2, EA1, CV, CB). Subsamples were taken from four sites with multi-sample sediment traps; three of them (WAB2, WA12 and WA15) were deployed on a SW-NE-transect during METEOR cruise 38/1 (see Fig. 1). Another mooring were deployed off Cape Blanc (CB) on the same cruise. Sediment surface samples were recovered at three stations (WAB2, WA15 and Cap Blanc) with a multicorer to compare the trace element composition in the sediment with both kinds of the particles.

4.2.1. Water Sampling

From the stations off Cape Blanc (CB), Cape Verden (CV), four stations from the Eastern Atlantic EA4, EA3, EA2, EA1 and the four stations from the Western Atlantic WAB2, WA12, WA4 and WA15, twelve GoFlo-bottles from GENERAL OCEANICS were taken to analyze the vertical distribution of trace elements in the water column (10-1500 m). At the stations WA12, EA4, EA2 and CB, a second series of 12 GoFLo-bottles were taken to analyze the entire water column down to the depth of resuspension. To minimize contamination, GoFlo-bottles with pressure valves were employed, enabling the bottles to remain closed while passing through the surface layer. At a depth of 10-15 m, these bottles will open. For lowering through the water column, the GoFlo-water-sampler and the in-situ pumps were attached to a metal-free and non-greased KEVLAR® wire. All samples from the water column were collected rigorously applying clean sampling techniques to avoid contamination. All manipulations after subsampling were

performed under clean benches in the lab onboard. A total of 152 water samples were collected for nutrients, oxygen and trace element analysis. The nutrients silicate, phosphate and nitrate were analyzed according to a standard photometric procedure. Immediately after collecting, oxygen content was determined by conventional Winkler titration. The resulting values show a similar depth profile than the oxygen sensor of the CTD-sonde. The absolute values, however, deviate somewhat from each other (see chapter 4.1).

After the water samples for trace elements were filtered through a polycarbonate filter (0,4 µm pore size, NUCLEPORE) in a plastic container, they were acidified with subboiled HNO_3 for storage. The trace elements (primarily Cd, Co, Cr, Cu, Mn, Ni and Pb) will be analyzed onshore with graphite furnance atomic absorption spectrometry (GF-AAS) after separation from the sea water matrix and preconcentration with an automated procedure using complexating resins (8-hydroxyquinoline/XE305). Total dissolved aluminium was directly determined employing a fluorometric method.

4.2.2. In-situ Filtration of Suspended Particles

At the same stations where sediment traps were recovered/redeployed and the other seven stations, suspended particulate material (SPM) was filtered using in-situ pumps at different depths (Table 2). The filtered suspended particulate material is supposed to consist of slowly sinking biogenic and terrestrial detritus exhibiting a large surface area for sorptive processes. Due to the low concentration of SPM, larger volumes of sea water have to be filtered, if trace elements are to be analyzed in SPM. Between 20 l and 300 l sea water from depths down to 1000 m (at four stations down to the bottom) were filtered through acid cleaned polycarbonate filter (∅ 142 mm; 0,4 µm pore size, NUCLEPORE) using an in-situ pump from McLane. To reduce contamination, a metal-free and non-greased KEVLAR® wire was used and all handling of the filters was performed under a clean bench. From pump deployments, a total of 78 filters was obtained. The filters with the retained particles will be examined for trace elements later in the laboratory in Bremen. Aliquots of the material caught at the four mooring stations

with intercepting sediment traps consists of larger, faster sinking particles which incorporated trace elements during their formation and by scavening of SPM; they will be analyzed in Bremen for trace and major components after digestion with nitric and hydrofluoric acid.

Table 2. Location and depth of sampling with the in-situ pumps (*pump failed).

Station GeoB #	Date	Location	Water depth [m]	Depth of pump [m]	Pumping volume [L]	Remark
5201-9	21.05.98	11°29,46S 28°33,32W	5421	15	17	Min flow reached
				50	20	Min flow reached
				90	12	Min flow reached
				125	72	Min flow reachedr
				200	187	Min flow reached
				400	300	Volume reached
				600	171	Time limit reached
				1000	161	Time limit reached
5202-1	23.05.98	7°31,51S 28°14,1W	5560	15	33	Min flow reached
				50	52	Min flow reached
				90	147	Min flow reached
				125	207	Min flow reached
				200	300	Volume reached
				400	300	Volume reached
				600	148	Time limit reached
				1000	165	Time limit reached
5202-11	24.05.98	7°25,05S 28°11,32W	5560	1500	300	Volume reached
				2000	300	Volume reached
				3000	300	Volume reached
				4000	300	Volume reached
				5160	300	Volume reached
				5360	300	Volume reached
				5460	174	Time limit reached
				5510	162	Time limit reached
5203-4	25.05.98	3°50,76S 25°41,19W	5533	15	37	Min flow reached
				50	46	Min flow reached
				90	171	Time limit reached
				125	277	Time limit reached
				200	300	Volume reached
				400	300	Volume reached
				600	300	Volume reached
				1000	300	Volume reached
5204-4	27.05.98	0°0,06S 23°29,09W	3716	15	24	Min flow reached
				50	20	Min flow reached
				90	236	Time limit reached
				125	274	Time limit reached
				200	300	Volume reached
				400	300	Volume reached
				600	300	Volume reached
				1000	300	Volume reached
5205-1	30.05.98	1°57,92S 10°16,03W	3590	15	27	Min flow reached
				50	43	Min flow reached
				90	265	Time limit reached
				125	281	Time limit reached
				200	300	Volume reached
				400	300	Volume reached
				600	300	Volume reached
				1000	300	Volume reached

Table 2. Continued.

Station GeoB #	Date	Location	Water depth [m]	Depth of pump [m]	Pumping volume [L]	Remark
5205-9	31.05.98	1°57,92S 10°16,03W	3580	1500	146	Time limit reached
				2000	158	Time limit reached
				2500	300	Volume reached
				3000	300	Volume reached
				3190	300	Volume reached
				3390	300	Volume reached
				3490	300	Volume reached
				5540	300	Volume reached
5206-1	01.06.98	0°29.96S 10°30,00W	3899	15	147	Time limit reached
				50	199	Time limit reached
				90	233	Volume reached
				125	274	Time limit reached
				200	277	Time limit reached
				400	300	Time limit reached
				600	164	Time limit reached
				1000	141	Min flow reached
5207-1	02.06.98	2°03,44N 11°1953W	4580	15	104	Min flow reached
				50	65	Min flow reached
				90	232	Time limit reached
				125	293	Time limit reached
				200	294	Time limit reached
				400	300	Volume reached
				600	160	Time limit reached
				1000	152	Time limit reached
5207-9	2.06.98	1°59,95N 11°15,04W	4630	1450	300	Volume reached
				1950	300	Volume reached
				2450	300	Volume reached
				3450	300	Volume reached
				4174	300	Volume reached
				4374	300	Volume reached
				4474	160	Time limit reached
				4524	151	Time limit reached
5208-4	03.06.98	3°11,34N 12°31,14W	4530	15	123	Min flow reached
				50	115	Min flow reached
				90	222	Time limit reached
				125	284	Time limit reached
				200	292	Time limit reached
				400	284	Time limit reached
				600	160	Time limit reached
				1000	152	Time limit reached
5209-4	6.06.98	11°31,02N 21°0,21W	4967	15	164	Min flow reached
				50	81	Min flow reached
				90	240	Time limit reached
				125	292	Time limit reached
				200	*	Unexpected error
				400	300	Volume reached
				600	151	Time limit reached
				1000	166	Time limit reached
5210-5	09.06.98	21°16,94N 20°40,50W	4124	15	147	Time limit reached
				50	75	Min flow reached
				90	76	Min flow reached
				125	244	Time limit reached
				200	276	Time limit reached
				400	154	Time limit reached
				600	150	Time limit reached
5210-13	10.06.98	21°18,38N 20°40,32W	4120	1000	174	Volume reached
				2000	300	Volume reached
				3000	300	Volume reached
				3720	300	Volume reached
				3920	300	Volume reached
				4020	157	Time limit reached
				4070	144	Time limit reached

4.3. Plankton samples

Plankton sampling in the surface water along the ship's course serves several research objectives. Together with data from sediment traps and pumping stations, these investigations allow for a quantitative assessment of biomass and a first impression on the species distribution thoughout the South Atlantic.

4.3.1. Dinoflagellate investigations

(I. Flatter, A. Freesemann, B. Hönisch)

Dinoflagellates are unicellular organisms forming a major part of the marine plankton community. They live either autotrophic, heterotrophic or can use both nutrition strategies. As primary producers they are very important in the marine food web. During their life cycle they pass a vegetative cellulosic thecate stage. Being biflagellated during that stage they are able to swim actively. The only known exception, having a calcareous walled vegetative coccoid stage, is the species *Thoracosphaera heimii*. The second stage is marked by the formation of resting cysts. The majority of the dinoflagellate species form organic-walled cysts. Only a few species form calcareous ones. Both cyst types as well as the coccoid stage of *Thoracosphaera heimii* are very resistant to degradation and can be found in recent and ancient oceanic sediments.

A number of studies showed that the resting cysts of dinoflagellates can be a very useful proxy for paleoceanographic reconstruction. However, the knowledge about dinoflagellates forming calcareous-walled resting cysts is still quite limited. For a better understanding of the palecological signals of this group it is necessary to investigate the recent geographic and vertical distribution of these organisms in comparison to the prevailing environmental parameters such as salinity, temperature, light, nutrient supply, stratification / mixing etc.. Furthermore, culturing experiments are a very useful tool for obtaining information about the ecological demands of the dinoflagellates. For these purposes water- and sediment samples were taken during the cruise.

Surface water samples

Surface water samples from a depth of approximately 5 m were collected between the stations three times a day (ca. 8:00 - 12:00; 13:00 - 17:00; 17:00 - 21:00 board time) using the ships membrane pump (Table 3). A measured amount of water passed a 100 µm and a 5 µm filter and was concentrated down to 100 ml using a 5 µm polycarbonate filter and a vacuum pump system. These samples were qualitatively analysed with a light microscope and briefly described regarding their plankton content with emphasis on the calcareous-walled resting cysts of the dinoflagellates and the calcareous task of *Thoracosphaera heimii.* Some of the living cysts were isolated and placed in sterile polytrene Cell Wells™ containing 0,2 µm-filtered sea water and different types of culturing media (f/2 35%, K 35% and a 1:1 mixture of these with sea water) for future culturing experiments carried out at the University of Bremen. On board the Cell Wells™ were kept under light conditions of the local day / night cycle and a temperature of ca. 20°C. After the isolation step the water samples together with the filters were fixed using about 7 ml formaldehyde (37%) and stored in the dark at 4°C.

Water column studies

At ten stations water samples from nine various depths were acquired (Table 4) using a rosette (Multi Water Sampler MWS, cat. nr. 436918A). Three to four of the 10 l NISKIN-bottles were closed at each depth, so the rosette had to be used twice at each station. The water was passed over a 100 µm mesh sieve (DIN 4188) and filtered using a vacuum pump in order to concentrate the samples to a volume of 100 ml per depth. These samples then were treated in the same way as the surface water samples taken with the membrane pump.

Light measurements

Photosynthetic organisms require different light regimes depending on their particular photosynthetic pigments. Thus the comparison of the depth distribution of autotrophic dinoflagellates and the corresponding underwater irradiance properties might elucidate patterns of preferred depths and migration. The MER-2040 Profiling Spectroradiometer (Biospherical Instruments) allows monitoring of apparent optical properties during

vertical profiles from the ship. In addition to a PAR broad-band (400-700 nm) sensor, 14 down- and 14 upwelling monochromatic sensors (narrow bandwidths) measure the spectral irradiance. At nine stations light profiles were recorded (Table 5). All profiles were driven at a winch speed of 0,1 m/sec. The maximum depth (ropelength) equals the 1% PAR-limit and thus the lower boundary of the euphotic zone. Lateron, the data will be related to surface irradiance measurements. The real depth data, given by a pressure transducer, will also be calculated later.

Surface sediment samples

At three stations sediment samples were taken from one core (9,5 cm in diameter) of the multicorer (Table 6). The surface sediments (fluffy material of the upper cm of the core) together with some of the bottom water were stored in petri dishes. The remaining core was cut into slices of 1 cm and also stored in petri dishes at 4°C. The aim of further investigations is to analyse the dinoflagellate cyst content, its changes in time and to compare it with environmental factors in order to gain information about climatic changes.

Preliminary results

Motile dinoflagellates as well as their cysts were found in almost all water samples. The samples derived from the lower part of the profiles contained mainly empty cysts. Motile thecate dinoflagellates occurred in every depth down to 200 m but were more abundant above 75 m water depht. All samples showed rather low numbers of calcareous resting cysts. Against the expectations, the same is true for the coccoid stage of *Thoracosphaera heimii*. In all water samples the association of calcareous cysts is predominated by the species *?Sphaerodinella albatrosiana*. The cyst species *Orthopithonella granifera* occurred sporadically, especially in the samples from stations GeoB 5207, 5208 and 5210 (East-Atlantic). Generally, highest amounts of cysts were observed in the material acquired at stations GeoB 5204, 5207 and 5208 (Mid-Atlantic Ridge and East-Atlantic) where salinity of the upper water masses is considerably lower than in the West-Atlantic. Other species of calcareous cysts did not occur or were detected just a few times. In the profiles no clear depth-related maximum of cyst concentration was noticed. In some

profiles a slightly higher concentration occured at dephts of 50 m or 75 m, rarely at 120 m. Organic-walled dinoflagellates were present in most samples and every depth. However, they seem to be more abundant in the upper 20 m of the water column. Regarding the water samples aquired with the membrane pump, no significant differences in cyst composition and quantity could be seen between samples taken at different times of the day. In the membrane pump samples the concentration of calcareous cysts and of the plankton in general was higher compared to the samples taken with the rosette. Of course, this is partly caused by the greater amount of water represented by the membrane pump samples.

