Poster #21-25

Effects of Natural Organic Matter and Minerals on Mercury Methylation

Linduo Zhao[1*], Xia Lu, [1] Shan Wu[1], Hongmei Chen[1], Eric M. Pierce[1], and Baohua Gu[1]

[1]Environmental Science Division, Oak Ridge National Laboratory, Oak Ridge, TN

Contact: gub1@ornl.gov

BER Program: SBR
Project: ORNL Critical Interfaces Scientific Focus Area (CI-SFA)
Project Website: http://www.esd.ornl.gov/programs/rsfa/

Net methylmercury (MeHg) production in the environment is a result of complex interactions among Hg, microbes, natural dissolved organic matter (DOM), and minerals in water and sediments, but the mechanisms of these interactions remain poorly understood. We systematically investigated the effects of DOM and selected minerals on mercury [Hg(II)] methylation by an iron-reducing bacterium (FeRB) *Geobacter Sulfurreducens* PCA and a sulfate-reducing bacterium (SRB) *Desulfovibrio desulfuricans* ND132 under anaerobic conditions. The study was performed in laboratory incubations in a phosphate buffered saline (pH 7.4) either in the presence or absence of a DOM isolate from the contaminated East Fork Poplar Creek (EFPC) water and three distinct types of minerals (e.g., hematite, kaolinite, and smectite) with varying physico-chemical properties. We found that DOM effects on microbial methylation are bacterial strain-specific, time- and DOM-concentration dependent. Addition of small amounts of DOM (< 10 mg/L) inhibits Hg methylation by *G. Sulfurreducens* PCA but enhances Hg methylation by *D. desulfuricans* ND132 cells. The result implies that DOM likely enhances Hg methylation at such sites where SRB dominates but inhibits methylation in ecosystems where FeRB dominates. Interestingly, we also found that the presence of minerals, regardless of the mineral type, enhanced Hg(II) methylation by ND132 cells, and MeHg production increased by 2 to 4 fold. Results thus indicate that the sorption of both Hg(II) (freshly added) and cells on mineral surfaces may have favored cell uptake and thus methylation of Hg(II), although aging and drying of the minerals with the sorbed Hg(II) significantly decreased Hg(II) methylation. While exact mechanisms of the DOM- or mineral-enhanced Hg(II) methylation or DOM-inhibited methylation by *G. Sulfurreducens* PCA remain to be explored, these observations provide new insights into complex environmental geochemical factors influencing mercury cycling and methylmercury production in the aquatic environment.