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After returning from our excursion to the north the last mooring was successfully deployed, and the hydrographic section to the coast of Greenland was completed. As compared to last year, the ocean surface temperatures indicate a warming in the east and a cooling in the middle and western regions of Fram Strait, so that we encountered more sea ice on our way to Greenland than the year before. At mid-depth (50-500m) the warming is continuing all across Fram Strait. The precursors of winter were with us all the way to Greenland and brought freezing temperatures of about -10°C, occasional snow showers and strong formation of new ice.

During our cruise the chemistry group, consisting of scientists from the University of Bergen and the AWI, has made measurements of dissolved methane and oxygen, nutrients, stable isotopes of oxygen and carbon and DMSP from more than two hundred stations. Further co-operation is planned, especially on chemical tracers in the marginal ice zone, so we decided to include two additional transects across the slope towards the Yermak Plateau from the open water, via the marginal ice zone, well into the ice-covered sea. Preliminary results show that in situ methane production takes place mainly in the marginal ice zone where biological activity is higher than in the open water and the ice-covered areas. This result will be compared with other chemical data to get a better understanding of the different processes that take place in this area, which is characterised by a high amount of meltwater. The concentration of meltwater will be determined with the help of the oxygen isotopes measured from the water samples. In addition, nutrients and oxygen will be used to quantify the biological production and (together with temperature and salinity data) to distinguish between the different water masses present in the water column.

Another aspect of our marine chemistry work was to study the distribution of human-made and naturally occurring radio-nuclides in the different water masses circulating through the Fram Strait. A set of water samples from the CTD/Rosette and the ship's sea water supply has been taken in order to characterize the in- and outflow. Several sea-ice samples were also taken, both in the Yermak Plateau area and over the Greenland shelf, to study the role of the sea-ice and the sea-ice-borne sediments in the transport of pollutants.

In addition, many phytoplankton (coccolithophores) and zooplankton (foraminifera) samples have been filtered from the ship's sea water supply, to improve the reliability of algal membrane lipids (alkenones) and the composition of trace elements in foraminiferal shells as paleoceanographic proxies at high latitudes.

One of the biological groups aboard was interested in the deep-sea biodiversity and the use of DNA to characterise it. Imagine you have two animals, one from the Antarctic deep sea and one from the Arctic deep sea.

Both look exactly the same. Are they the same species, given that they live about 18,000 km apart? This is a question we are trying to answer, using a group of single-celled organisms called Foraminifera, which usually live inside a shell. They move around the seafloor and catch food particles using a net of protoplasmic filaments that extend from the cell. In the deep sea, there are many diverse communities of Foraminifera that live in the sediment surface layer or attached to any solid support such as stones or shells. They play an important role in reprocessing the degraded dead plant and animal material that sinks down from the ocean surface. Some Foraminifera in the polar regions can be very large, with cells reaching up to several millimetres in size, but most of them are tiny and can be ob----served only with a microscope.

One of the aims is to use molecular markers to identify foraminiferan species and establish how they are related to one another by comparing their DNA. We will compare the specimens collected during this expedition with samples collected previously in the Antarctic in order to find out whether some of the species that look the same are also genetically iden---ti-cal. In order to do this, we have isolated hundreds of specimens of different species of Foraminifera samples of deep-sea sediment collected with a corer. We identify and photograph them and then either extract their DNA right away or freeze them for later processing.

If we find that Arctic and Antarctic deep-sea species are the same ge---- net-i--cally, that would suggest that there is a continuous gene flow among the populations living in the deep ocean and that at least some deep-sea organisms can have enormously large geographic ranges – e.g. from the Arctic all the way to the Antarctic! If such “cosmopolitan” species exist, we might find several hundred species in one small sample, but these will include many species found on the other side of the world as well. Then there would be a high local diversity, but a low global diversity of deep-sea animals. However, if we find that the species from the Arctic and Antarctic are not the same genetically, even though they appear the same (what we call cryptic species), then there may be many, many more species in the deep sea than we previously thought. This means that a global protection of the deep-sea biodiversity remains of crucial importance.

Another group of biologists was working on the quantification of at-sea distribution of seabirds and mammals in the Greenland Sea, as a function of the main water masses (Atlantic water, polar water, pack ice), identified on the base of hydrological parameters (water temperature, salinity), and of frontal structures between water masses and the ice edge.

Up to now, more than 470 transect counts of 30 minutes each have been carried out while the Polarstern was steaming. (Counting while the ship is moving minimizes the interactions between the ship and the birds; at sta---tions, the ship can attract seabirds from an unknown range.) The most numerous seabirds were fulmar, kittiwake, little auk and Brünnich’s guille-mot. In the pack ice, the most frequently encountered bird was the

ivory gull. Other seabirds seen were Ross's gull, glaucous gull, arctic tern, black guillemot, puffin, and arctic, pomarine, long-tailed and great skua. Two gyrfalcons (of the Greenlandic white morph) were also observed in the pack ice. Mammals seen included polar bears, whales (Minke, fin, and sperm), dolphins (white-sided and white-beaked), and seals (harp, bearded, ringed, hooded).
These data will be analysed as a function of local food availability, and compared to similar counts that have been performed in the Arctic, since 1973, as part of a long-term study of changes in polar regions.

The last scientific activity of this cruise took place on the Håkon Mosby Mud Volcano, which is located 145 nautical miles northwest of the northern tip of Norway. In mud volcanoes, mud rises from deeper layers to the ocean floor forced by high pressure and hot fluids. They represent unique natural laboratories for studying the interaction between geological, geophysical, geochemical, and biological processes. We measured temperature and salinity profiles above the volcano, and took water and sediment samples. A tem-----per-a-ture lance was deployed at the centre of the mud volcano for a long-term temperature observation. It will remain in the sediment for about one year and will be recovered in the course of an expedition of the French research vessel "Pourquoi Pas?" next summer. During this period of time, the lance will record sediment temperatures in order to obtain a more profound insight into the activity of the mud volcano and the associated mud and fluid flows.

With this activity our scientific programme is finished, and we are now steaming home to Bremerhaven. In the second part of this cruise 36 sci----en---tists and technicians (including 2 helicopter pilots) from 8 countries took part. We were ably supported by the excellent co-operation of 44 crew and ship staff, so that our program could be carried out with great success. Our sincere thanks goes to Captain Schwarze and his excellent crew.

In the name of all members of the expedition I send greetings from the Norwegian Sea, and bid you farewell from my position as Chief Scientist.

Yours Peter Lemke