Neodymium boundary exchange in two North East Atlantic water profiles

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The neodymium (Nd) isotopic composition of seawater is an important tool for reconstructing palaeo-ocean deep water circulation. The technique relies on the quasi-conservative nature of Nd in seawater, with atmospheric and riverine inputs at the surface and outputs through scavenging by particulate matter. However, it has been noted that the Nd isotopic composition of seawater may also be influenced by isotopic exchange with sediments on the continental margins, known as Boundary Exchange (BE), resulting in the alteration of bottom water Nd isotopic compositions.

Here we present two water column profiles, and a number of bottom water measurements, from the North East Atlantic Ocean. The results show bottom water εNd values that differ from either the measured, or expected, values of the overlying water mass. The first site, on the Rockall Banks, includes an open ocean profile down to a bottom depth of 2168m. This has a bottom water value of $\varepsilon_{\text{Nd}} = -11.94 \pm 0.10$, which differs by up to 1.5 εNd from open ocean measurements at the same depth nearby. The second site, in the Whittard Canyon, includes an open ocean profile down to 3595m, and a series of bottom water measurements taken up the slope of the canyon. The open ocean profile exhibits vertical εNd variation, representing the change in water masses with depth. In all cases the up-slope bottom water εNd measurements (at 7 depths from 500-4000m) are the same (within 2σ internal error), with a mean value of $\varepsilon_{\text{Nd}} = -11.53 \pm 0.15$. In a number of cases the bottom water εNd value is significantly different from the open ocean value at the same depth.

This has important implications for the reconstruction of palaeo-ocean circulation using Nd isotopes. Substrates for recording deep water Nd are always proximal to sediments, so that where BE occurs the record of Nd may not be representative of the overlying water mass. However, a paucity of data and a lack of understanding of the mechanisms of BE, means it is unclear whether this is a universal bottom water feature or a phenomenon isolated to continental margin settings such as those described above.