Crustal Shortening in the Tanggula-Tuotuohe Area, Northern Tibet

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Indo-Asian collision and intracontinental deformation resulted in large crustal shortening and uplift of the Tibetan Plateau, and much attention has been paid to determine the deformation, crustal shortening, and the uplift of the plateau（Patriat and others, 1984; Besse and others, 1984; Dewey and others, 1989; Harrison and others, 1992; Ratschbacher and others, 1994; Wang and others, 2002, 2008; Molnar and Tapponnier, 1975; Tapponnier and Molnar 1977; DeCelles and others, 1998, 2002). Previous research has indicated that the Tanggula-Tuotuohe area has undergone intensive deformation during the Cenozoic (Leeder and others, 1988; Yin and Harrison, 2000; Wang and others, 2002), and that the Tuotuohe basin was formed as a result of the Early Tertiary Tanggula thrust system (Li and others, 2006). However, compared to the Himalayas and other areas, the Cenozoic evolution and upper-crustal shortening in this area is almost unknown.

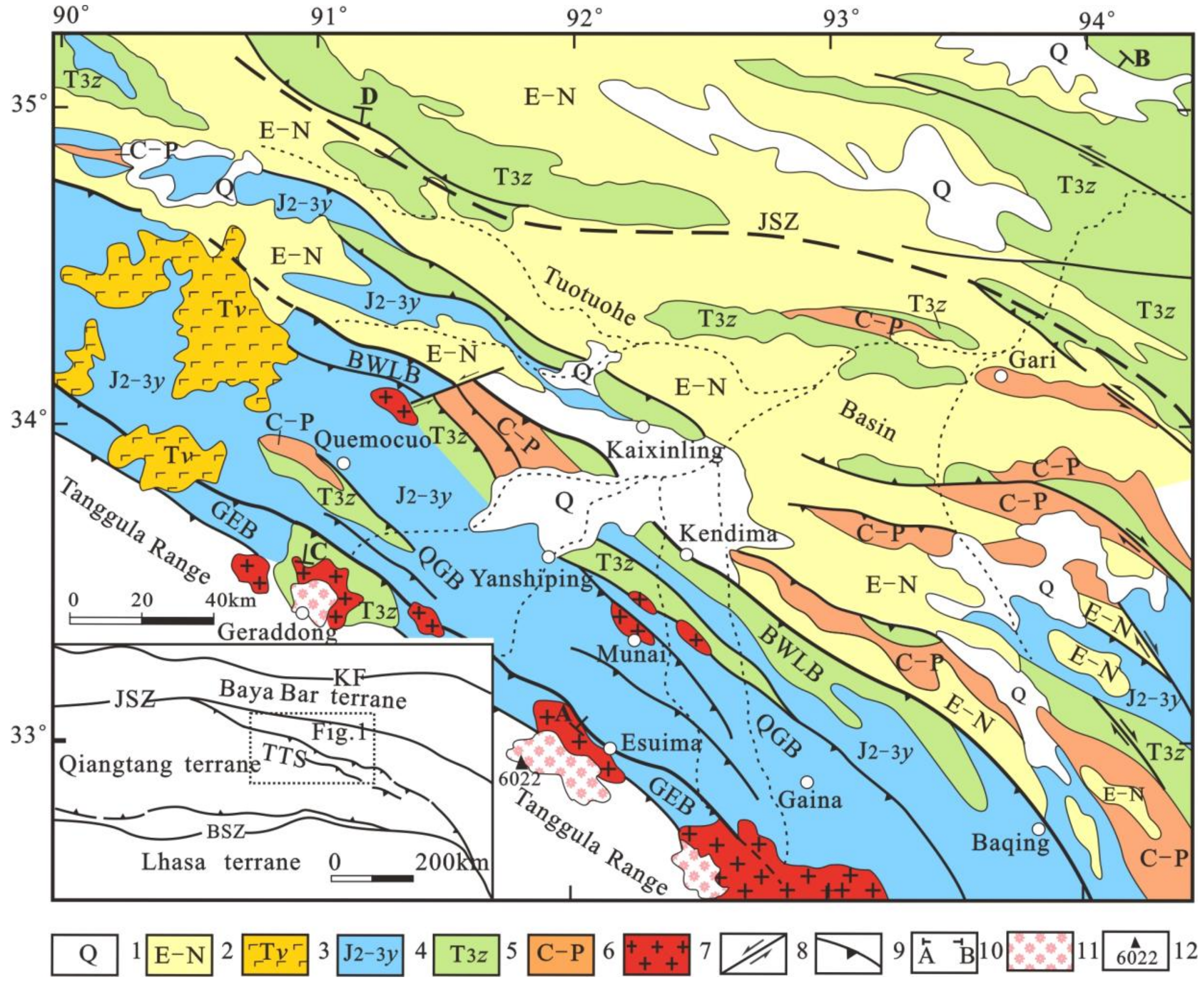

Figure 1. Simplified geological map of Tanggula Mountain and the Tuotuohe area. 1. Quaternary alluvial deposits; 2. Eocene-Miocene deposits; 3. Cenozoic volcanic rocks; 4. Middle-Upper Jurassic Yanshiping group; 5. Late Triassic Jieza Group; 6. Carboniferous-Permian strata; 7. Cenozoic granite; 8. strike-slip fault; 9. thrust; 10. location of balanced cross-section; 12. Glacier or year round snow; 13. mountain peak and elevation; JSZ: Jinshajiang Suture; BWLB-Baqing-Wulwl Lake thrust belt ; QGB-Quemocuo-Gaina fold-thrust belt; GEB -Geraddong-Esuima thrust belt.

Our investigation shows that the Tanggula thrust system, south to Geladandong-Esuima area and north to the Wulwl Lake-Kendima-Baqing area, runs parallel to the Tanggula Range. In the study area the Tanggula thrust system extends more than 320 km to the northwest with a width of 60-80 km (Figure 1). On the basis of the balanced cross-section laws, two routes were chosen for reconstructing balanced sections (AB and CD). Based on the restoration of balanced cross-sections, we calculated crustal-shortening ratios using line-length balancing techniques. The results show that: 1/ the Jurassic strata in two sections are presently 55.6 km and 72.2km long, while the original lengths were 156 km and 147 km respectively, indicating that the shortening is 100.4 km and 74.8 km and the shortening ratios are 64.4% and 50.9%; 2/ the Tertiary strata in Tuotuohe basin are currently 128 km and 76.4 km long in the two sections. Compared to the original lengths of the Tertiary strata, this suggests that the shortening is 114.4 km and 54.6 km and the shortening ratios are 47.2% and 41.7%. Consequently, the crustal shortening in the Tanggula-Tuotuohe area is 214.8 km and 132.4 km with shortening ratios of 53.9% and 47.0%.

Previous studies suggest that the Tanggula range has been uplifted and became the northern boundary of Paleo-Tibetan Plateau in the Paleogene (Wang and others, 2008, and others, 2006). Comparison of the Jurassic and Tertiary shortening in the two sections shows that the Jurassic strata have undergone only little shortening before the Tertiary, implying that the early Tertiary is the main period with intensive shortening in the study area. Our comprehensive analysis indicates that the age of the Tanggula thrust system can be confirmed as 67-23 Ma (Li and others, 2006), and that the age of the Tuotuohe and Yaxicuo Formations which is overlain by undeformed Wudaoliang Formation (Wang and others, 2002) is 52-23.8 Ma (Yi and others, 2004; Liu and others, 2005). This suggests that the main stage of crustal shortening was during the Paleocene-Oligocene in the Tanggula-Tuotuohe area.

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