P-wave velocity structures of the upper mantle and mantle transition zone beneath the northern South China Sea based on triplication fitting

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The South China Sea (hereafter as SCS) located in the southeastern Asia has been affected by the subduction of the western Pacific, Indo-Australian and Eurasian plates (Sun et al., 2018). Broadband P waveforms from the China Digital Seismograph Network (Zheng et al., 2010) for three intermediate-depth earthquakes that occurred closely in Mindoro, Philippine are used to detect velocity structures of the lowermost upper mantle and mantle transition zone (MTZ) beneath the northern SCS. The study area is divided into five profiles distributed from southwest to northeast azimuthally to reduce the computational costs and concern possible lateral variations (Li et al., 2018), and the corresponding 1-D best-fit velocity models are obtained from the observed and synthetic triplicated waveform fitting based on the iterative grid-search procedure. The searching grid can be described as below, three parameters for the low-velocity layer (LVL) atop the 410 km discontinuity (hereafter as the 410), five parameters for the high-velocity anomaly (HVA) atop the 660 km discontinuity (hereafter as the 660) and one parameter for the velocity perturbation below the 660. After the sensitivity tests of the synthetic waveforms with different parameters, the grid steps of the depth and velocity perturbation are set as 5 km and 0.5%, respectively.

Relative to the reference model IASP91 (Kennett and Engdahl, 1991), our results reveal that there are ubiquitous HVAs in five profiles at the bottom of the MTZ with a velocity increment of 1.5–3.5% and a thickness of 209–219 km, which show no apparent progressive velocity increment or decrement along the southwest-northeast direction. We prefer that the weak and abnormal thick HVAs are induced by the proto-SCS north slab remnants. We also observe an uplift 410 and depressed 660 with the depth change of 5 km and 5–15 km, respectively, which further support the low-temperature anomaly related to the stagnant slab. In addition, our results show there is an LVL atop the MTZ with a velocity decrement of 2.0–2.5% and a thickness of 60–75 km, and can be interpreted by the partial melting induced by upwelling materials from the MTZ, which are hydrated by water released from the stagnant slab. We infer that the LVL with little lateral variations may result from the percolation of the partial melts atop the MTZ under vertical
pressure.


