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Shear wave anisotropy near the core-mantle boundary beneath the Pacific

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The goal of this study is to evaluate the strength, orientation, and location of shear wave anisotropy that exists in the deepest 150-300 km of the mantle known as D''. We examined shear phases (Sdiff) that traverse D'' and diffract along the core-mantle boundary (CMB), providing unique information about the structure of the CMB region. Seismic analysis of D'' can help constrain structure and flow at the base of the mantle, core-mantle interactions, and the style of mantle convection near the CMB.

Waveforms used in this study were recorded by a combination of temporary and permanent stations and sampled several regions of D'' beneath the Pacific Ocean. In particular, we utilized data from several IRIS/PASSCAL temporary broadband seismic arrays located in North America and South America. Additionally, data from IRIS/GSN permanent stations provided additional information for near-array raypaths. The configuration of closely-spaced PASSCAL stations enabled us to utilize cross-correlation techniques to evaluate the data, which provides a more objective analysis of the character of Sdiff splitting.

We have analyzed Sdiff phases that propagate from western Pacific subduction zones to eastern North American stations, and calculated differential travel times for the radial and transverse components of Sdiff (SVdiff-SHdiff). These phases sample D'' beneath the northern and central Pacific, and exhibit SVdiff-SHdiff splitting times that range from 0 to 5 s. For all phases in the data set, SHdiff arrives before SVdiff. One particularly well-sampled area beneath the central Pacific exhibits an increase in average splitting with path length in D''. In this region, either lateral or vertical variations in the strength of D'' anisotropy and/or differential sampling of an anisotropic region may explain the observations. Raypaths in this region are similar on the receiver side; consequently, most of the splitting variations are likely due to localized anisotropy on the source-side of the paths in D".

Because SHdiff in general arrives before SVdiff, the cause of the anisotropy may be transverse isotropy with a vertical symmetry axis. However, due to the limited range of Sdiff polarizations in our current dataset, we cannot rule out the possibility that large-scale azimuthal anisotropy in D'' exists beneath the central Pacific. We are currently examining phases recorded at South American stations to provide new constraints on the character of D'' anisotropy beneath the central and southern Pacific. These raypaths will be utilized to evaluate and compare the larger-scale character of D'' anisotropy beneath the Pacific Ocean.