Particulate Rare Earth Element behavior in the North Atlantic (GEOVIDE cruise)

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The North Atlantic is a key region for the world ocean as the place of the deep water formation driving the Meridional Overturning Circulation (MOC). The GEOVIDE cruise (May-June 2014, R/V Pourquoi Pas?), a French contribution to the GEOTRACES programme, documented a section from Portugal to Newfoundland via south Greenland in order to constrain sources, internal cycling and sink of key trace elements and isotopes (TEIs) in this area. Such chemical species play major roles in oceanic processes, either as essential micronutrients, as chronometers of water (or particle) transport or as tracers of sources and dissolved-particulate exchanges.

Particles are transporting lithogenic and biogenic matter from the surface to the deep ocean. In the surface layers they combine various components, such as plankton cells, crustal and authigenic minerals, detrital material or organic gels. While sinking in the water column, this composition evolved due to continuous exchanges with the dissolved phase. Quantifying this evolution is an important challenge.

Rare earth elements (REE) are tracers that help to constrain physical and chemical processes which are driving these exchanges. This talk will discuss particulate REE (pREE) concentrations measured at 12 GEOVIDE stations (~ 180 samples). Preliminary results in the Labrador Sea show i) taken as example, pNd concentrations varying from 0.08 to 0.62 pmol/l close to the coast –with marked maxima at different depths along the margin- and 0.05 to 0.11 in the open sea; ii) marked pCe enrichment when concentrations are normalized to PAAS and to NADW; iii) an enrichment of pLREE compared to pHREE when normalized to NADW; iv) pEu and pGd positive anomalies below the surface layer in the middle of the Labrador Sea, observed with both normalizations. Complementary tracers help constraining the data interpretation: ^{232}Th, to estimate the lithogenic fraction; Mn, and Fe whose hydroxides are efficient scavengers, and yttrium (Y), the Y/Ho ratio being an interesting tracer of iron hydroxides.