Local networks operated in the gold mines of South Africa record mining-induced events with local magnitude as low as -4 (Legge and Spottiswoode 1987) and occasionally exceeding 5 on the Richter scale. Nearly all events of magnitude 2 and above are also recorded and located by the National Seismological Network of the South African Geological Survey (Femandez and Du Plessis 1988).

The rock in the vicinity of an active mining face is stressed beyond its elastic limit and a fractured zone is progressively generated ahead of the face (Cichowicz et al. 1988). This continuous failure generally ends in a violent failure known as a rockburst. From 1986 to 1988 four GEOS (General Earthquake-Observation System) surface instruments (Borcherdt et al. 1985) recorded data from three-component velocity and acceleration transducers at a sampling rate of 200Hz. Rockbursts have well developed shear-waves and this report examines ground acceleration and velocity recordings from these instruments of rockbursts with a local magnitude greater than three for shear-wave splitting.

As these events occur at shallow depths (3 ± 2 km), it is inevitable that many direct shear-wave ‘arrivals will be outside the shear-wave window (Booth and Crampin 1985). The rockmass in an active mining area is heavily fractured and it is expected that these fractures would be dry. These shear and extension fractures could be in the order of several metres in dimensions, and shear-waves radiating through such a zone of fractures could be severely scattered, resulting in complex seismograms with emergent shear-wave arrivals. Another important characteristic of the rockmass in a mine is the fact that it is distinctly layered, being of sedimentary origin (Cichowicz et al. 1988). However, the events analyzed suggest a reasonable alignment of the first shear-wave arrivals. The directions of the leading shear-wave polarization were determined from particle motion diagrams. To avoid subjectivity all horizontal (East-West and North-South) component seismograms were rotated into radial and transverse directions, using the great circle azimuth from epicentre to station. Higher frequency noise corrupting the signal and making picking of the shear-wave onset difficult was removed by applying a band-pass filter to all the seismograms. Time-delays were measured from both recordings of ground acceleration and velocity and normalized to propagation over 1 km. The time-delays appear to be stable and consistent for velocity and acceleration recordings.

The alignment of the shear-wave polarization directions could imply that the fracturing and layering in the mine have negligible effect at the wavelengths of the recorded shear-waves and that the uniform alignment of the shear-wave polarization directions and the delay between the two different arrivals are due to propagation through the effective...
anisotropic rock pervaded by EDA-cracks, as is found almost universally in rockmass everywhere (Crampin 1987).

The existence of microcracks in an active mining area, and a way of detecting changes in the geometry of these cracks, could have important application for rockburst prediction. Rockbursts involve high stress and it is expected this would modify the crack geometry and hence modify the shear-wave splitting. What would be required to monitor the change in the shear-wave splitting is a continuous monitoring of the physical properties of the in situ rockmass by a subsurface triaxial network. If temporal changes can be recognized before and after rockbursts as it has been before and after earthquakes (Peacock et al. 1988, Booth et al. 1990, Crampin et al. 1990), it would be an important step towards rockburst prediction.

REFERENCES


