3.8 Ga old rocks of the Innuksuac complex reveal the ^{176}Hf-^{142,143}Nd signature of Earth's primordial crust

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The evolution of early Earth's crust is obscured by the paucity of reworked Hadean material within Archean terranes. A major exception is the presence of negative ^{142}Nd anomalies in Eoarchean metabasalts of the Nuvvuagittuq and Ukaliq supracrustal belts (Innuksuac complex, Québec). These isotopic anomalies were inherited from a now-vanished Hadean crustal reservoir [1,2]. Coupled ^{146,147}Sm-^{142,143}Nd chronometry shows that this reservoir differentiated 4.36±0.05 Gyr ago [2], an age similar to model ages of mantle differentiation inferred from ^{142,143}Nd systematics in various Archean rocks [3]. These data suggest that ^{142}Nd anomalies recorded in the Innuksuac complex ultimately reflect global mantle-crust differentiation near the end of terrestrial accretion. The geochemical record of mafic rocks of the Innuksuac complex thus represents a rare opportunity to assess the composition of Earth's primordial crust and its involvement in Eoarchean crustal formation.

To further constrain the nature of the Hadean enriched component, we acquired ^{176}Lu-^{176}Hf data on metabasalts from the Ukaliq supracrustal belt (USB) carrying negative ^{142}Nd anomalies [2]. USB metabasalts define a positive ε^{176}Hf-ε^{143}Nd correlation with a slope of ~2.5, similar within error to the slope of the present-day crustal array. Correlations between ε^{176}Hf, $\varepsilon^{142,143}$Nd and Th/La indicate that USB metabasalts or their mantle source(s) were contaminated by material compositionally similar to the present-day upper crust. Eoarchean tonalites from the Innuksuac complex, however, are significantly more radiogenic than the most enriched metabasalts and thus do not represent a suitable contaminant. Overall, the isotopic composition of USB metabasalts appears to have been inherited from a mantle source metasomatized by small amounts (1-3wt%) of highly unradiogenic Hadean crustal material. This in turn implies the presence of evolved lithologies within Earth's primordial crust.

[1] O'Neil et al. (2008), *Science* 321, 1828-1831. [2] Caro et al. (2017) *EPSL* 457, 23-37. [3] Morino et al. (2017) *EPSL* 463, 136-150.