Development of normal faults affected by inherited extensional tectonic settings and their succeeding strata in the South Depression of Tainan Basin, NE South China Sea

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Development of normal faults that are affected by inherited extensional tectonic settings can be observed in many rift basins and is highly related to the some parameters, such as mechanical contrast between layers in different successive extensional tectonics, extensional ratio and post-rift stratal thickness of the inherited rift, etc. The South Depression of Tainan Basin (SD-TB), which consists of several half-grabens and went through two phases of rifting during the Paleogene and Neogene respectively, is one of a series of E-W to NE-SW trending Cenozoic rift basins in NE South China Sea. The main purpose of this study is, based on detailed description of normal fault structures on seismic sections and numerical PFC models, to investigate the sequential development of normal faults during the successive rifting and the effects of inherited tectonics on time-spatial distribution of the younger normal faults in the depression.

The normal faults in SD-TB can be grouped into three types. Type 1 normal faults cut downward through the pre-, syn- and the lowest part of post-rift strata of the Paleogene rift, Type 2 normal faults only cut off the Neogene strata, and Type 3 normal faults cut off both the Paleogene and Neogene strata and down to the basement. There is distinct distribution for the Type 2 normal faults; for the thinner post-rift strata of the Paleogene rift, the Type 2 normal faults would widely distribute in the area over the Paleogene grabens during the Neogene rifting, or rather concentrate on the margin the older graben if the post-rift strata are thick. As for Type 3 normal faults, the first type are the upward extended part of Type 1 normal faults that are characterized by significant displacement during the Paleogene rifting and the second type are located outside of the older grabens.

Such spatial distribution of normal faults can be demonstrated by numerical PFC models as set with different thickness of post-rift strata of the Paleogene rift before the initiation of the Neogene rifting. The models also demonstrate that the second type of Type 3 normal faults outside of the older graben initially were Type 2 normal faults but further cut downward to become Type 3 normal faults. While the second type of Type 3 normal faults have developed at variable thickness of post-rift strata, the first type did formed in the cases that thicker post-rift strata were deposited.

We propose that the thick post-rift strata of the Paleogene rift are related with the greater
displacement along the main boundary fault of the graben, which not only created thick syn-rift strata but also induced significant post-rift subsidence as indicated by the estimated extension ratio. Also for the thicker post-rift strata, the induced stress during the Neogene rifting was more focusing over the inherited main boundary faults and caused the localized Type 2 normal fault and the first type of Type 3 normal faults.

Key words: Normal fault, Inherited structure, Numerical PFC model, South China Sea