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Insight into asthenospheric seismic anisotropy and deformation in Mainland China

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Seismic anisotropy can provide direct constrains on asthenospheric deformation which also can be induced by the inherent mantle flow within our planet. Mantle flow calculations thus have been an effective tool to probe asthenospheric anisotropy. The seismic anisotropy probed by shear wave splitting (SWS) dominantly displays single-layer anisotropy, which allows us to infer the asthenospheric source of SWS and qualitatively evaluate asthenospheric deformation using mantle flow calculations in Mainland China. To date, simple asthenospheric flow (SAF) model has commonly been used to probe asthenospheric anisotropy in Mainland China. This model yields the anisotropy aligning along the direction of absolute plate motion and actually does not consider the effects of mantle flow which is inherent within our planet. To our knowledge, mantle flow is of importance to seismic anisotropy since it may lead to observation-comparable geophysical fields and seismic anisotropy. Therefore, in order to evaluate the effects of mantle flow and probe the more proper interpretation on seismic anisotropy in Mainland China, mantle flow models driven by plate motion (plate-driven) and by a combination of plate motion and mantle density heterogeneity (plate-density-driven) are used to predict the fast polarization direction (FPD) of SWS. Our results indicate that: plate-driven or plate-density driven mantle flow has dramatic effects on the development of seismic anisotropy when compared with SAF; plate-driven flow controls the FPD and large-strain-induced anisotropy strength while thermal mantle flow dominates the anisotropy strength due to low strain; asthenospheric flow is an assignable contributor to seismic anisotropy, and the asthenosphere is undergoing low, large or moderate shear deformation controlled by the strain model, the flow plane/flow direction model or the both in most regions of central and eastern China; and the asthenosphere is under more rapid extension deformation in eastern China than in western China.

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