Microbial Sulfate Reduction in the Presence of Zero Valent Iron: Responses to Purity and Surface Treatment

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Background/Objectives. Abiotic groundwater remediation using zero valent iron (ZVI) is highly effective at treating chlorinated contaminants, and recent studies show that sulfur-modified ZVI particles can reduce chlorinated ethenes with a high degree of efficiency and for extended periods of time. However, the impact of particles on indigenous subsurface microbial communities is unknown, and this is important for the long-term, sustainable treatment of aquifers. We hypothesized that ZVI would be less likely to impact indigenous communities when sulfidated, and that this effect would be most pronounced when ZVI was nanosized.

Approach/Activities. We assessed the influence of sulfidated and non-sulfidated particles on the sulfate-reducing activity of two model aquifer cultures, pure culture *Desulfovibrio desulfuricans* and enrichment culture AMR-1. Particle experiments included both commercial (Peerless) and laboratory grade particles, and particles were well-characterized prior to microbial experiments. Sulfate samples were collected following microbial exposure to particles and were analyzed via ion chromatography to determine the rate and extent of sulfate reduction. Microbial attachment and agglomeration to ZVI was visualized using scanning electron microscopy. 16S rRNA gene surveys were used to monitor enrichment cultures for changes in community composition.

Results/Lessons Learned. Results with Peerless particles show that particles significantly altered the rate at which *D. desulfuricans* reduced sulfate, and sulfidated Peerless reduced microbial respiration rates to a greater extent than unsulfidated particles. In contrast, laboratory grade particles of similar size showed little influence on *D. desulfuricans*, and this was true for both sulfidated and unsulfidated particles. High concentrations of unmodified nanoscale ZVI inhibited sulfate-reducing activity, but respiration was minimally impacted when nanoparticles were sulfidated. Experiments with enrichment culture AMR-1 are ongoing, but preliminary data parallel results obtained using *D. desulfuricans*. This work suggests that ZVI particles influence the metabolic behavior of in situ microorganisms as a function of both particle purity and surface treatment.