Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.34981

Mercury (Hg) speciation and phase stability in sedimentary rocks

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Sedimentary mercury (Hg) concentrations, together with stable Hg isotopes, which can provide information on Hg sources, are widely used to understand past volcanic events and paleoenvironmental perturbations such as anoxia and terrestrial ecosystem upheaval. Although substantial research on the polluted modern surface Hg cycle has improved our understanding of Hg sources and depositional pathways, the Hg concentrations and isotopic values recorded in sedimentary rocks are also influenced by (long-term) post-depositional processes that are largely unconstrained. This includes, for example, Hg transitioning from organic matter (scavenging phase) to mineral hosts (pyrite, HgS). Mercury mobilisation and phase-transformation may alter the primary depositional Hg distribution and, through mineral (re-)precipitation, also the Hg isotope signal. Therefore, a first step toward understanding the sedimentary Hg record is to recover its speciation from sedimentary rocks. A recent Hg thermal desorption study indicated speciation can be diverse and vary strongly between samples in a single succession.

We studied Hg stability and phase distribution in Mesozoic marine and terrestrial sedimentary rocks, focusing on chemical and physical separation experiments, and monitored Hg speciation changes after each step using thermal desorption characteristics. Our preliminary data suggest that physical separation (ultrasonication- and sodium-hexametaphosphate-assisted) as well as chemical extraction (e.g., HCl treatment) may provide a feasible, relatively time-efficient path to quantify Hg in association with clay minerals, as organic-matter-bound or sulphide mineral phases.