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Investigating the tempo and mechanism of magma generation at the Bana igneous complex (Cameroon Line, Central Africa)

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A systematic geochronological and geochemical study of the Bana igneous complex (BIC), Cameroon Line, was carried out to elucidate the timing and mechanism of magma generation. The BIC comprises intrusive units of granitoids and extrusive units consisting of basaltic to rhyolitic rocks. Zircon U-Pb dating of 16 samples from both the BIC and its basement rocks indicates that (i) felsic volcanic and plutonic rocks formed mainly during the middle Eocene (~43-44 Ma) over a short period of about two million years, (ii) the basement rocks into which the BIC intruded are of Neoproterozoic ages between 589 and 618 Ma, and (iii) zircon inheritance is diverse with Cambrian, Ordovician, Neoproterozoic, and Paleoproterozoic ages. Geochemically, the felsic rocks of the BIC have A-type affinity with peralkaline, metaluminous, and peraluminous compositions. These rocks display negative Sr, P, and Ti anomalies in trace element patterns, consistent with a combined control by feldspars, apatite, and Fe-Ti oxides. A subset of rocks shows positive Eu anomalies and high Ba/Th ratios indicative of alkali feldspar accumulation. Zircon Hf isotopic compositions reveal a range of $\varepsilon Hf_{44\ Ma}$ from +4.2 to -5.9, which exceeds the range extrapolated by zircons in the Neoproterozoic basement rocks and inherited zircon of similar ages.This indicates that the felsic rocks of the BIC could not have been pure crustal melts, but contain components derived from the asthenosphere or juvenile crust formed from it. Our findings refine the formation age of the BIC at the middle Eocene and suggest a comagmatic relationship between the intrusive and extrusive units. We propose that magmatism was triggered by the reactivation of Pan-African megashear zones and related transcurrent faults, leading to the upwelling of the asthenosphere and its partial melting. The resulting magma might have variably fractionated and interacted with country rocks during ascent, eventually solidifying into the variety of felsic rocks exposed in the BIC.