Project Summary

Intellectual Merit

The role of iron in regulating the growth and community composition of marine phytoplankton is now well established, and iron availability has been shown to regulate primary production in a variety of oceanic biomes, most notably the high-nutrient low chlorophyll regions of the open ocean. The oceanic cycling of iron thus exerts important controls on the ocean ecosystem, and on the distribution and fluxes of carbon and the macronutrient elements. However, as for many trace elements and isotopes, we have only a rudimentary understanding of the distribution of iron in the ocean, and the processes that control this distribution, thus hindering the development and validation of biogeochemical and biological ocean models. These gaps in our knowledge of iron and other trace elements in the ocean are being directly addressed by the international research program GEOTRACES, which will focus initial research efforts on the measurement of trace elements and isotopes in a series of basin-scale ocean section cruises. The first such section planned for the US GEOTRACES program is a zonal section of the North Atlantic Ocean, involving multiple investigators, in fall 2010.

On this cruise, we will carry out shipboard determinations of a GEOTRACES key parameter, dissolved iron, in water-column and surface-water samples, using a high-throughput flow-injection method for which the accuracy and precision have been well established in an international intercomparison exercise. We will also perform shipboard flow-injection analyses of the redox species dissolved iron(II), and post-cruise analyses of dissolved iron and iron(II) using flow-injection analysis and high-resolution inductively-coupled plasma mass spectrometry, to assess the effects of sample storage and to verify the accuracy of our shipboard measurements. All of our dissolved iron analyses will include the analysis of a suitable seawater reference material, such as the SAFe S1 and D2 seawater. As well as informing the shipboard sampling strategy by providing indications of sample integrity and environmental processes, our proposed measurements will be used to address specific research questions concerning the major processes that control the vertical and lateral distributions of dissolved iron and iron(II) in the North Atlantic Basin, and the potential roles of dissolved iron and iron(II) in regulating phytoplankton processes in this oceanic region. In order to facilitate the collection and interpretation of data during and after the cruise, our shipboard iron data will be made immediately available to all scientific participants. The principal investigators will also comply with the data and metadata submission policies of both NSF and the International GEOTRACES program.

Broader Impacts

The information obtained in this project will facilitate inclusion of iron in numerical models of ocean biogeochemistry and the marine ecosystem. This will in turn improve our ability to predict how the ocean will respond to and modulate future climatic change; for example, the impact of changes in the magnitude, source or transport of iron-bearing aerosols on marine primary production. Our project will make educational contributions in the research training and mentoring of an MS or PhD student at Old Dominion University, and in the development of materials that will be incorporated into undergraduate and graduate level courses at Old Dominion University. In addition, our research activities will be communicated to the general public via public lectures and media interviews, and our results will be disseminated to the scientific community by the traditional means of conference presentations and publications in peer-reviewed scientific journals, as well as by a central GEOTRACES web-based data server.