A Quantitative Assessment of the Importance of Mining for the Global Hg Cycle

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Humans have mined, used and released mercury (Hg) to the environment since antiquity. There has been considerable uncertainty in estimates of all-time Hg releases to the environment, particularly those predating the industrial period. Estimates of early Hg releases are needed to reconstruct the natural Hg cycle. These early Hg releases were dominated by direct Hg extraction, silver mining and gold mining. Here we present an updated global biogeochemical modeling framework for Hg that is forced by refined estimates of natural and anthropogenic releases, includes natural sources not previously considered such as hydrothermal vents and active volcanic activity, and new understanding of mercury cycling in terrestrial environments. We show that quantitative reconstruction of the present global Hg cycle using best-available information on anthropogenic and natural emissions, air-sea exchange, and deep ocean burial constrains the uncertainty ranges of estimates in the literature and presents a contrasting budget to that presented in the latest global mercury assessment (GMA). We find that the majority of Hg in the atmosphere and ocean originates from human releases of Hg. Uncertainty in historic mining emissions affects the magnitude of estimated all-time enrichment of the global Hg cycle but has a <10% influence on contemporary ocean Hg concentrations simulated in the model. We discuss the implications of this analysis for the global vs. local signature of Hg releases from contemporary artisanal and small scale gold mining (ASGM) operations.