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Petrography, geochemistry, and geochronology of granitoid rocks in the Neoproterozoic-Paleozoic Lufilian–Zambezi belt, Zambia: Implications for tectonic setting and regional correlation

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Abstract

There are several pre-orogenic Neoproterozoic granitoid and metavolcanic rocks in the Lufilian–Zambezi belt in Zambia and Zimbabwe that are interpreted to have been emplaced in a continental-rift setting that is linked to the break-up of the Rodinia supercontinent. However, no geochemical data were previously available for these rocks in the Zambian part of the belt to support this model. We conducted petrographic and whole-rock chemical analyses of the Neoproterozoic Nchanga Granite, Lusaka Granite, Ngoma Gneiss and felsic metavolcanic rocks from the Lufilian–Zambezi belt in Zambian, in order to evaluate their chemical characteristics and tectonic settings. Other magmatic rocks of importance for understanding the evolution of the belt in Zambia, included in this study, are the Mesoproterozoic Munali Hills Granite and associated amphibolites and the Mpande Gneiss. The Neoproterozoic rocks have monzogranitic compositions, aluminum-saturation indices (ASI) < 1.1, and high contents of high field strength elements (HFSE) and rare earth elements (REE). The chondrite-normalised spider diagrams are similar to those of A-type granites from the Lachlan fold belt and show negative Sr, P, and Ti anomalies. On various tectonic discrimination diagrams the Neoproterozoic rocks plot mainly in A-type granite fields. These petrographic and trace element compositions indicate that these rocks are A-type felsic rocks, but they do not have features of granites and rhyolites emplaced in true continental-rift settings, as previously suggested. On the basis of the A-type features and independent regional geological and geochronological data, we suggest that the Neoproterozoic granitoid and felsic metavolcanic rocks were emplaced during the earliest extensional stages of continental rifting in the Lufilian–Zambezi belt. The apparent continental-arc like chemistry of the granitoid and felsic metavolcanic rocks is thus inferred to be inherited from calcalkaline sources. The Mesoproterozoic Munali Hills Granite and Mpande Gneiss have trace element features e.g., Nb–Ta depletions, which indicate that that these gneisses were emplaced in a convergent-margin setting. The MORB-normalised spider diagram of co-magmatic amphibolites exhibit a fractionated LILE/HFSE pattern recognized in subduction zones. This inference is consistent with remnants of ocean crust, juvenile Island arcs and ophiolites elsewhere in the Mesoproterozoic Irumide belt in Zambia and Zimbabwe. In addition, we report the first U–Pb zircon age of 1090.1 ± 1.3 Ma for the Munali Hills Granite. The age for the Munali Hills Granite provides new constraints on correlation and tectono-thermal activity in the Lufilian–Zambezi belt. The age of the Munali Hills Granite indicates that some supracrustal rocks in the Zambezi belt of Zambia, which were previously thought to be Neoproterozoic and correlated with the Katanga Supergroup in the Lufilian belt, are Mesoproterozoic or older. Consequently, previous regional lithostratigraphic correlations in the Lufilian–Zambezi belt would require revision.

Keywords: Lufilian–Zambezi belt; Geochemistry; Munali Hills Granite; U–Pb zircon age; Tectonic setting; A-type granite

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