Data Management Plan:

Data Management Plan submitted to NSF at the time of submission:

"We will report all the data in a timely fashion from the cruise and accompanying meta data to BCO-SMO (http://www.beco-dmo.org), according to the international GEOTRACES data policy and NSF data policy. The data policies of GEOTRACES and NSF allow some flexibility for time-consuming analysis, such as those proposed here, and we anticipate submitting all the data within two years from the end of the cruise. We are committee to make the data available as soon as possible. We submitted all our data from the North Atlantic, cruise in timer and we will do the same once we complete our analysis on samples collected from the South Pacific cruise."

Since the submission of this proposal, we have published the South Pacific data to BCO-DMO. We are submitting the data for the Arctic GEOTRACES cruise now.

The Abstract of the funded project is given below:

Abstract:

Trace elements and isotopes (TEIs) in the natural U-Th radionuclide series are central to the goals of the U.S. GEOTRACES during its Western Arctic transect over the next three years. The radionuclide ^{210}Po-^{210}Pb pair was included in the GEOTRACES - Intercalibration (Church and Baskaran), GEOTRACES - Zonal North Atlantic (Church, Stewart, Baskaran) and GEOTRACES - Eastern Pacific (Baskaran and Stewart). The pair has seen application since GEOSECS for quantifying particulate scavenging and carbon flux within the ocean, but processes are still poorly understood at oceanic interfaces. The atmospheric source and half-lives of the two isotopes (138 d and 22.3 y) present time frames uniquely suited to trace interface (air-water, bio-water, and sediment-water) processes in the Western Arctic section.

At the air-sea interface, we hypothesize that the ^{210}Po/^{210}Pb ratios can be used to 'age date' the sea ice (ice-core and ice-rafted sediments). We will focus on about 10 ice cores, water from melt ponds and ice-rafted sediments. At the biotic-water interface, we hypothesize that different biogenic particle types encountered in the upper waters will affect the fractionation and remineralization depths of ^{210}Po and ^{210}Pb through the vertical profiles of the super stations in the Western Arctic section, due to variable extent of scavenging from the source waters. At the particle-water interface, we hypothesize that interfaces between intermediate lithogenic nepheloid layers (INL) will be zones of enhanced ^{210}Po and ^{210}Pb scavenging from the surrounding waters. Lateral detachment of these plumes will scavenge by proxy key particle-reactive TEIs (e.g. Fe, Pb and Mn). Deep gradients in the nuclide pair can estimate key proxy fluxes across the benthic boundary layer (BNL).

To test these hypotheses, we propose to 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 ^{210}Po and ^{210}Pb along the GEOTRACES Western Arctic section. About half of the samples will be focused at the four designated "super stations", half above the main thermocline and the other half down across the BNL. The depths will be chosen according to regional atmospheric input, ecosystems, and coordinated TEI sampling. The other half will be ice cores, water from melt ponds, ice-rafted sediments in sea ice, and aerosol samples.

Intellectual Merit :

This project focuses on three interfaces: In the Air-Sea Interface, we will establish the method to 'age date' sea ice (ice cores and sea ice sediments) using ^{210}Po-^{210}Pb disequilibrium method. Dating of multi-year ice core will enable to reconstruct atmospheric deposition of key TEIs in the Arctic. In sea ice sediments, this isotope pair will provide insight on the time scale of incorporation of sea ice sediments into the sea ice. In the Biotic-Sea Interface, we anticipate advancing our understanding of the fractionation and remineralization of Po and Pb due to dominance of lithogenic (sea ice sediments released during melting) and biogenic (e.g., presence of high concentrations of extracellular polymeric substances in sea ice) particles.

In the Particle-Sea Interface, quantification of the differences in the scavenging intensities of ^{210}Po and ^{210}Pb at different water masses in a vertical profile as well as in INL and BNL will advance our understanding of the role of wide continental shelves on the scavenging of Po and Pb and other key TEIs. As such, the proposed work will be closely coordinated with GEOTRACES PIs funded for other particle-reactive (e.g. Th, Pa) or dissolved (e.g. Ra) radionuclide isotopes in the Western Arctic transect of GEOTRACES.

Broader Impacts :

The broader impacts are closely linked to the GEOTRACES Program as a whole to enhance (1)

research infrastructure by providing a broad array of ^{210}Po and ^{210}Pb 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 WSU websites (www.clas.wayne.edu) and at GEOTRACES (www.geotraces.org).