

# BERICHTE

aus dem Fachbereich Geowissenschaften  
der Universität Bremen

No. 231

Meinecke, G., L. Barbero Munoz, C. Barrera,  
M. Bergenthal, M. Busack, K. Dehning,  
S. Klar, E. Kopsiske, G. Ruhland,  
M. Villagarcia, M. Zaun

REPORT AND PRELIMINARY RESULTS OF  
R/V POSEIDON CRUISE 296  
LAS PALMAS (SPAIN) - LAS PALMAS (SPAIN)  
April 04<sup>th</sup> -April 14<sup>th</sup>, 2003

Berichte, Fachbereich Geowissenschaften, Universität Bremen, No. 231 ,  
42 pages, Bremen 2004



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.

Reports can be ordered from:

Monika Bachur  
Forschungszentrum Ozeanränder, RCOM  
Universität Bremen  
Postfach 330 440  
**D 28334 Bremen**  
Phone: (49) 421 218 - 8960  
Fax: (49) 421 218 - 3116  
e-mail: [mbachur@uni-bremen.de](mailto:mbachur@uni-bremen.de)

Citation:

Dr. Meinecke, G. and participants

Report and preliminary results of Poseidon Cruise 296, Las Palmas – Las Palmas, 04.04.-14.04.2003.

Berichte, Fachbereich Geowissenschaften, Universität Bremen, No. 231, 42 pages, Bremen, 2004

ISSN 0931-0800

## CONTENTS

1.	Participants	4
2.	Research Objectives	5
	2.1 ESTOC	5
	2.2 DOLAN	5
	2.3 ANIMATE	5
3.	Narrative of the Cruise	6
4.	Scientific Report	7
	4.1 Equipment Development and Tests	7
	4.1.1 DOLAN-SBU and - MSU	7
	4.1.2 ESTOC / ANIMATE	12
	4.2 Particle Collection with Sediment Traps	14
	4.2.1 ANIMATE / ESTOC	14
	4.2.2 DOLAN-MSD	14
	4.3 Marine Chemistry	16
	4.2.1 Water Sampling and Analysis	19
	4.2.2 Preliminary Results	23
5.	List of Stations	25
6.	Acknowledgements	26
7.	References	27

**1. Participants****Participants Poseidon Cruise 296**

<b>Name</b>	<b>Domain</b>	<b>Institution</b>
Meinecke, Gerrit, Dr.	Marine Geology (Chief Scientist)	GeoB
Bergenthal, Markus	Technician DOLAN	GeoB
Klar, Steffen	Technician DOLAN	GeoB
Kopiske, Eberhard	Technician DOLAN	GeoB
Ruhland, Götz	Marine Geology	GeoB
Dehning, Klaus	Technician	GeoB
Busack, Michael	Technician	GeoB
Zaun, Marco	Technician	GeoB
Villgarcia, Marimar, Dr.	Marine Chemistry	ICCM
Barrera, Carlos	Marine Chemistry	ICCM
Barbero Muñoz, Leticia	Marine Chemistry	ULPGC

**Institutions**

**GeoB** Dept. of Geosciences FB5, University Bremen, Klagenfurter Straße, 28359 Bremen, Germany

**ICCM** Instituto Canario de Ciencias Marinas, Apto. Correos 55, 35200 Telde de Gran Canaria, Spain

**ULPGC** Universidad de Las Palmas de G. Canaria, Edificio de Ciencias Básicas, Campus Universitario Tafira, E-35017 Las Palmas de Gran Canaria, Canary-Islands, Spain

## 2. Research Objectives

The upwelling area off NW-Africa is one of the most important upwelling systems of the global ocean influenced by high amounts of Sahara dust which is transporting nutrients into the ocean. Both factors are of fundamental importance for the particle production in the ocean influencing the processes of the biological carbon pump system. Hence, they are controlling factors of the global atmospheric CO<sub>2</sub>-budget. Despite the main driving-force for climatic variability is located in the North-Atlantic, the upwelling area off NW-Africa is suitable to reconstruct the past climatic variability, via observation of present in-situ environmental datasets.

The research topics were carried out in correlation with the following projects:

### 2.1 ESTOC (European Station for Time series in the Ocean, Canary Islands)

One goal of POS 296 cruise will be the work at ESTOC station, which is located 60 nm north of Gran Canaria (29°10'N, 15°30'W) in the eastern boundary flow of the subtropical North Atlantic gyre. Standard parameters of hydrography, nutrients, oxygen, chlorophyll a and DIC have been determined monthly since 1994. In addition, long term particle flux has been determined with moored traps since 1991 and seasonal with free-drifting traps. This time-series station is now co-operated by the ICCM (Instituto Canario de Ciencias Marinas) and the GeoB (Department of Geosciences, University Bremen). The main purpose of the station is to build up a long-term oceanographic data base in order to be able to discern seasonal from long-term variability of hydrographic and biochemical parameters in this environmentally sensitive region.

### 2.2 DOLAN (Operational Data Transmission in the Ocean and Lateral Acoustic Network in the Deep-Sea)

During POS 296 cruise, it is planned to work on the DOLAN site as well. The DOLAN station is located 25 nm west of ESTOC and comprises technical devices for transmission of scientific data sets by means of acoustic communication in the water column via satellite into the internet and research institutes.

### 2.3 ANIMATE (Atlantic Network of Interdisciplinary Moorings and Time series for Europe)

Finally, the third task will concentrate on the ANIMATE EU project, which is closely linked to ESTOC and DOLAN. In the ANIMATE project, moorings were deployed on key sites in the northern Atlantic (ESTOC, Canary Islands; PAP, Porcupine Abyssal Plain; CIS, Central Irminger Sea) in order to gain data of CO<sub>2</sub>, nutrients and fluorescence, which will be transmitted directly via satellite to the participating scientific institutes. A significant element in ANIMATE is the transmission technology used in the DOLAN project. Till year 2003, ESTOC was used as reference site for the subtropical NE-Atlantic within the ANIMATE project. During this cruise a separate ANIMATE mooring (ACI\_2), consisting of several scientific sensors (MicroCat, ADCP, Currentmeters) should be moored 25 nm northwest of ESTOC site.

### 3. Narrative of the Cruise

R/V Poseidon left the port of Las Palmas on April 4<sup>th</sup> with heading to DOLAN position. Underway 6 XBT's were launched. During the morning of April 5<sup>th</sup> the DOLAN surface buoy (SBU) was recovered successfully. The station work was continued with two CTD/Rosette casts down to 3602 m water depth and finished by deploying a NOAA drifting buoy at 20:00 am. In the morning of April 6<sup>th</sup> R/V POSEIDON reached the position of the former CI15/ACI\_1 mooring. It was assuming that the mooring was broken, some month after deployment. Several tries to release the ANIMATE ACI\_1 mooring failed and we decided to leave the position and make another try to recover ACI\_1/CI 15 later, during the cruise. The station work was continued with communication tests of inductive modems during the afternoon. In the beginning of April 7<sup>th</sup> the scientific task started with a CTD/Rosette cast down to 3630 m. After that, the DOLAN Multi Sensor Device (MSD) mooring was released and completely recovered in the afternoon, at 2:00 am. Finally, the station work was finished with another CTD/Rosette cast. During April 8<sup>th</sup>, the DOLAN mooring was redeployed in two steps. In the first part, a dummy was deployed and the anchor was slipped afterwards. In the afternoon the dummy package was recovered again and replaced with the DOLAN surface data buoy. At 20:00 am all test were secluded.

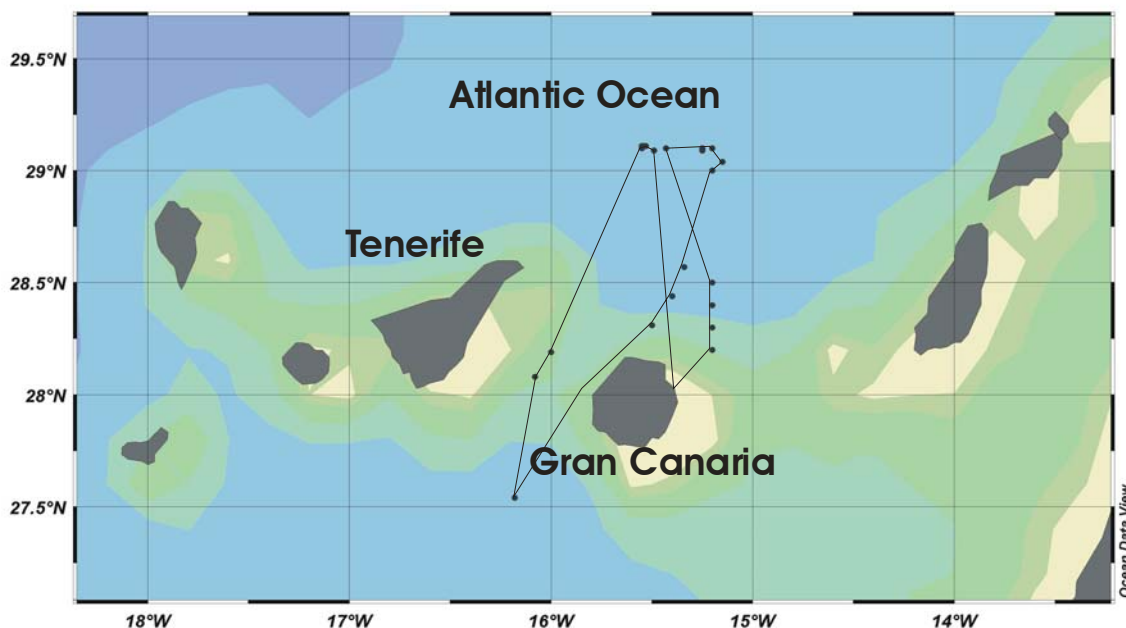


Figure 1: Cruise track R/V POSEIDON cruise 296

During the next two days, three CTD/Rosette station were run on a transect between Tenerife and Gran Canaria. Scientific work on April 11<sup>th</sup> started with another CTD/Rosette cast down to 3603 m. Subsequently we tried again to release the broken CI\_15/ACI\_1 array without success. R/V POSEIDON left this site with heading to ESTOC station, where we deployed the CI\_16 mooring, in the late afternoon. During night, R/V POSEIDON moved on to the new ACI-mooring located 5 nm SE of the DOLAN data buoy. On April 12<sup>th</sup>, the new ACI\_2 mooring was deployed again. Finally, the station work was finished with a CTD/Rosette cast down to 3622 m water depth. Due to the upcoming bad weather conditions the research work was cancelled on April 13<sup>th</sup> and R/V POSEIDON steamed back to Las Palmas harbour.

## 4. Scientific Report

### 4.1 Equipment Development and Tests

#### 4.1.1 DOLAN Surface Buoy (SBU) and Multi Sensor Device (MSD)

The DOLAN SBU mooring has been broken in December 2002. The drifting buoy was recovered by a Spanish SAR ship and shipped to the ICCM (Instituto Canario de Ciencias Marinas) on Gran Canaria. Scientists from University Bremen removed the electronics and the control mast of the buoy and sent it back to Bremen for repair. A new mast of stainless steel was prepared in Bremen and some more sensors and satellite communication units were added. The new mast has been mounted on the buoy inside the harbour of Las Palmas, before the R/V POSEIDON cruise 296.



Figure 2: Upgrading of the DOLAN buoy inside Las Palmas harbour.

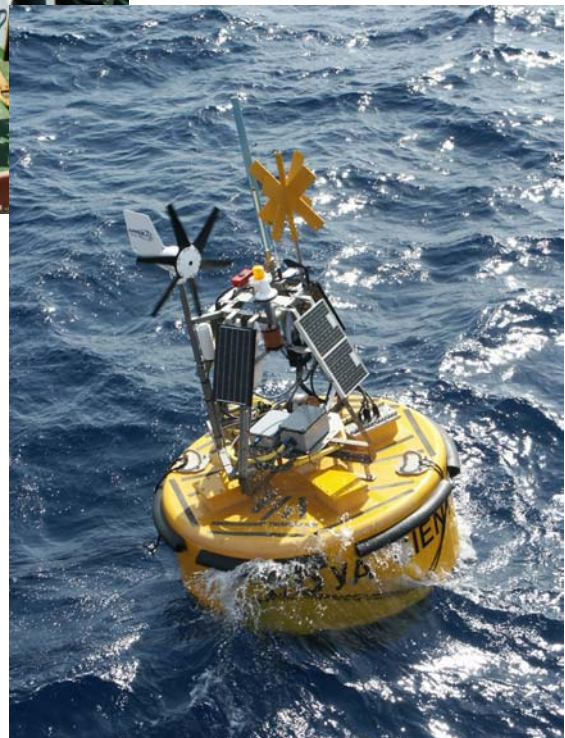
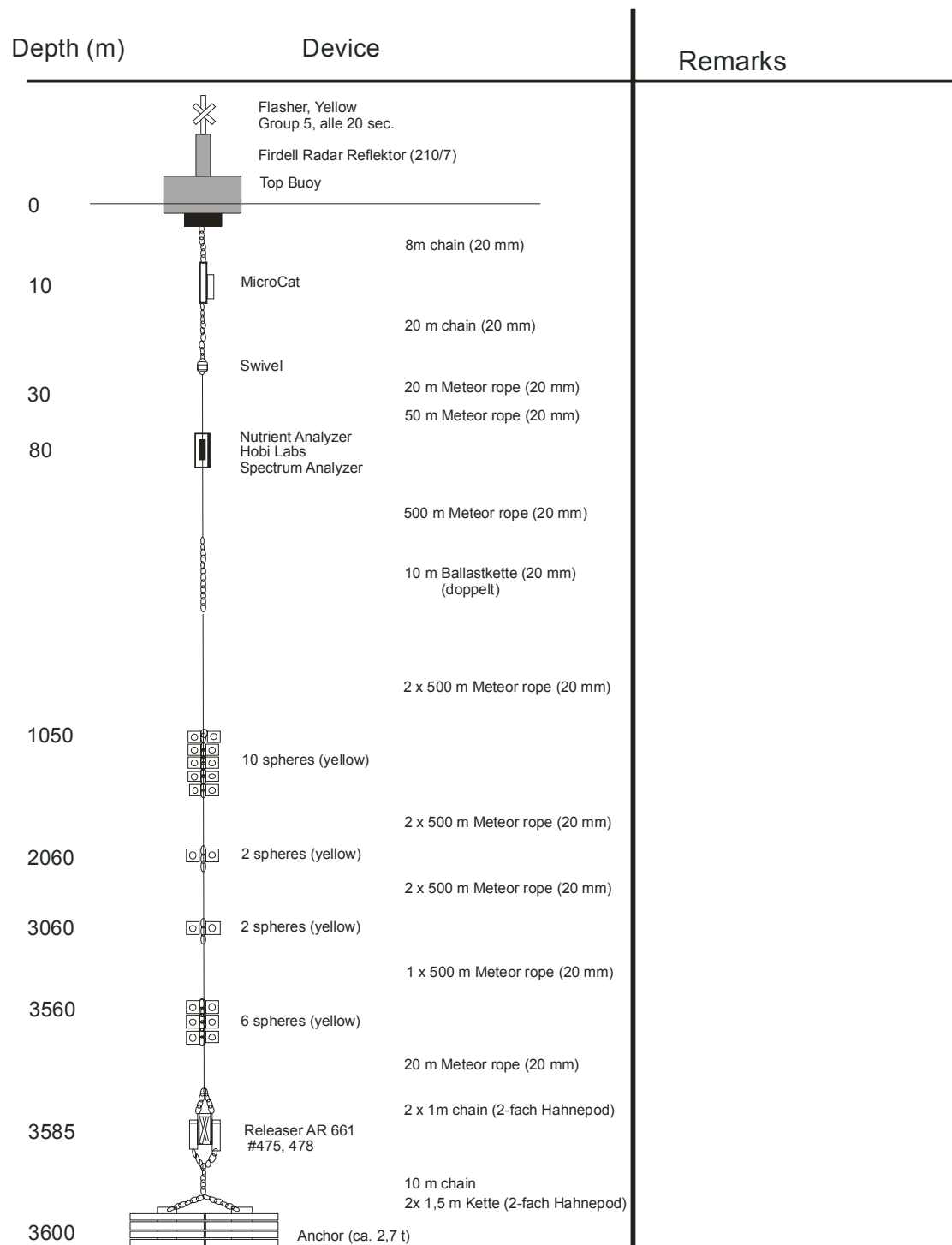


Figure 3: DOLAN buoy with the new mast and new configuration after deployment.

