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Major elements composition, Li distribution and isotopic composition in peridotite xenoliths from Allegre and Mont Coupet (French Massif Central)

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The peridotite xenoliths from two localities (the Ringue quarry in Allegre; Mont Coupet) belong to the Massif Central southern domain, which have been accredited as a circumcratonic segment and been rejuvenated during the Variscan orogeny (Lenoir et al. 2000). The Ringue quarry is opened in a lava lake and, in contrast, Mont Coupet is a strombolian eruptive volcano. Major element compositions, Li distribution and isotope compositions in minerals from these xenoliths were measured to describe the evolution of the sub-continental lithospheric mantle, and to look for Li exchange during the melt-rock interaction.

As for major element compositions, the samples from two localities fall into the off-craton field (Rudnick et al., 2004) and the compositional ranges of the southern domain of the French Massif Central (Downes et al., 2003). They have also been imprinted by mantle metasomatism, which engendered much higher Mg# of cpx (up to 93.5) relative to their co-existing olivines (89.2 to 91.5).

In the Allegre samples, large variations between the equilibration temperatures of mineral cores and rims indicate disequilibrium resulting from mantle metasomatism. Cpx display enriched Li contents (up to 24 ppm) and Li partitioning between cpx and olivine/opx strongly deviates from the equilibrated trend (Seitz and Woodland, 2000), suggestive of their interaction with mafic silicate melts and/or fluids with high Li contents. The highly negative δ^7Li values (down to -25‰) compared to the primary mantle value of 4±2‰ (Rudnick and Ionov, 2007) and the large inter-mineral Li isotope fractionations attest for Li exchange with melts and/or fluids during metasomatic events.

Mont Coupet samples display equilibrated Li distribution and isotopic composition at the thin section scale, but an inverse relationship between the Li contents and Li isotope compositions between the different samples, indicating a large-scale Li diffusion process, occurring before the xenoliths exhumation.

In conclusion, the different types of host magmas should be a significant factor that leads to these extremely diverse characteristics of Li distribution and isotope compositions in the samples from Allegre and Mont Coupet. In the lava lake, host magmas have kept relatively long-term high temperatures and this provided time for Li to diffuse from infiltrated metasomatic melts or host magmas. On the contrary, Mont Coupet has cooled rapidly and the xenoliths could preserve the geochemical state of Li in the mantle depth.

Lenoir et al, 2000, Earth Planet. Sci. Lett. 181, 359– 375.

Rudnick et al., 2004, Lithos 77, 609–637.

Downes et al., 2003, Chem. Geol. 200, 71–87.

Seitz and Woodland, 2000, Chem. Geol. 166, 47–64.

Rudnick and Ionov, 2007, Earth Planet. Sci. Lett. 256, 278–293.