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Upper crust shear wave tomography of South Korea estimated by explosion and earthquake data

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This study presents the 3 D variations of shear wave velocity of upper crust in the southern Korean peninsula, estimated using earthquake data as well as refraction experiment data with large explosion. Composing two different data sets in different period ranges, we obtained group velocities over an extended bandwidth. The inversion of the group velocities with the extended bandwidth secured better resolution and produced much better agreement between the group velocity data and the prediction from the inversion model. Our 3 D images of the shear wave velocities correlate very well with the local geology and tectonics, showing low velocities in the Cretaceous sedimentary basins in the Gyeongsang basin and the Honam shear zone and high velocities in the Gyeonggi and Yeongnam massifs. The velocities of the Okcheon fold belt are lower than those of the two massifs and higher than those of the Gyeongsang basin. The velocity profiles of three tectonic zones, the two massifs and the fold belt, are different from the velocity profile of the Gyeongsang basin. While the three tectonic zones show a rapid increase from 2.6 km/s at the surface to 3.2 km/s at 1 km depth, followed by a gradual increase to 3.2 km/s at 3-4 km depth, and then a very slow increase to 3.5 km/s at 6-7 km depth, the Gyeongsang basin shows the steepest velocity gradient between 2-3 km depth. The depth of the Gyeongsang basin inferred from the steepest velocity gradient in the vertical velocity sections is estimated at $\sim$3 km, while for the small basins along the Honam shear zone, it is estimated to be less than 2 km. High shear wave velocities are found in the NE area of the Gyeonggi massif and at the SW tip of the Yeongnam massif where the pre-Cambrian metamorphic complex is widespread.