Merian Expedition MSM03/1
Iceland – Azores – Lisboa/Portugal
21.9.-4.10.2006
Chief Scientist: Dr. Bernhard M. Fuchs

A first study of the picoplankton community north of 50°N of the Atlantic Ocean was done in 1996 during the PRIME cruise. Recent studies in the same area have focused on the bacterioplankton community of deep water masses below 1000 m water depths. An in-depth analysis of the diversity, structure and function of the microbial community in the photic layer down to genus and group level with modern molecular tools was not yet conducted for this area.

The main goal of this cruise was to study the diversity, structure and function of the microbial community including bacterioplankton, phytoplankton and virioplankton in the top 500 m of the North Atlantic Ocean. We were interested in comparing the microbial communities of the contrasting water bodies of the nutrient-rich, cold East Greenland Current, the warm North Atlantik drift and and the nutrient-depleted North Atlantic Gyre.

Specifically, we had the following objectives:

- to analyse the horizontal and vertical structure of the microbial community at high resolution along a transect from Iceland to south of the Azores.
- to link phytoplankton and bacterioplankton composition along the transect.
- to identified key species typical for the cold East Greenland Current, the warm North Atlantic Drift and the warm nutrient depleted Gyre.
- to follow and quantify key processes like photosynthesis, polymer degradation, amino acid uptake and metabolism and nitrogen cycling mediated by the different components of the microbial community.

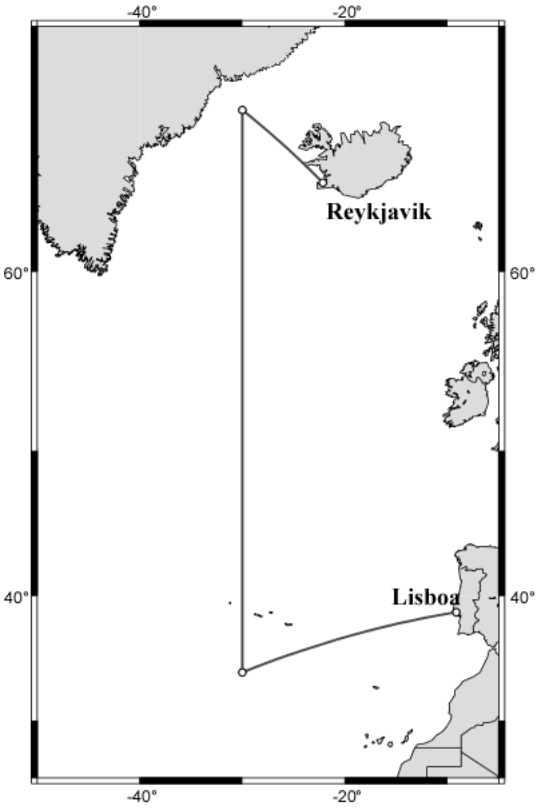
Twenty-one scientists and students from the Alfred-Wegener Institute in Bremerhaven, the International University Bremen and the Max Planck Institute for marine Microbiology and two external experts from the United States of America and the United Kingdom joined the expedition. The cruise was conducted within the framework of the Max Planck Research School MarMic and had both educational and research character.

We departed Reykjavik on the 21. September heading northwest towards the productive and cold East Greenland current (66°39'N, 30°W), then turned south sailing along the 30°W meridian towards the Azores. We crossed the warm North Atlantic drift and touched the northern edge of the oligotrophic North Atlantik Gyre south of the Azores (34°04,43'N, 30°'W), before we turned east heading towards Lisbon (see figure below).

We sampled the top 500 m water layer with the on-board installed Rosette/CTD-sampler twice a day. From nineteen stations 12 depths each were sampled along the entire transect. Per station two to three casts were done in order to meet the water demand for all biological (bacterioplankton, virioplankton, phytoplankton) and chemical analysis (chlorophyll, oxygen, POC, polymers, alkalinity, nutrients).

A continuous monitoring of the salinity, temperature and chlorophyll content (thermosalinograph, fluorometer) of the surface water gave us first hints of the state of the waters passed. The East Greenland current was as cold as 0.6°C and was characterised by low salinity of app. 33°/oo. There, the abundance of large phytoplankton was low and showed only a low diversity. Fast repetition rate fluorometry (FRRF) pointed to a reduced fitness of the large

phytoplankton. This was in contrast to satellite images, which suggested a high chlorophyll content of the East Greenland Current. Probably the intense coloration of the water was due to a high concentration of DOC ("Gelbstoff"). Travelling south the temperature increased dramatically in a steep gradient within few miles from below 1°C to 6°C and the salinity increased to 35°/oo. The chlorophyll content and concomitantly the abundance of phyto- and bacterioplankton in this area were highest on the entire cruise marking a highly productive area. In this area also a shift in dominance between diatoms and dinoflagellates occurred from north to south. The diatom maximum was observed at station 5 with 32,000 cells/l whereas the dinoflagellate maximum of 16,000 cells/l was found at station 6. Similarly *Synechococcus*, a cyanobactererium adapted to productive areas, was found in high abundances in the north (max. $140x10^3$/ml), but was replaced by the typical oligotroph *Prochlorococcus* further to the south (max. $40x10^3$/ml). The abundances of the heterotrophic bacterioplankton decreased gradually from $1.3x10^6$/ml near Iceland towards the Azores and were lowest in the Gyre at the southern most stations 15-19 ($0.5x10^6$/ml).



First on-board molecular analysis of the heterotrophic bacterioplankton showed also shift in their community composition. For example members of the *Cytophaga-Flavobacteria-Bacteroidetes* group were higher in numbers north of 50° N at depths between 20-75m (15-23%), but decreased towards the south and with depth greater than 100m (3-9%). The numbers of *Planctomycetes*, however, increased with depths greater than 100m (0.3-0.5%) and had their highest relative abundance at stations 6 (200m), 13 (2000m) and 19 (2000m) with 1.5, 2% and 1.5% of the total bacterioplankton community, respectively.

Thanks to a competent crew, a perfect working platform - the ship MS Merian - and calm weather conditions, we could successfully fulfil our entire scientific work program.

Figure 1: Track plot of the cruise MSM03/1