Early silicate differentiation of the Isua mantle? Insights from Tungsten isotopes and HSE abundances

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Interpreting the origin of ^{182}W anomalies in mafic Archean rocks and the role of a putative missing late veneer [1,2] hinges on tightly constraining the Archean mantle abundances of highly siderophile elements (HSE). However, most HSE estimates for Archean mantle-derived rocks are based on their mafic derivatives, an approach with large uncertainties. Previous ^{182}W isotope studies did either not include measurements of HSE [2,3] or examined inadequate mafic-ultramafic lithologies [4-6], where the ultramafic rocks could not unambiguously be identified as mantle peridotites.

Here, we present the first high-precision W-isotope measurements for > 3.8 Ga old peridotites from Isua that unambiguously show the geochemical characteristics of depleted mantle harzburgites or associated dunites. These mantle peridotites exhibit resolvable excesses in ^{182}W of +15 ppm (±2 ppm, 95% conf. limit). The observed absolute abundances and ratios of the PGE (Os, Ir, Ru, Pd, Pt), have previously shown to equal those of modern mantle peridotites [7], arguing against a missing late veneer component in these rocks. Our data are further corroborated by ^{182}W- and ^{176}Lu–^{176}Hf isotope data for 3720 Ma boninite-like metabasalts from the Isua supracrustal belt and 3.4 Ga Ameralik dikes. Both rock suites exhibit excesses in ^{182}W up to +20 ppm. Positive initial εHf values point to a derivation from a depleted mantle source. At a first glance, this would tentatively support models, where an early depletion of the Isua mantle might have caused the ^{182}W anomalies. However, up to 100 fold enrichments of W in many samples relative to similarly incompatible elements like Th argue for selective W mobilization. Hence, inheritance of the anomalous W isotope signatures from metasomatic fluids or from subduction zone components in an arc setting can therefore not be ruled out.

[1] Touboul et al. (2012) *Science* **335**, 1065-1069. [2] Willbold et al. (2011) *Nature* **477**, 195-198. [3] Willbold et al. (2015) *EPSL* **419**, 168-177. [4] Touboul et al. (2014) *Chem. Geol*. **383**, 63-75. [5] Rizo et al. (2016) *GCA* **175**, 319-336. [6] Dale et al. (2017) *EPSL* **458**, 394-404. [7] van de Löcht et al. (2016) EMC, conference abstract 2-2