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Influence of Electron Donor Type and Concentration on Dynamics of Bacterial Populations Associated with Uranium Reduction and Remobilization

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Background: Anthropogenic use of uranium has resulted in over 120 contaminated sites in the United States alone. Reductive precipitation of U(VI) by stimulating indigenous microorganisms dramatically decreases uranium solubility and is an attractive, low-cost bioremediation strategy. Our previous long-term sediment studies demonstrated that after an initial period of U(VI) reduction and immobilization significant reoxidation of U(IV) and remobilization of U(VI) occurred. **Methods:** We initiated a second long-term column study to determine the effect of differences in organic carbon (OC) substrate type (lactate, acetate), OC concentration and influent pH on the stability of bioreduced U. Microbial community composition and dynamics were analyzed using a custom high-density 16S microarray (16S Phylochip). **Results:** Analysis of the microbial communities during the reduction and remobilization phases demonstrated that OC concentration was the primary determinant of the bacterial community composition and that significant shifts in community dynamics occurred between the reduction and remobilization phases. Columns with low OC influent showed decreases in the abundance of α-, β-and γ-proteobacteria, primarily among *Caulobacterales*, *Burkholderiales*, *Nitrosomonadales*, and *Rhodocyclales*. Columns receiving high OC influent had significantly different populations between the reduction and remobilization phases within the orders *Bacteroidales*, *Flavobacteriales*, *Clostridiales*, and within members of the δ-proteobacteria, including a decrease in abundance of a *Geobacter* sp. and increases in *Desulfobacterales* and *Syntrophobacterales*. Significantly, the pattern of U(VI) reduction and U remobilization in the columns also varies primarily according to OC concentration, not OC type. **Conclusion:** The results of this study indicate that the type of organic carbon substrate provided to promote U(VI) reduction has less of an effect compared to OC concentration, and that the microbial communities differ significantly between the uranium reduction and remobilization phases.