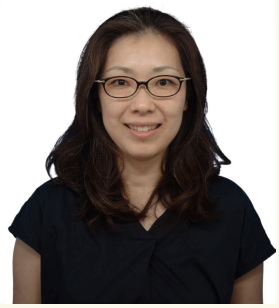
January 24, 2025

Effects of Pore Fluid Pressure on Extension and Extension-Shear Mixed-Mode Fracture in Berea Sandstone and Carrara Marble



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ABSTRACT: Pore fluid pressure in the geological formation at depth varies spatially and temporarily. Elevation of pore fluid pressure produced by natural or anthropogenic processes leads to extremely low normal stress conditions, where open-mode extension fractures or extension-shear hybrid fractures are formed. A series of triaxial extension deformation experiments under pore-fluid-pressure controlled conditions were conducted on porous Berea sandstone and impermeable Carrara marble to understand the effects of pore fluid pressure on extension-shear mixed-mode fractures. Fracture strength generally increases with effective maximum principal stress (s1'), and the transition of extension-dominant to shear-dominant fracture occurs at s1' = ~ 30 MPa for Berea sandstone and s1' = ~ 50 MPa for Carrara marble. All the saturated or pore fluid pressure-controlled Berea sandstone specimens exhibit lower fracture strength than dry samples, and the difference is distinct when the minimum principal stress is tensile (i.e., s3' < 0). On the other hand, the fracture strength of pore fluid pressure-controlled Carrara marble is greater than that of dry samples. This implies that various microscopic deformation mechanisms, including subcritical crack growth and dilatancy hardening, which are largely dependent on rock types and properties such as porosity and permeability, control the formation of extension-shear mixed-mode fractures under elevated pore fluid conditions.

BIOGRAPHY: Hiroko Kitajima received her Ph.D. in Geology from Texas A&M University in 2010. Dr. Kitajima's research focuses on the mechanics of earthquakes and faulting, specializing in experimental rock and soil mechanics. She has participated in five scientific ocean drilling expeditions of the International Ocean Discovery Program, including a deep-riser drilling project offshore Japan where she served as one of the chief scientists.

Seminar Details

Friday, January 24, 2025 2:30pm – 4:00pm

UH Campus Classroom & Business Building Room CBB 108

Online via Zoom https://www.cive.uh.edu/research/seminars