BIOGEOCHEMICAL PROCESSES AND METHYLMERCURY PRODUCTION IN FRESHWATER WETLANDS

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Mercury is the number one contaminant issue worldwide in terms of the number of sites affected. Mercury contamination of the environment has increased since the industrial revolution through release of this volatile metal into the atmosphere from various anthropogenic sources. Human health is primarily impacted by consumption of fish containing high levels of mercury, mostly in the form of neurotoxic and bioaccumulative methylmercury (MeHg). MeHg may cause neurological impairment and cardiovascular impairment. Minamata disease is a neurological disorder caused by extreme MeHg exposures. Neurological damage in developing fetuses is a particular concern. All fifty U.S. states now have fish consumption advisories for MeHg, and it remains a concern worldwide. MeHg also poses a threat to piscivorous wildlife through endocrine disruption and neurologic effects, resulting in gradual population declines.

Mercury is a problem in medical geology because biogeochemical processes in the environment convert inorganic mercury from anthropogenic sources into MeHg. The Everglades, Florida has some of the highest levels of MeHg in fish in the USA. We have been investigating the environmental conditions promoting MeHg production and bioaccumulation in this large wetland ecosystem. Obligate anaerobes, including sulfatereducing and iron-reducing bacteria are responsible for methylating inorganic mercury. Wetlands are particularly important habitats for MeHg production as anoxic sediments provide the environmental conditions that support anaerobic metabolism. In many respects the Everglades is an ideal environment for MeHg production due to: (1) extensive wetland area, (2) high inorganic mercury deposition, (3) sulfate contamination from agricultural runoff, and (4) high dissolved organic carbon (DOC) content. Sulfate contamination is 60100 times levels present prior to development and stimulates microbial sulfate reduction and MeHg production in the Everglades. The relationship between sulfur and MeHg production is complex, however, with stimulation by sulfate and inhibition by sulfide. DOC plays a key role by binding and stabilizing inorganic mercury and transporting it to sites of methylation. This presentation will summarize the results of more than ten years of study of the biogeochemical basis of MeHg production in freshwater wetlands, as well as presenting some recent data on MeHg production in coastal areas.

Keywords: mercury, wetlands, biogeochemical processes