

Evidence for reworking of variable Hadean sources recorded by the Archean crust from the Superior Province

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The Superior Province represents the largest tract of Archean crust on Earth, yet, rocks formed within the first billion years of Earth's history are almost absent, obscuring its earliest crustal evolution. The northeastern part of the Superior Province includes the craton's oldest rocks (>3.6 Ga), but it is dominated by Mesoarchean to Neoarchean granitoids from the tonalite-trondhjemite-granodiorite series (TTG). Since granitoids are typically produced from the melting of an older crustal component, isotopic tracers can be used to study the crustal history of Archean cratons, as these rocks inherit the isotopic signatures of their precursors.

However, long-lived isotopic systems such as ^{147}Sm - ^{143}Nd and ^{176}Lu - ^{176}Hf can often be disturbed in terrains that have recorded a complex and protracted thermal history. The short-lived ^{146}Sm - ^{142}Nd isotopic system is however much less susceptible to post-magmatic disturbance. Because ^{142}Nd is produced from the decay of ^{146}Sm , which has a half-life of 103 Ma, variations in the $^{142}\text{Nd}/^{144}\text{Nd}$ ratio can only be produced by Sm-Nd fractionation prior to ~4 Ga. Any Archean granitoid which displays a $^{142}\text{Nd}/^{144}\text{Nd}$ ratio deviating from the Nd terrestrial standard implies a precursor source which experienced Sm-Nd fractionation in the Hadean.

Here, we present new ^{142}Nd data for TTG and granites collected over 5 geological domains and covering the whole extent of the Hudson Bay Terrane of the Northeastern Superior Province in order to constrain the nature and age of their crustal precursor source(s). A series of ~3.2 Ga to 2.7 Ga samples exhibit variable $^{142}\text{Nd}/^{144}\text{Nd}$ ratios, ranging between $m^{142}\text{Nd}$ values of -8 to +8. Most samples exhibit negative $m^{142}\text{Nd}$ values consistent with the reworking of a Hadean mafic crust, but a number of samples showing resolved high $^{142}\text{Nd}/^{144}\text{Nd}$ ratios suggest that the Archean crust from the Hudson Bay Terrane also reworked an early depleted component. Although most felsic crustal rocks from the Hudson Bay Terrane show low $^{142}\text{Nd}/^{144}\text{Nd}$ ratios consistent with reworking of older crust being the dominant process for their formation, the observed variations in $m^{142}\text{Nd}$ values, including samples with positive $m^{142}\text{Nd}$ values, suggests that the Archean TTG of the Superior Province reworked heterogeneous source components.