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Highly siderophile elements and Re-Os systematics of Archean komatiitic rocks in the Gorumahisani greenstone belt, Singhbhum craton, India

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The highly siderophile element (HSE) contents of komatiites have been widely used to estimate the evolution of the HSE budget of Earth`s mantle over time. We present HSE abundances for komatiites of the Singhbhum craton for which a Sm-Nd age of 3.51 Ga was obtained from 8 samples, an age supported by Os T_{RD} ages strongly skewed towards values >3.2 Ga. These komatiites include extreme examples of both Al-depleted and Ti-depleted types. Calculated parental melts contain 2.57±0.04 ppb Ru, 3.0±0.2 ppb Pt, 2.5±0.3 ppb Pd for Al-depleted komatiites, and 4.0±0.1 ppb Ru, 2.8±0.1 ppb Pt, 2.2±0.1 ppb Pd for Ti-depleted types. In one commonly accepted model [1], early to mid Archean komatiite sources are taken to have low HSE contents, reflecting incomplete mixing with a late accretion component. The estimated mantle source of the Gorumahisani komatiites, determined by extrapolation along an olivine control line, has HSE abundances equivalent to ~37-57% of primitive upper mantle (PUM) Ru contents, and ~46% and ~47% of PUM Pt and Pd contents, which would be consistent with this model. However in an alternative model the source is assumed to have PUM-like HSE abundances, and relatively low komatiite HSE concentrations are attributed to melting effects [2]. We apply a critical melting model to investigate whether such processes could explain the low Ru, Pd and Pt contents of the Singhbhum komatiites. We find that Ru contents of Al-depleted komatiites can be produced from a PUM-like mantle source, whereas those of Ti-depleted komatiites may indicate a source residual to the extraction of Al-depleted komatiitic melts, which exceeded sulfide exhaustion based on model results for Ru and Pd. Nevertheless, Pt and Pd fractionation behaviors cannot be successfully modelled for either komatiite type, likely reflecting our current limited understanding of Pt and Pd partitioning behavior. Thus, at present we cannot distinguish between the two models used to explain the HSE abundances of early Archean komatiites. Further advances require new constraints on HSE partitioning pertinent to the conditions of komatiite generation.

[1] Maier et al. (2009) Nature, **460**, 620-623. [2] Waterton et al. (2021) Geochimica et Cosmochimica Acta, **313**, 214-242.