ANT XXIII/7 Weekly Report No. 7 (Cape Town - Cape Town)
2 October 2006 - 8 October 2006

In the meantime we have reached the southernmost position of our cruise and are steaming north again. This week we have collected interesting data from new ice frozen in the regions of the former Larsen-A and –B ice shelves. A part of the investigations involved the biogeochemistry of sea ice, which is concerned with the interactions between biological and chemical processes in an ecosystem, and their impact on the geological signal of material sinking to the seafloor. Optical techniques are used to determine the fluorescence properties of algal assemblages from the interior and the bottom of the ice floes.

These measurements give information on the physiological conditions and growth of the ice algae, which have to cope with extreme environmental conditions of low temperatures, high salinities and low light conditions. This information is compared with analyses of the species composition of the assemblages that will be performed at home. Another set of optical measurements are designed to characterize the chemical properties of sea ice brines and ice. Dissolved organic matter (DOM) in marine systems constitutes the largest potential source of nutrients for bacteria and algal growth. The coloured fraction of DOM (CDOM) largely controls the light climate of natural waters as it absorbs light not only in the visible spectrum but also in the ultra violet. During our expedition, water, ice and brine samples have been taken and the results indicate that brines consistently have a distinctive spectrum to those found in the waters from which the ice is formed.

Another research topic is concerned with carbonate minerals, the product of the reaction of calcium and bicarbonate ions in natural waters. The mineral phase can form spontaneously through chemical reaction under thermodynamically favourable conditions, but several marine organisms are also actively involved in their formation in the sea because calcium carbonate is the main constituent of their shells. The result is one of the most extensive deposits of carbon in the Earth's crust. It is consequent that the dynamics of carbonate minerals has been studied extensively in every part of the biosphere except for sea ice. Carbonate minerals are also expected to form in sea ice through chemical reaction in the highly concentrated brines enclosed in the ice matrix during seawater freezing. To date, the evidence for this has been theoretical or indirect, but during this cruise we have gathered the first direct observation of the beautiful cryogenic carbonate in the ice.

Sea ice has a prominent role in the earth’s climate in many respects - one of the fairly unknown aspects is that sea ice is a potential source of the climate active sulphur gas dimethyl sulphide (DMS). DMS is produced by algae and once in the atmosphere, its oxidation products are involved in the formation of condensation nuclei and clouds. As a consequence, it affects the reflectivity of skies and clouds and results in a cooling of the earth's surface. Calculations from climate models have shown that high DMS concentrations around Antarctica may affect climate of the entire Southern Hemisphere. The few measurements done so far, indicate the im---por--tance of sea ice as a source of DMS, however, the magnitude of this source both in space and in time is largely unknown. Along our cruise track, we have analysed sea ice samples for DMS and other sulphur compounds and concentrations of 2 to even 4 orders of magnitude higher than in the surface ocean have been measured, thereby confirming the sea-ice source of DMS. It appears that these sulphur compounds are very well suited to keep biological processes going at low temperatures. In fact, one of these sulphur compounds has long been used in medical/microbiological research to keep bacteria alive during storage at –80°C. It now seems that nature has already found out how to survive life in a freezer, long before man did.

Best wishes from all participants of this cruise,

Yours Peter Lemke
Polarstern, 65°6'S, 57°24'W