

Creating Earth's Most Ancient Crust

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Earth's most ancient surviving crust consists of small remnants of generally highly metamorphosed rocks that postdate Earth formation by hundreds of millions of years. We have been using the short-lived radiometric system ^{146}Sm - ^{142}Nd in concert with traditional radiogenic isotope tracers to investigate the petrogenesis of these ancient crustal rocks, in particular, the nature of their source materials. Supracrustal rocks from the northern Superior Province appear to be Hadean in age, but even Neoproterozoic granitoid rocks in this area show low $^{142}\text{Nd}/^{144}\text{Nd}$ suggestive of the reworking of Hadean LREE enriched crustal material. Hadean rocks in Acasta appear to be derived from mantle with BSE compositions, but from 3.9-3.6 Ga show evidence for the involvement of Hadean LREE enriched components in their genesis. The signature of these older crustal components is missing from younger Acasta rocks and from the much larger expanse of the Eo- to Neoproterozoic Central Slave Basement Complex just east of Acasta. Evidence for the involvement of crustal sources significantly older than the rocks themselves is present, but diminished, in the Neoproterozoic rocks of the Kaapvaal Craton that reproducibly have $^{142}\text{Nd}/^{144}\text{Nd}$ slightly below the modern mantle value. In contrast, the Neoproterozoic igneous rocks and sediments of the southern Superior Province show $^{142}\text{Nd}/^{144}\text{Nd}$ ratios just slightly above the terrestrial Nd standard. Early Archean rocks from both Greenland and Labrador show even larger excesses in $^{142}\text{Nd}/^{144}\text{Nd}$ indicative of Hadean sources with high Sm/Nd ratios, though the rocks do not have trace element signatures consistent with derivation from strongly incompatible element depleted sources. The data thus show that different ancient crustal terranes were generated from wide ranging sources – reworked Hadean crust in some cases, directly out of “normal” mantle in others, and some from mantle sources of compositions that do not appear to exist anymore.