3D topography of mantle transition zone beneath Northeast China :constraints from receiver function with Ps scattering kernel

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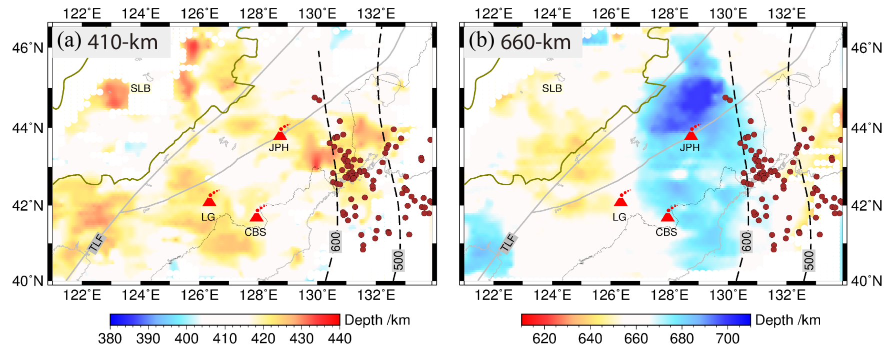
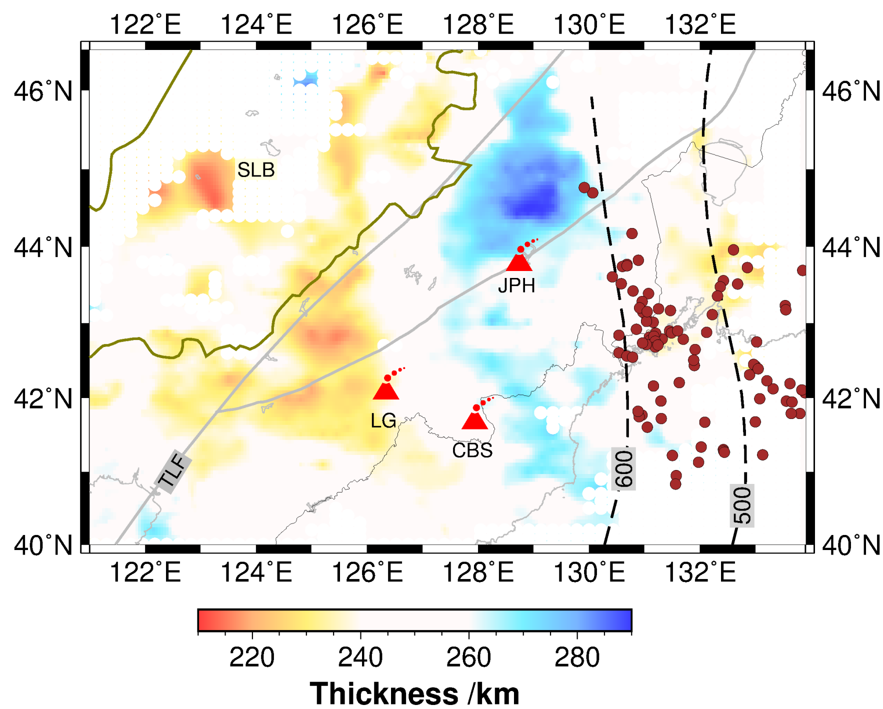
Abstract

Mantle transition zone (MTZ) is the layer between two seismic upper mantle discontinuities, which are generally believed to be caused by the transformation of high-pressure polymorphs of olivine occurred around depth of 410 km (d410) and 660 km (d660). The fine structure around the discontinuities, especially the undulation of them can be used to infer the variation of temperature and/or composition in the deep mantle. Seismic images have revealed a subhorizontally deflected slab beneath Northeast China, and thus the seismic mapping of the interaction between the slab and the deep mantle is important in understanding the mantle circulation as well as the upper mantle composition. Recently, a temporary NECsaids Array has been installed, and it consists mainly of two nearly orthogonal dense profiles with station spacing of 15–20 km, which provides us an unprecedented opportunity to obtain a high-resolution 3D topography of the MTZ. Considering the dipping and stagnant structure of the slab, we used a novel Ps scatter kernel migration technique to obtain the detailed image of the d410 and d660, which has been proved to be efficient and better for more complex structures. Our results show that the boundaries of the subducting Northwest Pacific slab can be clearly identified in the image, with a dip angle of about 30° in the MTZ. The depth of the d660 depressed 20 - 40 km around the stagnant part of the subducting slab, which could be explained with the lower temperature caused by the cold Pacific slab. Moreover, the d660 is uplifted about 5 - 15 km beneath northwest of Changbaishan and Longgang Volcano, suggesting that the upwelling feeding the volcanoes might originate from the MTZ. Apart from the prominent depression of the d410 observed in the volcanic area, we also observed a wide-distributed depression of the d410 with value ~10 km over most studied areas, seeming inconsistent with the thermal anomaly associated with the subduction environment. We argue that subtle variations of water and/or chemical composition contribute to the observed depth variation of the d410, and the apparent depressed "410" can be related to the wet/dry wadsleyite boundary, which might be caused by the high water content at the top of the MTZ.


(a) 410-km
(b) 660-km
122˚E
124˚E
126˚E
128˚E
130˚E
132˚E
40˚N
42˚N
44˚N
46˚N
SLB
JPH
LG
CBS
TLF
600
500
Depth /km
380
390
400
410
420
430
440
620
640
660
680
700


122˚E
124˚E
126˚E
128˚E
130˚E
132˚E
40˚N
42˚N
44˚N
46˚N
SLB
JPH
LG
CBS
TLF
600
500
220
240
260
280
Thickness /km

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3D topography of mantle transition zone beneath Northeast China： constraints from receiver function with Ps scattering kernel

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Abstract Text:

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