Active Transport, Substrate Specificity, and Methylation of Hg(II) in Anaerobic Bacteria

Session: ORNL SFA (Laboratory Research Manager: Liyuan Liang)

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ABSTRACT

One key factor controlling the production and accumulation of methylmercury in environments such as the East Fork Poplar Creek (EFPC) ecosystem at the US DOE Oak Ridge Reservation, is the species of Hg(II) available for uptake by methylating bacteria. Little is known regarding the mechanism of Hg(II) uptake by these organisms, in part because of the inherent difficulty in measuring the intracellular Hg concentration. Using the model Hg methylating bacteria *Geobacter sulfurreducens* and *Desulfovibrio desulfuricans* ND132, we demonstrate that Hg(II) uptake occurs by active transport. We also show that Hg(II) uptake by *G. sulfurreducens* is highly dependent on the characteristics of the thiols that bind Hg(II) in the external medium, with some thiols promoting uptake and methylation and others inhibiting both. The Hg(II) uptake system of *D. desulfuricans* has a higher affinity for Hg(II) than that of *G. sulfurreducens* and promotes Hg(II) methylation in the presence of stronger complexing thiols. Our results raise the question of the physiological function of the underlying Hg(II) cellular uptake system and point at Hg(II) complexation by thiols as an important factor controlling Hg(II) methylation in anaerobic environments.