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Evolutionary Aspects of Lithosphere Discontinuity Structure in the Western U.S.

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We have produced common conversion point (CCP) stacked Ps and Sp receiver function image volumes of the lithosphere beneath the western United States using teleseismic data recorded by the EarthScope Transportable Array. Ps and Sp receiver functions are made with different frequency bands, and produce images of different resolutions, and provide somewhat independent estimates of the crust-mantle and lithosphere-asthenosphere boundary depths. The large volume that has been imaged with the broadband seismic data and the diversity of tectonic environments it encompasses allow us to investigate existing views of the evolution of these structural discontinuities. From our lithospheric images we identify the Mohorovičić boundary (Moho) as a nearly continuous topographic surface, varying in depth between 22-52 km with a few tectonically understandable punctures associated with regions of convective downwelling. The lithosphere-asthenosphere boundary (LAB) has greater depth variation (∼40-150 km), and in contrast to the Moho cannot be described as a single continuous surface, in places it has a complex expression.

The LAB is almost uniformly twice as thick east as west of the Cordilleran hinge line, which marked the edge of the Precambrian passive margin along the southwestern North American craton. The Moho and the LAB are Mesozoic or younger almost everywhere west of the hingeline, a result of modification during Farallon subduction and its aftermath.

Much of the seismicity and recent volcanism in the western U.S. not associated with the plate boundaries are found concentrated along steep gradients in either crustal or lithospheric thickness, or both, particularly along the eastern edge of the coastal batholiths and the hingeline. This suggests that lateral gradients in lithosphere topography and integrated lithospheric strength focus deformation in a variety of ways.