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Crustal versus hydrothermal sources to 2.7-2.3 Ga seawater: Constraints from Os isotopes and Re, Mo abundances in black shales

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Re-Os geochronology and redox-sensitive metal abundances (e.g., Re, Mo) in black shales have great potential to constrain Early Earth marine geochemical cycles and the chronology of atmosphere and ocean oxygenation. Seawater $^{187}\text{Os}/^{188}\text{Os}$ (as recorded by the initial $^{187}\text{Os}/^{188}\text{Os}$ [I_{Os}] of Re-Os isochron regressions) reflects a balance between the riverine flux of radiogenic Os from oxidative weathering of upper continental crust (present-day value of ~ 1.0 - 1.5) and the flux of unradiogenic Os from hydrothermal alteration of oceanic crust and peridotites, and cosmic dust (~ 0.11 - 0.13). Chondritic I_{Os} obtained from the 2.70 Ga Joy Lake Sequence (Superior Province, Minnesota, USA) [1], 2.50 Ga Mt. McRae Shale (Hamersley Group, western Australia) [2], and 2.32 Ga Rooihooigte and Timeball Hill Formations (Transvaal Supergroup, South Africa) [3] are consistent with dominance of the Late Archean to Early Paleoproterozoic marine Os budget by hydrothermal and extraterrestrial inputs. However, an interval of elevated Re and Mo abundances in the Mt. McRae Shale together with elevated Re abundances in the Joy Lake sequence may record mild shallow water oxygenation (whether local or global) prior to the 2.45-2.32 Ga Great Oxidation Event [2]. Thus, oxidative weathering of crustal sulfides may represent a measurable, albeit minor source of Re and Mo to Late Archean seawater relative to the hydrothermal and extraterrestrial fluxes. New high-resolution chemostratigraphic profiles through black shale intervals in the 2.6-2.5 Ga Ghaap Group (Transvaal Supergroup, South Africa) are consistent with this hypothesis.

[1] Yang *et al.* (2007) GSA Abstr. Prog. **39**, 274. [2] Anbar *et al.* (2007) Science **317**, 1903-1906. [3] Hannah *et al.* (2004) EPSL **225**, 43-52.