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Improved seismic tomography offshore northeastern Taiwan: implications for subduction and collision processes between Taiwan and the southernmost Ryukyu

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SUMMARY

To improve the resolution in imaging the 3-D V_P and V_P/V_S structures in the Taiwan region, especially offshore eastern Taiwan, we combine the arrival times from eleven ocean bottom seismometers (OBSs) and from seismic stations of the Japan Meteorological Agency (JMA) with those from the permanent stations of Taiwan Central Weather Bureau Seismic Network (CWBSN) and Taiwan Strong Motion Instrumentation Program (TSMIP). By doing so, we have obtained a new 3-D tomographic model for Taiwan and its surrounding regions with a better resolution, especially in the area offshore northeastern Taiwan. We also used this new tomography model to relocate the hypocentres of the earthquakes in northeastern Taiwan and determined the focal mechanisms of relatively large events. Our tomography results indicate that in the region northeast of Taiwan, the subducting oceanic Philippine Sea Plate beneath the Eurasian continental lithosphere is characterized by a high V_P layer, surrounded by lower V_P areas. This *P*-wave velocity characteristics of the subducting slab provides a better constraint on the geometry of the subduction interface, especially in its shallower portion. In the hangingwall (Eurasian) block above the subduction interface, a vertically elongated high V_P/V_S body appears to originate from the interface at depths between 100 and 140 km. We suggest that it represents the partially melted materials that are related to the magmatic activity of the Ryukyu volcanic arc.

Key words: Seismicity and tectonics; Seismic tomography; Subduction zone processes; Dynamics: seismotectonics; Asia.

1 INTRODUCTION

A good understanding of the 3-D seismic structure is a very important foundation for a variety of earthquake research topics, such as earthquake relocation, earthquake source study and seismotectonic investigations. In the area of Taiwan, an active collision zone between the Eurasian and the Philippine Sea plates, a detailed 3-D velocity model is crucial to the understanding of the active structural characteristics and the tectonic evolution of the collision zone. To this end, there has been a long history of attempts in imaging the seismic velocity structure in the Taiwan region. One of the first tomographic studies for Taiwan was carried out more than two decades ago by Roecker *et al.* (1987) using the *P*-wave arrival times observed by the Taiwan Telemetered Seismographic Network (TTSN), which was operated by the Institute of Earth Sciences, Academia Sinica.

Initially, the TTSN consisted of only 25 stations, equipped with vertical-component, short-period seismometers. Since the incorporation of TTSN into the Central Weather Bureau Seismic Network (CWBSN) in 1991, many more stations have been installed, and now the CWBSN involves 71 telemetered stations, equipped with three-component S13 seismometers. Including the retired stations, the CWBSN has a total of 91 different sites. Fig. 1 shows the distribution of the CWBSN stations. The CWBSN offers a better station coverage for the Taiwan region, leading to a series of *P*- and *S*-wave velocity models (e.g. Shin & Chen 1998; Rau & Wu 1995; Ma *et al.* 1996; Kim *et al.* 2005).

Recently, we obtained regional 3-D *P*-wave and V_P/V_S structures by combining a large data set of *S*–*P* times from the Taiwan Strong Motion Instrumentation Program (TSMIP) records, with the *P*- and *S*-wave arrival times from the CWBSN stations (Wu *et al.* 2007). The TSMIP data set, with more than 800 stations located