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Constraints on olivine deformation mechanisms from SKS shear-wave splitting beneath the High Lava Plains, Northwestern Basin and Range and Western Yellowstone Snake River Plain

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Shear-wave splitting observations of SKS and SKKS phases have been used widely to map azimuthal anisotropy, and to constrain the dominant mechanism of upper mantle deformation. As the interpretation is often ambiguous, it is useful to consider additional information, e.g. based on the non-vertical incidence of core-phases. Depending on the lattice-preferred orientation of anisotropic minerals, this condition leads to a variation of splitting parameters with azimuth and enables a differentiation between various types of olivine deformation. As the fabric of olivine-rich rocks in the upper mantle relates to certain ambient conditions, it is of key importance to further define it. In this study, we predict the azimuthal variation of splitting parameters for A-, C-, and E-type olivine, and match them with observations from the High Lava Plains, Northwestern Basin and Range, and Western Yellowstone Snake River Plain. This can help to constrain the amount of water in the upper mantle beneath an area, known for a consistent, mainly E-W fast orientation, and increased splitting delay in the back-arc of the Cascadia Subduction Zone. Comparing expected and observed variations renders a C-type olivine mechanism unlikely; a differentiation between A- and E-type olivine remains more difficult though. However, the agreement of the amplitude of azimuthal variation of the fast orientation, and the potential to explain larger splitting values, suggest the occurrence of E-type olivine and the presence of a hydrated upper mantle. Along with a discrepancy to predict delay times from azimuthal surface wave anisotropy, deeper sources could further affect shear-wave splitting observations.