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# Seismic tomography of Taiwan: Improved constraints from a dense network of strong motion stations

Yih-Min Wu,[1] Chien-Hsin Chang,[2] Li Zhao,[3] J. Bruce H. Shyu,[4] Yue-Gau Chen,[1] Kerry Sieh,[4] and Jean-Philippe Avouac[4]

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[1] In this study, a large collection of 41,141 *S-P* times from the untapped records of the Taiwan Strong Motion Instrumentation Program (TSMIP) network is combined with the *P* and *S* wave arrival times from the Taiwan Central Weather Bureau Seismic Network (CWBSN) to image the $V_p$ and $V_p/V_s$ structures beneath Taiwan. The records from the 680 TSMIP stations throughout Taiwan in the past 15 years enhance the path coverage and the resolution in the tomography inversions tremendously. Our result for the $V_p$ structure largely confirms previous studies but brings better constraint on the $V_p/V_s$ structure. The colliding Luzon volcanic arc is characterized by a belt of high $V_p$ and high $V_p/V_s$ with high seismicity that includes the offshore islands of Lutao and Lanyu and the Coastal Ranges in eastern Taiwan, at the depth between about 13 and 25 km. This high $V_p/V_s$ belt can be traced to the subduction zone in the region between Hualian and Ilan in the deeper portion. The shallow portions of the southwestern coastal plain and the Pingtung region are also characterized by a belt of high $V_p/V_s$ with lower seismicity. Most of the events occurred at the base of the high $V_p/V_s$ zones. We suggest that material strength in those regions may be too low to accumulate stress, which may indicate water-saturated young sediments. Finally, the Central Range region is characterized by a low $V_p/V_s$ belt.

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## 1. Introduction

[2] Taiwan is situated in the western portion of the Pacific Rim seismic belt. In the east, the Philippine Sea plate subducts northward under the Eurasian plate along the Ryukyu trench. Off the southern tip of Taiwan, the South China Sea subplate, part of the Eurasian plate, subducts eastward under the Philippine Sea plate. Figure 1 is a schematic diagram showing the major geologic settings in the region. Most of Taiwan is under a northwest-southeast (NW-SE) compression with a convergence rate of about 8 cm/yr [*Yu et al.*, 1997]. The Taiwan orogeny, started around 4 Ma [*Suppe*, 1984], is relatively young on the geological timescale. The island has a high rate of crustal deformation and a strong seismic activity, and many disastrous earthquakes have occurred in the past. These damaging earthquakes can be divided into two general classes: earthquakes offshore Hualien due to the subduction of the Philippine Sea plate northward under the Eurasian plate, and the ones associated with active faults on the main island.

[3] The Longitudinal Valley in the southeast (4 in Figure 1) is the suture zone of Eurasian and Philippine Sea plates, and separates Taiwan into two major tectonic provinces. The eastern side consists of the Coastal Ranges and several volcanic islands, and is the leading edge of the Philippine Sea plate. The western province is associated with the Eurasian continental shelf [*Ho*, 1999] and can be classified into four NNE-SSW trending geological belts. They are, from west to east, the Coastal Plain, the Western Foothills, the Hsueshan Ranges, and the Central Ranges.

[4] One of the earlier tomographic studies in the Taiwan region was carried out by *Roecker et al.* [1987] using the *P* wave arrival times observed by the Taiwan Telemetered Seismographic Network (TTSN). The TTSN was operated by the Institute of Earth Sciences, Academia Sinica, and consisted of only 25 stations equipped with vertical component, short-period seismometers. The network provided very limited coverage on the three-dimensional (3-D) seismic structure in the region.

[5] The TTSN was incorporated into the Central Weather Bureau Seismic Network (CWBSN) in 1991. Since then, many more stations have been added to the CWBSN, which now consists of 71 telemetered stations equipped with three-component S13 seismometers. Figure 2 shows the station distribution of the CWBSN. *Rau and Wu* [1995]

[1]Department of Geosciences, National Taiwan University, Taipei, Taiwan.
[2]Central Weather Bureau, Taipei, Taiwan.
[3]Institute of Earth Sciences, Academia Sinica, Nankang, Taipei, Taiwan.
[4]Tectonics Observatory, California Institute of Technology, Pasadena, California, USA.


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