Shallow crustal velocity structures obtained from ambient noise study of dense broadband seismic array in the Tatun Volcano Group of Taiwan

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The Tatun Volcano Group (TVG) is located in the northern tip of Taiwan Island with a radius of 10 km. The TVG situates adjacent to the Taipei metropolis in the north and was predominantly active in the Quaternary period. Shanchiao Fault is an active normal fault transits the TVG in northeastern orientation. A sequence of normal faults and scarps inspected on the hanging wall of Shanchiao Fault and sub-parallel to its orientation in the extent of TVG. Since the major geothermal activities such as fumaroles, solfataras and hot springs also expose on the hanging wall of the Shanchiao Fault, it is thought to be the passage for volcanic-hydrothermal gas and fluid. Besides, Kanchiao Fault is a suspected active fault and known as the important geologic structures adjacent to the southeast of TVG.
The subjects about TVG is already extinct or still active are also under frequent discussion. Attribute to new technological advances and methodologies improvement, various types of observations and experiments were implemented to monitor the activities of TVG in recent years. Basing on the results of these recent researches, various evidence proved that TVG is not extinct, should be a potentially active volcano and cannot exclude the possibility of volcanic eruptions in the future. It is important to understand the magma chamber and detailed velocity structures below the TVG but are still not well resolved. The fundamental theory to obtain S-wave velocity structure from ambient seismic noise analysis has been already proofed and provided important constraints around the world in the past decade. We present the results of ambient seismic noise studies in the TVG with dense seismic monitoring network.
The seismic network in this research is composed with three sub-networks, totally there are 40 free-field seismic stations equipped with Güralp CMG-6TD broadband seismometers and GPS timing system. The interstation distances are between 0.6 km and 28 km, with an average of 8.5 km. The cross-correlation functions (CCFs) were calculated with the methodologies of one-bit cross-correlation and spectral whitening. We selected vertical component to obtain the CCFs in the period band 0.5-7 s for all station-pairs and derived with the selected daily recordings in 2014. The daily CCFs were stacked monthly and then the monthly CCFs were stacked again to further obtain TDEGFs and Rayleigh wave phase velocity dispersion curves. We stacked positive and negative lag times of TDEGF to enhance coherent signals and suppress the effect of uneven seismic noise sources distribution. The maximum period can be measured for each station-pair is related to the inter-station distance and phase velocity. For far-field approximation, the inter-station distance is required to be at least twice of propagating surface wave wavelengths in this study to assure surface wave can well develop between station-pair.
We focus on phase velocity maps in the period band 0.5-3 s in the TVG and the study region is parameterized by 0.02°×0.02° grid points. Phase velocity maps show high velocities are dominate between Shanchiao Fault and Kanchiao Fault at study periods, which maybe relate to the solidified andesite lava. Especially in the south parts of Jinshan area, which locates the earliest stage of volcanic activities in the TVG. At periods longer than 2.5 s, high velocities separate into two major regions beneath the ChiShingShan and south parts of Jinshan area. At periods shorter than 1 s, there are some localized low velocity areas correlate well with the surface geothermal

activities. The regions north (footwall) of Shanchiao Fault show low velocities at the study periods maybe relate to the Tertiary strata already covered by andesite lava flows with dozens of meters thickness. The detailed S-wave velocity structures in the shallow crust will be investigated and searching for possible candidates of magma passages and hydrothermal reservoirs beneath TVG.

Keywords: ambient seismic noise tomography, Tatun Volcano Group, shallow crust

