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Delineation of large localized damage structures forming ahead of an active mining front by using advanced acoustic emission mapping techniques

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Abstract

The authors applied advanced mapping techniques to 291 230 acoustic emission (AE) events as small as around M -4 that were recorded over 50 days by an ultra-high resolution network close to the active front of a tabular mining stope being advanced northward at 1 km depth in the Cooke 4 Gold Mine in South Africa. They first applied joint hypocenter determination (JHD) to improve absolute locations, and then applied the double-difference relative location algorithm to the JHD output. These steps resolved the seemingly continuous, dense cloud of AEs that extend about 20 m ahead of the stope front into several discrete, steeply dipping tabular clusters a few meters thick and 10–30 m in dip extent, separated by quiet intervals a few meters thick. The clusters have a strike parallel to the stope face and a dip of about 65°, resembling commonly observed large shear fractures along the plane of maximum shear (Ortlepp shears). In general, the activity of the clusters changed in similar ways as the stope face advanced, but each cluster remained stationary and the gaps between clusters were impressively quiet. This study demonstrates that high-resolution AE mapping can delineate the formation of large structures of localized damage in the highly stressed intact rock mass ahead of the stope face, a process that may culminate in hazardous seismic events.