Title: US GEOTRACES North Atlantic Section: Analysis of Key Trace Elements in Size-fractionated Marine Particles
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Intellectual Merit

GEOTRACES is an international program to study the global marine biogeochemical cycles of trace elements and their isotopes (TEIs). Its guiding mission is to "identify processes and quantify fluxes that control the distributions of key trace elements and isotopes [TEIs] in the ocean" (GEOTRACES, 2006). Because particles in the ocean serve as important sources and/or sinks for many trace elements and isotopes, particulate TEIs are key parameters for GEOTRACES (see Table 2 of the GEOTRACES Science Plan). Indeed, the composition and distribution of particles in the ocean is crucial to understanding all three themes identified by the Science Plan: 1) Fluxes and processes at ocean interfaces, 2) Internal cycling, and 3) Development of proxies for past change.

The primary objective of the proposed work is to ensure the collection of high quality trace-metal clean size-fractionated particles on the US North Atlantic GEOTRACES Atlantic section and the analysis of key trace elements and major particulate phases. I request 1-2 berths to participate in the Atlantic GEOTRACES section to analyze size-fractionated particles collected by battery operated in-situ filtration (pumps manufactured by McLane Research, Inc.) for all key trace elements listed in Table 2 of the Science Plan (Fe, Al, Zn, Mn, Cd, Cu), a suite of other trace elements of interest (e.g. Co, Ti, Ba), and major carrier phases (e.g. $CaCO_3$, biogenic Si, and POC). The operation of battery operated in-situ filtration (McLane pumps) for short-lived radionuclides is already funded for the Atlantic GEOTRACES section. I propose to work closely with the short-lived radionuclide group to adapt McLane pumps for simultaneous sampling of size-fractionated particles for trace metal analysis and radionuclide collection (see attached letter of support from Matt Charette).

In addition to producing an overview paper with the complete dataset of size-fractionated total trace element and major carrier phases, with the same dataset submitted to the NSF supported Biological and Chemical Oceanography Data Management Office (BCO DMO), I will interpret the data in the context of a research theme that is of interest to me: understanding the relative importance of atmospheric deposition and ocean margins as sources of particulate TEIs, two of the key processes affecting TEI cycling along the Atlantic section cruise track as outlined in the Science Plan and the North Atlantic Zonal Section Implementation Plan (NAZSIP).

Broader Impacts

This will be the first full ocean depth zonal section of size-fractionated particulates. The result will be a novel and comprehensive understanding of the distribution, composition, and dynamics of the particles that control much of the chemical distribution, carbon uptake, and the biological productivity of the ocean. Because of the importance of particles in so many processes affecting the cycling of TEIs, we expect that this dataset will be invaluable in conjunction with other parameters measured on the GEOTRACES Atlantic section. Many as yet unposed scientific questions will emerge from this unprecedented dataset, which will be made available through publication and electronically through BCO-DMO so that it can be mined in the future by anyone in the community who has explored questions about particle distribution and composition.

A summer undergraduate student will help with some sample analyses, as will a graduate student in the MIT-WHOI Joint Program in Oceanography.