

**GEOTRACES Atlantic Section: Total Dissolved Cobalt and Cobalt Speciation in the North Atlantic
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Project Summary

Intellectual Merit

This proposal makes the case for a full-depth ocean section of total dissolved cobalt and cobalt speciation to be included in the first US GEOTRACES North Atlantic Section in 2010. Cobalt has a complex and intriguing geochemistry that is especially suited to oceanic sectional studies capable of capturing multiple processes that extend over wide geographic ranges. It is influenced strongly by biological processes that result in nutrient-like distributions in vertical profiles and correlations with the macronutrient phosphate in surface waters (Noble et al., 2008; Saito and Moffett, 2002; Saito et al., 2004; Saito et al., 2005). Moreover, cobalt is often bound by natural organic ligands with very high conditional stability constants that likely influence its bioavailability to phytoplankton. Finally, significant differences exist in the biological requirements for cobalt, and biochemically related elements zinc and cadmium. Differences in the relative abundance of Co, Zn and Cd and their bioavailabilities could present significant ecological influences on phytoplankton species composition.

The proposed US GEOTRACES cruise transects two distinct coastal regimes (the New England continental shelf and the North African Upwelling region) and the oligotrophic gyre of the Sargasso Sea. Detailed sectional analysis of this region with the array of chemical and biological parameters expected in US GEOTRACES would allow testing of four specific hypotheses relating to cobalt geochemistry:

- 1. There is a major signal of cobalt emanating from the New England coastline associated with water-shelf interactions and riverine inputs.**
- 2. The nutrient-like profiles observed in the South Atlantic for cobalt may not be as prevalent in the North Atlantic Subtropical gyre due to significant atmospheric input.**
- 3. There is a major plume of labile cobalt emanating from the North African Upwelling Region due to low oxygen waters and sedimentary escape and/or water column redox properties.**
- 4. Cobalt and zinc seawater concentrations and particulate metal concentrations will reflect biogeochemical regimes associated with Cyanobacteria and Eukaryotic phytoplankton, where complete cobalt complexation and low zinc will reflect Cyanobacterial dominance, and higher zinc seawater and particulate abundances will coincide with an increase in diatoms and other Eukaryotic phytoplankton.**

The multi-element architecture and significant logistical support of the US GEOTRACES program would facilitate the testing of these hypotheses.

This proposal requests support for a post-doctoral researcher and modest time for myself to produce a total dissolved cobalt section and cobalt speciation section for the US GEOTRACES cruise. My laboratory's capability for high-throughput cobalt analyses is demonstrated through a full-depth total dissolved cobalt section from the South Atlantic that is included as supporting data.

Broader Impacts

The proposed activities would contribute significantly to our understanding of cobalt geochemistry and the influence of the bioactive trace elements on marine carbon cycling. Only a relatively small amount of seawater cobalt data actually exists at this time. This program would provide a major increase in data and most likely our understanding of cobalt biogeochemistry. The proposed research would also contribute to the education of a Post-Doctoral researcher and MIT-WHOI Graduate Student Abigail Noble.