Contribution ID: **71** Type: **Poster**

Climate vulnerability of iron-associated soil organic matter: insights from synchrotron-based X-ray absorption spectroscopy

Thursday, July 13, 2023 4:30 PM (1 hour)

Physicochemical interactions between soil organic matter (SOM) and iron (Fe) minerals contribute to long-term protection and storage of organic carbon in soils. However, the persistence of Fe-stabilized SOM depends on environmental controls on the redox state and solubility of Fe. In this work, we show that frequent wet-dry cycles in mineral soils result in distinct Fe-SOM interaction processes with implications for the microbial mineralization of Fe-associated SOM under changing moisture regimes. We used a suite of synchrotron-based X-ray absorption spectroscopy (XAS) measurements to probe Fe redox state, Fe crystallinity, Fe-SOM bonding, and chemical composition of SOM in model Fe-SOM systems and in soils with frequent wet-dry cycling. These analyses were conducted at the Canadian Light Source SGM endstation (C K-edge) and the CHESS F3 endstation (Fe K-edge). Paired with high spatial-resolution mapping of metal-SOM associations, we showed that (1) oxidized Fe(III)-SOM interactions are lost and (2) reduced Fe(II) is preferentially stabilized under conditions that favor frequent dissolution and co-precipitation of Fe and SOM. Using short-term (14-d) incubation experiments, we showed that microbial SOM mineralization increased 3-fold after soils with frequent wet-dry cycles in the field were exposed to persistently dry conditions. Based on preliminary 16S sequencing results, this response co-occurred with a shift in the relative abundance of bacterial taxonomic families. This microbial community response was unique to historically variably saturated soils, pointing towards a tightly coupled relationship among Fe biogeochemical transformations, microbial community processes, and SOM cycling. In ongoing work, we are developing approaches for higher-throughput characterization of soil mineralogical characteristics using X-ray excitation-emission matrix spectroscopy (EEMS), enabling rapid tracking of temporally variable Fe-SOM transformations as described here. Collectively, these findings illustrate how synchrotron-based characterization can inform new perspectives on environmental processes critical for understanding ecosystem response to global change.

Primary author: POSSINGER, Angela (Virginia Tech)

Co-authors: BADGLEY, Brian (Virginia Tech); ARTHUR, Zachary (Canadian Light Source); DYNES, James (Canadian Light Source); LEHMANN, Johannes (Cornell University); REGIER, Tom (Canadian Light Source); SPOTSWOOD, Abby (Virginia Tech); SCOTT, Durelle (Virginia Tech); STRAHM, Brian (Virginia Tech)

Presenter: POSSINGER, Angela (Virginia Tech)

Session Classification: Poster Session 2

Track Classification: Poster Session