To summarize the light measurements, it can be stated that in general the light penetration was deepest in the western part and decreased towards the East-Atlantic. At stations GeoB 5205, 5209 and 5210 significantly shallower penetration depths were measured. For station GeoB 5205 this is explained by the early daytime of the measurement and thus the low angle of the sun. Data at station GeoB 5209 showed a normal exponential decrease with depth and below 40 m the light suddenly diminished. This, as well as the small penetration depth at station GeoB 5210, can be related to the presence of high plankton abundances in these depths: high numbers of different diatom species (50 m, station GeoB 5209) and numerous motile dinoflagellates (10 m and 20 m, station GeoB 5210).

Table 3. Surface water samples for dinoflagellate analyses (10 µm membrane pump filtration).

Sample No.	Time Filtration UTC	Start of Filtration of Latitude N/S	Longitude E/W	End of Filtration Latitude N/S	Longitude E/W	Water Depth (m)	Water temp (°C)	Salinity (‰)	Volume (l)
5/20a	10:35-14:06	11°55,87S	31°26,47W	11°51,26S	30°51,32W	5230	27,6	33,60	233
5/20b	15:15-19:06	11°49,67S	30°39,00W	11°44,71S	30°00,25W	5335	26,9	33,60	262
5/20c	20:10-23:06	11°43,20S	29°49,12W	11°39,11S	29°17,96W	5420	27,8	36,80	230
5/22a	9:35-14:13	10°00,45S	28°24,68W	09°13,26S	28°21,25W	9038	28,0	36,33	538
5/22b	14:55-19:33	09°05,20S	28°20,68W	08°14,52S	28°17,06W	5542	28,5	36,52	620
5/22c	20:20-22:20	08°15,32S	28°16,45W	07°45,28S	28°14,99W	no data	28,5	36,12	158
5/24b	14:13-19:00	06°52,56S	27°48,08W	06°11,33S	27°18,73W	5604	28,4	35,86	338
5/24c	19:13-23:05	06°09,42S	27°17,42W	05°35,67S	26°53,33W	5620	28,2	35,99	513
5/26a	9:15-12:43	01°56,83S	24°35,96W	01°25,47S	24°17,22W	6795	26,5	36,38	240
5/26b	12:54-20:26	01°23,63S	24°16,30W	00°12,74S	23°36,21W	4847	26,7	36,04	606
5/27c	19:15-23:59	00°03,87S	22°59,57W	00°11,26S	22°11,00W	3981	26,1	36,14	92
5/28a	9:45-14:09	00°27,34S	20°24,91W	00°33,61S	19°43,80W	3642	26,2	36,10	171
5/28b	15:41-18:45	00°36,01S	19°28,20W	00°43,51S	18°38,76W	3368	26,0	36,13	180
5/29a	10:03-14:34	01°04,56S	16°19,83W	01°11,44S	15°34,58W	2992	26,4	33,20	293
5/29b	15:21-19:06	01°12,64S	15°26,98W	01°18,22S	14°49,92W	3437	26,3	35,78	370
5/30a	8:36-13:55	01°39,06S	12°32,96W	01°47,32S	11°38,67W	3336	26,1	33,00	205
5/30b	14:04-18:05	01°47,50S	11°37,15W	01°53,90S	10°55,83W	3792	25,9	33,00	193
5/30c	18:15-20:58	01°54,00S	10°50,12W	01°57,64S	10°30,30W	3608	25,8	33,10	163
6/4c	18:00-22:00	05°35,96N	14°58,71W	06°07,70N	15°30,50W	4865	28,6	34,80	398
6/5a	8:26-11:33	07°34,60N	16°59,05W	08°01,36N	17°26,54W	4750	28,8	35,14	316
6/5b	11:41-15:57	08°02,52N	17°27,74W	08°37,67N	18°03,76W	4714	28,9	36,75	369
6/5c	16:07-20:00	08°39,20N	18°05,27W	09°10,50N	18°37,40W	4366	28,6	36,05	220
6/6a	8:17-12:15	10°44,66N	20°14,14W	11°15,36N	20°45,88W	4839	26,5	35,98	259
6/9a	9:32-13:53	20°40,09N	20°42,72W	21°15,60N	20°41,97W	4001	22,4	no data	226

Table 4. Water samples for dinoflagellate analyses from 10 l NISKIN-bottles at about 10, 20, 50, 75, 100, 120, 150, 175, 200 m water depth. Filtration with 0,5 µm Polycarbonate filters.

Station No.	Sample No.	Time UTC	Latitude N/S	Longitude E/W	Water Depth (m)	Water temp. (°C)	Salinity (‰)	Volume (l)
5201-4	200	5:50-6:10	11°33,34S	28°34,32W	5469	16,8	33,2	37,0
	175		11°33,34S	28°34,32W	5469	18,,2	33,1	29,0
	150		11°33,34S	28°34,32W	5469	20,6	33,4	37,2
	120		11°33,34S	28°34,32W	5469	23,2	33,7	29,6
	100		11°33,34S	28°34,32W	5469	24,5	33,9	27,6
5201-5	75	6:40-6:50	11°33,39S	28°34,31W	5468	27,4	33,7	29,4
	50		11°33,39S	28°34,31W	5468	27,5	33,6	29,6
	20		11°33,39S	28°34,31W	5468	27,6	33,7	29,2
	10		11°33,39S	28°34,31W	5468	27,8	33,8	28,0
5202-3	200	5:00-5:20	07°31,54S	28°14,05W	4715	15,1	32,9	39,0
	175		07°31,54S	28°14,05W	4715	16,7	33,0	30,4
	150		07°31,54S	28°14,05W	4715	19,2	33,3	38,6
	120		07°31,54S	28°14,05W	4715	22,2	33,6	31,5
	100		07°31,54S	28°14,05W	4715	24,7	33,9	38,0
5202-4	75	5:50-6:00	07°31,60S	28°14,05W	4714	28,1	33,6	38,6
	50		07°31,60S	28°14,05W	4714	28,3	32,9	39,1
	20		07°31,60S	28°14,05W	4714	28,2	33,0	39,0
	10		07°31,60S	28°14,05W	4714	28,5	33,0	38,6
5203-2	200	11:57-12:20	03°53,20S	25°41,53W	5514	13,6	32,9	39,4
	175		03°53,20S	25°41,53W	5530	14,6	33,0	31,2
	150		03°53,20S	25°41,53W	5530	15,2	32,8	39,2
	120		03°53,20S	25°41,53W	5530	17,3	33,2	28,2
	100		03°53,20S	25°41,53W	5530	19,8	33,3	27,7

Table 4. Continued.

Station No.	Sample No.	Time UTC	Latitude N/S	Longitude E/W	Water Depth (m)	Water temp. (°C)	Salinity (‰)	Volume (l)
5203-3	75	12:45-12:56	03°52,80S	25°41,70W	5530	24,9	33,6	30,4
	50		03°52,80S	25°41,70W	5530	27,6	32,8	28,2
	20		03°52,80S	25°41,70W	5530	27,7	32,8	36,4
	10		03°52,80S	25°41,70W	5530	27,9	32,9	38,6
5204-6	200	6:00-6:20	00°00,50N	23°26,30W	3713	13,9	33,0	38,6
	175		00°00,50N	23°26,30W	3744	14,2	32,9	28,2
	150		00°00,50N	23°26,30W	3744	15,6	33,1	38,6
	120		00°00,50N	23°26,30W	3744	16,9	32,9	29,8
	100		00°00,50N	23°26,30W	3744	18,2	32,5	37,5
5204-7	75	6:37-6:48	00°00,70N	23°26,30W	3699	20,6	33,5	29,2
	50		00°00,70N	23°26,30W	3699	23,9	33,5	28,6
	20		00°00,70N	23°26,30W	3699	26,2	33,1	38,2
	10		00°00,70N	23°26,30W	3699	26,9	33,1	36,4
5205-6	200	6:22-6:42	02°00,01S	10°15,03W	3802	13,8	33,0	37,8
	175		02°00,01S	10°15,03W	3802	14,6	33,1	28,8
	150		02°00,01S	10°15,03W	3802	16,6	33,2	37,6
	120		02°00,01S	10°15,03W	3802	15,0	33,1	29,4
	100		02°00,01S	10°15,03W	3802	16,1	33,2	38,3
5205-7	75	7:02-7:12	02°00,01S	10°15,03W	3803	16,5	33,2	37,8
5205-7	50		02°00,01S	10°15,03W	3803	17,3	33,1	38,6
	20		02°00,01S	10°15,03W	3803	24,7	32,9	37,6
	10		02°00,01S	10°15,03W	3803	25,6	33,1	36,8
5206-6	200	10:07-10:28	00°29,89S	10°29,00W	3926	13,3	32,9	37,8
	175		00°29,89S	10°29,00W	3924	14,2	33,0	30,2
	150		00°29,89S	10°29,00W	3924	14,5	33,1	37,0
	120		00°29,89S	10°29,00W	3924	15,0	33,3	30,2
	100		00°29,89S	10°28,60W	3924	15,6	33,1	38,8
5206-7	75	10:43-10:56	00°29,70S	10°28,60W	3932	17,3	33,2	38,0
	50		00°29,70S	10°28,60W	3932	18,5	33,3	34,0
	20		00°29,70S	10°28,60W	3932	24,2	33,1	37,6
	10		00°29,70S	10°28,60W	3932	25,1	33,2	37,0
5207-6	200	8:55-9:18	02°00,00N	11°15,20W	4571	14,9	32,9	40,0
	175		02°00,00N	11°15,20W	4571	15,6	33,2	29,5
	150		02°00,00N	11°15,20W	4571	15,9	33,3	38,5
	120		02°00,00N	11°15,20W	4571	16,3	33,2	30,2
	100		02°00,00N	11°15,20W	4571	17,0	33,2	38,5
5207-7	75	9:34-9:47	02°00,00N	11°15,30W	4585	17,9	33,2	38,1
	50		02°00,00N	11°15,30W	4585	21,5	33,2	17,3
	20		02°00,00N	11°15,30W	4585	27,9	32,2	38,5
	10		02°00,00N	11°15,30W	4585	28,6	32,4	38,3
5208-1	200	10:16-10:41	03°10,00N	12°29,90W	4532	15,4	32,9	40,2
	175		03°10,00N	12°29,90W	4532	15,9	33,1	30,8
	150		03°10,00N	12°29,90W	4532	16,5	33,2	39,0
	120		03°10,00N	12°29,90W	4532	16,8	33,2	31,2
	100		03°10,00N	12°29,90W	4532	17,5	33,3	38,5
5208-2	75	10:57-11:11	03°10,00N	12°29,90W	4526	19,6	33,2	39,2
	50		03°10,00N	12°29,90W	4526	27,3	32,3	32,2
	20		03°10,00N	12°29,90W	4526	28,0	32,0	38,8
	10		03°10,00N	12°29,90W	4526	28,5	32,4	38,2
5209-2	200	14:34-14:57	11°29,00N	21°00,40W	4972	13,2	33,1	39,0
	175		11°29,00N	21°00,40W	4972	13,7	33,1	39,3
	150		11°29,00N	21°00,40W	4972	14,3	33,1	38,3
	120		11°29,00N	21°00,40W	4972	14,6	33,2	30,8
	100		11°29,00N	21°00,40W	4972	15,3	33,2	39,0

Table 4. Continued.

Station No.	Sample No.	Time UTC	Latitude N/S	Longitude E/W	Water depth (m)	Water temp. (°C)	Salinity (‰)	Volume (l)
5209-3	75	15:09-15:20	11°29,10N	21°00,40W	4971	16,1	33,3	39,4
	50		11°29,10N	21°00,40W	4971	16,9	33,2	37,5
	20		11°29,10N	21°00,40W	4971	17,3	33,2	40,5
	10		11°29,10N	21°00,40W	4971	26,7	33,5	39,0
5210-3	200	16:12-16:30	21°16,19N	20°41,58W	4118	17,1	33,8	38,6
	175		21°16,19N	20°41,58W	4118	18,3	34,0	31,4
	150		21°16,19N	20°41,58W	4118	19,6	34,2	38,0
	120		21°16,19N	20°41,58W	4118	21,0	34,4	30,0
	100		21°16,19N	20°41,58W	4118	21,1	34,2	38,2
5210-4	75	16:42-16:52	21°16,19N	20°41,70W	4118	21,9	34,1	29,4
	50		21°16,19N	20°41,70W	4118	22,0	34,1	37,2
	20		21°16,19N	20°41,70W	4118	22,6	34,0	38,2
	10		21°16,19N	20°41,70W	4118	22,9	34,2	40,2

Table 5. Light measurements in combination with dinoflagellate analyses using a MER-2040 Profiling Spectroradiometer.

Station No.	Latitude	Longitude	Water depth (m)	Time UTC	max. length of rope
5202-6	07°27,80 S	28°15,20 W	5361	12:00-12:25	80m
5203-1	03°53,40S	25°41,30 W	5530	11:20-11:45	70m
5204-9	00°02,70 N	23°28,70 W	3722	10:35-11:00	55m
5205-8	02°00,00 S	10°15,00 W	3807	7:30-7:45	20m
5206-8	00°28,40 S	10°28,50 W	3917	11:15-11:40	59m
5207-8	02°01,30N	11°15,60 W	4609	10:00-10:45	58m
5208-3	03°10,00 N	12°29,50 W	4526	11:20-12:00	56m
5209-1	11°28,90N	21°00,20W	4972	14:00-14:25	43m
5210-1	21°15,27N	20°41,60W	4113	12:55-13:02	15m

Table 6. Sediment samples for dinoflagellate analyses. Sampling was done using the Multicorer.

Station No.	Date	Time UTC	Latitude N/S	Longitude E/W	Water depth (m)	Salinity (‰)	Core length (cm)
5201-8	21.05.98	18:10	11°31,70S	28°31,23W	5461	33,2	41
5204-11	27.05.98	14:54	00°00,60N	23°29,09W	3701	36,06	17
5210-7	10.06.98	23:02	21°16,80N	20°41,00w	4150	no data	33

4.3.2. Coccolithophore Communities

(R. Huber, J. Brüning)

In the present day oceans over 150 known species of coccolithophorids are known (Haq and Boersma, 1978). These autotrophic, marine algae (Prymnesiophyceae) are biflagellate or coccoid unicells, whose longest dimensions rarely exceed 30 µm and are most often smaller than 10 µm (Heimdal, 1993). They produce numerous external carbonate plates, named coccoliths which are a major component in almost all pelagic sediments. The occurrence and distribution of coccolithophores closely correspond to the hydrography of the water masses.

