

Active deformation front off Hsin-Chu industrial area revealed by fault-propagation folds in northwestern Taiwan

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The western foothills of the Taiwan orogen is characterized by a series of highly active folds and thrust faults. The largest earthquake that occurred in northwestern Taiwan is about magnitude ML6.8, happened in the Hsinchu area in 1935. Several significant aftershocks also happened in the onshore/offshore area. Based on the focal mechanisms, faults belong to right-lateral oblique thrusts. From north to south, the major faults in this area are the Hukou Fault, the Hsinchu Fault, and the Longkang Fault, which are roughly in E-W orientation. The deformation front is supposed to be distributed across the onshore and offshore area, though the deformation front in the offshore area is not unknown. In order to understand the structure of this tricky deformation front, we have collected several sub-bottom profiler data and 24-channel high-resolution sparker reflection seismic profiles. Our analysis shows that three consecutive folds in the nearshore area of northwestern Taiwan are fault-propagation folds. The folds are located from the north to the south in three areas (Area 1, Area 2 and Area 3). Three fault series are also identified in the three areas and are named F1, F2, and F3, respectively. Three seismic strata were identified; T1 and T2 are the top surfaces of folds in Area 1, Area 2, and Area 3, and U3 is the uppermost unconformity in the seismic profiles. The T1 surface is overlaid by the sediments, and the trend is around N60°E, which is the same as the fold structure onshore. The F1 fault series are branching, and the F1c fault only cuts through the T1. As the faults propagated eastward, faults F1b and F1a are the high-angle south-dipping thrust faults and cut through the seafloor. Fault F1a, located in the foremost position, could be the offshore extension of the Hukou Fault. The F2 fault series also cuts through the T1, T2, U3 and seafloor. T2 surface was truncated from the seafloor in Area 2, and the trending is about N70°E, roughly related to the onshore Chingtsaohu anticline. The fold in Area 2 and fault F2c have been truncated since T1, and numerous normal faults are observed near the fold axis. However, the hanging wall of F2a and F2b faults is still uplifted after U3. It indicates that the F2 fault series are propagated eastward, and the high-angle south-dipping thrust fault (F2a) at the foremost position could be the offshore extension of the Hsinchu Fault. The F3 fault series cuts through the T2, U3 and seafloor and exhibits a steep south-dipping thrust fault. However, only Fault F3a is still active at present day. The T2 surface in Area 3 is physically connected to the topographic high onshore. So, Fault F3a is possibly linked to the onshore Longkang Fault. Moreover, the flattened horizon interpretations on U3 across Fault F3a show that the fault offsets are larger and larger landward, which indicates that Fault F3a has also propagated eastward. The deformation front is clearly on the sparker seismic profiles. The deformation front has extended to the offshore area from Taichung in the northwest direction and reaches the westernmost at about 120°E 26' and connects back to the Hukou Fault or the foremost of foothills in Taoyuan.

Keywords: Structural inversion, fault-propagation fold, deformation front, plate collision, Hsinchu Fault, sparker reflection seismic, northwestern Taiwan