Geochemistry and Nd-isotopic composition of potassic magmatism in the Neoarchaean Musoma-Mara Greenstone Belt, northern Tanzania

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Abstract

The Neoarchaean Musoma-Mara Greenstone Belt (MMGB) of northern Tanzania is underlain in part by the ~2649 Ma post-orogenic potassic-rich granites, which are the most abundant intrusive rocks in the belt. The rocks are composed of plagioclase + K-feldspar + quartz + biotite ± sphene ± zircon ± hornblende ± chlorite. They are characterized by high contents of SiO_2 (68.90–77.76 wt%), K_2O (3.71–5.44 wt%) and low Na_2O (3.27–5.70 wt%) leading to low ratios of Na_2O/K_2O (0.63–1.02). The rocks are depleted in CaO (0.22–2.41 wt%) as well as in Sr (15–412 ppm), Cr (≤16 ppm) and Ni (≤5 ppm); and their major element composition are similar to those of experimental melts derived from partial melting of tonalite. On chondrite-normalized REE patterns, these rocks show fractionated patterns (La/Yb_{CN} = 1.22–41.32) that are characterised by moderate to strongly negative Eu anomalies (Eu/Eu* = 0.04–0.86). On primitive mantle-normalized spidergrams, these rocks are generally enriched in Th, U, K and Pb and depleted in Ba, Sr, Nb, Ta and Ti relative to adjacent elements. The K-rich granites have εNd_o (at 2.649 Ga) values of +0.55 to +1.70 that compare well with those of associated volcanic rocks and TTG (εNd = +0.44 to +2.66) which predate the emplacement of the K-rich granitoids. Their mean crustal residence ages are 170 to 450 Ma older than their emplacement ages.

The overall geochemical features of this suite of rocks, together with evidence from experimental results, are consistent with their generation by partial melting of relatively juvenile igneous rocks within the continental crust at pressures corresponding to depths <15 km where plagioclase was a stable phase. The transition from earlier TTG magmatism to potassic magmatism in the MMGB is interpreted as marking a transition from growth of the Neoarchaean continental crust through the addition of juvenile mantle-derived material to intra-crustal recycling of pre-existing material.

Keywords

Tanzania Craton; Greenstone Belt; K-granites; Geochemistry; Nd-isotopes