RV METEOR, Cruise No. 48, leg 4.
Walvis Bay (Namibia) – Walvis Bay (Namibia), 19. Sep.– 10. Oct. 2000

Report

written by the Chief Scientist of the cruise: Prof. Dr. W. Balzer,
University of Bremen, Postfach 330440, D-28334 Bremen, Germany

The cruise M48 leg 4 of the Research Vessel METEOR began on September 19, 2000, at 9:12 a.m. (UTC) when leaving the harbour of Walvis Bay, Namibia. In addition to the regular nautical crew (Master of RV METEOR: Cpt. Kull), the METEOR had on board a crew of 20 scientists including 3 guests from Namibia (UNAM) and one guest from South Africa. The main aims of this leg were studies of the distribution of dissolved and particulte trace metals in the upper water column, the sampling of natural radionuclides in the water column and the porewater, and investigations of calcareous nanoplankton.

Only a few hours after leaving of the harbour, the RV METEOR reached at its first station during this leg, which is part of the monitoring transect of the NatMIRC (Swakopmund) from the coast to the continental margin at exactly 23° Southern latitude . At least parts of this transect were sampled several times before in the year 2000 to follow the seasonal development of the hydrogen sulphide concentration in the bottom water. While poisonous H_2S was detected during all former cruises with decreasing concentrations since March, we could not find this gas at depths 20 m above the sea floor. Probably due to high rates of upwelling, we found only oxygen depleted water layers but no H_2S, too, when occupying 3 more stations of this transect for the determination of the oxygen and hydrogen sulphide distribution. Using bottles and in-situ-pumps for trace metal sampling in the water column, we found large amounts of dust particles in the water column of all shelf stations which originated from the dust storms of the week before. On the second day we put a new plastic coated wire (1000 m) on the drum which was expected to be advantageous for trace metal sampling with low contamination risks. The performance of the wire had to be tested during the cruise. A failure was the first deployment of a new fully-automatic sampler for trace metals which was borrowed from American colleagues.

In the third night the RV METEOR left the shelf heading northwest for a station at the continental margin (water depth 2825 m) to sample dissolved radionuclides and trace metals. By using the multicorer we obtained 15 cm of silty carbonate ooze in all cores which was perfectly suited for pore water squeezing. The next station at 20°00S/009°00E was occupied, because several years before (operated by geologists from the University of Bremen) a mooring containing time-series sediment traps was deployed at this position and because from this station samples of dissolved and particulate trace metals were still lacking. The particles obtained from these sediment traps on the Walvis Ridge had a low ratio of dust to organic matter when compared to stations in the upwelling regions off North-West Africa exhibiting a similarly high productivity. This is the reason why suspended trace metals from this position are interesting for the modelling the solution/solid-interaction and the assoziation of organic matter and dust when sinking towards the sea floor. The three casts of the CTD/Niskin-Rosette (for dissolved radionuclides), the two casts of the GoFlo-Rosette (for dissolved trace metals), the three deployments of the in-situ-pumps (sampling of suspended particles) and the one deployment of the multicorer lasted for 22 hours.

Operations of these four sampling devices filled also the time of all the other stations during this cruise: the CTD-profiles gave information about the temperature-salinity-structure of the water column, the water from the CTD/Niskin-Rosette was used both for dissolved radionuclides samples (to be analyzed at home) and for ecological investigations of calcareous plankton organisms; the water from the GoFlo-Rosette was used for dissolved trace metal samples (to be analyzed at home) and for immediate determinations on board ship of oxygen and nutrients; the deployments of the in-situ-pumps served for the in-situ-filtration of ca. 200 L sea water for home determinations of the trace metal and radionclide content of the suspended particles; the multicorer was used to get near-surface sediments to derive the historical record of both certain radionuclides and certain trace metals, and to sqeeze pore waters from sectioned sediment layers under inert gas atmosphere. The latter pore waters have to be analyzed at the home lab for concentration gradients of uranium to derive the diffusion intensity from the ocean into the sediment. The next three stations north of the Walvis Ridge (i.e. in

the Angola basin; at 20°00S/007°00E, 21°35S/005°38E, 25°00S/003°00E) mainly served for the research goals of the radiological groups from the University of Kiel and University of Heidelberg.

