

<p>Fractured Rock Conference Field Day September 16, 2004</p>	
<p>Bedrock Bioremediation Center Affiliations and Funding</p>	
<p>Station 2: Site Microbiology</p>	<p>The goals of the microbial research at the Bedrock Bioremediation Center (BBC) are to: (i) examine whether microbial communities in organically-contaminated bedrock aquifers are capable of biodegrading the contaminants, (ii) develop laboratory and field methods to estimate and accelerate <i>in situ</i> rates of bioremediation of organic contaminants in bedrock aquifers, and (iii) to develop and apply innovative microbial and molecular biology techniques to enhance <i>in situ</i> bioremediation and assess the efficacy of remediation strategies. Detailed molecular studies of the groundwater and bedrock at the BBC site have determined that the microbial communities in the water and associated with the fracture surfaces are different. While the overall microbial abundance is low in the competent bedrock, the diversity is high and includes <i>Dehalococcoides</i> and sulfate-reducing and methanogenic bacteria, along with protists. Several of the bacteria are similar to those found at other bedrock sites. Interestingly, the microbes inhabit not only the open fractures, but also the microfractures that are partially sealed with minerals and clays. The research also includes development of microcosm protocols and molecular probes to predict TCE biodegradation rates and to speed detection and enumeration of key microbial constituents in the process.</p>
<p>Microcosm Protocol Development</p>	<p>The objective of this research is to develop a reliable microcosm protocol with reduced variability for the evaluation of TCE biodegradation in bedrock aquifers. Because the geochemistry, hydrology and microbiology of the competent bedrock at the BBC site are well-characterized, it is easier to compare <i>in situ</i> degradation processes/ rates with laboratory- derived rates. This microcosm research is evaluating the sources of variability within microcosm methods, including such factors as preparation technique, incubation conditions, sample volume, buffering capacity, and sample homogeneity.</p>
<p>Rock Fragments in Microcosms</p>	<p>Rock surfaces may be important to microbial biodegradation processes due to geochemical interaction and the potential for the rock surface to host microbes. This research investigates the importance of rock chemistry to the TCE degradation rates by comparison of groundwater-only microcosms to microcosms with surface outcrop rock fragments and those that include inert glass beads colonized by microbes from the bedrock aquifer. Concurrent evaluation on the effect of the microbial community is done by comparison of the use of sterile rock fragments and glass beads to those that have been incubated for 45 days in an isolated interval in a bedrock well.</p>
<p>Rock Core Microcosms</p>	<p>For a microcosm to most closely replicate <i>in situ</i> bedrock conditions requires studies with actual microbial communities, geochemistry and rock fracture geometry. Using rock core in a microcosm best simulates these <i>in situ</i> conditions. In the rock core microcosms developed by the BBC, a preexisting fracture in a rock core is isolated to create a fill and draw permeameter reactor. The objectives of this work are to first develop a standardized protocol for the assembly of these rock core microcosms, and then to compare the degradation rates derived using them to the rates obtained in the bedrock at the BBC site.</p>
<p>Fluorescent In Situ Hybridization</p>	<p>Fluorescent <i>In Situ</i> Hybridization (FISH) is used to analyze groundwater samples from the BBC site. FISH uses DNA probes to target specific types of bacteria within a given community. When the fluorescently-labeled DNA probe binds to the DNA sequence of its target organism, the entire bacterial cell glows and can be counted by microscopy. This method can detect and quantify different members of the microbial community and is a powerful tool when multiple probes are used simultaneously. With a better understanding of the diversity and abundance of potentially relevant microbial players, better predictions can be made as to how the <i>in situ</i> microorganisms are influencing the chemical conditions and biodegradation at the site.</p>
<p>Role of Protists in Enhancing TCE Biodegradation</p>	<p>Previous work in unconsolidated aquifers has shown that bacterial degradation of contamination is enhanced when protists prey upon bacteria. Research is being conducted to determine the role that protists play in the contaminated bedrock at the BBC site. Flow-through reactors, containing bacteria and protists and bacteria alone, are being used to evaluate the effect of the protists on the bacterial degradation rates of TCE and its progeny during intrinsic and amended conditions.</p>
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