Today, relatively sparse information about their seasonal and spatial abundance and ecology in the surface water is available. Therefore, an investigation of the living coccolithophore communities in the South Atlantic was carried out in the uppermost water column. The water samples taken during this cruise will allow a better understanding of the relationship between living communities and the assemblages in the sediments. At 10 stations 2 l water samples were taken from NISKIN-bottles of the rosette at 200 m, 150 m, 100 m, 75 m, 50 m, and 20 m water depth (see Table 7). In addition, 30 surface water samples were taken from the vessel's membrane pump system at about 5 m water depth (Table 8). Samples were taken about every second longitude plus every latitude, except in the 200nm zone of Brazil, Cape Verde and Spain. Collection time usually was at dawn, high noon and twilight. Generally, two liters of the water samples were filtered through cellulose nitrate filters (50 mm diameter, 0,45 µm pore size) by a vacuum pump immediately. The total filtration area of the sartorius glass vacuum filter holder is 12.5 cm^2.

Without washing, rinsing or chemical conservation the filters were dried at 50°C for at least 24 h and then kept permanently dry with silica gel in transparent film to protect them from humidity. The filtered material will be used for studies on the distribution and composition of the coccolithophorid communities in the upper 200 m of the water

column using Scanning Electron Microscope (SEM). Species composition and abundance will be determined by identification and counting on measured filter transects.

Table 7. Samples taken in the water column for coccolithophores.

No.		Date 1998	Time (UTC)	GeoB No.	Water depth (m)	Sample depth (m)	Latitude	Longitude	Temp. (°C)	Salinity uncorr. (psu)	Volume (l)
I)	1	21.05.	05:50-	5201-4	5468	200	11°33,34'S	28°34,31'W	16,8	33,0	2
I)	2	21.05.		5201-4	5468	150	11°33,34'S	28°34,31'W	20,6	33,4	2
I)	3	21.05.	-06:10	5201-4	5468	100	11°33,34'S	28°34,31'W	24,5	33,9	2
I)	4	21.05.	06:40-	5201-5	5468	75	11°33,34'S	28°34,31'W	27,4	33,7	2
I)	5	21.05.	-	5201-5	5468	50	11°33,34'S	28°34,31'W	27,5	33,6	2
I)	6	21.05.	-06:50	5201-5	5468	20	11°33,34'S	28°34,31'W	27,6	33,7	2
II)	1	23.05.	05:00-	5202-3	4713	200	07°31,53'S	28°14,03'W	15,1	32,9	2
II)	2	23.05.		5202-3	4713	150	07°31,53'S	28°14,03'W	19,2	33,3	2
II)	3	23.05.	-05:20	5202-3	4713	100	07°31,53'S	28°14,03'W	24,7	33,9	2
II)	4	23.05.	05:50-	5202-4	4713	75	07°31,53'S	28°14,03'W	28,1	33,6	2
II)	5	23.05.		5202-4	4713	50	07°31,53'S	28°14,03'W	28,3	32,9	2
II)	6	23.05.	-06:00	5202-4	4713	20	07°31,53'S	28°14,03'W	28,2	33,0	2
III)	1	25.05.	11:57-	5203-2	5529	200	03°53,14'S	25°41,54'W	13,6	32,9	2
III)	2	25.05.		5203-2	5529	150	03°53,14'S	25°41,54'W	15,2	32,8	2
III)	3	25.05.	-12:20	5203-2	5529	100	03°53,14'S	25°41,54'W	19,8	33,3	2
III)	4	25.05.	12:45-	5203-3	5529	75	03°53,14'S	25°41,54'W	24,9	33,6	2
III)	5	25.05.		5203-3	5529	50	03°53,14'S	25°41,54'W	27,6	32,8	2
III)	6	25.05.	-12:56	5203-3	5529	20	03°53,14'S	25°41,54'W	27,7	32,8	2
IV)	1	27.05.	06:00-	5204-6	3713	200	00°00,50'N	23°26,53'W	13,9	33,0	2
IV)	2	27.05.		5204-6	3713	150	00°00,50'N	23°26,53'W	15,6	33,1	2
IV)	3	27.05.	-06:20	5204-6	3713	100	00°00,50'N	23°26,53'W	18,2	32,5	2
IV)	4	27.05.	06:37-	5204-7	3713	75	00°00,50'N	23°26,53'W	20,6	33,5	2
IV)	5	27.05.		5204-7	3713	50	00°00,50'N	23°26,53'W	23,9	33,5	2
IV)	6	27.05.	-06:48	5204-7	3713	20	00°00,50'N	23°26,53'W	26,2	33,1	2
V)	1	31.05.	06:22-	5205-6	3803	200	02°00,01'S	10°15,03'W	13,8	33,0	2
V)	2	31.05.		5205-6	3803	150	02°00,01'S	10°15,03'W	16,6	33,2	2
V)	3	31.05.	-06:42	5205-6	3803	100	02°00,01'S	10°15,03'W	16,1	33,2	2
V)	4	31.05.	06:22-	5205-7	3803	75	02°00,01'S	10°15,03'W	16,5	33,2	2
V)	5	31.05.		5205-7	3803	50	02°00,01'S	10°15,03'W	17,3	33,1	2
V)	6	31.05.	-06:22	5205-7	3803	20	02°00,01'S	10°15,03'W	24,7	32,9	2
VI)	1	01.06.	10:07-	5206-6	3926	200	00°29,89'S	10°29,09'W	13,3	32,9	2
VI)	2	01.06.		5206-6	3926	150	00°29,89'S	10°29,09'W	14,5	33,1	2
VI)	3	01.06.	-10:28	5206-6	3926	100	00°29,89'S	10°29,09'W	15,6	33,1	2
VI)	4	01.06.	10:43-	5206-7	3926	75	00°29,89'S	10°29,09'W	17,3	33,2	2
VI)	5	01.06.		5206-7	3926	50	00°29,89'S	10°29,09'W	18,5	33,3	2
VI)	6	01.06.	-10:56	5206-7	3926	20	00°29,89'S	10°29,09'W	24,2	33,1	2

Table 7. Continued.

No.		Date 1998	Time (UTC)	GeoB No.	Water depth (m)	Sample depth (m)	Latitude	Longitude	Temp. (°C)	Salinity uncorr. (psu)	Volume (l)
VII)	1	02.06.	08:55-	5207-6	4566	200	01°59,97'N	11°15,05'W	14,9	33,9	2
VII)	2	02.06.		5207-6	4566	150	01°59,97'N	11°15,05'W	15,9	33,3	2
VII)	3	02.06.	-09:18	5207-6	4566	100	01°59,97'N	11°15,05'W	17	33,2	2
VII)	4	02.06.	09:34-	5207-7	4566	75	01°59,97'N	11°15,05'W	17,9	33,2	2
VII)	5	02.06.		5207-7	4566	50	01°59,97'N	11°15,05'W	21,5	33,2	2
VII)	6	02.06.	-09:47	5207-7	4566	20	01°59,97'N	11°15,05'W	27,9	33,2	2
VIII)	1	03.06.	10:15-	5208-1	4533	200	03°10,09'N	12°30,01'W	15,4	32,9	2
VIII)	2	03.06.		5208-1	4533	150	03°10,09'N	12°30,01'W	16,5	33,2	2
VIII)	3	03.06.	-10:41	5208-1	4533	100	03°10,09'N	12°30,01'W	17,5	33,3	2
VIII)	4	03.06.	10:57-	5208-2	4533	75	03°10,09'N	12°30,01'W	19,6	33,2	2
VIII)	5	03.06.		5208-2	4533	50	03°10,09'N	12°30,01'W	27,3	32,3	2
VIII)	6	03.06.	-11:11	5208-2	4533	20	03°10,09'N	12°30,01'W	28	32	2
IX)	1	06.06.	14:34-	5209-2	4971	200	11°26,92'N	21°00,31'W	13,2	33,1	2
IX)	2	06.06.		5209-2	4971	150	11°26,92'N	21°00,31'W	14,3	33,1	2
IX)	3	06.06.	-14:57	5209-2	4971	100	11°26,92'N	21°00,31'W	15,3	33,2	2
IX)	4	06.06.	15:09-	5209-3	4971	75	11°26,92'N	21°00,31'W	16,1	33,3	2
IX)	5	06.06.		5209-3	4971	50	11°26,92'N	21°00,31'W	16,9	33,2	2
IX)	6	06.06.	-15:20	5209-3	4971	20	11°26,92'N	21°00,31'W	17,3	33,2	2
X)	1	09.06.	16:12-	5210-3	4118	200	21°16,19°N	20°41,58'W	17,1	33,8	2
X)	2	09.06.		5210-3	4118	150	21°16,19°N	20°41,58'W	19,6	34,2	2
X)	3	09.06.	-16:30	5210-3	4118	100	21°16,19°N	20°41,58'W	21,1	34,2	2
X)	4	09.06.	16:42-	5210-4	4118	75	21°16,19°N	20°41,58'W	21,9	34,1	2
X)	5	09.06.		5210-4	4118	50	21°16,19°N	20°41,58'W	22	34,1	2
X)	6	09.06.	-16:52	5210-4	4118	20	21°16,19°N	20°41,58'W	22,6	34	2

Table 8. Samples taken in the surface water for coccolihophores.

No:	Date	Time (UTC)	Water depth (m)	Sample depth (m)	Longitude	Latitude	Temp. (°C)	Uncorr. Salinity (psu)	Volume (l)
1	20.05.	10:17	3149	5	31°29,65'W	11°56,23'S	27,6	33,70	2
2	20.05.	15:05	5343	5	30°41,30'W	11°49,96'S	27,6	33,80	2
3	20.05.	22:23	3689	5	29°25,61'W	11°40,14'S	27,8	33,80	2
4	22.05.	11:11	4661	5	28°23,85'W	09°48,35'S	27,9	33,30	2
5	22.05.	15:56	5533	5	28°19,87'W	08°54,01'S	28,3	33,30	2
6	22.05.	20:41	5553	5	28°16,20'W	08°02,03'S	28,4	33,20	2
7	24.05.	11:40	5593	5	28°03,53'W	07°14,24'S	28,4	33,00	2
8	24.05.	16:41	5589	5	27°33,19'W	06°31,62'S	28,4	33,10	2
9	24.05.	21:45	5634	5	27°01,53'W	05°47,17'S	28,3	33,20	2
10	26.05.	10:20	4040	5	24°29,52'W	01°47,17'S	26,8	33,60	2
11	26.05.	16:10	5034	5	23°58,86'W	00°52,69'S	26,7	33,60	2
12	26.05.	21:10	3440	5	23°32,33'W	00°05,69'S	26,8	33,20	2
13	28.05.	08:30	3900	5	20°21,43'W	00°27,93'S	26,2	33,30	2
14	28.05.	14:45	3581	5	19°18,90'W	00°37,50'S	26,3	33,40	2
15	28.05.	22:15	5034	5	18°21,20'W	00°46,07'S	26,0	33,40	2
16	29.05.	09:55	2791	5	16°21,22'W	01°04,35'S	25,9	33,30	2
17	29.05.	14:45	3633	5	15°33,45'W	01°11,46'S	26,4	33,20	2
18	29.05.	19:10	5293	5	14°49,34'W	01°18,11'S	26,3	33,10	2
19	30.05.	10:35	2637	5	12°13,50'W	01°42,05'S	25,9	33,10	2
20	30.05.	14:51	5062	5	11°28,75'W	01°48,82'S	26,1	33,10	2
21	30.05.	20:15	5039	5	10°35,83'W	01°56,86'S	25,9	33,00	2
22	01.06.	14:04	2509	5	10°38,05'W	00°01,82'S	25,0	33,20	2
23	04.06.	14:26	4808	5	14°30,09'W	05°08,15'N	28,6	31,90	2
24	04.06.	19:30	4892	5	15°10,30'W	05°47,75'N	28,9	32,80	2
25	05.06.	09:05	4749	5	17°04,70'W	07°39,99'N	28,9	32,80	2
26	05.06.	13:37	4705	5	17°44,28'W	08°18,73'N	28,9	33,00	2
27	05.06.	19:58	4458	5	18°36,63'W	09°09,77'N	28,6	33,40	2
28	06.06.	09:13	4886	5	20°21,50'W	10°51,72'N	26,1	33,20	2
29	07.06.	09:05	4763	5	20°58,06'W	12°33,91'N	25,4	33,30	2
30	09.06.	09:13	3951	5	20°42,72'W	20°38,22'N	21,3	33,4	1

4.3.3. Pumped Samples for Diatom and Silicoflagellate Analysis

(G. Mollenhauer, H. Kuhlmann)

To qualitatively assess the diatom and silicoflagellate commutinies of the surface water in the Equatorial Atlantic and to compare them with the associations collected in the sediment traps, daily plankton samples were taken when sailing in international waters. Approximately 3000 litres of surface water from the shipboard installed seawater pump ("Kreiselpumpe") were filtered through a 20 mm meshsize net during the period from

10 am and 4 pm local time (Table 9). After stopping the water flow, the plankton was washed into 1 l KAUTEX plastic bottles, fixed with formaldehyde 37 % and stored at 4°C until further laboratory examination in Bremen.

Table 9. Plankton samples for silicoflagellate and diatom analysis.