In the following a short introduction of the research and sampling programmes is given for the different working parties on board. The Marine Chemistry programme aimed at a better understanding of the trace element cycling in the ocean. For this purpose the exchange processes between dissolved and particulate trace elements are studied. Uptake of dissolved trace elements onto particulate matter and subsequent sinking mechanisms (scavenging) exert major control on the chemical composition of seawater. The atmosphere, via dust deposition, provides significant inputs of both dissolved and particulate trace elements to the ocean. With Fe being a prominent example, many of the trace elements studied here are essential for marine life, and thus also for the biogenically induced particle flux within the water column. The trace elements which were studied during this cruise cover a broad range of chemical properties, enabling to investigate the relevant biogeochemical processes in greater detail. In contrast to the upwelling system off Northwest Africa, where high biological productivity is accompanied by high rates of dust deposition, in the upwelling system off Namibia the sole biological effect on the trace element cycling was to be studied. Thus, the study will contribute to a comparison of these two differing upwelling systems with respect to element cycling. In addition, aerosol particulates and surficial sediments were collected for comparison.

The major objective of the radioisotopic investigation was to determine the effects of bioproductivity,of the composition of the particle flux and the influences of the hydrography on the distribution of radioisotopes (^{230}Th, ^{232}Th, ^{234}Th, ^{231}Pa, ^{210}Pb, ^{210}Po) and Nd in the water column and in the sediments of the Angola and Cape basins. While there is much information about these effects for the North Atlantic and for the Atlantic sector of the Antarctic ocean, no such studies have been conducted in the upwelling region off Namibia. Therefore, the distribution of ^{231}Pa and ^{230}Th and their ratio in the water column and in the sediments were studied with respect to the effect of boundary scavenging in the upwelling area off Namibia. Differences in the water column distribution of these radioisotopes between the Angola and Cape basins were to be assessed. Furthermore, based on pore water measurements in sediments, the relations between primary productivity and authigenic uranium enrichment and uranium diffusion were investigated. Coccolithophores together with other planktonic organisms form the basis of the marine ecosystems. The occurrence and distribution of coccolithophores is directly dependent on the hydrography of the water masses. Their fossil remains are therefore important indicators for the reconstruction of previous ecological conditions of the water masses. The main goal of the present research was to study the ecological conditions for the composition and distribution of coccolithophore communities in the upwelling area off Namibia in order to broaden our knowledge of the paleoceanographic and climatic evolution of the late Quaternary coccolith assemblages

