Trace element cycling in the North Atlantic

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Many factors impact the residence time of trace elements (TEs) in the ocean. In the upper-ocean, their bioavailability is partially controlled by their complexation with organic ligands. This is crucial for maintaining the dissolved TE pool and fueling the primary production that is then exported to and regenerated in the deep ocean. Radionuclides and isotopes are tools not only to estimate export fluxes of these metals but also to better constrain their sources and sinks and evaluate the processes affecting their partionning between different pools.

To illustrate the biogeochemical aspects of these TEs, we take the example of the GEOTRACES GA01 cruise (GEOVIDE; May-June 2014) in the North Atlantic, a challenging area characterized by a strong spring bloom, a variety of trace metal sources, and different water masses.

We focus on iron (Fe) and zinc (Zn) export fluxes determined by the thorium-234 method and use many other tracers studied during the GEOVIDE cruise to better identify the processes affecting the magnitude of the elemental fluxes inside and outside the upper-ocean. The highest TE export fluxes are observed close to the margins. As evidenced by radionuclides, margins, sediments, and atmospheric dust are sources of TEs to the North Atlantic. Similarly, Zn isotopes point to sedimentary inputs but also suggest the presence of a hydrothermal plume close to the Reyjkanes Ridge. The magnitude of the TE export fluxes thus depends on the influence of lithogenic particles but also on the occurrence of oxides and biogenic particles. The multi-proxy approach also helps to untangle the much-debated isotopically light Zn signature of the upper-ocean. Finally, using excess barium concentrations, we estimate the highest mesopelagic remineralisation fluxes in the western part of the transect, where the biogenic contribution to export seems to be the greatest.