No	Date	Start Filtration				Stop Filtration				Vol.	Remarks/Station
		Time (UTC)	Position (Lat./Long.)	Salinity (‰)	Temp. (°C)	Time (UTC)	Position (Lat./Long.)	Salinity (‰)	Temp. (°C)	(l)	
1	20.05.	12:00	11°54.1'S 31°12.38'W	37.14	27.6	18:00	11°46.24'S 30°11.97'W	37.09	27.8	2850	
2	21.05.	12:00	11°32.98'S 28°39.36'W	36.91	27.7	18:00	11°31.74'S 28°31.21'W	36.91	27.9	3161	5201
3	22.05.	12:00	09°38.24'S 28°22.99'W	36.35	28.5	18:00	08°31.37'S 28°18.26'W	3612	28.4	3275	
4	23.05.	12:00	07°27.72'S 30°15.28'W	36.01	28.5	18:00	07°26.73'S 28°12.53'W	36.00	28.5	2845	5202
5	24.05.	12:15	07°07.59'S 27°58.79'W	35.87	28.4	18:25	06°16.62'S 27°22.55'W	35.87	28.4	2755	
6	25.05	12:00	03°53.12'S 25°41.55'W	35.74	27.9	13:05	03°52.50'S 25°41.88'W	35.74	27.9		Filtration interrupted,
6	25.05.	18:30	03°50.53'S 25°41.25'W	35.77	28.0	23:30	03°27.49'S 25°27.70'W	35.92	27.8	2486	Clean Ship station work 5203
7	26.05.	12:00	01°32.26'S 24°20.98'W	36.38	26.6	18:28	00°31.39'S 23°46.69'W	36.19	26.6	32954	
8	27.05.	12:00	00°02.40'N 23°27.96'W	35.97	26.8	18:45	00°03.10'S 23°04.75'W	36.07	26.7	3005	interrupted between 14:59 and 15:48
9	28.05.	12:00	00°30.35'S 20°05.56'W	36.10	26.3	18:00	00°39.49'S 19°05.16'W	36.12	26.1	3025	
10	29.05.	11:00	01°05.93'S 16°10.79'W	35.94	26.0	17:05	01°15.17'S 15°09.99'W	35.80	26.4	3355	
11	30.05.	12:35	01°45.21'S 11°52.12'W	35.77	25.6	18:35	01°54.41'S 10°52.29'W	35.76	25.9	3301	
12	31.05.	18:30	01°57.75'S 10°15.93'W	35.62	26.0	00:30	00°49.11'S 10°26.83'W	35.79	25.3	3334	Station work, Clean Ship at daytime
13	01.06.	11:30	00°28.38'S 10°28.49'W	35.81	25.2	18:00	00°45.96'N 10°52.83'W	35.54	25.4	3417	
14	03.06.	01:46	02°03.77'N 11°!19.56'W	35.00	28.6	8:23	02°56.76'N 12°15.83'W	34.75	28.3	3721	Station work, Clean Ship at daytime
15	03.06.	17:30	03°11.18'N 12°30.77'W	34.93	28.3	23:34	03°41.05'N 13°01.60'W	34.82	28.5	3382	Station work, Clean Ship at daytime
16	04.06.	11:45	04°56.17'N 14°12.92'W	34.26	28.4	17:51	05°34.66'N 14°57.43'W	34.46	28.5	3427	
17	05.06.	10:00	07°48.20'N 17°13.06'W	35.56	28.8	16:00	08°38.17'N 18°04.31'W	35.74	28.9	3405	
18	06.06.	10:15	10°59.51'N 20°29.52'W	35.96	26.9	16:30	11°30.99'N 21°00,20'W	35.98	26.5	3494	
19	09.06.	10:00	20°46.16'N 20°42.47'W	35.98	21.4	15:54	21°15.96'N 20°42.73'W	36.7	22.5	3148	

4.3.4. Chlorophyll-a Measurements

(Mollenhauer, H. Kuhlmann)

For the determination of chlorophyll-a concentrations in the surface waters, seawater from the shipboard installed seawater pump ("Membranpumpe") was sampled at three times daily (8 am, 12 o'clock and 6 pm local time) when sailing in international waters (Table 10). Two portions of 0.5 l seawater each were filtered onto a glass microfibre filter (Whatman, GF/F, 25 mm diameter). The samples were frozen at dark and will be analyzed by means of photometry at the laboratory in Bremen. The chlorophyll-a data should give information on seasonal and regional variability in biomass distribution. The results will be compared with satellite-derived chlorophyll concentration maps and may serve as calibration of these data.

Table 10. Sampling locations for chlorophyll-a measurements.

No.	Date	Time UTC	location	Water-depth (m)	Salinity (‰)	Water-temp. (°C)	Sample volume (l)	Station
1/2	20.05.	10:00	11°56.64'S 31°32.50'W		37.13	27.6	2x0.5	
3/4	20.05.	14:00	11°51.44'S 30°52.48'W	5370	37.07	27.6	2x0.5	
5/6	20.05.	20:00	11°43.34'S 29°50.23'W	5419	36.91	27..9	2x0.5	
7/8	21.05.	10:00	11°32.89'S 28°31.29'W	5450	36.91	27.7	2x0.5	5201
9/10	21.05.	14:00	11°34.00'S 28°31.67'W	5425	36.91	27.8	2x0.5	5201
11/12	21.05.	20:00	11°31.68'S 28°31.18'W	5460	36.92	27.8	2x0.5	5201-8 (MUC)
13/14	22.05.	10:00	09°59.54'S 28°24.60'W		36.41	27.9	2x0.5	
15/16	22.05.	14:00	09°16.96'S 28°21.54'W	5540	36.33	28.0	2x0.5	
17/18	22.05.	20:00	08°10.08'S 28°16.76'W		36.13	28.5	2x0.5	
19/20	23.05.	10:00	07°28.51'S 28°14.51'W	~5500	36.00	28.4	2x0.5	5202
21/22	23.05.	14:00	07°27.42'S 28°14.07'W	~5500	36.01	28.5	2x0.5	5202
23/24	23.05.	20:00	07°25.15'S 28°11.34'W	5563	35.99	28.5	2x0.5	5202
25/26	24.05.	10:00	07°25.16'S 28°11.29'W	6615	35.98	28.4	2x0.5	.
27/28	24.05	14:00	06°54.61'S 27°49.61'W	5601	35.88	28.4	2x0.5	

Table 10. Continued.

No.	Date	Time UTC	location	Water-depth (m)	Salinity (‰)	Water-temp. (°C)	Sample volume (l)	Station
29/30	24.05.	20:00	06°03.32'S 27°13.01'W	5618	36.02	28.3	2x0.5	
31/32	25.05.	10:00	04°05.36'S 25°49.09'W	~5540	35.75	27.9	2x0.5	
33/34	25.05.	14:00	03°50.91'S 25°41.18'W	5532	35.79	28.0	2x0.5	5203
35/36	25.05.	20:00	03°50.13'S 25°41.28'W	5532	35.77	27.9	2x0.5	5203
37/38	26.05.	10:00	01°51.08'S 24°31.68'W	6794	36.38	26.9	2x0.5	
39/40	26.05.	14:00	01°13.41'S 24°10.44'W	4446	36.39	26.5	2x0.5	
41/42	26.05.	20:00	00°17.20'S 23°38.78'W	3591	36.07	26.7	2x0.5	
43/44	27.05.	10:00	00°03.31'N 23°27.91'W	3732	35.97	26.8	2x0.5	5204
45/46	27.05.	14:00	00°00.65'N 23°29.19'W	3725	35.95	26.9	2x0.5	5204
47/48	27.05.	20:00	00°04.83'S 22°53.10'W	4016	36.12	26.5	2x0.5	
49/50	28.05.	10:00	00°26.89'S 20°28.13'W	3610	36.09	26.2	2x0.5	
51/52	28.05.	14:00	00°33.30'S 19°46.18'W	5072	36:12	26.4	2x0.5	
53/54	28.05.	20:00	00°42.63'S 18°44.46'W	4519	35.13	26.0	2x0.5	
55/56	29.05.	09:00	01°02:83'S 16°31.44'W	2682	35.98	28.8	2x0.5	
57/58	29.05.	13:00	01°09.01'S 15°51.00'W	4086	35.90	26.2	2x0.5	
59/60	29.05.	19:15	01°18.37'S 14°49.00'W	5308	35.79	26.2	2x0.5	
61/62	30.05.	09:00	01°39.48'S 12°30.12'W	3542	35.76	25.9	2x0.5	
63/64	30.05.	13:00	01°45.78'S 11°48.64'W	3745	35.79	25.9	2x0.5	
65/66	30.05.	19:00	01°55.04'S 10°47.69'W	4026	35.72	26.0	2x0.5	
67/68	31.05.	08:57	01°57.95'S 10°16.00'W	3591	35.66	25.7	2x0.5	5205
69/70	31.05.	13:00	01°57.97'S 10°15.99'W	3598	35.64	25.8	2x0.5	5205
71/72	31.05.	19:00	01°53.47'S 10°16.63'W	3419	35.66	28.8	2x0.5	
73/74	01.06.	09:00	00°29.72'S 10°29.03'W	3923	35.82	25.0	2x0.5	5206
75/76	01.06.	13:00	00°14.90'S 10°33.79'W	4788	35.87	25.6	2x0.5	
77/78	01.06.	19:00	00°56.88'N 10°56.08'W	4339	35.43	25.8	2x0.5	
79/80	02.06.	09:00	01°59.97'N 11°15.06'W	4567	34.93	28.7	2x0.5	5207
81/82	02.06.	13:00	02°03.33'N 11°18.63'W	4635	34.94	28.8	2x0.5	5207

Table 10. Continued.

No.	Date	Time UTC	location	Water-depth (m)	Salinity (‰)	Water-temp. (°C)	Sample volume (l)	Station
83/84	02.06.	19:00	02°03.40'N 11°19.51'W	4578	34.97	28.7	2x0.5	5207
85/86	03.06.	09:00	03°01.22'N 12°20.52'W	4515	34.79	28.3	2x0.5	
87/88	03.06.	13:00	03°11.28'N 12°31.14'W	4536	34.93	28.3	2x0.5	5208
89/90	03.06.	19:00	03°11.11'N 12°30.59'W	4536	34.92	28.3	2x0.5	5208
91/92	04.06.	08:55	04°50.95'N 14°08.86'W	4780	34.28	28.1	2x0.5	
93/94	04.06.	13:00	04°57.64'N 14°16.89'W	4788	34.32	28.5	2x0.5	
95/96	04.06.	19:00	05°43.71'N 15°06.06'W	4886	34:48	28:4	2x0.5	
97/98	05.06.	08:00	07°30.47'N 16°55.02'W	4755	35.14	28.8	2x0.5	
99/100	05.06.	12:00	08°04.68'N 17°29.94'W	4714	35.65	28.6	2x0.5	
101/102	05.06.	18:00	08°54.08'N 18°20.53'W	1617	35.75	28.9	2x0.5	
103/104	06.06.	08:00	10°41.98'N 20°11.48'W	4823	35.84	26.0	2x0.5	
105/106	06.06.	12:00	11°13.45'N 20°43.85'W	4976	35.99	26.4	2x0.5	
107/108	06.06.	18:00	11°31.09'N 21°00.26'W	4967	35.98	26.4	2x0.5	5209
109/110	07.06.	08:00	12°21.12'N 20°58.39'W	4813	35.97	25.5	2x0.5	
111/112	09.06.	10:00	20°46.42'N 20°42.47'W	4007	35.98	21.3	2x0.5	
113/114	09.06.	12:00	21°06.89'N 20°41.72'W	4092	36.77	22.5	2x0.5	
115/116	09.06.	18:00	21°16.07'N 20°41.59'W	4116	35.71	22.6	2x0.5	5210
117/118	10.06.	08:00	21°14.50'N 20°42.72'W	4119	36.71	22.2	2x0.5	5210
119/120	10.06.	12:00	21°18.42'N 20°40.23'W	4123	36.72	22.5	2x0.5	5210

4.3.5. Plankton and Water Sampling using a Multiple Closing Net

(H. Kuhlmann, G. Mollenhauer)

Plankton was sampled with a multiple closing net (Fa. HYDROBIOS) with 0.25 m^2 opening and 64 µm mesh size. It was used for vertical hawls at 10 sites (Table 11). Each multinet station, except station GeoB 5209 where only the 1. and the 3. hawl were taken, comprised three hawls with:

1. depth intervals from 500-300, 300-200, 200-100, 100-50 and 50-0 m.
2. depth intervals from 400-200, 200-100, 100-40, 40-20 and 20-0 m.
3. depth intervals from 250-100, 100-75, 75-50, 50-25 and 25-0 m.

Hawl 1 will be used for studies on planktonic foraminifera, hawl 2 for radiolarian and diatom analyses, and hawl 3 for geochemical and isotopic analyses. The samples containing mostly zooplankton and some phytoplankton were carefully rinsed with seawater into KAUTEX bottles, fixed with mercury chloride for the reduction of bacterial degradation, and stored at 4°C. At all stations, 1.5 l NISKIN-bottles were used during the first and the third hawl to obtain water samples from the different water depths for analyses of carbon and oxygen stable isotopes and phytoplankton investigations.

Table 11. Water samples for $\delta^{13}C$ and $\delta^{18}O$ analyses (multinet (MN) and multicorer (MUC)).

Station GeoB	depth (m)	$\delta^{13}C$	$\delta^{18}O$	Position Latitude Longitude	Remarks
5201-1 (MN)	300	x	x	11°33.4'S 28°34.4'W	
	200	x	x		
	100	x	x		
	50	x	x		
	0	x	x		
5201-3 (MN)	250	x	x	11°33.4'S 28°34.3'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		
5201-8 (MUC)	5461	x	x	11°31.7'S 28°31.23W	
5201-8 (MN)	500	x	x	07°26.7'S 28°12.5'W	
	300	x	x		
	200	x	x		
	100	x	x		
	50	x	x		
5202-10 (MN)	250	x	x	07°26.7'S 28°12.5'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		
5203-6 (MN)	500	x	x	03°50.3'S 25°41.3'W	
	200	x	x		
	100	x	x		
	50	x	x		
5203-8 (MN)	250	x	x	03°50.1'S 25°41.3'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		

Table 11. Continued.

