**Hg(II) Uptake and Methylation in Iron-Reducing Bacteria**

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Mercury uptake and methylation by microorganisms is a key first step in the accumulation of methylmercury in aquatic ecosystems such as the East Fork Poplar Creek (EFPC) in the US DOE Oak Ridge Reservation. Our current model for this process in *Geobacter sulfurreducens* is that Hg(II) enters cells by active transport where it is methylated and rapidly exported as methylmercury. To determine the likely role of a divalent metal transporter in the uptake of Hg(II), we have tested mercury methylation in the presence of a variety of essential heavy metals to act as possible competitive substrates for Hg(II) uptake. Experiments are currently on-going. Further, we have performed knock-outs of a number of putative heavy metal transporters and are now testing these mutants for the ability to take up and methylate Hg(II). Although transport appears to be a critical first step in the methylation of Hg(II), it remains unclear whether methylation occurs in the cytosol or periplasm of these organisms. To clarify this, methylmercury production was monitored in lysed spheroplasts isolated from *G. sulfurreducens*, indicating a cytosolic location for Hg methylation. Thus, mercury must cross both the outer and inner membranes prior to its methylation, and we are actively trying to identify such transporters. In addition, we have observed differences in the type of cellular exudates released during growth of methylating and non-methylating iron-reducing bacteria which have significant impacts on Hg availability. For instance, *G. sulfurreducens* produces cysteine during growth which enhances Hg(II) uptake and methylation; while *Shewanella oneidensis*, a non-methylating species, excretes an unknown compound only during anaerobic growth which renders Hg(II) unavailable to both the parent strain and to *G. sulfurreducens*. Identification of the possible compound(s) by solid-phase extraction and electrospray mass spectrometry is on-going. These results will provide a greater understanding of the biological factors governing methylmercury production in known methylating strains which is critical for controlling its accumulation in the environment.