During the forenoon on the April 5<sup>th</sup> the remaining buoy mooring was released. All sensors, which were attached into the chain below the SBU-data buoy, could be recovered successfully. This comprises the fluorometer and the acoustic transducer. The nutrient sensor which was fitted into a steel cable below the swivel got lost. The new DOLAN SBU mooring was redeployed on April 8<sup>th</sup>.



**Mooring: DOLAN SBU (Top buoy)**

**Expedition: POS 296**

**Position 29°11,33'N; 015°54,9'W**

**Area: Canary Islands, 25nm west of ESTOC Station**

**Water depth: ca 3600m**

**Date: 08.04.2003**



Codes	#475: I/R	5843
	Rel	5844
	#478: I/R	5850
	Rel	5859

Figure 4: Drawing of the DOLAN-SBU.



*Status of DOLAN before POS 296*

On the R/V METEOR M53 cruise (2002) the SBU (Surface Buoy Unit) and 0.5 nm apart the MSD (Multi Sensor Device) were deployed.

The MSD contains one Kiel type sediment trap, one FSI CTD/ACM with acoustic current meter and a compass. The PARCA (Particle Camera, based on a Sony VX 1000 camcorder) and a strobe have been mounted in the MSD frame as well. The different sensors were connected to the BC2 computer. The BC2 is able to communicate with the SBU via a bi-directional acoustic modem (MATS, Orca). The SBU contains the counterpart modem, connected to the BC10, the control computer for the DOLAN data buoy. Sensors on the buoy are one wind vane, a cup anemometer and a compass. For tracking purposes one GPS is connected to the BC10. Additionally, a complete separated Tracking Unit, powered by an own Battery pack, is mounted on the buoy. This Unit contains one Panasonic Orbcomm Transceiver with integrated GPS unit. This unit sends the current buoy position once a day.

The other Sensors can be contacted via Orbcomm, the BC10 and the sub-sea link. The sensor data will be sent via Orca modem, BC10 and Orbcomm. For the first tests of the buoy one SATEL packed radio is modem is installed, which can communicate to a ship within a distance of one nautical mile. One ARGOS PTT is mounted on the buoy for tracking because the original tracking unit stopped sending position reports in November 2002. Thus, it was unable to recover the buoy in December 2002.

*New Systems on the Buoy**Inmarsat Mini-C*

One Inmarsat Mini-C Transceiver (Thrane&Thrane), with integrated GPS, has been mounted on the buoy which replaces the Orbcomm tracking unit.

*Wind Generator*

A wind generator has been added to support the 24 V power supply network. In addition, a new charging regulator for the generator has been installed, also. This was necessary due to some problems with the power supply of the buoy and the high power consumption of the Orca acoustic modems.

*Animate Telemetry*

Some sensors coming from the ANIMATE Project need to be deployed in very precise depth of about 10 m and 80 m below the surface. Because of this it has been decided to put the following sensors into the separate DOLAN SBU mooring instead of the ACI\_2 mooring:

*Vaisala Weather Sensors:*

Air Temperature	
Barometric Air Pressure	
Relative Humidity	
SAMI CO <sub>2</sub>	10 m
Microcat	10 m

HS2 Fluorometer	80 m
NAS-2E Nutrient Analyzer	80 m

These sensors shall be integrated into the telemetry as far as possible. The ANIMATE Telemetry has been designed to transmit the sensor data via an Orbcomm transceiver. The SAMI CO<sub>2</sub> sensor and the MicroCat CTD have been integrated into the telemetry and connected to the ANIMATE Telemetry box via a cable. The HS2 Fluorometer and the NAS-2E Nutrient Analyzer have not yet been integrated into the telemetry.

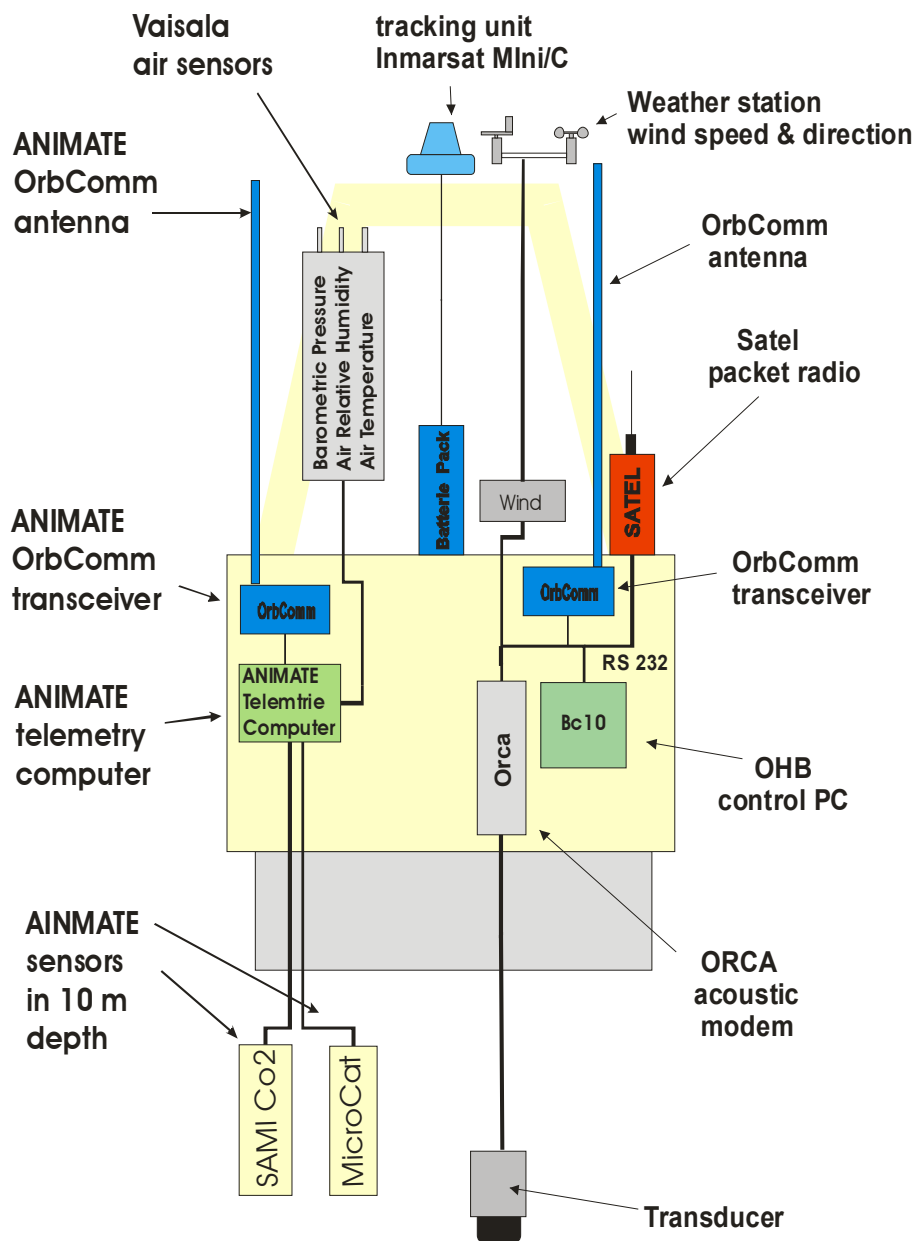


Figure 5: Configuration of the DOLAN Buoy

### *A Change in the Electrical Architecture*

The electrical concept has been changed due to many power problems in the past. The power supply has been split into one 12V power supply for the BC10, the sensors on the buoy, GPS, Panasonic transceiver, Flashlight etc. The high power branch with the Orca modem has its own 24V power supply. The 12V system is supported by two 20W solar panels, the 24V branch by two 10W solar panels and the wind generator (Ampair Pacific 100W 24V).

### *Test Concept*

All systems in the DOLAN Network have been tested on device level before shipment. The whole system has been checked after the assembly, before deployment on deck of the ship. The last test before deployment was the in-situ test with the MSD, lowered by the ships winch down to a depth of 3000 m. The buoy was on board of R/V POSEIDON, but the acoustic transducer was in 5 m depth. For controlling and monitoring reasons, the DOLAN Acoustic Rack has been used to record and monitor the acoustic transmission between SBU and MSD with a second Hydrophone.

All MSD sensors have been addressed on the following path:

Ship (Laptop->SATEL) ->  
SBU (SATEL -> BC10 -> Orca Modem) ->  
MSD (Orca Modem -> BC2 -> Sensor)

The tests were successful after some adjustments of the modem addresses of some units. After these tests some tests have been performed via the Orbcomm link instead of the SATEL Radio link. These tests are very difficult with the buoy located on board the ship, because the Orbcomm antenna is shielded by the ships facilities, like the A-Frame. The Orbcomm performance of the SBU at sea deployed is much better.

#### 4.1.2 ESTOC / ANIMATE

This study site is located 60 nm north off Gran Canaria in about 3600 m water depth. The mooring was at least deployed during the R/V METEOR cruise M53, 2002.

Before the R/V POSEIDON cruise 296 the ESTOC mooring was coupled with the ANIMATE mooring near the original ESTOC site. On the April 6<sup>th</sup> it was tried to recover the CI\_15/ANIMATE\_1 array. Both releasers were contacted without any problems but the mooring does not rise up. During the next 5 hours the releasers were rounded upon several directions. Every time they offer a distance from 3700 m, so we decided to cancel this working part at 3:00 am for that day. On the April 11<sup>th</sup> R/V POSEIDON reaches again the ESTOC position. We tried again to recover the array. In consideration of the fact, that we get depth between 3630 and 3639 m from both releasers, we assume that the remaining mooring array must be torn off, while the releasers lay at the bottom without buoyancy.

During this cruise, we decided to split the moorings and to place separate mooring arrays for both projects ESTOC and ANIMATE. This has been carried out because of the fact that the moorings, involved in the ANIMATE project, often got lost in the past, what seems to be a problem of the steel ropes in use and the visible surface buoyancy parts of the telemetry.

##### *ESTOC (CI\_16, Canary Island Mooring)*

The deployment of the ESTOC array was carried out on the April 11<sup>th</sup> in the afternoon. Attached to the mooring are two sediment traps at depths of 1025 m and 3055 m. The water depth is about 3630 m. The recovery of this array is planned in April 2004 during the R/V POSEIDON cruise 310.

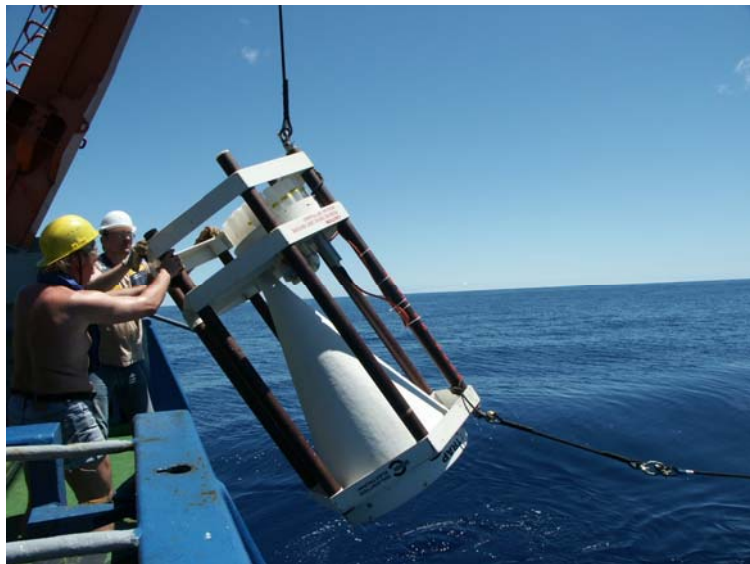


Figure 6: Deployment of the upper sediment trap attached to the ESTOC mooring CI\_16.

*ANIMATE (ACI\_2, ANIMATE Canary Island)*

The ANIMATE (ACI\_2) mooring was deployed at April 12<sup>th</sup>, at a water depth about 3600 m. The research site included the ARGOS telemetry buoy, 8 MicroCats, a floatation sphere with integrated ADCP, one sediment trap (McLane, SOC (Southampton Oceanography Center)) and two currentmeter.

