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Teleseismic traveltime tomography of the southern Korean Peninsula: Implications for the lithospheric evolution in the eastern continental margin of the Eurasian plate

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The eastern margin of Precambrian Eurasian plate has experienced multiple tectonic events since the post-Paleozoic including continental collisions and extensions, subduction of oceanic plates, and intraplate volcanism. To understand the evolution of the continental margin, we constrained 3-D upper mantle velocity structure beneath the southern Korean Peninsula (SKP) by teleseismic traveltime tomography. We used seismic data recorded by 189 permanent stations deployed in and around SKP. The dataset allowed us to estimate high-resolution P and S wave velocity structures from the uppermost mantle to depths of 400 km. We found a prominent velocity contrast within the upper mantle beneath SKP showing relatively low (dVp<-1%, dVs<-2%) in the east and northeast and relatively high (dVp>1%, dVs>2%) in the west and southwest. In particular, the high-velocity anomaly extends vertically to depth greater than 200 km beneath the southwestern part of SKP. Considering that SKP is mainly composed of Precambrian basements (e.g., Gyeonggi and Yeongnam massifs), the high-velocity structure indicates a fragment of continental lithosphere with a deep root. In addition, the high-velocity structure exhibits a sharp decrease in thickness to 100 km within ∼100 km of horizontal distances toward its eastern, southern, and northern margin, as an evidence of modified marginal lithosphere. On the other hand, there are low-velocity zones beneath the eastern mountain ranges and Cretaceous Gyeongsang back-arc basin. We also found small-scale positive velocity anomalies surrounded by low-velocity anomalies beneath the eastern SKP at depth ∼300 km which may indicate detached lithosphere. Our results suggest heterogeneously modified continental lithosphere beneath SKP which might have suffered from complex thermal and geodynamic processes likely at the continental lithospheric margin (e.g., convective erosion/lithospheric delamination).