Improving Focal Mechanisms for Earthquakes in Taiwan Strait and Ryukyu Subduction Zone with Broadband Waveforms of Combined Networks

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Taiwan region is a seismically active region formed by the oblique convergence between Philippine Sea Plate and Eurasia Plate. Focal mechanisms of most small-moderate sized earthquakes can be well constrained by the local seismic array, except for those occurred offshore Taiwan where azimuthal coverage is limited. To better understand the tectonic structures, it is desirable to improve the focal mechanisms using better located hypocenters, reasonable velocity models, and the best available stations. In this study we focus on the shallow earthquakes in Taiwan Strait and the intermediate-depth earthquakes in southernmost Ryukyu. Both regions are less explored but large historic events had been reported.

For earthquakes in Taiwan Strait, we systematically studied earthquakes from 1996 to 2019, including the Mw 5.7 Taiwan Shoal sequence happened on 2018/11/25. A total of 22 new moment tensors (MTs) were resolved in the passive margin by combining Fujian and Taiwan seismic networks from either side of the strait. For events closer to Fujian, China, the velocity model with Moho depth of 35 km yields overall lower compensated linear vector dipole (CLVD) and acceptable misfit values; while as a 40 km thick crust is better for events closer to or on the shore of Taiwan. This Moho variation under the Taiwan Strait, although subtle, agrees well with the velocity structure constrained independently by previous studies. Earthquakes in the middle of the strait are dominant in strike-slip and normal slip within 30 km depth. Shallow thrusting events are found only in the Miaoli offshore area of Taiwan. As for the 2018 Taiwan Shoal earthquake sequence, it is located right on the region absence of known fault-plane solutions, therefore offers important new constraints. All events of the sequence show high angle strike-slips and shallow centroid depth of 11-21 km, more consistent with seismicity determined by Fujian seismic center. This event is far away from the M8 1604 Quanzhou earthquake, and is also clearly unrelated to the structure of 1994 Mw 6.7 normal-faulting event in Tainan Basin. The 2018 sequence is probably the reactivation of a pre-existing normal fault that was created by rifting during the Cenozoic.

For future work, we will re-evaluate the MTs of M>5.5 intermediate-depth earthquakes of the Ryukyu subduction zone by including waveforms of stations YNG and IGK from Japan network in the inversion. We will also test different upper mantle velocities in the model for the computation of Green’s functions. We anticipate that our work can provide a set of parameters more suitable
for the MT inversion, and the MT results can delineate the Ryukyu subduction zone properties better.

keywords: Taiwan Strait, focal mechanisms, moment tensor inversion