Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35247

Resolving Hadean Mantle Events from Global Patterns of 142-neodymium Isotopic Variations Recorded in Eoarchean Terranes

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Increasingly it is recognised that Earth's current mantle composition and structure may reflect accretionary and earliest differentiation events of which there is now little direct evidence. Given the paucity of the Hadean rock record a powerful alternative investigative approach is through the use of the lithophile element-based ^{146}Sm-^{142}Nd decay scheme ($t_{1/2}$≈ 92 Ma) to identify ^{142}Nd isotopic variations (with respect to bulk silicate Earth as represented by the JNdi-1 standard) in the oldest rock record; these isotopic signatures are considered indisputable recorders of processes generating chemical (Sm/Nd) variations in the first ca. 300 myr of Earth history.

At present, negative or positive ^{142}Nd isotopic anomalies are well-resolved in ca. 12 Eoarchean-Hadean terranes worldwide, with areal extents ranging from single outcrop to regional scales. Here we present new ^{142}Nd data from the Napier Complex, Antarctica, one of the oldest (up to ≈4 Ga), least-studied (due to remoteness and ice cover), but likely one of the largest preserved Eoarchean terranes. Prior study by Guitreau et al. [1] identified two samples with well-resolved negative ^{142}Nd anomalies. Our new data are from Eoarchean Napier localities ca. 200 km distant, but again showing distinct negative ^{142}Nd signatures; the two areas are interpreted as contiguous under the ice, and if correct, represent the most extensive region of such signatures. This likely reflects a substantial region of reworking of originally Hadean age crust.

We also present new data from 3.6-3.3 Ga samples from the Yilgarn craton, Western Australia, including detrital material from the Jack Hills Hadean zircon locality, none of which show ^{142}Nd compositional anomalies.

Using both new and complied ^{142}Nd data, supplemented with other geochemical and isotopic (^{143}Nd and ^{176}Hf) information we compare and contrast the characteristics of the different ^{142}Nd signature terranes with respect to inferred tectonic settings, potential ages of anomalies and their original distribution, and possible signature origins. Overall, preserved positive and negative ^{142}Nd Eoarchean terranes are not complementary and are likely different manifestations of early formed and persisting compositional and process heterogeneity on the early Earth.

[1] Guitreau, M., et al., 2019, *Geochemical Perspectives Letters*, 12, pp.7-11.