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Numerical modeling of seismogenic stress pattern and cohesive strength along the Main Himalayan décollement thrust zone, NW-Himalaya

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Cohesive strength of the fault zones can play a pivotal role to accumulate seismogenic stress for the future earthquake during the interseismic period, and mainly controlled by several factors especially coseismic stress drop, recovery rates of stresses (shear/normal) and change in cohesion and angle of internal friction within the fault zone. Moreover, significant mineralogical changes, existing heat flow and fluid-rock reactions in the fault zone further affect the cohesive strength of the fault. In this contribution, we have present series of 2-D finite element numerical modeling experiments that incorporate faults, elastic rheology, topographic load due to gravity and plate velocity boundary conditions. A plain strain models presented here to understand and quantify the role of cohesive strength in interseismic period and its effect on interseismic deformation and earthquake generation in the Himalayan fold-and-thrust belt. In present study, we tested different values of cohesion ranged from 1 (weak fault) to 25 (strong fault) and angle of internal friction ranged from 10 (weak fault)to 60 (strong fault)consistent of the natural conditions of weak and strong faults. Morh-Coulomb failure criterion with different rock mechanical properties were applied to examine fault type. Numerical modeling results presented here are based on (i) orientation, distribution and magnitude of principle stresses (ii) strain distribution (iii) displacement vectors, and (iv) distribution and concentration of maximum shear stress contour lines. In case of weak fault assumption, simulation results show that the significant compressive stress and strain are mainly distributed along the Main Himalayan décollement thrust. However, in case of strong fault condition, there are no failure occurred along the Main Himalayan décollement thrust but the significant amount of maximum shear stress is accumulated in the northern segment of the Main Himalayan décollement thrust at shallow crustal depth. On the basis of simulation results we conclude that the cohesive strength have important role to accumulate considerable amount of seismogenic stress/strain in interseismic period to produce medium to large scale earthquakes along the active fault zone.

Keywords: cohesive strength, fault zone, interseismic period, Himalayan décollement thrust, numerical modeling, NW-Himalaya