Hydrothermal mercury in the Yellowstone lake ecosystem

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Sublacustrine hydrothermal vents in Yellowstone are strongly enrichment in Hg, as well as As, B, Cl, CO_2, Ge, H_2S, K, Li, Mo, Na, Rb, Sb, Si, and W. Sublacustrine hot springs have dissolved Hg concentrations up to 170 µg/L.

Mercury concentrations in cutthroat and lake trout populations are significant in muscle (cutthroat=0.07-0.53, lake trout=0.03-0.88 µg/g, wet weight; both ave.=0.21) and liver (cutthroat = 0.13-0.89 µg/g, 0.32 ave.; lake trout = 0.11-0.93 µg/g, 0.50 ave., wet weight) relative to trout collected elsewhere in the Yellowstone River basin. Methylation of Hg in thermal waters is probably carried out by bacteria that live around hot springs and these bacteria are consumed by amphipods. Stomach contents of cutthroat trout, which contain amphipods in many cases, average 0.20 µg Hg/g, wet weight. Hg in cutthroat trout has implications for grizzly bear, otter, eagle, and osprey populations that feed on the cutthroat trout that spawn in the rivers. For example, the hair of grizzly bears collected (by the Interagency Grizzly Bear Study Team) near Yellowstone Lake have higher Hg concentrations (0.6-1.7 µg/g, dry weight) than bear hair sampled at more remote areas in the Greater Yellowstone Ecosystem (0.006-0.09 µg/g, dry weight). Other grizzly bear foods, such as pine nuts and various megafauna show insignificant Hg concentrations.

The isotopic composition of mercury as a tool in understanding the natural and anthropogenic cycling of a highly toxic element

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The industrialised countries have varying degrees of regulatory control on the uses and disposal of Hg, but in many developing countries anthropogenic usage of Hg is poorly regulated. Consequently, the persistence, high mobility, bioaccumulation, biomagnification, and toxicity of mercury (Hg) indicate that anthropogenic use continues to be an issue in regard to global health. Global sources, sinks, rates and loads that comprise the general Hg cycle in the surficial environment have been established. More importantly, however, the complex regional and local sub-cycles, determined by climate, geology, and biology are quite uncertain. Here, I present a review of Hg isotope systematics that suggests an additional tool in understanding Hg cycling. Second generation multi-collector ICPMS instruments provide opportunities to make precise measurements of Hg isotope ratios although there is much to be learned regarding methodologies. In particular, the degrees of mass fractionation during chemical processing of samples and appropriate application of instrumental mass bias corrections are areas requiring attention. There is also a lack of certified standards for Hg isotopes although this situation is slowly being rectified, mainly by IRMM. Hg isotope fractionation should occur during natural processes given the physical and organic chemistry of Hg. There is an emerging body of literature indicating Hg isotopes are fractionated in cinnabar deposits, meteorites, and during coal combustion and the natural /anthropogenic variation is likely to exceed 5 per mil; quite large considering the small relatively mass range (<4%).