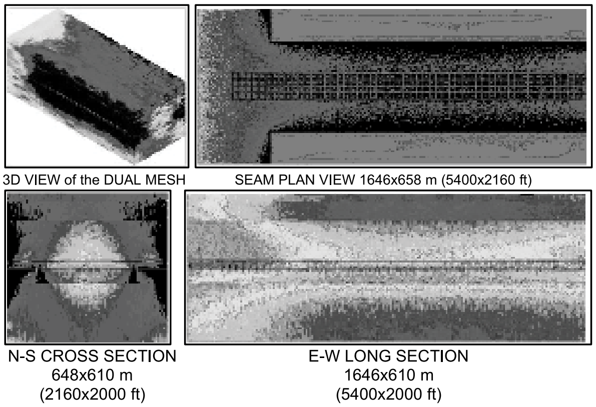

Figure 10. Element safety factor distributions after mining panels and main entries. Grey elements are mined.

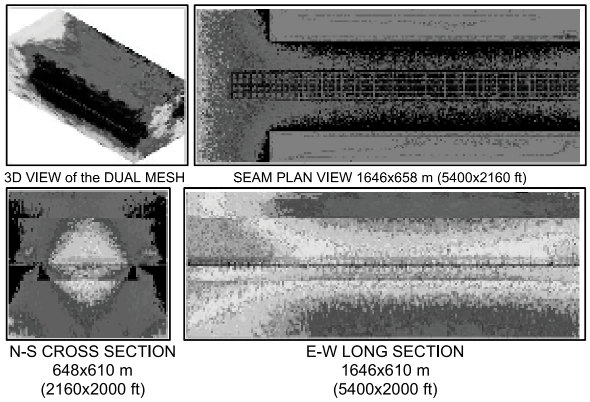

Figure 10. Element safety factor distributions after mining panels and main entries. Grey elements are mined.

Mining Induced Seismicity

Mining-induced seismic events must come from inelastic events occurring during advance of a mining face. The reason is simple, elastic behavior of strata conserves strain energy; release of strain energy must therefore be associated with dissipative events such as joint slip, joint extension, yielding, fracture and failure. In a recent companion study an encouraging correlation was obtained between counts of detected events and yielding or failing elements in a similar numerical model of another mine in the Wasatch Plateau coal field (8).

Figure 13 shows cumulative seismic events during two periods of observation. The first period began in February and extended into March, 2007 and spans the time when a severe bump occurred in the north barrier pillar. The sudden increase in slope of the blue data is associated with the bump. Subsequently, mining moved to the south barrier pillar. The second period of observation began in July and extended into August, 2007. A fatal collapse occurred on August 6 and a subsequent fatal bump occurred on August 16, 2007. The sudden increase in slope of the red data is associated with the collapse event. In fact, plot slopes are event rates. Sudden increases in slope in blue and red data are associated with bumps. However, no sudden increase in event rate was noted before the fatal bump that occurred during rescue operations. Seismic details are presented in (9). In the plots, days from separate start dates are used to allow for comparison histories. Also shown in the figure is the number of yielding elements in the detailed finite element model. Both axes are percentages of totals for ease of comparison.

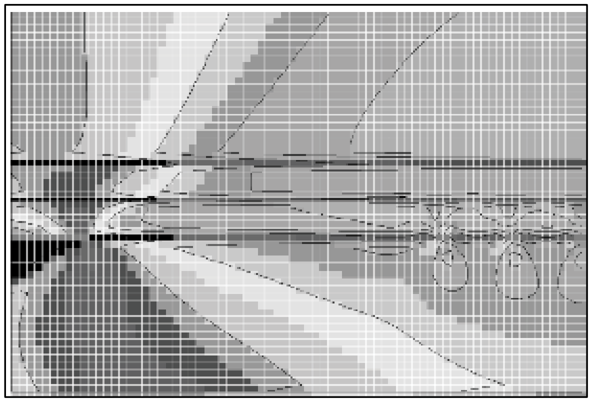

Figure 11. (B) Enlarged cross section from 2D results using uniform (constant) laboratory rock properties without consideration of joint effects. Room, pillar and barrier geometry is the same as in Figure 11(A) for comparison.

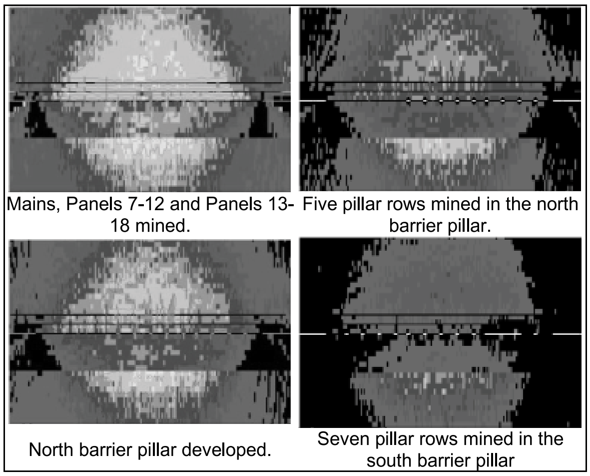

Figure 12. Evolution of yield zones as mining progresses.

The roughly parallel slopes of the three data sets in Figure 13 suggest a correlation between mine seismicity and yielding elements in the numerical model. If the event count were aggregated into the same time intervals as the element failures, the plots would appear more alike. However, no attempt was made to obtain improve "appearances". Figure 14 shows that indeed there is an association of seismic event count with yielding elements. The squares of the correlation coefficients (R2) are over 0.9