Sp receiver functions have been widely used to detect the lithosphere-asthenosphere boundary (LAB) and other mantle discontinuities, as the Sp phase is not contaminated by crustal reverberations. However, traditional common-conversion point (CCP) stacking is biased by the assumption of horizontal layers, and fails to image structures that dip at more than 10˚. A new pre-stack migration method based on recently developed Sp scattering kernels offers an alternative that more accurately captures the timing and amplitude of scattering. To test the method, synthetic Sp phases were predicted using SPECFEM2D (Tromp et al., 2008) for velocity models with a flat Moho and an LAB with a ramp structure. Sp times are estimated with the fast-marching method. To minimize spatial aliasing due to insufficient interference when using larger station spacing (for example 50 km), receiver function wavefield interpolation is conducted by either averaging (Neal and Pavlis, 1999) or compressive sampling (Herrmann and Hennenfent, 2008). The kernel-based prestack migration captures dipping features better than CCP stacking, but resolution is still poor. Several adjustments to the method offer additional improvement, including use of more vertically incident phases such as SKSp, and limiting the kernels to only those portions that are most sensitive to structures with a given dip. However, a third approach, which is more practical with real data and unknown structure, is to determine the portions of the kernels that have the greatest positive interference for the array geometry, and to downweight these portions, thus enhancing scattering from dipping structure where positive interference is lower. With this modification, the kernel-based prestack migration expands the dip range of well-resolved LAB dip to 20˚.

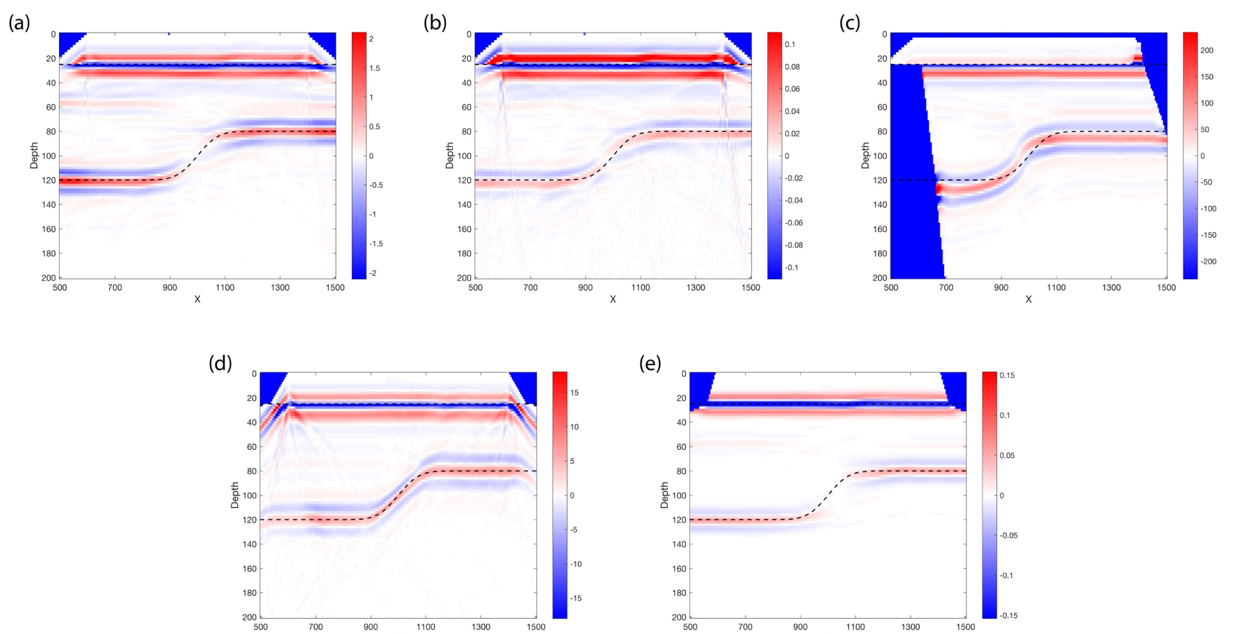

Figure 1. Migration results for the same structure using different methods. The velocity model contains crust, mantle lithosphere and asthenosphere. The locations of the Moho and LAB are shown by dashed lines on each plot; maxiumum LAB dip is 15˚. Axes have units of km. The station spacing here is 5km. A blue phase with red sidelobes indicates a velocity increase with depth, and vice versa a) Results of the new migration method without weighting for kernel interference. b) Results after weighting for kernel interference. c) Results using only the portion of the sensitivity kernel that is most sensitive to structure with dips of 10˚ to 20˚. d) Results with SKSp phases, and without weighting for kernel interference. e) CCP stacking.