

Recent advancements in understanding mercury emissions from global volcanic degassing

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Volcanic degassing is an important pathway in the geochemical cycling of many elements on Earth. The trace metal mercury (Hg) is emitted from volcanoes and geothermal systems in both gaseous and particulate-bound forms. While other major Hg sources such as anthropogenic emissions have been relatively well characterized, the total flux from volcanic degassing – and its role in the global Hg budget relative to other sources – remains the subject of debate. More recent estimates suggest the volcanic Hg flux is on the order of ~100 tonnes per year (or <5% of total natural emissions to the atmosphere) [1,2], with the caveat that short-term emissions from explosive eruptions remain unquantified due to the infrequency of these events and challenges for sampling [3]. Here we review recent advances in volcanic Hg research, including the results of our extensive multi-year fieldwork in Iceland measuring Hg emissions from two eruptions and several high-temperature geothermal fields across the region. We provide an updated estimate of the global volcanic Hg flux from subaerial volcanic degassing using a recently published 2023 compilation of high-resolution, satellite-based SO₂ fluxes from ~100 persistently degassing volcanoes [4], and a range of Hg/SO₂ mass ratios obtained from recent field measurements. We discuss the likely effects of explosive eruptions on the global atmospheric Hg pool and formulate a time-averaged annual Hg flux from these sources. The poorly understood but potentially important contributions from submarine sources (i.e., mid-ocean spreading ridges, hydrothermal vents) are also discussed in terms of both ocean and atmospheric Hg inputs.

[1] Li, C., Sonke, J.E., et al. (2020) *ACS Earth Space Chem* 4, 2073-2081.

[2] Bagnato, E., Aiuppa, A., et al. (2011) *Bull Volcanology* 73, 497-510.

[3] Edwards, B.A., Kushner, D.S., et al. (2021) *Sci Total Environ* 757, 143800.

[4] Fioletov, V.E., McLinden, C.A., et al. (2023) *Earth Sys Sci Data* 15, 75-93.