High-resolution 3-D Shear Wave Upper-crust Structures in Ilan Plain using Ambient Noise Tomography

Presenter: Kai-Xun Chen [1]　　Adviser: Po-Fei Chen [1], Wen-Tzong Liang [2]

[1] Department of Earth Sciences, National Central University

[2] Institute of Earth Sciences, Academia Sinica

The Ilan Plain (IP) in NE Taiwan locates on the western end of the Okinawa trough and exhibits high geothermal gradients with abundant hot springs, likely resulting from magmatism associated with the back-arc spreading as manifested by the offshore volcanic island (Kueishantao) [Lin *et al.,* 2004]. North and south sides of IP are divided by Lan-Yang river with distinctive characteristics. Comparing to the northern part, the southern part exhibits, relatively, thin unconsolidated Quaternary alluvium layer with depths ranging from 0 to 1.4 km (Chiang., 1976), high on-land seismicity and significant SE movements relative to Penghu island. Purposes of this study are two folds. By obtaining a high-resolution 3-D shear wave upper-crust structures, we aim at (1) assessing the extent of underground geothermal sources as revealed by low velocity anomalies, (2) mapping 3-D sedimentary structures as revealed by the structures of very low velocity zones at surface.

To fulfill this goal, we deployed 89 Texan instruments (~2 km station interval) between Aug. 2014 and Jan. 2015, covering most of the IP and its vicinity. We conduct methods of ambient noise tomography for inversion of high-resolution 3-D shear wave upper-crust velocity structures. Firstly, we estimate empirical Green's functions (EGF) of Rayleigh wave between station pairs by ambient noise cross-correlation. Secondly, dispersion curves of group and phase velocities are measured at the frequency range between 0.2 and 1.66 Hz from each EGFs. Frequency-time analysis [Levshin *et al.,* 1989] and Image transformation technique [Yao *et al.,* 2006] are used to measured group and phase velocities at each period, respectively. Finally, we apply a fast marching method for inhomogeneous-medium ray tracing between station pairs. We also adopt a wavelet-based sparsity-constrained tomography method for the direct inversion of 3-D shear wave velocity structures [Fang *et al.,* 2015].

Results show that the lowest shear wave velocity can be as low as 0.2 km/s. mostly at depths shallower than 625 meters. Having examined the vertical cross-sections of each profiles, the spatial distributions of low velocity zones well match to those of sedimentary structures as shown by seismic reflection survey (Chiang, 1976). Results in west IP show that local low velocity anomalies with depth shallower than 1.875 km display in regions of known geothermal wells.

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