Evidence for recycling of crust and mantle lithosphere during a 2.4 Ga rifting event

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The Farmington Canyon Complex (FCC) of northeastern Utah is located along the southwestern margin of the Archean Wyoming Province. U-Pb zircon geochronology by ion probe indicates that the FCC constitutes the largest exposure of Early Paleoproterozoic crust along the southwestern Laurentian margin and is one of the few exposures of ~2.4 Ga crust in the northern hemisphere. It is composed of quartzofeldspathic gneisses and migmatites intercalated with amphibolites and metasedimentary rocks metamorphosed at ~1.8 Ga. Geochemical and isotopic data indicate that the metasupracrustal rocks of the FCC represent recycling of Wyoming Province Archean crust and mantle lithosphere. Common Pb isotope data range from ~15.5-17.5 for 207/204 and ~17.6-27.5 for 206/204. These values plot well above the Pb evolution curve for continental crust indicating that the protoliths of the metasedimentary rocks were derived predominantly from an Archean continental source, namely the Wyoming craton. The mafic rocks of the complex are characterized by HFSE depletion and Archean (2.9-3.8 Ga) Nd model ages indicating that the mantle lithosphere was remobilized during the 2.4 Ga rifting event, but retained its initial Archean arc-like signature. In addition, the mafic rocks exhibit flat HREE pattern and negative Eu anomalies that are consistent with melting in a shallow lithospheric mantle in a rift environment. We interpret the FCC to have formed as a 2.4 Ga rift margin wherein Archean crust and mantle lithosphere were remobilized, but retained their distinct Archean geochemical and isotopic signatures.

Is there a hidden primordial ^{3}He-rich reservoir in the deep Earth?

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The earliest basalts erupted by the Iceland plume have a chemistry consistent with melting at 100-200°C hotter than normal upper mantle. High-Mg basalts from Baffin Island - closest to the plume centre at 61 Ma - have extremely high ^{3}He/^{4}He (35-50 R_a). These are significantly higher than active hotspots, e.g. Iceland and Loihi, and is the first geochemical fingerprint of the proto-Iceland plume. The extremely high-^{3}He/^{4}He basalts do not have a unique trace element/isotopic composition, e.g. ^{143}Nd/^{144}Nd = 0.51288-0.51302 (Starkey *et al.* this meeting). They span the range of high ^{3}He/^{4}He OIB from the N hemisphere, and global MORB. Primordial He is not accompanied by enrichments in other primordial noble gases. Ne, Ar and Xe isotope ratios are similar to Iceland-Loihi, and distinct from MORB. ^{3}He/^{22}Ne and ^{3}He/^{36}Ar are significantly greater than OIB and MORB. Maintaining extremely high He concentrations in small mantle heterogeneities for Gyrs is difficult. The simplest explanation is that the plume head included material from a hot, deep reservoir that is rich enough in He to dominate subsequent mixtures. The absence of ^{182}W anomalies rules out involvement of core. Decoupling from Ne and Ar may reflect a solar origin for the He. However the He enrichment may result from diffusion of He from a primordial gas-rich reservoir.