On-line Risk Management in Deep Mines (ORMID)

The deepest metal mines in Europe (1) and in the world (2) are located in Finland and in South Africa. Deep holes (3, 4) have been drilled down to 12 km. Deep mining is limited by technical, economical and safety aspects. Rapid and comprehensive analysis is needed to control the risks. The goal is to better understand the time-dependent failure process and to control the deep mining geotechnical risks.

Aalto University (Finland) and Council for Scientific and Industrial Research (South Africa) have identified two missing links in on-line risk management: the connection between geophysics and rock mechanics (WP1) and the development of suitable real-time research sensors (WP2). The project begins with the expansion of the current inversion method (Fig. 1) towards a real-time method. The aim is to connect the geophysical measurements to rock mechanics. Testing for suitable equipment for harsh environments is an essential part of this research project and a deep mine will be instrumented.

Deep mines provide a window to Earth’s crust. The mining activities disturb the local in situ stresses and create small earthquakes (Fig. 2). Deep mining requires new approaches for risk management. The research produces a new constitutive model validated in a deep mine. Complete chain is established: real time monitoring of rock mass response, risk assessment and representation of risk levels. The scientific potential lies in the connection between geophysics and rock mechanics and how to translate the risk levels into prevention and mitigation actions.

\[
\sigma = \begin{bmatrix}
1 & 0 & 0 \\
0 & 1 & 0 \\
0 & 0 & 1
\end{bmatrix}, \quad \sigma_y = \begin{bmatrix}
0 & 0 & 0 \\
0 & 0 & 0 \\
0 & 0 & 0
\end{bmatrix}, \quad \tau_{xy} = \begin{bmatrix}
1 & 0 & 0 \\
0 & 1 & 0 \\
0 & 0 & 1
\end{bmatrix}
\]

\[
\sigma = A \sigma_x + B \sigma_y + C \tau_{xy}
\]

Figure 1. Stress inversion components in 2D. [1] Figure 2. Stress driven damage in deep mines. [2]

Contact us:
Coordinator Lauri Uotinen, Lauri.Uotinen@aalto.fi, +358 504 642 970
Prof. Mikael Rinne, Mikael.Rinne@aalto.fi, Aalto University
Dr. Alexander Milev, AMILEV@csir.co.za, CSIR