Geophysical Research Abstracts
Vol. 16, EGU2014-12883, 2014
EGU General Assembly 2014

Seismological and mineral physics constraint of velocity/density contrast across the 410 km seismic discontinuity beneath Chinese continent

Xuzhang Shen (1), Teh-Ru Alex Song (2), Xiaohui Yuan (3), and Lars Stixrude (4)

(1) Lanzhou Insititute of Seismology, China Earthquake Administration, Lanzhou, China (shenxzh@gmail.com), (2) Seismological Laboratory, Department of Earth Sciences, University College London, United Kingdom (alex.song@ucl.ac.uk), (3) GeoForschungsZentrum Potsdam, Telegrafenberg, 14473 Potsdam, Germany (yuan@gfz-potsdam.de), (4) Department of Earth Sciences, University College London, United Kingdom (l.stixrude@ucl.ac.uk)

Probing upper mantle discontinuities are essential to our understandings of mantle convection and the composition of Earth's interior. In particular, subduction process operating over long period of time induced long-term mantle mixing and provided a possible pathway of volatiles into the mantle. In this study, we focus on probing the density and shear velocity contrast across the 410 km seismic discontinuity (here after the 410) with receiver functions observed beneath China. In particular, we focus observations and modeling on direct P-to-s conversion (P410s) and reflection (PpP410s) to better constrain the density contrast across the 410.

We processed waveforms from 1000 stations of the Chinese seismic array using an automatic scheme to remove noisy waveforms to retain close to $\sim$300,000 high quality receiver functions. We only select receiver functions between 68-90 degrees to avoid interferences from PP and PcP phases. These receiver functions are then stacked as a function of epicentral distance at a period of 1 second, 3 seconds, 5 seconds and 10 seconds, respectively. The bootstrap method was used to obtain the amplitude estimate and uncertainties of P410s and PpP410s for each distance. Finally, we perform slowness stack for P410s and PpP410s for the entire China as well as each subnetwork to obtain robust amplitude estimates and uncertainties. These observations are used to constrain velocity and density contrast across the 410.

Typically, the amplitude of P410s is close to predictions by IASP91 model and some previous estimates. But the observed PP410s is generally very weak, consistent with a very low density contrast of 2% or less, which is smaller than previous seismic estimate and mineral physics prediction. While the amplitude of P410s and PpP410s may be influenced by topography of '410' and heterogeneities along the ray path, our results obtained for the whole China and several subnetworks indicate that moderate velocity contrast and very low density contrast across the 410 are consistently observed over spatial scale of 1000s of kilometers as well as 100s of kilometers.

This preliminary result may be influenced by the assumption of a first-order discontinuity in the model, which can be examined by the amplitude and pulse width of P410s and PpP410s and their frequency dependence. The pulse widths of P410s and PpP410s are almost identical at the period of 5 sec or less, but it is wider for the P410s at the 10 second period, potentially suggesting a non-linear gradient across the 410. The effect of velocity gradient on P410s and PpP410s as a function of frequency will be exploited and a suite of latest mineral physics predictions will be tested against these unique dataset to explore the effect of composition, temperature and melt.