Title: Microbial contributions to environmental iron oxidation at the Savannah River Site

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Project Abstract:

At the Savannah River Site (SRS) in South Carolina, extensive iron-oxidizing microbial mats form and appear to be a major sink of uranium. To understand the significance of microbial Fe oxidation and incorporate it into hydrobiogeochemical models, we need to know the environmental rates of biotic and abiotic oxidation, and the controls on these rates. To evaluate this, we conducted two field campaigns to the SRS to sample iron mats at two sites in the Tim's Branch stream and wetlands. We performed iron oxidation kinetics experiments on these terrestrial freshwater iron mats, in conjunction with 16S rRNA gene sequencing and metagenomic analyses of mats to identify the major iron oxidizing bacteria (FeOB) and the flanking community. The iron mats were dominated by known FeOB, notably a diverse set of *Gallionella* OTUs. We compare biotic oxidation rates with abiotic azide-killed controls and show that mat iron oxidation is dominated by biotic oxidation while oxidation by killed mat was much slower (2-9% of total rate in dark incubations). There was also relatively low oxidation in filtered controls in light and dark treatments (3-6% of total rate). Scanning electron microscopy shows the major morphologies in the mats are FeOB biominerals, including twisted stalks and sheaths. We have enriched a stalk-forming *Gallionella* (>97% of culture) from the wetland iron mats, and are continuing to isolate for further metabolic and genomic analyses. This work is part of a larger project focused on integrated kinetics, 'omics, and metabolic modeling work. We will present the results of metagenomic sequencing of the Fe mat communities used in the kinetics experiments, including the major physiological mechanisms of the dominant FeOB. These results set the stage for metatranscriptomics analyses and microbial modeling work towards our longer-term goal to link FeOB metabolic models and kinetics to biogeochemical models in order to predict Fe, C, nutrient and contaminant metal cycling.