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Metasomatism of Triassic ultramafic cumulates and lavas in Othris, Greece

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Cumulate wehrlites, ultramafic lavas, and associated mafic dykes and pillow-lavas outcrop within a Middle-Late Triassic igneous and sedimentary sequence in Othris, Central Greece. These rocks have been variably affected by metasomatic and metamorphic processes (Figure 1). Ultramafic rocks (wehrlites and ultramafic lavas) are serpentinized in processes that are restricted (moderate alteration) or pervasive, forming serpentinites. Balanced lizardite/antigorite ratios suggest that serpentinization took place under conditions that reached greenschist facies. Most trace element concentrations were relatively decreased during serpentinization. Local rodingitization is characterized by the formation of hydrogarnets, secondary diopside, chlorite, pumpellyite and prehnite. This metasomatic mineral assemblage replaced cumulus clinopyroxene as well as primary accessory plagioclase. Rodingitization occurred with diffusive mass transfer of CaOH+ species under relatively mildly oxidizing physicochemical conditions, along with fluid solutions with an increased CO2/H2O ratio.

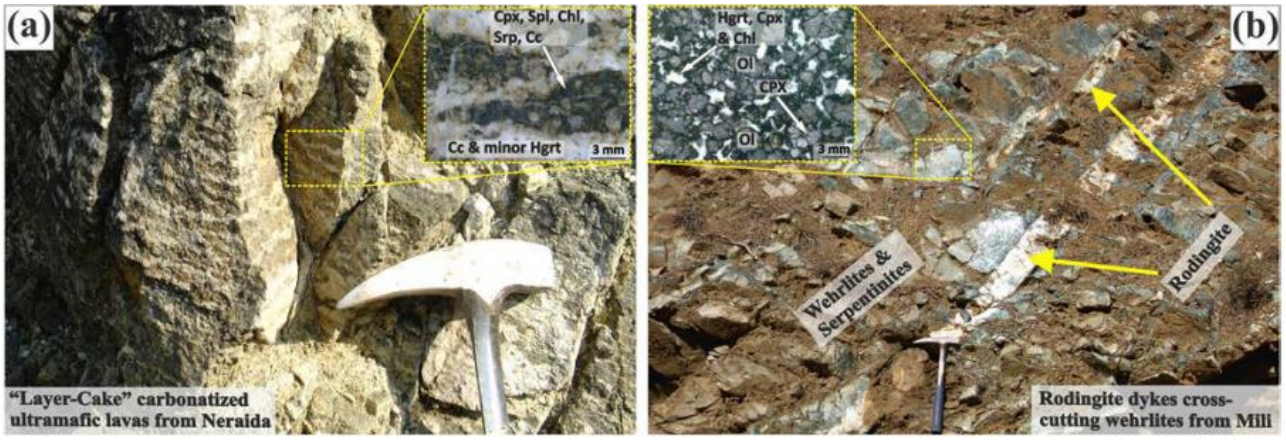

Figure. 1. (a) "Layer-cake" carbonatized ultramafic lavas from the region of Neraida. Enclosed is a stereoscopic image of a polished hand specimen displaying the penetration of calcite. (b)Rodingite dykes crosscutting partially serpentinized and rodingitized wehrlites. Enclosed is a stereoscopic image of a polished hand specimen of a partly rodingitized wehrlite displaying the occurrence of hydrogarnet. (Figure 1 is Figure 2 of Koutsovitis et al. 2018).

Rodingites formed as a result of extensive metasomatism that replaced protolithic boninitic dykes intruding wehrlites. The metasomatic hydrous fluids responsible for this process were relatively alkaline, occurring under low to moderate P-T conditions (180-320 °C, P≈2-5 kbar), in conditions of increased fO2. Rodingites experienced desilification, and rodingitization also resulted in variable decreases and less often increases in trace element concentration.

Carbonation processes affected ultramafic lavas; the most intense carbonation is exposed in the Neraida locality where it has created "layer-cake" structures within the lavas. Metasomatic carbonation was caused by shallow-level continuous circulation of Ca-rich fluids too low in temperature to significantly affect clinopyroxenes. The restricted occurrence of serpentine and hydroandradite indicates that carbonation occurred in association with low-grade serpentinization and rodingitization processes. The metasomatic phenomena documented herein are related to subduction settings and more specifically to the seafloor exhumation of the mafic–ultramafic rocks in the fore-arc area.

We have calculated that serpentinization and rodingitization of wehrlites began within relatively moderate temperature and pressure conditions (~350 °C, P≈6 kbar), with rodingitization processes in both wehrlites and rodingites progressing during further continuous cooling of circulating hydrothermal fluids at shallower depths. The final metasomatic stage is represented by carbonation processes.

References

Koutsovitis, P., Magganas, A., Ntaflos, T., Koukouzas N. 2018. Rodingitization and carbonation, associated with serpentinization of Triassic ultramafic cumulates and lavas in Othris, Greece. Lithos, 320-321, 35-48.