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Geological structures and seismicity in foothills of western Taiwan and their implications of deformation in fold-and-thrust belt

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Characteristics of seismicity in the frontal part of an ongoing mountain-building belt can be tied to geological structural style to give some crucial information concerning the deformation of the belt. In this study, we address variation in fault plane solutions of strike-slip fault in the foothills of western Taiwan. We first describe the characteristics of structural settings on the surface in the subsurface to illustrate the differences and define the boundary between the inner and outer foothills. We then delineate variation in characteristics of seismicity in the foothills. The correspondence between the geological structure and the seismicity is demonstrated in the final.

The foreland tectonics of western Taiwan can be divided into three domains: the structures of the pre-orogenic extensional tectonics, the outer part of the fold-and-thrust belt, in which low-angle thrusts mingle with high-angle reactivated normal faults, and the inner part of the belt characterized by imbricate low-angle thrusts. Pre-existing normal faults have altered the local maximum compressive stress field and trajectory of evolving thrust and strongly affected the features of the low-angle thrusts, forming orocline of the fault-and-thrust belt. The outer part of fault-and-thrust belt in northwestern Taiwan is characterized by two settings of thrust and accompanied fold, one trending ENE-WSW, representing reactivated structures of pre-existing normal faults, and the other trending NNE-SSW, parallel to the main strike of the fold-and-thrust belt. The trend of structural settings in the inner foothills is parallel to that of the fold-and-thrust belt. In the central and southern parts of western Taiwan, very few settings that trend ENE-WSW appear in the outer foothills; almost all of them remain as normal fault features. However, some of the active faults in western Taiwan may be strongly related with the reactivated normal fault, with right-lateral slip component, and occur in the frontal area of the fold-and-thrust belt or even beneath the low angle thrust.

Most of the hypocenters of earthquake are located at the depth shallower than 15-20 kilometers. In the inner foothills of northwestern and central Taiwan, the resolved maximum stress axes from one set of strike-slip fault planes mainly strike NW-SE, normal to that of the fold-and-thrust belt. The orientation changes counterclockwise and then clockwise from north to south, in correspondence to the orocline of the belt. In the inner foothills of southernmost part of the study area, the resolved maximum stress axes trend obliquely at the strike of the fault-and-thrust belt. Nonetheless, one set of strike-slip fault planes are nearly parallel to the local tear faults. On the other hand, the orientation of strike-slip fault planes in the outer foothills and coastal plane strikes variably and might reflect different structural styles in different segments of the belt. Some of strike-slip fault planes might be related to the reactivated normal faults. The others might correspond to the remote stress field transmitted into the outer foothills.

The coincidence between the strike of fault plane solution and that of structural setting in different parts of the foothills in northwestern Taiwan suggests that two distinct processes of mountain-building, normal fault reactivation and low angle thrusting, have been happening in different belts since the beginning of tectonics that eventually result in the structural features in the foothills today.