# Origine des basaltes alcalins du massif du Cantal (Massif Central, France): contraintes minéralogiques et géochimiques pour une source mantellique hétérogène

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*Supervisor: Prof Jean Hernandez, Institut de Minéralogie et Géochimie*

The Cantal massif is located in the French Massif Central, 150 km south of Clermont-Ferrand. With a volume of 2500 km3 and a surface of approximately 5000 km2, the Cantal is the largest Tertiary stratovolcano of the Tertiary-Quaternary volcanic province of western and central Europe. The Cantal lavas can be related to a Hot Spot mechanism considering the compositional similarity between these rocks and oceanic island basalts. A geochemical variation seems to occur between the emission of Infracantalian and Supracantalian basalts (first and last erupted basalts in the Cantal massif). This variation is ascribed to a metasomatic event involving an enrichment in Ta and Nb of the lava source, due to the deposition of Ta,Nb-rich oxides in the mantle. This process would be related to the percolation of Si- and K-rich metasomatic melts through the mantle. The melt composition and the timing of percolation suggest a genetic relationship with the green-core clinopyroxenes found in the Cantal basalts. A microprobe study demonstrated that the green-core pyroxenes crystallized in differentiated liquids at high pressure.

Wulff-Pederson et al. (1999) described augite within amphibole veins found in spinel peridotite xenoliths from La Palma (Canary Islands). These veins are considered as evidence for the existence of metasomatic liquids within the mantle. The augite composition shows a perfect similarity with some green-core pyroxene analyses from Cantal basalts. This compositional similarity is an important argument for a connection between the formation of green-core pyroxenes and metasomatic melts, especially as Nb-rich, Fe-Ti oxides were described in the same amphibole veins.

The LA-ICP-MS study carried out on green-core pyroxenes indicates a large range of Ta/Th ratios in the green-cores (~0.5-10), when compared to Ta/Th ratios of pyroxenes in equilibrium with the basalts (~1.5-2.5). This wide range agrees well with the hypothesis of a relationship between green-core pyroxenes and the deposition of Ta,Nb-oxides in the Supracantalian basalts mantle source.

We propose a heterogeneous mantle source for the Cantal basalts, composed of a depleted lithospheric peridotite crosscut by metasomatic veins. The latter would result from the crystallization of evolved melts, differentiated by a mechanism of "percolative fractional crystallization", as defined by Harte et al. (1993). Partial melting modeling of such a heterogeneous source reproduces the high Ta,Nb contents of the Supracantalian basalts, the abnormal behavior of Ta and Nb during melting and the observed correlation between Sr, Nd and Pb isotopic data versus degree of partial melting.

In conclusion, the presence of green-core pyroxenes in basaltic rocks points to the existence of metasomatic phases in their mantle source. The widespread distribution of these pyroxenes in many similar provinces around the world, as well as frequently described Nb, Ta anomalies suggest that our hypothesis of a heterogeneous mantle

source is not a local phenomenon, but could well be extended to the genesis of alkali-balsaltic provinces in general.