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Geotectonic Evolution of Tertiary Continental Margin Basins of Taiwan

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ABSTRACT

Taiwan comprises a collision orogen located on the southeast China continental margin. The continental margin is underlain by a thick Cenozoic sedimentary sequence floored with a block-faulted pre-Tertiary basement. In terms of sediment distribution, the Paleogene deposits are mostly confined to fault-bounded troughs, whereas the Neogene-Quaternary deposits drape the entire continental margin.

In the Taiwan orogen, the continental margin basement and its overlying sediments are exposed as the metamorphic complex and deformed sedimentary strata. In spite of the intense tectonization, the depositional basin for the deformed Tertiary strata can be reconstructed as a half-graben trough, termed the Hsuehshan trough. The trough was floored with a Mesozoic basement, filled by Eocene and Oligocene strata, and covered by Miocene deposits. It was originally located on the outer continental shelf and compares with the Paleogene troughs in the neighboring continental margin.

Based on the onshore and offshore geological data, the Tertiary basins of southeast China continental margin can be divided into the Paleogene syn-rift troughs and the Neogene post-rift depressions. The Paleogene troughs can be further subdivided into the inner troughs located in the inner shelf and the outer troughs in the outer shelf. The inner troughs, including the Tungyintao, Nanjihtao, and Penghu Basins, and the Zhu 1 and Zhu 3 Sags are filled with Paleocene to Middle Eocene strata. The outer troughs, including the Hsuehshan trough, Taiwan and Tainan Basins, and the Zhu 2 Sag, comprise mainly Upper Eocene and Oligocene strata.

The Taiwan area and its neighboring China continental margin was part of a landmass fringed with a west-dipping subduction zone during the Mesozoic. Since the Late Cretaceous, the landmass has been subjected to stretching and rifting. In the Paleocene and Early Eocene, continental stretching resulted in fault-bounded troughs and widespread subsidence. Terrigenous sediments derived from the China continent were trapped in the inner troughs and accumulated as terrestrial to shallow marine deposits. In the Late Eocene and Early Oligocene, continental stretching shifted to the outer continental margin and rifting stopped in the inner troughs. Continent-derived sediments filled up the inner troughs and then progaded into the outer troughs to deposit coastal and marine strata. In the Early Oligocene, intense stretching induced the spreading of the oceanic crust of the South China Sea and subdued the rifting on the continental margin. Continent-derived sediments filled up the outer troughs in the Early Miocene and draped the entire continental margin thereafter. A drifting passive margin featured with shelf-slope-rise settings thus formed and persists in the present South China Sea area. In the Taiwan area,

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however, the outer continental margin has been deformed by the impinging Luzon arc since the Late Miocene.

INTRODUCTION

The island of Taiwan comprises a collision orogen located on the southeastern verge of the China continental margin (Fig. 1). Tertiary sedimentary strata are widely exposed in the Taiwan orogen and were disclosed by drilling in the surrounding coastal and offshore region (Ho, 1986; Yuan et al., 1989). In the past thirty years, accumulation of these Tertiary sedimentary strata has been an intriguing subject for geologists in Taiwan and sparked a number of basin studies (Chou, 1973; Ho, 1971; Meng, 1971; Sun, 1982, 1985; Wang, 1987). As most of the Tertiary sequences are either buried subsurface in the offshore and coastal areas or heavily deformed in the mountain ranges, analyzing the Tertiary basins needs to deal with varied terranes and database. For the subsurface portion, geologic information relies on drilling and seismic data which are not all open to the public. For the outcrops in the mountain ranges, structural disruption usually obscured the sedimentary features of the rock sequences such that the original depositional settings become hardly discernible. Previous studies tend to focus on local depositional systems without regards to the basin architecture (e.g., Chou, 1975; Chow et al., 1988).

As a result of the recent efforts of hydrocarbon exploration in the Taiwan Strait, an appreciable amount of subsurface geologic data were published (Hsiao et al., 1991a,b; Chow et al., 1991). Together with the outcrop studies of the metasedimentary sequences in the Central Range of Taiwan (Teng et al., 1988, 1991), the available geological information is sufficient enough to offer some new insights into the origin of the Tertiary basins in the Taiwan area. The aim of this paper is to summarize the geological essentials of the Tertiary sequences of the China continental margin and thereby to depict the Tertiary depositional history of Taiwan in the context of continental margin tectonics.

TECTONIC FRAMEWORK

The Taiwan island is located on the convergent boundary between the Philippine Sea plate and the Eurasian plate (Fig. 1). South of Taiwan, the rifted China continental margin, bordered by the oceanic crust of the South China Sea, is subducting beneath the Luzon arc. Northeast of Taiwan, the Philippine Sea plate is subducting beneath the Ryukyu arc-trench system on the eastern fringe of the continent margin. In Taiwan, the Luzon arc has been colliding with the China continent in the last 10 m.y. and resulted in tectonization of the Taiwan orogen (Chai, 1972; Teng, 1990). The Coastal