Geochemistry of the Palaeoproterozoic volcanic and associated potassic granitic rocks of the Ngualla area of the Ubendian Belt, SW Tanzania

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Abstract

The Ngualla area of the Lupa terrane in the Ubendian Belt of SW Tanzania is underlain by well-preserved greenschist facies calc-alkaline volcanic rocks which have been intruded by low-Sr, peraluminous K-rich granites. The Ngualla volcanic rocks are subdivided into four groups: the basaltic andesites-trachyandesites, Group I porphyritic dacites-trachytes, Group II porphyritic dacites-trachytes, and rhyolites. The basaltic andesites-trachyandesites were emplaced at ∼1943 Ma and their most primitive members are characterized by MgO contents of up to 7.43 wt % at a SiO2 content of 54.0 wt %, Ni contents of up to 170 ppm and Mg# of up to 62. They show fractionated REE patterns (La/YbCN = 11.5–36.5), sub-chondritic Zr/Hf (37.8–43.9) and Nb/Ta (7.14–20.0) ratios, εNd (1943 Ma) values of −3.33 to −6.24 and TDM ages of 2521–2883 Ma. These geochemical features are consistent with derivation of the basaltic andesites-trachyandesites by at least 0.1% partial melting of garnet peridotite mantle, followed by 50–80% fractional crystallization involving the removal of 61% clinopyroxene, 20% hornblende, 4% plagioclase and 15% orthopyroxene. The magmas were contaminated by Neoarchaean crustal materials incorporated in the Ubendian Belt during their ascent to the surface. The evolution of these magmas led to the formation of Group I porphyritic dacites-trachytes and rhyolites in a Palaeoproterozoic continental arc setting.

The Group II porphyritic dacites-trachytes (1871 ± 5 Ma) were coevally emplaced with the low-Sr, peraluminous K-granites (1878 ± 15 Ma) forming a felsic plutonic-volcanic suite. Despite some differences, these rocks share geochemical features including negative Eu anomalies (mean Eu/Eu* = 0.19 for the dacites and 0.5 for the granites) and εNd (1871 Ma) values of −5.72 for the dacites and εNd (1878 Ma) values of −6.00 to −11.2 for the granites. These geochemical features are consistent with the generation of the ∼1.87 Ga Ngualla felsic plutonic-volcanic

suite by partial melting of heterogeneous Neoarchaean crust at low pressure conditions in the stability field of plagioclase in an intracontinental setting along a sutured margin.

The 1.89–1.87 Ga felsic plutonic-volcanic suite also occurs in the Ndembera area of the Usagaran belt to the SW. Our results corroborate previous evidence that the Palaeoproterozoic regional K-granitic magmatism that affected parts of the Ubendian and Usagaran belts was caused by a regional thermal anomaly that was induced by large scale magmatic underplating that precipitated widespread crustal anatexis.