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Constraints on Upper Mantle Velocities beneath Tibet and Stable Continents using Shear-coupled P waves

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Upper mantle velocities are often constrained using surface waves or refracted phases at regional distances from either nature earthquakes or man-made sources. In this study we demonstrate an alternative approach using S waveforms at teleseismic distances. Unlike S receiver functions studies that focus on the S converted P across the Moho as S precursors, we further consider phase SsPmp which is originated from direct S and reflects underside at the free surface as P then reflected back up from the base of the crust near a station. The timing of SsPmp depends on the average VP and thickness of the crust. The amplitude and waveforms, on the other hand, are sensitive to the velocities in the uppermost mantle when the incidence is near critical angle. By observing phase variations of SsPmp from earthquakes at distances between 40 and 60 degrees straddling the critical distances, we are able to determine the upper mantle velocity beneath northern Australia and Tibetan plateau. The results show that the crustal thickness under northern Australia is about 45 km with Pn velocity approaching to 8.3 km/s, typical in old continents. The lithospheric structure in northern Australia seems to lack of additional deeper positive discontinuity which is different from the findings in the eastern North America. Under high plateau Tibet along broadband array Hi-CLIMB, there is a decrease of P-wave velocity in the uppermost mantle from values near 8.1 km/s under Lhasa terrane to about 7.8 km/s beneath central Qiangtang, consistent with the estimates using wide-angle seismic data. The crustal thickness also shallows toward north by over 10 km along the profile.