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

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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 d_1 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.