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plane orientation in the upper mantle under the United States from SKS shear-wave splitting observations

The cause of seismic anisotropy is still an open question, e.g., to which degree it is due to more recent geodynamic activities in the asthenosphere, or to frozen-in deformation in the lithosphere. We show that these two endmember cases can in principle be distinguished using shear-wave splitting observations from SKS waves. This is illustrated by the simple example of pure olivine with horizontal a-axis, and differing orientations of the other two axes, namely vertical b and vertical c. The azimuthal dependence of shear-wave splitting measurements is described by two parameters, which can provide additional information about subsurface deformation. In particular the oscillation parameter d1 constrains the orientation of foliation. We demonstrate that shear-wave splitting in Western and Central United States indeed shows the predicted azimuthal dependence, related to a mainly subhorizontally-oriented flow plane of deformation in the upper mantle. This has important implications for asthenospheric flow.

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