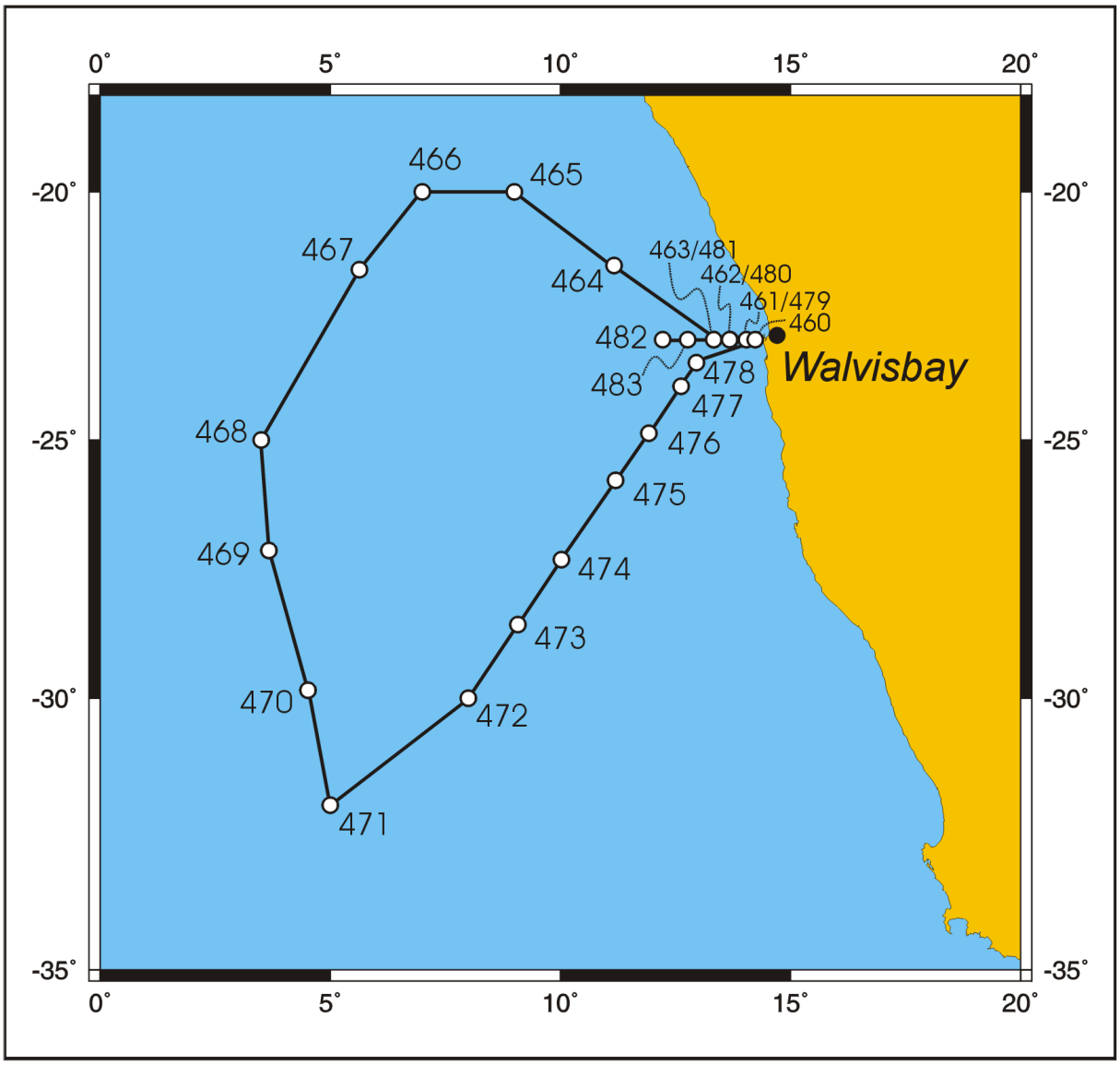
On Thursday afternoon, Oct.28 we left the Angola basin heading for a station in the Walvis Ridge area and two additional stations furthewr south in the Cape basin (29°50S/004°20E, 32°00S/005°00E) for the sampling of large amounts of sea water for our radionuclide work. During this week, the sailing with southward directions and especially the work at the stations was always accomponied by unpleasant rolling movements of the ship, which was less due to actual wind stress of only 5-7 Bft but the swell from different directions originating from storms much further south. At the station #471 (32°00S/005°00E, water depth 5040 m) we reached the southernmost position of our cruise to study the influence of water masses advected from the south on the ratio ^{231}Pa/ ^{230}Th.

Our next goal was the re-sampling of the IOC-station No.9 in the Cape Basin (30°00S/008°00E), where during the METEOR cruise M12/1 in 1990 the first baseline study took place which aimed at assessing typical trace element concentrations for the main water masses in the East-Atlantic Ocean. For the Marine Chemistry Group at M48/4 this station served (i) as a reference, (ii) to study near-surface concentration changes and (iii) to obtain data for suspended particulate trace elements. The trace metal work was supplemented with sampling of large amounts of sea water for radionuclide determinations.

This station also formed the first position of a transect that went all the way up the continental margin until the shelf off Walvis Bay was reached. The main reason for the sampling of this transect was to identify the changes in the trace metal signature between the oligotrophic basin (far from the coast) and the part of the inner margin which is affected by upwelling. During most of the time expended for

this transect only air masses from South and South-East reached the ship, which deposited extremely low amounts of mineral dust on our filters for aerosol sampling which were run all the time. The transect comprising 8 stations with water depths of 5100m, 4990m, 4770m, 4300m, 3510m, 2001m, 750m and 131m ended with the endmember position at 23°00S/014°03E which was reached at Oct. 8. The last 1.5 days served to re-sample some positions of the transect at 23°00S latitude, which were already sampled 3 weeks before at the beginning of our cruise under conditions of considerable dust input. The reason for this re-sampling was a study the short-term effects of dust deposition on the inventories of trace metals in the water column.

The RV METEOR reached its destination port Walvis Bay in due time (10.Oct.2000, 08:00) where the cruise M48/4 ended. Summary: during M48/4 altogether 24 stations (#460 to #483) were occupied and a total of 117 deployments of various instruments and devices were performed. The two continuous pumps of the ship delivered surface water for which the Thermosalinograph recorded the properties.



R/V Meteor cruise leg M48-4

Station locations and station numbers