Meteor 60-5: Weekly Report #5

The 5th week of Meteor 60-5 started with an attempted biological station on top of the Atlantis Seamount (33 deg 59'N 30 deg 5 W). We found a good shallow location for the station and collected an interesting-looking fluorescence and oxygen profile with the CTD. Unfortunately difficult wind, current and wave conditions then forced us to cancel the particle catcher deployment. We then headed southeast into the Canary Basin, gradually encountering a stronger influence of Salinity Maximum Water (SMW, sometimes known as the Subtropical Underwater). This water mass is formed convectively in the eastern Atlantic as a result of strong evaporation driven by dry winds leaving NW Africa. The salinity of this water mass has increased over the past several decades, perhaps reflecting large-scale changes in the hydrological cycle. However this water mass appears to be of significance not only for climate but also for biogeochemistry.

The same hot, dry winds that drive evaporation also deposit dust carried from the Sahara/Sahel onto the ocean surface. And our experimental and field results from Meteor 55 had strongly supported the hypothesis that dust addition can stimulate nitrogen fixation. During the first week of our cruise we had already sampled SMW as a subsurface layer off the Caribbean Islands, where it is marked by high levels of nitrate relative to phosphate. This 'excess nitrate' signal has been attributed to high rates of oceanic nitrogen fixation in the source regions of this water mass. Our transit towards the SMW formation region therefore provided a perfect opportunity for our biologists to start their 7th nutrient limitation bioassay experiment. Interestingly, along the transit, the on-board iron measurements revealed increased levels of Fe (II), perhaps a signal of increased dust deposition. We now have to await shore-based analyses to determine whether we did in fact encounter enhanced nitrogen fixation. We collected DNA samples in the region for characterization of nifH genes coding for the nitrogenase enzyme. This will help us to determine the type of organisms responsible for any enhanced nitrogen fixation measured there.

This part of the cruise was marked by flat calm conditions, sun and warm temperatures and was very, very pleasant.

Abbildung 1: Warm. sunny skies and calm seas in the Canary Basin.

The southernmost point on this part of the cruise was reached on the 6th of April at 30° 49'N 26° 44'W. We then returned along a line of TTO stations, in a northeasterly direction, towards the Azores. Upon approaching the Azores it was decided to make a detour to Ponta Delgada to offload a sick crewmember. Thanks to thorough preparations by Captain Jakobi and the other Officers, the entire operation consumed the absolute minimum of time. Only one station was cancelled and this, fortunately, was not a TTO station. Despite the detour, we will be able to complete our planned program within the allotted time.

Scientifically, as data collection becomes more routine, we have been looking more intensely at the data collected earlier in the cruise. The patterns of CO_2 increase in different water masses, in particular, are striking and not completely what we expected. We have also been looking more closely at the distributions of a range of naturally produced gases that we are measuring on board.

These biogenic gases range from the important greenhouse gas, N_2O, through to a variety of naturally produced halocarbons. For N_2O, it is the relation to dissolved oxygen that dominates its sub-surface distribution. The Meteor 60-5 data can be compared to data from earlier zonal sections collected by the IFM-GEOMAR group at 42°N and along 10°N over the past 3 years. A strong correlation with O_2 is present in all the data sets, but the regression slope and intercept varies with latitude and between the western and eastern basins for reasons that are not yet clear.

On a separate gas chromatograph, we have been measuring the concentrations of a range of compounds including bromoform ($CHBr_3$), chloroform ($CHCl_3$), dichloromethane, dibromomethane, and methyl iodide. These compounds play potentially significant roles in atmospheric chemistry. We have been measuring their distributions in vertical profiles, surface water and air. The vertical profiles, in particular, are quite different between western and eastern Atlantic basins and these differences likely contain clues to the underlying oceanic production and consumption processes. Of particular interest is the behaviour and sea-to-air flux of $CHCl_3$: an important trace gas that definitely has oceanic sources but about which very little is known. A great deal of effort during Meteor 60-5 has gone into calibration and

quality control of these very difficult measurements; it now appears that we have a high-quality data set available for interpretation.

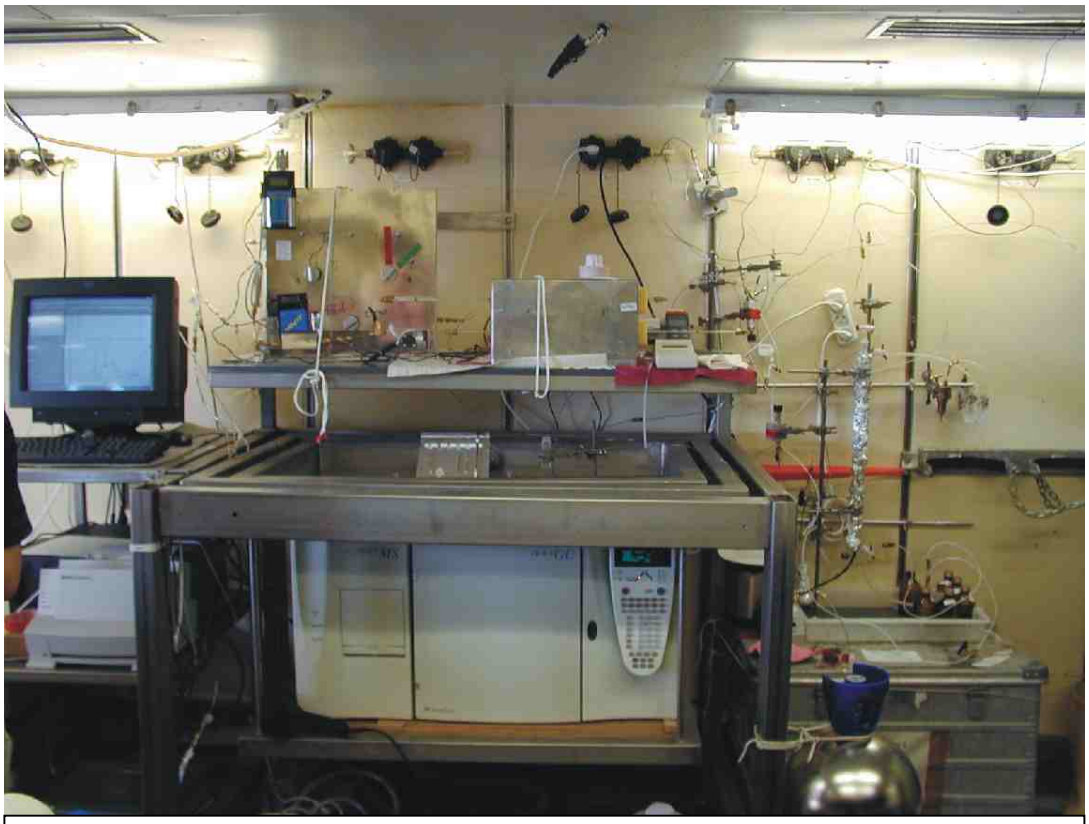

Abbildung 2: Gas-chromatograph/Mass spectrometer system in the GeoLabor.

Today we were able to celebrate Easter Sunday in a relaxed manner, with an excellent lunch. Life on board Meteor has settled into a routine and we have been well cared for by the crew. But now, as the cruise draws to an end, we are increasingly thinking about the end of the voyage and looking forward to returning home. There are only 4 more stations left to sample with the last station scheduled for Tuesday evening. After that we still have a great deal of work to do: making the final measurements, dismantling equipment and packing before our arrival in Lisbon on Thursday morning.

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