Stratigraphic architecture, magnetostratigraphy, and incised-valley systems of the Pliocene-Pleistocene collisional marine foreland basin of Taiwan

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ABSTRACT

Lithofacies analysis, magnetostratigraphy, and seismic profiles of Pliocene-Pleistocene foreland basin deposits of Taiwan provide a framework to evaluate the stratigraphic development of a collisional marine foreland basin. We have recognized several scales of stratigraphic packages and unconformities in deposits of the Taiwan foreland basin. Small-scale (20 to 150 m thick) stratigraphic sequences contain upward-shallowing, marine lithofacies successions that are bracketed by thin coquina sandstones. We interpret the small-scale stratigraphic packages as "parasequences" in the traditional sequence stratigraphy model, the thin coquina sandstones representing marine-flooding intervals. The average duration of individual small-scale packages was in the range of 37.5 k.y., on the basis of our magnetostratigraphy. These sequences are interpreted as the product of eustatic sea-level change possibly related to the orbital time series of obliquity.

Intermediate-scale stratigraphic sequences are 150 to 1000 m thick and are bounded by unconformities that are well exposed in outcrop and can be clearly identified in seismic sections. The unconformity surfaces have several hundred meters of relief and represent periods of major fluvial valley incision in the foreland basin. One of the unconformities is locally an angular one that we interpret as representing a growth structure that formed during structural uplift of the proximal margin of the foreland basin at ca. 1.25 Ma. Across this angular unconformity, there were marked increases in rates of sediment accumulation and tectonic subsidence in the foreland basin. Other major unconformities that bound intermediate-scale stratigraphic sequences are high-relief disconformities. These unconformities may be the product of eustatic changes, because there has been little change in rates of sediment accumulation and tectonic subsidence across these unconformities. The duration of individual, intermediate-scale packages ranges from ~100 000 to 700 000 yr, on the basis of magnetostratigraphy and biostratigraphy. We interpret the intermediate-scale sequences as "sequences" in the traditional sequence stratigraphy model.

Our analysis of the Pliocene-Pleistocene deposits of the Taiwan foreland basin has several implications for understanding the stratigraphic evolution of this collisional marine foreland basin. (1) Deposition in the Taiwan foreland basin appears to have been punctuated by at least five episodes of erosion and major fluvial valley incision. Large volumes of sediment were eroded from the proximal margin of the foreland basin and transported to more distal parts of the foreland basin or to depocenters outside the foreland basin system during all stages of basin development. (2) The presence of high-relief unconformities and growth structures in the Pliocene-Pleistocene foreland basin deposits suggests a well-developed wedge-top depozone in the foreland basin system. (3) The Pliocene-Pleistocene strata of the foreland basin of Taiwan record ~2.3 m.y. of deposition, on the basis of our magnetostratigraphy. Sediment accumulation rate was on the order of ~950 m/m.y. during the earlier stages of basin development. During the later stages of basin development, sediment accumulation rate increased to ~1900 m/m.y. Sediment accumulation rates in the collisional marine foreland basin of Taiwan are much higher than previously published rates

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