TITLE

"Collaborative Research: GEOTRACES – Application of ^{210}Pb and ^{210}Po distribution at North Atlantic interface regimes"

COLLABORATIVE INVESTIGATORS

Tom Church, University of Delaware (tchurch@udel.edu)

Gillian Stewart, Queens College, NYC (gillian.stewart@qc.cuny.edu)

Mark Baskaran, Wayne State University (Baskaran@wayne.edu)

PROJECT SUMMARY

INTELLECTUAL MERIT

Trace elements and isotopes (TEIs) in the natural U-Th radionuclide series are central to the goals of the U.S. GEOTRACES during its funded North Atlantic phase over the next three years. The radionuclide ^{210}Po-^{210}Pb pair is designated as one of the priority TEIs by the *U.S. GEOTRACES Zonal North Atlantic Survey Section Implementation Plan*. 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 North Atlantic sections.

At the air-sea interface (Church), we hypothesize that as the primary input of ^{210}Pb into the surface ocean, levels will be source dependent on the continental input mixtures, in the western temperate and easterly sub-tropical sections. This will be most evident in the east under the Saharan dust plume with the effect of precipitation scavenging near the ITCZ. Thus we will focus on water and particulate profiles above the seasonal thermocliine. At the biotic-water interface (Stewart), 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. Deficits of dissolved ^{210}Po vs.^{210}Pb will be higher in surface waters near productive coasts and lower in the middle of oligotrophic gyres, but reversed deeper during meso-pelagic regeneration. Further fractionation will depend on the different types of dominant plankton based on their unique chemical affinities for membranes, biominerals, and ballasting. At the particle-water interface (Baskaran), we hypothesize that interfaces between intermediate lithogenic nepheloid layers (INL) or hydrothermal plumes 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). In particular, redox mobilization of TEIs associated with Fe/Mn-oxyhydroxides in coastal sediments intersecting the OMZ in the east could affect the differential release of ^{210}Pb and ^{210}Po. In the TAG hydrothermal plume, differential scavenging of ^{210}Po by sulfides (as a S group congener) and ^{210}Pb by Fe/Mn-oxyhydroxides can be ascertained from stable Pb/^{210}Pb and stable Pb/^{210}Po relationships.

To test these hypotheses, we propose to sample and analyze several hundred dissolved and particulate (large and small) samples for ^{210}Po and ^{210}Pb along the GEOTRACES North Atlantic section. About two thirds of the samples will be focused at the six 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 third will be detailed across INL detached plumes from coastal waters,

across the BNL, and within hydrothermal plumes. The data will be synthesized according to interface scavenging models by particle types (e.g. fine/colloidal, lithogenic and biogenic). As such, the proposed work will be closely coordinated with GEOTRACES PIs already funded to for other particle-reactive (e.g. Th, Pa) or dissolved (e.g. Ra) radionuclide isotopes in the Atlantic Survey Section 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 UD websites (www.ocean.udel.edu) and at GEOTRACES (www.geotraces.org).