Investigating Ultra-Low Velocity Zones in the Southern Hemisphere using an Antarctic Dataset

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Given limited seismic coverage of the lowermost mantle, less than one-fourth of the core-mantle boundary (CMB) has been surveyed for the presence of ultra-low velocity zones (ULVZs). Investigations that sample the CMB with new geometries are therefore important to further our understanding of ULVZ origins and their potential connection to other deep Earth processes. Using core-reflected ScP waves recorded by the recently deployed Transantarctic Mountains Northern Network in Antarctica, our study aims to expand ULVZ investigations in the southern hemisphere. Our dataset samples the CMB in the vicinity of New Zealand, providing coverage between an area to the northeast, where ULVZ structure has been previously identified, and another region to the south, where prior evidence for an ULVZ was inconclusive. This area is of particular interest because the data sample across the boundary of the Pacific Large Low Shear Velocity Province (LLSVP). The Weddell Sea region near Antarctica is also well sampled, providing new information on a region that has not been previously studied. A correlative scheme between 1-D synthetic seismograms and the observed ScP data demonstrates that ULVZs are required in both study regions. Modeling uncertainties limit our ability to definitively define ULVZ characteristics but also likely indicate more complex 3-D structure. Given that ULVZs are detected within, along the edge of, and far from the Pacific LLSVP, our results support the hypothesis that ULVZs are compositionally distinct from the surrounding mantle. ULVZs may be ubiquitous along the CMB; however, they may be thinner in many regions than can be resolved by current methods. Mantle convection currents may sweep the ULVZs into thicker piles in some areas, pushing these anomalies toward the boundaries of LLSVPs.