ANT XXIII/1 Weekly Report No. 3 27 October - 2 November 2005

This week we sailed around West Africa. Our cruise track passed through the Canary Islands where we had to make a very short visit to the harbour of Las Palmas to obtain spare parts for a malfunctioning reefer van loaded with food for the Neumayer station. After leaving Las Palmas, we took a course maintaining a 200 nautical miles distance to the African continent. Since we had left Spain, the ocean was deep blue: the chlorophyll content in the surface water was very low. Here, the ocean is very poor in nutrients and can be considered a desert. Further south, off Morocco and Mauritania, the ocean becomes richer. Nets that we use continuously to filter surface water started to collect large amounts of zooplankton. There were many flying fishes, a beautiful sight when, apparently to flee from the ship, they launched themselves in the air and sailed far away like a flock of birds just above the water surface. Some of them landed on deck, especially at night. Other intruders on the ship were large black crickets, making their familiar sound at night on deck, and reminding us of our proximity to the mainland.

It is indeed this proximity to the mainland that is the cause for the higher productivity of this area. This has two causes: first, the winds blow water away from the coast, and this water is replenished by deeper water, which is rich in nutrients. And second, the winds carry large amounts of dust from the continent across the ocean and when this falls down it also fertilizes the surface of the sea. This is not only the case for the classical nutrient elements, such as phosphorus and nitrogen, but also for trace elements, the so-called micronutrients like iron, that are equally essential for plankton growth.

It is this contrast between ocean deserts and zones of high continental influence that makes the long north-south transect we are following now such a unique opportunity for trace element studies. The cycling of elements has long been an important part of oceanography. Much has been learned on how elements are weathered from rocks on the continents, carried to the ocean by rivers or by the atmosphere, taken up in the biological cycle, and how they ultimately end up in marine sediments. The pathways of this cycling, and the role of the general conveyor-belt ocean circulation, were beautifully illustrated by a major international program GEOSECS carried out in the 1970s, which made expeditions to all major oceans. But for many questions GEOSECS was just too early. At that time we were not yet able to measure trace metals in the ocean, simply because we had not yet learned how to get the samples on board without contaminating them. Adequate sampling techniques have now been developed, and our trace metal people have dedicated clean sampling bottles, winch and wire, and they have their own clean-room container where they operate like surgeons. There has also been a major development in analytical techniques within the field of mass spectrometry. When a decade ago we were happy to be able to determine the concentration of an element in seawater, we can now not only do so with much better precision in much smaller volumes (often litres instead of cubic meters), but we can also determine the ratio in which the various isotopes of that same element occur. The interesting thing is that these isotopic ratios can vary according to the source of the element (for example between the various continents or between rivers) and can change in every process the element is involved in, for example, when it is taken up by phytoplankton or by bacteria. Ultimately, these elements are bound in skeletons of marine organisms or on other particles, sink out, and are deposited on the seafloor. The isotopic ratios are preserved in the sediment layers, and so form a record of conditions in the past ocean.

These developments have drawn renewed attention to trace elements as tools to study the changes of the cycling of elements through time in response to the change of our climate, in the past and in the future. That is why a new international program has been set up, called GEOTRACES, with the objective to make the best use of these new tracers. We plan to coordinate expeditions, over the next 10-15 years or so, to determine the details of the cycling of trace elements and their isotopes on a global scale. Our present expedition is considered a pilot study for this program. We put emphasis on intercalibration and on the parallel sampling for many tracers in the same water mass. For example, we draw a “fish” made of steel beside the ship through the water with a tube attached to it that allows us to obtain surface water that has not been contaminated by the hull of the ship. We pump up one large mixed sample that is then distributed to all labs on board. In addition to this surface water study, we have up to now performed three deep-water stations, where we use the Rosette sampler with a conductivity-temperature-depth (CTD) sensor to obtain water at desired depths from the water column. Notwithstanding the mentioned analytical advances and corresponding reduction in sample volumes for several types of analyses, other new tracers that we want to investigate require so large volumes that we perform up to 5 casts at the same station to meet the thirst of all.

Most groups take their samples back home, but some analyses are performed on board. We clearly see the effect of the dust inputs off West Africa by increasing levels of Aluminium and Titanium in surface waters. The atmospheric chemists, using their green laser beam piercing the sky from the helicopter deck, identified the Saharan dust layer at a height of around 4 km since we had reached the latitude of 26°N.

All on board are well. We celebrated Halloween with costumes and beautifully carved pumpkins and wonder whether Neptune will allow us to cross the equator.

In the name of all I send you my best regards,
Michiel Rutgers van der Loeff, Chief Scientist ANT XXIII/1