Osmium mass transfer processes upon oxidative weathering of sulfide minerals: Experimental constraints

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At present, large uncertainties exist in our knowledge of how oceanic/continental hydrothermal alteration and weathering processes govern the mass balance of osmium (Os) in seawater. Despite the tremendous potential of Os as a paleoweathering proxy, our understanding of the geochemical processes controlling continental and oceanic weathering fluxes of Os to ancient seawater has been predominantly determined through an imperfect patchwork of observational data taken from modern natural systems. Further, it is unclear *how* Os becomes mobile into fluids since few studies haved specfically focused mechanistically on the mass transfer of Os upon oxidative alteration of primary and secondary sulfide minerals, which act as the primary Os-bearing reservoirs residing within the oceanic and continental crust.

To gain a more comprehensive mechanistic understanding of how Os becomes mobile during sulfide-seawater interactions, we present experimental Os time-series concentration and isotopic data from a set of oxidative sulfide dissolution experiments conducted at 25° C. Specifically, the experiments monitor the mass transfer of Os into solution as a function of reactant material, pH, and solution composition. The reactant sulfide for individual experiments, is either derived from highly radiogenic ~540 Ma copper sulfides hosted in ~730 Ma black shales (~20 pg/g) or from mostly unradiogenic copper sulfides from the modern East Pacific Rise 9° N mid-ocean ridge hydrothermal system (~5 pg/g).

Briefly, we predict that the mobility of Os and other redox sensitive metals will be dissolved into solution with time, however, the presence of organic complexes in natural waters and pH dependence on Fe^{3+}-oxide mineral formation will ultimately control the fate of dissolved Os upon oxidation sulfide dissolution. These data will be coupled with existing global Os mass balance models to better understand the contribution of low temperature weathering processes relevant to the oceanic and continental; ultimately providing fundamental constraints on what physiochemical processes govern the flux of dissolved Os upon water-rock alteration of continental and oceanic crust into seawater.