New insights into structural elements of the upper mantle below the contiguous United States from S-to-P converted seismic waves

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The S-receiver function (SRF) technique is an effective tool to study seismic discontinuities in the upper mantle like the lithosphere-asthenosphere boundary (LAB). It uses deconvolution and aligns traces along the maximum of the deconvolved SV signal. Both of these steps lead to acausal signals, which may cause interference with real signals from below the Moho. We go back to the origin of the S-receiver function method and process S-to-P converted waves applying the original processing method by using S-onset times as reference and waveform summation without deconvolution. We apply this "causal" SRF (C-SRF) method to data of the USArray and obtain partially different results in comparison with previous studies using the traditional acausal SRF method. The new method does **not** confirm the existence of a mid-lithosphere discontinuity (MLD) beneath the cratonic US. The shallow LAB in the western US is, however, confirmed with the new method. The elimination of the MLD signal below the cratonic US reveals lower amplitude but highly significant phases that previously had been overwhelmed by the apparent MLD signals. Along the northern part of the data coverage area we see relics of Archean or younger north-west directed low-angle subduction below the entire Superior Craton. In the cratonic part of the US we see indications of the cratonic LAB near 200 km depth. In the Gulf Coast of the southern US we image relics of southeast directed shallow subduction, likely of mid-Paleozoic age.

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