Geomorphology of the southernmost Longitudinal Valley fault: Implications for evolution of the active suture of eastern Taiwan

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[1] In order to understand fully the deformational patterns of the Longitudinal Valley fault system, a major structure along the eastern suture of Taiwan, we mapped geomorphic features near the southern end of the Longitudinal Valley, where many well-developed fluvial landforms record deformation along multiple strands of the fault. Our analysis shows that the Longitudinal Valley fault there comprises two major strands. The Luyeh strand, on the west, has predominantly reverse motion. The Peinan strand, on the east, has a significant left-lateral component. Between the two strands, late Quaternary fluvial sediments and surfaces exhibit progressive deformation. The Luyeh strand dies out to the north, where it steps to the east and joins the Peinan strand to become the main strand of the reverse sinistral Longitudinal Valley fault. To the south, the Luyeh strand becomes an E-W striking monocline. This suggests that the reverse motion on the Longitudinal Valley system decreases drastically at that point. The Longitudinal Valley fault system is therefore likely to terminate abruptly there and does not seem to connect to any existing structure further to the south. This abrupt structural change suggests that the development of the Longitudinal Valley suture occurs through discrete structural "jumps," rather than by a continuous northward maturation. **Citation:** Shyu, J. B. H., K. Sieh, Y.-G. Chen, R. Y. Chuang, Y. Wang, and L.-H. Chung (2008), Geomorphology of the southernmost Longitudinal Valley fault: Implications for evolution of the active suture of eastern Taiwan, *Tectonics*, *27*, TC1019, doi:10.1029/2006TC002060.

1. Introduction

[2] The island of Taiwan is the product of the ongoing collision of the Eurasian and the Philippine Sea plates [e.g., *Ho*, 1986; *Teng*, 1987, 1990; *Shyu et al.*, 2005a, and references therein] (Figure 1). As one of the very few places on Earth that is undergoing active suturing of lithospheric blocks, Taiwan provides valuable opportunities for understanding suturing processes. The collision involves three lithospheric blocks, separated by two sutures on the island [*Shyu et al.*, 2005a]. The eastern one, along the Longitudinal Valley in eastern Taiwan, is the active suture between the Luzon volcanic arc and a continental sliver that includes the Central Range, the mountainous backbone of Taiwan. The valley is very active seismically and contains many active structures, the most important being the Longitudinal Valley fault, one of the most active structures in the world [e.g., *Angelier et al.*, 1997; *Shyu et al.*, 2005b].

[3] As the suturing matures from south to north, active structures of the Taiwan orogen manifest different characteristics, separating the island into several discrete neotectonic domains [*Shyu et al.*, 2005b] (Figure 2). Along the Longitudinal Valley are two: the Hualien and the Taitung Domains. In the Hualien Domain, which includes the northern third of the Longitudinal Valley fault, the fault appears to be predominantly sinistral and to slip at a lower rate. In the Taitung Domain to the south, the fault slips obliquely at a much higher rate, in association with the rapid uplift of the Coastal Range, in the hanging wall block of the fault [*Yu and Liu*, 1989; *Hsu et al.*, 2003; *Shyu et al.*, 2006a].

[4] Although the activity of the Longitudinal Valley fault has been known for decades and attracted numerous geodetic and seismologic investigations [e.g., *Angelier et al.*, 1997; *Lee et al.*, 2001, 2003; *Yu and Kuo*, 2001; *Kuochen et al.*, 2004; *Wu et al.*, 2006], there have been very few detailed geomorphic analyses of the fault. Most maps of the fault are large-scaled maps of the entire Longitudinal Valley, which contain very little detail [e.g., *Wang and Chen*, 1993; *Lin et al.*, 2000]. As a result, current knowledge of the fault is limited mostly to the main fault trace, which may absorb only a portion of the total deformation across the entire fault system. Without knowledge of details of the surface manifestation of the fault system, it is difficult to design proper experiments to observe the details of active deformation. For example, many of the current short-aperture geodetic experiments focus only on the main fault trace [e.g., *Lee et al.*, 2001, 2003], and may underestimate the slip rate of the fault.

[5] Near the southern end of the Longitudinal Valley, a suite of well-developed fluvial surfaces provide a useful tool for mapping the Longitudinal Valley fault system in detail [*Shih et al.*, 1983, 1984]. The clear deformational patterns of these fluvial surfaces allow us to understand the charac-

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