Station GeoB	depth (m)	$\delta^{13}C$	$\delta^{18}O$	Position Latitude Longitude	Remarks
5204-1 (MN)	500	x	x	00°00.01'N 23°2928.8'W	
	300	x	x		
	200	x	x		
	100	x	x		
	50	x	x		
5204-3 (MN)	250	x	x	00°00.02'N 23°28.4'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		
5204-11 (MUC)	3718	x	x	00°00.06'N 23°29.1'W	
5205-3 (MN)	500	x	x	02°00.00'S 10°14.9'W	
	300	x	x		
	200	x	x		
	100	x	x		
	50	x	x		
5205-5 (MN)	250	x	x	02°00.05'S 10°15.05'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		
5206-3 (MN)	500	x	x	00°29.96'S 10°28.5'W	
	300	x	x		
	200	x	x		
	100	x	x		
	50	x	x		
5206-5 (MN)	250	x	x	00°29.73'S 10°28.5'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		
5207-3 (MN)	500	x	x	02°00.02'N 11°15.17'W	
	300	x	x		
	200	x	x		
	100	x	x		
	50	x	x		
5207-5 (MN)	250	x	x	01°59.91'N 11°15.27'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		
5208-6 (MN)	500	x	x	03°11.2'N 12°30.7'W	
	300	x	x		
	200	x	x		
	100	x	x		
	50	x	x		
5208-8 (MN)	250	x	x	03°11.1'N 12°30.5'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		
5209-7 (MN)	500	x	x	11°31.3'N 20°59.9'W	
	300	x	x		
	200	x	x		
	100	x	x		

Table 11. Continued.

Station GeoB	depth (m)	$\delta^{13}C$	$\delta^{18}O$	Position Latitude Longitude	Remarks
	50	x	x		
5209-8 (MN)	250	x	x	11°31.3'N 20°59.8'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		
5210-7 (MUC)	4121	x	x	21°16.9'N 20°40.9'W	
5210-9 (MN)	500	x	x	21°16.9'N 20°40.9'W	
	300	x	x		
	200	x	x		
	100	x	x		
	50	x	x		
5210-11 (MN)	250	x	x	21°16.9'N 20°40.9'W	
	100	x	x		
	75	x	x		
	50	x	x		
	25	x	x		

4.4. Sampling of Eolian Dust

(V. Ratmeyer, R. Huber)

Eolian dust was sampled during intervals shown in Table 12. However, depending on relative wind direction and -strength only several intervals were suitable for sampling. In order to avoid pollution from particles delivered by the chimney of the ship no sampling was done when the relative wind direction was in between 130° and 230°, and during station work. Sampling started on 29.05. and was continued until 12.06.1998. The dust samplers consist of a vacuum-cleaner motor and a frame to put the filter on. The size of the filters is 20.3*24.5 cm. One of the dust samplers has a "critical-flow ventouri" which forces a flux of 1.13 m^3 per minute. The flux of the other dust collector normally is calculated by measuring the pressure drop over the filter but due to computer breakdown this could not be established. The flux is estimated to be about 2 m^3 per minute.

At each sampling interval the two dust collectors were used, each with its own particular type of filter. Glass-fibre filters were used for future studies with stress on the organic content of the eolian dust. After sampling, these filters were wrapped in alu foil and stored at —20°C. Organic-geochemistry measurements will be carried out at the biogeochemical department at the NIOZ. Cellulose filters were used in order to be able

to study the terrigenous fraction part of the eolian dust. These filters were stored at room temperature. The siliciclastic fraction of the eolian dust will be obtained by dissolving the filter in H_2O_2. Clay mineralogy will be studied using XRD (NIOZ). Grain-size distributions will be measured using a laser particle sizer, major elements will be analysed using XRF and ICP (Utrecht University).

Table 12. Dust samples taken during the cruise.

Sample Nr.:	Start/End	Date 1998	Time	Total	Position		True wind dir	Rel. Wind dir.	True wind speed (m/s)	Rel. Wind speed (m/s)
DO27 / DI27	Start	29. Mai	15:55		01°13,59'S	15°20,58'W	143°	18°	5,5	17,7
	Stop	30. Mai	19:12	27:17	01°18,38'S	15°48,95'W	127°	13°	5,7	10,8
DO28 / DI28	Start	01. Jun	13:35		00°07,26'S	10°36,14'W	160°	197°	5,9	0
	Stop	01. Jun	20:04	6:29	01°09,46'N	10°59,89'W	176°	209°	7,5	1,9
DO29 / DI29	Start	06. Jun	09:00		10°50,56'N	20°20,33'W	22°	101°	5,6	9,1
	Stop	06. Jun	13:28	4:28	11°25,27'N	20°56,26'W	21°	101°	5,5	9,1
DO30 / DI30	Start	07. Jun	08:35		12°31,66'N	20°58,03'W	6°	87°	6,1	11,6
	Stop	07. Jun	18:35	10:00	14°15,52'N	20°54,85'W	7°	90°	8,1	12,2
DO31 /DI31	Start	07. Jun	18:40		14°15,55'N	20°54,86'W	7°	90°	8,1	12,2
	Stop	08. Jun	12:30	17:50	17°13,76'N	20°49,33'W	41°	90°	8,1	12,2
DO31 / DI31	Start	08. Jun	12:30		17°13,76'N	20°49,33'W	41°	99°	9,8	13,8
	Stop	09. Jun	12:39	24:09	21°13,97'N	20°41,59'W	37°	96°	8,8	13,7
DO32 / DI32	Start	11. Jun	08:20		22°48,61'N	19°25,97'W	40°	264°	9	13,7
	Stop	11. Jun	18:30	10:10	24°13,94'N	18°15,48'W	40°	1°	8,8	14,6
DO33 / DI33	Start	11. Jun	18:40		24°13,94'N	18°15,48'W	40°	1°	8,8	14,6
	Stop	12. Jun	13:30	18:50	26°47,31'N	16°06,65'W	72°	96°	9,8	14

4.5. In-situ Particle Camera System (ParCa II)

(V. Ratmeyer)

For measuring the vertical particle concentration, size distribution and aggregate composition in the water column, a video in-situ camera system was build and used during M41-4. A new CCD-based videocamera was equipped with controlling electronics and highly collimating strobelights. The videosystem was tested on and calibrated inside a seawater-filled basin on deck prior to deployment for image sharpness and instrument electronics. Development and instrument testing could be successfully finished at the northernmost EA-Station. Two profiles were then taken at station GeoB 5209 and at station GeoB 5210.

The system was designed and improved in consideration of similar systems used by Honjo et al.(1984), Asper (1987), Lampitt (1985) and Ratmeyer and Wefer (1996). This method provides in-situ information on the origin and abundance of particles and aggregates (marine snow). In addition to the use of sediment traps, particle flux can be measured also in areas or depths with high lateral transport.

The aim of deployment during M41-4 was to observe the deep-sea particle population and abundance of large amorphous aggregates in the open ocean. Videographic abundance profiles were made on the mooring stations CV (4000 m) and CB (1500 m) (Table 13). Due to a camera- malfunction, the first profile constists of images only down to 880 m waterdepth. The videos show variable particle and plankton concentrations, with highest concentrations in the upper 100 m. This correlates to previous measurements with particle camera and chlorophyll sensors in the Brasil Basin (Ratmeyer and Wefer, 1996). Different species of plankton and makroplankton can be identified on the images, including foraminifera, pteropods, copepods and medusa. Particle and aggregate sizes vary from 200 µm to > 10 cm. Quantitative analysis of concentration, shape and size of particles will be performed using a PC-based image analysis system. This was not possible during the cruise and will be done in Bremen.

However, first results show a higher abundance of particles in the southernmost profile (GeoB 5209), were very large, amorphous aggregates (so-called stringers) could be observed. These „stringers" are most probably responsible for a large part of the verticle particle transport from surface waters to the deep sea, as they consist of mucus fathoms scavenging smaller particles from the water column on their way down. The second profile at GeoB 5210 shows a higher abundance of zooplankton in the upper 150 m, but much less large particles with sizes > 1000 µm compared to the GeoB 5209 station. A similar trend is visible in the chlorophyll profiles from both stations: Within the the upper 1000 m of the water column, values at GeoB 5210 are almost twice the values at GeoB 5209. A possible explanation for these differences within the same large region of coastal upwelling gives the MUC taken at GeoB 5210: A green-brownish fluffy layer of organic material was observed on top of the sediment surface. The color and fluffy character of

this organic material shows that it cannot be very old. A conclusion might be, that the relatively low particle concentrations in the water column are a result of a previous "fallout" event, were larger particles and aggregates "washed out" the water column and were finally deposited on the sediment.

The ParCa II system consists of the following components:
The Video-System constists of a modified SONY VX 1000 digital 3-chip CCD camera controlled by two PIC-microprocessors. The illumination is provided through a high-precision strobe head manufactured by DeepSea Power & Light. Strobe rates can be switched between 1 Hz and 50 Hz, the trigger signal is synchronized with the framerate of the videocamera. Programming and testing of the camera can be done using serial RS232 communication. Different test-programs were tested and run inside a deck-mounted seawater basin, in order to find the best relation between probe-volume, zoom-factor, illumination, repetition rate and size-resolution. Finally a winch speed of 0.3 m/s was found to meet both sufficient speed and sharp images without smear effects. The system is fixed inside a collapsible frame of the dimension 100 x 500 x 200 cm, which is made of 48 mm hot galvanized steel pipe. The complete system weight is approximately 150 kg in air. The ParCa II system will be further improved during following cruises, concerning different zoom-stages, different illuminations and an automated in-situ image analysis. Online video and RS232 communication during deployment will be another aim of further development.

Table 13. Deployment of the ParCa II Videosystem.

GeoB-Station	Water depth	Profile depth	Trigger	System
5209-6	4996 m	800 (4000) m	10 m	ParCa II
5210-7*	4124 m	1500 m	10 m	ParCa II + FS-CTD

*During station GeoB 5210-7, lowering of the system was stopped every 10 m during the upper 200 m.
A total of 35 minutes of digital video tape was used.

4.6. Particle Collection with Sediment Traps

(G. Ruhland, V. Ratmeyer und G. Fischer)

The data of deployment and recovery of the moorings are listed in Table 14 together with the sampling data of the traps. Three moorings were recovered in the western equatorial South Atlantic; another system was recovered off Cape Blanc. All arrays were redeployed on their original positions (Fig. 1). The first one was located in the oligotrophic central Brazil Basin. The other moorings were deployed in the more productive northern Brazil Basin and in the western equatorial upwelling area. The arrays were equipped each with two multisample traps and one current meter. All moorings are planned to be recovered by RV METEOR (M46/1) in November, 1999.

On May, 21st the mooring WAB1 was recovered on the southernmost position in the central Brazil Basin. The array was equipped with two multisample particle traps in 727 m and 4515 m water depth. A current meter was placed 20 m below the upper trap. Additionally an inclinometer was fitted to the upper trap. The traps started sampling February 27th, 1997 with an sampling interval of 22.5 days, except for the first and last cups (each 21.5 days). The instruments worked well except of the inclinometer which did not record data due to low battery power. At the same day, the mooring was redeployed as WAB2 with the same configuration except of the inclinometer. The traps were programmed for a 27.5 day interval starting at May, 22th 1998, the last cup was scheduled for a 30.5 day interval.

On May 23th, the mooring WA13 was recovered successfully at a site located in the lower productive subtropical gyre of the northern Brazil Basin. This mooring array was equipped with two multisample traps in 871 and 4736 m and one current meter in 895 m water depth. Both traps provided a complete sequence of samples but the lower one stopped at the first cup due to an unknown error. Therefore, the first sample was lost. The traps were programmed for 22.5 day sampling intervals starting on February 25th, 1997.

The moored current meter recorded no data due to an low power failure of the lithium battery. At the same day, the mooring array was redeployed again as WA14 at the same position. The traps were scheduled for a 27.5 day sampling interval starting May 24th, 1998. To synchronize the sample intervals for all moorings, the first cup changed after 25.5 days. The last sample interval will be 28.5 days.

The third mooring WA12 was recovered on May 27th. This mooring was located in the western equatorial upwelling area. The two moored traps in 688 and 3173 m depth worked perfectly and provided two sample sets of 20 samples each. Each sample covers a time interval of 22.5 days for each sample except for the first cup (26.5 days) and the last cup (24.5 days). The current meter registered data for the complete deployment time in 712 m water depth. At the same day, a similar mooring named WA15 was redeployed at the same position. The traps started sampling on May 28th.

The mooring CB8 was recovered successfully at a site located in the filamental zone of the coastal upwelling area off Cape Blanc on June, 9th. This array was deployed as all other moorings during the METEOR cruise M38/1. It was equipped with two multisample particle traps in 745 and 3579 m water depth. One current meter was placed 24 m below the upper trap. The traps both provided a full sample set with a sample interval of 24.5 days. Also the current meter recorded data for the entire deployment time. On June 10th, a comparable mooring was redeployed at the same position named CB9. This mooring contained two particle traps in 746 m and 3580 m water depth and a current meter in 770 m depth. The sample interval for these traps was 27.5 days except for the first cup (7.5 days) and the last (11.5 days).

Table 14. Mooring data for recoveries and redeployments.

