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Late Cenozoic East-West Crustal Shortening in the Southern Longmen Shan Range Front, Eastern Tibet: Implications for Regional Stress Field Changes

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Co-seismic slip sense of the devastating 2008 Wenchuan earthquake (Mw 7.9) shows the present-day east-west crustal shortening and oblique thrusting across the Longmen Shan, which is inconsistent with the late Triassic southeast-directed thrusting. Although two major

periods of compressional deformation in the Longmen Shan and adjacent Sichuan basin have long been recognized, the exact age of the E-W crustal shortening and, more importantly, the shortening rate of the late Cenozoic deformation remain not well known. In this

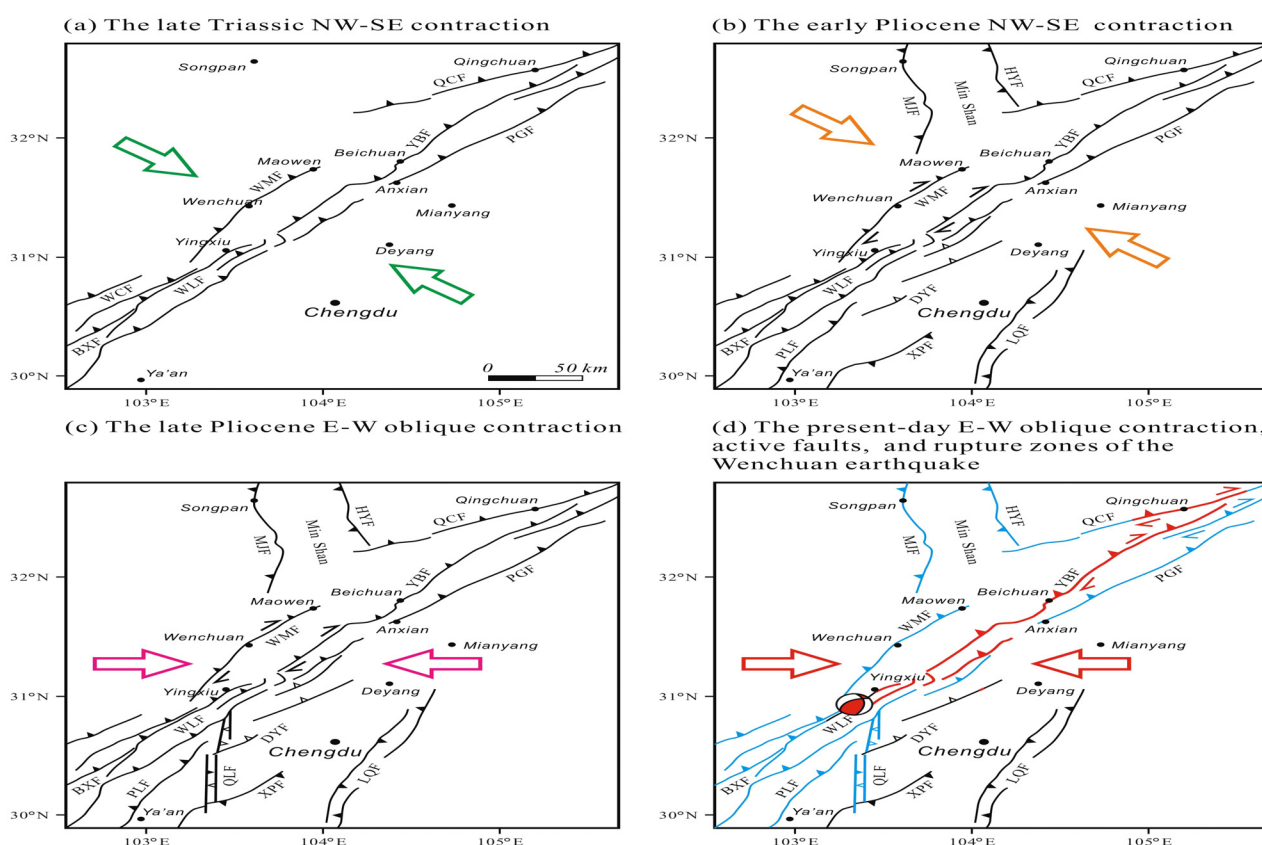
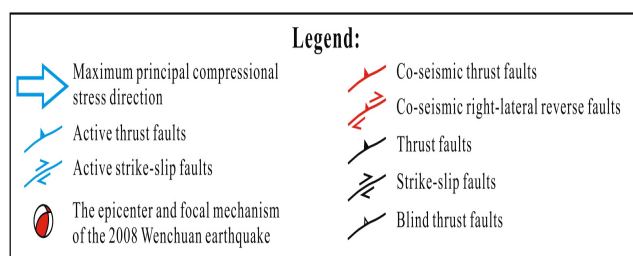


Fig. 1. Diagram illustrating the evolution process of tectonic stress field in the Longmen Shan and adjacent area.

(a) The direction of the maximum horizontal compressive stress (σ_{1max}) in the late Triassic of mountain building was northwest-southeast. The NE-trending faults and structures were developed in the stage (Burchfiel et al., 1995). (b) The early Pliocene northwest-southeast contraction. The NE-trending faults and structures in the Sichuan basin were developed in the second stage. (c) The late Pliocene nearly east-west contraction. The NS-trending faults and structures were developed in the third stage (Burchfiel et al., 1995). (d) The present-day east-west contraction, active faults, and co-seismic oblique NE-trending rupture zones of the Wenchuan earthquake (Liu-Zeng et al., 2009; Xu et al., 2009; Wang et al., 2013). YBF, Yingxiu-Beichuan fault; PGF, Pengguan fault; WMF, Wenchuan-Maowen fault; QCF, Qingchuan fault; MJF, Minjiang fault; HYF, Huya fault; LRBF, Longriba fault; WLF, Wulong fault; BXF, Baoxing fault; DYF, Dayi fault; QLF, Qionglai fault; PLF, Pingluo fault; LQF, Longquan fault; XPF, Xionqpo fault.

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paper, we investigate the E-W crustal shortening, using the combination of the 3-D seismic reflection data, satellite image interpretation and field investigation of the Dayi thrust fault system (DYFS), to determine the late Cenozoic stress field changes and shortening rate. Our results demonstrate that two-period tectonic deformations were

developed in the DYFS during the late Cenozoic, corresponding to the NE-trending structures and NS-trending structures, respectively. We suggest that the activity of the DYFS may reflect a change of the regional stress field direction from NW-SE in the Oligocene to early Pliocene to E-W in the late Pliocene to Holocene, which is consistent with present-day stress measurements. We infer that the 120 km NS-trending structures in the southern Longmen Shan range front and the Wenchuan earthquake co-seismic ruptures both reflect active, east-west crustal shortening in the Longmen Shan. Moreover, we obtain that the ca. 55 km shortening displacement since ca. 30-15 Ma give out an average shortening rate 1.8-3.7 mm/y in the southern Longmen Shan.