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Analysis of strain IRB-1 as a potential candidate for uranium bioremediation in an extreme environment

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Soap Lake, a halo-alkaline meromictic lake, in central Washington State is host to a variety of microorganisms capable of growth in these extreme conditions. These microorganisms have been shown to play a central role in geochemical cycling of the lake. In particular, an isolate designated strain IRB-1, a sulfur- and iron-reducing obligately anaerobic bacterium, exhibits qualities that may be beneficial for bioremediation in highly alkaline and saline environments found in contaminated industrial sites and some water systems. Strain IRB-1 was cultivated in batch cultures under anaerobic conditions in a medium that simulated site geochemistry. The original cultures were grow at a pH of 9.5, 1.2M NaCl, 60mM lactate, and 2mM Fe(III)-citrate as an electron acceptor. In all cultures growth was observed through increased protein biomass and reduction of Fe(III) over time. Scanning electron microscopy was used to analyze planktonic and biofilm cultures of IRB-1. The electron micrographs depicted the presence of extracellular appendages extending into the substrate and creating cell to cell connections. The original medium was modified by altering the terminal electron acceptor to 50mM of either sulfate, sulfite, thiosulfate, or elemental sulfur to determine the metabolic flexibility of the organism. Growth was observed only in cultures containing sulfur and thiosulfate and was confirmed over the span of several subcultures. We infer from the ability of IRB-1 to reduce Fe(III), thiosulfate, and sulfur that it may also have the ability to reduce heavy metals, specifically U(VI). Experiments are currently underway to determine the capacity of IRB-1 to grow in the presence of and/or reduce 2mM U(VI) as the sole terminal electron acceptor. Should this bacterium have the capability to reduce U(VI) and other heavy metals, it would become a candidate for bioremediation efforts in saline and highly alkaline environments where organisms traditionally employed for bioremediation can not be used.