Aftershock activity of M2.1 event within AE mesurement network in a South African deep gold mine

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Japanese-German Underground Acoustic Emission Research in South Africa (JAGUARS) project is started to bridge the knowledge of rock mechanics in a laboratory and seismology. Since the mining induced earthquakes in a deep mine have a variety of size from micro-earthquakes to acoustic emission (AE) events in a laboratory, we developed an underground laboratory along a cross-cut at a depth of 3540 m in Mponeng gold mine to observe seismic events in broad scale down to AE events (~10 mm in fault length).

The cross-cut traverses the Pink-and-Green dyke of diorite striking in an N-S orientation in quartzite host rock. The material contrast between the dyke and host rock should enhance stress perturbation associated with mining. AE activities on the dyke contacts are expected to become significant. We installed eight contact-coupling AE sensors, one grout-coupling AE sensor and one triaxial accelerometer in boreholes of 10 m long in a 70 m x 40 m area around the dyke contacts. The contact-coupling AE sensors can observe signals up to 200 kHz. The grout-coupling AE sensor and accelerometer has sensitivity up to 30 kHz and 25 kHz, respectively. The observed waveforms are digitized at a sampling frequency of 500 kHz. Seismic events are automatically discriminated and located on site. The waveforms of events are stored for detailed analyses. In addition to these AE measurement instruments, two strainmeters were installed in both sides of the east contact of dyke for detecting aseismic deformation on the contact as well as evaluating stress changes in this area. We are now expanding our network to enclose about 100 m x 150 m area.

A larger mine tremor was occurred on 27 December 2007. The focus of this event was determined by the mine seismic network to be on the east contact of dyke and about 40 m above our underground laboratory. The magnitude was estimated to be M2.1. Our AE measurement system automatically located more than 15,000 events for one day after the event, showing high capability of our system. Significant number of events was distributed in an area of 100 m in extent on the east contact of dyke. The focus of M2.1 event was almost at a center of the event distribution. The area of high seismic/AE activity may correspond to faulting area of the M2.1 event.