

Thorium isotopes as tracers of the biological carbon pump in the Arctic

BLACK, E.E.^{*1,2}, CHARETTE, M.A.², LAM, P.J.³,
ANDERSON, R.F.⁴, KIPP, L.E.², XIANG, Y.³, VIVANCOS,
S.M.⁴, AND BUESSELER, K.O.²

¹Dalhousie University Ocean Frontier Institute, 1355 Oxford
St, PO Box 15000, Halifax, NS, B3H4R2, Canada
(correspondence: EBlack@dal.ca)

²Woods Hole Oceanographic Institution, 266 Woods Hole
Road, Woods Hole, MA 02543, USA

³University of California at Santa Cruz, 1156 High Street,
Santa Cruz, CA 95064, USA

⁴Lamont Doherty Earth Observatory, 61 Route 9W, PO Box
1000, Palisades, NY 10964, USA

Measures of upper ocean export and remineralization are a vital means of assessing potential shifts in the efficiency and strength of the biological carbon pump, and are particularly useful in a changing Arctic. Thorium-234 ($t_{1/2} \sim 24$ d), Thorium-228 ($t_{1/2} \sim 1.9$ yr), and Thorium-230 ($t_{1/2} \sim 75,380$ yr) are naturally occurring radioisotopes whose disequilibrium with parents Uranium-238, Radium-228, and Uranium-234 can be exploited to quantify fluxes of carbon traveling out of the upper ocean with sinking particulate matter. High-resolution sampling of these isotope pairs was performed at in the Western Arctic Ocean in order to constrain upper ocean fluxes of particulate organic carbon (POC) as a part of the 2015 U.S. GEOTRACES program. Preliminary results indicate intense scavenging through the Bering Strait and over the coastal shelves of the Chukchi Sea, although negligible ^{234}Th -derived POC export was observed in the surface waters of the Western and Central Arctic basin in the late summer. While these shallow data would suggest a weak biological pump in the basin, subsurface maxima in particulate ^{234}Th and ^{228}Th , as well as broad remineralization features, suggest there could be a greater influence of lateral inputs of POC to the basin below the polar mixed layer. These paired isotope systems will be used to evaluate POC export magnitudes over timescales of month to hundreds of millennia. Comparisons to prior radionuclide-based trap and sediment flux estimates will be made where possible.