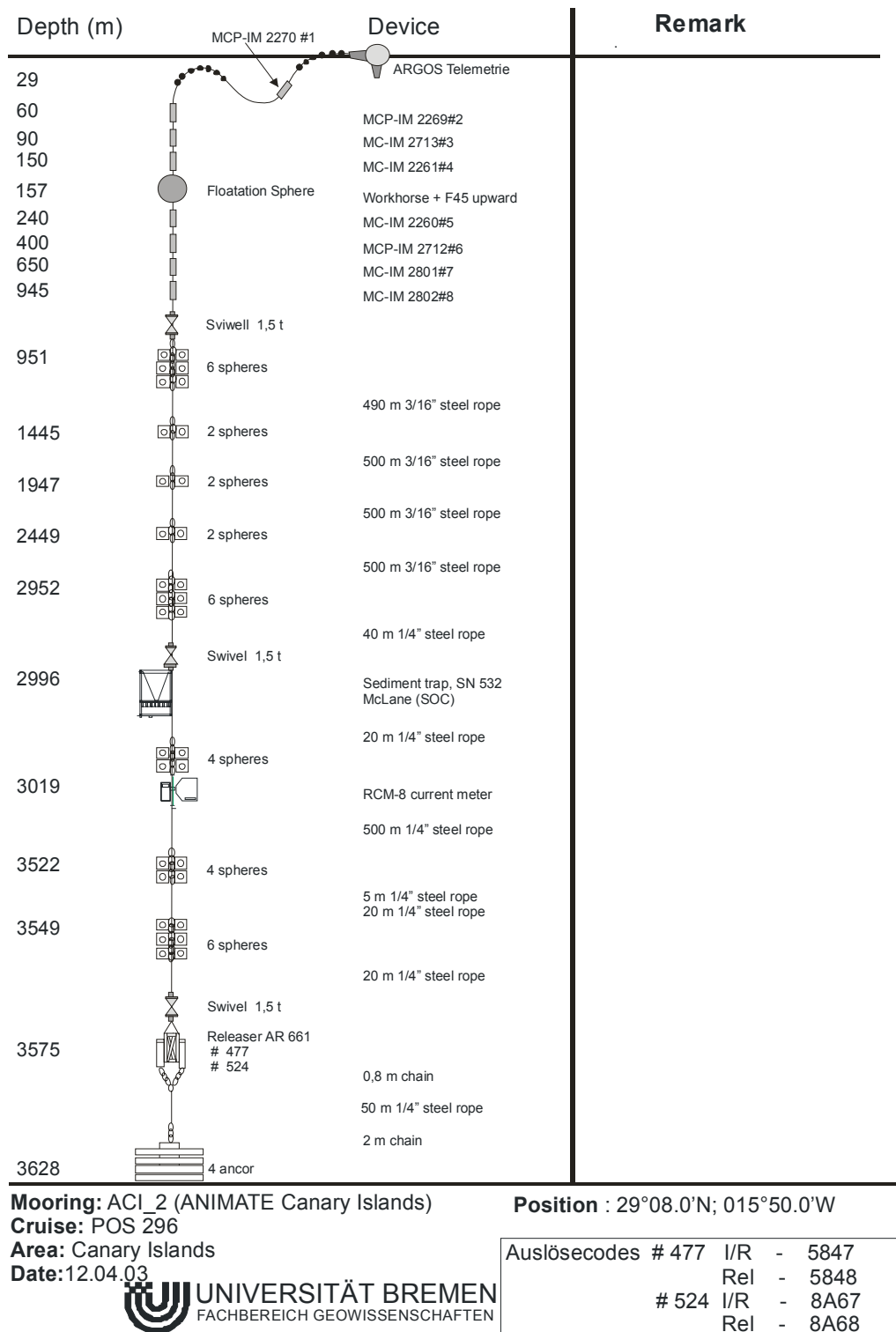


Figure 7: Design of the ANIMATE mooring ACI\_2

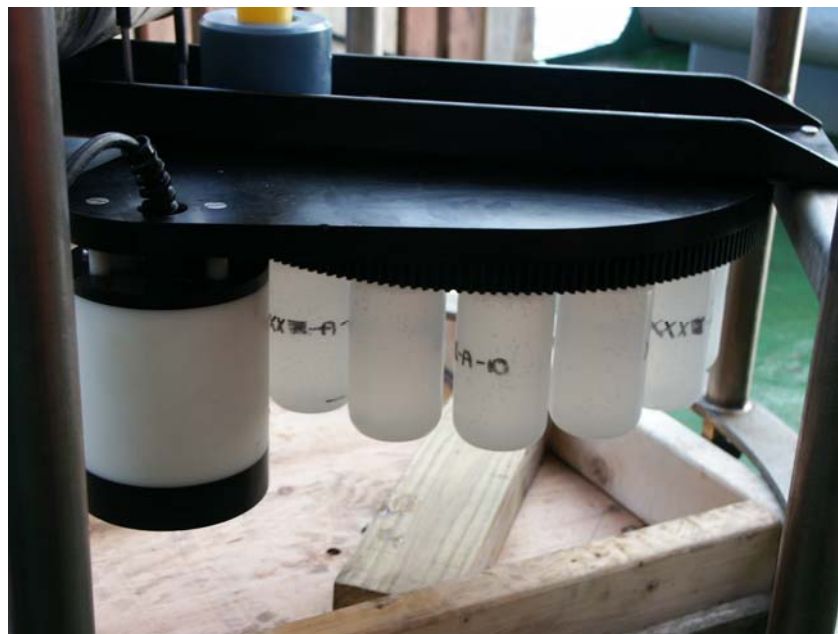


Figure 8: ANIMATE sediment trap from SOC (McLane SN 532).

## 4.2 Particle Collection with Sediment Traps

The particulate material collected will be analysed to determine total flux, particulate flux, particulate organic carbon, particulate nitrogen, biogenic opal, carbonate and stable isotopes of organic matter, and lithogenic material. The trapped material also will be investigated for species composition of the planktonic organisms (pteropods, foraminifera, coccolithophorides and diatoms). The objective of these studies is to identify signals of seasonal variations in those components, which play an important role in the sediment formation process. The result of these investigations will form a basis for the reconstruction of paleo-current systems and paleoproduction from the sediments.

### 4.2.1 ANIMATE / ESTOC

For the R/V POSEIDON cruise 296 it was planned to recover and deploy the ESTOC / ANIMATE array. Attached to this mooring was a sediment trap. Thus, the mooring (CI\_15 / ACI\_1) got lost and no samples from a sediment trap could be taken on this cruise (Tab.1).

### 4.2.2 DOLAN-MSD

On the April 7<sup>th</sup> the recovery of the MSD started. The array was positioned at 29°10,40'N and 15°55,30'W at a water depth of 3630 m. This site was at least deployed during R/V METEOR cruise M 53/1a. It contains among other devices one sediment trap. That MSD trap consists of two sample devices, which both deliver the whole sample set of 20 cups.

The array could not redeploy since the releaser must be used for the new ESTOC mooring (CI\_16). But it is planned to deploy a new DOLAN-MSD during the R/V METEOR cruise M58/3 in June 2003.

Table 1: Mooring data for recoveries and redeployments during R/V POSEIDON cruise 296.

Mooring	Position (m)	Water depth (m)	Interval	Instr. (m)	Depth (no x days)	Intervals
<b><u>Mooring recoveries</u></b>						
DOLAN MSD 1	29°10,40'N 15°55,30'W	3630	16.04.2002 11.04.2003	MSD	3050	1x10, 39x9
<b><u>Mooring deployments</u></b>						
ANIMATE ACI_2	29°09,60'N 15°50,05'W	3628	20.04.2003 04.04.2004	(SOC) RCM 8	2996 3019	2x21, 11x28
ESTOC CI_16	29°04,25'N 15°15,08'W	3600	12.04.2003 06.04.2003	SMT 234 SMT 230	1025 3055	20x18 20x18
<b>Instruments used:</b>						
SMT 243	= Titan particle sediment trap SMT 243 KUM, Kiel					
SMT 230	= Particle sediment trap SMT 243 KUM, Kiel					
MSD	= Particle sediment trap KUM, Kiel					
SN 532	= SOC sediment trap					
RCM 8	= Aanderaa current meter, RCM 8					

### 4.3 Marine Chemistry

Along this cruise, and as part of the ANIMATE/ESTOC mooring redeployments 4 stations were sampled along 29°N (be aware that St. 47 is the deep cast of St. 45), both at the ESTOC and DOLAN positions and to the west and east; six more stations were also sampled between Gran Canaria and Fuerteventura (see map in Fig. 9). A total of 11 sampling Rosette-CTD stations were made and one more station with CTD and MicroCats; ESTOC was sampled to the bottom, the calibration cast for the fluorometer was only made to 500 m of nominal depth due to restrictions of the device and the rest to 2000 m. A CTD/Rosette unit with 12 bottles from surface to the bottom was used. Physical (CTD, salinity samples at certain depths) and biochemical (oxygen, alkalinity, pH, nutrients, gelbstoff, chlorophyll) parameters were measured in order to characterize the water masses present in the study area (Tab. 2). Some of the parameters (oxygen, alkalinity, pH, gelbstoff, chlorophyll filtration) were analysed on board after sampling and others were taken frozen to the ICCM (nutrients and filters from chlorophyll). Additionally, and as part of the ESTOC customary sampling scheme, 6 XBT's (eXpendable BatiThermograph, T7) were launched to 800 m in the transit from Las Palmas to the ESTOC station (Tab. 3).

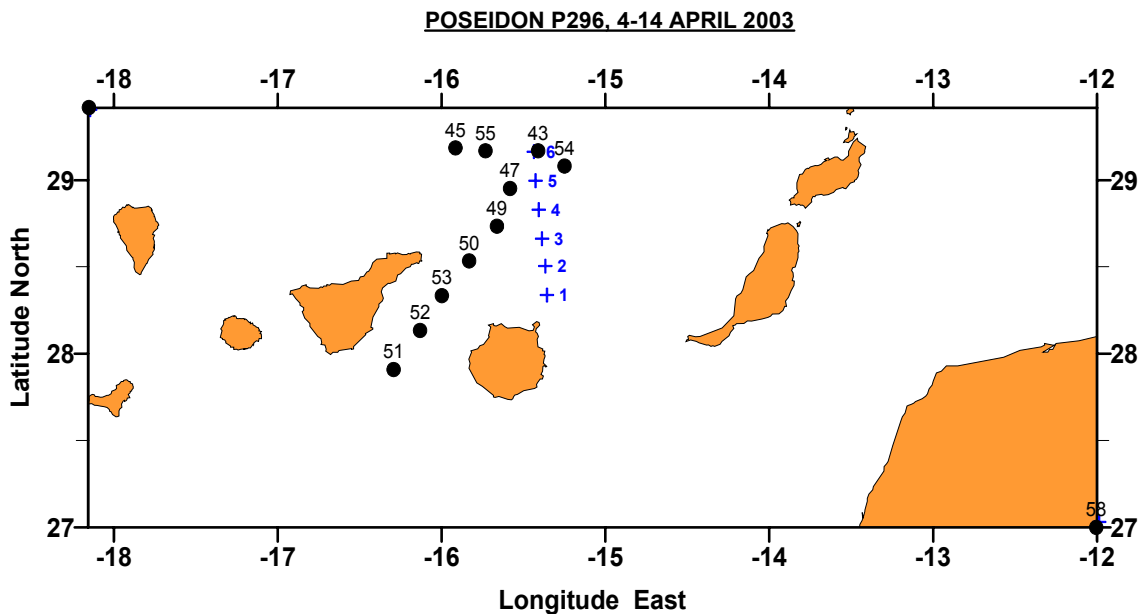


Figure 9: Position of the CTD stations (dots) and XBT launches (crosses) made by ICCM along R/V Poseidon cruise 296.



Table 2: Details of Sampling Stations.

(O=oxygen, A= alkalinity, P=pH, N=nutrients, G=Gelbtoff, S=salinity, C=chlorophyll "a", E=extra sampling).

Date	St. #, Cast #	water depth (m)	Lat N	Lon W	depth sample	PARAMETERS												
						O	A	P	N	G	S	C	E					
05.04	43,002 ESTOC 04/03	3602	29°10.0'	15°24.7'	800	✓	✓	✓	✓	✓		✓						
					600	✓	✓	✓	✓		✓							
					400	✓	✓	✓	✓		✓							
					300	✓	✓	✓	✓		✓							
					200	✓	✓	✓	✓		✓	✓						
					150	✓	✓	✓	✓		✓	✓						
					125	✓	✓	✓	✓		✓	✓						
					100	✓	✓	✓	✓		✓	✓						
					75	✓	✓	✓	✓		✓	✓						
					50	✓	✓	✓	✓		✓	✓						
					25	✓	✓	✓	✓		✓	✓						
					10	✓	✓	✓	✓		✓	✓						
					05.04	43,004 ESTOC 04/03	3602	29°10.0'	15°24.7'	3503	✓	✓	✓	✓	✓		✓	
2999	✓	✓	✓	✓						✓		✓						
2789	✓	✓	✓	✓						✓		✓						
2500	✓	✓	✓	✓						✓		✓						
2000	✓	✓	✓	✓						✓		✓						
1800	✓	✓	✓	✓						✓		✓						
1499	✓	✓	✓	✓						✓		✓						
1300	✓	✓	✓	✓						✓		✓						
1201	✓	✓	✓	✓						✓		✓						
1100	✓	✓	✓	✓						✓		✓						
1000	Niskin bottle did not close																	
800	✓	✓	✓	✓						✓		✓	✓					
07.04	45,006	3630	29°11.0'	15°55.0'						508	✓	✓	✓	✓	✓		✓	✓
					150	✓	✓	✓	✓	✓		✓	✓					
					125	✓	✓	✓	✓	✓		✓	✓					
					ANIMATE Fluorometer calibration at ESTOC	100	✓	✓	✓	✓	✓		✓	✓				
					90	✓			✓	✓		✓	✓					
					79	✓			✓	✓		✓	✓					
					71	✓	✓	✓	✓	✓		✓	✓					
					54	Niskin bottle did not close												
					41	✓	✓	✓	✓	✓		✓	✓					
					24	✓	✓	✓	✓	✓		✓	✓					
					10	✓	✓	✓	✓	✓		✓	✓					
					07.04	47,008	3630	29°11.0'	15°55.0'	3500	✓	✓	✓	✓	✓		✓	
										2998	✓	✓	✓	✓	✓		✓	
2501	✓	✓	✓	✓						✓		✓						
2000	✓	✓	✓	✓						✓		✓						
1500	✓	✓	✓	✓						✓		✓						
1301	✓	✓	✓	✓						✓		✓						
1201	✓	✓	✓	✓						✓		✓						
1101	✓	✓	✓	✓						✓		✓						
956	✓	✓	✓	✓						✓		✓						
801	✓	✓	✓	✓						✓		✓						
600	✓	✓	✓	✓						✓		✓						
300	✓	✓	✓	✓						✓		✓	✓					
09.04	49,010	3610	28°57.0'	15°35.0'						2001	✓	✓	✓	✓	✓	✓		
					1499	✓	✓	✓	✓	✓		✓						
					1299	✓	✓	✓	✓	✓		✓						
					1149	✓	✓	✓	✓	✓		✓						
					999	✓	✓	✓	✓	✓		✓						
					799	✓	✓	✓	✓	✓		✓						
					600	✓	✓	✓	✓	✓		✓						
					300	✓	✓	✓	✓	✓		✓						
					122	✓	✓	✓	✓	✓		✓	✓					
					100	✓	✓	✓	✓	✓		✓	✓					
					51	✓	✓	✓	✓	✓		✓	✓					
9	✓	✓	✓	✓	✓		✓	✓										

Table 2: continued

Date	St. #, Cast #	water depth (m)	Lat N	Lon W	depth sample	PARAMETERS							
						O	A	P	N	G	S	C	E
09.04	50, 012	3587	28°44.0'	15°40.0'	2005	✓	✓	✓	✓	✓	✓		
					1500	✓	✓	✓	✓	✓			
					1300	✓	✓	✓	✓	✓			
					1149	✓	✓	✓	✓	✓			
					1000	✓	✓	✓	✓	✓			
					800	✓	✓	✓	✓	✓			
					600	✓	✓	✓	✓	✓			
					300	✓	✓	✓	✓	✓			
					125	Bottle did not close properly							
					100	✓	✓	✓	✓	✓		✓	
					50	✓	✓	✓	✓	✓		✓	
					10	✓	✓	✓	✓	✓	✓	✓	
					09.04	51, 014	3436	28°32.0'	15°50.0'	2000	Niskin bottle did not close		
1500	✓	✓	✓	✓						✓	✓		
1300	✓	✓	✓	✓						✓			
1150	✓	✓	✓	✓						✓			
1000	✓	✓	✓	✓						✓			
800	✓	✓	✓	✓						✓			
599	✓	✓	✓	✓						✓			
300	✓	✓	✓	✓						✓			
125	Niskin bottle did not close												
100	✓	✓	✓	✓						✓		✓	
50	✓	✓	✓	✓						✓		✓	
10	✓	✓	✓	✓						✓	✓	✓	
10.04	52, 015	2521	27°55.0'	16°18.0'						2003	✓	✓	✓
					1500	✓	✓	✓	✓	✓			
					1299	✓	✓	✓	✓	✓			
					1149	✓	✓	✓	✓	✓			
					999	✓	✓	✓	✓	✓			
					800	✓	✓	✓	✓	✓			
					599	✓	✓	✓	✓	✓			
					298	✓	✓	✓	✓	✓			
					123	✓	✓	✓	✓	✓		✓	
					99	✓	✓	✓	✓	✓		✓	
					49	✓	✓	✓	✓	✓		✓	
					10	✓	✓	✓	✓	✓	✓	✓	
					10.04	53, 017	2291	28°08.0'	16°09.0'	2001	✓	✓	✓
1500	✓	✓	✓	✓						✓	✓		
1300	✓	✓	✓	✓						✓			
1150	✓	✓	✓	✓						✓			
1000	✓	✓	✓	✓						✓			
800	✓	✓	✓	✓						✓			
600	✓	✓	✓	✓						✓			
300	✓	✓	✓	✓						✓			
124	✓	✓	✓	✓						✓		✓	
100	✓	✓	✓	✓						✓		✓	
50	✓	✓	✓	✓						✓		✓	
9	✓	✓	✓	✓						✓	✓	✓	
10.04	54, 019	2815	28°20.0'	16°00.0'						2002	✓	✓	✓
					1499	✓	✓	✓	✓	✓			
					1296	✓	✓	✓	✓	✓			
					1150	✓	✓	✓	✓	✓			
					1000	✓	✓	✓	✓	✓			
					800	✓	✓	✓	✓	✓			
					600	✓	✓	✓	✓	✓			
					296	✓	✓	✓	✓	✓			
					124	✓	✓	✓	✓	✓		✓	
					100	✓	✓	✓	✓	✓		✓	
					49	✓	✓	✓	✓	✓		✓	
					10	✓	✓	✓	✓	✓	✓	✓	

