THE ROLE OF DISSOLVED ORGANIC CARBON IN ACETATE BIOSTIMULATED URANIUM ATTENUATION[1]

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Abstract: The Integrated Field Challenge Site at Rifle, Colorado (RIFC) is home to a legacy of subsurface uranium contamination resulting from mill operations. Research at RIFC has shown that acetate amendment (as an electron donor and carbon source), and the consequential growth of iron-reducing microbial communities results in the bioreduction of uranium. As microbial communities metabolize the acetate, dissolved organic carbon (DOC) changes both concentration and composition. Subsurface OC affects the biogeochemistry of an aquifer through equilibrium metal complexation and microbially mediated electron transfer and metabolic reactions. Accordingly, an understanding of DOC composition and evolution over the course of bioremediation is useful in modeling the fate and transport of uranium.

Groundwater from the RIFC was analyzed before, during, and after acetate biostimulation for total and operationally defined fractions of uranium and organic carbon. The defined fractions of OC in the dissolved phase can give insight into the microbial and chemical reactively of the organic carbon fractions. The DOC fractionation scheme involved XAD-8 and XAD-4 resins to isolate and measure hydrophobic, transphillic, and hydrophilic organic carbon. Fractionated DOC was further analyzed for specific UV absorbance. The unfractionated DOC was analyzed by HPLC for short change organic acids. Research findings have shown the enrichment of the transphillic organic carbon fraction in groundwater as a result of acetate stimulation. Additional data will be presented outlining the changes in uranium and OC composition from temporally and spatially varying Rifle groundwater. The evaluation of the composition of groundwater before and after biostimulation allows for a direct comparison of the extent of natural U(VI) bioreduction to acetate-stimulated bioreduction. This information will facilitate the design of a more effective bioremediation strategy for the Rifle IFC. More importantly, it will aid in the design of uranium bioremediation strategies for other sites with subsurface uranium contamination.

Additional Keywords: Acetate Biostimulation, Bioreduction of Uranium, Dissolved Organic Carbon

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