Origin of the West Taiwan basin by orogenic loading and flexure of a rifted continental margin

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[1] Seismic and well data suggest that the West Taiwan basin developed by orogenic loading and flexure of a rift-type continental margin. The most likely source of the loading is Taiwan, where oblique convergence between the Eurasian and Philippine Sea plates has produced an orogenic belt up to 300 km in length, 100 km in width, and 4 km in height. Flexure modeling shows that surface loading is unable to explain the depth of the West Taiwan basin. Other, subsurface or buried loads are required. Combined surface and buried loading explains the depth and width of the basin. It also accounts for a Bouguer gravity anomaly "high" and flanking "low" over the orogenic belt, a lateral offset of 20–30 km between the peak topography and the maximum depth to the seismic Moho, and evidence for tectonic uplift in the Penghu Islands. The depth of the base of the foreland sequence in the northern part of the West Taiwan basin can be explained well by an elastic plate model with an effective elastic thickness, T_e, of 13 km. While this value is low when compared to most other foreland basins, it is within the range of values derived from rifted continental margins. The northern part of the West Taiwan basin unconformably overlies a passive margin sequence and therefore appears to have inherited the long-term (>1 Myr) flexural properties of the margin. In the southern part of the basin, however, the depth to the base of the foreland sequence dips too steeply to be explained by elastic plate models. This part of the basin therefore appears to be yielding rather than flexing. Differences in the flexural behavior along strike of the West Taiwan foreland basin lithosphere are reflected in seismicity patterns west of the thrust front. The northern part of the basin is associated with a low level of seismic activity, while the south correlates with an abundance of earthquakes, especially at shallow (<25 km) depths. There is a cluster of earthquakes along two extensional faults that were active during rifting of the underlying margin. Therefore lithospheric flexure and fault reactivation may be important contributors to the seismicity of the Taiwan region. *INDEX TERMS:* 1236 Geodesy and Gravity: Rheology of the lithosphere and mantle (8160); 3010 Marine Geology and Geophysics: Gravity; 7230 Seismology: Seismicity and seismotectonics; 8120 Tectonophysics: Dynamics of lithosphere and mantle—general; *KEYWORDS:* gravity anomaly, flexure, foreland basin, seismicity

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1. Introduction and Background

[2] Foreland basins are deep depressions of the continental crust that form in compressional plate settings. The depressions are usually flanked by one or more orogenic belts and are infilled by a substantial thickness (up to 10 km) of sediment. The stratigraphic record of foreland basins is a "tape recorder" of the tectonic and erosional history of the flanking orogenic belt and their "architecture" provides information on the physical properties of the underlying lithosphere.

[3] It is generally accepted [e.g., *Price*, 1973; *Beaumont*, 1981; *Jordan*, 1981] that foreland basins develop by flexure of the lithosphere in front of migrating orogenic loads. These include surface as well as buried loads. Surface loads comprise the thrust and fold belts that make up the topography of orogenic belts. Buried loads, on the other hand, include loads that act within and beneath the crust due to overthrusting of one, relatively dense, crustal block over another [e.g., *Holt and Stern*, 1994], subduction of crust and mantle that had already been thinned during a previous extensional event [e.g., *Karner and Watts*, 1983], or a dense downgoing slab [e.g., *Royden*, 1993].

[4] The relative importance of surface and buried loads varies within and between different orogenic belts. Foreland basins that flank some orogenic belts (e.g., Himalaya [*Karner and Watts*, 1983; *Lyon-Caen and Molnar*, 1983], Papua-New

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