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Crustal melting during subduction at mantle depth: anatomy of near-UHP nanogranites (Orlica-Śnieżnik Dome, Bohemian Massif)

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Small volumes ($\leq 50\mu$m) of hydrous melt were trapped as primary inclusions in peritectic garnets during partial melting of metagranitoids from the Orlica-Śnieżnik Dome (Bohemian Massif) at mantle depth [1]. Detailed microstructural/microchemical investigation confirmed the occurrence of a granitic assemblage (biotite+feldspars+quartz) in every investigated inclusion, i.e they are nanogranites [2].

MicroRaman mapping of unexposed inclusions showed the occurrence of residual, H_2O-rich glass in interstitial position. Despite the oddity of this finding within a classic regional HP/HT terrain, an incomplete crystallization of the melt inclusions (MI) is consistent with the (relatively) rapid exhumation of the Orlica-Śnieżnik Dome proposed by some authors [e.g. 3]. Moreover glassy and partially crystallized MI have been already reported in lower-P (<1 GPa) migmatites [4]. MicroRaman investigation also showed the possible presence of kumdykolite, a high-temperature polymorph of albite reported in UHP rocks from the Kokchetav Massif as well as the Bohemian massif ([5] and references therein).

Experimental re-homogenization of nanogranites was achieved using a piston cylinder apparatus at 2.7 GPa and 875°C under dry conditions, in order to investigate melt composition and H_2O content with in situ techniques. The trapped melt is granitic, hydrous (6 wt% H_2O) and metaluminous (ASI=1.03), and it is similar to those produced experimentally from crustal lithologies at mantle conditions.

Re-homogenization conditions are consistent with the results of geothermobarometric calculations on the host rock, suggesting that no H_2O loss occurred during exhumation - this would have caused a shift of the inclusion melting T toward higher values. Coupled with the absence of H_2O-loss microstructural evidence, e.g. decrepitation cracks and/or vesciculation [4] in re-homogenized nanogranites, this evidence suggests that the nanogranites still preserves the original H_2O content of the melt. Our study supports therefore the hypothesis that H_2O re-equilibration via diffusion of MI in garnet cannot be implicitly inferred, as already proposed by [5] for lower-P nanogranites, even in case of near-UHP inclusions.

In conclusions, the combined petrological-experimental investigation of near-UHP nanogranites is a novel and fruitful approach, which unlocks the access to deep melt in natural eclogite-facies crustal rocks, improving our understanding of deep melting processes in collisional settings.

References

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