Ecology of Fe(III)-reducing prokaryotes that catalyze critical geobiological processes in sedimentary ecosystems

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Iron(III) is one of the most abundant electron acceptors available to microorganisms in soils/ sediments of the Earth's crust. Iron(III) minerals often predominate the solid phase of porous media and their reduction is established as a key biogeochemical process supporting the terminal decomposition of organic matter and influencing the fate of many nutritive or contaminant elements. Though the biogeochemical significance of microbial Fe(III) reduction is established, quantification of the process remains tedious and difficult. Unlike other key microbial groups, no functional genetic marker is available to track terminal electron transfer to Fe(III) and the ecology of Fe(III)-reducing prokaryotes (FeRP) remains understudied. In short, the ecology of Fe(III) reduction has risen from infancy but has not yet come of age. Recent evidence suggests that a much larger diversity of microorganisms is capable of utilizing Fe(III) minerals as a terminal electron acceptor indirectly by diverting electron flow to soluble electron shuttles (such as humic acids or S compounds). Genome-enabled studies have revolutionized our understanding of cultivated FeRP and also show promise for the development of functional gene targets to detect *in situ* rates and controls of Fe(III) reduction. However, the true diversity of FeRP remains in question and it is difficult to attribute taxa to specific tasks in ecosystems. This talk will explore exciting new advances in the physiology, phylogenetic and metabolic diversity of FeRP. We will discuss the latest experimental approaches that seek to characterize the distribution and metabolic activity of FeRP in marine and aquatic sediments.

Subsurface microbial community structure correlates with uranium redox phases during *in situ* field manipulation in a contaminated aquifer

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Long-term field manipulation experiments investigating the effects of subsurface redox conditions on the fate and transport of soluble uranium(VI) were conducted over a 3 year period at the Oak Ridge Integrated Field Research Center (OR-IFRC) in Oak Ridge, TN. In the highly contaminated source zone, introduction of ethanol to the subsurface stimulated native denitrifying, sulfate-reducing, iron-reducing and fermentative microorganisms and reduced U to below 0.03 mg/L. Subsequently, oxygen and nitrate were experimentally re-introduced into the subsurface to examine the potential for re-oxidation and re-mobilization of U(IV). Introduction of oxygen or nitrate caused changes in subsurface geochemistry and re-oxidation of U. After reoxidation, the subsurface experienced several months of starvation conditions before ethanol injection was restored to reduce the treatment zone. Subsurface microorganisms were characterized by community fingerprinting, targeted population analyses, and quantitative PCR of key functional groups in 50 samples taken during multiple phases of field manipulation. Statistical analysis confirmed the hypothesis that the microbial community would co-vary with the shifts in the subsurface geochemistry. The level of hydraulic connectivity of sampling wells to the injection well was readily tracked by microbial community analysis. We demonstrate quantitatively that specific populations, especially *Desulfosporosinus*, are heavily influenced by geochemical conditions and positively correlate with the immobilization of uranium. Following nitrate reoxidation, populations of Fe(II)-oxidizing, nitrate reducing organisms (*Thiobacillus*) showed an increase in relative abundance.