Petrogenesis of andesites in Mesoarchaean supracrustal belts of SW Greenland: Geodynamic implications

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We present an overview of geochemical data for the Mesoarchaean supracrustal belts from the Tasiusarsuaq terrane, SW Greenland. These ultramafic, basaltic and andesitic enclaves are located within younger tonalite-trondhjemite-granodiorite (TTG) orthogneisses and are mainly dominated by tholeiitic basalts. However, calc-alkaline andesites are also present and comprise up to ca. 50% of individual supracrustal belts. These two lithological groups can roughly be divided into tholeiitic and calc-alkaline affinity by having La/Sm ratios less than, or over 3.5, respectively. While the mafic rocks have flat trace element patterns with negative Nb- and Ta-anomalies, the andesitic rocks have strongly fractionated trace element patterns, with distinctly negative Nb-, Ta- and Ti-anomalies, as well as positive Hf- and Zr-anomalies. Thus, they are not related by fractional crystallisation and no gradational transitions between the two groups have been observed. Assimilation of pre-existing continental crust can also not explain the trace element variations of the andesites. Modelling suggests that simple binary mixing of a mafic magma and a TTG-type component in a 1:1 ratio can explain most of the variation that the andesites display. This is confirmed by Hf-isotope modelling that support the large mixing ratio and therefore that actual melting of the local felsic crust must have occurred. We suggest that the hotter conditions during the Mesoarchaean could explain the significant proportion of melting of the lower crust during addition of juvenile mafic magmas. Overall, the geochemical data are compatible with a modern-style subduction zone environment, for which recent studies have also concluded that substantial magma mixing is a significant process.

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10.1180/minmag.2013.077.5.19