Mercury isotope systematics in aqueous environment of the Tibetan Plateau

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Preliminary studies have demonstrated both mass-dependent fractionation (MDF) and mass-independent fractionation (MIF, mainly odd isotopes, odd-MIF) of Hg isotopes in natural samples, and the potential of Hg isotope determination in biochemistry and geochemistry, and demonstrated the potential of Hg isotopes in tracing the source, processes and the fate of Hg in the atmosphere, biosphere, lithosphere, and hydrosphere. Moreover, recent work reported, unexpectively, intriguing MIF of even Hg isotopes (even-MIF, Δ^{200}Hg up to 1.24‰) in natural samples mainly related to the atmosphere, rendering Hg as a “three dimentional” isotope tracer.

Unlike the Arctic and Antarctic, little was reported on the bio-geochemical cycle of Hg and its isotopes on the Tibetan Plateau (TP), known as “the world’s third pole”. The TP is the world's largest and highest plateau, has a unique landform, fragile ecosystem and special monsoon circulation. The TP provides water for nearly one-third of the global population and still has a potential risk of Hg contamination of the long-term transported Hg emitted from the two largest Hg-emission countries China and India. Moreover, the strong ultraviolet radiation may strengthen the intensity of almost all kinds of photochemical reaction of Hg, the TP is thus the best place to study Hg isotope geochemistry.

We carried out a systematic study of Hg isotopes in precipitation, surface stream, lake water, snow pack and even glacier. All samples displayed large variation of Δ^{199}Hg of about 2.00‰ and slightly positive Δ^{200}Hg up to 0.30‰. The Tibetan precipitation samples showed the highest Δ^{199}Hg compared to other precipitation worldwide, and an important contribution to Hg in surface system. Hg isotopic signature in streams was likely impacted by both precipitation and glacier melting. Interestingly, the odd-MIF pattern of highland lakes deviated from that of Canadian forest lakes, indicating likely a different source contribution. Our work highlights the importance of studying the biogeochemical cycling of Hg and its isotopes on the Tibetan Plateau, which may possess different fractionation mechanisms from the north and south poles.