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Synchronous crystallization of amphibole and phlogopite in anorogenic and subduction related mantle xenoliths

COSTANZA BONADIMAN AND GIANLUCA BIANCHINI
University of Ferrara
Presenting Author: bdc@unife.it

Amphibole and phlogopite are widely accepted as a major mineral indicators of the modal metasomatism in the upper mantle within wide P–T range and fluid/melt compositions. They occur as disseminated or as discrete vein/veinlets in the peridotite matrix. Their coexistence with the peridotitic assemblage is explained as a sequential crystallization due to processes such as diffuse melt percolation within the upper mantle (porous flow) or distinct types of metasomatic melts acting in different times and spaces. It is also explained by the replacement of one mineral by the other, induced by the variation of the physical–chemical mantle conditions (P, T, fO_2). More rarely, the two minerals appear in textural and chemical equilibrium, suggesting their synchronous crystallization at a nearly subsolidus stage [1]. A spinel-bearing mantle harzburgite from the Mt. Leura, Newer Volcanic Province (Victoria State, Australia) and two composite (veined) mantle derived xenoliths from Cabezo Negro de Tallante in South-East Spain, were analyzed. They represent shallow portion of subcontinental lithospheric mantle mobilized in anorogenic and subduction-related geodynamic settings, respectively, and all the samples show textually equilibrated amphibole+phlogopite pairs. Combining mineralogical and thermodynamics modelling, we explored the geochemical conditions at which the amphibole + phlogopite pair forms from an ultramafic assemblage in completely different geodynamic frames. Mount Leura harzburgite interacted with K-Na-OH rich melts that stabilized the hydrous phases in a peridotite metasomatized ambient characterized by reduced conditions [~-2.4 Δ(FMQ) log units].Tallante xenoliths are amphibole+ phlogopite bearing - orthopyroxene rich harzburgites veined by exotic felsic assemblage (norite/ gabbronorite) formed by multiple injections of silica-saturated melt/s that stabilized the hydrous minerals pair at the mantle /crust boundary [2,3]. Surprisingly, the preliminary results show that, despite the different geochemical conditions at which the amphibole+phlogopite assemblages became stable, the Tallante harzburgites/orthopyroxenites, also reflect a metasomatized ambient still characterized by low oxygen fugacity values [~-2.0 Δ(FMQ) log units].

[1].Bonadiman, Brombin, Andreozzi, et al. (2021) *Scientific Reports*, 11, 11829.

[2].Bianchini, i Beccaluva, Nowell, D. et al. (2011) *Lithos,* 124, 208-318

[3].Dallai, Bianchini, Avanzinelli, et al. (2022) *Nature Communications* 13, 7765