

Palaeoarchean intermediate - felsic volcanics of the Toggekry Formation, Nondweni Greenstone Belt, RSA: A rifted volcanic arc?

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The ca. 3.53 Ga Toggekry Formation of the Nondweni Greenstone Belt (northern KwaZulu-Natal, RSA), consists of, mainly extrusive, mafic to felsic igneous rocks. More mafic samples (Group A: TiO₂ 0.8-1.2 wt.% , 1-5% MgO) have moderate LREE/HREE enrichment, indistinct Eu anomalies, flat HREE patterns, and weak negative Nb-Ta anomalies in mantle-normalised trace element patterns. Intermediate samples (MgO 0.6-0.9, TiO₂ 0.3-0.4%; Group B) from the same area have higher L/HREE ratios (because of steeper HREE patterns and low Y), indistinct Eu anomalies and strong Nb-Ta anomalies. The most felsic and more northern group C has high HREE and Y (60-90 ppm), flat HREE patterns, Eu/Eu* =0.3-0.4 and no significant Nb-Ta anomalies. Despite these distinct elemental characteristics, the zircon εHf_i values (and U-Pb ages) are indistinguishable for the three groups at ca. +1.5, with a depleted mantle extraction age of ca. 3.65-3.7 Ga.

The Toggekry Group C is similar to ca. 3.54 Ga felsic Theespruit Fmt. samples (high HFSE), whereas Group B resembles 3.45 Ga Hooggenoeg Fmt. samples (HFSE depletion) from the Barberton Greenstone Belt. The three distinct geochemical groups within the Toggekry Formation cannot be related by fractional crystallisation from a common parental magma, but necessitate the involvement of distinct parental magmas. Modern tectonic environments in which such variable magmas can be found are volcanic arcs with localised rifting.