# Mechanical behavior modulated by shear surface morphology of simulated shear zone

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Mechanical behaviors of geologic granular materials in shear provide fundamental insights into the mobility mechanisms related to the dynamics of landslides and tectonic faults. Some previous experimental studies have shown that the mineralogy of constituent materials plays a first-order control on the transitions of mechanical behaviors, including sliding stability or instability. Moreover, other laboratory investigations have demonstrated the importance of shear rate as a primary control on the strength properties, leading to rate-strengthening or rate-weakening. Despite these efforts, however, neither the knowledge of general relationships between material properties and failure modes nor the underlying processes are well understood. Here we report on a series of ring-shear friction experiments designed to investigate the shear surface morphology on the mechanical behaviors along pre-existing granular shear zones. Two kinds of commercial granular materials were used in our experiments, say, halite and silica. Results directly show that only inclusion a low proportion of granular halite can produce the transition from stable sliding to stick-slip instability. The visual observations of shear surfaces further indicate that the variations with halite content form different morphologies. By analyzing the shear displacement and acoustic emission data, the microslip precursors were identified to stick-slip instability. It is expected that the mechanical behavior transition may constrain the evolution of asperity mechanism in nucleating rupture instability along heterogeneous shear surfaces owing to breakage of grain interfaces.

Keywords: granular materials, mechanical behavior, shear surface, acoustic emission, ring shear apparatus