Source, cycling and circulation effects on seawater rare earth elements in the NE Atlantic

K.C. CROCKET[1], E. HILL[1], R.E. ABELL[1], C. JOHNSON[1], S.F. GARY[1], T. BRAND[1], E.C. HATHORNE[2]

[1]Scottish Association for Marine Science, Oban, UK
[2]GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany

Seawater rare earth element (REE) data are increasingly applied to reconstruct water mass histories by exploiting relative changes in the distinctive normalised pattern of dissolved seawater REE concentrations. However, the mechanisms by which water masses gain their seawater REE patterns have yet to be fully explained. To address this, we collected water samples during the Extended Ellett Line (EEL) cruise, an oceanographic transect between Iceland and Scotland, and measured REE in the dissolved fraction. The proximity of the two geologically distinct landmasses and the importance of deep water mass circulation in this climatically sensitive gateway region make it an ideal location to investigate sources of REE to seawater and the effects of vertical cycling and lateral advection on their distribution.

An obvious concentration gradient from seafloor sediments to the overlying water column highlights release of light REE and mid REE to the overlying water column, with the most likely sources being anoxic pore waters, FeMn oxides and oxyhydroxides. Mid-depths of the water column (~20-60% above seafloor) have REE compositions closest to typical open ocean seawater and are dominated by lateral advection. The intense spring bloom in the NE Atlantic coincides with the timing of the EEL (May/June), and thus affords the opportunity to consider how the intensity of biogeochemical cycling influences water column concentrations of REE. Heavy (H)REE (especially Lu) show the strongest correlation with water column nutrient concentrations. The EEL dissolved oxygen minimum corresponds to positive HREE deviations, indicating maximum rates of organic matter remineralisation and associated HREE release. The Iceland Basin has higher REE and silica concentrations than the Rockall Trough, although more intense primary productivity (as represented by satellite derived chlorophyll-a concentrations) in the surface waters of the Rockall Trough could account for the difference. Without fully constrained inputs, identifying the reason for the difference between the basins is not possible.