Toward Simultaneous Determination of Bulk Crustal Properties Using Virtual Deep Seismic Sounding

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We augment the method of virtual deep seismic sounding (VDSS) by adding the phases *Sp*, the *SV-P* conversion across the Moho, to determine the average speed of the *S* wave (V_S) in the crust. VDSS uses the strong *SV-P* conversion below the free surface from teleseismic earthquakes as a virtual source for wide-angle reflections of the *P* wave. The large signal generated by the virtual source is the strongest aspect of VDSS in which no stacking is necessary to build up the signal. Previous work used the large moveout of the wide-angle reflection, phase *SsPmp*, relative to the direct *S*-wave arrival, phase *Ss*, to minimize the trade-off between bulk *P*-wave speed (V_P) and thickness of the crust (H). It is then straightforward to use the timing of the phase *Sp* to constrain V_S. As examples, we show that this method works for data from both temporary and permanent seismic deployments in contrasting tectonic settings. Specifically, V_S under stations FORT in western Australia and H1620 in central Tibet are 3.77 ± 0.08 and 3.42 ± 0.11 km/s, respectively. This development complements the undertaking of using information from only the *S*-wave train to extract all three seismic parameters of the bulk crust, V_P, V_S, and H. These parameters are important for constraining overall silica content of the crust. (https://doi.org/10.1785/0120190294)