European Mineralogical Conference
Vol. 1, EMC2012-174-3, 2012
European Mineralogical Conference 2012

Geochemical constraints on the origin and relationship of magmatic source regions beneath the eastern and western Massif Central volcanic provinces (France)

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The abundance of Tertiary and Quaternary mafic volcanic rocks in the French Massif Central provides the opportunity to study the origin and evolution of the mantle source for some of the largest intraplate volcanic provinces in central Europe. Pioneering geochemical studies on volcanic rocks focused on magmatic mantle sources beneath the western Massif Central (Chauvel and Jahn, 1981; Downes, 1984; Wilson and Downes, 1990) and the coexistence of silica saturated and undersaturated magmatic series (Briot et al., 1991; Downes, 1984). Recent studies on lava hosted peridotitic mantle xenoliths point towards contrasting northern and southern mantle domains beneath the area (Lenoir et al., 2000; Downes et al., 2003). This study aims to geochemically characterize the magmatic mantle source beneath the eastern Massif Central and compare it to the western provinces. We evaluate whether the mantle-derived melts reflect the proposed geochemical differences between northern and southern mantle domains, as suggested by geochemical data derived from peridotite xenoliths. A large suite of fresh and mostly olivine-bearing mafic volcanic rocks was sampled in order to cover all major Massif Central volcanic provinces. Peridotite xenoliths within some samples were analyzed via electron microprobe and otherwise removed from samples prior to whole rock geochemical analyses. Most samples consist of alkaline basalts and basanites and show no signs of significant differentiation as revealed by their major element distributions (40 – 46 wt.%SiO_2, 6 – 13 wt.% MgO, 4,5 – 7,5 wt.% total K_2O + Na_2O). Trace element patterns are remarkably uniform for samples from all volcanic provinces and display slight enrichments in incompatible over compatible elements (e.g., Sr/Y of 13 – 20, La/Yb of 17 to 29). Marked positive Nb and Ta anomalies are in agreement with previous constraints that invoke a mantle plume as the origin of the volcanism present in the area (e.g., Wilson and Downes, 1990). These geochemical data are consistent with geophysical evidence that indicates one single volcanic chain beneath the eastern and western Massif Central volcanic provinces. Accordingly, both provinces are related to the same asthenospheric component and a single mantle plume (Granet et al. 1995). Additional Sr, Nd, Hf and Pb isotope data will contribute to constrain the extent of the proposed contrasting northern and southern mantle domain and it's relation to the sub continental mantle beneath eastern and western Massif Central volcanic provinces.