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Multi-geochronological approach (Lu-Hf and U-Pb) as a sound strategy to decipher polycyclic crustal evolution: Evidence from the Nyong Complex, SW Cameroon

NOEMIE BOSC[1], **DELPHINE BOSCH**[2], OLIVIER BRUGUIER[3], JULIEN BERGER[4], PAUL-DÉSIRÉ NDJIGUI[5], MELODY PHILIPPON[6], STIJN GLORIE[7], PASCAL PHILIPPOT[8], SYLVESTRE GANNO[9] AND SYLVESTRE NTOMBA[10]

[1]Géosciences Montpellier
[2]CNRS-UMR5243, Géosciences Montpellier, Université de Montpellier
[3]Géosciences Montpellier, Université de Montpellier, CNRS
[4]Géosciences Environnement Toulouse, Université de Toulouse
[5]Departement of Earth Sciences, Université of Yaoundé I
[6]Géosciences Montpellier, Université des Antilles, CNRS, Universit. de Montpellier,
[7]Adelaide University
[8]Géosciences Montpellier, Université de Montpellier, CNRS, Université des Antilles, Montpellier, France
[9]University of Yaoundé I
[10]Centre for Geological and Mining Research

The Nyong Complex, forming the northwestern part of the Archean Congo Craton in Cameroon, represents a key example of exposed lower crust material. This complex has traditionally been interpreted as a Paleoproterozoic nappe thrust onto the Congo Craton that underwent high-grade metamorphism under granulite- and eclogite-facies conditions during the Eburnean. In this study, seven meta-sedimentary and meta-igneous granulitic samples were studied. The samples compositions range from felsic to mafic and were classified into three main groups: garnet-biotite-amphibole granulites (3 samples), garnet-kyanite paragneisses (2 samples) and basic garnet granulites (2 samples). Despite their lithological diversity, all samples contain almandine-rich garnets. PT estimates indicate peak metamorphic conditions of approximately 900°C and 12kbar for all lithologies. All samples were dated using both in-situ Lu-Hf geochronology on garnet and U-Pb dating on accessory minerals (apatite, monazite, rutile and zircon). For the garnet-biotite-amphibole granulites Lu-Hf method yielded homogeneous Pan-African dates of ~600Ma. U-Pb zircon results revealed a more complex history, with Neoarchean relics at ~2600Ma, polyphased Paleoproterozoic dates between 2100 to 2000Ma and a concordant Pan-African zircon population at ~630Ma. Additionally, apatite yielded late Pan-African dates at ~540Ma. Garnet-kyanite paragneisses yielded Paleoproterozoic garnet Lu-Hf dates, which are in agreement with the U-Pb zircon and monazite dates. The occurrence of an inherited Neoarchean component was also detected in these rocks. Finally, basic garnet granulites display homogeneous Paleoproterozoic dates using both garnet Lu-Hf and zircon/rutile U-Pb techniques. These results indicate that the Nyong Complex preserves inherited Archean protoliths and experienced at least two metamorphic events during Paleoproterozoic and Neoproteorozoic times. Our data point to a more complex tectono-metamorphic history than previously reported, which involves at least two major events during the Eburnean and Pan-African orogenies, possibly linked to the assembly of the Columbia and Gondwana supercontinents, respectively. Overall, this study shows that a multi-methodological approach combining different in-situ geochronological techniques (Lu-Hf, U-Pb) applied on different mineral phases (garnet and accessory minerals) and lithologies (mafic and felsic) is a sound strategy for constraining the evolution of polymetamorphic terrains.