High-Al/Ti komatiites from the Archaean Nova Lima Group – multi-stage melting in the Archaean mantle?

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Archaean komatiites have in the past been suggested to have formed by hydrous melting of the mantle, as an alternative to dry extremely high-degree melts reflecting higher Archaean mantle temperatures. As the Archaean marks the potential transition from 'stagnant-lid' to modern-style plate tectonics around 3 Ga, komatiites are important to study mantle dynamics in the early Earth.

High-Al/Ti komatiites from the 3.33 Ga Commondale greenstone inlier have been suggested to have formed from subduction-related hydrous remelting of a previously depleted mantle source. Here we present trace element and Os isotope data from the ~3 Ga Quebra Osso High-Al/Ti komatiites from the lowermost Nova Lima Group, Minas Gerais, Brazil. These subaquatically erupted komatiites show strong LREE depletion coupled with small positive and negative Eu anomalies. The samples are poorer in Highly Siderophile Elements (HSE) compared to other komatiite suites, and show a range of $^{187}Os/^{188}Os$ from 0.1140 to 0.1476 and Re/Os below chondritic values, corresponding to γOs between -10.2 and +16.2 and initial γOs_{3Ga} between -12.0 to +29.7. Highly siderophile element signatures are similar to those observed in the 3.26 Ga Weltevreden komatiites from the Barberton Greenstone Belt.

While crustal contamination could conceivably account for the more radiogenic Os isotope compositions and fractionated HSE signatures, no corresponding LREE enrichment indicative of crustal influence is present. The lack of correlation of potentially disturbed indicative ratios such as Re/Os or La/Yb with L.O.I. rules out secondary stage alteration as the source of the isotope signatures as well.

Thus, the Quebra Osso komatiites represent another occurence of high-Al/Ti komatiite worldwide, suggesting that multi-stage melting might have been a widespread process in the Archaean.