Quantifying Cr(VI) production rates as a function of manganese oxide mineralogy and dissolved organic carbon composition

F.O. BALOGUN[1*] AND M. L. POLIZZOTTO[1]

[1]100 Cascade Hall, Department of Earth Sciences, University of Oregon (*Correspondence: fbalogun@uoregon.edu)

Toxic chromium (Cr) contamination of soils and water from anthropogenic and geogenic sources is a pervasive environmental and health issue. The toxicity of Cr is dependent on its interactions in the environment, particularly in redox transformations that convert Cr between benign Cr(III) to carcinogenic Cr(VI). Manganese (Mn) oxides are ubiquitous soil minerals that facilitate Cr(III) oxidation [1,2]. However, in environmental systems, Cr availablity and reactivity are also dependent on the suite of structurally diverse natural dissolved organic carbon (DOC), which can limit Cr oxidation. These confounding factors make it difficult to assess the specific risks of Cr contamnation in natural systems.

The objectives of this research are to evaluate the rates of Cr(VI) production as a function of Mn oxides, DOC concentration and type and to investigate the role of DOC on reaction product speciation. Mixed batch experiments using synthesized Cr hydroxide, manganese oxide (50 nm), citric and/or salicylic acid are being conducted, with dissolved Cr(VI), Mn(II), total Cr and Mn quantified over time. Results are being used to quantify Cr(VI) production rates across DOC gradients of 0 – 10 mM.

Preliminary results at pH of 5 show that Cr(VI) production is a function of citric acid concentration. At starting concentrations of 0.5 mM, citric acid caused rapid Cr(VI) production, which peaked within 48 hours. However, within the same period, 10 mM citric acid produced 7.5 times less Cr(VI). Ongoing work seeks to quantify reaction kinetics at pH 7 and 9 and measure changes in DOC concentrations in concert with Cr redox processes. X-ray absorption spectroscopy data are being analyzed to determine speciation of Cr and Mn in solid-phase reaction products. These results will show the efficacy of DOC in limiting Cr oxidation and help better understand fate of Cr in multi-component systems.

References

[1] Pan et al. (2019). *ACS Earth and Space Chemistry*, *3*(3), 357–365. [2] Oze et al. (2007). *Proceedings of the National Academy of Sciences*, *104*(16), 6544–6549.