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3D geometry and evolutionary sequence of fold-thrust systems in NW Taiwan

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During the arc-continental collision from the Pliocene to the Pleistocene, two sets of fold-and-thrust system developed in NW Taiwan, a series of NNE-SSW striking low-angle thrust faults and their related folds (set A) and the other series of NEE-SWW striking high-angle thrust faults and their related folds (set B). The latter one cuts the former one and extends forelandward. The geometry of intersection and development sequence of both sets of structures are still in debate. In this study, we utilized a grid of seismic profiles to constrain our interpretation on the subsurface structural geometry of the two structural sets, which then was tested by structural restoration. We also made some simulations on the formation of fault-related folds by trishear modeling. The influence of normal fault reactivation on and the transitional relationships among the structures were investigated to establish an evolutionary sequence for the fold-and thrust systems of NW Taiwan.

The strike of set A is NNE-SSW in the northern part of the study area but becomes N-S to the south. The location of the strike change is cut by a NEE-SWW high-angle fault of set B. According to the seismic interpretation, shallower anticline is asymmetric whereas deeper anticline is symmetric. The low-angle thrust of set A extends to the south and transfers into high-angle where it is cut by the high-angle fault of set B. The trishear model suggests that the shallower anticline resulted from low-angle fault thrusting in early period, whereas the deeper one was caused by basal detachment faulting in the late stage. Seismic interpretation also reveals an asymmetric and gentle fold cut by a high-angle thrust fault of set B. The result of trishear modeling indicates that the anticline was formed by slip along a high angle thrust, which is a low-angle fault in the deep but turns into high angle along a pre-existing normal fault up to the surface.

In summary, the development of the shallower anticline of set A is controlled by low-angle thrusting while the deeper one by basal detachment faulting. The anticlines of set B are not only controlled by the high-angle faulting but also influenced by the deeper low-angle thrusting. The depth of low-angle thrust fault of set B in the foreland is shallower than that of basal detachment fault of set A near the orogen. Such spatial variation in thrust shape suggests that set B was formed earlier than set A and, therefore, both sets of thrust and related structures can be viewed as an out-of-sequence development.