Tectonic features associated with the overriding of an accretionary wedge on top of a rifted continental margin: An example from Taiwan

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Abstract

Off southwest Taiwan, a west-advancing orogenic wedge has obliquely impinged on the northern continental slope of the South China Sea (SCS) margin. We analyzed a dense grid of multi-channel seismic profiles to reveal the tectonic features in this oblique collision setting. In the upper SCS slope and adjacent to the accretionary wedge, the rifted continental margin is characterized by a deep-seated, oceanward-dipping, listric and active normal fault with rotated hangingwall strata beneath the slope. To the west of this slope segment, the mid-Oligocene to Recent post-breakup sediments show prograding and aggrading shelf-margin clinoforms that cover a series of small, possibly Paleogene, rift basins.

In the submarine accretionary wedge, a series of west-vergent, NNW-striking fold-and-thrust structures characterizes the lower wedge, which can be further divided into frontal and rear segments with distinct structural features. The frontal segment is characterized by four west-vergent blind thrusts with gently folded limbs. In contrast, the rear, arcward segment is characterized by west-vergent, emergent and imbricate thrusts with tilted beds truncated at the hangingwalls. Strata within slope basins are tilted arcward, with dips that increase with depth, indicating continued relative uplift along thrust planes during sedimentation. Pulsed thrust activity is further evidenced by an array of arcward-dipping unconformable surfaces with westward onlapping strata in the basins. Longitudinal sedimentary tapering of pre-orogenic sediments correlates strongly with curvature of the submarine frontal accretionary belt, suggesting that pre-orogenic sediment thickness is the major control on the geometry of frontal structures. The preexisting SCS slope that lies obliquely in front of the advancing accretionary wedge has impeded the advancing of frontal folds resulting in a successive termination of folds against and along strike of the SCS slope. The existence of the SCS slope also leads the strike of impinging folds with NNW-trend to turn more sharply to a NE-strike, parallel to strike of the SCS slope. Our analysis shows that the pre-orogenic mechanical/crustal heterogeneities and seafloor morphology exert strong controls on the thrust-belt development in the incipient Taiwan arc-continent collision zone.

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1. Introduction

The region off SW Taiwan (Fig. 1) lies in the frontal zone of initial oblique collision between the China continent and the Luzon arc (e.g., Huang et al., 1997; Lacombe et al., 2001) where the South China Sea basin closes and the submarine accretionary wedge emerges to form subaerial collisional orogenic wedges (i.e., the Taiwan orogen). The close proximity of the rifted continental margin to the collisional wedge provides us with a rare opportunity to address the geometric and kinematic processes operating in the accretion of passive margin rocks into an accretionary wedge and the controls of rifted-margin crustal inhomogeneity and seafloor relief on subsequent development of the frontal orogenic wedge.

Various geological features of the orogenic wedge and rifted continental margin (i.e., the Tainan Basin) off SW Taiwan have been reported in the literature. For examples, Reed et al. (1992), Sun and Liu (1993), and Liu et al. (1997, 2004) have demonstrated the compressive structures in the accretionary wedge. Yang et al. (1991), Lee et al. (1993), Lin and Watts (2002), Lin et al. (2003) and Li et al. (2007) have reported the stratigraphy and tectonic features of the Tainan Basin, which lies in the rifted continental margin. In spite of all these previous efforts, aspects of the structural styles of the accretionary

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