High-resolution mapping of seismic properties across upper mantle discontinuities in the stagnant slab region beneath Korea

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Plate tectonic processes operating over much of the Earth’ s history induce long-term mantle mixing of chemical heterogeneities, recycling of volatiles into the mantle and regulate basalt geochemistry. Fundamental questions relevant to the mantle transition zone concern the nature of phase transition, the distribution of chemical heterogeneities (e.g., harzburgite, basalt), the temperature gradient, as well as the degree and extent of hydration and melting. One particularly important question is how the slab stagnation may be influenced by hydration or/and basalt enrichment in the mantle transition zone. To help answer these questions, we aim to detail upper mantle seismic discontinuity properties, including the shear velocity contrast, the density contrast, the transition sharpness and the gradient using high-quality receiver functions using broadband data in South Korea, which is located in the immediate vicinity of the imaged stagnant slab near northeast China.

Our approach involves broadband observation and amplitude analysis of direct converted waves (Pds) and multiples (PpPds) from the 410 and 660 seismic discontinuities, following our previous effort in a similar analysis in China. We processed waveforms from available broadband seismic stations of the Korea seismic array using an automatic scheme to remove noisy waveforms and retained close to ~12,000 high quality receiver functions. After gathering receiver functions as a function of epicentral distance, we perform slowness stacking of direct converted waves and the multiples, respectively, at several discrete frequency bands between 1 sec and 15 sec.. To avoid interferences from other mantle waves (PP, PPP, PcP, PP410s, PP660s), we stack receive functions across epicentral distances of 74-90 (62-76) degrees for the 410 (660) seismic discontinuity and obtain amplitude estimates and uncertainties through the bootstrap method. To properly calibrate the amplitudes of receiver functions, we take into account the effect of incoherent stacking due to discontinuity topography and frequency-dependent attenuation. Preliminary result will be presented and contrasted against our previous work in east China.

Keywords: transition zone, receiver function

