Cd and Proton Adsorption onto a Halophilic Archaeal Species: The Role of Cell Envelope Sulfhydryl Sites

JINLING LIU[1, 2], QIANG YU[2], ALLISON R. SHOWALTER[3], BRUCE A. BUNKER[3], AND JEREMY B. FEIN[2]

[1] School of Earth Science, China University of Geosciences, Wuhan 430074, China, liujinling@cug.edu.cn.

[2] Department of Civil & Environmental Engineering & Earth Sciences, University of Notre Dame, Notre Dame, IN 46556, USA, jliu20@nd.edu, qyu@nd.edu, fein@nd.edu.

[3]Department of Physics, University of Notre Dame, Notre Dame, IN 46556, USA, allison.showalter1@gmail.com, bunker@nd.edu.

Archaea are the predominant microbes in extreme environments and adsorption onto their surfaces could have major impacts on the biogeochemical cycling of a number of metal pollutants. In this study, we conducted Cd adsorption experiments, potentiometric titrations, and Cd x-ray absorption fine structure (XAFS) spectroscopy analyses in order to determine and model the mechanism of metal adsorption by the halophilic archaeon *Halobacterium noricense*. The adsorption experimental results show that Cd adsorption kinetics are significantly slower than exhibited by previously-studied bacterial species, with Cd adsorption equilibrium requiring at least 8 hours of reaction time. The extent of Cd adsorption is independent of pH across the pH range studied (5.5-7.5). Potentionmetric titration experiments, conducted with and without sulfhydryl site blocking using qBBr, yield site concentrations and pKa values for the cell envelope binding sites, and place constriants on the total concentration of sulfhydryl sites. The XAFS results indicate that under the low metal loading conditions of the experiments, Cd is bound almost exclusively via inner-sphere binding to sulfhydryl sites within the archaeal cell envelope and that carboxyl and phosphoryl sites are not involved. Our results suggest that sulfhydryl sites play an important role in metal binding under environmentally-relevant low metal-loading conditions. Sulfhydryl binding may represent an adaptive strategy for halophiles to obtain metal nutrients in environments in which aqueous metal-chloride complexation dominates the speciation for many metals.