Award Abstract #1434578

GEOTRACES Arctic section: Application of 210Po and 210Pb distribution at contrasting interface regimes of Western Arctic

NSF Org: PLR
Division Of Polar Programs

Initial Amendment Date: August 1, 2014

Latest Amendment Date: July 24, 2015

Award Number: 1434578

Award Instrument: Continuing grant

Program Manager: Henrietta N. Edmonds
PLR Division Of Polar Programs
GEO Directorate For Geosciences

Start Date: October 15, 2014

End Date: September 30, 2017 (Estimated)

Awarded Amount to Date: $265,798.00

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NSF Program(s): ARCTIC NATURAL SCIENCES

Program Reference Code(s): 1079, 1670, 4444, 9156, 9189

Program Element Code(s): 5280

ABSTRACT

In this project, a team of investigators participating in the 2015 U.S. Arctic GEOTRACES expedition will study the distribution of the naturally-occurring radioactive isotopes lead-210 and polonium-210 in the western and central Arctic Ocean. These measurements are expected to be very useful in helping to meet the goals of the U.S. Arctic GEOTRACES expedition: namely, to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes (TEIs) in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions. Some trace elements are essential to life, others are known biological toxins, and still others are important because they can be used as tracers of a variety of physical, chemical, and biological processes in the sea. A primary source of lead-210 to the oceans is from the atmosphere, where it is produced from the decay of radon-222. In the oceans, it decays to polonium-210. The half-lives of polonium-210 (138 days) and lead-210 (22.3 years) provide "natural clocks" with which to investigate processes such as the sorption of elements on to sinking particles, and the transport of elements between the ocean margins and deep basins.

The lead investigator proposes to concentrate sampling and investigate processes at three "interfaces:" the air-sea-ice...
interface at the surface, the interface between biologically produced particles and water, and the interface between non-biological particles and water. The investigator proposes the following three hypotheses: 1) At the air-sea interface, the polonium-210/lead-210 ratios can be used to "age date" the sea ice (and sediments contained within the ice). 2) At the biotic-water interface, different biogenic particle types encountered in the upper waters will affect the fractionation and remineralization depths of polonium-210 and lead-210. 3) At the particle-water interface, layers of resuspended sediments in the water column will be zones of enhanced polonium and lead scavenging from the surrounding waters. These processes are important for understanding the distributions of other key particle-reactive trace elements such as iron, lead, and manganese. To test these hypotheses, the investigator will sample and analyze about four hundred dissolved and particulate (large and small) samples, 10 multi-year ice cores, ice-rafted sediments, and water from melt ponds for polonium-210 and lead-210 along the GEOTRACES Western Arctic section. About half of the samples will be focused at the four designated "super stations", with half of these in the highly dynamic upper water column and the other half near the sea floor where resuspension of bottom sediments can affect element cycling. The depths will be chosen according to regional atmospheric input, ecosystems, and coordinated sampling with groups measuring other trace elements and isotopes. The remainder of the samples will be ice cores, water from melt ponds, ice-rafted sediments in sea ice, and atmospheric aerosol samples. The proposed work will be closely coordinated with other GEOTRACES. The broader impacts are closely linked to the GEOTRACES program as a whole to enhance (1) research infrastructure by providing a broad array of polonium-210 and lead-210 data useful for biogeochemical scavenging models, (2) education by mentoring graduate and undergraduates, teaching by example from proposed research, (3) participation of under-represented students careers in the geosciences, (4) research training of graduates in marine radiochemistry, and 5) broad dissemination of results through publications, presentations, and on dedicated public Wayne State University websites (www.clas.wayne.edu) and at GEOTRACES (www.geotraces.org).

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