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Partial melting and *P-T* evolution of eclogite-facies metapelitic migmatites from the Egere terrane (Central Hoggar, South Algeria)

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Abstract

The Egéré terrane (Central Hoggar, South Algeria) includes mafic eclogite lenses boudinaged in metapelitic rocks with high-pressure relicts. These metapelites show textural records of partial melting, mainly primary melt inclusions enclosed in garnet crystals and later crystallized as "nanogranitoids." Garnet porphyroblasts also contain inclusions of quartz, kyanite, phengite, biotite, staurolite, and rutile and show a smoothed prograde zoning with a Mn bell-shaped profile. The peak high-pressure metamorphic assemblage consists of garnet, kyanite, phengite (Si up to 6.36), quartz, rutile, ±ilmenite, ±feldspars, and melt. Phengite has partially transformed into fine-grained aggregates of biotite, plagioclase, and K-feldspar, a microstructure interpreted as resulting from a dehydration melting during exhumation. Phengite breakdown, along with other retrograde reactions, produced a late paragenesis with biotite, plagioclase, K-feldspar, quartz, almandine-rich garnet, ±sillimanite, ±staurolite, ±muscovite, and ilmenite. The thermodynamic modeling of *P-T* pseudosections allows us to constrain various steps of the metamorphic history: beginning of the garnet growth at 4.0 kbar and ~600 °C during prograde metamorphism; pressure peak at 14–20 kbar; temperature peak at 800–820 °C; formation of the last assemblage at 6.0–5.5 kbar and 725–685 °C. Partial melting likely started during the prograde path when crossing the H_2O-saturated solidus, at $T \geq$ 650–670 °C and $P \geq$ 10 kbar, continued upon heating, up to the peak conditions, as well as during decompression. This evolution is interpreted in terms of subduction of the continental crust to mantle depths, followed by an exhumation through a clockwise *P-T* path during the Pan-African orogeny. The Egéré metapelites are relatively well-preserved eclogite-facies rocks, contain inclusions of "nanogranitoids" hitherto very little known in eclogite-facies metamorphic rocks, and represent an unusual trace of subduction within a Neoproterozoic orogen.

Keywords: Hoggar, Egéré, high-pressure metapelites, phengite, partial melting, nanogranitoids, pseudosections; High-Grade Metamorphism, Anatexis, and Granite Magmatism