Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.6617

Thallium isotope cycling in a manganese-rich brackish meromictic pond

CHADLIN M OSTRANDER[1], SUNE GRØNLUND NIELSEN[1], HAYLEY J GADOL[2], TRISTAN J HORNER[1] AND COLLEEN M HANSEL[1]

[1]Woods Hole Oceanographic Institution

[2]Massachusetts Institute of Technology

Presenting Author: costrander@whoi.edu

There has been a recent acceleration in the use of thallium (Tl) isotopes to track changes in past ocean oxygenation. Critically, Tl isotopes are not directly sensitive to O_2, but instead sensitive to manganese (Mn) oxide minerals that can form in the presence of O_2. This utility therefore demands a strong understanding of how Tl isotopes are cycled in the presence of Mn oxides.

In this presentation, we will discuss our recent investigation of Tl isotope cycling in Siders Pond (Massachusetts, USA). Siders Pond is a meromictic kettle hole (~15 meters deep) located inland of the Vineyard Sound on Cape Cod. The pond is salinity- and redox-stratified, with O_2-bearing freshwaters overlying anoxic to euxinic, dense saltier waters. Formation of Mn oxides in surface waters of the pond is at times extremely efficient and highly dynamic (i.e., fluctuating over weeks to months), making this an ideal field site to test the linkages between Mn oxide cycling and Tl isotope variations.

We find highly variable Tl isotope compositions (ε^{205}Tl) in waters and particles collected from Siders Pond during the 2020 field season – variations that are probably linked to dynamic Mn cycling. Particles collected in surface waters in September and November were always isotopically heavier than coeval waters, but especially heavier when Mn oxide formation peaked in September (up to 4.5 epsilon units heavier). Manganese oxides are known to preferentially sorb the heavier-mass Tl isotope. Moreover, especially heavy ε^{205}Tl in surface waters in August (up to $\varepsilon^{205}\text{Tl} = -0.1$) could have been a consequence of Mn oxide dissolution. Particulate Mn oxide concentrations on this day were low, and any dissolution would have led to the release of isotopically heavy Tl.

These hypotheses, and others, will be tested during the upcoming 2021 field season. We will also generate ε^{205}Tl for pond sediments to see what imprints, if any, these dynamic water column Mn-Tl interactions might leave behind in the sedimentary record. Any imprints that are recorded must be taken into consideration when using Tl isotopes to track past ocean oxygenation.