Building Archean cratons from Hadean mafic crust

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Geologic processing of Earth's surface has removed most of the evidence concerning the nature of Earth's first crust. The largest volumes of ancient crust, the so-called Archean cratons, are dominated by a variety of granitoid rock types that in part derive by remelting of an older basaltic precursor rock. The origin and nature of this precursor holds key information about the formation of the earliest crust. The Hudson Bay terrane of northeastern Canada is mainly composed of Neoarchean felsic crust, forming the nucleus of the Northeastern Superior Province. Felsic rocks from the tonalite-trondhjemite-granodiorite (TTG) series are however not the product of direct melting of mantle peridotite, but are instead produced by melting crustal rocks and hence require some type of crust as a precursor. New data show the ~2.7 Ga Hudson Bay terrane rocks to be the youngest to yield significant variability in ^{142}Nd, the decay product of short-lived radioactive ^{146}Sm (half-life of 103 Ma). Tonalites and trodhjemites from the Hudson Bay terrane yeilded low ^{142}Nd/^{144}Nd compared to the terrestrial Nd standard with μ^{142}Nd values as low as -15. Paleo to Eoarchean TTG bordering the Nuvvuagittuq greenstone belt also show similar deficits in ^{142}Nd. Variations in ^{142}Nd/^{144}Nd ratio can only be produced by Sm-Nd fractionation in the Hadean. Post-Hadean rocks, however, also can yield ^{142}Nd/^{144}Nd ratios different from the modern Nd terrestrial standard if their precursor (crust or mantle) had acquired a ^{142}Nd/^{144}Nd anomaly in the Hadean. Combined ^{146,147}Sm–^{142,143}Nd data reveals that this large block of Archean crust was formed by reworking of much older >4.2 Ga mafic crust over a 1.5 billion year interval of early Earth history. Thus, unlike on the modern Earth, mafic crust apparently could survive for billions of years to form an important source rock for Archean crustal genesis. Reworking of long-lived basaltic crust appears to have been an important mechanism contributing to the stabilization of Earth's first continents.