Considerable fracturing occurs around the deep mine stopes because of the mining induced stresses superimposed on the high overburden stresses encountered at these depths. The frequency and orientation of fracturing is largely affected by the presence of geological structures, as well as the stope layout and mining configurations. Being able to accurately predict the effect of these interfaces and mining configurations would greatly assist in designing less dangerous stoping layouts and support systems which could in turn drastically reduce the hazards associated with rock falls and rock bursts.

A computer program, Discontinuity Iteration and Growth Simulation code (DIGS), based on the boundary element method is being developed with the objective of predicting the mining induced fracture patterns (Napier 1990). The philosophy of the validation process has been that the program should be able to model fracture growth in idealized, laboratory, tests where the loading is known and the fracture patterns can be extensively studied before embarking on the analysis of fracturing around underground excavations where qualitative data relating the boundary conditions to the fracture pattern is difficult to obtain.

The samples being tested are typically cubic blocks with a side length of 80 mm. A slot is machined to the required depth half way across the lower half of the block to simulate the excavation layout. The samples are made from Elsburg Quartzite, Timeball Hill Quartzite and Black Reef Quartzite. The sample is confined triaxially to a pressure of 27 MPa and loaded in the vertical direction. The results show that the inclusion of horizontal parting planes alters the fracture state considerably. The rock stiffness influences the amount of back area closure, which in turn, changes the observed fracture pattern. Closed slots cause fractures to extend ahead of the opening, whereas in open slots, the fractures curve behind the excavation. Sequential mining tests indicate that a reason for the periodic initiation of mining induced shear fractures is stress shielding by previous fractures. Good agreement is obtained between numerical modelling, observed fracture patterns and observed acoustic emission locations (Tomlin et al., 1997a,b). Similarly, the modeling of underground fracture patterns agrees well with observations (Sellers, et al, 1998).

A series of experiments were performed to create fractures with three-dimensional characteristics so that they could serve as verification examples for numerical models that are being developed to analyze the fracture processes around mine excavations. The experiments proved to be very successful for creating 3D fracture patterns that have similar characteristics to those observed underground. The shape and position of the fracture surface is determined by the mining geometry and the interaction with pre-existing discontinuities. The application of a state-of-the-art medical x-ray scanner and the development of automatic surface reconstruction software provided a method of producing a full three-dimensional, digital view of fractures within laboratory test samples. A number of 3-D numerical models have been developed and are being tested to determine how well they are able to model the 3-D fracture surfaces observed in the tests (Sellers, 2001).
References