Table 2: continued

Date	St. #, Cast #	water depth (m)	Lat N	Lon W	depth sample	PARAMETERS								
						O	A	P	N	G	S	C	E	
10.04	55, 021	3590	29°04.75'	15°15.0'	2999	Microcat cast for calibration prior to deployment. Niskin bottles on the frame to take substandard water for McLain sediment trap.								
					3001									
					3004									
					3006									
					1500	√	√	√	√	√	√			
					1300	√	√	√	√	√				
					1200	√	√	√	√	√				
					1100	√	√	√	√	√				
					1000	√	√	√	√	√				
					800	√	√	√	√	√				
					600	√	√	√	√	√				
					300	√	√	√	√	√				
					125	√	√	√	√	√			√	
					100	√	√	√	√	√			√	
					50	√	√	√	√	√			√	
					10	√	√	√	√	√	√		√	

Table 3: List of XBT that were launched between Las Palmas and ESTOC station.

XBT sta #	Date	Latitude	Longitude
ESTOC-D6	04.04.2003	28°20,02'N	15°29,95'W
ESTOC-D5	04.04.2003	28°30,09'N	15°30,03'W
ESTOC-D4	04.04.2003	28°39,99'N	15°29,98'W
ESTOC-D3	04.04.2003	28°49,85'N	15°30,02'W
ESTOC-D2	04.04.2003	28°59,93'N	15°30,03'W
ESTOC-D1	04.04.2003	29°09,87'N	15°29,95'W

#### 4.3.1 Water Sampling and Analysis

Samples from each depth were collected immediately after the Niskin bottles were on board. The sampling sequence was as follows:

##### *Oxygen*

Oxygen was taken in glass bottles of about 125 ml of volume which were previously cleaned and washed with HCl acid and was fixed at once; then it was kept for at least six hours according to WOCE regulations and finally it was analysed at the laboratory on board R/V POSEIDON. The samples were analysed using the method described in the WOCE Operations Manual, WHP Office Report No. 68/91; the final titration point was detected using a Metrohm 665 Dosimat Oxygen Auto-Titrator Analyser.

##### *Nutrients*

Nutrients were taken in polypropylene bottles which were previously cleaned and washed with HCl acid and were completely dry. Samples were immediately frozen at -20°C, analysing them as soon as possible after arrival at the laboratory. Freezing the samples is a common practice; it does not or only in a non-significant way affects the nitrate+nitrite and the phosphate values (by a slight decrease) and is not noticeable in the silicate values (Kremling and Wenck, 1986; McDonald and McLunghlin, 1982).

The nutrients determination was performed with a segmented continuous-flow autoanalyser, a Skalar® San Plus System (ICCM).

#### *Nitrate and Nitrite*

The automated procedure for the determination of nitrate and nitrite is based on the cadmium reduction method; the sample is passed through a column containing granulated copper-cadmium to reduce the nitrate to nitrite (Wood et al., 1967), using ammonium chloride as pH controller and complexer of the cadmium cations formed (Strickland and Parsons, 1972). The optimal column preparation conditions are described by several authors (Nydahl, 1976; Garside, 1993).

#### *Phosphate*

Orthophosphate concentration is understood as the concentration of reactive phosphate (Riley and Skirpow, 1975) and according to Koroleff (1983a) is a synonym of “dissolved inorganic phosphate”. The automated procedure for the determination of phosphate is based on the following reaction: ammonium molybdate and potassium antimony tartrate react in an acidic medium with diluted solution of phosphate to form an antimony-phospho-molybdate complex. This complex is reduced to an intensely blue-coloured complex, ascorbic acid. The complex is measured at 880 nm. The basic methodology for this anion determination is given by Murphy and Riley (1962); the used methodology is the one adapted by Strickland and Parsons (1972).

#### *Silicate*

The determination of the soluble silicon compounds in natural waters is based on the formation of the yellow coloured silicomolybdic acid; the sample is acidified and mixed with an ammonium molybdate solution forming molybdosilicic acid. This acid is reduced with ascorbic acid to a blue dye, which is measured at 810 nm. Oxalic acid is added to avoid phosphate interference. The used method is described in Koroleff (1983b).

#### *Phytoplankton pigments*

Pigments were measured using fluorimetric analysis, following the methodology described by Welschmeyer (1994). The determination was achieved using a fluorometer TURNER 10-AU-000.

#### *Salinity*

Salinity samples were taken in dark glass bottles which were previously cleaned and washed with HCl acid. Then, they were kept in boxes to protect them from light till analysis on land. Samples were measured with a salinometer, model Autosal 8400a, whose measurement range was between 0.005-42 (psu), with an accuracy of  $\pm 0.003$ , according to the manufacturer. It was calibrated following the manufacturer's information and standarizing it with IAPSO Standard Seawater. Salinity values were calculated as practical salinity according to Unesco (1978, 1984).

### *Chlorophyll*

Chlorophyll samples of one liter of water were taken. The chlorophyll samples were filtered immediately and the filters were frozen subsequently at  $-20^{\circ}\text{C}$ . Their analyses takes place at the ICCM laboratory on land.

### *Carbonate system measurements*

Carbonate system measurements, in this case pH and alkalinity samples were taken in glass bottles and were fixed immediately on board. Finally, they were also analysed on board along the cruise. Additionally, fugacity of carbon dioxide in the air and in the seawater was determined using a flow system continuously along the ship track. The  $\text{pH}_t$  in total scale ( $\text{mol}(\text{kg-SW})^{-1}$ ) was measured following the spectrophotometric technique of Clayton and Byrne (1993) using the m-cresol purple indicator (DOE, 1994). 0.0047 pH units were added to the pH experimental values in order to take into consideration the recommendations by Lee et al. (2000). A system similar to that described by Bellerby et al. (1995) was developed in our lab. The  $\text{pH}_t$  measurements were carried out using a Hewlett Packard Diode Array spectrophotometer in a  $25^{\circ}\text{C}$ -thermostated 1-cm flow-cell using a Peltier system. A stopped-flow protocol was used to analyse seawater previously thermostated to  $25^{\circ}\text{C}$  for a blank determination at 730, 578 and 434 nm. The flow was restarted, and the indicator injection valve switched on to inject  $10\ \mu\text{l}$  dye through a mixing coil (2 m). Three photometric measurements were carried out for each injection in order to remove all dye effect on the seawater  $\text{pH}_t$  measurement. Repeatedly, seawater measurements of the different Certified Reference Materials (CRM provided by Dr. Dickson, Scripps Institution of Oceanography) samples gave a standard deviation of  $\pm 0.0015$  ( $n = 54$ ).

The total alkalinity of seawater ( $A_T$ ) was determined by titration with HCl to the carbonic acid end point using two similar potentiometric systems, as described in more detail by Mintrop et al. (2000). In order to yield an ionic strength similar to open ocean seawater, the HCl solution (25 l, 0.25 M) was made from concentrated analytical grade HCl (Merck<sup>®</sup>, Darmstadt, Germany) in 0.45 M NaCl. The acid was standardised by titrating weighed amounts of  $\text{Na}_2\text{CO}_3$  dissolved in 0.7 M NaCl solutions. The total alkalinity of seawater was evaluated from the proton balance at the alkalinity equivalence point,  $\text{pH}_{\text{equiv}} = 4.5$ , according to the exact definition of total alkalinity (Dickson, 1981). The performance of the titration systems was monitored by titrating different samples of certified reference material (CRM, batch 42) with known inorganic carbon and  $A_T$  values. The agreement between our data and CRM values was within  $\pm 1.5\ \mu\text{mol kg}^{-1}$ . Total inorganic carbon ( $C_T$ ) is computed from experimental values of  $\text{pH}_t$  and total alkalinity, using the carbonic acid dissociation constants of Mehrbach after Dickson and Millero (1987). This set of constants presented the best agreement between  $C_T(\text{pH}, A_T)$  calculations and certified  $C_T$  values for CRM, batch 42, with a  $C_T$  residual of  $\pm 3\ \mu\text{mol kg}^{-1}$ ,  $n=54$  (Millero, 1995, Lee et al., 1997).

Fugacity of carbon dioxide ( $f\text{CO}_2$ ) in the air and in surface seawater was determined using a flow system similar to the unit designed by Wanninkhof and Thoning (1993) and developed by Frank J. Millero's group at the University of Miami. The equilibrator used is based on the design by R.F. Weiss and described by Butler et al. (1988). The concentration of  $\text{CO}_2$  in the air and in the equilibrated air sample was measured with a differential, non-dispersive,

infrared gas analyser supplied by LI-COR (LI-6262 CO<sub>2</sub>/H<sub>2</sub>O Analyser). The sample was measured wet and the signal corrected for water vapour using the water channel of the LI-COR detector. The instrument was operated in the absolute mode and gathered CO<sub>2</sub> concentrations directly from the instrument. The LI-COR instrument analyses the concentration of CO<sub>2</sub> every six seconds, then averaged these values over a 5-min interval, and recorded them. Atmospheric air was pumped at the bow of the ship and measured every hour. The system was calibrated by measuring two different standard gases with mixing ratios of 348.55 and 520.83 ppm CO<sub>2</sub> in the air. These calibrated standards were provided by the National Oceanographic and Atmospheric Administration and they are traceable to the World Meteorology Organisation scale. Our system has demonstrated a precision of less than 1 µatm and is accurate, relative to standard gases, to 2 µatm. Fugacity of CO<sub>2</sub> in the seawater is calculated from the measured xCO<sub>2</sub> (mol fraction of CO<sub>2</sub> gas corrected to dry air and to the pressure of 1 atm).

### *Gelbstoff*

Gelbstoff water was taken in dark glass bottles which were previously cleaned and washed with HCl acid. The samples were analysed on board within 3 hours of having taken them by spectrofluorometry. The values of gelbstoff or yellow substance were obtained using the methodology described by Determann et al. (1994, 1996). The samples were measured with a spectrofluorometer SHIMADZU RF-1501 at an excitation wavelength of 341 nm and the intensities taken at emission wavelength between 350 and 500 nm. Gelbstoff fluorescence is derived from the emission spectra and obtained in Raman units.

All samples were taken using the procedures established in the WOCE Operations Manual, WHP Office Report WHPO 91-1/WOCE Report No.68/91.

### 4.3.2 Preliminary Results

The temperature/salinity diagrams made from the CTD casts (Fig. 10) shows at intermediate waters the presence of Antarctic Intermediate Water (AAIW) at around

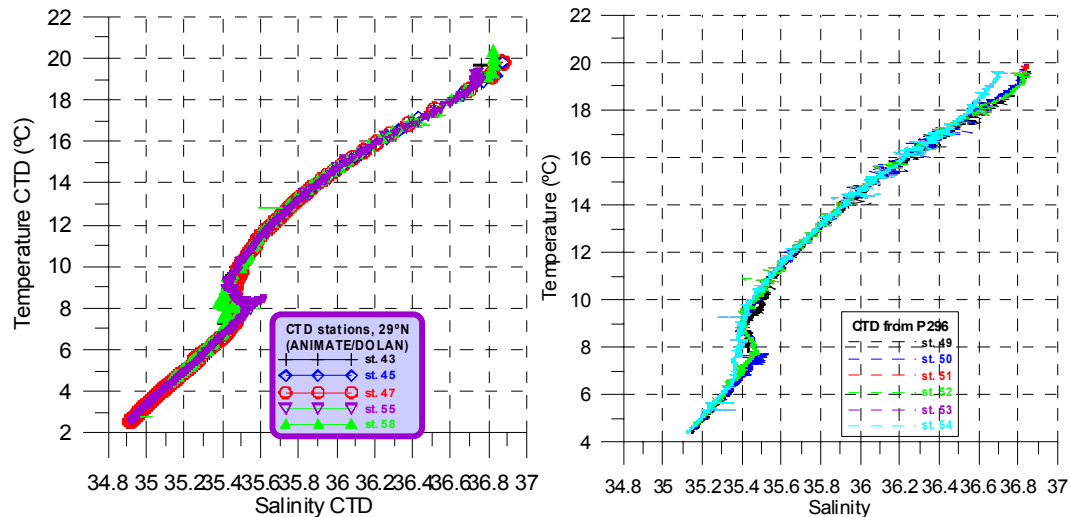


Figure 10: T/S diagrams from CTD stations of POSEIDON cruise 296 along 29°N (left) and between Tenerife and Gran Canaria (right).

1000 m of depth at 29°N, except in station 55, done a few days later and to the east of ESTOC, where the Mediterranean Water (MW) is more explicit. Some stations between Gran Canaria and Tenerife Islands have a presence of MW, showing different mixing states of the AAIW and MW water masses too; stations to the north have more Mediterranean water than those located towards the south of the channel between both islands, obviously more influenced by the AAIW.

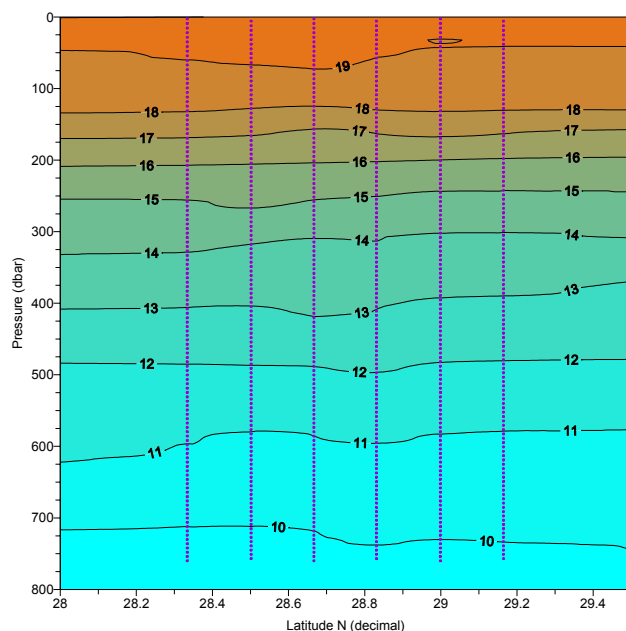


Figure 11: Temperature variation with latitude from the 6 XBT launches (crosses, Fig. 9).

