

Assessing Sources of Mercury to Arctic and Subarctic Soils using Mercury Stable Isotopes

BRIDGET A. BERGQUIST¹, BRIANNA BARNHART¹,
JACQUELINE GOORDIAL², LEXI MOLLIKA², KRYSTAL
NASON¹, PETER MORSE³, RUTH HALL¹, SARAH
FINKELSTEIN¹ AND ALEXANDRE POULAIN⁴

¹University of Toronto

²University of Guelph

³Natural Resources Canada, Geological Survey of Canada

⁴University of Ottawa

Presenting Author: bergquist@es.utoronto.ca

Although northern regions are remote and usually far removed from point sources, long range atmospheric transport of mercury (Hg) has led to the continuous accumulation of Hg in Arctic soils, ice, and water bodies, with permafrost accumulation estimated to be one of the largest sinks of Hg on the surface of the planet. Due to warming, Hg stored in the active layers and permafrost soils is prone to mobilization because of enhanced erosion driven by thawing and increased exposure to air and water. These systems are also becoming more hydrologically connected to downstream ecosystems. It is now recognized that Hg pollution and methylation in Arctic aquatic ecosystems will increasingly be controlled by changing permafrost landscapes (and not changing external sources), with unknown impacts on bioaccumulation in traditional/country foods. In this study, we measured Hg concentrations and Hg isotopes in five northern soil profiles spanning two subarctic peat sites and two Arctic permafrost sites including one being an active retrogressive thaw slump (RTS). In the non-RTS sites in both the subarctic and Arctic, soil depth profiles had clear Hg trends with the shallower layers having higher organic matter, higher Hg concentrations, and more negative odd-mass independent fractionation (MIF). In contrast, the deeper layers had low organic matter, lower Hg concentrations, and no measurable odd-MIF. Mercury isotopes indicated changing sources of Hg with depth. The negative odd-MIF nearer to the surface supported the Hg was dominated by incorporation of Hg associated with vegetation derived organic matter. This Hg was derived from uptake/adsorption of atmospheric gaseous elemental Hg (GEM, Hg⁰) by vegetation (and also possibly direct adsorption of GEM into the soils). In the deeper sections, the lack of MIF suggested that Hg was mostly from geogenic/bedrock sources. Based on negligible even-MIF, deposition of Hg²⁺ species appears to not be an important source to the soils in this study. The RTS site did not have trends in Hg concentrations or isotopes, with relatively constant Hg concentrations and negligible odd-MIF even in the shallow layers. This suggests that perhaps the younger, vegetative derived Hg was lost and only geogenic Hg is still present.