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The influence of LAB topography on the evolution of sub-continental lithospheric mantle in the French Massif Central

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We will be discussing the influence lithosphere-asthenosphere topography on the chemical and isotopic composition of French Massif Central (FMC) mantle xenoliths.

The spinel-facies mantle xenoliths from the FMC were sampled by the voluminous tertiary volcanism in Western Europe. These peridotites are grouped according to their chemical composition, which is more refractory in the northern FMC, relative to those available from the southern volcanic vents [1]. Trace element abundances and Lu-Hf isotope systematics of mantle clinopyroxenes verify the existence of different lithospheric domains beneath the northern and southern FMC.

Northern FMC clinopyroxenes have extreme Lu/Hf ratios and ultra-radiogenic Hf (εHf = +39.6 to +2586) that reflect ~15-25% partial melting in Variscan times (depleted mantle model ages ~360 Ma)[2]. Zr and Hf abundances in these clinopyroxenes are low and unaffected by hydrous/carbonatitic metasomatism that overprinted LILE and light REE abundances and caused decoupling of Lu/Hf-Sm/Nd ratios and Nd-Hf isotopes (εNd = +2.1 to +91.2). The Variscan depletion ages of the northern FMC continental mantle root correlate with the subduction of the Massif Central ocean, which resulted in calc-alkaline magmatism and the exhumation of ophiolites and eclogites marking the Variscan suture in this region [3-7].

Clinopyroxenes from *southern* FMC lherzolites are generally marked by overall incompatible trace element enrichment including Zr and Hf abundances. Hf isotope ratios are less radiogenic (εHf = +5.4 to +41.5) relative to northern FMC mantle and have been overprinted by silicate-melt-dominated metasomatism that affected this part of FMC mantle. Major element and Lu concentrations of clinopyroxenes from southern FMC harzburgites are broadly similar to northern FMC clinopyroxenes and suggest they may have experienced similar degrees of melt extraction as northern FMC mantle [2, 8, 9].

The varying metasomatic styles relate to pre-existing variation in the thickness of the continental lithospheric lid [10], which controlled the extent to which upwelling mantle could ascend and melt. In the northern FMC, a thicker and more refractory lithospheric lid (≥ 80 km) only allowed incipient degrees of melting resulting in fluid/carbonatitic metasomatism of the overlying sub-continental lithospheric mantle. The thinner lithospheric lid of the southern FMC (≤ 70 km) allowed larger degrees of melting and resulted in silicate-melt-dominated metasomatism, and also focused the location of the volcanic fields of the FMC above this region [1, 8].

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