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Rodingitization and carbonization processes in Triassic ultramafic cumulates and lavas, Othris Mt, Central Greece

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A Triassic magmatic sequence from the south Othris region is comprised of early stage basaltic pillow lavas, as well as late stage ultramafic rocks, lava flows, high-Mg doleritic dykes and pyroclastic tuffs. The ultramafic rocks include slightly serpentinized wehrlites and lavas consisting of cumulate olivine, variably textured clinopyroxene (cumulate, quench, hollow, skeletal or blade shaped), magnesiohornblende, tremolite, phlogopite, spinel, chlorite, garnet, serpentine, calcite and devitrified glass[1]. Part of their secondary mineralogy developed due to percolation of metasomatic fluids during rodingitization and carbonization processes.

In ultramafic rocks from Agia Marina and Mili, rodingitization was rather penetratively and expressed with crystallization of hydrogarnets, accompanied by secondary diopside and chlorite. Hydrogarnets are characterized by their low Ti-contents (<0.56 wt.%). These include hydroandradites (Avg. $Adr_{85.0}Grs_{14.5}Prp_{11.9}Sps_{0.5}Uv_{1.0}$), hydrogrossulars (Avg. $Adr_{14.4}Grs_{75.7}Prp_{14.3}Sps_{0.9}Uv_{0.6}$) and mixed series phases between hydroandradite and hydrogrossular end-members (Avg. $Adr_{46.4}Grs_{47.0}Prp_{9.3}Sps_{0.6}Uv_{0.4}$). Formation of hydroandradite probably occurred at the expense of hydrogrossular under lower temperatures. Small sized calcite amygdales and veinlets were occasionally formed in a subsequent phase. Ultramafic lavas from the region of Neraida have experienced carbonation. They were intensely penetrated by secondary calcitic veins forming remarkable infiltrating structures. Apart from the predominant calcite, the Neraida ultramafics also include small sized hydroandradites (Avg. $Adr_{93.7}Grs_{1.3}Prp_{4.8}Sps_{0.0}Uv_{2.3}$).

Whole-rock chemistry data show that rodingitization resulted in restricted enrichment of Ca, as well as depleting silica and alkalies. The hydrogarnet-bearing ultramafics display subparallel REE patterns, with slightly enriched LREE (4.1–8.9×CN) and flat HREE patterns (2.3-5.5×CN) [$(La/Yb)_{CN}$ =1.2–1.8]. Compared to non-garnet bearing ultramafics, they have experienced a decrease in their ΣREE (∼33%). Calcite-rich lavas from Neraida have also undergone a ΣREE reduction (∼47%), mostly affecting the HREE, due to replacement of clinopyroxene. It is worth noting that a serpentinized ultramafic sample has experienced greater ΣREE losses (∼62%) compared to the metasomatically affected ultramafics. The PM-normalized patterns show that Sr and U are enriched in the calcite-rich ultramafics, whereas the hydrogarnet-bearing ultramafics have been moderately enriched in Pb and Nb and depleted in Ti, K, P, Cs, Rb, Sr, Zr and Y.

Rodingitization, which is also observed in the associated Jurassic ophiolite of Othris[2], may have taken place in an infant intraoceanic subduction system followed by carbonization during continuous temperature decrease. Rodingitization fluids possibly infiltrated from the subducted slab and/or produced during serpentinization and ocean water interaction. Carbonization probably occurred when ultramafics reached close to the seafloor by recycling thermal carbonated seawater, leached from the rifted Triassic platform carbonates.

References. [1] Koutsovitis, Magganas, Ntaflos 2012: Lithos 144-145, 177-193; [2] Koutsovitis, Magganas, Pomonis, Ntaflos 2013: Lithos 172–173, 139–157.