Tomography of the source zones of the recent damaging earthquakes in Taiwan

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The 2016 Southern Taiwan earthquake (Mw 6.4) occurred on February 6, 2016, in Kaohsiung City, southern Taiwan, at a depth of 17 km. On February 6, 2018, an Mw 6.4 earthquake occurred near Hualien City, northern Taiwan, at a depth of 11 km (hereinafter we call it the 2018 Hualien earthquake). The two inland earthquakes caused many fatalities and widespread damage to infrastructures in the populated areas. To clarify the generating mechanism of these damaging earthquakes, we conducted seismic tomography for high-resolution 3-D Vp, Vs and Poisson’ s ratio (σ) structures in the epicentral areas. In this presentation we review the results for the 2016 Southern Taiwan earthquake (Toyokuni et al., 2016, GJI), and show the first tomographic results for the 2018 Hualien earthquake.

For both of the tomographic analyses, we used a huge number of P- and S-wave arrival times from local earthquakes (0.6 <= M <= 7.1) recorded at local seismic stations operated by the Central Weather Bureau in Taiwan during 2000-2011. Our tomographic images reveal significant variations of up to 6% for Vp and Vs, and 10% for Poisson’ s ratio in the crust and uppermost mantle beneath the two source areas.

The hypocenters of both the 2016 Southern Taiwan and the 2018 Hualien earthquakes are located in a boundary zone where seismic velocity and Poisson’ s ratio change drastically in both the horizontal and vertical directions. The 2016 Southern Taiwan hypocenter is underlain by a vertically elongated high- σ anomaly at depths of 23-40 km. The 2018 Hualien hypocenter is located at the eastside of a wall of high- σ anomaly at depths of 5-30 km. These high- σ anomalies coincide with areas of low heat flow (Hsieh et al., 2014), negative Bouguer gravity anomaly (Yen and Hsieh, 2010), and low magnetotelluric resistivity (Bertrand et al., 2012), which may reflect crustal fluids contained in the young fold-and-thrust belt and the dehydration of the subducting Eurasian plate under South Taiwan and the subducting Philippine Sea slab under North Taiwan. These results suggest that the 2016 Southern Taiwan and the 2018 Hualien earthquakes were caused by a similar mechanism, related to the ascending fluids from the subducting slab dehydration, invading into an active fault with a high loading rate.

Reference:
Toyokuni, G., D. Zhao, K.H. Chen (2016) Tomography of the source zone of the 2016 South Taiwan earthquake. Geophys. J. Int. 207, 635-643.

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