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Characteristics and development of the flexural forebulge and basal unconformity of Western Taiwan Foreland Basin

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Abstract

The Western Taiwan Foreland Basin formed during the Early Pliocene as the flexural response to the loading of Taiwan orogen on the Eurasian plate. Using more than 4000 km of marine multi-channel seismic reflection profiles and 22 exploration wells offshore and on land, we recognized a major unconformity separating the overlying sediments of foreland basin from the underlying passive margin strata and a flexural forebulge located at the distal part of the foreland basin. Those allow us to refine and extend the area of the Western Taiwan Foreland Basin to the middle of the Taiwan Strait. The Western Taiwan Foreland Basin is about 350 km long and 150 km wide between the west front of the Taiwan orogen and the Chinese craton.

Seismic lines show that a narrow zone of uplifted Miocene passive margin sequences at the distal parts of the foreland basin extends approximately parallel to the strike of the deformation front of the Taiwan orogen. The Miocene bulge is generally 200 m high, a subtle morphologic/structural feature, and is characterized by an unconformity where Quaternary sediments overlie the eroded Miocene strata. Positive Bouguer gravity anomalies associated with the bulge on the cratonic side suggest that the Chinese continental margin is flexed upward to produce the bulge with higher density materials compared to the negative gravity anomalies of the sediments deposited in the adjacent foreland basin.

The base of the foreland basin fills is a regional angular unconformity. The stratigraphic patterns of sediments overlying the unconformity change laterally, towards the Taiwan orogen, into conformity or disconformity of insignificant gap at the coastal areas. In contrast, the chronostratigraphic gap across the unconformity increases cratonward, with the largest gap at flexural forebulge. The increase in stratigraphic gap reflects the progressively younger transgression of the Pliocene–Quaternary orogenic sediments from Taiwan onto the Chinese passive margin combined with progressively older Miocene units subcropping towards the forebulge. The characteristic geometry, stratigraphic pattern and large gap up to 10 Ma suggest that the basal unconformity is a flexural forebulge unconformity rather than a type 1 unconformity, mainly due to sea level change.

The flexural forebulge and associated basal unconformity mark transition from shelf-slope-rise deposition on a passive margin to deposition in a foreland basin associated with a convergent margin. The flexural unconformity developed during the collision between the Luzon Arc and the Chinese continental margin, reflecting the uplift and erosion of progressively cratonward migrating forebulge.

Keywords: flexure; forebulge; unconformity; foreland Basin; Taiwan

1. Introduction

Flexure of foreland creates an asymmetrical subsiding basin bounded on the cratonic side by a peripheral bulge. The flexural bulge is a subtle morphologic/structural feature, compared to the adjacent foredeep, with a height from a few tens to a few hundreds meters (Jacobi, 1981; Stockmal et al., 1986; Crampton and Allen, 1995; DeCelles and Giles, 1996). The recognition of a peripheral forebulge and

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