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Mechanical analysis of fault activation in southern Longmen Shan fold-and- thrust belt

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A mixed fault activation mode with obvious hinterland rupture in the southern Longmen Shan, the eastern margin of Tibetan Plateau, is revealed by recent 2008 Mw7.9 Wenchuan and 2013 Mw6.6 Lushan earthquakes together with GPS measurements. How to systematically understand the coexistence and competition mechanisms of fault activation, especially the principal-subordinate relationship on deformation absorption, in essence, involves mechanical onset analysis of this fold-and-thrust belt. However, due to the two-décollement- level thrust system with active 'flat-ramp- flat' geometry décollement, the predication of fault activation in the LMS has beyond the scope of Critical Coulomb wedge theory, not to mention the synchronous listric-type splay fault rupturing in the Beichuan fault (BCF) and Pengguan fault (PGF). For that purpose, we adopted maximum strength theorem, the kinematic approach of limit analysis, to deal with mechanical analysis of fault activation. Four end-member failure modes, or collapse mechanisms (CMs) in classical limit analysis, are proposed corresponding to the rupture of BCF, PGF, Range Frontal Blind Fault (RFBF) and the rupture of the flat-ramp- flat décollement into Sichuan Basin via RFBF. By selecting the available CMs via finite element limit analysis, the listric geometry of BCF and PGF is demonstrated to the dominant factor in trapping deformation in the hinterland. To activate the high-angle Beichuan splay fault, low cohesion and low friction angle on the BCF are combined effects on the rupturing of BCF. The change in cohesion and friction on BCF eventually forms the transition state between high angle BCF and low-angle PGF. Besides, due to the existence of low frictional upper décollement layer in Sichuan Basin (the Triassic

evaporate layer), small amount of deformation is attracted into the Sichuan Basin forming small-scale thrusting folding. Moreover, favorable deformation migration toward Sichuan Basin is jointly influenced by larger upper décollement layer rock strength, the vergence of thrusting fold in the deformation front, the low density and small bulk rock strength of the overlying strata in Sichuan Basin since Mesozoic. Hence, present-day mixed fault activation mode of the LMS region is a combined effect on fault geometry and frictional properties.