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Development of Tectonostratigraphy in Distal Part of Foreland Basin in Southwestern Taiwan

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In a young and on-going mountain building belt such as that in Taiwan, the geological records in the foreland basin and the fold-and-thrust belt are still well preserved. Analysis of stratal sequences, lithofacies and subsidence history of the basin, especially in the distal part and the forebulge, would not only reveal the evolutionary history of the basin itself but also provide the most crucial implications to infer the kinematics of the mountain-building process. Based on the analysis of subsurface well bore and seismic data, this study aims to reconstruct the tectonostratigraphy and the subsidence history in distal part of the foreland basin in southwestern Taiwan.

A typical foreland basin in southwestern Taiwan has been formed by loading from the orogenic belt to the east. During the same period the foreland areas has been under the rifting tectonics. The onset of foreland basin development was at 4.4 Ma, younger than that proposed in some previous studies. After that, the distal part of foreland basin encountered two discernible episodic events of rapid subsidence at 4.4 to 4.2 and 2 to 1.8 Ma. The age of the initial rapid subsidence was younger toward the craton.

During the first rapid subsidence in the basin area, concurrent uplifting that corresponds to forebulge happened in the distal part of foreland basin and was followed by rapid subsidence and deposition of the ubiquitous strata onlapping toward the craton. In the next rapid subsidence, the forebulge first shifted toward the basin center and caused part of strata to be eroded. Shortly after that, the uplifted area started to subside again and received another unit of ubiquitous strata.

Therefore, there are two unconformities, which divide the foreland basin megasequences into three sequences of third-order scale and are characterized by the following features: 1, they gradually merge into one unconformity toward the craton; 2, the time gap of each unconformity increases toward the craton, except where the normal faulting created the accommodation for older strata overlying the unconformity; 3, the distribution of both the younger unconformity and its correlated conformity spatially shifts toward the craton. The time-spatial distribution of the unconformities illustrates back-and-forth migration of the basin margin in the distal part of foreland basin. The overlying sedimentary cycle of coarsening-upward sequences also implies the tectonic influence on the deposition of the foreland basin sequences in southwestern Taiwan.

The migration rate of the forebulge in the distal part of foreland basin was slower in the early stage than that derived from the previously proposed kinematic model for the steady migration of the orogenic belt. This implies that the pre-collision extensional tectonics might have caused weaker lithosphere beneath the foreland basin and that once the foreland basin migrated onto the less stretched lithosphere the basin would expand rapidly into the craton.