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Recent observations and comprehension of global even-MIF in atmospheric samples

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Hg in precipitation presumably integrates the properties of Hg present in the upper atmosphere (or free atmosphere) and the atmospheric boundary layer and could provide insights to the deposition of atmospheric Hg. Hg isotope has been utilized to characterize transportation and transformation of atmospheric Hg (Bergquist and Blum, 2007; Chen et al., 2012). Since Chen et al. (2012) and Gratz et al. (2010) found the significant δ^{200}Hg in atmospheric precipitation around the Grate Lake, δ^{200}Hg was determined in variable regions with different altitude and latitude globally, thus, the occurrence of even-MIF is a worldwide phenomenon, especially related to atmosphere. Here, we try to synthesize the recent observations of even-MIF in global atmospheric samples, as well as the even-MIF in atmospheric precipitation from Peterborough, Ca last year, and try to give a tentative comprehension of the origin.

In contrast to slightly positive δ^{200}Hg (< 0.30‰) values frequently observed in most atmospheric precipitation and negative δ^{200}Hg (~ -0.20‰) values related to GEM, significant δ^{200}Hg (up to 1.24‰) in precipitation from Peterborough (Ontario, Canada) stands out and adds to the mystery of the origin of even-MIF. The systematic analysis of rainfall and snowfall samples collected in Peterborough during cold weather last year revealed significant even-MIF in dissolved Hg (from 0.25‰ to 1.19‰ for δ^{200}Hg) and a negative relationship between δ^{200}Hg and δ^{204}Hg, which provide further evidence for the previously proposed model of δ^{200}Hg formation developed by Chen et al (2012). Opposing odd-MIF and even-MIF trends were detected in sequentially collected precipitation samples, which further suggests different sources for both δ^{199}Hg and δ^{200}Hg. Particularly, the high δ^{200}Hg values may highlight the potential source of stratospheric Hg during polar vortex periods. Moreover, the frequently high δ^{200}Hg values in global aerosol and less than 0.30‰ δ^{200}Hg in Tibetan precipitation may suggest vertical exchanges (gravitational sedimentation and scavenging by clouds or particles) of atmospheric RHg between troposphere and stratosphere. The new δ^{200}Hg data for particulate Hg add to existing information on atmospheric Hg(II) worldwide and suggest a global distribution of even-MIF in the atmosphere