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Slow Late Cenozoic Slip of the Kangxiwa Fault, Northwestern Tibet, China

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The Tibetan Plateau is one of the most remarkable topographic features on Earth, and has widely taken to be the classic example of continent-continent collision. In the northern Tibet, the over 2000-km-long Altyn Tagh fault (ATF) system is the longest left-lateral strike-slip fault in the Asia, which accommodates sinistral motion between the Tibetan Plateau and the Tarim block within the India-Eurasia collision zone. The Kangxiwa fault, extending over a length of 700 km, is located on in northwestern Tibet as the most western segment of the ATF. One of the goals of this study is to determine how long-term tectono-geomorphic and geologic features respond to changes in driving forces within continental collision zone. In this study, we document well-preserved tectono-geomorphic and geologic features along the Kangxiwa fault to reconstruct the late Cenozoic tectonic history of the ATF based on the analyses of high-resolution satellite images (Landsat ETM, IRS and SRTM DEM data) as well as the field observations. Our results indicate that the Karakax and Yulongkax rivers across the Kangxiwa fault appear to have the largest lateral offset of 85∼90 km. Triassic basement rock also shows the same order of sinistral offset. Meanwhile, an 80-km-long surface rupture zone, produced by the most recent large seismic event with a maximum 4 m of coseismic displacement, has been identified along the Karakax River valley. Consequently, this surface rupture zone might be caused by large earthquake with moment magnitude (M_w) 7.3. The active tectono-geomorphic features such as systematic stream offsets, displaced fluvial fans and terrace risers, pull-apart grabens, and pressure ridges or push-ups are well developed along the surface rupture zone. These well-preserved late Quaternary geomorphic features are related to long-term geomorphic growth caused by repeated large seismic events as well as the dry and cold alpine climate. In addition, we estimate a long-term slip rate of 8∼12 mm/a since 55±5 ka according to these displaced geomorphic features and their apparent dating age, which is close to the results estimated from geologic (9±2mm/a) and geodetic measurements (9±4mm/a) in the central and eastern segments of the ATF. However, it is far lower than the high slip rate (20∼30 mm/a) as the extrusion model expected. Geologic and tectonic studies indicate that continental fault systems are active continuously for millions of years. If a long-term slip rate of 8∼12 mm/a can keep for millions of years, these large-scale offsets of geomorphic and geologic features (ca.90 km) likely represent the long-term displacement of the ATF since 7.5 ∼11.3 Ma (late Miocene).

Key words Late Miocene, left-lateral movement, tectono-geomorphic feature, the Kangxiwa fault, north Tibet