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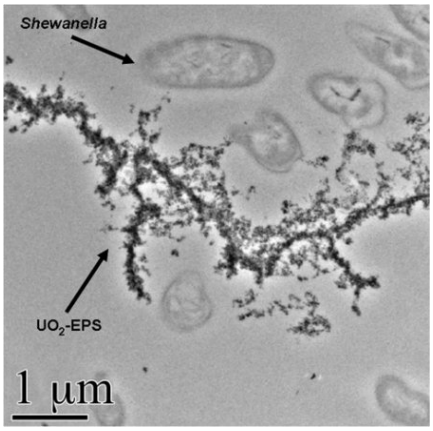
EMSL In Brief
Environmental Molecular Sciences Laboratory

EMSL Grand Challenge Offers Insight About Uranium Bioremediation

According to the U.S. Department of Energy, more than 2,500-billion liters of groundwater nationwide are contaminated with the toxic metal, uranium. Some microbes, including *Shewanella oneidensis* MR-1, can affect the solubility of metals and possibly serve as bioremediating agents.



Researchers are using EMSL electron microscopy in conjunction with synchrotron-based microscopy at ANL to study the interactions of uranium and S. oneidensis.

Researchers from the Pacific Northwest National Laboratory and the Environmental Molecular Sciences Laboratory (EMSL), along with scientists from Argonne National Laboratory (ANL) and the University of Wisconsin, Milwaukee, are studying the biomolecular mechanisms of the *S. oneidensis* and uranium interaction. This research is being performed, in part, under the EMSL Biogeochemistry Scientific Grand Challenge.

Under anaerobic conditions, microbes like *S. oneidensis* can donate electrons to, or reduce, metals. Changing a metal's chemistry in this way affects its solubility. For example, *S. oneidensis* reduces very soluble hexavalent uranium, U(VI), to less soluble uranium oxide, UO_2, limiting its movement in groundwater. To study electron transfer at the microbe-mineral interface and how extracellular UO_2 is formed, the researchers used a novel combination of high-resolution electron microscopy analyses at EMSL and synchrotron-based X-ray fluorescence microscopy at ANL's Advanced Photon Source.

The team is the first to confirm that *c*-type cytochromes, which are proteins on the bacterial outer membrane, are essential for U(VI) reduction and UO_2 particle formation. Further, the cytochromes and biogenically reduced UO_2 particles are co-localized in the extracellular polymeric substance (EPS), a protective matrix on the outside of some bacteria.

The association of cytochromes and UO_2 in the EPS may shed some light on the long-term fate of biogenically reduced UO_2 in the environment. The EPS may affect the fate of UO_2 by influencing its susceptibility to oxidation or its transport in soils and sediments.

Results of this research were reported in the August 2006 issue of *Public Library of Science Biology*. The EMSL portion of the research is supported by the DOE Office of Biological and Environmental Research's Environmental Remediation Science and Genomics: GTL programs.

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