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Various metasomatism types in the lithospheric mantle from the French Massif Central revealed by micro-scale chemical and textural analyses of lherzolites.

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Mantle xenoliths frequently display evidences of metasomatism by various melts/fluids that occurs in the mantle and during/after the transport to the surface. Here, we present a petrographic description, major and trace element compositions and textural analyses of minerals in fresh lherzolites from the Devès (FMC). Besides imprints of alkali and alkali-carbonate related metasomatism, they present unusual metasomatism evidenced by the presence of secondary orthopyroxene. The characteristics and relationships between the different metasomatic events are discussed.

Pargasite is known in xenoliths from different localities from the Devès. Here, one sample contains minor pargasite crystals, sometimes surrounded by a reactional zone containing secondary clinopyroxene, olivine, spinel, ±plagioclase, glass and formerly volatile-filled bubbles. Amphibole decompression alone fails to explain the phase composition and the percolation of an alkali-rich agent is required.

Carbonate are less reported in mantle xenoliths. Carbonate occurs in a few samples as interstitial crystals, in veins and in carbonate-silicate pockets of secondary clinopyroxene, olivine, spinel, plagioclase and glass. It is an alkali-free Mg-poor calcite with low REE abundances. Its characteristics rule out an origin as quenched carbonatitic melts or immiscible carbonate liquids and favor an origin as crystal cumulates from mantle-derived alkali-carbonated melts.

Secondary orthopyroxene forms veinlets cross-cutting/rimming primary olivine and rarely associated with secondary clinopyroxene. Pores are present in the veins and at the contact with primary olivine. It includes small rounded chloroapatite. It contains less Al_2O_3, Cr_2O_3 and TiO_2 than primary orthopyroxene but similar mg#. EBSD results show that it does not fit the fabric defined by the primary minerals. The presence of pores, chloroapatite and the compositional and textural characteristics support its formation by a pervasive Si-rich and Cl-bearing metasomatic agent. Orthopyroxene-rich veins are well-known in mantle xenoliths from arc magmas, less frequent in continental settings and never studied in the FMC.

The following scenario was proposed: Secondary orthopyroxene formed in the mantle (1200°C and 1.6-1.7 GPa) from a Si-rich and Cl-bearing metasomatic agent. Then, the percolation of alkali/alkali-carbonated melt/fluid leaded to the formation of amphibole followed by the reactional textures near the base of the crust (1000-1100°C and 0.8-1.1 GPa).