Mantle discontinuities topography by SS precursors across the Amazon

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Abstract

The mantle transition zone (MTZ) separates the upper and lower Earth's mantle and is characterized by two large velocity gradients associated with mineral changes as the pressure and temperature increases. The MTZ thicknesses (MTZt) is influenced by the temperature close to the expected depths associated with the α- to **β**-Olivine (410km) and from □-Olivine to Spinel (660km). Mapping the MTZt can normally be performed by analyzing receiver functions (RF) for the upper mantle, or by SS precursors data. RF method is limited by station density in the area and recent studies showed important variations of the MTZt in stable south america. Nevertheless, the Amazon and surrounding areas showed large estimates of uncertainties and were very poorly resolved. We processed 143 GB of RAW global data, providing 163.419 seismograms used to estimate the travel time difference between the SS midpoint reflected waves in the mantle discontinuities. For that, we deconvolved the SS waveform in a window from the whole T (tangential) component seismogram, enhancing small amplitude conversions. Procedures were: 1. Verify stations ZNE direction; 2. Calculate bouncing point (BP) location; 3. Obtain T traces; 4. Select events with epicentral distances between 100° and 170° and depths < 75km; 5. Define SS Window Length (based on an Adapted Arias Intensity Algorithm); 6. Automatic statistical selection of traces; 7. Deconvolve; 8. Move-out using the IASP91 model; 9. Stack using instantaneous phase as weight; 10. Discard traces with SNR < 1.2. An automatic algorithm searched for BPs located near regular grid nodes and stacked all traces found in a radius that ranged from 3° to 10°, generating a final MTZt grid. Our algorithm searched for the minimum radius that returns at least 150 BPs inside the area. For each stacked trace, we picked the 410km and 660km precursors phase times. Time differences were converted to thickness, using a velocity model. Our final map had enough density of points between latitudes -20°S and 10ºN, with a higher density along an East-West direction over the Amazon region. Observed thickness anomalies for the SS precursors have a wavelength of at least 2-4 times the wavelength of the RF, due to the characteristics of the SS wave. The main observed anomaly is a region of thicker MTZ (270-280km) associated with the Nazca plate from -80°W (over Peru) to -50°W in the Amazon part. Also considering the northern part of the south american continent, we observed a slightly increased MTZt (260km) anomaly that joins to another positive anomaly under the Caribbean islands. Other areas of the plate did not show any significant changes. Considering specifically a profile over the latitude at -5°S our results indicate that the area of thickened MTZ spans from -80°W to -50°W, contrasting to previous results of RFs that had indicated a thinner zone centered on longitude -60°W. Due to the large amount of BPs that we have in this area, we believe that this was an effect of the low density of stations in the area when the RFs were processed.