



Geodynamic Implication and Constraint of seismic anisotropy in Tibetan Lithosphere: Inferred from Mantle Xenoliths

Xiaosong Yang (1), Yu Yang (2), and Yongmei Shang (1)

(1) Institute of Geology, China Earthquake Administration, Beijing, China(xsyang@ies.ac.cn), (2) Department of Lithospheric Research, University of Vienna, Vienna, Austria

It is commonly agreed that the seismic anisotropy is a very important indicator of lithospheric deformation, especially the plastic flow of upper mantle. Trying to understand the origin of subcontinental mantle anisotropy revealed by SKS splitting measurements in Tibet, we have been perplexed for very large delay time (> 2.0 s) of SKS splitting in Qiangtang terrane and the conversion of NNE-SSW fast polarization direction into E-W at the south side of Banggong-Nujiang Suture. Peridotite xenoliths within Cenozoic potassic volcanic rocks located in the north-western Lhasa and the south-western Qiangtang terrane may provide a constraint on the interpretation of the genesis of the abnormal SKS splitting and inferring Tibetan upper mantle deformation.

The olivine in xenoliths has distinctly Fo between 89 and 90, also contains lower CaO (0.03 wt.% - 0.16 wt.%) and TiO_2 (< 0.04 wt.%). The Cr# in olivine is 0.42 - 0.54, implying melt fraction of 13 % - 15 %. These xenoliths were derived from depths of 70 km - 80 km estimated by two pyroxene thermobarometer. The olivine CPO (crystal preferred orientations) mainly shows a strong concentration of [010] perpendicular to foliation plane and large circle gridles of [100] and [001] in the foliation plane (AG-pattern), with a few (010)[001] pattern (B-pattern). On average, the CPO of olivine has the fastest and slowest P-wave propagations parallel and approximately perpendicular to the foliation plane (010), respectively. Polarization anisotropy (AVs) is highest in direction nearly normal to the highest density of [010]. The anisotropy feature of peridotite xenoliths shows a marked resemblance to their olivine, which is the primary mineral in these xenoliths. These peridotite xenoliths are characterized as moderate AVs with 4.6 % in average in large circle gridles of [100] and [001], whereas AVs is very weak or close to zero in the direction approximately normal to slip plane.

On the base of dominant slip system of olivine, an upright foliation generated by a high-angle subduction lithospheric mantle or/and vertical upwelling mantle can induce strong SKS wave splitting. According to the anisotropic magnitude, the delay times ranging from 1.5 s to more than 2.0 s observed in Lhasa and Qiangtang terrane require an anisotropic layer with the incredible thickness of 150 km - 200 km at least to be matched. We therefore propose to attribute the very large delay time to very high anisotropy magnitude which has been enhanced by melt pocket preferred orientation. The conversion of fast polarization direction may reflect the change of the fabric of olivine or the architecture of lithospheric mantle.