Mooring	Position	Water depth (m)	Interval	Instr.	Depth (m)	Intervals (no x days)
Mooring recoveries during M41/4:						
BRAZIL BASIN / WESTERN EQUATORIAL ATLANTIC						
WAB1	11°33.00'S	5483	27.02.97	S/MT 234	727	1x20.5,18x22.5,1x20.5
	28°31.33'W		19.05.98	S/MT 234	4515	1x20.5,18x22.5,1x20.5
				RCM 8	751	
				S/MT 105	727	
WA13	07°28.51'S	5576	25.02.97	S/MT 230	871	20x22.5
	28°13.76'W		21.05.98	S/MT 230	4736	20x22.5
				RCM 8	895	
WA12	00°02.21'N	3714	21.02.97	S/MT 234	688	1x26.5,18x22.5,1x25.5
	23°27.84'W		24.05.98	S/MT 234	3173	1x26.5,18x22.5,1x25.5
				RCM 8	712	
CAPE BLANC REGION:						
CB8	21°16.26'N	4120	30.01.97	S/MT 230	745	20x24.5
	20°41.48'W		04.06.98	S/MT 230	3579	20x24.5
				RCM8	769	
Mooring deployments during M41/4:						
BRAZIL BASIN / WESTERN EQUATORIAL ATLANTIC						
WAB2	11°34.8'S	5460	22.05.98	S/MT 243	710	19x27.5,1x30.5
	28°31.9'W		26.11.99	S/MT 230	4421	19x27.5,1x30.5
				RCM8	734	
WA14	07°27.6'S	5525	24.05.98	S/MT 234	822	1x25.5,18x27.5,1x28.5
	28°14.0'W		24.11.99	S/MT 234	4705	1x25.5,18x27.5,1x28.5
				RCM8	845	
WA15	00°02.6'N	3720	28.05.98	S/MT 234	697	1x21.5, 18x27.5,1x24.5
	23°27.5'W		20.11.99	S/MT 230	3180	1x21.5, 18x27.5,1x24.5
				RCM8	721	
CAPE BLANC REGION:						
CB9	21°15.2'N		11.06.98	S/MT 234	746	1x7.5,18x27.5,1x11.5
	20°42.4'W		07.11.99	S/MT 234	3580	1x7.5,18x27.5,1x11.5
				RCM8	770	

Instruments used:

S/MT 230	= Particle trap S/MT 230 Aquatec Meerestechnik, Kiel
S/MT 243	= Particle trap S/MT 243 Aquatec Meerestechnik, Kiel
S/MT 234	= Particle trap S/MT 234 Aquatec Meerestechnik, Kiel
S/MT 105	= Inclinometer S/MT 105 Aquatec Meerestechnik, Kiel
RCM 8	= Current meter Aanderaa, RCM 8

Preliminary Results

Particle flux at the oligotrophic Brazil Basin (site WAB1) was the lowest of all sites in the westen tropical Atlantic (Fig. 3). Seasonality was also the lowest with respect to the upper trap levels. The deeper WAB1 trap showed lower fluxes than the upper one. As expected, fluxes and seasonality increased towards the north in the western equatorial upwelling regime. Maxima occurred in winter but mainly in spring and summer at sites WA13 (at 7°S) and WA12 (equator) (Figs. 4 and 5). In most cases, the deeper traps revealed lower fluxes compared to the upper ones. Thus, no strong influence of lateral transported material or strong resuspension at the seafloor seemed to occur. At site Cape Blanc (CB8), only the upper trap worked perfectly, the lower one sampled only 3 periods with a lot of material in cup 3. Unfortunately, this trap was recovered upside down and the material which obviously was anoxic was lost. The upper trap collected much material and showed a strong seasonality (Fig. 6). High fluxes were estimated for winter and spring and fall 1997 showing a strong decline towards the end of the year and in winter 1998. The spring peak in 1998 was much lower compared to 1997.

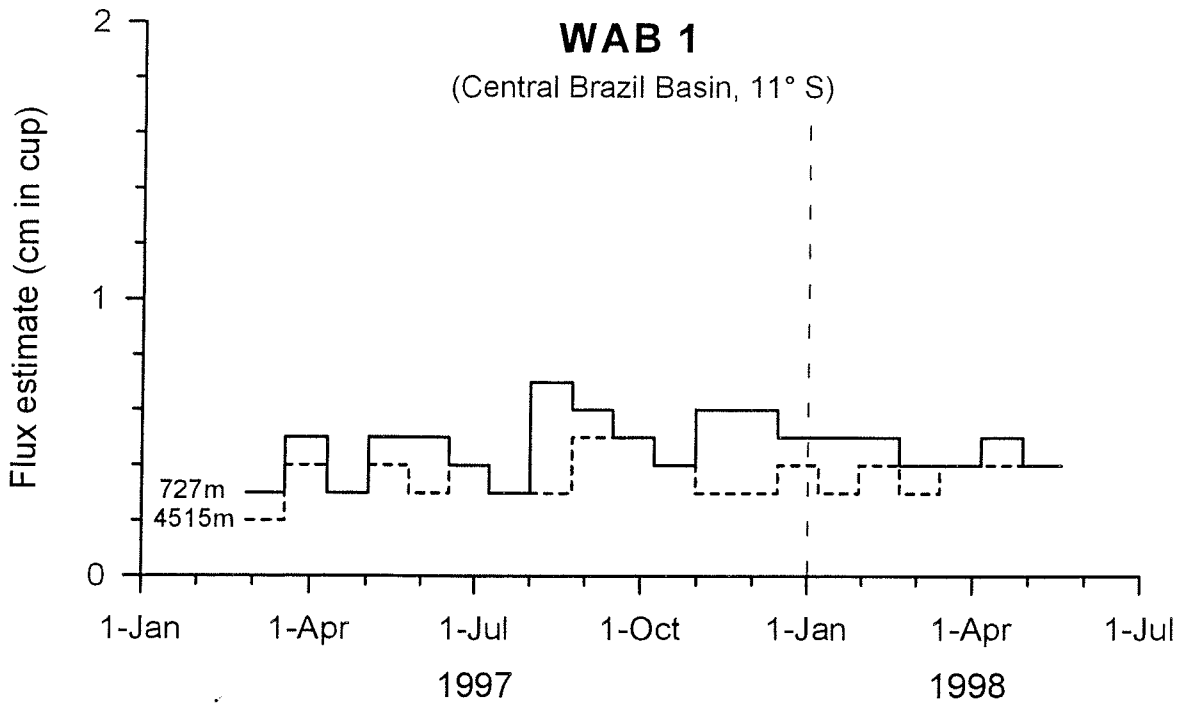

Fig. 3. Flux estimate at site WAB1. For location see Table 14 and Fig. 1.

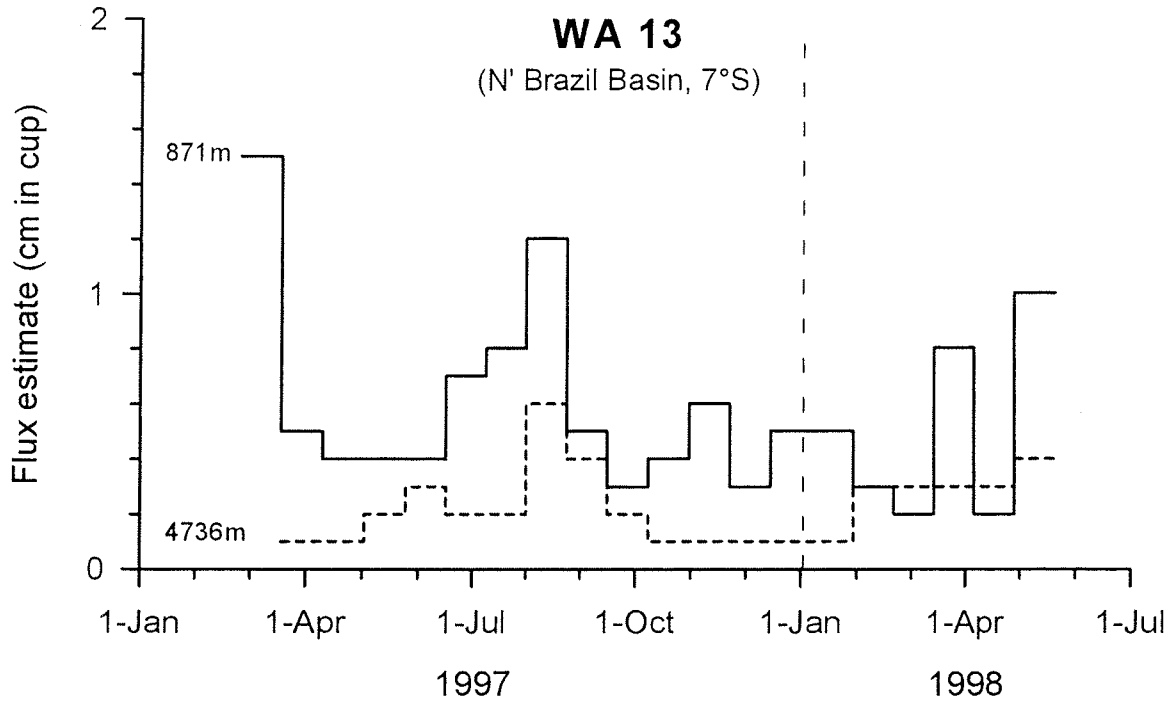

Fig. 4. Flux estimate at site WA13. For location see Table 14 and Fig. 1.

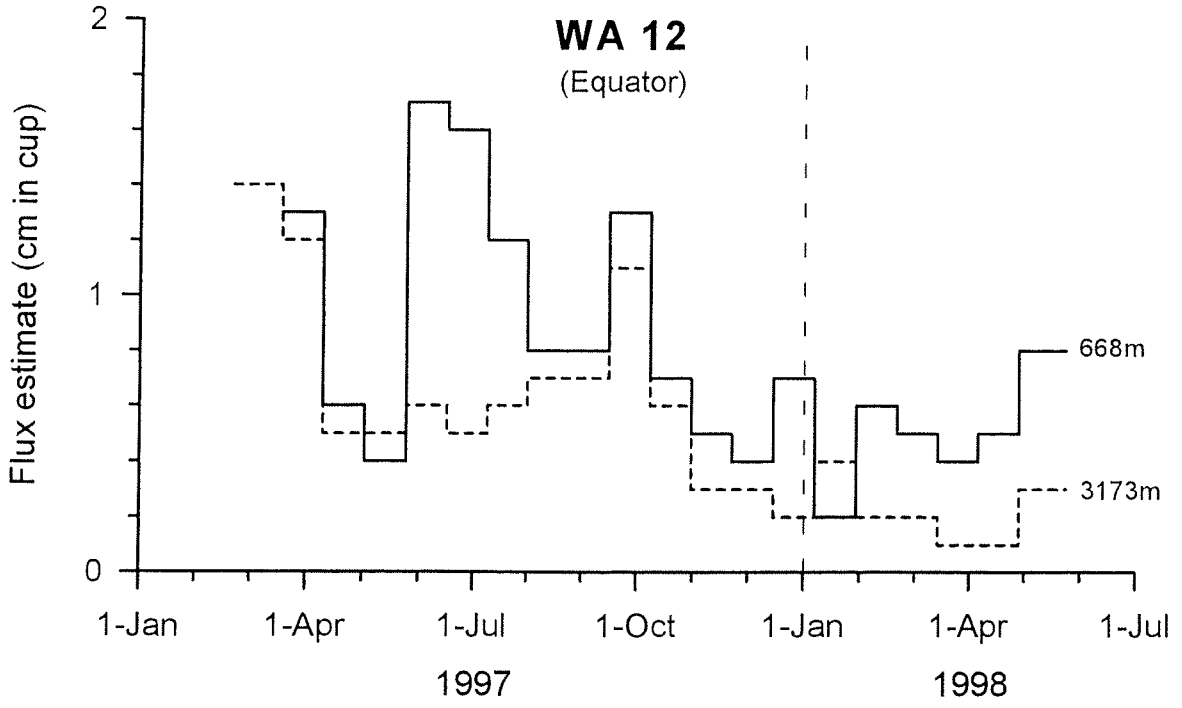

Fig. 5. Flux estimate at site WA12. For location see Table 14 and Fig. 1.

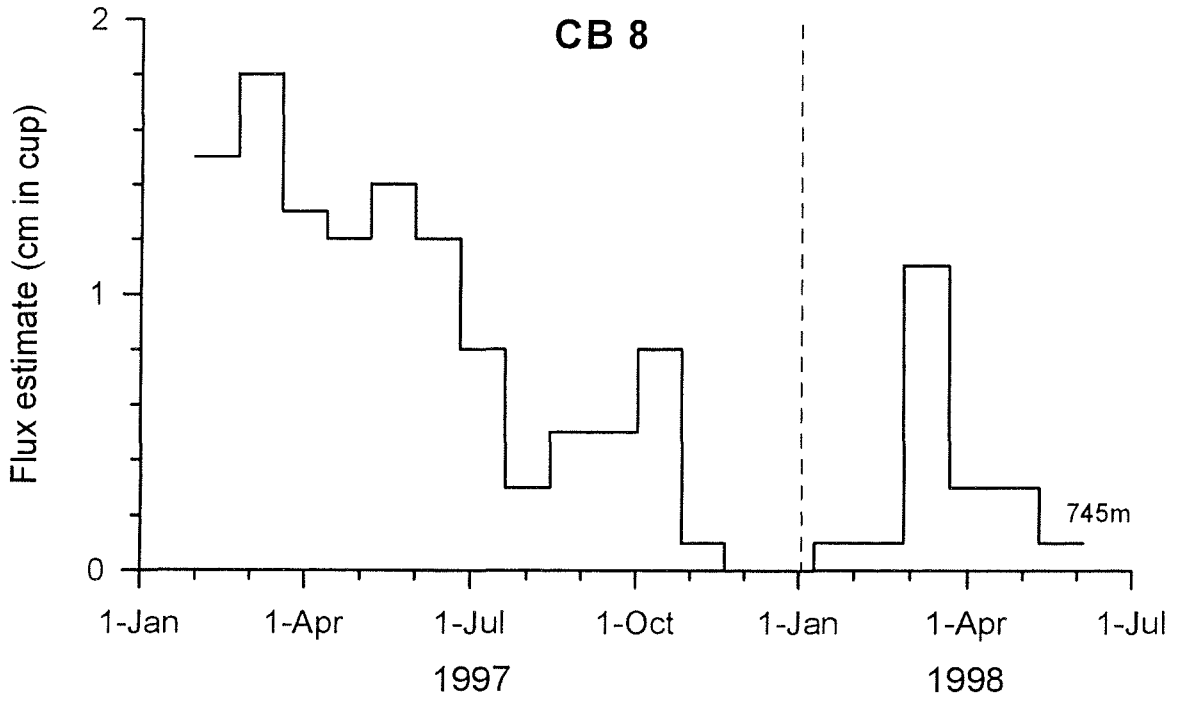

Fig. 6. Flux estimate at site CB8 off Cape Blanc. For location see Table 14 and Fig. 1.

