^{176}Hf-^{142,143}Nd evidence for a long-lived Hadean lithosphere

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We report coupled ^{146,147}Sm-^{142,143}Nd and ^{176}Lu-^{176}Hf data for a suite of mafic and ultramafic rocks of the Eoarchean Nulliak assemblage (Labrador, Canada). Whole-rock ^{147}Sm-^{143}Nd and ^{176}Lu-^{176}Hf errorchrons yield concordant ages of 3.78±0.09 Ga and 3.77±0.14Ga, respectively, with positive $\varepsilon^{143}Nd_i$ (1.4±0.6), $\varepsilon^{176}Hf_i$ (5.7±3) and μ^{142}Nd (8.6±3.3) indicating early depletion of the Nulliak mantle source. Application of coupled ^{146,147}Sm-^{142,143}Nd chronometry yields a model age of differentiation of 4.40±0.05 Ga with a corresponding $(^{147}Sm/^{144}Nd)_{source}$ of 0.211. Both the differentiation age and ^{147}Sm/^{144}Nd of the Nulliak source are similar to those estimated for the 3.7-3.8 Ga Isua metabasalts and the 2.7 Ga Theo's flow (Abitibi), suggesting derivation from a common reservoir. The radiogenic $\varepsilon^{176}Hf_i$ requires that the Nulliak source evolved with a time integrated ^{176}Lu/^{177}Hf ratio of 0.046±0.007, which cannot be easily explained by perovskite segregation in a deep magma ocean but rather suggests inheritance from a refractory reservoir that experienced a primary depletion event in the garnet stability field. Preservation of this depleted domain on a multi-billion year timescale requires prolonged isolation, consistent with storage in the lithospheric mantle. The preservation of ^{142}Nd heterogeneities in the Archean rock record may thus reflect episodic sampling of enriched and depleted components from a long-lived primordial lithosphere, rather than progressive homogenization of a highly heterogeneous Hadean mantle.