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Role of Water on Faulting–Diffusion of Pore Pressure due to Water Injection

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In order to investigate the role of fluid as well as pore pressure diffusion on rock fractures and induced earthquakes, laboratory experiments were performed on several rock samples under triaxial conditions with water injection. Change of seismic velocity due to rock deformation and water migration was monitored using seismic difference tomography. Microcracking activity was monitored using acoustic emission(AE) utilizing a high-speed waveform recording system. In the present study, we focus mainly on relationships between spatio-temporal distribution of microcracking and fluid migration during the deformation process, particularly the nucleation stage of faulting; from quasi-static to dynamic ruptures. In most cases the ultimate fracture was initiated at the front of water if the rock sample was not fully saturated. Experimental results also show that open fluid system may restrain development of the dilatancy hardening and weaken the rock sample significantly. For verifying the experimental results in large scales, we analyzed the catalog of earthquakes induced by water injection into a deep borehole of 1900m depth near the Huaying-mountain fault, western Chongqing, China. More than 30, 000 induced earthquakes were recorded since the water injection started in 1988. Our study confirms that the diffusion of fluid and pore pressure can be estimated either by precise difference tomography or by monitoring the tempo-spatial distribution of induced micro-seismic activity.