☐ **Talk** ☒ **Poster**

# Mn oxides have the potential to store more organic C than Fe oxides in Arctic tundra soils

Kristen Bidas[1,2], Erin Rooney[1], Erin VanderJeugdt[3], Imtiaz Miah[4, 5], Lauren Kinsman-Costello[3], Michael Weintraub[4, 6], Qian Zhao[6], Elizabeth Herndon[1,2]

*1) University of Tennessee Knoxville, Knoxville, TN, USA*
*2) Oak Ridge National Laboratory, Oak Ridge, TN, USA*
*3) Kent State University, Kent, OH, USA*
*4) University of Toledo, Toledo, OH, USA*
*5) Sylhet Agricultural University, Sylhet 3100, Bangladesh*
*6) Pacific Northwest National Laboratory, Richland, WA, USA*

*Author Email: kbidas@vols.utk.edu*

Permafrost thaw associated with a warming Arctic changes soil saturation and associated redox conditions[1]. Redox sensitive elements, such as iron (Fe) and manganese (Mn), form organic complexes or insoluble oxides in oxic conditions or undergo dissolution in reducing conditions. Manganese and Fe oxides sequester organic matter while Mn oxides can sequester or degrade organic matter[2]. Iron has been studied in tundra environments[1] while less research exists for Mn. The goal of this research was to understand how organic matter interacts with Mn and Fe oxides in permafrost-underlain soils. Organo-mineral interactions were examined by encasing quartz sand or quartz sand coated with either Mn or Fe oxides in mesh bags and burying them in the active layer, the shallow layer of soil that thaws during the summer, along a hillslope transect near Toolik Lake, Alaska. Manganese and Fe were examined in soil thin sections using micro x-ray fluorescence spectroscopy (μXRF). Colloidal (0.02 – 0.45 μm) and dissolved (<0.02 μm) Mn, Fe and organic C were determined in soil porewater. The mineral bags were analyzed for total C/N and dithionite-soluble Fe and Mn. Organic C functional groups and average oxidation states (AOS) of Fe and Mn on the mineral surfaces were evaluated using X-ray photoelectron spectroscopy (XPS). Iron and Mn oxides were further characterized using X-ray Absorption Near Edge spectroscopy and μXRF. Mn oxides sequestered more organic C than Fe oxides during the mineral bag incubation despite dissolution of the Mn and Fe oxides. AOS on the Mn oxide surface decreased suggesting reactivity with organic C. Organic C functional groups became more oxidized for all the mineral bags during the incubation. Colloidal organic C and Fe were correlated in the soil porewater suggesting formation of organo-mineral assemblages. These results suggest that Mn oxides protect organic C in tundra soils despite being less abundant than Fe.

**References**

[1] Herndon, E., Kinsman-Costello, L. & Godsey, S. Biogeochemical cycling of redox-sensitive elements in permafrost-affected ecosystems. *Biogeochemical Cycles: Ecological Drivers and Environmental Impact*, 245-265 (2020).

[2] Li, H., Santos, F., Butler, K. & Herndon, E. A Critical Review on the Multiple Roles of Manganese in Stabilizing and Destabilizing Soil Organic Matter. *Environmental Science & Technology* (2021). https://doi.org:10.1021/acs.est.1c00299