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Crustal Structure Across Northern Taiwan Determined by the 2008 TAIGER Land Refraction Experiment Data

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Taiwan is located along a segment of the convergent boundary between the Eurasian and Philippine Sea plates. East of the island, the Philippine Sea plate has subducted northward beneath the Eurasian Plate. The collision of two plates has generated the ongoing Taiwan Orogen. Currently, seismic studies have given us some indications of the velocity structure beneath Taiwan and the gravity data also have provided depth models of the Mohorovičić discontinuity. However, high-resolution images of the crust and upper mantle adjacent to the boundary and detailed seismic velocity analyses are still insufficient in this region. The experiment of the 2008 wide-angle seismic refraction from the project of Taiwan Integrated Geodynamic Research (TAIGER) provided a valuable dataset to determine high resolution image of the crust. We attempt to construct a two-dimensional model for seismic velocity across the northern part of the island from P-wave arrival times of TAIGER data. We selected data from the Transect 6 line. It is an onshore seismic survey spanned approximate 100-km in northern Taiwan with receiver spacing in 200 meters and consists of five explosions with the dynamite from 750 to 3000 kilograms.

In this study, we employed the ray-tracing method for forward modeling which is developed by Zelt and Smith in 1992. This popular and readily method is able to determine depth and velocity simultaneously. By adjusting iteratively until the minimum of root-mean-square misfits between observed and simulated travel times is achieved. In addition, the normalized chi-squared, χ^2, is taken into account as well. In general, an appropriate value of χ^2 is considered that the data have been fit suitably. Eventually, we can thus obtain the optimal velocity model. During the modeling that we referred as layer stripping, we first picked the initial arrivals to constrain the uppermost crustal structure. We then traced ray paths from different layers respectively. In this way, we could build up the whole velocity structure step by step. The preliminary results for shallow structures indicate that this method yield results consistent with geological structures and provide details for velocity with depths. Velocities at the uppermost crust indicate strong lateral variations of P-wave velocities, ranging from 2.3 km/sec to 4.4 km/sec and increase from 2.8 km/sec to 4.8 km/sec at the bottom of this layer. The largest velocity gradient in this layer is under the Central Range. We will continue our study for the deep layers to establish a detailed velocity models.