Application of Ps Scattering Kernels to Imaging the Mantle Transition Zone with Receiver Functions

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Abstract

Both the thermal structures and the hydration level of the mantle transition zone are important to researchers in solid Earth science fields. Although some aspects of the questions have been answered based on current geophysical observations, high-resolution seismic mapping of the transition zone on a continental scale is still valuable for improving our understanding of the lateral variations in structure. Here we extend a 3D pre-stacking migration method to make it more applicable for imaging the mantle transition zone depths. After the validation of the method with 1D synthetic data, three types of hypothetical structures are adopted for exhibiting the advantages and disadvantages of different practical imaging parameters. The results indicate that the method is capable of mapping dipping anomalies as well as laterally discontinuous low velocity layers just above or below the transition zone. The test results also show that some practical parameters, such as the slowness window and the wavelet can heavily affect the migrated results. Therefore, these imaging parameters should be chosen based on the understanding of the primary targets as well as associated synthetic tests. Finally, the observed data from the USArray are migrated with the new method. The profiles show the major discontinuities, the 410 and the 660, inside the mantle transition zone clearly. Some topographic changes of the two interfaces are consistent with the prediction from mineral physics in sign while a few are not. The observation suggests factors other than temperature may also have influence on the topography of the two discontinuities in the region.

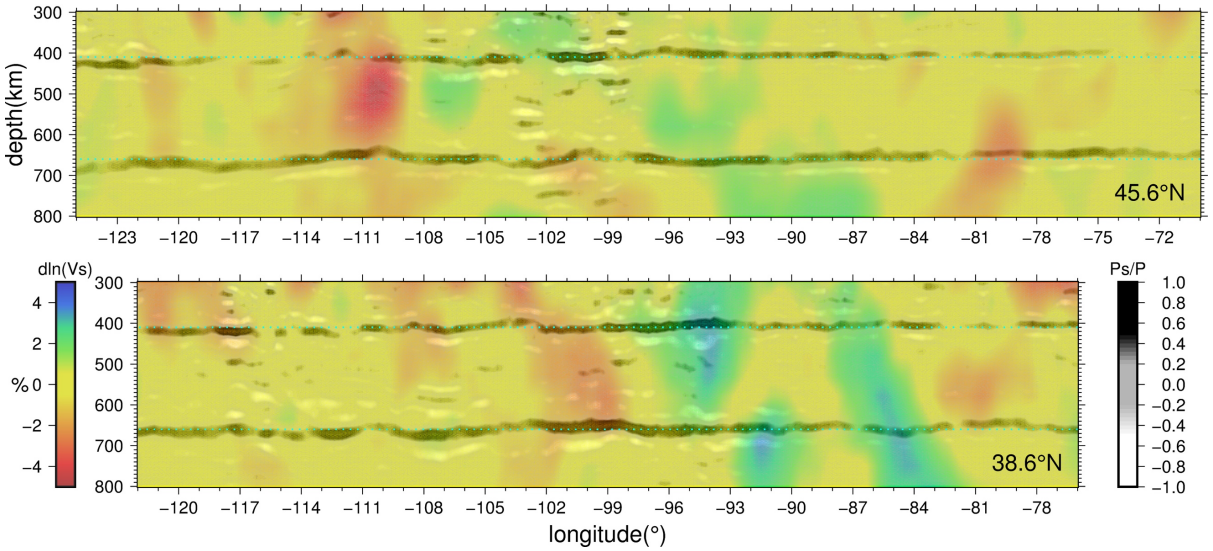

Fig. Two west-east migrated profile (black and white) with the observed data. The latitude of the profiles is denoted at the right-bottom corner. The tomographic model (color) from Schmandt and Lin (2014) are plotted as color background. The normal depth of the 410 and the 660 are marked by the cyan dashed lines.