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RAPID DECOMPRESSION FROM DEEP CRUSTAL LEVEL: EVIDENCE FROM FLUID INCLUSION DENSITIES IN METAMORPHIC INDEX MINERALS OF UHP ROCKS

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Fluid inclusion studies were carried out on metapelites of an UHP area in the northeastern Rhodope Mountains (Greece). Based on the occurrence of micro-diamonds within cores of garnet porphyroblasts, it is established that the metapelites underwent UHP metamorphism. The rocks were affected by melting and magmatism (i.e., intrusion of pegmatites) during exhumation and commonly transferred into fold and thrust geometries under amphibolite- to granulite facies conditions. Fluid inclusion densities were estimated from garnet, kyanite and quartz (matrix and inclusions within garnets). Kyanites, which are locally aligned parallel to the main stretching lineation, flow around the garnet and into their pressure shadows, suggesting that garnet growth occurred prior to the main ductile deformation stage. $CO_2 \pm N_2$-fluids dominate in the studied metapelite samples. Pure primary carbonic inclusions within quartz aggregates enclosed near garnet rims re-equilibrated to densities up to 0.50 g/cc. They are elongated, almost oriented parallel to the inclusion trails of solid phases and are surrounded by small carbonic inclusions with the same densities and degrees of fill. Rare single H_2O-NaCl fluid inclusions with fluid densities in the range of 0.92 to 0.78 g/cc occur additionally and are interpreted as having been trapped successively during formation of quartz at pressures of about 9 kbar, assuming temperatures of 750-800°C from geothermometry. Fluid inclusions within garnet appear on the one hand as stretched low-density carbonic inclusions and on the other hand as small high-density carbonic inclusions with densities of 1.05 g/cc. The latter inclusion type forms pseudo-secondary trails near the rims through both, garnet and quartz aggregates. They provide minimum conditions for garnet rim formation at ca. 6 kbar. Fluid inclusions within kyanite appear texturally as primary and also as stretched re-equilibrated inclusions. The first type has densities of max. 1.18 g/cc, which is higher than fluids from garnet rims but lower compared to estimated pressures from high-density aqueous inclusions derived from quartz aggregates enclosed in garnets. This limits formation conditions of late garnet rims and kyanite to 6 to 9 kbar. Hence, after peak metamorphism during which garnet started to grow within the diamond stability field, rapid decompression is required for the exhumation of the metapelitic rocks from UHP to higher crustal levels, the latter characterised by amphibolite / granulite facies conditions, where garnet rims and kyanite have formed. Primary fluids within the matrix quartz of metapelites are without exception re-equilibrated and display decrepitation textures, which evidence rather isothermal decompression. However, the occurrence of carbonic and aqueous transgranular fluid planes suggests late fluid mineral reactions and perhaps fluid unmixing at shallow crustal levels.