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Trishear model and kinematics of a fault-related structure in the frontal part of Fault-and-thrust belt, NW Taiwan

C.-Y. Hsieh, K.-M. Yang, and B.-I. Chuang
Department of Earth Sciences, National Cheng Kung University, Tainan, Taiwan (l46991134@mail.ncku.edu.tw)

The orogenic belt of Taiwan has been considered as the result from an oblique arc-continent collision along the boundary between the Eurasian and Philippine Sea plates. The Western Foothills Belt in the orogenic belt is comprised of various types of thrust faults and folds. In northwestern Taiwan, the Tiehchanshan gas field in the frontal part of the foothills belt is an intact fault-related fold structure in the fault-and-thrust belt. However, the subsurface geometry of fold-forming fault remains unclear. The main purpose of the study is to apply trishear model to simulate subsurface geometry of the fold structure by testing various fault geometry and kinematics.

On the surface, the Tiehchanshan structure is comprised of two segmented N-S striking anticlines. However, interpretation of seismic and well-bore data reveals different subsurface geometry for the two anticlines with opposite vergence that corresponds to opposite thrust faulting. The results of trishear modeling for the two folds not only allowed us to obtain best fitted fault geometry but also to reconstruct most probable evolution of the fault-related folding.

Preliminary studies show different solutions of geometry and kinematics for the two fold-forming faults. For the northern anticline with forelandward vergence, the fold-forming fault developed as a propagating low-angle thrust of narrow trishear angle. In the next stage before the thrust was cutting up to the very shallow depth and breaking through the surface, ramp angle of the propagating fault increased gradually with increasing trishear angle to form the final gentle geometry of the anticline.

There are two solutions for the fold-forming fault of the southern anticline with hinterlandward vergence. The first model illustrates that the strata were originally dipping forelandward before they were thrusted and folded by the slip along a high-angle thrust with higher rate of propagation. Alternatively, the strata were originally horizontal and the fold structure might be formed by the slip along a thrust with similar geometry to that of the northern one but with higher maximum ramp angle. The first model result implies that the high-angle thrust might be resulted by normal fault inversion. The second modeled fault geometry, although similar to that of the northern one, might also be related to pre-existing normal fault or high-angle fault.