Geophysical Research Abstracts
Vol. 20, EGU2018-5149, 2018
EGU General Assembly 2018

A true-triaxial acoustic emission experiment simulating the *in situ* 3D stress path of an excavated repository tunnel

Qingsheng Bai (1) and Paul Young (2)

(1) University of Toronto, Civil and Mining Engineering, Toronto, Canada; China University of Mining and Technology, School of Mines, Xuzhou, China (qingsheng.bai@utoronto.ca), (2) University of Toronto, Civil and Mining Engineering, Toronto, Canada

Acoustic emissions (AE) generated by rocks undergoing deformation has become one of the most highly effective tools for boosting our understanding of rock fracturing mechanisms. In this study, a true-triaxial acoustic emission experiment simulating the *in situ* 3D stress path is presented and the results are compared with *in situ* induced seismicity recorded during the tunnel excavation. The *in situ* data comes from the Mine-by tunnel experiment at Underground Research Laboratory (URL) located in Manitoba, Canada. The excavation-induced microseismicity data in the tunnel roof highlighted classic "borehole" breakout failure, while AE data in the tunnel wall indicated millimeter-scale cracks. In the laboratory experiment, the *in situ* 3D stress path coming from a point 1.0 cm from the Mine-by tunnel crown was calculated using an elastic numerical model as the tunnel advances past. The stress path was applied to a cubic (80 mm) granite sample (from a nearby location at the same depth) to simulate rock mass damage in the roof induced by tunnel excavation. AE activity was monitored with 16 sensors at a sampling rate of 10 MHz and 12-bit resolution. Using a time-varying transverse isotropic velocity model, 308 events were locatable inside the sample volume. In the field, spatial evolution of the events in the roof was presented as the tunnel advanced. In this experiment, temporal characteristics of AE events was converted to spatial distribution in relation to the tunnel advance according to the relationship between stress states and distances to the tunnel face. Spatial distribution of the AE events was found to be comparable with the microseismicity recorded in the roof of the tunnel. A source parameter analysis for cluster events within 2 mm of a potential damage plane in the sample was undertaken using a spectral fitting method. Corner frequency and moment magnitude were found to be inside the ranges 295 kHz $< f_c <$ 707 kHz and -7.7 $< M_w < -6.8$, respectively. Both of them agree with the AE source parameters recorded at the wall of the tunnel, where similar sensors and instrumentation were used. Unfortunately, the experimental parameters could not compare to the microseismicity data recorded in the tunnel roof, since a low frequency system was employed to record larger events (-2.9$< M_w < -4.2$). Static stress drops of the experimental events ranged from 0.6 to 6 MPa, which is comparable with larger seismicity recorded both at the Mine-by tunnel roof and around the URL shaft. Velocities measurements during the experiment were equated with the *in situ* results at the similar stress states, indicating the stress path experiment was competent to simulate the tunnel excavation process. This study highlights the potential role of laboratory stress path experiments to illuminate the fracture processes that are occurring *in situ* at the various stages of excavation and its associated induced seismicity.