Rock Fracture Dynamics and Induced Seismicity

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Understanding rock deformation and fracture is important at all scales in nature. Such processes vary from intergranular microcracking, leading to preferential alignment of microcracks in laboratory rock samples and in situ rock masses, to massive earthquakes due to rupture along key lithospheric plate boundaries. Thus, fracturing contributes directly to seismic behaviour, mechanical properties, rock fluid interactions, and engineering applications. The research described in this talk utilizes unique experimental rock deformation and geophysical imaging instrumentation at the University of Toronto to simulate in the laboratory true 3D stress, thermal and fluid conditions in the Earth to study dynamic rock fracture and induced seismicity. Laboratory experiments and micromechanical modeling techniques have been used to carry out investigations into the physics of rock fracture with relevance to induced seismicity, fault mechanics and fluid transport in rocks. Laboratory true-triaxial experiments will be described that show the influence of sigma 2 on induced seismicity and 3D permeability of rock. In addition, in situ experiments will be described which show the application of induced seismicity and micromechanical modelling and provide insight into hydro-thermal-mechanical processes associated with full scale experiments for the deep geological disposal of radioactive waste and enhanced oil recovery processes using hydraulic fracturing.

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