Mercury Mass-Independent Fractionation in Freshwater Plankton and Aquatic Systems

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Mercury (Hg) is a globally distributed pollutant that bioaccumulates in aquatic food webs. Mercury enters terrestrial and aquatic ecosystems dominantly in its inorganic form. Within these ecosystems, Hg can be transformed into methylmercury (MeHg), the form of Hg that bioaccumulates. Methlylation occurs in many environments and the links between Hg sources, methylation and MeHg in biota are not easy to trace. A rapidly growing tool to study Hg is the stable Hg isotope system, which is largely due to Hg isotopes exibiting large mass independent fractionation (MIF), and Hg isotopes are already being used to successfully trace sources and quantify transformations of Hg. For example, one of the major destructive pathways for MeHg is photo-demethylation in surface waters, which results in large MIF. Numerous studies have used Hg MIF preserved in fish and biological samples, which are often dominated by MeHg, to estimate photo-demethylation in surface waters and to trace sources of Hg in biota. However, these exciting applications are limited by controlled studies that explore how Hg MIF in biota vary with respect to many environmental variables.

In this study, we analyzed Hg MIF in plankton from two mid-latitude lakes biweekly with differing amounts of dissolved organic carbon (DOC) and sunlight penetration over the full spring to fall period. This period experienced a large seasonal cycle in UV radiation, a paramater thought to affect the degree of MIF. In addition to Hg isotopes, MeHg was also measured in the plankton. Hg MIF signatures in the plankton were higher in the lake with lower DOC and greater sunlight penetration. In addition, the plankton MIF varied in both lakes over the spring to fall with a delayed offset from the UV variation. The Hg MIF did not vary with %MeHg nor Hg concentration. Results demonstrate that the Hg MIF in the plankton is very sensitive to the seasonal variation in sunlight as well as sunlight penetration in the lakes.

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