4.7. Marine Geology

(G. Mollenhauer)

To complement the data collected by the moored sediment traps, multicorer sediment and bottom water samples were taken at the mooring stations. Undisturbed seafloor surfaces and cores of the upper few centimeters of the sediment as well as bottom water samples provide important additional information to understand the sedimentary environment at the mooring sites. The data obtained through coring combined with the analysis of the trapped sediment helps budgeting the flux through the water column. During this cruise, only a multicorer was used. No gravity cores were retrieved.

4.7.1 . Multicorer Samples

For the sampling of complete and undisturbed sediment surfaces and the overlying bottom water, a multicorer (MUC) equipped with six large (10 cm diameter) and four small (6 cm diameter) tubes was used. Core recovery was good at all stations. Penetration depths range from 15 cm at the Mid Atlantic Ridge to 42 cm in the Brazil Basin (Table 15).

Table 15. Multicorer sampling.

GeoB	Water depth (m)	Core length (m)	Core recov. Large/ small tubes	Organic Geo-chemistry	Foramini-fera	Dino-flagell.	Cocco-lithoph.	Trace metals	Archive frozen	Bottom water C-Isot. O.Isot.	Radiol./ Diatoms from surface
5201-8	5461	42	6/4	1/0	2/0	1/0	1/0	1/0	0/4	x	0/1
5204-11	3701	16	6/4	1/0	2/0	1/0	1/0	1/0	0/4	x	0/1
5210-7	4150	34	6/4	1/0	2/0	1/0	1/0	1/0	0/4	x	0/1

4.7.2.1 . Sampling

Sediment from the MUC tubes was sampled as follows:

- 1 large tube cut into slices of 1 cm thickness was frozen for organic carbon (TOC) measurements, bottom water samples were taken for stable isotope analysis (2 x 50 ml for $\delta^{13}C$, poisoned with mecury chloride, 1 x 50 ml for $\delta^{18}O$; water sample bottles were sealed with hot wax and stored at 4°C).

- 2 large tubes were cut into slices of 1 cm, filled into KAUTEX plastic bottles and fixed with a solution of rose begal in ethanol (1g/l) and stored at 4°C for the study of foraminifera.

- 1 large tube was cut into 1 cm slices and stored at 4°C for investigation of dinoflagellate communities (top 1 cm bottom water included).

- 1 large tube was cut into slices of 1 cm thickness and frozen for the study of coccolithophorid communities.

- 1 large tube was used for trace metal analysis. The bottom water was sampled, the top 2 cm of the sediment were cut into 0.5 cm slices, the sediment between 2 and 10 cm core depth was cut into slices of 1 cm thickness, the rest of the core was sampled in 2 cm slices. The outer part of the sediment was scraped off to avoid contamination by contact with the tubes. Sediment samples were frozen, water samples were analyzed for nutrients and oxygen in the shipboard labs.

- The surface of 1 small tube was taken for radiolaria and diatom investigations, the rest of the sediment was frozen as an archive core.

- 3 small tubes were frozen as archive cores.

4.7.2.2. Lithology of the Surface Sediments

GeoB 5201-8; 11°31.7'S, 28°31.2'W

At this location in the Central Brazil Basin where the mooring station WAB 1/2 is located, ten multicorer tubes of surface sediment and the overlying bottom water were retrieved out of a water depth of 5461 m. The maximum penetration depth was 42 cm. The sediment is clayey. Its colour is grey-brownish (soil colour chart # 2.5Y5/4) at the top 22 cm and changes to grey-brown-yellow further down the core. A general trend to lighter colour can be observed downcore. Contrary to the general decrease in water content downcore, a layer of higher water content occurs at 27 cm core length. Bioturbation is intense and obvious throughout the whole core.

GeoB 5204-11; 00°00.6'N, 23°29.1'W

At the site of the mooring station WA 12/15 on the eastern flank of the Mid Atlantic Ridge, ten multicorer tubes of sediment and overlying bottom water were recovered. The water depth at this site is 3701 m. The maximum length of the cores is 16 cm. The sediment retrieved is a clayey foraminifera ooze. The carbonate content of the sediment is high. Especially at the sediment surface, the grain size of the foraminifera tests is in the coarse sand fraction. The top of the sediment core is grey (soil colour chart # 2.5Y5/2 or 2.5Y6/2), changing to grey yellowish (soil colour chart # 5Y6/2) at a depth 9 cm down the core. This colour change was interpreted at the transgression from the last glacial to the present interglacial. At a core depth of 7 to 8 cm, black spots are observed. Bioturbation is visible throughout the whole core length.

GeoB 5210-7; 21°16.8'N, 20°41.0'W

At the position of the mooring station CB 8/9, 6 large and 4 small tubes of surface sediment were recovered out of 4150 m water depth. The maximum core length is 34 cm. The sediment consists of clayey foraminifera ooze, the grain size of the foraminifera tests is medium to coarse sand. The colour of the sediment changes from yellowish light grey-brown (soil colour chart # 2.5Y7/4 at the top, # 2.5Y7/3 at 7 cm core length) to light grey-brown with black spots downcore from 22 cm core length (soil colour chart #

2.5Y7/2). No bioturbation or any other sedimentary structures could be observed. The sediment surface was wavy. Partly decayed organic material (fluff) was deposited on the surface of the cores. On one of the coretops, there was a fragment of a calcareous algae.

4.8. Profiling Hydroacoustic Systems

(G. Mollenhauer)

During METEOR Cruise M 41/4 the shipboard hydroacoustic systems HYDROSWEEP and PARASOUND were operated only at the mooring and coring sites to select appropriate coring locations for the multicorer device. The two systems are valuable tools to examine seafloor topography and sedimentary characteristics. Information on these parameters is essential for successful coring and helps interpreting the core material.

4.8.1. HYDROSWEEP

This multibeam sounder provides bathymetric data. It employs a swath of echobeams with a width of twice the water depth. Thus, a topographic map of the ocean floor along the ship's course is obtained, the breadth of which varies with water depth. Knowing the local topography of a coring site is essential to evaluate the impact of morphology, slope angles, sediment instabilities, and erosion on the sedimentary environment. The system worked reliably without any technical problems.

4.8.2. PARASOUND

The sediment echosounder system PARASOUND gives information on the internal structure of the sedimentary cover of the oceanfloor by means of high frequency (4 kHz) seismograms. The penetration of the signal is determined by the density and acoustic impedance of the sediment layers. Therefore, the penetration depth and the reflector characteristics of the ocean floor are important information on the physical properties of

the sediment and the suitability of a certain site for coring. The echosounding data at the coring locations were digitized and stored by using the software package PARADIGMA. The online plots of the seismograms were the predominant criterion for the selection of a coring site.

5. Ship's Meteorological Station

5.1. Cruise Course and Weather

(Christian Knaack)

Leg 4 of the RV METEOR cruise nr. 41 began on the 18th of May 1998 at 10:30 local time in Salvador (Bahia). The ship set out on an easterly course. At the northwestern edge of the subtropical high the trade winds of force 5 were blowing from east to southeast. The waves were composed by a sea of 2 m and a swell from southeast of 2,5 to 3 m height. Some showers occurred. On the 21st of May, the first waypoint at 11.5°S, 28.5°W was reached. The subtropical high had weakened. So the wind decreased to force 4, and the height of the waves was reduced to 1,5 m. The equator was crossed on the 26th of May. From the waypoint at 0.5°N, 24°W the ship sailed a distance of about 800 nm in an east to southeasterly direction. On the 30th of May METEOR reached the eastern most point of the cruise at 2°S, 10,5°W (Guinea Basin). At that time steady trade winds from of force 5, later 4, dominated. On the 1st of June, the ship crossed the equator once more at 10.5°W. Soon the wind of force 5 veered from southeast (trade winds) to south/southwest. This is due to the gradually increasing Coriolis effect causing deflection to the right in the northern hemisphere. During the following days, the Intertropical Convergence Zone (ITCZ) was traversed. In the night from 3rd/4th June intense showers brought almost 40 mm of precipitation. Apart from some shower gusts, the wind abated: METEOR had reached the doldrums. A short meeting with RV POLARSTERN in the morning was favoured by weather with no showers and some sunny periods. In the afternoon new showers ocurred. Our radiosoundings showed a very humid and unstable layered troposphere with convection up to 13 km. On the 6th of June, METEOR left the ITCZ having passed the thermal equator (air temperature 28°C, water temperature 29°C) the day before at 10°N. From now on the subtropical high southwest of the Azores was dominant. Its northeasterly trade winds were blowing mostly with force 4 to 5. With the help of our radio soundings during this time, the characteristic trade wind inversion was observed. The sounding of the 9th of June e. g. showed temperature inversion between 918 and 1250 m height with an increase of 7,2 K. Below the inversion, mostly flat cu clouds were observed, although somtimes almost

overcast sc layers also appeared. Above the inversion layer the atmosphere was dry, and temperature decreased with the tropospheric lapse rate of 0,65 K/100 m. At 21°N, 21°W (off Cape Blanc) the scientific work on board was completed on the 10th of June. During the last days of the cruise, the subtropical high moved to its characteristic location at the Azores. It became stronger with an air pressure of more than 1030 hPa causing an increase of the northeast trade winds, which were blowing with force 5, occasionally 6. As a result, the sea amounted to about 2,5 m height. In the morning of the 13th of June, METEOR arrived safely in Las Palmas (Gran Canaria, Spain).

6. Concluding Remarks and Acknowledgements

The aims of the RV METEOR cruise M41-4 were fully achieved. With a few exceptions, the instruments and systems had worked well. We were able to recover all moorings successfully which were deployed during RV METEOR cruise M38-1. Except of one site, the traps and current meters had worked well and problems due to corrosion were minimal. We obtained very interesting sediment trap material to study the influence of the 1997/98 El Niño event on sedimentation in the Atlantic Ocean.

Acknowledgements

The success of the cruise was only possible because of the excellent teamwork with the ship's crew which was highly competent. The scientific party would like to thank Captain Kull and the entire crew for the friendly cooperation and efficient technical assistance. This work was funded by the Deutsche Forschungsgemeinschaft within the scope of the Sonderforschungsbereich 261 at Bremen University since 1989.

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8. Station List

Table 16. Station list of RV METEOR-Cruise 41, Leg 4.

GeoB #	Date 1998	Device	Time seafloor/ max. length of wire (UTC)	Latitude	Longitude	Water depth	Samples/ Core recovery	Remarks
Central Brazil Basin								
5201-1	21.05.	MN	03:46	11°33.4'S	28°34.4'W	5469	5 cups	Forams, water isot., 300, 200, 100, 50, 0 m
5201-2		MN	04:50	11°33.4'S	28°34.3'W	5469	5 cups	Radiolaria, 400, 200, 100, 40, 20 m
5201-3		MN	05:30	11°33.4'S	28°34.4'W	5469	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m
5201-4		KWS	05:56	11°33.3'S	28°34.3'W	5468	17x10l	4x200m,4x150m, 3x175m,3x120m,3x100m
5201-5		KWS	06:44	11°33.4'S	28°34.3'W	5468	12x10 l	3x75 m, 3x50 m, 3x20 m,3x10 m
5201-6		WAB1	08:14	11°33.0'S	28°32.4'W	5407	2 sed.-	Release, start recovery
		WAB1	11:03	11°32.9'S	28°31.4'W		traps	Stop recovery; 2x20 cups with sediment
5201-7		WAB2	12:55	11°32.9'S	28°31.1'W		2 sed.-	Start deployment
		WAB2	15:24	11°36.0'S	28°32.4'W		traps-	Weight over board, stop deployment
5201-8		MUC	18:10	11°31.7'S	28°31.2'W	5461	42 cm	6 l., 4 s. tubes filled; clay, brownish-grey, 3 bottomwater samples
		with CTD						Profile depth: 5504 m
5201-9		ISP	22:00	11°29.5'S	28°33.3'W	5420	60 min.	1000, 600, 400, 200, 125, 90, 50, 15 m
5201-10	22.05.	GoFlo	01:07	11°29.5'S	28°33.3'W	5420	11x12 l	15, 50, 90, 125, 200, 300, 400, 600, 800, 1250, 1500 m
Northern Brazil Basin								
5202-1	23.05.	ISP	00:40	07°31.5'S	28°14.0'W	4712	60 min.	1000,600, 400, 200, 125, 90, 50, 15 m
5202-2		GoFlo	03:59	07°31.5'S	28°14.1'W	4717	12x12 l	15, 50, 90, 125, 200, 300, 400, 600, 800, 1000, 1250, 1500 m
5202-3		KWS	05:10	07°31.5'S	28°14.0'W	4715	18x10 l	4x200, 3x175, 4x150, 3x120, 4x100 m
5202-4		KWS	05:54	07°31.6'S	28°14.0'W	4714	15x10 l	4x75, 4x50, 4x20, 3x10 m
5202-5		WA13	08:21	07°28.7'S	28°14.3'W	5474	2 sed.-	Release, start recovery
		WA13	11:37	07°28.1'S	28°14.9'W		traps	Stop recovery; upper trap at position 20, 20 cups with material., lower trap at position 1
5202-6		MER	12:10	07°27.8'S	28°15.2'W	5361	80 m	Digital light absoption measurements down to 1 % PAR
5202-7		WA14	12:58	07°27.4'S	28.15.0'W	5407	2 sed.-	Start deployment
		WA14	15:04	07°27.9'S	28°12.9'W	5575	traps	Weight over board, stop deployment
5202-8		MN	16:55	07°26.7'S	28°12.5'W	5578	5 cups	Forams, water isot., 500, 300, 200, 100, 50 m
5202-9		MN	17:55	07°26.7'S	28°12.5'W	5576	5 cups	Radiolaria, 400, 200, 100, 40, 20 m
5202-10		MN	18:32	07°26.7'S	28°12.6'W	5576	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m
5202-11	24.05.	ISP	00:05	07°25.1'S	28°11.3'W	5562	60 min.	1500,2000,3000,4000,5160,5360, 5460,5510m
5202-12		GoFlo	07:27	07°25.1'S	28°11.3'W	5585	12x12 l	25, 1500, 2000, 2500, 3000, 3500, 4000, 4760, 5160, 5360, 5460, 5510 m
		with CTD						Profile depth: 5536 m

Table 16. Continued.

