Millennial recurrence interval of large earthquakes and non-uniform slip rate along the Kunkun fault, northern Tibet

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Palaeoseismic studies show that while return times of surface-faulting related earthquake events can be placed within relatively confined recurrence intervals, and provide the most direct measure of the past recurrence intervals of moderate to large earthquakes on active faults (e.g., Yeats et al., 1997). Recurrence intervals of surface-faulting related paleo-seismic events are generally estimated from the event timings identified from trench and field investigations. The Kunlun fault is a major left-lateral strike-slip active fault in the Tibet Plateau. Studying on the long-term behavior of the Kunlun fault is important for understating the tectonic behavior of strike-slip faults and for assessing continental deformation modes and seismic hazards in the Tibet Plateau. However, because of difficult access, lack of field investigations and thinly scattered modern monitoring instruments, the knowledge on the paleoseismicity and seismic behavior of the Kunlun fault is still poor and controversial. In this study, we carried out field and trench excavation investigations, analyses and interpretations of remote sensing imageries on the eastern (Maqu) segment (101-102E) of the Kunlun fault around the town of Maqu, Gansu Province, China. Systematical deflection (offset) of rivers and gullies and mole track structures developed along the Kunlun fault are observed in the study area. Trench excavations exposed horizons of fluvial sand-gravel and silt-soil deposits containing organic soil and peat materials, which are disturbed and offset by the fault. Based on the sedimentary and fault-related structures and 14C ages, nine surface-faulting related paleo-seismic events are identified in the past 9000-10000 years, in which the latest event is constrained in the past 1000-1500 years. A millennial recurrence interval of large earthquakes is estimated with a characteristic slip of 3 m and an average slip rate of 3 mm/yr is constrained during Holocene time along the Maqu segment of the Kunlun fault.

Our results together with previous studies show that recurrent intervals are variable in different segments and the slip rate is non-uniform and diminishes from the west to the east with an average gradient of 1 mm/100 km along the strike-slip Kunlun fault, which challenge the previous view that the slip rate is uniform in an order of 11.5 mm/yr along the Kunlun fault.