# "Basement impinged" or "basement involved" frontal orogenic belt, central Taiwan

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## Abstract

New available seismicity data underneath the Coastal Plain together with difference structural styles in the frontal of the Taiwan orogenic belt are combined in order to divide and discuss the segmentation in the Western fold-and-thrust belt of the active Taiwan collision zone. The result indicated that it is significance to divide the frontal thrust belt into three domains in the central Taiwan by not only the structural styles, the anomalous morphotectonic and surface heat flow in the hanging wall side of mountain belt but also the irregular distribution of the Mesozoic basement in the footwall side. They are named the Taichung Domain, Chiayi Domain and Tainan Domain from north to south, respectively (Figure 1).

It has long believed that: (1) The well developed and wider thrust sheets in the Taichung domain are related to the homogeneous basement. (2) The anomalously high topographic relief in the Chiayi domain is related to the shallow but block-faulted basement of Penghu Platform. (3) The narrow thrust sheets in Tainan domain are related to the deeper basement of Tainan Basin. As a summary, the irregular Mesozoic basement impinges the development of the thrust belt. However, according to the new data and balanced cross-sections analysis, the basement is not involved into the frontal orogenic belt, even in the shallowest area of the Chiayi domain. On the other hand, the wedge type and a thin-skinned collision model can account for the frontal orogenic belt of central Taiwan; also, the underplating is probably the dominant deformation mode underneath the Western Foothills in the Chiayi domain.

## Taichung Domain

In Taichung Domain, a case study from the 1999 Chi-Chi earthquake, the frontal orogenic belt of central Taiwan had been well constructed to be an imbricated thrust faults (Yue et al., 2005). Those faults are recently locked and root into an aseismic decollement, along which the thrust wedge creeps at about 27~42 mm/yr (Dominguez et al., 2003; Hsu et al., 2003). Furthermore, based on foreland basin retrieving and river terraces investigation, the Changhua blind thrust and Chelungpu thrust totally consume about ~32 mm/yr long-term shortening (Chen et al., 2003a; Chen et al., 2003b; Simoes and Avouac, 2006). Those results indicated that a highly crustal strain has been accommodated at the frontal thrust belt and where the disastrous earthquake will happen. Indeed, the homogeneous and eastward tilted of Mesozoic basement in the footwall side suggested by the flexure of the elastic lithosphere in the front of migrating orogenic loads (Lin and Watts, 2002); also, the basement migrated southwestward at nearly ~25 mm/yr by retrieving the foreland basin records (Simoes and Avouac, 2006).

## Chiayi Domain

In Chiayi Domain, the shallowest with block-faulted of Mesozoic basement (Lin et al., 2003) (i.e. depth ~2-4 km, the Penghu Platform) beneath the plain area suggested the most possibility to consider the basement involved region (Mouthereau and Lacombe, 2006). However, together with the seismic profile and borehole data across the Hsiaomei anticline indicated that a shallow flat-ramp structure to account for the forming of the Hsiaomei anticline. The shallow decollement is lying along the early Miocene strata at depth nearly 4-6 km. Furthermore, a significant difference of thickness in Miocene strata exists on both side of the Chukou fault inferred that a pre-existing normal fault is associated with the development of the Chukou fault. Also, the shallow decollement will drop to deeper depth, maybe over 10 km by connecting some ramp structures based on the balanced cross-section restoration. We interpret that the underplating is significant deformation mode in the location of the deep ramp structure to account for the anomalous highly morphotectonic, surface heat flow and uniform geodetic slip rate in the eastern side of Chukou fault.

## Tainan Domain

In Tainan Domain, the characteristic of the thrust belt consists of five narrow thrust sheets from eastern Chishan fault to the western Liouchia fault. In fact, the deeper and block-faulted Mesozoic basement (i.e. depth ~6-8 km, Tainan Basin) is located underneath the plain area in the southern part of the E-W trending pre-existing Yichu fault. Two balanced cross-sections suggest that a frontal blind thrust is developing underneath the plain area and all the thrust sheets can root into a decollement at shallow depth of 6-7 km that dips $6^{o}$ to the east. Also, kinematically, from the restoration of the cross sections indicates that at least 60-70 km shortening had been consumed in the Western Foothills. Comparing with the geodetic data suggested about ~40 mm/yr shortening rate will be consumed in this domain (Hsu et al., 2003; Tsai et al., 2006), we can calculate the initial timing of each thrust sheet. The initial timing of the eastern Chishan fault about 1.5~1.7 Ma ago, this result corresponds to the observation that an unconformable early Pleistocene strata is found in the hanging wall side of the Chishan fault (Horng et al., 2006; Wu, 1993).

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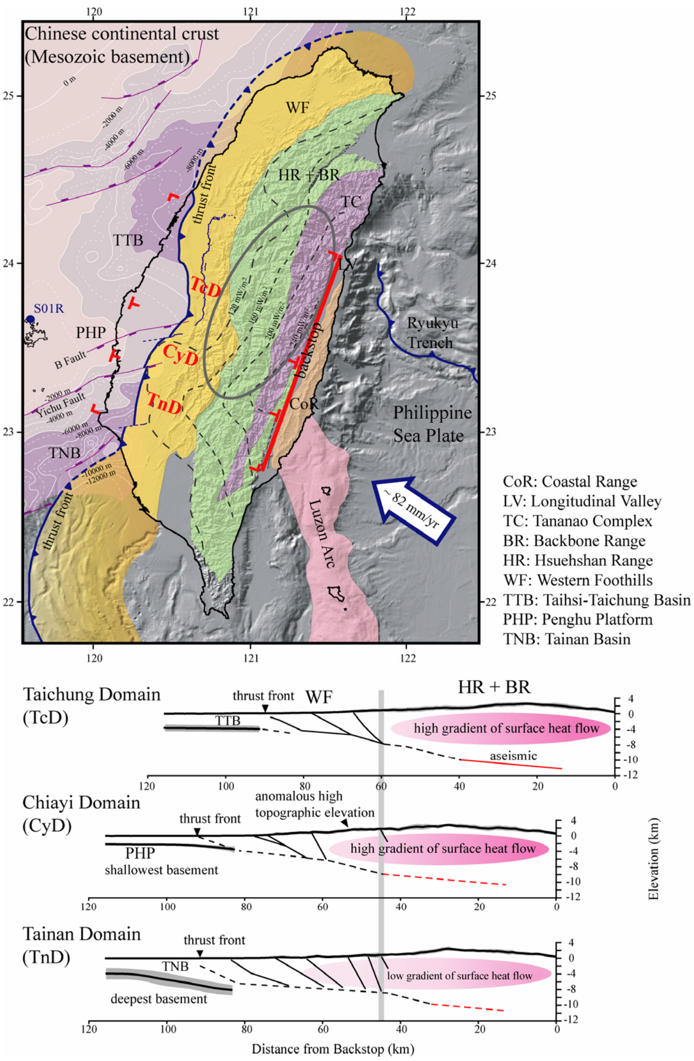


Figure 1 Geodynamical setting of the arc-continent collision of Taiwan and the segmentation of orogenic belt in central Taiwan. The Mesozoic basement distribution underneath the plain area and Taiwan Strait (white line) is suggested from Lin et. al. (2002) and the smoothed surface heat flow pattern (gray dash line) in the mountain range is suggested from Barr and Dahlen (1990).