GeoB #	Date 1998	Device	Time seafloor/ max. length of wire (UTC)	Latitude	Longitude	Water depth	Samples/ Core recovery	Remarks
5203-1	25.05.	MER	11:39	03°53.4'S	25°41.3'W	5530	70 m	Digital light absoption measurements to 1% PAR
5203-2		KWS	12:06	03°53.2'S	25°41.5'W	5530	18x10 l	4x200, 3x175, 4x150, 3x120, 4x100 m
5203-3		KWS	12:49	03°52.8'S	25°41.7'W	5530	16x10 l	4x75, 4x50, 4x20, 4x10 m
5203-4		ISP	14:24	03°50.8'S	25°41.2'W	5531	60 min.	15, 50, 90, 125, 200, 400, 600, 1000 m
5203-5		GoFlo	17:44	03°50.7'S	25°41.3'W	5532	12x12 l	15, 50, 90, 125, 200, 300, 400, 600, 800, 1000, 1250, 1500 m
		with CTD						Profile depth 1450 m
5203-6		MN	19:10	03°50.3'S	25°41.3'W	5533	5 cups	Forams, 500,300,200,100,50 m; water isot. 500, 200, 100, 50 m
5203-7		MN	20:07	03°50.1'S	25°41.3'W	5532	5 cups	Radioilaria, 400, 200, 100, 40, 20 m
5203-8		MN	20:43	03°49.9'S	25°41.2'W 1	5531	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m
Mid Atlantic Ridge, Eastern Flank								
5204-1	26.05.	MN	22:31	00°00.1'N	23°28.8'W	3685	5 cups	Forams, water isot., 500, 300, 200, 100, 50 m
5204-2		MN	23:32	00°00.2'N	23°28.4'W	3682	5 cups	Radiolaria, 400, 200, 100, 40, 20 m
5204-3	27.05.	MN	00:11	00°00.3'N	23°28.3'W	3682	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m
5204-4		ISP	01:50	00°00.4'N	23°26.8'W	3710	60 min.	15, 50, 90, 125, 200, 400, 600, 1000 m
5204-5		GoFlo	05:07	00°00.4'N	23°26.7'W		12x12 l	15, 50, 90, 125, 200, 300, 400, 600, 800, 1000, 1250, 1500 m
5204-6		KWS	06:07	00°00.5'N	23°26.3'W	3744	18x10 l	4x200, 3x175, 4x150, 3x120, 4x100 m
5204-7		KWS	06:40	00°00.7'N	23°26.3'W	3699	16x10 l	4x75, 4x50, 4x20, 4x10 m
5204-8		WA12	07:37	00°02.7'N	23°28.8'W	3725	2 sed.-	Release, start recovery
		WA12	10:24	00°02.4'N	23°28.5'W		traps	Stop recovery; rope ripped 2x20 cups of material
5204-9		MER	10:49	00°02.7'N	23°28.7'W	3722	55 m	Digital light absoption measurements down to 1% PAR
5204-10		WA15	11:22	00°03.1'N	23°28.8'W	3717	2 sed.-	Start deployment
		WA15	12:30	00°02.1'N	23°27.6'W	3715	traps	Weight over board, stop deployment
5204-11		MUC	14:54	00°00.6'N	23°29.1'W	3701	16 cm	6 large, 4 small tubes filled, clayey foram ooze, 3 bottomwater samples
		with CTD						Profile depth 1600, battery failure

Table 16. Continued.

GeoB #	Date 1998	Device	Time seafloor/ max. length of wire (UTC)	Latitude	Longitude	Water depth	Samples/ Core recovery	Remarks
Southern Guinea Basin								
5205-1	30.05.	ISP	23:47	02°00.0'S	10°15.0'W	3867	60 min.	15, 50, 90, 125, 200, 400, 600, 1000 m
5205-2	31.05.	GoFlo	03:00	02°00.0'S	10°15.0'W	3815	12x12 l	15, 50, 90, 125, 200, 300, 400, 600, 800, 1000, 1250, 1500 m
5205-3		MN	04:22	02°00.0'S	10°14.9'W	3819	5 cups	Forams, water isot., 500, 300, 200, 100, 50 m
5205-4		MN	05:18	02°00.0'S	10°15.0'W	3803	5 cups	Radiolaria, 400, 200, 100, 40, 20 m
5205-5		MN	05:55	02°00.0'S	10^°15.0'W	3807	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m
5205-6		KWS	06:30	02°00.0'S	10°15.0'W	3802	18x10 l	4x200, 3x175, 4x150, 3x120, 4x100 m
5205-7		KWS	07:05	02°00.0'S	10°15.0'W		16x10 l	4x75, 4x50, 4x20, 4x10 m
5205-8		MER	07:41	02°00.0'S	10°15.0'W	3807	20 m	Digital light absoption measurements down to 1% PAR
5205-9		ISP	10:50	01°57.9'S	10°16.0'W	3588	60 min.	1500, 2000, 2500, 3000, 3190, 3390, 3490, 3540 m
5205-10		GoFlo	16:44	01°58.0'S	10°15.9'W	3600	12x12 l	25, 70, 170, 500, 700, 2000, 2500, 3000, 3190, 3390, 3490, 3540 m
		with CTD						Profile depth: 3521m
Equatorial Upwelling								
5206-1	01.06.	ISP	03:13	00°30.0'S	10°29.7'W	3902	60 min.	15, 50, 90, 125, 200, 400, 600, 1000 m
5206-2		GoFlo	06:36	00°30.0'S	10°29.7'W	3916	10x12 l	15, 50, 90, 125, 200, 300, 400, 600, 800, 1500 m
		with CTD						Profile depth: 1488 m
5206-3		MN	08:00	00°30.0'S	10°29.3'W	3923	5 cups	Forams, water isot., 500, 300, 200, 100, 50 m
5206-4		MN	08:55	00°29.7'S	10°29.0'W	3925	5 cups	Radiolaria, 400, 200, 100, 40, 20 m
5206-5		MN	09:35	00°29.7'S	10°28.5'W	3926	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m
5206-6		KWS	10:15	00°29.9'S	10°29.0'W	3924	18x10 l	4x200, 3x175, 4x150, 3x120, 4x100 m
5206-7		KWS	10:48	00°29.7'S	10°28.6'W	3932	16x10 l	4x75, 4x50, 4x20, 4x10 m
5206-8		MER	11:32	00°28.4'S	10°28.5'W	3917	59 m	Digital light absoption measurements down to 1% PAR
Western Guinea Basin								
5207-1	02.06.	ISP	01:38	02°00.1'N	11°15.4'W	4591	60 min.	15, 50, 90, 125, 200, 400, 600, 1000 m
5207-2		GoFlo	05:12	01°59.6'N	11°15.2'W	4585	11x12 l	15, 50, 90, 125, 300, 400, 600, 800, 1000, 1250, 1500 m
5207-3		MN	06:27	02°00.0'N	11°15.2'W	4578	5 cups	Forams, water isot., 500, 300, 200, 100, 50 m
5207-4		MN	07:25	01°59.9'N	11°15.3'W	4577	5 cups	Radiolaria, 400, 200, 100, 40, 20 m
5207-5		MN	08:08	01°59.9'N	11°15.4'W	4579	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m
5207-6		KWS	09:02	02°00.0'N	11°15.2'W	4571	18x10 l	4x200, 3x175, 4x150, 3x120, 4x100 m
5207-7		KWS	09:38	02°00.0'N	11°15.3'W	4585	16x10 l	4x75, 4x50, 4x20, 4x10 m
5207-8		MER	10:27	02°01.3'N	11°15.6'W	4609	58 m	Digital light absoption measurements down to 1% PAR

Table 16. Continued.

GeoB #	Date 1998	Device	Time seafloor/ max. length of wire (UTC)	Latitude	Longitude	Water depth	Samples/ Core recovery	Remarks
5207-9		ISP	16:15	02°03.4'N	11°19.4'W	4576	60 min.	1450, 1950, 2450, 3450, 4174, 4374, 4474, 4524 m
5207-8		GoFlo	23:18	02°03.6'N	11°19.6'W	4588	12x12 l	25, 70, 200, 500, 2000, 2500, 3000, 3780, 4180, 4380, 4480, 4530 m
		with CTD						Profile depth: 5529
Southeastern Sierra Leone Basin								
5208-1	03.06.	KWS	10:26	03°10.0'N	12°29.9'W	4532	18x10 l	4x200, 3x175, 4x150, 3x120, 4x100 m
5208-2		KWS	11:02	03°10.0'N	12°29.9'W	4526	16x10 l	4x75, 4x50, 4x20, 4x10 m
5208-3		MER	11:41	03°10.0'N	12°29.5'W	4526	56 m	Digital light absoption measurements down to 1% PAR
5208-4		ISP	13:19	03°11.4'N	12°31.2'W	4533	60 min.	15, 50, 90, 125, 200, 400, 600, 1000 m
5208-5		GoFlo	16:34	03°11.2'N	12°30.9'W	4541	11x12 l	15, 50, 90, 125, 200, 300, 400, 800, 1000, 1250, 1500 m
		with CTD						Profile depth 200 m, battery failure
5208-6		MN	17:52	03°11.2'N	12°30.7'W	4537	5 cups	Forams, water isot., 500, 300, 200, 100, 50 m
5208-7		MN	18:44	03°11.1'N	12°30.6'W	4536	5 cups	Radiolaria, 400, 200, 100, 40, 20 m
5208-8		MN	19:20	03°11.1'N	12°30.5'W	4536	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m
Eastern Gambia Plain								
5209-1	06.06.	MER	14:16	11°28.9'N	21°00.2'W	4972	43 m	Digital light absoption measurements down to 1% PAR
5209-2		KWS	14:43	11°29.0'N	21°00.4'W	4972	18x10 l	4x200, 3x175, 4x150, 3x120, 4x100 m
5209-3		KWS	15:12	11°29.1'N	21°00.4'W	4971	16x10 l	4x75, 4x50, 4x20, 4x10 m
5209-4		ISP	16:35	11°31.0'N	21°00.2'W	4967	60 min.	15, 50, 90, 125, 200, 400, 600, 1000 m
5209-5		GoFlo	19:57	11°31.2'N	20°59.96'W	4969	10x12 l	15, 50, 125, 200, 300, 400, 800, 1000, 1250, 1500 m
5209-6	07.06.	ParCa	01:57	11°31.3'N	21°00.0'W	4966	4000 m	Digital video observation of particles
		with CTD						Profile depth 4033 m
5209-7		MN	02:30	11°31.3'N	20°59.9'W	4967	5 cups	Forams, water isot., 500, 300, 200, 100, 50 m
5209-8		MN	03:15	11°31.3'N	20°59.8'W	4966	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m

Table 16. Continued.

GeoB #	Date 1998	Device	Time seafloor/ max. length of wire (UTC)	Latitude	Longitude	Water depth	Samples/ Core recovery	Remarks
West of Cape Blanc								
5210-1	09.06.	MER	13:00	21°15.3'N	20°41.6'W	4113	15 m	Dgital light absoption measurements down to 1% PAR
5210-2		CB8	13:04	21°15.3'N	20°41.6'W		2 sed.-	Release, start recovery
		CB8	15:40	21°15.5'N	20°43.6'W		traps	Stop recovery, upper trap: 20 cups with material,
5210-3		KWS	16:19	21°16.2'N	20°41.6'W	4118	18x10 l	4x200, 3x175, 4x150, 3x120, 4x100 m
5210-4		KWS	16:45	21°16.2'N	20°41.7'W	4118	16x10 l	4x75, 4x50, 4x20, 4x10 m
5210-5		ISP	18:48	21°16.9'N	20°40.9'W	4121	60 min.	15, 50, 90, 125, 200, 400, 600 m
5210-6		GoFlo	22:01	21°16.9'N	20°41.0'W	4121	10x12 l	15, 50, 90, 125, 300, 400, 800, 1000, 1250, 1500 m
5210-7	10.06.	MUC	23:02	21°16.8'N	20°41.0'W	4150	34 cm	6 large, 4 small tubes filled, clayey foram ooze, 3 bottomwater samples
		with CTD						Profile depth 4146 m
5210-8		ParCa	03:56	21°16.9'N	20°41.0'W	4124	1500 m	Digital video observation of particles
5210-9		MN	05:03	21°16.9'N	20°41.0'W	4121	5 cups	Forams, water isot., 500, 300, 200, 100, 50 m
5210-10		MN	05:54	21°16.9'N	20°41.0'W	4119	5 cups	Radiolaria, 400, 200, 100, 40, 20 m
5210-11		MN	06:30	21°16.9'N	20°40.9'W	4122	5 cups	C_{org}, water isot., 250, 100, 75, 50, 25 m
5210-12		CB9	08:15	21°14.5'N	20°42.7'W	4120	2 sed.-	Start deployment
		CB9	09:45	21°15.7'N	20°42.1'W	4121	traps	Weight over board, stop deployment; position determined at: 21°15.2'N, 20°42.4'W
5210-13		ISP	13:51	21°18.4'N	20°40.3'W	4124	60 min.	1000, 2000, 3000, 3720, 3920, 4020, 4070 m
5210-14		GoFlo	19:36	21°18.4'N	20°40.4'W	4124	9x12 l	25, 200, 500, 600, 2000, 3000, 3720, 3920, 4020 m

Table Legend:

(xx)	Number of water or plankton samples, pumping time, core length, etc.
CB	Cape Blanc Mooring
CTD	Conductivity, Temperatur, Density sensor (standard), equipped with oxygen and chlorophyll-fluorescence sensor, profile depth after wire length
GoFlo	GoFlow Water Samplers
ISP	In Situ Pumps
KWS	Multiple Water Sampler
MER	Profiling Spectroradiometer
MN	Multinet with 5 NISKIN-bottles
MUC	Multiple Corer, 6 tubes with 10 cm diameter, 4 tubes with 6 cm diameter
ParCa	Profiling Particle Camera
WA	West Atlantic Mooring
WAB	West Atlantic Brazil Basin Mooring