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Age, origin and significance of SKS splitting in SE Iberia: insights from mantle xenoliths from Neogene alkaline basalts

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The volcanic activity in the SE Iberian Volcanic Province (SE IVP) is the surface expression of magmatism in a complex geodynamic setting during the Cenozoic development of a Mediterranean-type back-arc basin in the Alboran realm. The late stage of this geodynamical evolution was characterized by Neogene alkaline basalt volcanism erupted at 2-3 Ma in the Tallante and Los Perez (Murcia) volcanic centers. This volcanism entrained numerous mantle xenoliths that provide a recent snapshot of the structure of the lithospheric mantle beneath this region. Xenoliths are spinel (± plagioclase ± amphibole) lherzolite, and minor harzburgite and wehrlite showing porphyroclastic to fine- to medium-grained granoblastic textures. Mantle xenoliths display a marked axial [100] pattern olivine Crystal Preferred Orientation (CPO) characterized by a strong alignment of olivine [100] axes near or parallel to the peridotite lineation and a girdle distribution of [010] axes with a maximum normal to the peridotite foliation. This CPO is consistent with dominant activation of the high temperature [100]{0kl} slip systems of olivine formed under a deformation regime dominated by simple shear or combinations of simple shear and pure shear with a transtensional component. The age of this deformation event is constrained by syn-tectonice composite xenoliths formed by reactive percolation of Si-rich melt/fluids with the lithospheric mantle during middle Miocene subduction/delamination of the paleo-iberian margin beneath the SE IVP.

In order to investigate whether SKS anystropy recently measured beneath this region can be accounted by the olivine CPO of the lithospheric mantle, we have computed the theoretical seismic anisotropy of mantle xenoliths from their olivine CPOs and modal compositions. The averaged seismic properties of SE-IVP mantle xenoliths are characterized by fast propagation of P-waves and polarization of fast S-waves parallel to the peridotite lineation. The computed highest S-waves delay times are observed for waves propagating within the foliation, but at high angle to the lineation. These calculation indicate that the measured S-wave delay time of c. 1.75s measured beneath the Cartagena seismic station can be accounted for by a 160 km thick anisotropic layer of lithospheric mantle with an olivine CPO similar to that of SE-IVP mantle xenoliths and with a olivine a-axis lineation parallel to the polarization of the fast S-wave. Such thikness is also consistent with the paleogeotherm derived from geothermometric data and thickness of the lithopsheric mantle in the area derived for geophysics. For a vertically propagating S-wave, the combination of calculated seismic properties of xenoliths and the SKS measurements constrains the foliation plane to be vertical and the mantle flow direction (i.e. lineation) to be horizontal beneath the SE IVP. Combined with the deformation record of mantle xenoliths, our results indicates that measured SKS spliting in SE-Iberia can be accounted for Negoene trans-tensional regime with a strong transcurrent flow sub-paralell to the Iberia-Betic chain, rather than with shortening or sublithospheric channel flow and/or Pre-Alpine inherited mantle structures.