

Ground penetrating radar profiling across the Sanchiao fault in northeast Taiwan

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Keelung earthquake (M 6.9-7.2) occurred on December 18, 1867, in northeast Taiwan. The seismic intensity distribution and tsunami runup height distribution for this earthquake were estimated from a review of relevant literature. The seismic intensity of the earthquake reached a maximum of VII at downtown Jinshan (northeast Taiwan) according to the scale of the Central Weather Bureau of Taiwan (Cheng et al., 2016 TAO), whilst the tsunami runup height reached 6-15 m along the northeast coast of Taiwan. From the seismic intensity distribution, the source fault of the Keelung earthquake is estimated to have been at the seaward extension of the Sanchiao fault (Cheng et al., 2016 TAO). The Sanchiao fault is a normal fault, approximately 53 km in length, and passes from the south of Taipei through to Jinshan (Shyu et al., 2015 TAO). From morphological surveys, borehole surveys, and seismic reflection surveys, the Sanchiao fault is estimated to pass along the foot of the mountain to the north of downtown Jinshan. However, it is unclear whether the land area of the Sanchiao fault moved in 1867. Therefore, we carried out a Ground Penetrating Radar (GPR) survey to detect the location of the Sanchiao fault.

The GPR survey was carried out on a coastal dune to the north of Jinshan. The coastal sand dune runs in a northwest-southeast direction along the shore, perpendicularly to the Sanchiao fault. The following two types of GPR survey lines were set up: a long range type (100-200 m) running parallel to the coastal dune, and a short range type (20 m) running perpendicularly to the coastal dune. Surveys were carried out from August 15-17, 2017 and from August 13-17, 2018. Three short lines were set up parallel to the dune and two lines perpendicularly to the dune. The pulseEKKO from Sensors & Software Inc. was used for the GPR survey, and the survey frequency of the radar was 50 MHz, 100 MHz, and 250 MHz.

A conspicuous radar reflector was found in the survey line running parallel to the coastal dune. The depth of this reflection changed near the fault trace of the Sanchiao fault, as estimated from boreholes. Furthermore, the depth of the reflection at the northwestern region of the fault was approximately 1 m deeper than that at the southeastern region. This is inconsistent with the vertical displacement of the normal faulting of the Sanchiao fault that dips southeastward, and suggests that the deformation could have been caused by the branching off of the splay fault from the main Sanchiao fault.

Keywords: active fault, 1867 Keelung earthquake, Ground Penetrating Radar