High Resolution 3-D Shear Wave Velocity Model of Northern Taiwan via Bayesian Joint Inversion of Rayleigh Wave Ellipticity and Phase Velocity with Formosa Array

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Taiwan located at the convergence margin of the Eurasian Plate (EP) and Philippine Sea Plate (PSP) is one of the most active orogenic belts around the world. Under vigorously tectonic activities, the northern Taiwan is composed of complicated geological features including rifting basins, fold-and-thrust systems, volcanoes, and hydrothermal activity. In this study, we apply the technique of Ambient Noise Tomography (ANT) to eight months of continuous waveforms from the Formosa Array and Broadband Array for Seismology in Taiwan (BATS), with 137 broadband stations and ~5km station spacing. We first calculate multi-components cross-correlation functions to extract the information of Rayleigh wave signals. We then invoke Eikonal tomography to calculate the phase velocity map through 3 to 10 second periods and estimate Rayleigh wave ellipticity at each station between 2 to 13 second periods. For each grid point, we jointly invert the two types of Rayleigh wave measurements through a Bayesian-based inversion method to obtain the local 1-D shear wave velocity model. All 1-D models are then combined to construct a comprehensive 3-D model. Our 3-D model reveals upper crustal structures that well correlate with surface geological features. Near the surface, the model delineates the low-velocity Taipei and Ilan basins from the adjacent fast-velocity mountainous areas, with basin geometries consistent with the results of previous geophysical exploration and geological studies. At greater depths, low velocity anomalies are observed associated with the Linkou tableland, Tatun volcano group, and a possible dyke intrusion beneath the southern Ilan basin. The model also provides new geometrical constraints on the major active fault systems in the area, which are important to understand the basin formation and orogeny dynamics. The new 3-D shear wave velocity model allows a comprehensive investigation of shallow geologic structures in northern Taiwan.