



Can we recognise early Archaean mantle in the rock record ?

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It has been suggested that 3.8 Ga peridotites from Greenland and Labrador, enclosed in felsic gneisses and associated with other ultramafic rocks, represent unmodified early Archaean mantle. This claim is important in the light of the proposed very early differentiation of the mantle, for there are no outcrops of 'peridotite' known older than 3.8 Ga. Here the hypothesis that 3.8 Ga peridotites represent former mantle is tested using three geochemical criteria, developed for samples of the modern mantle. These discriminants include the major element composition of peridotites as plotted in Mg/Si vs Al/Si (wt %) space, peridotite REE patterns from different types of mantle, and peridotite chrome-spinel compositions as expressed as a function of their cr# and fe#.

Geochemical data for early Archaean peridotites from south of Isua, west Greenland, were taken from the previously published works of Friend et al. (2002) and Bennett et al. (2002), for the Isua greenstone belt from Dymek et al. (1988) and for the Saglek-Hebron area of northern Labrador from Collerson et al. 1989. Of these three data sets, only two samples, from the region south of Isua satisfied all criteria, indicating that the area south of the Isua Greenstone Belt in west Greenland is the most suitable place to search for early Archaean mantle. This study also confirms the observation by Friend et al. (2002) that early Archaean mantle from south of Isua is of a different character from Archaean mantle from the subcontinental lithosphere. Calculations presented here show that mantle fragments from south of Isua experienced a lower degree of melt extraction and were probably more oxidizing than early Archaean mantle preserved in the subcontinental lithosphere. Elemental concentrations of Os in early Archaean mantle are lower than the new estimate for the primitive upper mantle of Becker et al. (2006). Peridotites from the Isua greenstone belt are not mantle, but have an affinity with the layered intrusions found south of Isua. Peridotites from Labrador cannot be shown to have had an unequivocal mantle origin.