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Decoding microbial iron oxidation: integrating isolates, omics, and environmental studies to understand mechanisms and biogeochemical consequences

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The past decades have seen remarkable progress in microbial iron oxidation, much of it inspired by or anchored in the work of Dave Emerson. Working with Dave and his isolates and field sites, we now understand much about how microbes oxidize iron and form biominerals in the environment. This comes from a combination of detailed physiological studies, genomics, and observations/experimentation in environments like the deep sea and coastal wetlands. Work thusfar has shown that wherever there exists iron and redox gradients, we will find microbial iron oxidizers. How do these iron oxidizers shape their physical and biogeochemical environment, and contribute to key environmental processes? Toward this, we will present our work on iron oxidizer isolates, environmental studies, and comparative genomics/pangenome analyses using isolate and metagenome-assembled genomes. Integrating these approaches allows us to make connections between iron oxidizer physiology/metabolism, phylogeny-genotype patterns, and biogeochemical outcomes. We will discuss our progress on unravelling iron oxidation mechanisms and how these help us to detect microbial iron oxidation and link iron oxidizers to transformations of C, N, and other elements in wetlands.