Receiver function imaging of the Mantle Transition Zone beneath the Alpine region

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Abstract

The region between 410 km and 660 km depth, referred to as the Mantle Transition Zone (MTZ), is essential to understanding the Earth's thermal and chemical evolution. The thickness of the Mantle Transition Zone (MTZ), and seismic anomalies in this region could hold clues to its current thermal and chemical state. The seismic structure of MTZ is inferred from P-to-S (Ps) receiver function imaging, using data from 723 stations from 2016 – 2020, covering a much larger area of the Alpine region than previously imaged. A total of 1368 events with magnitude > 5.5 Mw, and a distance range of 35 to 80 degrees were used. Seismic records were pre-processed to remove instrument response, filtered using a zero-phase second order Butterworth filter with cut-off frequencies at 0.025 and 0.2 Hz, followed by rotation to ZRT and LQT system. Ps receiver functions were computed by deconvolving traces with clear P-wave phase from radial (R) and SV components (Q). Iterative time domain deconvolution and extended time multi-taper frequency domain deconvolution were used. Waves with clear P-, P410s, and P660s were selected and migrated to depth using regional 3D surface wave tomography model, and then back projected onto a 3D grid. Observations of the Moho from Ps receiver functions are consistent with global and regional crustal thickness estimates. The Alpine MTZ shows evidence for subduction of the European plate in the western Alps. Punctuated anomalies beneath the Alpine region, indicated by the deflection of the 410 km and 660 km discontinuities, show evidence of slab from past subduction events reaching the MTZ, consistent with previous regional studies. Further analysis could provide clues to the dipping orientation of the subducted slab.