The interplay between particulate and dissolved neodymium in the western North Atlantic

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Dissolved neodymium (Nd) isotopes (expressed as εNd) have been widely used as a water mass tracer to reconstruct paleo ocean circulation. However, the marine geochemical cycle of Nd is not well understood. Unclear input mechanisms, scarcity of available data, and observed decoupling between dissolved εNd and Nd concentration patterns ([Nd]) are only a few of the unresolved issues.

Here we address these issues and present an unprecedented data set on particulate Nd isotope and concentration data from five stations along the Dutch GEOTRACES transect GA02 in the western North and equatorial Atlantic Ocean in 2010. Particulates were collected with in-situ pumps on 0.8 μm Supor filters and subjected to a total digestion.

The particulates collected near Irminger and Labrador Basin show a provenance from the nearby land masses in their Nd isotope composition: Very negative values (εNd ≈-20) are observed in the Labrador Basin, which is surrounded by old continental rocks. More positive values of up to εNd ≈-4 are found east of Greenland probably derived from the Nansen Fjord Formation's basaltic rocks. In these two areas the particulate εNd is offset from dissolved Nd isotopes by up to 7.7 ε-units. Further downstream of the flow path of the North Atlantic Deep Water, dissolved and particulate Nd isotopic compositions seem to merge and become indistinguishable south of Bermuda (BATS station). This suggests that particulate and dissolved fractions exchange with increasing distance from source regions. Neodymium concentrations in particulates [pNd] are low (K_D<5%) and invariant. However, most stations show a significant increase in [pNd] close to the seafloor, where [pNd] nearly matches [dNd].

Our new data set provides invaluable information towards addressing unresolved questions in seawater Nd geochemistry as it constitutes the first regional data set on combined Nd concentrations and isotopes in particulate and dissolved samples.