

Fe(II) – Fe(III) Oxide Electron Transfer: Influence on Contaminant, Nutrient, and Carbon Dynamics

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Iron oxides are found in virtually all surface environments on Earth and have also been identified as a dominant feature on the surface of Mars. These tiny, often nanoscale sized particles are the main components of a range of industrially and technologically important materials, including biomedical and energy storage and conversion devices. In addition, they are well-known to participate in a variety of environmental redox processes including adsorption reactions, elemental cycling, weathering, water treatment, corrosion control, and semiconductor photoredox processes. Despite their environmental and technological relevance, the redox behavior of Fe oxides in the environment remains poorly understood. This is partly due to the inherently complex and heterogeneous nature of reactions on environmental nanoparticles.

We have been collaborating for more than a decade now to combine ⁵⁷Fe Mössbauer spectroscopy, Fe isotope tracer experiments, and molecular modeling to investigate Fe electron transfer and redox processes at Fe mineral surfaces. Here we present our latest finding on Fe electron transfer reactions on commonly occurring Fe oxides with a focus on the role of defects [1] and possible passivation by reaction with Fe(II). We will discuss the implications of our work for environmentally important processes, such as carbon cycling, contaminant fate, and oxide dissolution.

[1] Andrade et al. (2018) *ES&T* 52 (5) 2751-2759.