Minerals as key markers of melt/fluid percolation in the lithospheric mantle from the French Massif Central

Christiane Wagner, Etienne Deloule, Marie-Lola Pascal, and Omar Boudouma

Peridotite xenoliths from the French Massif Central (FMC) have undergone a complex mantle metasomatic history by percolation of melts/fluids of variable composition. The two main points are: How do the minerals react with the percolating agent? What information can be extracted from these interactions? We present a detailed investigation of major/trace element and Li isotopic composition in fresh spinel lherzolites from the FMC (Devès area). We discuss 1) the variations in the amphibole composition with focus on the Ti behaviour; and 2) the distribution of Li and Li isotopic composition in co-existing phases.

1) **Amphibole** occurs as disseminated crystals generally developed at the expense of spinel $\pm$ cpx, fills cross-cutting veinlets, and forms bands with variably abundant relict spinels. Some samples are surrounded by an amphibole selvage (3 mm thick) with sharp contact with the peridotite. The amphibole composition varies from the selvage to the peridotite part. In the selvage outer part amphibole is a cumulative Cr-free Al-rich kaersutite, which shows a decrease in Ti and Al, while mg^* increases towards the contact. The outer part of the selvage is the remnant of a dyke, while in the selvage inner part amphibole has reacted with the peridotite. Disseminated amphibole farther from the selvage-peridotite contact is a Cr-rich pargasite. The distinct Ti-Al trends observed in amphibole from the selvage (positive) and the peridotite (negative) are linked to distinct Ti-incorporation mechanisms in the octahedral sites of the amphibole structure: a) $(\text{Ti}^{4+6}\text{Al}^{3+}_{-2})(\text{M}^{2+}_{-1}\text{Si}^{4+}_{-2})$ for amphibole in the selvage and b) $(\text{Ti}^{4+}\text{M}^{2+})(\text{Al}^{3+}_{-2})$ for disseminated amphibole in the peridotite. Mechanism (a) is likely to result from the crystallization of a percolating silicate melt in the mantle, whereas mechanism (b) results from hydration of the peridotite reacting with a percolating fluid emanating from the silicate melt.

2) **Li** is preferentially incorporated into olivine compared to pyroxenes (1.1-1.4 ppm/0.2-0.9 ppm, average values) in the anhydrous xenoliths. Metasomatic processes increase Li abundances in all phases of the amphibole-bearing xenoliths, which deviate from the trend of equilibrium partitioning between phases, showing a preferential enrichment in cpx (2.4-5.4 ppm). In the hydrous xenoliths, the correlation between Li and REE elements in cpx and between Li in cpx and amp suggests that the carrier of the Li was a silicate melt. The $\delta^7\text{Li}$ (‰) average values range (+5 to +15) in the anhydrous samples extend up to +35 in the amphibole-bearing xenoliths with large intra-grain variations (up to 18 ‰). These variations do not provide evidence for different sources but likely result from high temperature diffusion-related Li fractionation during metasomatism. The absence of correlation between the Li concentration and the isotopic composition in the anhydrous phases is linked to the pervasive character of the metasomatism, which allows strong Li exchanges as the melt interacts with the peridotite minerals. The preservation of the Li isotope kinetic fractionation in minerals and the sample isotopic heterogeneities implies that the Li exchange event occurs just before the extraction of the xenoliths from the mantle.

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