Figure 11 shows the XBT results stating the variation of the temperature with the latitude as going north from Las Palmas harbour towards station ESTOC, corresponding with the last XBT launch to the ESTOC site. This section started in 1995 and it has been continuously sampled since then. Furthermore, it has generated a set of relevant information about the North Atlantic Central Water (NACW) variability, and its formation process in the most southern area where the process takes place.

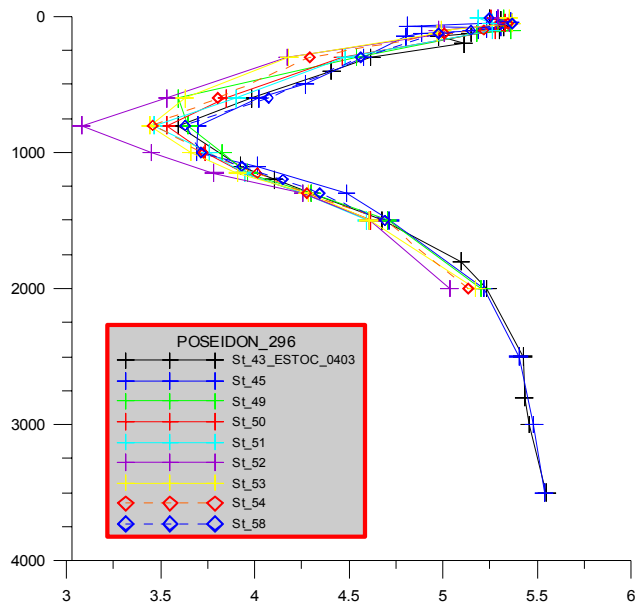


Figure 12: Evolution of the oxygen values from surface to the depth sampled in the stations sampled during R/V POSEIDON cruise 296.

Oxygen shows as a general trend in this area of the subtropical North Atlantic a minimum at around 800 m for all the sampled stations, having the lowest values at the station located southern most. The minimum encountered in the 29°N area is usually located around 800-1000 m with values in the range of 3.6-3.8 ml/l. However, the stations in the channel between Tenerife and Gran Canaria have a tendency towards lower values and in fact, station #52 shows a minimum of about 3.1 ml/l, which denotes the presence of Antarctic Intermediate Water (Fig. 12).



## 6. List of Stations

Station - No.	Date 2003	Description	LAT	LONG	WD [ m ]	Remarks
	04.04.	Beginnung of research work				
41-1		XBT #1	28-20	N 015-20	W	
41-2		XBT #2	28-30	N 015-20	W	
41-3		XBT #3	28-40	N 015-20	W	
41-4		XBT #4	28-50	N 015-20	W	
41-5		XBT #5	29-00	N 015-20	W	
41-6		XBT #6	29-10	N 015-20	W	
42	05.04.	station end	29-10,62	N 015-54,42	W 3628	SBU recovered
43-1	05.04.	CTD/Rosette	29-10,15	N 015-24,83	W 3601	
43-2	05.04.	CTD/Rosette	29-09,67	N 015-25,08	W 3603	
43-3	05.04.	NOAA buoy	29-09,91	N 015-25,08	W 3603	
44-1	06.04.	array released	29-10,18	N 015-25,68	W 3604	remaining-mooring ANIMATE/ESTOC several times released, did'nt rise
44-2		Inductiv modems	29-10,79	N 015-25,61	W 3603	test
44-3		Transducer	29-11,23	N 015-55,09	W 3630	
45	07.04.	CTD/Rosette	29-11,20	N 015-55,53	W 3630	
46	07.04.	array released	29-10,70	N 015-55,20	W 3629	MSD-mooring
47	07.04.	CTD/Rosette	29-11,20	N 015-55,00	W 3630	
48-1	08.04.	Dummy (25 spheres)	29-09,11	N 015-52,88	W 3627	DOLAN deployment
48-2		recovery Dummy	29-11,18	N 015-54,77	W 3629	
48-3		DATA Buoy DOLAN	29-11,33	N 015-54,89	W 3630	
49	09.04.	CTD/Rosette	28-57,04	N 015-35,00	W 3609	
50	09.04.	CTD/Rosette	28-44,05	N 015-40,05	W 3587	
51	09.04.	CTD/Rosette	28-31,91	N 015-50,11	W 3423	
52	10.04.	CTD/Rosette	27-54,97	N 016-18,04	W 2526	
53	10.04.	CTD/Rosette	28-08,00	N 016-08,88	W 2291	
54	10.04.	CTD/Rosette	28-19,98	N 016-00,01	W 2814	
55	11.04.	Hydrophon	29-10,55	N 015-25,53	W 3603	new release test without effect ESTOC don't rise
56	11.04.	2 sediment traps	29-04,53	N 015-15,02	W 3589	ESTOC (CI 16) deployment
57	12.04.	telemetry ADCP, current meter	29-04,59	N 015-48,62	W 3623	ANMATE (ACI 2) deployment
58	12.04.	CTD/Rosette	29-10,00	N 015-43,94	W 3621	
	13.04.	breakup due to weather	29-07,65	N 015-22,46	W	

## **6. Acknowledgement**

The scientific cruise participants would like to thank Captain Lutz Mallon and his entire crew for the good assistance during the R/V Poseidon cruise 296, especially during the complicated mooring work with the DOLAN data buoy. The teamwork among the crew and scientists on one hand and the warm and friendly way of communication on the other hand lead to the success of this cruise. Again, we gratefully enjoyed the stay onboard the R/V POSEIDON.

## 7. References

- BELLERBY R.G.J., TURNER D.R., MILLWARD G.E. and P.J. WORSFOLD (1995) Shipboard flow injection determination of sea water pH with spectrophotometric detection, *Anal. Chim. Acta*, **309**, 259-270.
- BUTLER J.H., ELKINS C.M., BRUSON C.M., EGAN K.B., THOMPSON T.M., CONWAY T.J. and B.D. HALL (1988) Trace gases in and over the West Pacific and East Indian Oceans during the El Niño-Southern Oscillation event of 1987, NOAA Data Report, ERL-ARL-16, 104 pp. Air Resources Laboratory, Silver Spring, Md.
- CLAYTON T.D. and R.H. BYRNE (1993) Spectrophotometric seawater pH measurements: total hydrogen ion concentration scale calibration of m-cresol purple and at-sea results, *Deep Sea Res.*, **42**, 411-429.
- DETERMANN S., REUTER R., WAGNER P. and R. WILLKOMM (1994) Fluorescent matter in the eastern Atlantic Ocean: Part 1, method of measurement and near-surface distribution, *Deep-Sea Research* **41**, 659-675.
- DETERMANN S., REUTER R. and R. WILLKOMM. (1996) Fluorescent matter in the eastern Atlantic Ocean: Part 2, vertical profiles and relation of water masses, *Deep-Sea Research* **43**, 345-360.
- DICKSON A.G. (1981) An exact definition of total alkalinity and a procedure for the estimation of alkalinity and total inorganic carbon from titration data, *Deep Sea Res.*, **28**, 609-623.
- DICKSON A.G. and C. GOYET (Eds.) (1994) *DOE, Handbook of methods for the analysis of the various parameters of the carbon-dioxide system in sea water*, Version 2, ORNL/CDIAC-74.
- DICKSON A.G. and F.J. MILLERO (1987) A comparison of the equilibrium constants for the dissociation of carbonic acid in seawater media, *Deep Sea Res.* **34**, 1733-1743.
- GARSDIE C. (1993) Nitrate reductor efficiency as an error source in seawater analysis, *Mar. Chem.*, **4**(1), 25-30.
- KOROLEFF F. (1983) Determination of dissolved inorganic phosphate. In *Methods of Seawater Analysis*. K. Grasshoff, A. Ehrhardt and K. Kremling (eds), Verlag Chemie, 126-129.
- KOROLEFF F. (1983b) Determination of dissolved inorganic silicate. In *Methods of Seawater Analysis*, K. Grasshoff, A. Ehrhardt and K. Kremling (eds), Verlag Chemie, 175-180.
- KREMLING K. & A. WENCK (1986) On the storage of dissolved inorganic phosphate, nitrate and reactive silicate in Atlantic Ocean water samples, *Meeresforschung*, **31**, 69-74.
- LEE K., MILLERO F.J. and R. WANNINKHOF (1997) The carbon dioxide system in the Atlantic Ocean, *J. Geophys. Res.*, **102**, 15693-17707.
- MCDONALD R.W. & F.A. MCLAUGHLIN (1982) The effect of storage by freeing of disolute inorganic phosphate, nitrate and reactive silicate for samples from coastal and internal water, *Water Research*, **16**, 95-104.
- MILLERO F.J. (1995) Thermodynamics of the carbon dioxide system in the oceans, *Geochim. Cosmochim. Acta*, **59**, 661-677.
- MINTROP L.M., PÉREZ F.F., GONZÁLES-DÁVILA M., SANTANA-CASIANO J.M., and A. KÖRTZINGER (2000) Alkalinity determination by potentiometry – intercalibration using three different methods, *Ciencias Marinas*, **26**, 23-37.
- MURPHY J. & J.P. RILEY (1962) A modified single solution method for the determination of phosphate in natural waters, *Anal. Chim. Acta*, **27**, 31-36.
- NYDAHL F. (1976) On the optimum conditions for the reduction of nitrate by cadmium, *Talanta*, **23**, 349-357.
- RILEY J.P. & J.P. SKIRPOW (1975) The Micronutrient Element, *Chemical Oceanography*, **2**, 245-297.

STRICKLAND J.D.H & PARSONS (1972) A practical handbook of seawater analysis, *Fisheries Research Board of Canada*, 167 pp.

UNESCO (1978) Technical Papers in Marine Science, **28**, 35pp.

UNESCO (1984) La escala de salinidades practicas de 1978 y la ecuacion internacional de estado del agua de mar de 1980, Documentos tecnicos de la Unesco sobre Ciencias del Mar, no. **36**.

WANNINKHOF R. and K. THONING (1993) Measurement of fugacity of CO<sub>2</sub> in surface water using continuous and discrete sampling methods, *Mar. Chem.*, **44**, 189-204.

WELSCHMEYER N.A. (1994) Fluorimetric Analysis of Chlorophyll a in presence of Chlorophyll b and Phaeopigments, *Limnol. Oceanog.* **39** (8), 1985-1992.

WOODS E.D., ARMSTRONG F.A.J. & F.A. RICHARDS (1967) Determination of nitrate in seawater by cadmium-copper reduction to nitrate, *J. Mar. Biol. Ass. UK.*, **47**, 31-43.

Publications of this series:

- No. 1**      **Wefer, G., E. Suess and cruise participants**  
Bericht über die POLARSTERN-Fahrt ANT IV/2, Rio de Janeiro - Punta Arenas, 6.11. - 1.12.1985.  
60 pages, Bremen, 1986.
- No. 2**      **Hoffmann, G.**  
Holozänstratigraphie und Küstenlinienverlagerung an der andalusischen Mittelmeerküste.  
173 pages, Bremen, 1988. (out of print)
- No. 3**      **Wefer, G. and cruise participants**  
Bericht über die METEOR-Fahrt M 6/6, Libreville - Las Palmas, 18.2. - 23.3.1988.  
97 pages, Bremen, 1988.
- No. 4**      **Wefer, G., G.F. Lutze, T.J. Müller, O. Pfannkuche, W. Schenke, G. Siedler, W. Zenk**  
Kurzbericht über die METEOR-Expedition No. 6, Hamburg - Hamburg, 28.10.1987 - 19.5.1988.  
29 pages, Bremen, 1988. (out of print)
- No. 5**      **Fischer, G.**  
Stabile Kohlenstoff-Isotope in partikulärer organischer Substanz aus dem Südpolarmeer (Atlantischer Sektor).  
161 pages, Bremen, 1989.
- No. 6**      **Berger, W.H. and G. Wefer**  
Partikelfluß und Kohlenstoffkreislauf im Ozean.  
Bericht und Kurzfassungen über den Workshop vom 3.-4. Juli 1989 in Bremen.  
57 pages, Bremen, 1989.
- No. 7**      **Wefer, G. and cruise participants**  
Bericht über die METEOR - Fahrt M 9/4, Dakar - Santa Cruz, 19.2. - 16.3.1989.  
103 pages, Bremen, 1989.
- No. 8**      **Kölling, M.**  
Modellierung geochemischer Prozesse im Sickerwasser und Grundwasser.  
135 pages, Bremen, 1990.
- No. 9**      **Heinze, P.-M.**  
Das Auftriebsgeschehen vor Peru im Spätquartär.  
204 pages, Bremen, 1990. (out of print)
- No. 10**     **Willems, H., G. Wefer, M. Rinski, B. Donner, H.-J. Bellmann, L. Eißmann, A. Müller, B.W. Flemming, H.-C. Höfle, J. Merkt, H. Streif, G. Hertweck, H. Kuntze, J. Schwaar, W. Schäfer, M.-G. Schulz, F. Grube, B. Menke**  
Beiträge zur Geologie und Paläontologie Norddeutschlands: Exkursionsführer.  
202 pages, Bremen, 1990.
- No. 11**     **Wefer, G. and cruise participants**  
Bericht über die METEOR-Fahrt M 12/1, Kapstadt - Funchal, 13.3.1990 - 14.4.1990.  
66 pages, Bremen, 1990.
- No. 12**     **Dahmke, A., H.D. Schulz, A. Kölling, F. Kracht, A. Lücke**  
Schwermetallspuren und geochemische Gleichgewichte zwischen Porenlösung und Sediment im Wesermündungsgebiet. BMFT-Projekt MFU 0562, Abschlußbericht.  
121 pages, Bremen, 1991.
- No. 13**     **Rostek, F.**  
Physikalische Strukturen von Tiefseesedimenten des Südatlantiks und ihre Erfassung in Echolotregistrierungen.  
209 pages, Bremen, 1991.
- No. 14**     **Baumann, M.**  
Die Ablagerung von Tschernobyl-Radiocäsium in der Norwegischen See und in der Nordsee.  
133 pages, Bremen, 1991. (out of print)
- No. 15**     **Kölling, A.**  
Frühdiaagenetische Prozesse und Stoff-Flüsse in marinen und ästuarinen Sedimenten.  
140 pages, Bremen, 1991.
- No. 16**     **SFB 261 (ed.)**  
1. Kolloquium des Sonderforschungsbereichs 261 der Universität Bremen (14.Juni 1991):  
Der Südatlantik im Spätquartär: Rekonstruktion von Stoffhaushalt und Stromsystemen.  
Kurzfassungen der Vorträge und Poster.  
66 pages, Bremen, 1991.

