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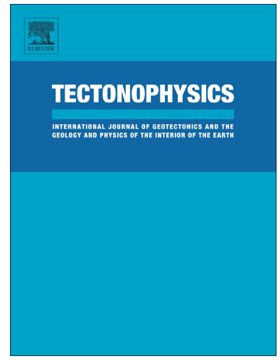

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Persistent Rupture Terminations at a Restraining Bend from Slip Rates on the eastern Altyn Tagh Fault

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Abstract

Restraining double-bends along strike-slip faults inhibit or permit throughgoing ruptures depending on bend angle, length, and prior rupture history. Modeling predicts that for mature strike-slip faults in a regional stress regime characterized by simple shear, a restraining bend of >18° and >4 km length impedes propagating rupture. Indeed, natural evidence shows that the most recent rupture(s) of the Xorkoli section (90°–93°E) of the eastern Altyn Tagh Fault (ATF) ended at large restraining bends. However, when multiple seismic cycles are considered in numerical dynamic rupture modeling, heterogeneous residual stresses enable some ruptures to propagate further, modulating whether the bends persistently serve as barriers. These models remain to be tested using observations of the cumulative effects of multiple earthquake ruptures. Here we investigate whether a large restraining double-bend on the ATF serves consistently as a barrier to rupture by measuring long-term slip rates around the terminus of its most recent surface rupture at the Aksay bend. Our results show a W—E decline in slip as the SATF enters the bend, as would be predicted from repeated rupture terminations there. Prior work demonstrated no Holocene slip on the central, most misoriented portion of the bend, while 19 – 79 m offsets suggest that multiple ruptures have occurred on the west side of the bend during the Holocene. Thus we conclude the gradient in the SATF's slip rate results from the repeated termination of earthquake ruptures there. However, a finite slip rate east of the bend represents the transmission of some slip, suggesting that a small fraction of ruptures may fully traverse or jump the double-bend. This agreement between natural observations of slip accumulation and multi-cycle models of fault rupture enables us to translate observed slip rates into insight about the dynamic rupture process of individual earthquakes as they encounter geometric complexities along faults.

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