^{182}W anomalies in Archean rocks: a vestige of variable late accretion?

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Small excesses of ^{182}W have been reported for a number of Eoarchean terranes. Two competing models have been inferred to explain these isotope anomalies. In the first model [e.g., 1] the excesses are explained by variable additions of late veneer components having chondritic ^{182}W abundances. In the second model [e.g., 2] the excesses are explained by early silicate differentiation (<60 Myrs after solar system formation), during the lifetime of now extinct ^{182}Hf. In support of the late veneer model, small ^{182}W excesses in lunar rocks were interpreted to mirror the silicate Earth composition prior to late accretion [e.g., 3].

In a concerted approach to evaluate both models further, we examined distinct rock suites from Isua and lunar samples for their W isotope composition and elemental W inventory. Peridotites from Isua, now unambiguously identified as mantle rocks [4], exhibit small ^{182}W excesses of ca. +15 ppm [5], although their PGE patterns resemble those of modern peridotites and lack any evidence for a missing late veneer [4]. If combined with data for other mafic units from Isua, it can be shown that W is substantially enriched in these rocks, either by metasomatic processes or by ancient subduction zone recycling. The ^{182}W excesses found are therefore inherited and cannot be easily combined with PGE patterns to estimate late veneer contributions.

New high precision data for incompatible elements in lunar rocks [6] reveal that the Hf/W ratio of the lunar mantle must be at least 10-20% higher than that of the present day terrestrial mantle. This new finding now supports models, wherein the ^{182}W excesses in lunar rocks are explained via *in situ* radiogenic ingrowth at a higher lunar mantle Hf/W. As this must have occurred during the lifetime of ^{182}Hf, formation of the Moon is therefore constrained to within <60 Myrs after solar system formation.

[1] Willbold et al. (2014) Nature 477 [2] Touboul et al. (2016) Science 335 [3] Toboul et al. (2016) Nature 520 [4] van de Löcht et al., this volume [5] Tusch et al., this volume [6] Thiemens et al., this volume