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Zircon U-Pb and Lu-Hf Constraints on the Paleo- to Mesoproterozoic Evolution of the Southwest Angolan Shield (Congo Craton).

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The crustal evolution of the Angolan Shield (AS) remains poorly constrained. To address this, we analysed U-Pb and Lu-Hf isotopes in detrital and igneous zircons to determine the age and provenance of extensive sedimentary strata in southwest Angola, and use them as a proxy for the Paleoproterozoic to Mesoproterozoic evolution of the southwest AS.

Mesoproterozoic maximum depositional ages between 1334 ± 8 Ma and 1184 ± 23 Ma for the Iona, Cahama, and Ompupa siliciclastic rocks refute previous correlations with the Paleoproterozoic Chela Group. Detrital zircon U-Pb and Lu-Hf isotopes closely match those of magmatic rocks from the southwest AS, indicating that Mesoproterozoic siliciclastic rocks were primarily derived from the AS.

Integrating detrital and igneous zircon U-Pb and Lu-Hf isotopes with whole-rock Sm-Nd isotopes reveals significant spatio-temporal heterogeneities in the AS. We identify two contrasting Paleoproterozoic (2.05–1.73 Ga) settings with distinct U-Pb age distributions and Hf-Nd isotopic signatures. Early-Orosirian Eburnean magmatism (2.05–1.93 Ga) exhibits strongly negative $\varepsilon Hf_{(i)}$ and $\varepsilon Nd_{(i)}$, reflecting reworking of Archean crust in a possible collisional setting. A shift towards more radiogenic $\varepsilon Hf_{(i)}$ and $\varepsilon Nd_{(i)}$ at ~1.87–1.73 Ga suggests a change in geodynamics, with Late-Orosirian to early-Statherian magmatism of the Epupa-Namibe Metamorphic Complex (ENMC) likely reflecting the development of an extensional accretionary orogen along the southern margin of the Eburnean–Archean crustal block. Mesoproterozoic magmatism (~1.56–1.50 Ga) displays suprachondritic $\varepsilon Hf_{(i)}$ and $\varepsilon Nd_{(i)}$ values, indicating juvenile crustal growth. The Kunene Anorthosite-Mangerite-Charnockite-Granite Complex (KC; ~1.50–1.36 Ga) exhibits sawtooth-shaped evolution trends, ranging from highly evolved to moderately juvenile compositions, consistent with mixing between reworked ENMC crust and juvenile melts in a long-lived accretionary orogen back-arc region. Post-KC magmatism (~1.36–1.30 Ga) shows a slightly increased juvenile contribution, potentially linked to renewed slab retreat and back-arc extension or melting of ENMC and ~1.56–1.50 Ga juvenile crust during extensional collapse following an orogenic event. Subsequent ~1.29–1.18 Ga magmatism involved reworking of ~1.56–1.50 Ga crust and/or mixing between ENMC- and mantle-derived melts. Regionally extensive, undeformed ~1.13–1.10 Ga mafic dikes and sills mark the termination of Mesoproterozoic magmatism in the AS. Our new data enhance the understanding of the Archean to Mesoproterozoic crustal evolution of the AS.