- No. 17 Pätzold, J. and cruise participants**  
Bericht und erste Ergebnisse über die METEOR-Fahrt M 15/2, Rio de Janeiro - Vitoria, 18.1. - 7.2.1991.  
46 pages, Bremen, 1993.
- No. 18 Wefer, G. and cruise participants**  
Bericht und erste Ergebnisse über die METEOR-Fahrt M 16/1, Pointe Noire - Recife, 27.3. - 25.4.1991.  
120 pages, Bremen, 1991.
- No. 19 Schulz, H.D. and cruise participants**  
Bericht und erste Ergebnisse über die METEOR-Fahrt M 16/2, Recife - Belem, 28.4. - 20.5.1991.  
149 pages, Bremen, 1991.
- No. 20 Berner, H.**  
Mechanismen der Sedimentbildung in der Fram-Straße, im Arktischen Ozean und in der Norwegischen See.  
167 pages, Bremen, 1991.
- No. 21 Schneider, R.**  
Spätquartäre Produktivitätsänderungen im östlichen Angola-Becken: Reaktion auf Variationen im Passat-Monsun-Windsystem und in der Advektion des Benguela-Küstenstroms.  
198 pages, Bremen, 1991. (out of print)
- No. 22 Hebbeln, D.**  
Spätquartäre Stratigraphie und Paläozeanographie in der Fram-Straße.  
174 pages, Bremen, 1991.
- No. 23 Lücke, A.**  
Umsetzungsprozesse organischer Substanz während der Frühdiagenese in ästuarinen Sedimenten.  
137 pages, Bremen, 1991.
- No. 24 Wefer, G. and cruise participants**  
Bericht und erste Ergebnisse der METEOR-Fahrt M 20/1, Bremen - Abidjan, 18.11.- 22.12.1991.  
74 pages, Bremen, 1992.
- No. 25 Schulz, H.D. and cruise participants**  
Bericht und erste Ergebnisse der METEOR-Fahrt M 20/2, Abidjan - Dakar, 27.12.1991 - 3.2.1992.  
173 pages, Bremen, 1992.
- No. 26 Gingele, F.**  
Zur klimaabhängigen Bildung biogener und terrigener Sedimente und ihrer Veränderung durch die Frühdiagenese im zentralen und östlichen Südatlantik.  
202 pages, Bremen, 1992.
- No. 27 Bickert, T.**  
Rekonstruktion der spätquartären Bodenwasserzirkulation im östlichen Südatlantik über stabile Isotope benthischer Foraminiferen. 205 pages, Bremen, 1992. (out of print)
- No. 28 Schmidt, H.**  
Der Benguela-Strom im Bereich des Walfisch-Rückens im Spätquartär.  
172 pages, Bremen, 1992.
- No. 29 Meinecke, G.**  
Spätquartäre Oberflächenwassertemperaturen im östlichen äquatorialen Atlantik.  
181 pages, Bremen, 1992.
- No. 30 Bathmann, U., U. Bleil, A. Dahmke, P. Müller, A. Nehr Korn, E.-M. Nöthig, M. Olesch, J. Pätzold, H.D. Schulz, V. Smetacek, V. Spieß, G. Wefer, H. Willems**  
Bericht des Graduierten Kollegs. Stoff-Flüsse in marinen Geosystemen.  
Berichtszeitraum Oktober 1990 - Dezember 1992.  
396 pages, Bremen, 1992.
- No. 31 Damm, E.**  
Frühdiagenetische Verteilung von Schwermetallen in Schlicksedimenten der westlichen Ostsee.  
115 pages, Bremen, 1992.
- No. 32 Antia, E.E.**  
Sedimentology, Morphodynamics and Facies Association of a mesotidal Barrier Island Shoreface (Spiekeroog, Southern North Sea).  
370 pages, Bremen, 1993.
- No. 33 Duinker, J. and G. Wefer (ed.)**  
Bericht über den 1. JGOFS-Workshop. 1./2. Dezember 1992 in Bremen.  
83 pages, Bremen, 1993.
- No. 34 Kasten, S.**  
Die Verteilung von Schwermetallen in den Sedimenten eines stadtbremischen Hafenbeckens.  
103 pages, Bremen, 1993.

- No. 35**     **Spieß, V.**  
Digitale Sedimentographie. Neue Wege zu einer hochauflösenden Akustostratigraphie.  
199 pages, Bremen, 1993.
- No. 36**     **Schinzl, U.**  
Laborversuche zu frühdiagenetischen Reaktionen von Eisen (III) - Oxidhydraten in marinen Sedimenten.  
189 pages, Bremen, 1993.
- No. 37**     **Sieger, R.**  
CoTAM - ein Modell zur Modellierung des Schwermetalltransports in Grundwasserleitern.  
56 pages, Bremen, 1993. (out of print)
- No. 38**     **Willems, H. (ed.)**  
Geoscientific Investigations in the Tethyan Himalayas. 183 pages, Bremen, 1993.
- No. 39**     **Hamer, K.**  
Entwicklung von Laborversuchen als Grundlage für die Modellierung des Transportverhaltens von Arsenat, Blei, Cadmium und Kupfer in wassergesättigten Säulen.  
147 pages, Bremen, 1993.
- No. 40**     **Sieger, R.**  
Modellierung des Stofftransports in porösen Medien unter Ankopplung kinetisch gesteuerter Sorptions- und Redoxprozesse sowie thermischer Gleichgewichte.  
158 pages, Bremen, 1993.
- No. 41**     **Thießen, W.**  
Magnetische Eigenschaften von Sedimenten des östlichen Südatlantiks und ihre paläozooanographische Relevanz.  
170 pages, Bremen, 1993.
- No. 42**     **Spieß, V. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 23/1, Kapstadt - Rio de Janeiro, 4.-25.2.1993.  
139 pages, Bremen, 1994.
- No. 43**     **Bleil, U. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 23/2, Rio de Janeiro - Recife, 27.2.-19.3.1993  
133 pages, Bremen, 1994.
- No. 44**     **Wefer, G. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 23/3, Recife - Las Palmas, 21.3. - 12.4.1993  
71 pages, Bremen, 1994.
- No. 45**     **Giese, M. and G. Wefer (ed.)**  
Bericht über den 2. JGOFS-Workshop. 18./19. November 1993 in Bremen.  
93 pages, Bremen, 1994.
- No. 46**     **Balzer, W. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 22/1, Hamburg - Recife, 22.9. - 21.10.1992.  
24 pages, Bremen, 1994.
- No. 47**     **Stax, R.**  
Zyklische Sedimentation von organischem Kohlenstoff in der Japan See: Anzeiger für Änderungen von Paläozooanographie und Paläoklima im Spätkänozoikum.  
150 pages, Bremen, 1994.
- No. 48**     **Skowronek, F.**  
Frühdiagenetische Stoff-Flüsse gelöster Schwermetalle an der Oberfläche von Sedimenten des Weser Ästuars.  
107 pages, Bremen, 1994.
- No. 49**     **Dersch-Hansmann, M.**  
Zur Klimaentwicklung in Ostasien während der letzten 5 Millionen Jahre: Terrigener Sedimenteintrag in die Japan See (ODP Ausfahrt 128).  
149 pages, Bremen, 1994.
- No. 50**     **Zabel, M.**  
Frühdiagenetische Stoff-Flüsse in Oberflächen-Sedimenten des äquatorialen und östlichen Südatlantik.  
129 pages, Bremen, 1994.
- No. 51**     **Bleil, U. and cruise participants**  
Report and preliminary results of SONNE-Cruise SO 86, Buenos Aires - Capetown, 22.4. - 31.5.93  
116 pages, Bremen, 1994.

- No. 52**      **Symposium: The South Atlantic: Present and Past Circulation.**  
Bremen, Germany, 15 - 19 August 1994. Abstracts.  
167 pages, Bremen, 1994.
- No. 53**      **Kretzmann, U.B.**  
<sup>57</sup>Fe-Mössbauer-Spektroskopie an Sedimenten - Möglichkeiten und Grenzen.  
183 pages, Bremen, 1994.
- No. 54**      **Bachmann, M.**  
Die Karbonatrampe von Organyà im oberen Oberapt und unteren Unteralt (NE-Spanien, Prov. Lerida): Fazies, Zyklus- und Sequenzstratigraphie.  
147 pages, Bremen, 1994. (out of print)
- No. 55**      **Kemle-von Mücke, S.**  
Oberflächenwasserstruktur und -zirkulation des Südostatlantiks im Spätquartär.  
151 pages, Bremen, 1994.
- No. 56**      **Petermann, H.**  
Magnetotaktische Bakterien und ihre Magnetosome in Oberflächensedimenten des Südatlantiks.  
134 pages, Bremen, 1994.
- No. 57**      **Mulitza, S.**  
Spätquartäre Variationen der oberflächennahen Hydrographie im westlichen äquatorialen Atlantik.  
97 pages, Bremen, 1994.
- No. 58**      **Segl, M. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 29/1, Buenos-Aires - Montevideo, 17.6. - 13.7.1994  
94 pages, Bremen, 1994.
- No. 59**      **Bleil, U. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 29/2, Montevideo - Rio de Janeiro 15.7. - 8.8.1994.  
153 pages, Bremen, 1994.
- No. 60**      **Henrich, R. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 29/3, Rio de Janeiro - Las Palmas 11.8. - 5.9.1994. Bremen, 1994. (out of print)
- No. 61**      **Sagemann, J.**  
Saisonale Variationen von Porenwasserprofilen, Nährstoff-Flüssen und Reaktionen in intertidalen Sedimenten des Weser-Ästuars.  
110 pages, Bremen, 1994. (out of print)
- No. 62**      **Giese, M. and G. Wefer**  
Bericht über den 3. JGOFS-Workshop. 5./6. Dezember 1994 in Bremen.  
84 pages, Bremen, 1995.
- No. 63**      **Mann, U.**  
Genese kretazischer Schwarzschiefer in Kolumbien: Globale vs. regionale/lokale Prozesse.  
153 pages, Bremen, 1995. (out of print)
- No. 64**      **Willems, H., Wan X., Yin J., Dongdui L., Liu G., S. Dürr, K.-U. Gräfe**  
The Mesozoic development of the N-Indian passive margin and of the Xigaze Forearc Basin in southern Tibet, China. – Excursion Guide to IGCP 362 Working-Group Meeting "Integrated Stratigraphy".  
113 pages, Bremen, 1995. (out of print)
- No. 65**      **Hünken, U.**  
Liefergebiets - Charakterisierung proterozoischer Goldseifen in Ghana anhand von Fluideinschluß-Untersuchungen.  
270 pages, Bremen, 1995.
- No. 66**      **Nyandwi, N.**  
The Nature of the Sediment Distribution Patterns in the Spiekeroog Backbarrier Area, the East Frisian Islands.  
162 pages, Bremen, 1995.
- No. 67**      **Isenbeck-Schröter, M.**  
Transportverhalten von Schwermetallkationen und Oxoanionen in wassergesättigten Sanden. - Laborversuche in Säulen und ihre Modellierung -  
182 pages, Bremen, 1995.
- No. 68**      **Hebbeln, D. and cruise participants**  
Report and preliminary results of SONNE-Cruise SO 102, Valparaiso - Valparaiso, 95  
134 pages, Bremen, 1995.



- No. 69**      **Willems, H. (Sprecher), U. Bathmann, U. Bleil, T. v. Dobeneck, K. Herterich, B.B. Jorgensen, E.-M. Nöthig, M. Olesch, J. Pätzold, H.D. Schulz, V. Smetacek, V. Speiß, G. Wefer**  
Bericht des Graduierten-Kollegs Stoff-Flüsse in marine Geosystemen.  
Berichtszeitraum Januar 1993 - Dezember 1995.  
45 & 468 pages, Bremen, 1995.
- No. 70**      **Giese, M. and G. Wefer**  
Bericht über den 4. JGOFS-Workshop. 20./21. November 1995 in Bremen.  
60 pages, Bremen, 1996. (out of print)
- No. 71**      **Meggers, H.**  
Pliozän-quartäre Karbonatsedimentation und Paläozeanographie des Nordatlantiks und des Europäischen Nordmeeres - Hinweise aus planktischen Foraminiferengemeinschaften.  
143 pages, Bremen, 1996. (out of print)
- No. 72**      **Teske, A.**  
Phylogenetische und ökologische Untersuchungen an Bakterien des oxidativen und reduktiven marinen Schwefelkreislaufs mittels ribosomaler RNA.  
220 pages, Bremen, 1996. (out of print)
- No. 73**      **Andersen, N.**  
Biogeochemische Charakterisierung von Sinkstoffen und Sedimenten aus ostatlantischen Produktions-Systemen mit Hilfe von Biomarkern.  
215 pages, Bremen, 1996.
- No. 74**      **Treppke, U.**  
Saisonalität im Diatomeen- und Silikoflagellatenfluß im östlichen tropischen und subtropischen Atlantik.  
200 pages, Bremen, 1996.
- No. 75**      **Schüring, J.**  
Die Verwendung von Steinkohlebergematerialien im Deponiebau im Hinblick auf die Pyritverwitterung und die Eignung als geochemische Barriere.  
110 pages, Bremen, 1996.
- No. 76**      **Pätzold, J. and cruise participants**  
Report and preliminary results of VICTOR HENSEN cruise JOPS II, Leg 6, Fortaleza - Recife, 10.3. - 26.3. 1995 and Leg 8, Vitoria - Vitoria, 10.4. - 23.4.1995.  
87 pages, Bremen, 1996.
- No. 77**      **Bleil, U. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 34/1, Cape Town - Walvis Bay, 3.-26.1.1996.  
129 pages, Bremen, 1996.
- No. 78**      **Schulz, H.D. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 34/2, Walvis Bay - Walvis Bay, 29.1.-18.2.96  
133 pages, Bremen, 1996.
- No. 79**      **Wefer, G. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 34/3, Walvis Bay - Recife, 21.2.-17.3.1996.  
168 pages, Bremen, 1996.
- No. 80**      **Fischer, G. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 34/4, Recife - Bridgetown, 19.3.-15.4.1996.  
105 pages, Bremen, 1996.
- No. 81**      **Kulbrok, F.**  
Biostratigraphie, Fazies und Sequenzstratigraphie einer Karbonatrampe in den Schichten der Oberkreide und des Alttertiärs Nordost-Ägyptens (Eastern Desert, N'Golf von Suez, Sinai).  
153 pages, Bremen, 1996.
- No. 82**      **Kasten, S.**  
Early Diagenetic Metal Enrichments in Marine Sediments as Documents of Nonsteady-State Depositional Conditions. Bremen, 1996.
- No. 83**      **Holmes, M.E.**  
Reconstruction of Surface Ocean Nitrate Utilization in the Southeast Atlantic Ocean Based on Stable Nitrogen Isotopes.  
113 pages, Bremen, 1996.
- No. 84**      **Rühlemann, C.**  
Akkumulation von Carbonat und organischem Kohlenstoff im tropischen Atlantik: Spätquartäre Produktivitäts-Variationen und ihre Steuerungsmechanismen.  
139 pages, Bremen, 1996.

