Project summary: US GEOTRACES North Atlantic Section: Sample collection for iron stable isotopes.

The distribution and chemical form of iron (Fe) has a profound impact on life in the marine realm. In about 20% to 50% of the world's oceans primary productivity is limited because phytoplankton cannot obtain enough Fe to satisfy their physiological needs. Small changes in seawater Fe concentrations can therefore have an immense impact on the growth of phytoplankton, affecting the productivity of ecosystems and the sequestration of carbon in both the modern and ancient oceans. Despite the importance of Fe, many questions remain about the marine Fe cycle. Sampling for iron stable isotopes on the US GEOTRACES Atlantic Section would provide a unique opportunity to address three key questions.

What is the source of dissolved Fe in the world's oceans? Dust deposition, flux of reduced Fe from continental margins, and hydrothermal Fe input have all been hypothesized as major contributors to the global dissolved Fe pool. However, it is often difficult to know the provenance of Fe from concentration distributions alone. The GEOTRACES Atlantic Section traverses regions impacted by each of these possible Fe sources, including a strong gradient in Saharan dust deposition, crossing the Mid-Atlantic Ridge, and intersecting the oxygen mimimum zone off the African coast. Measuring seawater δ^{56}Fe across this section will allow us to learn whether these inputs lead to a unique δ^{56}Fe signature in seawater, and how global seawater dissolved δ^{56}Fe can be used to trace marine Fe sources.

By what processes does marine particulate Fe become bioavailable? The bioavailability of particulate Fe is directly related to the exchange of Fe between the particulate and dissolved phases. Paired analysis of dissolved and particulate δ^{56}Fe will help to constrain the processes by which Fe cycles between these two phases.

Is dissolved δ^{56}Fe a tracer of biological cycling of Fe? Fe concentrations are depleted by biological uptake in surface waters. It is possible that there is an isotopic fractionation associated with this Fe acquisition. We will measure surface ocean dissolved δ^{56}Fe in order to develop a new tracer of biological Fe cycling.

This proposal will enable sample collection for Fe stable isotopes on the upcoming U.S. GEOTRACES Atlantic Section by funding sample bottle purchase and providing logistical support for sampling and sample distribution. Participating labs are Olivier Rouxel at Woods Hole Oceanographic Institution, Seth John/Jess Adkins at the California Institute of Technology, and Francois Lacan at LEGOS in Tolouse, France. We are requesting 2 L seawater samples from each of the 'surface' casts and 1 L samples from each of the 'deep' casts for a total of 528 samples, plus subsamples of the particulate samples collected by *in situ* pumping. Each of the participating labs has agreed to meet certain analytical benchmarks before accepting samples and will aim to produce data within one year of receiving samples in compliance with NSF data submission policies, so that we can produce high-quality data and make it rapidly available to the wider scientific community.

Broader impacts: The aim of this proposal is to facilitate cooperation among several labs and an international group of scientists in order to measure Fe stable isotopes on the U.S. GEOTRACES Atlantic Section. Each of these labs is already engaged in research efforts into the marine cycling of Fe isotopes. This proposal leverages existing funding and existing infrastructure among each of the individual labs in order produce an extensive collaborative dataset, which will help us to understand the biogeochemical cycling of Fe on a global scale.