Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.34033

Evidence of Mesoproterozoic intraplate magmatism at NW margin of Congo Craton: Insights from whole-rock geochemistry and U-Pb baddeleyite geochronology

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Mafic dykes and sills are widespread and crosscut greenstone belts of the northwestern Congo craton in southern Cameroon. Geochemically, the dolerite sills of the northwestern Congo craton display within-plate tholeiitic basalt signatures with enrichment in light rare earth elements (LREEs), large ion lithophile elements (LILEs; e.g., Rb and Ba), and selective high field strength elements (HFSEs; e.g., Nb, U, Nd, Ti, Gd), together with depletion in heavy rare earth elements (HREEs) and some HFSEs (e.g., Zr, Th). Their REE patterns and $^{87}Sr/^{86}Sr$ values of 0.707707–0.710057 indicate derivation from a mantle plume source modified by enriched crustal components.

Whole-rock $^{40}Ar/^{39}Ar$ dates of dolerite sills from the northwestern Congo craton yield apparent ages of 1228 ± 52 Ma and 1368 ± 105 Ma; however, these results are highly disturbed, as indicated by exceptionally elevated MSWD values reaching up to ~16,000. Their isochron and anti-isochron regressions yield poorly constrained dates and anomalously high $^{40}Ar/^{36}Ar$ values (~6,000), pointing to substantial excess of ^{40}Ar. These features indicate open-system Ar behaviour, and the $^{40}Ar/^{39}Ar$ data may not provide meaningful constraints on the timing of magmatism.

High-precision U–Pb baddeleyite geochronology obtained by laser-ablation inductively coupled plasma mass spectrometry (LA–ICP–MS) constrains the emplacement of the mafic dykes to ca. 1100 Ma, documenting a significant episode of Mesoproterozoic mafic magmatism within the northern Congo craton. In a broader paleogeographic framework, these results provide compelling evidence for the involvement of the northern Congo craton in the assembly and subsequent evolution of the Rodinia Supercontinent. Geochemical and geochronological correlations support paleogeographic reconstructions linking ca. 1100 Ma magmatism across the Amazonia, Congo, Kalahari, and Bundelkhand cratons, defining a giant LIP with a minimum diameter of ~5,000 km during the late Mesoproterozoic.