- No. 85**      **Ratmeyer, V.**  
Untersuchungen zum Eintrag und Transport lithogener und organischer partikulärer Substanz im östlichen subtropischen Nordatlantik.  
154 pages, Bremen, 1996.
- No. 86**      **Cepek, M.**  
Zeitliche und räumliche Variationen von Coccolithophoriden-Gemeinschaften im subtropischen Ost-Atlantik: Untersuchungen an Plankton, Sinkstoffen und Sedimenten.  
156 pages, Bremen, 1996.
- No. 87**      **Otto, S.**  
Die Bedeutung von gelöstem organischen Kohlenstoff (DOC) für den Kohlenstofffluß im Ozean.  
150 pages, Bremen, 1996.
- No. 88**      **Hensen, C.**  
Frühdiaagenetische Prozesse und Quantifizierung benthischer Stoff-Flüsse in Oberflächensedimenten des Südatlantiks.  
132 pages, Bremen, 1996.
- No. 89**      **Giese, M. and G. Wefer**  
Bericht über den 5. JGOFS-Workshop. 27./28. November 1996 in Bremen.  
73 pages, Bremen, 1997.
- No. 90**      **Wefer, G. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 37/1, Lisbon - Las Palmas, 4.-23.12.1996.  
79 pages, Bremen, 1997.
- No. 91**      **Isenbeck-Schröter, M., E. Bedbur, M. Kofod, B. König, T. Schramm & G. Mattheß**  
Occurrence of Pesticide Residues in Water - Assessment of the Current Situation in Selected EU Countries.  
65 pages, Bremen 1997.
- No. 92**      **Kühn, M.**  
Geochemische Folgereaktionen bei der hydrogeothermalen Energiegewinnung.  
129 pages, Bremen 1997.
- No. 93**      **Determann, S. & K. Herterich**  
JGOFS-A6 "Daten und Modelle": Sammlung JGOFS-relevanter Modelle in Deutschland.  
26 pages, Bremen, 1997.
- No. 94**      **Fischer, G. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 38/1, Las Palmas - Recife, 25.1.-1.3.1997, with Appendix: Core Descriptions from METEOR Cruise M 37/1. Bremen, 1997.
- No. 95**      **Bleil, U. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 38/2, Recife - Las Palmas, 4.3.-14.4.1997.  
126 pages, Bremen, 1997.
- No. 96**      **Neuer, S. and cruise participants**  
Report and preliminary results of VICTOR HENSEN-Cruise 96/1. Bremen, 1997.
- No. 97**      **Villinger, H. and cruise participants**  
Fahrtbericht SO 111, 20.8. - 16.9.1996. 115 pages, Bremen, 1997.
- No. 98**      **Lüning, S.**  
Late Cretaceous - Early Tertiary sequence stratigraphy, paleoecology and geodynamics of Eastern Sinai, Egypt.  
218 pages, Bremen, 1997.
- No. 99**      **Haese, R.R.**  
Beschreibung und Quantifizierung frühdiaagenetischer Reaktionen des Eisens in Sedimenten des Südatlantiks.  
118 pages, Bremen, 1997.
- No. 100**     **Lührte, R. von**  
Verwertung von Bremer Baggergut als Material zur Oberflächenabdichtung von Deponien - Geochemisches Langzeitverhalten und Schwermetall-Mobilität (Cd, Cu, Ni, Pb, Zn).  
Bremen, 1997.
- No. 101**     **Ebert, M.**  
Der Einfluß des Redoxmilieus auf die Mobilität von Chrom im durchströmten Aquifer.  
135 pages, Bremen, 1997.
- No. 102**     **Krögel, F.**  
Einfluß von Viskosität und Dichte des Seewassers auf Transport und Ablagerung von Wattsedimenten (Langeooger Rückseitenwatt, südliche Nordsee).  
168 pages, Bremen, 1997.

- No. 103 Kerntopf, B.**  
Dinoflagellate Distribution Patterns and Preservation in the Equatorial Atlantic and Offshore North-West Africa.  
137 pages, Bremen, 1997.
- No. 104 Breitzke, M.**  
Elastische Wellenausbreitung in marinen Sedimenten - Neue Entwicklungen der Ultraschall Sedimentphysik und Sedimentechographie.  
298 pages, Bremen, 1997.
- No. 105 Marchant, M.**  
Rezente und spätquartäre Sedimentation planktischer Foraminiferen im Peru-Chile Strom.  
115 pages, Bremen, 1997.
- No. 106 Habicht, K.S.**  
Sulfur isotope fractionation in marine sediments and bacterial cultures.  
125 pages, Bremen, 1997.
- No. 107 Hamer, K., R.v. Lührte, G. Becker, T. Felis, S. Keffel, B. Strotmann, C. Waschkowitz, M. Kölling, M. Isenbeck-Schröter, H.D. Schulz**  
Endbericht zum Forschungsvorhaben 060 des Landes Bremen: Baggergut der Hafengruppe Bremen-Stadt: Modelluntersuchungen zur Schwermetallmobilität und Möglichkeiten der Verwertung von Hafenschlick aus Bremischen Häfen.  
98 pages, Bremen, 1997.
- No. 108 Greeff, O.W.**  
Entwicklung und Erprobung eines benthischen Landersystemes zur *in situ*-Bestimmung von Sulfatreduktionsraten mariner Sedimente.  
121 pages, Bremen, 1997.
- No. 109 Pätzold, M. und G. Wefer**  
Bericht über den 6. JGOFS-Workshop am 4./5.12.1997 in Bremen. Im Anhang: Publikationen zum deutschen Beitrag zur Joint Global Ocean Flux Study (JGOFS), Stand 1/1998.  
122 pages, Bremen, 1998.
- No. 110 Landenberger, H.**  
CoTReM, ein Multi-Komponenten Transport- und Reaktions-Modell. 142 pages, Bremen, 1998.
- No. 111 Villinger, H. und Fahrtteilnehmer**  
Fahrtbericht SO 124, 4.10. - 16.10.199.  
90 pages, Bremen, 1997.
- No. 112 Gietl, R.**  
Biostratigraphie und Sedimentationsmuster einer nordostägyptischen Karbonatrampe unter Berücksichtigung der Alveolinen-Faunen.  
142 pages, Bremen, 1998.
- No. 113 Ziebis, W.**  
The Impact of the Thalassinidean Shrimp *Callianassa truncata* on the Geochemistry of permeable, coastal Sediments.  
158 pages, Bremen 1998.
- No. 114 Schulz, H.D. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 41/1, Málaga - Libreville, 13.2.-15.3.1998.  
Bremen, 1998.
- No. 115 Völker, D.J.**  
Untersuchungen an strömungsbeeinflussten Sedimentationsmustern im Südozean. Interpretation sedimentechographischer Daten und numerische Modellierung.  
152 pages, Bremen, 1998.
- No. 116 Schlünz, B.**  
Riverine Organic Carbon Input into the Ocean in Relation to Late Quaternary Climate Change.  
136 pages, Bremen, 1998.
- No. 117 Kuhnert, H.**  
Aufzeichnung des Klimas vor Westaustralien in stabilen Isotopen in Korallenskeletten.  
109 pages, Bremen, 1998.
- No. 118 Kirst, G.**  
Rekonstruktion von Oberflächenwassertemperaturen im östlichen Südatlantik anhand von Alkenonen.  
130 pages, Bremen, 1998.
- No. 119 Dürkoop, A.**  
Der Brasil-Strom im Spätquartär: Rekonstruktion der oberflächennahen Hydrographie während der letzten 400 000 Jahre.  
121 pages, Bremen, 1998.

- No. 120**     **Lamy, F.**  
Spätquartäre Variationen des terrigenen Sedimenteintrags entlang des chilenischen Kontinentalhangs als Abbild von Klimavariabilität im Milankovič- und Sub-Milankovič-Zeitbereich.  
141 pages, Bremen, 1998.
- No. 121**     **Neuer, S. and cruise participants**  
Report and preliminary results of POSEIDON-Cruise Pos 237/2, Vigo – Las Palmas, 18.3.-31.3.1998.  
39 pages, Bremen, 1998
- No. 122**     **Romero, O.E.**  
Marine planktonic diatoms from the tropical and equatorial Atlantic: temporal flux patterns and the sediment record.  
205 pages, Bremen, 1998.
- No. 123**     **Spiess, V. und Fahrtteilnehmer**  
Report and preliminary results of RV SONNE Cruise 125, Cochin – Chittagong, 17.10.-17.11.1997.  
128 pages, Bremen, 1998.
- No. 124**     **Arz, H.W.**  
Dokumentation von kurzfristigen Klimaschwankungen des Spätquartärs in Sedimenten des westlichen äquatorialen Atlantiks.  
96 pages, Bremen, 1998.
- No. 125**     **Wolff, T.**  
Mixed layer characteristics in the equatorial Atlantic during the late Quaternary as deduced from planktonic foraminifera.  
132 pages, Bremen, 1998.
- No. 126**     **Dittert, N.**  
Late Quaternary Planktic Foraminifera Assemblages in the South Atlantic Ocean: Quantitative Determination and Preservational Aspects.  
165 pages, Bremen, 1998.
- No. 127**     **Höll, C.**  
Kalkige und organisch-wandige Dinoflagellaten-Zysten in Spätquartären Sedimenten des tropischen Atlantiks und ihre palökologische Auswertbarkeit.  
121 pages, Bremen, 1998.
- No. 128**     **Hencke, J.**  
Redoxreaktionen im Grundwasser: Etablierung und Verlagerung von Reaktionsfronten und ihre Bedeutung für die Spurenelement-Mobilität.  
122 pages, Bremen 1998.
- No. 129**     **Pätzold, J. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 41/3, Vitória, Brasil – Salvador de Bahia, Brasil, 18.4. - 15.5.1998. Bremen, 1999.
- No. 130**     **Fischer, G. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 41/4, Salvador de Bahia, Brasil – Las Palmas, Spain, 18.5. – 13.6.1998. Bremen, 1999.
- No. 131**     **Schlünz, B. und G. Wefer**  
Bericht über den 7. JGOFS-Workshop am 3. und 4.12.1998 in Bremen. Im Anhang: Publikationen zum deutschen Beitrag zur Joint Global Ocean Flux Study (JGOFS), Stand 1/ 1999.  
100 pages, Bremen, 1999.
- No. 132**     **Wefer, G. and cruise participants**  
Report and preliminary results of METEOR-Cruise M 42/4, Las Palmas - Las Palmas - Viena do Castelo; 26.09.1998 - 26.10.1998.  
104 pages, Bremen, 1999.
- No. 133**     **Felis, T.**  
Climate and ocean variability reconstructed from stable isotope records of modern subtropical corals (Northern Red Sea).  
111 pages, Bremen, 1999.
- No. 134**     **Draschba, S.**  
North Atlantic climate variability recorded in reef corals from Bermuda.  
108 pages, Bremen, 1999.
- No. 135**     **Schmieder, F.**  
Magnetic Cyclostratigraphy of South Atlantic Sediments.  
82 pages, Bremen, 1999.

- No. 136**     **Rieß, W.**  
In situ measurements of respiration and mineralisation processes – Interaction between fauna and geochemical fluxes at active interfaces.  
68 pages, Bremen, 1999.
- No. 137**     **Devey, C.W. and cruise participants**  
Report and shipboard results from METEOR-cruise M 41/2, Libreville – Vitoria, 18.3. – 15.4.98.  
59 pages, Bremen, 1999.
- No. 138**     **Wenzhöfer, F.**  
Biogeochemical processes at the sediment water interface and quantification of metabolically driven calcite dissolution in deep sea sediments.  
103 pages, Bremen, 1999.
- No. 139**     **Klump, J.**  
Biogenic barite as a proxy of paleoproductivity variations in the Southern Peru-Chile Current.  
107 pages, Bremen, 1999.
- No. 140**     **Huber, R.**  
Carbonate sedimentation in the northern Northatlantic since the late pliocene.  
103 pages, Bremen, 1999.
- No. 141**     **Schulz, H.**  
Nitrate-storing sulfur bacteria in sediments of coastal upwelling.  
94 pages, Bremen, 1999.
- No. 142**     **Mai, S.**  
Die Sedimentverteilung im Wattenmeer: ein Simulationsmodell.  
114 pages, Bremen, 1999.
- No. 143**     **Neuer, S. and cruise participants**  
Report and preliminary results of Poseidon Cruise 248, Las Palmas - Las Palmas, 15.2.-26.2.1999.  
45 pages, Bremen, 1999.
- No. 144**     **Weber, A.**  
Schwefelkreislauf in marinen Sedimenten und Messung von *in situ* Sulfatreduktionsraten.  
122 pages, Bremen, 1999.
- No. 145**     **Hadeler, A.**  
Sorptionsreaktionen im Grundwasser: Unterschiedliche Aspekte bei der Modellierung des Transportverhaltens von Zink.  
122 pages, 1999.
- No. 146**     **Dierßen, H.**  
Zum Kreislauf ausgewählter Spurenmetalle im Südatlantik: Vertikaltransport und Wechselwirkung zwischen Partikeln und Lösung.  
167 pages, Bremen, 1999.
- No. 147**     **Zühlsdorff, L.**  
High resolution multi-frequency seismic surveys at the Eastern Juan de Fuca Ridge Flank and the Cascadia Margin – Evidence for thermally and tectonically driven fluid upflow in marine sediments.  
118 pages, Bremen 1999.
- No. 148**     **Kinkel, H.**  
Living and late Quaternary Coccolithophores in the equatorial Atlantic Ocean: response of distribution and productivity patterns to changing surface water circulation.  
183 pages, Bremen, 2000.
- No. 149**     **Pätzold, J. and cruise participants**  
Report and preliminary results of METEOR Cruise M 44/3, Aqaba (Jordan) - Safaga (Egypt) – Dubá (Saudi Arabia) – Suez (Egypt) - Haifa (Israel), 12.3.-26.3.-2.4.-4.4.1999. 1  
35 pages, Bremen, 2000.
- No. 150**     **Schlünz, B. and G. Wefer**  
Bericht über den 8. JGOFS-Workshop am 2. und 3.12.1999 in Bremen. Im Anhang:  
Publikationen zum deutschen Beitrag zur Joint Global Ocean Flux Study (JGOFS), Stand 1/ 2000.  
95 pages, Bremen, 2000.
- No. 151**     **Schnack, K.**  
Biostratigraphie und fazielle Entwicklung in der Oberkreide und im Alttertiär im Bereich der Kharga Schwelle, Westliche Wüste, SW-Ägypten.  
142 pages, Bremen, 2000.

- No. 152 Karwath, B.**  
Ecological studies on living and fossil calcareous dinoflagellates of the equatorial and tropical Atlantic Ocean.  
175 pages, Bremen, 2000.
- No. 153 Moustafa, Y.**  
Paleoclimatic reconstructions of the Northern Red Sea during the Holocene inferred from stable isotope records of modern and fossil corals and molluscs.  
102 pages, Bremen, 2000.
- No. 154 Villinger, H. and cruise participants**  
Report and preliminary results of SONNE-cruise 145-1 Balboa – Talcahuana, 21.12.1999 – 28.01.2000.  
147 pages, Bremen, 2000.
- No. 155 Rusch, A.**  
Dynamik der Feinfraktion im Oberflächenhorizont permeabler Schelfsedimente.  
102 pages, Bremen, 2000.
- No. 156 Moos, C.**  
Reconstruction of upwelling intensity and paleo-nutrient gradients in the northwest Arabian Sea derived from stable carbon and oxygen isotopes of planktic foraminifera.  
103 pages, Bremen, 2000.
- No. 157 Xu, W.**  
Mass physical sediment properties and trends in a Wadden Sea tidal basin.  
127 pages, Bremen, 2000.
- No. 158 Meinecke, G. and cruise participants**  
Report and preliminary results of METEOR Cruise M 45/1, Malaga (Spain) - Lissabon (Portugal), 19.05. - 08.06.1999.  
39 pages, Bremen, 2000.
- No. 159 Vink, A.**  
Reconstruction of recent and late Quaternary surface water masses of the western subtropical Atlantic Ocean based on calcareous and organic-walled dinoflagellate cysts.  
160 pages, Bremen, 2000.
- No. 160 Willems, H. (Sprecher), U. Bleil, R. Henrich, K. Herterich, B.B. Jørgensen, H.-J. Kuß, M. Olesch, H.D. Schulz, V. Spieß, G. Wefer**  
Abschlußbericht des Graduierten-Kollegs Stoff-Flüsse in marine Geosystemen.  
Zusammenfassung und Berichtszeitraum Januar 1996 - Dezember 2000.  
340 pages, Bremen, 2000.
- No. 161 Sprengel, C.**  
Untersuchungen zur Sedimentation und Ökologie von Coccolithophoriden im Bereich der Kanarischen Inseln: Saisonale Flussmuster und Karbonatexport.  
165 pages, Bremen, 2000.
- No. 162 Donner, B. and G. Wefer**  
Bericht über den JGOFS-Workshop am 18.-21.9.2000 in Bremen:  
Biogeochemical Cycles: German Contributions to the International Joint Global Ocean Flux Study.  
87 pages, Bremen, 2000.
- No. 163 Neuer, S. and cruise participants**  
Report and preliminary results of Meteor Cruise M 45/5, Bremen – Las Palmas, October 1 – November 3, 1999.  
93 pages, Bremen, 2000.
- No. 164 Devey, C. and cruise participants**  
Report and preliminary results of Sonne Cruise SO 145/2, Talcahuano (Chile) - Arica (Chile), February 4 – February 29, 2000.  
63 pages, Bremen, 2000.
- No. 165 Freudenthal, T.**  
Reconstruction of productivity gradients in the Canary Islands region off Morocco by means of sinking particles and sediments.  
147 pages, Bremen, 2000.
- No. 166 Adler, M.**  
Modeling of one-dimensional transport in porous media with respect to simultaneous geochemical reactions in CoTRem.  
147 pages, Bremen, 2000.

