Role of Sulfur Intermediates and Volatiles in Euxinic and Ferruginous Environments

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Redox cycling of sulfur between its oxidized form (sulfate) and reduced form (sulfide) plays an important role in the subsurface carbon cycle. Although this anaerobic sulfur cycling is dominated by bacterial sulfate reduction and sulfide oxidation, a number of intermediate-valence-state and volatile sulfur compounds can be produced, consumed, and released to the environment. These compounds have the ability to interact with other biogeochemical cycles, such as iron and carbon, as well as play a role in broader sedimentary geochemistry and may be responsible for subsurface-to-surface volatile fluxes. Despite their potential importance, uncertainty remains regarding the exact role intermediate-valence-state and volatile sulfur compounds play in the sedimentary sulfur cycle .

Salt marshes in Norfolk, England, present an interesting and unique environment to study the importance of these minor species. Within these marshes, two distinct geochemical environments exist in close proximity. The porewater of some sediments are ferruginous, with high levels of dissolved ferrous iron, and a previously reported 'cryptic sulfur cycle', while others are sulfidic, with high levels of dissolved sulfide and methane. The addition of labile carbon allows switching between the ferruginous and sulfidic sedimentary conditions. As an active and dynamic environment, salt marshes provide a unique opportunity to explore the impact of different environmental factors on the subsurface sulfur cycle.

In situ and laboratory incubation studies of the geochemistry of Norfolk salt marsh sediments are used to better understand the role and fate of intermediate-valence-state and volatile sulfur species in these environments. The impact of environmental factors, including seasonal variation and iron concentration, are explored. We find high concentrations of methane thiol in sulfidic sediments and dimethyl sulfide in the ferruginous sediments. We present these results in an effort to contribute to our understanding of the dynamics of these species and the the broader sulfur, iron, and carbon biogeochemical cycles.