Statement of Interest for the US GEOTRACES Alaska-Tahiti Workshop, La Jolla, CA, October 5-7, 2016.

Nd Isotopes and REE in the US GEOTRACES Alaska-Tahiti Section

Steven L Goldstein, Chandranath Basak, Yingzhe Wu

Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY 10964.

Neodymium isotopes are listed as key parameters to be analyzed in every GEOTRACES section (GEOTRACES Science Plan, 2006). Nd isotope ratios reflect the long-lived radioactive decay of ^{147}Sm to ^{143}Nd, and the physical and biological processes that cause variability of light element isotope ratios are small and negligible. Rather, Nd isotope ratios in the seawater reflect the age of the continental sources of Nd to the oceans. As long as no external Nd is added, the Nd isotope ratio in a water mass remains the same. Since GEOTRACES began, Nd isotope ratio data on seawater has doubled in comparison to what was available beforehand. These new data have helped us to better understand how well Nd isotopes trace ocean circulation and water mass mixing, as opposed to changes along water mass transport paths from addition of external Nd from continental margins, bottom sediment, eolian dust, and hydrothermal sources.

The range of Nd isotope ratios in the global oceans reflects addition of Nd from old continental crust in the North Atlantic, which tags North Atlantic Deep Water today with low εNd-values of ε ~ -13.5, and addition of continental and volcanic Nd in the North Pacific, which tags North Pacific Deep Water (NPDW) today with high values of εNd ~ -4. Most of the Nd in the oceans affected by the general "conveyor belt" circulation show isotope ratios between these values, although in the North Pacific εNd-values can be as high as -2 or -1. For NADW we have a good understanding of the how it obtains its Nd isotope ratio. That is, the various water masses that mix to form NADW are tagged by the Nd from erosion of the surrounding continents, and the NADW value is a mixture of these sources, with some small impact from exchange between water and particulates along the Greenland margin. However, how the Pacific end-member acquires its value is still unknown. Eolian dust from Asia and North America, and Pacific surface sediment show much lower εNd-values than NPDW, typically around ~ -11, while volcanics from with the Pacific "ring of fire" show much higher εNd-values of up to ~ +8, and contributions from northward flowing Southern Ocean waters show εNd-values of ~ -8. While the NPDW εNd-value of ~ -4 likely represents a mixture of these sources, given their high variability, one would expect the value to be geographically variable, and to change with time, yet the εNd-value of ~ -4 is both widespread throughout the deep Pacific, and all the evidence indicates that it has been stable for the last million years or more, through many glacial-interglacial cycles including the Mid-Pleistocene Transition.

The US Alaska-Tahiti GEOTRACES section provides a unique opportunity to address the question of how the NPDW acquires its Nd isotopic signal. We propose to study dissolved Nd isotopes and the other rare earth elements in the oligotrophic North Pacific gyres, and to collect bottom sediment samples, and suspended particulates. We plan to quantify the extent of the influence of volcanic sources on the North Pacific basin. A detailed study of dissolved and particulate Nd and REEs will help us better constrain the biogeochemical behavior of Nd isotopes.

The LDEO group is set up to efficiently analyze Nd isotope ratios and REE in seawater samples, and has put efforts into minimizing sample sizes. Besides fulfilling the section specific goal, participation in the Alaska-Tahiti section will also complement our ongoing research from the Eastern-Pacific Equatorial Transect (EPZT) samples.