Determination of pre-earthquake megathrust strength and frictional properties on seismogenic faults from near-field data

*Hongfeng Yang[1], Suli Yao[1]

1. The Chinese University of Hong Kong

Frictional properties on seismogenic faults are essential for understanding earthquake nucleation and rupture propagation, as well as ground shaking during earthquakes. However, they are difficult to constrain at seismogenic depths because no direct measurements are available. Frictional strength on faults has been inferred from different approaches, but none of them has reported constraint immediately before a large earthquake. Here, we quantify the frictional strength on seismogenic faults by conducting spontaneous rupture simulations with constraints from near-field observations and kinematic source models. We first estimate stress drop using the kinematic source models, and then conduct a large number of dynamic rupture simulations to search for the best-fit frictional parameters. In the cases of the 2015 Mw 7.8 Nepal and the 2012 Mw 7.6 Nicoya earthquakes, our preferred models show remarkable waveform fit with near-field coseismic displacements and velocities, providing robust constraints of an average strength drop <5MPa. Considering typical ranges for dynamic friction coefficient 0.2 and static friction coefficient , we infer that the maximum value of average effective normal stress and yield stress are ~12.5MPa and ~7.5MPa, respectively. Such low strength is attributed to near-lithostatic pore pressure along the fault interface, which has been implied by seismic studies.

Keywords: Megathrust strength, Frictional properties, Near-field observations

