Stress triggering of the 1927 Gulang earthquake by 1920 Haiyuan shock

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The M = 8 1927 Gulang earthquake occurred 100 km away from, 6.5 years after, the M = 8½ 1920 Haiyuan earthquake. Both of them were located on the Haiyuan fault zone which is one of the big strike slip fault system distributed on the northeastern Tibetan Plateau. The close temporal and spatial spacing between these two earthquakes suggests that the Haiyuan earthquake trigger the Gulang event. Various geological fieldworks indicate that the surface rupture of the Haiyuan earthquake is explicit and straightforward along the NW direction while that of the Gulang event is not clear. Although Gulang earthquake ruptured a complex thrust surface, aerial photographs and satellite images revealed no recent rupture. Here we investigate the Coulomb stress changes which could help us understand how the Gulang shock occurs affected by the Haiyuan event by considering broad parameter ranges.
We consider a model of viscoelastic half space which includes postseismic relaxation of the lower crust and upper mantle to investigate how the Haiyuan earthquake has advanced or delayed the Gulang earthquake. Our calculations suggest that the epicenter of the future Gulang event is totally located in the increased Coulomb stress lobe, where stresses were raised 0.107 bar by the Haiyuan rupture. This value is a little greater than the static stress change threshold. The postseismic stress change induced by Haiyuan earthquake is increased by about 0.1 bar only after 6.5 years at the hypocentral location of Gulang event.
We investigate coseismic Coulomb stress changes on some possible Gulang rupture planes by changing key source parameters including strike, dip and rake angles of receiver faults. The failure mechanism is mainly left-lateral thrusting rather than right-lateral thrusting according to the calculated results. A mechanism of strike=290˚, dip=90˚ and rake=30˚ is a possible first ruptured fault plane in the process of the Gulang earthquake on which the Coulomb stress change imposed by the Haiyuan shock is the maximum by assuming broad uncertainties of the key parameters. The fault along N15˚W direction could be the second failure plane. The 1920 Haiyuan mainshock might promote the rupture of those faults associated with the event of 1927 Gulang event.

Keywords: Coulomb stress changes, Haiyuan earthquake, Gualng earthquake

