

Managing seismicity in South African deep mines

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Earthquakes mechanisms and seismicity in deep mines show many similarities to natural earthquakes. This has given many opportunities for mine seismologists to learn from earthquake seismologists. We hope that the converse is also true.

Mine seismicity is driven by the transfer of load from the rock that is mined to the rock mass around the mines. Mine excavations are frequently surrounded by fractured ground, extending around 10m into the previously solid rock ahead of deep tabular stopes. Faults can be reactivated at distances up to several hundred metres from mine workings.

Short-term hazard assessments are practiced on a daily basis in some deep-level mines using various measures of activity rate and “seismic stress”. Geological factors and ground condition also influence the hazard assessments in a qualitative sense. Miners take additional precautions in the working areas when the probability of seismicity is considered to be anomalously high. While this may well improve the level of safety in mines, there is considerable doubt that the warnings are substantially, or even significant, better than random.

Mining is accompanied by small earthquakes at a rate approximately proportional to the work done to crush the rocks at the advancing faces. We have found that the character of seismicity prior to the larger quakes on five deep gold mines looks very similar to the pattern before the multitude of small quakes.

In conclusion, seismicity rate and measures of “seismic stress” have not shown much promise as predictors of larger earthquakes in deep mines.