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Analysis of Fracture Pattern of Pulverized Quartz Formed by Stick Slip Experiment

Osamu Nishikawa (1), Jun Muto (2), Kenshiro Otsuki (2), Harumasa Kano (3), and Osamu Sasaki (3)

(1) Graduate School of Engineering and Resource Science, Akita University, Akita, Japan (nishi@gipc.akita-u.ac.jp), (2) Department of Earth Sciences, Tohoku University, Sendai, Japan, (3) The Tohoku University Museum, Sendai, Japan

In order to clarify how wall rocks of faults are damaged, fracture pattern analysis was performed imaging experimentally pulverized rocks by a micro-focus X-ray CT. Analyzed samples are core (diameter of 2cm) of single crystals of synthetic quartz and natural quartzites, which were pre-cut 50º to the core axis and mirror-polished. Experiments were conducted with axial strain rate of 10-3/s under the confining pressure of 180 MPa and room temperature using gas apparatus. Intense fracturing of the core occurred during the stick-slip with very large stress drop. Although thin melt layer is formed on the slip plane, the core is pulverized overall by tensile fracturing characterized by apparent lack of shear deformation. X-ray CT images demonstrate the fracture pattern being strongly controlled by slip direction and shear sense. Cracks are exponentially increased toward the slip plane and concentrated in the central portion rather than outer margin of core. Cracks tend to develop parallel to core axis and at high to moderate angles (90º $\sim \pm 50^{\circ}$) with the plane including both core axis and slip direction, and lean to be higher angle to the surface near the slip plane. Due to this fracture pattern, the pulverized fragments show polygonal column or needle in shape with sharp and curving edges irrespective of their sizes, and the intensely fractured slip surface exhibit distinct rugged topography of an array of ridges developed perpendicular to slip direction. Mode and distribution pattern of fractures indicate that the stress concentration at the rupture front during dynamic rupture propagation or the constructive interference of reflected seismic waves focused at the center of core are possible mechanisms of pulverization.