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Archean UHT metamorphism and Paleoproterozoic reworking at Uweinat in the East Sahara Ghost Craton

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The enigmatic East Sahara Ghost Craton lies in northeastern Africa, between the Arabian-Nubian Shield in the East and the Tuareg Shield in the West and the Congo Craton in the South. Its northern margin is obscured under Phanerozoic cover. In its present status, it is neither a craton nor an orogenic belt in the classical meanings of the term.

Previous geochronological and isotopic data indicate the existence of a craton prior to the Neoproterozoic orogenic events, possibly since the Archean. But the craton is thought to have decratonized during Neoproterozoic time possibly after thickening as a result of Neoproterozoic collisional events (Black and Liegeois, 1993; Abdelsalam et al. 2002); or suffered repeated intense thermal events during Paleoproterozoic time (Bea et al. 2011).

Ultra-high-temperature metapelites from a locality between Jebel Uweinat and Jebel Kamil, in the central part of the Ghost Craton, occur in association with fuchsite-quartzite and BIFs, in some places, interbanded with charnockitic gneisses. The metapelites are highly heterogeneous locally in their mineral assemblage and show a variety of multiphase reaction textures. The sequence of reactions, as deduced from inclusions-in-porphyroblasts, symplectites and corona assemblages, together with petrogenetic grid considerations record a P-T evolution with the following distinct stages: (1) Equilibration of initial ultra-high-T assemblages (Spr-Qz) in the deep crust (10-12 kbar) followed by near isobaric cooling. This resulted in the assemblage Grt+Sil+Opx+Spr co-existing with melt. (2) Subsequently, due to decompression, to 6-8 kbar, at ca. 1000°C (with some initial heating), a sequence of symplectite assemblages (Opx+Sil+Spr+Crd / Opx+Spr+Crd / Opx+Crd / Crd+Spl) developed at the expense of garnet, orthopyroxene and sillimanite. This stage of near isothermal decompression implies a rapid ascent of the metapelites to mid crustal depths. (3) Regrowth of garnet at the expense of symplectite assemblages and development of late biotite, sapphirine and orthopyroxene due to back-reaction of melt with residual garnet and symplectite minerals indicate a stage of near isobaric cooling. The second and third stages of the evolution are also supported by textures from the mafic granulites. Complete to partial replacement of garnet porphyroblasts by orthopyroxene-plagioclase symplectites, and clinopyroxene relicts within orthopyroxene represent the stage of near isothermal decompression, while the regrowth of garnet around the symplectite orthopyroxene grains represent the stage of isobaric cooling.

BSE images and U-Th-total Pb dating of monazite grains reveal that the grains, occurring as inclusions within garnet, are compositionally homogeneous and have an apparent age of 2.6 $\pm$ 0.1 Ga. The grains occurring outside garnet, in the symplectite and matrix, show complex compositional zoning and are younger 1.9 $\pm$ 0.1 Ga, but sometimes with a core giving the older age. This clearly indicates that the first part of the evolutionary history (1) i.e. the UHT metamorphism occurred during Archean time at 2.6 $\pm$ 0.1 Ga. The isothermal decompression of the granulites (2) is probably the retrograde path of a separate high temperature metamorphic event, possibly a crustal thickening event, that occurred during late Paleoproterozoic time at 1.9 $\pm$ 0.1 Ga; leaving a 700 Ma gap between the two events. The assumed Pan-African crustal thickening and decratonization is not reflected in the metamorphic history of the crust at Uweinat.

References

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