Lack of late-accreted materials in Archean mantle sources

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Small ^{182}W excesses in Archean mantle-derived rocks [e.g., 1-8] may reflect crystal-liquid fractionation in an early magma ocean [2], high P-T metal-silicate equilibration at the base of a magma ocean [2], or heterogeneous distribution of late accreted components with low $^{182}W/^{184}W$ [1]. To distingiush between these disparate origins of ^{182}W excesses in Archean mantle sources, we investigated the $^{182}W/^{184}W$ of Archean mantle-derived rocks from the Pilbara Craton.

The $\mu^{182}W$ values (ppm deviations of $^{182}W/^{184}W$ from terrestrial standards) for Pilbara volcanics are all *ca.* +10, similar to commonly reported values for rocks from other localities, including Nuvvuagittuq, Isua, Acasta, Saglek-Hebron, Kostomuksha, and Abitibi [1-8]. The ^{142}Nd and Re-Os systematics of Pilbara volcanics rule out both crystal-liquid fractionation in a magma ocean and high P-T metal-silicate equilibration at the base of a magma ocean. Estimated highly siderophile element (HSE) abundances, however, are *ca.* 50% lower than modern mantle, and the mantle source of these Archean rocks therefore likely lacked late-accreted material with low $^{182}W/^{184}W$, resulting in the observed ^{182}W excesses. Similar ^{182}W excesses observed for other mantle sources may also reflect a lack of late-accreted material, because it is unlikely that a nearly constant ^{182}W excess in the Archean mantle is produced by different and unrelated processes. Estimated HSE abundances for some of these sources are more variable, but this disparatity can be explained by dissimilar behaviors of late-accreted W and HSE within the mantle. Since 10-15 ppm ^{182}W excesses observed for many Archean samples corresponds to mantle that received *ca*. 50% late accretion, the estimated pre-late accretion $^{182}W/^{184}W$ of the BSE must have been higher, and was thus similar to that of the Moon. This similarity likely requires post giant-impact Earth-Moon equilibration [9].

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