Evolution of lithospheric mantle in NE Spain: Insight from deformation fabrics and geochemistry of mantle xenoliths

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Mantle xenoliths in Neogene-Quaternary alkali basaltic rocks from the Catalan Volcanic Zone are composed of anhydrous spinel lherzolites, harzburgites and minor olivine websterites. The volcanism is related to the prolongation of the European rift system along the Mediterranean coast of the Iberian peninsula. Crystallographic preferred orientations (CPOs), thermobarometric estimates and major and trace element geochemistry have been used to assess the dynamic and geochemical evolution of the lithospheric mantle in this area

Olivine CPOs show [010]-fiber textures in most protogranular peridotites and websterites, whereas they change gradually into orthorhombic or rare [100]-fiber in most porphyroclastic and equigranular lherzolites. This change is interpreted to have occurred with decreasing temperature (T) and pressure (P). Fabric strength also decreases with T and P.

There is no apparent relationships between CPOs and whole-rock and mineral geochemistry. Basalt components and mildly incompatible trace elements define a broad melt depletion trend, but a different melting and metasomatic history is envisaged for harzburgites and lherzolites. Lherzolites display scattering in covariation diagrams suggesting that simple melt depletion was not the sole process involved. Finally, a mainly cryptic metasomatism related to alkaline-carbonatite melt percolation affected the harzburgites and a few lherzolites. Their geochemical signature is not correlated with fabric strength nor equilibrium temperatures.

It is suggested that earlier deformation event(s) followed by annealing resulted in olivine [010]-fiber fabrics, whereas the orthorhombic and [100]-fiber types reflect lower T and higher strain deformation in shallow shear zones. These might be related to the Neogene rifting event.