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Role of crustal contribution in the early stage of the Damara Orogen, Namibia: new constraints from combined U-Pb and Lu-Hf isotopes from the Goas Magmatic Complex

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The tholeiitic to calcalkaline Goas intrusive Complex of Namibia reflects the Pan-African plate convergence between the Congo and Kalahari Cratons and marks the first Pan-African magmatic event in the inland branch of the Damara Orogeny. We present new laser-ablation ICP-MS zircon U-Pb geochronology coupled with single-zircon Hf isotopic data obtained on Goas samples, in order to constrain the age of emplacement and investigate the crustal contribution on the magma sources. New ages on magmatic and detrital zircons on a pegmatitic and two metapsammitic samples are also presented, and help in constraining the major geotectonic events which affected the Goas magma sources through time.

The new ages bracket the magmatic event between 580 Ma and 545 Ma, providing a better constraint on the timing record of the magmatic suite. Data, furthermore, show that the complex has been emplaced in a relatively short time, with a continuous magmatic activity from early tholeiitic metagabbro/hornblendite to main diorite or granite bodies with calcalkaline affinity.

Hf isotopes analysis on zircons show invariably negative εHft values (from -34.4 to -3.8), indicating a significant crustal residence time with long-term reworking of multiple and mixed Archean to Mesoproterozoic components. Although the role of multiple crustal components is apparent from the wide range of εHft distribution, values of single intrusions cluster within relatively small ranges. The subchondritic data attest that no significant Pan-African juvenile magma was involved in the magmatogenesis. A subduction environment, although plausible, it is not inevitably disclosed by the new data.

As we suggest magma underplating as a likely heating source for the Goas magmatism, the prolonged crustal residence time and the apparent lack of juvenile components suggest that the magma below the Pan-African active margin was unable to pass through the lithosphere, but managed to heat up sections of the crust sufficiently to invoke large-scale reworking in the lower crust.

Hf model ages, coupled with an exhaustive set of U-Pb geochronological data and with the new magmatic and detrital age record, suggest that the crustal components which developed the Goas sources might have formed during specific orogenic events, with a maximum contribution of rocks derived from the central-western African Paleoproterozoic Eburnean Orogeny.