The Distribution of Mid-Lithospheric Discontinuities on Precambrian Continents

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Layering within the mantle lithosphere beneath cratons contains information about lithospheric formation and evolution, but the presence and characteristics of cratonic mid-lithospheric discontinuities (MLDs) are still debated. To provide additional insight on cratonic MLDs, we have developed a new approach to processing teleseismic converted S-to-P body waves and have applied it to 20 stations of the IRIS/USGS Global Seismic Network and other networks in regions that have been tectonically stable since the Proterozoic. We separate data into 30^{o} backazimuthal bins to account for lateral variations in structure. We use a free-surface transform to separate daughter (P) from parent (S) components, after determining free surface velocities from P and S particle motions. When calculating receiver functions, we use a broad period range (2-100s) and time domain deconvolution to avoid data processing artifacts such as side-lobes. Individual receiver functions are objectively culled and weighted using k-means clustering to improve signal-to-noise ratios. Stacks of Sp receiver function indicate a variety of mantle structures. At some stations the data show no evidence for layering within the underlying mantle. However, many stations contain Sp phases that indicate negative velocity gradients in the cratonic mantle lithosphere at depths of 60-150 km. Positive velocity gradients are also observed at some stations, more commonly at depths greater than ~150 km, but also in the shallower mantle in some cases. The relationship of this apparent layering in seismic velocity to tectonic histories and geochemical data is under investigation.

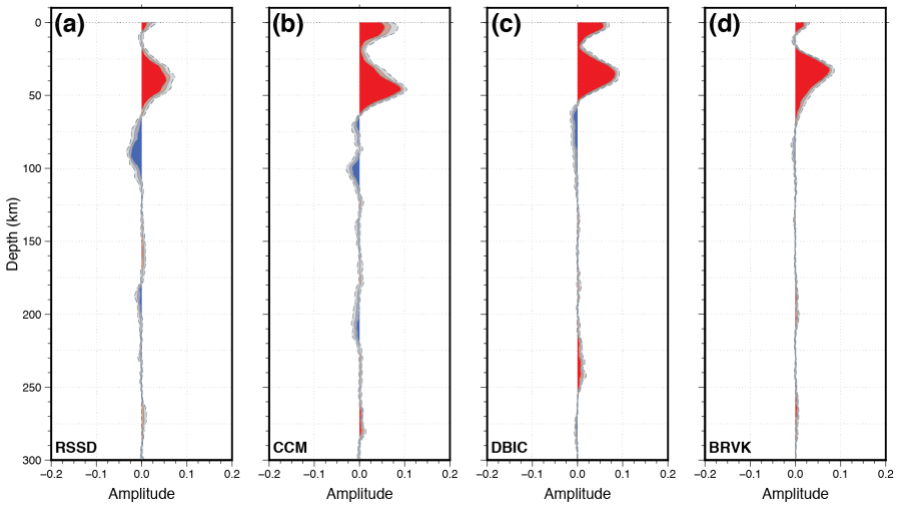

Figure 1. Sp receiver function stacks for four stations overlying cratonic mantle. **(a)** RSSD is at the eastern edge the Archean Wyoming craton. **(b)** CCM lies above the Proterozoic Mazatzal Province. **(c)** DBIC is at the southern edge of the West African craton. **(d)** BRVK is in stable Kazakhstan. Red phases correspond to velocity increases with depth, blue to velocity decreases with depth. Dashed lines indicate 90% confidence limits from bootstrapping. The stacks for all stations show clear Moho phases. The BRVK stack contains no evidence for layering within the cratonic mantle, while the stacks for RSSD, CCM and DBIC indicate negative velocity gradients in the shallow mantle lithosphere. The DBIC stack also shows a positive velocity gradient at ~230 km depth.