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Editorial: Environmental chemistry of mercury: sources, pathways, transformations and impact

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Editorial on the Research Topic
Environmental chemistry of mercury: sources, pathways, transformations and impact

In terms of inorganic pollutants that are globally distributed, mercury (Hg) is a global pollutant of major concern because of its ability to be transported globally via the atmosphere, and through the ocean and via river watersheds. It has been released into the environment from anthropogenic sources, from its intentional use, such as in artisanal and small-scale goldmining (ASGM), and because it is a trace element in coal, ores and other primary resources extracted and used by humans. Anthropogenic emissions globally far exceed the natural inputs of Hg to the biogeosphere. While it is primarily released as inorganic Hg, elevated levels of Hg as methylmercury (MeHg) in seafood and other foods is a health concern for humans and wildlife. Mercury is taken up into vegetation and soils, and into ocean surface waters primarily from the atmosphere, and can be released back to the atmosphere due to natural processes, including those that are anthropogenically enhanced, such as biomass burning and deforestation.

The exchange of Hg between the reservoirs of the biogeosphere, and the aquatic and atmospheric chemistry of Hg are complex, as it can exist in many different inorganic and organic forms, including elemental Hg, ionic Hg, and mono- and dimethylmercury, in the dissolved phase, while also binding to organic ligands in water or attached to particles. In the atmosphere, Hg is found mainly in the gaseous phase. The conversion of inorganic Hg to the more toxic methylated Hg forms is primarily mediated by bacteria and the factors influencing the net conversion (methylation) to methylated Hg are not yet fully understood. While most studies examine the environment chemistry of Hg using measurements of concentrations and kinetic and other chemical characterizations of the fate, transport and transformation of Hg, there is a growing number of studies that use the environmental fractionation of Hg stable isotopes, and differences in isotopic composition in different source materials to examine the origin and fate of Hg from industrial pollution.

Given the complexities of the environmental chemistry of Hg, and the lack of knowledge, and the advancement of techniques for quantifying Hg species in the biogeosphere, this Research Topic was defined to invite scientific contributions that examined the complex environmental chemistry of Hg and was designed to enhance the publication of new and exciting results. The paper in the Research Topic included those published prior to, and after, the 15th International Conference on Mercury as a Global Pollutant (ICMGP) that was held in July 2022 remotely because of the pandemic.

The papers published in this Research Topic examined the following aspects of Hg environmental chemistry by:

1. Examining the chemical speciation of Hg in air, and advances in speciation analysis of mercury (Gustin et al.).
2. Focusing on the examination of the methylation/demethylation pathways, Hg redox reactions, and interactions with of Hg with particles Lamborg et al. (dark reduction of Hg); Coulibaly et al. (Hg reduction); Cui et al. (Hg partitioning in the ocean); Despins et al. (Arctic Hg methylation).
3. Using stable mercury isotope to examine biogeochemical processes, transformations and transport of mercury Eckley et al.; Schwab et al. (both examining historical mercury contamination).
4. Examining the factors influencing mercury deposition over paleo timescales Nalbant et al. (tropical lake).
5. Through regional studies of mercury biogeochemical cycling, fate and transport Graham et al. (river); Fostier et al. (Amazon rain forest).

The papers in this Research Topic cover all aspects of Hg fate and transport and transformation in the biogeosphere with studies focused on the atmosphere, oceans, terrestrial landscapes and freshwater ecosystems, as well as examining the impacts of historical Hg contamination and the controlling factors on its fate and effects. These studies provide an insight into the important factors influencing the fate, transport and bioavailability of Hg in the environment, and demonstrate that while major advances in understanding have occurred, there is still more studies needed to further understand the factors controlling the formation and bioaccumulation of methylmercury and its impact on humans.

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Conflict of interest

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