Mercury isotopes in California rivers impacted by historic gold and mercury mining

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The Yuba River and Cache Creek (in CA) are both highly contaminated with mercury (Hg) from historic gold and Hg mining, respectively. Both tributaries eventually flow into the San Francisco Bay-Delta via the Yolo Bypass, a lowland wetland and flood control basin where monomethyl mercury (MMHg) accumulation is a threat to wildlife. Sediment and aquatic invertebrates in these rivers were collected and analyzed for total Hg (THg), MMHg and Hg isotopic composition (δ^{202}Hg, Δ^{199}Hg). This study provides insight on how contrasting Hg sources are biogeochemically processed and accumulated in these contaminated fluvial systems.

Sediment exhibited a wide range in THg and overlapping Hg isotope values. Streambank terrace sediment along the Yuba R. had THg between 0.14 and 7.62 μg/g and a relatively constant Hg isotopic composition (δ^{202}Hg of -0.42 ± 0.18‰, Δ^{199}Hg of 0.04 ± 0.02‰; mean ± 1SD). In Cache Creek, bar sediment THg ranged from 0.09 to 3.87 μg/g with more variable δ^{202}Hg (-0.89 ± 0.42‰), and Δ^{199}Hg (0.09 ± 0.06‰) comparable to the Yuba R. Aquatic invertebrates exhibited a large range in %MMHg and their Hg isotopic composition could be attributed to mixing between inorganic Hg (IHg) and MMHg. In the Yuba R., invertebrates had between 36% and 79% MMHg and relatively high Δ^{199}Hg (0.62 to 0.99‰). Cache Creek invertebrates had a similar range in %MMHg (16-85%) but lower Δ^{199}Hg (0.51 to 0.67‰). The results allowed us to estimate the isotopic composition of MMHg and IHg and suggest that there are differences in the extent of photochemical degradation of MMHg in the two tributaries. Pending field work will investigate the distribution and accumulation of these sources downstream, in Yolo Bypass.