The Reduction and Surface Complexation of Mercury by *Geobacter sulfurreducens* PCA

HAIYAN HU[1,2], WANG ZHENG[1], JEFFRA SCHAEFER[3], XINBIN FENG[2], LIYUAN LIANG[1], DWAYNE ELIAS[1], AND BAOHUA GU[1*]

[1]Oak Ridge National Laboratory, Environmental Sicences Division, Oak Ridge, TN 37830, USA, gub1@ornl.gov ([*]presenter)

[2]Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, China

[3]Department of Geosciences, Princeton University, Princeton, NJ 08544, USA

Understanding the biogeochemical processes that control mercury (Hg) redox transformations is necessary to predict Hg availability for microbial methylation, its fate and transport in the environment. Previous studies have shown that a wide variety of microorganisms are capable of reducing the mercuric Hg(II) to elemental Hg(0) under anaerobic conditions, but others have indicated an inverse correlation between microbial biomass and Hg(0) production. In this study, we systematically examined the reduction kinetics and surface interactions between Hg(II) and washed cells of *G. sulfurreducens,* as influenced by the growth stage of cells, cell density, the presence or absence of various complexing ligands, including glutathione and naturally dissolved organic matter (DOM). We found that Hg(II) can be rapidly reduced to Hg(0) upon contact with washed cells, but reduction rates and extent are influenced by the growth stage, cell density and Hg(II)/cell ratio. The initial reduction rates can generally be described by a pseudo-first order kinetics with half-lives on the order of minutes to less than 2 hr. An optimal reduction of Hg(II) at a fixed concentration of 50 nM was observed at a cell density of ~10^{11} L^{-1}; an increase in cell density inhibited the reduction of Hg(II) due to surface adsorption and complexation of Hg(II) on bacterial cells. Similarly, the presence of complexing organic ligands inhibited the Hg(II) reduction at varying degrees, with glutathione among the most effective in inhibiting Hg(II) reduction and surface complexation by *Geobacter* cells. Our findings explain some previously observed inconsistencies with respect to the roles of microorganisms in Hg(II) reduction and may have important implications to the availability and bioaccumulation of Hg in the aquatic food web.