**Methylmercury Cycling in Aquatic Ecosystems**

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Methylmercury (MeHg) is the toxic form of mercury that accumulates in fish to levels that may pose a health threat to wildlife and humans. Most MeHg is produced from complexes of inorganic Hg (Hg(II)) by anaerobic bacteria; however, little is known quantitatively about the principal environmental controls on this process, its relation to MeHg bioaccumulation, and the role of anthropogenic Hg loadings. Recent investigations in arctic Alaskan watersheds, Long Island Sound, and the continental shelf of southern New England indicate that *in situ* benthic production is the primary source of MeHg to each of these physicochemically disparate systems, and that sedimentary MeHg production is limited by the availability of dissolved Hg(II) to methylating bacteria. Gross potential rates of Hg methylation in sediments, assayed by incubation with a stable Hg isotope, are correlated strongly with the concentration of Hg(II), most probably as $HgS^0$, in filtered pore water of these low-sulfide deposits. Bioavailability of Hg(II) in pore fluids is governed by partitioning with solid-phase organic material, the speciation of dissolved Hg–S complexes, and Hg loadings. Moreover, and among these systems, whole-basin sediment–water effluxes of MeHg (i.e., net benthic production) are related positively to sedimentary loadings of Hg(II), most of which are derived from the atmosphere. Bioaccumulation is an important sink for MeHg, and the connection between Hg loadings and benthic MeHg production is reflected in cosmopolitan bio-indicator organisms—mosquitoes and largemouth bass. These results suggest that MeHg production and bioaccumulation in freshwater and coastal marine ecosystems is linked to atmospheric Hg loadings, two-thirds of which are estimated to be from fossil fuel combustion, and imply that future reductions in anthropogenic Hg emissions to the atmosphere may result in proportionately lower levels of MeHg in aquatic organisms, including fishes consumed by humans.