Title: Mechanisms of Uranium Reduction in Sulfate-Reducing Bacteria

Author(s): Erica L-W. Majumder[1*] (majumdere@missouri.edu), Sharien Fitriasari[1], Judy D. Wall[1], Adam Arkin[2], **Paul D. Adams[2] (PDAdams@lbl.gov)**

Author Affiliation: *[1]University of Missouri, Columbia MO; [2]Lawrence Berkeley National Laboratory, Berkeley CA*

http://enigma.lbl.gov

Project Goals: The goals of this project are to understand how Sulfate-Reducing Bacteria handle metal contamination on a molecular level. The Oak Ridge Reservation Field Research Site has many contaminating toxic metals that along with other geochemical factors drive community formation. SRB are found throughout the site in significant numbers. In the work, we are determining how the SRB tolerate, resist and chemically transform one of the major contaminating metals, uranium.

Abstract: Sulfate-reducing bacteria (SRB) are anaerobic soil bacteria that interact with many metals, over twenty have been have been characterized to date. Some interactions are detrimental to human interests, such as bio-corrosion of pipes and ships, but others are potentially beneficial, such as the reduction of soluble uranium (VI) to insoluble U(IV). The process of uranium reduction has been investigated in the model SRB, *Desulfovibrio vulgaris* Hildenborough because of the presence of SRB at the Oak Ridge Reservation in the areas contaminated with uranium and other metals. Single deletion mutants were created for each of the genes proposed in the literature to be involved in the reduction process: cytoplasmic atypical thioredoxins on a putative metal reducing operon, periplasmic tetraheme cytochrome c_3, and extracellular pili forming protein PilA. Mutant strains were tested for their ability to reduce uranium, tolerate uranium, and respire uranium. The thioredoxin mutants were able to reduce and tolerate almost as much uranium as wild-type suggesting that they are not the main contributor to uranium reduction. Both the cytochrome c_3 mutant and the pili-less mutant were significantly impaired in their ability to reduce and tolerate uranium suggesting that extracellular and periplasmic mechanisms are more important for this interaction than cytoplasmic. Reduction rates were increased for wild type and mutant strains under pyruvate fermentation rather than sulfate respiration indicating that metal reduction might be more favorable when the organism employs fermentative pathways. Key electron donors, acceptors and proteins were identified for this SRB mechanism of uranium reduction.

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