A Step in the D” Discontinuity Imaged by Kirchoff Migration Through 3D Tomographic Models

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A simple migration scheme is used to image topography of between 50 and 100 km over less than 200 km laterally of the D” discontinuity. Correcting for first-order travel-time perturbations based on one-dimensional ray tracing through S-wave tomography models does not change our interpretation, but does affect the absolute depth of the reflector. The abrupt change in its height is unlikely to be due to a phase change and temperature differences alone, so chemical heterogeneities are required to be consistent with the observations. We also observe a low-velocity scatterer that is approximately 2 degrees in diameter. This feature is more model dependent but agrees with finite frequency tomography results from Hung et al. (2004). Though this ray-based method does not account for bending of the ray path due to three-dimensional structure nor does it include scattered energy after the ray has reached its turning point, we find it works remarkably well where data density is sufficient, while having significant gains over wave equation based methods. In its initial phase, US Array will have an aperture approximately three times greater than currently available to study the lower mantle beneath the Americas. The greater number of crossing rays, which is critical for lower mantle studies, will undoubtedly lead to further exciting discoveries and new constraints for other members of the Earth science community.

Map showing earthquakes (black stars), seismographs (red triangles), ScS bounce points on the CMB (blue dots), and the great circle paths along which the migrated data stack (bottom figure) was made (green lines). Our data set consists of 273 seismograms from 61 receivers recording ground displacement from 15 deep earthquakes. The black rectangle shows the area where our resolution is high enough to map D” discontinuity topography and detect features as small as 100 km. The grey rectangle shows the approximate area that we will be able to image at High-Resolution with data from US Array. Imaging small features in the lowermost mantle across large scale lengths is key to understanding their relationship with the overlying tectonics.