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Earthquake clustering along major continental faults: the influence of strain pattern and geometrical complexities on rupture propagation

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The temporal clustering of large earthquakes is a salient characteristic of major continental faults in active zones. Decisive examples are large earthquake clusters along the East Anatolian fault (1820 - 1905), the North Anatolian fault (1912 - 1999), the Dead Sea fault (1137 - 1293), the southern San Andreas fault (1502 - 1680), the Kunlun Fault (1937 - 2001), the Tien Shan fault system (1885 - 1992) and Bulnay-Bogd fault system (1905 - 1957). Recent projects and faulting studies with paleoseismic investigations along the Dead Sea Fault (DSF), the East Anatolian Fault (EAF) and the North Anatolian Fault (NAF) provided a wealth of field data and results on the physical characteristics of earthquake ruptures. Using individual and cumulative slip, and the rich historical seismicity catalogue and archeoseismic investigations along fault strike, I examine the length of earthquake ruptures and timing of past earthquakes. The detailed mapping of rupture zones showing structural restraining bends, releasing step-overs, patch and segment boundaries, and slip distribution along strike illustrate their geometrical complexities. I observe that the long-term behaviour of fault segments and/or patches determines the occurrence of seismic sequences and the location of seismic gaps. In most cases, the clustering of large earthquakes migrate along fault segments and show off sequence seismic events. The mechanical coupling between off sequence distant earthquakes and laterally propagating ruptures depend mostly on the stress change at fault discontinuities and related block tectonics. The temporal clustering and multi-segment earthquakes ruptures in the past with coupling between step-overs and stress change suggests the size and probable length of future large earthquakes along major continental faults.