Meteor 60-5: Weekly Report #3

At the time of writing the third weekly report, we have just completed one of our main objectives for the cruise: our northernmost station at 42°N, 42°W. This station completed a long week-long section along old TTO and GEOSECS stations. On the way we also stopped at a station occupied last year by US colleagues during a US CLIVAR-Carbon of WOCE line A20 (29°34'N 52°20'W). The intention had been to resample this station as a cross-check on data intercomparability. Unfortunately at this station we encountered our only major technical difficulty of the cruise to-date when signal transmission to/from the CTD was interrupted during two separate attempts at a deep cast. Both times the connection was lost at depths of about 5000m. Eventually we left the station with complete CTD downcast profiles available for comparison, but only 7 water samples. While limited in scope, comparison of these 7 deep water samples with their CLIVAR equivalents was encouraging, with the chemical properties such as nutrients, oxygen and carbon agreeing to within the desired tolerances. We will get another chance at an intercomparison later in the cruise when we cross the WOCE A16N line in the eastern basin. This section was also occupied last year by US investigators.

In general, weather conditions have been remarkably favourable, including sunny and warm conditions at our northernmost station today. Given the conditions in the region over the past few weeks, which we have been monitoring, we have been lucky. In general our region of the Atlantic has been filled with high pressure systems, both north of the Azores and SW of Newfoundland. Nevertheless, mid-week found us located directly at the air mass boundary between the two Highs which gave us strong winds and swell and forced us to miss one planned station. The missed station was a shallow TTO station that had been occupied on top of a seamount with relatively few chemical measurements: our failure to 'collect' it, is therefore not damaging to our program.

In some ways, Meteor 60-5 is two separate expeditions sharing the same vessel and cruise track. The program of physical and chemical measurements of the deep water column occupies the majority of the scientific staff on board. However there is another group on board who never even go near the CTD/rosette system and whose activity is almost completely out-of-phase with that of the rest of the staff. For example, this group, will be working feverishly round the clock for the next 2 days while most people take a much needed break as we steam southwards, without stations, to resume our transect eastwards towards Lisbon. This other group is the 'Bioassay Group'.

Photo: The Bioassay Group ready for a long night in the Clean Lab. Container. From left to right: Mark Mills, Rebecca Langlois (IfM-GEOMAR), Angie Milne and Eric Achterberg (Plymouth Univ., UK). Not shown are: Mark Moore (Southampton Oceanogr. Centre) who took the photo, Kerstin Nachtigall and Peter Fritsche (IfM-GEOMAR). Assistance with nutrient measurements is provided by Frank Malien (IfM-GEOMAR).

The Bioassay Group is seeking to determine the nutrient(s) (nitrogen, phosphorus, or iron) that limit the productivity and biomass of the phytoplankton, the fixation of nitrogen (N_2) by the microbial community, as well as the bacterial productivity. They have been conducting a series of on-board experiments involving manipulations of surface seawater pumped from a towed 'fish'. Each experiment consists of filling approximately 150 1-liter bottles under trace-metal clean conditions in our on-board clean laboratory container. Nutrient forms of nitrogen, phosphorus, iron are then added to these bottles in all possible combinations. The bottles are incubated on-deck for 48 hours. Parameters such as phytoplankton productivity and chlorophyll, as well as nitrogen fixation, and bacterial productivity are made both at the beginning and end of the incubations in order to determine the effects of the different nutrient additions. Samples are also being collected for molecular analysis of DNA and RNA in order to identify and quantify organisms responsible for nitrogen fiaxation.

At this time, the group has already successfully completed four of these experiments, and they plan to complete another 4 prior to arrival in Lisbon. The experiments benefit from the wide range of conditions we have encountered on the

cruise so far, ranging from oligotrophic surface waters of the tropics to pre-bloom, 400-m deep mixed layers of the northern Atlantic. Initial results seem clear and show that nitrogen additions stimulate phytoplankron productivity and chlorophyll concentrations, whereas a combination of nitrogen and phosphorus is required to stimulate bacterial productivity. This may run counter to some recent work suggesting a primary role for phosphorus in limiting productivity. Further conclusions have to await more detailed analysis of the results including analysis of stored samples in Kiel.

The Bioassay Group is also examining how dust derived from the African continent might affect these biological processes. Atmospheric transport of dust from the Saharan desert is well known to be an important source of iron. During Meteor 55 to the tropical Atlantic, similar bioassay experiments suggested that additions of Saharan Dust might stimulate nitrogen fixation by relieving both phosphorus and iron limitation. Presently, experiments are being conducted on board to determine the amount of N, P and Fe released when dust is added to seawater.

In the next weekly report, I will discuss the results of the transient tracer measurement programs.

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