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Tectonic Subsidence Model in Distal Part of Foreland Basin in Southwestern Taiwan

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Tectonic subsidence and evolution of a foreland basin are affected not only by orogenic loading but also by inherited structure. It is very common that the basement of a peripheral foreland basin inherits extensional structures and the basin development is influenced by normal faulting. In order to investigate a typical foreland basin development, it is very important to understand the effect of normal faulting on the development of stratigraphy sequences in the basin. The main purpose of this study is to construct history of tectonic subsidence and evolution of foreland basin in SW Taiwan, where pre-orogenic extensional tectonics, which east-west trend is at high-angle to the front of orogenic belt, had shaped and were influencing basement morphology before and during the basin development.

The foreland basin of southwestern Taiwan is situated at frontal area of the orogenic belt. The basin has been developing under the tectonic load from the orogenic belt to its east since the Pliocene. The study area covers the distal part of foreland basin and the forebulge, where rifting were still ongoing during the orogeny until the Pleistocene. There are several important characteristics about the basin evolution. Both east-west and north-south stratigraphy cross sections showing decompacted stratal thickness in the basin demonstrate that the boundary of basin moved back and forth rapidly. Nonetheless, distribution of foreland basin sequences locally are highly restricted, especially shown on the north-south cross section parallel to the front of orogenic belt, in the hanging wall side of the major normal faults with large slip during the basin development.

The tectonic subsidence curves of this study demonstrate that, in general, the subsidence rate and magnitude of subsidence in the same period decrease toward the craton. The timing of initial subsidence in the foreland basin was younger toward the craton. However, the changes of subsidence rate are different between the areas near the basin center and in the distal parts of the basin, the subsidence rate being increasing in the former while decreasing in the latter in the Pliocene. Subsidence history is different on both sides of the east-west trending major normal faults; in the footwall areas the foreland basin had been uplifting until 4.4 Ma when the strata started to accumulate in the basin. Two phases of rapid subsidence during the basin development were recognized in this study. The timing of the main phases of major normal faulting is not consistent for all the normal faults. More importantly, the timing of main phases of major normal faulting is not consistent to that of the regional rapid subsidence in the foreland basin. This fact denies any causal relationships between the normal faulting with the active tectonic loading from the orogenic belt.
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In summary, the rapid tectonic subsidence can be viewed as the indication of the thrusting in the orogenic belt. There had been at least two phases of active phases of orogeny in southwestern Taiwan. The foreland basin has developed northwestward to the craton. During the active phases of the orogeny, the forebulge moved toward the basin center and the basin changed from wide-shallow to narrow-deep shape. During the same period, the foreland basin subsided rapidly near the basin center but was uplifting in the distal part. The normal faulting in southwestern Taiwan was still active during the foreland basin development and affected the late Pliocene sequences accumulated in the hanging wall side of major normal faults. However, it never affected magnitude and rate of the regional subsidence in the foreland basin.