Geochemistry and petrogenesis of volcanic rocks of the Neoarchaean Sukumaland Greenstone Belt, northwestern Tanzania

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Abstract

The late Archaean volcanic rocks of the Rwamagaza area in the Sukumaland Greenstone Belt consists of basalts and basaltic
andesites associated with volumetrically minor rhyodacites and rhyolites. Most basalts and basaltic andesites yield nearly flat patterns
(La/SmCN = 0.89–1.34) indicating derivation by partial melting of the mantle at relatively low pressure outside the garnet stability field. On primitive mantle normalized trace element diagrams, the basalts and basaltic andesites can be subdivided into two groups. The first group is characterised by moderately negative Nb anomalies (Nb/Lapm = 0.51–0.73, mean = 0.61 ± 0.08) with slight enrichment of LREE relative to both Th and HREE. The second group is characterised by nearly flat patterns with no Nb anomalies
(Nb/Lapm = 0.77 ± 0.39). The observed Nb and Th anomalies in the Rwamagaza basalts and basaltic andesites, cannot be explained by alteration, crustal contamination or melt–solid equilibria. Rather, the anomalies are interpreted, on the basis of Nb–Th–La–Ce systematics, as having formed by partial melting of a heterogeneous mantle consisting of variable mixtures of components derived from two distinct sources. These sources are depleted mantle similar to that generating modern MORB and an LREE-enriched and HFSE-depleted source similar to that feeding volcanism along modern convergent margins. The rhyolites are characterised by high Na2O/K2O ratios (>1) and Al2O3 (>15 wt.%), low HREE contents (Yb = 0.24–0.68 ppm) leading to highly fractionated REE patterns (La/YbCN = 18.4–54.7) and large negative Nb anomalies (Nb/Lapm = 0.11–0.20), characteristics that are typical of Cenozoic adakites and Archaean TTG which form by partial melting of the hydrated basaltic crust at pressures high enough to stabilize garnet ± amphibole. The Rwamagaza basalts and basaltic andesites are geochemically analogous to the Phanerozoic Mariana Trough Back Arc Basin Basalts and the overall geochemical diversity of Rwamagaza volcanic rocks is interpreted in terms of a geodynamic model involving the interaction of a depleted mantle, a melting subducting oceanic slab in a back arc setting.
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Keywords:

Tanzania Craton; Greenstone Belt; Basalts; Rhyolites; Geochemistry