

Elucidation of slip characteristics in shallow crustal faults from deformation experiments on sandstone gouges within Himalayan Main Frontal Thrust

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Faults are structural discontinuities within the rock that range from few centimeters to kilometer-scale, in response to the stress buildup and their eventual release within the rock. The stress release can be instantaneous as is the case of earthquakes or it can be at infinitesimally small rates over the geological timescale that is also called aseismic creep. Therefore, elucidating the deformation mechanisms affecting the development of earthquakes or aseismic creep within rock bodies are a prerequisite in understanding the fault rheology and dynamics. This research focusses on the understanding the controls of constituent mineralogy on the active deformation mechanism and earthquake generation in Himalayas. The mean convergence rate of Himalaya is considered to be ~ 15 mm/year leading to stress accumulation along crustal-scale Main Himalayan Thrust. However, only few stress release events represented by greater than M5+ magnitude earthquakes in the Himalayan region have been observed. Hence, elucidating the constraints leading to the disparity in stress accumulation and stress release, is crucial to understand the stress accommodation mechanism and seismicity in the Himalayas. The current active subduction boundary is marked by Main Frontal Thrust separating the sub-Himalayas and the Gangetic alluvial plains. The rock types within the Main Frontal Thrust sheet show two primary types of sandstone protoliths, and three gouge types exhibiting cataclastic to foliated microstructural features. In this study, we have performed rotary-shear velocity step experiments on the powdered samples of the sandstone, as well as the gouge rocks, within the Main Frontal Thrust to determine their frictional properties at slow (10-200 μ m/s; creep) to fast (1.5 m/s; seismic) velocity under 10 MPa effective normal stress condition. We discuss these results and their implications on seismic nucleation in Himalayan Main Frontal Thrust.

Keywords: Main Frontal Thrust, Main Himalayan Thrust, Rotary Shear experiments, seismic nucleation