

Study of Proton, Pb⁺² and Zn⁺² adsorption onto *Shewanella oneidensis* MR-1 strain and a mutant Strain (Δ EPS): Spectroscopic observation and modeling approach

JUYOUNG HA^{1*}, ALEX GELABERT¹, YINGGE WANG¹, ALFRED M. SPORMANN² AND GORDON E. BROWN, JR.^{1,3}

¹Surface & Aqueous Geochemistry Group, Department of Geological & Environmental Sciences, Stanford University, Stanford, CA 94305-2115, USA (jyha@stanford.edu, gelabert@stanford.edu,

ygwang@stanford.edu, gordon.brown@stanford.edu)

²Department of Civil & Environmental Engineering, Stanford University, Stanford, CA, USA (spormann@stanford.edu)

³Stanford Synchrotron Radiation Laboratory, 2575 Sand Hill Road, SLAC, MS 69, Menlo Park, CA 94025, USA

In this study we examined the adsorption affinities of Pb²⁺ and Zn²⁺ on *Shewanella oneidensis* strain MR-1 (wild type) and a mutant strain (Δ EPS), which is deficient in exopolysaccharide (EPS) production, and developed a model to describe the thermodynamic and chemical properties of the bacterial surfaces.

ATR-FTIR spectra of wild type and the Δ EPS mutant strain both exhibited carboxyl, amide, phosphate, and carbohydrate groups. Potentiometric titrations indicated that both wild type and Δ EPS mutant cells exhibit similar surface charge as a function of pH, suggesting a weak contribution of the removed polysaccharides to the overall charge of *S. oneidensis* surfaces. Negative electrophoretic mobilities at pH > 3.5 were observed on both strains of *S. oneidensis* indicating that the outermost layer of organic groups, such as carboxyls, bear negative charges. No significant differences in metal uptake were observed for the three different ionic strengths investigated (1M, 0.1M, and 0.01M of NaNO₃), indicating that the structure of the cell wall does not depend on electrolyte concentration. Extended X-ray absorption fine structure (EXAFS) spectroscopic studies of Zn²⁺ and Pb²⁺ on both strains of bacteria were combined with equilibrium titration studies to investigate the nature of metal binding sites on *S. oneidensis*. Based on these experimental results, the thermodynamic stability of metal complexes on the two different strains of *S. oneidensis* and the concentration of binding sites on the bacterial surfaces for such complexes will be discussed.

Quantification of dehydration and mass fluxes from subducting slabs

A.C. HACK AND A.B. THOMPSON

Dept. Erdwissenschaften, Institute for Mineralogy & Petrology, ETH Zurich, Zurich, CH-8092, Switzerland (Alistair.Hack@erdw.ethz.ch, Alan.Thompson@erdw.ethz.ch)

Various kinds of subduction geotherms were modeled through petrogenetic grids for subducted oceanic crust, sediments and mantle, and overlying mantle wedge. Hot geotherms (convergence velocity ca. 4.5 cm year⁻¹) cut dehydration and melting reactions for hydrous metasediments, MORB and mantle (depending upon which solidus). Cold geotherms (convergence velocity ca. 9 cm year⁻¹) cut dehydration curves at higher pressure (5 to 6 GPa) than for hot geotherms (2 to 3 GPa) and do not cut any H₂O-saturated solidi.

H₂O fluxes through the top of the slab are shown in relation to depth, ranging from maximum spurts up to 50 g m⁻³ per metre of burial for hot subduction to 30 g m⁻³ m⁻¹ for cold subduction. This dehydration flux either moves back up the slab/mantle interface or vertically into the mantle wedge. For the case of greater subduction velocity than buoyant fluid Darcian velocity, the dehydration H₂O could be carried deeper into the mantle. For buoyant flow up the slab/mantle interface solubility was calculated at quartz saturation. The maximum precipitation of quartz and vein formation here will take place in the depth range 100 to 50 km (ca. 10 times greater than that at deeper or shallower levels). For vertical flow from slab to mantle wedge, massive decrease in SiO₂ solubility becomes manifest as conversion of forsterite to enstatite or serpentine. These layers can be up to 500 m thick for the hot geotherm, but only 30 m thick for the cold geotherms.