Geotraces in the Arctic

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Arctic Change

Various other proposals have described the need to study the changes in the Arctic in the field of atmospheric fluxes and concentrations, hydrography, ice thickness and distribution, permafrost, shelf-basin exchange and river discharges. We specifically refer to the proposals entitled SNAPSHOT, SPACE, CARE. Here we propose to coordinate efforts during the IPY to obtain a better view of the inputs of trace elements and their isotopes (TEIs) from the Arctic into the global circulation as a component of the GEOTRACES program.

Geotraces

Our knowledge of ocean circulation and global biogeochemical cycles has a strong basis in the GEOSECS programme, conducted in the 1970s. As a matter of fact, GEOSECS included stations in the Greenland, Norwegian and Bering Seas, but due to logistic constraints, not the Arctic Ocean proper. The ensuing development of analytical techniques now allows studies of trace elements and their isotopes at concentration levels and at space and time resolution that were inconceivable during the GEOSECS era. These developments include clean sampling, sensitivity, miniaturisation, automation, in-situ techniques or entirely new detection principles. This means that detailed mapping can be obtained of far more tracers including their isotopic composition with the potential to provide unique insights into a wide range of oceanic processes. This opportunity was the stimulus of the recently inaugurated GEOTRACES programme.

The two primary objectives for the GEOTRACES programme are:
• To determine global distributions of selected TEIs in the ocean; and
• To evaluate the oceanic sources, sinks, and internal cycling of these TEIs and thereby characterize more completely their global biogeochemical cycles.

We feel that IPY offers an opportunity to tackle major questions for this GEOTRACES program in the Arctic that would otherwise not be manageable by national programmes.

IPY

We propose to expand the proposals already submitted on the study of arctic change, climate studies, shelf-deep interaction and fresh water budgets by including determination of fluxes of trace elements from the Arctic rivers and their pathways into the global circulation.

The present proposals already include the study of tracers of fresh water mixing, but we propose to expand the studies with other TEIs like micronutrients, rare earth elements, and naturally occurring isotopes. The development of a wider spectrum of isotopic tools may help to better constrain the fluxes and to better distinguish between the various inputs into the Arctic Ocean.
There is not very much information on chemical and isotopic tracers in the Arctic but the few results produced (e.g. on $^{14}$C and other natural radioisotopes) have always been very important for the understanding of how processes work and how different they are from other ocean basins. New data suggest that the Russian rivers supply quite large amounts of dissolved metals (Hf, Nd, Be) and that not all gets stripped on the shelves, despite them being so wide. In addition, the Nd isotope composition of Arctic waters is very distinct and may serve as a tracer for Arctic waters in the Atlantic.

Although micronutrients are not expected to limit production in the shelf regions, a systematic study of the distribution of micronutrients in the central Arctic and of their role in regions of Arctic outflow has not yet been made.

We thus propose to study

- Distribution and fluxes of TEI on transects from the major rivers into the central Arctic and sections intersecting the major pathways to the global biogeochemical circulation

River inputs in the Arctic have varied in the past and can be expected to change. Permafrost areas may be reduced. These changes can bring about important changes in the inputs of trace elements to the Arctic and further into the global circulation. The study proposed here will help us understand the transport and turnover of the TEI in the Arctic and to predict how their fluxes may change in response to

- changing river inputs
- permafrost melt/destabilization
- changing ice cover

This study will provide first order information that will allow the development and exploitation of TEI as paleoproxies in the Arctic context and so contribute to understanding past variability in this system which plays a vital role in our global climate.