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Mantle Discontinuities Beneath Eastern North America

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The goal of this study is to image upper mantle discontinuities beneath the eastern United States using Ps conversions in stacked receiver functions. A high velocity continental root that extends to depths of 300 km or more beneath the interior of North America is a consistent feature of numerous upper mantle velocity models. The 1995-1996 Missouri to Massachusetts Broadband Seismometer Deployment (MOMA) was an array of portable seismometers that spanned the eastern margin of this structure. To determine whether the depths of upper mantle discontinuities reflect this strong lateral velocity gradient, we are in the process of calculating receiver function stacks for the 18 stations of the MOMA array (an IRIS/PASSCAL experiment) and permanent IRIS/GSN stations HRV (Harvard, MA) and CCM (Cathedral Caves, MO) which define the MOMA array endpoints. To enhance the signal of Ps phases generated at mantle discontinuities, separate receiver function stacks were calculated for different Ps conversion depths (40, 270, 410, 520 and 660 km). In each, the timing of individual receiver functions was corrected for the move-out predicted by the IASP91 velocity model for the given conversion depth. Ps conversions from the Moho and mid-crustal depths exhibit significant variability along the MOMA array. Most stations are consistent with Moho depths of 40-45 km assuming reasonable regional crustal velocities, but receiver functions for the two most eastern stations (MM01 and HRV) suggest either a substantially thinner crust or a strong mid-crustal impedance contrast. The receiver function stacks also contain two prominent Ps phases at times that correspond to conversions in the vicinity of 410 km and 660 km depth. No phases from a discontinuity near 520 km are apparent. After correction for crustal structure, the P_{410S} and P_{660S} times relative to the IASP91 model give the impression that the "410" and "660" km are on average shallower at eastern stations MM06-HRV than at western stations MM07-CCM. However, if lateral variations in upper mantle velocity are accounted for by comparing P_{410S} and P_{660S} times to the model of Grand [1994] which contains a high velocity root beneath the western stations, the transition zone discontinuities exhibit virtually no topography across the array. Average discontinuity depths are 410 ± 10 km and 659 ± 12 km, although these values vary for different scaling relations between P-wave velocity and the Grand [1994] S-wave model. These preliminary results suggest that any thermal gradients associated with the margin of the fast (and presumably cold) continental root do not extend to transition zone depths.