東北アジアのプレート内部火山の深部構造と起源
Deep structure and origin of the intraplate volcanoes in Northeast Asia

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We have investigated the detailed mantle transition zone (MTZ) structure beneath the active Changbai intraplate volcano in NE Asia by using seismic tomography and receiver-function methods. Teleseismic receiver functions recorded at many broadband stations are obtained by using a common-conversion-point stacking method. For conducting the time-to-depth conversion, we use a 3-D velocity model of the study region so as to take into account the influence of structural heterogeneities. Our results reveal significant depth variations of the 410, 520, and 660 km discontinuities. A broad depression of the 410 km discontinuity and a low-velocity (low-V) anomaly are revealed beneath the Changbai volcano, which may reflect a large-scale hot mantle upwelling around the 410 km discontinuity with a positive Clapeyron slope. The 520 km discontinuity is identified clearly, and its uplift occurs above the stagnant Pacific slab. We also find a prominent depression of the 660 km discontinuity, which is elongated along the trend of deep earthquake clusters in a range of 39˚N–44˚N latitude, and the depression area has a lateral extent of about 400 km. Because the 520 and 660 km discontinuities correspond to positive and negative Clapeyron slopes, respectively, we think that the 520 uplift and the 660 depression are caused by the cold subducting Pacific slab. A part of the Pacific slab may have penetrated into the lower mantle and so caused the large-scale 660 depression in front of the deep earthquake clusters. Our results also reveal a part of the upper boundary of the subducting Pacific slab in the MTZ.

High-resolution P-wave velocity (Vp) tomography of the upper mantle beneath NE China is obtained by inverting teleseismic P-wave travel-time data recorded by two dense linear arrays. The inclusion of the new data set has greatly improved sampling of the upper mantle beneath the study region, providing tight constraints on the seismic structure under the intraplate Wudalianchi and Halaha volcanoes. Local-scale low-Vp anomalies are revealed in the shallow mantle beneath the two volcanoes, whereas a large-scale high-Vp zone is imaged in the MTZ. These new results suggest that the two volcanoes, though located at different sites above the stagnant Pacific slab in the MTZ, are likely related to the deep subduction and dehydration of the Pacific slab, possibly through hot and wet upwelling in the big mantle wedge beneath Wudalianchi and through deeper hydrous upwelling related to slab avalanche beneath Halaha. Our results also reveal other striking features, such as high-Vp anomalies resting atop the 410-km discontinuity beneath the Great Xing'an Range and the Songliao Basin, which are attributed to detached continental lithosphere. The delamination most likely occurred in the Cretaceous, which induced widespread magmatism in NE China.

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