Early Mantle Heterogeneities Recorded by 2.7 Ga Komatiites

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Despite efforts directed towards acquiring high-precision Sm-Nd, Lu-Hf, W, and Re-Pt-Os isotopic systematics for early terrestrial rocks, the available database is still limited and a number of questions pertaining to the origin and timing of the primordial differentiation and mixing of the mantle, as well as the nature of possible hidden or missing reservoirs, remain unresolved. Initial studies found no terrestrial samples younger than 3.5 Ga to have μ^{142}Nd or μ^{182}W values distinct from terrestrial standards. This was interpreted as evidence for complete homogenization of early formed silicate reservoirs on the time scale of ca. 1 Ga [1]. Recent isotopic studies of Archean komatiites, however, have shown that the terrestrial mantle remained poorly mixed until at least the end of the Archean [2,3,4]. Here, we present ^{142}Nd and ^{182}W isotopic data for the Boston Creek komatiitic lava flow in the 2.7 Ga Abitibi belt, Canada. The primary komatiitic melt to this lava is unique in having an FeO content as high as 17 wt.%, strong depletions in heavy REE and Al, and enrichments in light REE. These characteristics indicate derivation from a strongly incompatible trace element-enriched mantle source. Rocks from this flow were also shown to be characterized by initial ε^{143}Nd = +2.5 [5] and γ^{187}Os = -3.8 [6], indicating derivation from a mantle domain with long-term suprachondritic Sm/Nd and subchondritic Re/Os ratio. Rocks from the flow have small, but resolvable depletion in ^{142}Nd and enrichment in ^{182}W, with μ^{142}Nd and μ^{182}W values of -3.9±2.2 and +7.0±2.0 ppm, respectively (2σSE). The presence of the ^{142}Nd anomaly indicates involvement of mantle domains with sub-terrestrial Sm/Nd that likely formed within the first 300 Ma of solar system history, yet survived in the mantle until at least the time of komatiite formation at 2.7 Ga. The W isotopic anomaly likely requires the formation of a reservoir with elevated Hf/W within the first 50 Ma of solar system history. The mechanism for the generation of the ^{182}W anomaly in the source of these rocks remains to be established, as well as whether or not the W and Nd anomalies are related. Determination of initial ^{186}Os/^{188}Os isotopic composition and HSE abundances is expected to help resolve these issues.

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