Electron Donor Effects on Bioreduction Rates of Uranium and Microbial Community under Varying Bicarbonate and Sulfate Conditions

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Objectives:

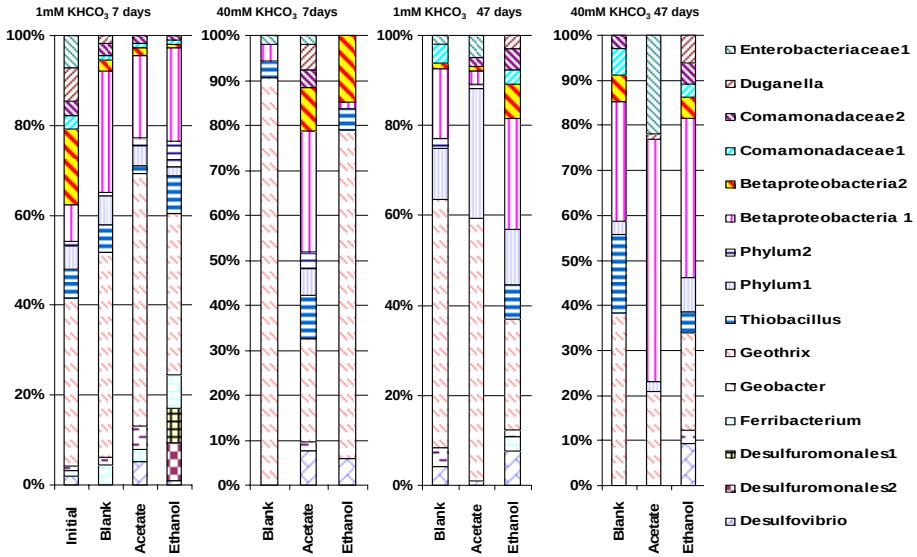
A factorial microcosm test was performed to study the effect of ethanol and acetate on biological reduction rates of uranium(VI) and changes of microbial community in a contaminated sediment under various geochemical conditions.

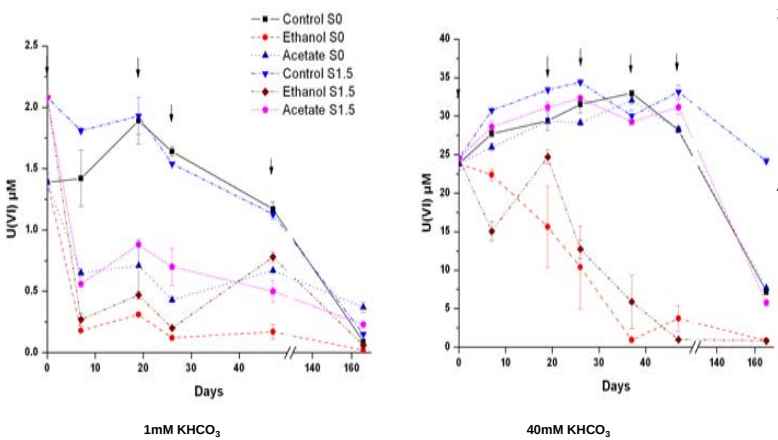
Methods:

Each microcosm contained a highly contaminated sediment (uranium concentrations up to 2.8 g/kg) suspended in buffer with one of two bicarbonate concentrations (1 mM or 40 mM) and sulfate concentrations ranging from 1.1 to 3.2 mM. The microcosms were incubated on a shaker at ambient temperature (22–24°C), and 2 mM ethanol or acetate was periodically added.

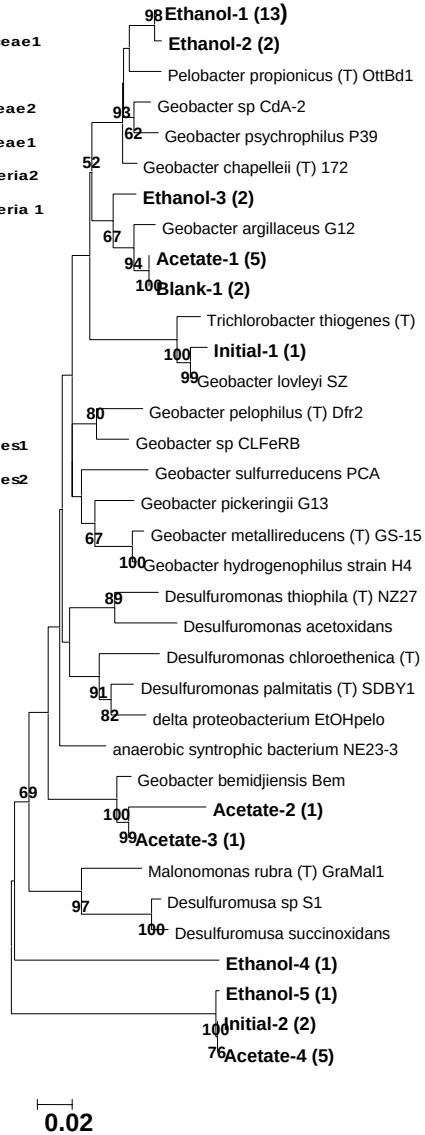
Results:

1) Both ethanol and acetate proved capable of stimulating biological reduction of U(VI) in sediments, although ethanol amendments produced significantly higher reduction rates than acetate under given geochemical conditions. At the higher bicarbonate concentration, acetate failed to enhance the reduction of U(VI).
2) High sulfate concentration also decreased the reduction rates of U(VI).





3) Microbial communities were dominated by species from the *Geothrix* genus and *Proteobacteria* phylum in all microcosms. However, species in the *Geobacteraceae* family capable of reducing U(VI) were significantly more enriched by the ethanol than by the acetate amendment at the lower bicarbonate concentration. Ethanol amendment also increased the population of an unclassified *Desulfuromonales*, while acetate increased the population of *Desulfovibrio.*
4) Another important finding of this study is that species in the *Geobacteraceae* family were not enriched at the high bicarbonate concentration, but the *Geothrix* and the unclassified *Betaproteobacteria* species were enriched, suggesting that the latter may be responsible for the reduction of U(VI).

Conclusion:

This study indicates that ethanol is a better electron donor than acetate for stimulating the biological reduction of U(VI) in sediments, but geochemical conditions can affect microbial community structure and thus the reduction rates of U(VI).