A partial late veneer for the source of 3.8 Ga Isua rocks: Evidence from highly siderophile elements and ^{182}W

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Highly siderophile elements (HSEs) are strongly sequestered into metallic planetary cores, leaving silicate mantles almost devoid of HSEs. Late accretion, after core formation had ceased, partially replenished HSEs in planetary mantles and occurred within a few million years of solar system formation on many parent bodies [1], but probably later on Earth, after a final episode of core formation associated with the giant Moon-forming impact. Ancient isolated domains in Earth's mantle – such as the source of 3.8 billion-year-old Isua basalts – might represent mantle isolated from late accreted material, as has been suggested based on their small ^{182}W excesses compared to the present-day Earth's mantle [2]. However, such ^{182}W excesses may also represent signatures of early differentiation processes in the Earth's mantle, which have been preserved through the giant impact [3]. To assess the origin of the ^{182}W anomalies and the ^{182}W composition of the pre-late veneer mantle, we determined the HSE abundances and ^{182}W compositions of a suite of mafic to ultramafic rocks from Isua.

Our data show that the Isua source mantle had HSE abundances at ~60% of the present-day mantle, inconsistent with isolation from the late veneer. For the same samples we obtained a 13±4 ppm ^{182}W excess over the modern terrestrial mantle, in excellent agreement with previous data [2]. A recent study argued that Earth's earliest mantle had higher ^{182}W than previously thought; indistinguishable from the revised value for the Moon of 27±4 ppm [4]. Using the late veneer composition of [4], we calculate that the Isua mantle source, containing 60% late veneer, would have a ^{182}W value of 9±4 ppm, in very good agreement with the measured value for Isua. The combined W-HSE data, therefore, are consistent with only partial addition of the late veneer to the Isua mantle source, and with the interpretation that the 27±4 ppm ^{182}W excess of the Moon represents the ^{182}W composition of the pre-late veneer Earth's mantle [4].

[1] Dale et al (2012) *Science* ***336****, 72*. [2] Willbold et al. (2011) *Nature* ***477****, 195*. [3] Touboul et al. (2012) *Science* ***335***, 1065-1069. [4] Kruijer et al. (2015) *Nature*, in press.