- No. 167 Santamarina Cuneo, P.**  
Fluxes of suspended particulate matter through a tidal inlet of the East Frisian Wadden Sea (southern North Sea).  
91 pages, Bremen, 2000.
- No. 168 Benthien, A.**  
Effects of CO<sub>2</sub> and nutrient concentration on the stable carbon isotope composition of C<sub>37:2</sub> alkenones in sediments of the South Atlantic Ocean.  
104 pages, Bremen, 2001.
- No. 169 Lavik, G.**  
Nitrogen isotopes of sinking matter and sediments in the South Atlantic.  
140 pages, Bremen, 2001.
- No. 170 Budziak, D.**  
Late Quaternary monsoonal climate and related variations in paleoproductivity and alkenone-derived sea-surface temperatures in the western Arabian Sea.  
114 pages, Bremen, 2001.
- No. 171 Gerhardt, S.**  
Late Quaternary water mass variability derived from the pteropod preservation state in sediments of the western South Atlantic Ocean and the Caribbean Sea.  
109 pages, Bremen, 2001.
- No. 172 Bleil, U. and cruise participants**  
Report and preliminary results of Meteor Cruise M 46/3, Montevideo (Uruguay) – Mar del Plata (Argentina), January 4 – February 7, 2000. Bremen, 2001.
- No. 173 Wefer, G. and cruise participants**  
Report and preliminary results of Meteor Cruise M 46/4, Mar del Plata (Argentina) – Salvador da Bahia (Brazil), February 10 – March 13, 2000. With partial results of METEOR cruise M 46/2.  
136 pages, Bremen, 2001.
- No. 174 Schulz, H.D. and cruise participants**  
Report and preliminary results of Meteor Cruise M 46/2, Recife (Brazil) – Montevideo (Uruguay), December 2 – December 29, 1999.  
107 pages, Bremen, 2001.
- No. 175 Schmidt, A.**  
Magnetic mineral fluxes in the Quaternary South Atlantic: Implications for the paleoenvironment.  
97 pages, Bremen, 2001.
- No. 176 Bruhns, P.**  
Crystal chemical characterization of heavy metal incorporation in brick burning processes.  
93 pages, Bremen, 2001.
- No. 177 Karius, V.**  
Baggergut der Hafengruppe Bremen-Stadt in der Ziegelherstellung.  
131 pages, Bremen, 2001.
- No. 178 Adegbic, A. T.**  
Reconstruction of paleoenvironmental conditions in Equatorial Atlantic and the Gulf of Guinea Basins for the last 245,000 years.  
113 pages, Bremen, 2001.
- No. 179 Spieß, V. and cruise participants**  
Report and preliminary results of R/V Sonne Cruise SO 149, Victoria - Victoria, 16.8. - 16.9.2000.  
100 pages, Bremen, 2001.
- No. 180 Kim, J.-H.**  
Reconstruction of past sea-surface temperatures in the eastern South Atlantic and the eastern South Pacific across Termination I based on the Alkenone Method.  
114 pages, Bremen, 2001.
- No. 181 von Lom-Keil, H.**  
Sedimentary waves on the Namibian continental margin and in the Argentine Basin – Bottom flow reconstructions based on high resolution echosounder data.  
126 pages, Bremen, 2001.
- No. 182 Hebbeln, D. and cruise participants**  
PUCK: Report and preliminary results of R/V Sonne Cruise SO 156, Valparaiso (Chile) - Talcahuano (Chile), March 29 - May 14, 2001.  
195 pages, Bremen, 2001.
- No. 183 Wendler, J.**  
Reconstruction of astronomically-forced cyclic and abrupt paleoecological changes in the Upper Cretaceous Boreal Realm based on calcareous dinoflagellate cysts.  
149 pages, Bremen, 2001.

- No. 184** **Volbers, A.**  
Planktic foraminifera as paleoceanographic indicators: production, preservation, and reconstruction of upwelling intensity. Implications from late Quaternary South Atlantic sediments. 122 pages, Bremen, 2001.
- No. 185** **Bleil, U. and cruise participants**  
Report and preliminary results of R/V METEOR Cruise M 49/3, Montevideo (Uruguay) - Salvador (Brasil), March 9 - April 1, 2001. 99 pages, Bremen, 2001.
- No. 186** **Scheibner, C.**  
Architecture of a carbonate platform-to-basin transition on a structural high (Campanian-early Eocene, Eastern Desert, Egypt) – classical and modelling approaches combined. 173 pages, Bremen, 2001.
- No. 187** **Schneider, S.**  
Quartäre Schwankungen in Strömungsintensität und Produktivität als Abbild der Wassermassen-Variabilität im äquatorialen Atlantik (ODP Sites 959 und 663): Ergebnisse aus Siltkorn-Analysen. 134 pages, Bremen, 2001.
- No. 188** **Uliana, E.**  
Late Quaternary biogenic opal sedimentation in diatom assemblages in Kongo Fan sediments. 96 pages, Bremen, 2002.
- No. 189** **Esper, O.**  
Reconstruction of Recent and Late Quaternary oceanographic conditions in the eastern South Atlantic Ocean based on calcareous- and organic-walled dinoflagellate cysts. 130 pages, Bremen, 2001.
- No. 190** **Wendler, I.**  
Production and preservation of calcareous dinoflagellate cysts in the modern Arabian Sea. 117 pages, Bremen, 2002.
- No. 191** **Bauer, J.**  
Late Cenomanian – Santonian carbonate platform evolution of Sinai (Egypt): stratigraphy, facies, and sequence architecture. 178 pages, Bremen, 2002.
- No. 192** **Hildebrand-Habel, T.**  
Die Entwicklung kalkiger Dinoflagellaten im Südatlantik seit der höheren Oberkreide. 152 pages, Bremen, 2002.
- No. 193** **Hecht, H.**  
Sauerstoff-Optopoden zur Quantifizierung von Pyritverwitterungsprozessen im Labor- und Langzeit-in-situ-Einsatz. Entwicklung - Anwendung – Modellierung. 130 pages, Bremen, 2002.
- No. 194** **Fischer, G. and cruise participants**  
Report and Preliminary Results of RV METEOR-Cruise M49/4, Salvador da Bahia – Halifax, 4.4.-5.5.2001. 84 pages, Bremen, 2002.
- No. 195** **Gröger, M.**  
Deep-water circulation in the western equatorial Atlantic: inferences from carbonate preservation studies and silt grain-size analysis. 95 pages, Bremen, 2002.
- No. 196** **Meinecke, G. and cruise participants**  
Report of RV POSEIDON Cruise POS 271, Las Palmas - Las Palmas, 19.3.-29.3.2001. 19 pages, Bremen, 2002.
- No. 197** **Meggers, H. and cruise participants**  
Report of RV POSEIDON Cruise POS 272, Las Palmas - Las Palmas, 1.4.-14.4.2001. 19 pages, Bremen, 2002.
- No. 198** **Gräfe, K.-U.**  
Stratigraphische Korrelation und Steuerungsfaktoren Sedimentärer Zyklen in ausgewählten Borealen und Tethyalen Becken des Cenoman/Turon (Oberkreide) Europas und Nordwestafrikas. 197 pages, Bremen, 2002.
- No. 199** **Jahn, B.**  
Mid to Late Pleistocene Variations of Marine Productivity in and Terrigenous Input to the Southeast Atlantic. 97 pages, Bremen, 2002.



- No. 200** **Al-Rousan, S.**  
Ocean and climate history recorded in stable isotopes of coral and foraminifers from the northern Gulf of Aqaba.  
116 pages, Bremen, 2002.
- No. 201** **Azouzi, B.**  
Regionalisierung hydraulischer und hydrogeochemischer Daten mit geostatistischen Methoden.  
108 pages, Bremen, 2002.
- No. 202** **Spieß, V. and cruise participants**  
Report and preliminary results of METEOR Cruise M 47/3, Libreville (Gabun) - Walvis Bay (Namibia),  
01.06 - 03.07.2000. 70 pages, Bremen 2002.
- No. 203** **Spieß, V. and cruise participants**  
Report and preliminary results of METEOR Cruise M 49/2, Montevideo (Uruguay) - Montevideo,  
13.02 - 07.03.2001. 84 pages, Bremen 2002.
- No. 204** **Mollenhauer, G.**  
Organic carbon accumulation in the South Atlantic Ocean: Sedimentary processes and glacial/interglacial Budgets.  
139 pages, Bremen 2002.
- No. 205** **Spieß, V. and cruise participants**  
Report and preliminary results of METEOR Cruise M49/1, Cape Town (South Africa) - Montevideo (Uruguay), 04.01.2000 - 10.02.2000.  
57 pages, Bremen, 2003.
- No. 206** **Meier, K.J.S.**  
Calcareous dinoflagellates from the Mediterranean Sea: taxonomy, ecology and palaeoenvironmental application.  
126 pages, Bremen, 2003.
- No. 207** **Rakic, S.**  
Untersuchungen zur Polymorphie und Kristallchemie von Silikaten der Zusammensetzung  $Me_2Si_2O_5$  (Me:Na, K).  
139 pages, Bremen, 2003.
- No. 208** **Pfeifer, K.**  
Auswirkungen frühdiagenetischer Prozesse auf Calcit- und Barytgehalte in marinen Oberflächen-sedimenten. 110 pages, Bremen, 2003.
- No. 209** **Heuer, V.**  
Spurenelemente in Sedimenten des Südatlantik. Primärer Eintrag und frühdiagenetische Überprägung.  
136 pages, Bremen, 2003.
- No. 210** **Streng, M.**  
Phylogenetic Aspects and Taxonomy of Calcareous Dinoflagellates.  
157 pages, Bremen 2003.
- No. 211** **Boeckel, B.**  
Present and past coccolith assemblages in the South Atlantic: implications for species ecology, carbonate contribution and palaeoceanographic applicability.  
157 pages, Bremen, 2003.
- No. 212** **Precht, E.**  
Advective interfacial exchange in permeable sediments driven by surface gravity waves and its ecological consequences. 131 pages, Bremen, 2003.
- No. 213** **Frenz, M.**  
Grain-size composition of Quaternary South Atlantic sediments and its paleoceanographic significance.  
123 pages, Bremen, 2003.
- No. 214** **Meggers, H. and cruise participants**  
Report and preliminary results of METEOR Cruise M 53/1, Limassol - Las Palmas - Mindelo,  
30.03.2002 - 03.05.2002.  
81 pages, Bremen, 2003.
- No. 215** **Schulz, H.D. and cruise participants**  
Report and preliminary results of METEOR Cruise M 58/1, Dakar - Las Palmas, 15.04..2003 - 12.05.2003. Bremen, 2003.

- No. 216**     **Schneider, R. and cruise participants**  
Report and preliminary results of METEOR Cruise M 57/1, Cape Town – Walvis Bay, 20.01. – 08.02.2003.  
123 pages, Bremen, 2003.
- No. 217**     **Kallmeyer, J.**  
Sulfate reduction in the deep Biosphere.  
157 pages, Bremen, 2003.
- No. 218**     **Røy, H.**  
Dynamic Structure and Function of the Diffusive Boundary Layer at the Seafloor.  
149 pages, Bremen, 2003.
- No. 219**     **Pätzold, J., C. Hübscher and cruise participants**  
Report and preliminary results of METEOR Cruise M 52/2&3, Istanbul – Limassol – Limassol, 04.02. – 27.03.2002. Bremen, 2003.
- No. 220**     **Zabel, M. and cruise participants**  
Report and preliminary results of METEOR Cruise M 57/2, Walvis Bay – Walvis Bay, 11.02. – 12.03.2003.  
136 pages, Bremen 2003.
- No. 221**     **Salem, M.**  
Geophysical investigations of submarine prolongations of alluvial fans on the western side of the Gulf of Aqaba-Red Sea.  
100 pages, Bremen, 2003.
- No. 222**     **Tilch, E.**  
Oszillation von Wattflächen und deren fossiles Erhaltungspotential (Spiekerooger Rückseitenwatt, südliche Nordsee).  
137 pages, Bremen, 2003.
- No. 223**     **Frisch, U. and F. Kockel**  
Der Bremen-Knoten im Strukturnetz Nordwest-Deutschlands. Stratigraphie, Paläogeographie, Strukturgeologie.  
379 pages, Bremen, 2004.
- No. 224**     **Kolonic, S.**  
Mechanisms and biogeochemical implications of Cenomanian/Turonian black shale formation in North Africa: An integrated geochemical, millennial-scale study from the Tarfaya-LaAyoune Basin in SW Morocco.  
174 pages, Bremen, 2004. Report online available only.
- No. 225**     **Panteleit, B.**  
Geochemische Prozesse in der Salz- Süßwasser Übergangszone. 106 pages, Bremen, 2004.
- No. 226**     **Seiter, K.**  
Regionalisierung und Quantifizierung benthischer Mineralisationsprozesse.  
135 pages, Bremen, 2004.
- No. 227**     **Bleil, U. and cruise participants**  
Report and preliminary results of METEOR Cruise M 58/2, Las Palmas – Las Palmas (Canary Islands, Spain), 15.05. – 08.06.2003.  
123 pages, Bremen, 2004.
- No. 228**     **Kopf, A. and cruise participants**  
Report and preliminary results of SONNE Cruise SO175, Miami - Bremerhaven, 12.11 - 30.12.2003.  
218 pages, Bremen, 2004.
- No. 229**     **Fabian, M.**  
Near Surface Tilt and Pore Pressure Changes Induced by Pumping in Multi-Layered Poroelastic Half-Spaces.  
121 pages, Bremen, 2004.
- No. 230**     **Meinecke, G. and cruise participants**  
Report and preliminary results of METEOR Cruise M 58/3, Las Palmas – Ponta Delgada, 11.06 - 24.06.2003.  
53 pages, Bremen, 2004.