

Structure and Sorption Reactivity of Biogenic Iron Oxides

ANDREW H. WHITAKER¹, TYLER D. SOWERS,^{1,2} AARON THOMPSON³, DEREK PEAK⁴, F. MARC MICHEL⁵, AND OWEN W. DUCKWORTH¹

¹ Department of Crop and Soil Sciences, North Carolina State University, Raleigh, NC, USA, ahwhitak@ncsu.edu, owduckwo@ncsu.edu

² Department of Plant and Soil Sciences, University of Delaware, Newark, DE, USA, tdsowers@udel.edu

³ Crop and Soil Sciences Department, University of Georgia, Athens, GA, USA, AaronT@uga.edu

⁴ Department of Soil Science, University of Saskatchewan, Saskatoon, SK, CA, jdp648@mail.usask.ca

⁵ Department of Geosciences, Virginia Tech, Blacksburg, VA, USA, mfrede2@vt.edu

Although the oxidation of iron in circumneutral environments has long been thought to occur by abiotic processes, iron oxidizing bacteria have been shown to promote iron mineral formation at redox gradients. Despite the growing awareness of the ubiquity of this process, little is known about the structure and reactivity on bacteriogenic iron minerals formed at circumneutral pH.

In the present study, we collect natural bacteriogenic oxides from surface waters in North Carolina. We utilize spectroscopic, microscopic, and scattering techniques to understand the structural details of the minerals, which are poorly ordered iron hydroxides that are similar to ferrihydrite. These techniques as suite suggest that the biogenic minerals may have slightly different local ordering, aggregation, and resistance to wetting/drying cycles. In addition, we also conducted sorption experiments with a suite of potentially toxic cations (including Pb, Zn, and Cu) and anions (As and Cr). These biogenic minerals, as well as associated biomass, cause a unique tapestry of reactivities that may be similar to or quite different than synthetic oxides. The results may have implications for the retention of trace metals at redox gradients, including wetland rhizospheres and sites of groundwater discharge.