Geophysical Research Abstracts
Vol. 20, EGU2018-3551-2, 2018
EGU General Assembly 2018

Seismic anisotropy in the lowermost mantle beneath Iceland and implications for mantle flow

Jonathan Wolf (1,2), Neala Creasy (1), Maureen D. Long (1), and Christine Thomas (2)

(1) Yale University, Department of Geology and Geophysics, New Haven, CT, USA, (2) University of Münster, Geophysics, Seismology, Germany (jonathan-wolf@gmx.net)

Iceland represents one of the most well-known examples of hotspot volcanism, but the details of how surface volcanism connects to geodynamic processes in the deep mantle remain poorly understood. Recent work has identified evidence for an ultra-low velocity zone (ULVZ) in the lowermost mantle beneath Iceland and argued for a cylindrically symmetric upwelling at the base of a deep mantle plume. This scenario makes a specific prediction about flow and deformation in the lowermost mantle, which can potentially be tested with observations of seismic anisotropy. Here we present observations of shear wave splitting due to lowermost mantle anisotropy beneath Iceland and the surrounding region using differential shear wave splitting measurements of SKS-SKKS and S-ScS phases. We apply our techniques to waves coming from multiple azimuths, with the goal of gaining good geographical and azimuthal coverage of the region. We find evidence for sporadic SKS-SKKS discrepancies beneath our study region, with most of the discrepant measurements sampling the D" region directly beneath Iceland. In contrast, most SKS-SKKS pairs that do not show discrepant splitting sample mantle away from the region of low mantle velocities and a likely ULVZ. Our measurements of ScS splitting due to lowermost mantle anisotropy clearly show a rotation of the fast splitting direction from nearly horizontal away from the low velocity region (implying $V_{sh} > V_{sv}$) to nearly vertical directly beneath Iceland (implying $V_{sv} > V_{sh}$). We carried out some simple forward modeling for different anisotropic scenarios (crystallographic preferred orientation development in post-perovskite, as well as shape preferred orientation of aligned partial melt) and tested these predictions against our observations. Our measurements are generally consistent with a mantle flow model that invokes nearly vertical flow directly beneath the Iceland hotspot, with horizontal flow just outside the region.