AOB Seminar

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講演題目&要旨 :

Assessment of stress ahead of the face at Ezulwini gold mine, South Africa

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Abstract:

Planer clusters delineated by AE monitoring at Ezulwini mine (headed by Masao Nakatani and described, amongst others by Moriya et al., in prep. and Naoi et al., 2014 IMS Seminar) provide a unique opportunity to test numerical stress modelling against measured observations of rock failure, and this presentation reports on a small numerical experiment in this regard.
Several studies using numerical modelling to explain the observed details of the geometry and distribution of different kinds of fractures (as, for example, postulated by Adams et al., 1981 22th USRM) have been done in the past (e.g. Roberts, 2012, SHIRMS), but the accuracy of the models are limited. One problem, I believe, is that the models do not appropriately simulate the dynamic evolution of extension fractures. Shear fractures appear easier to emulate using the non-linear techniques of FLAC or ELFEN.
The geometry of the AE clusters suggests the development of 'deformation bands' yielding in discrete and narrow planar zones along which thousands of small shear-type events occurred. Note that the AE monitoring failed to detect the extension fracturing that must take place within a metre or two of the mining face - either because the extension fractures are very low stress drop events or because they mostly occur within minutes of blasting during a time when rock noise makes the AE monitoring system less sensitive.
The evolution of such discrete bands of failure is difficult to emulate through numerical modelling. A hint as how one may try and understand the physical phenomenon is given by Stefanizzi & Barla (2007 Euro Tunnel Congress). They showed in multi-layered systems, the development of fractures and their spacing vary according to the extension strain localization - when a brittle layer is sandwiched between softer layers and the package is compressed, the extension of the brittle layer will result in equally spaced extension fractures. It may be that some similar mechanism also plays a role to allow the spacing and localization of shear-type failure zones in the area of high stress ahead of the mining face. The pre-requisite is the presence of weak bedding planes in the

sedimentary rock ahead of the face.

If we accept that the planar AE clusters do indeed reflect the evolution of type II shear zones, it does suggest that large scale dynamic shearing (Ortlepp shears) are preceded by the evolution of a preparation zone. This would contradict the notion that such dynamic failures evolved dynamically with the shear rupture spreading as a very rapidly extending fracture front through a pristine highly - stressed (but not yet failed) rock (van Aswegen, 2013 RaSim8). The AE results are therefore fundamentally important and all effort should be put into explaining the rock failure process that they represent. It is, however, unlikely that appropriate modelling tools exist today to do the job.