Influence of Ethanol and Acetate as Electron Donor on Microbial Community Changes and Uranium Bioreduction under Varied Bicarbonate and Sulfate Concentrations

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Abstract

Ethanol and acetate have been found to stimulate bioreduction of uranium (VI). A microcosm test is designed to study the bio-stimulated microbial population in contaminated sediments under varied aqueous geochemical conditions during biological U(VI) reduction. The microcosms containing highly uranium contaminated sediments (up to 2.8 g/kg) from US Department of Energy managed site, Oak Ridge, TN were amended with two distinct concentrations of bicarbonate (1 vs 40 mM) with two levels sulfate (1.1 vs 2.6 mM) and incubated at ambient temperature condition (22-24 ^{o}C). Ethanol and acetate was tested as respective electron donor source. After 47 days, reduction of uranium and sulfate occurred in all microcosms. At the tested conditions, ethanol had significant higher U(VI) bioreduction rates than acetate at all of the incubation conditions; acetate did not accelerate U(VI) reduction in high concentration of bicarbonate. U(VI) reduction rate was decreased by elevated sulfate concentration. The microbial communities regardless of treatment were dominated by species from *Geothrix* genus and *Betaproteobacteria* order. Species in *Geobacteraceae* family, which reduces U(VI), were significantly increased by the ethanol and the acetate treatment in low concentration of bicarbonate, which were likely responsible for the uranium bioreduction in the buffer. However, species in *Geobacteraceae* family did not enriched in high concentration of bicarbonate, which suggest the *Geothrix* and the unclassified *betaproteobacteria* were important for uranium reduction in the buffer. This confirmed that ethanol was the better choice than acetate for uranium bioreduction under the tested conditions and indicates that bicarbonate concentration influences microbial populations responsible for uranium bioreduction.