On-line Risk Management in Deep Mines (ORMID)

The deepest mines in the world are located in South Africa while the deepest mine in Europe is the Pyhäsalmi mine in Finland. Geophysical measurements indicate that some Finnish orebodies continue to depth of several kilometers. Mining deep within the crust of Earth is limited by technical, economical, health and safety factors. Technically deep mining is limited by high temperature, stress induced rock failure and movement of rock wedges. To avoid loss of life and materials and to improve the efficiency of the mining, more advanced tools are needed. There is a demand for rapid and comprehensive rock mechanical analysis for control of geotechnical risks.

The goal of ORMID is to understand the rock failure process surrounding the mine openings over time and to apply this knowledge to mitigate the geotechnical risks. The secondary goal is to develop on-line measurement equipment suitable for deep mining environments. The tertiary goal is to promote and advance the development of suitable research instruments capable of on-line monitoring. The main research is carried out at Aalto University's Otaniemi campus, in Espoo Finland. Our partners are working from Council for Scientific and Industrial Research in South Africa and the project includes mobility actions to and from there.

There are two missing links in on-line risk management: the connection between geophysics and rock mechanics and the development of suitable real-time research sensors (Figure 1). The project begins with the expansion of the current inversion method 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 study and a deep mine will be instrumented. The final part of the research is putting it all together and evaluation of the outcome.

Deep mines provide a window to the earth's crust. The stresses at extreme depths are close to the uniaxial strength of the rock mass and the rock exhibits explosive stress driven brittle failure. Deep mines require new methods for risk management. Together Aalto and CSIR already possess many pieces of the puzzle: the risk framework, the numerical solution, the geophysical methods, experience from mine instrumentation, and access to the deep mines. The scientific potential lies in the connection between geophysics and rock mechanics, development of suitable sensors and how to translate the risk levels into prevention, mitigation and damage control.
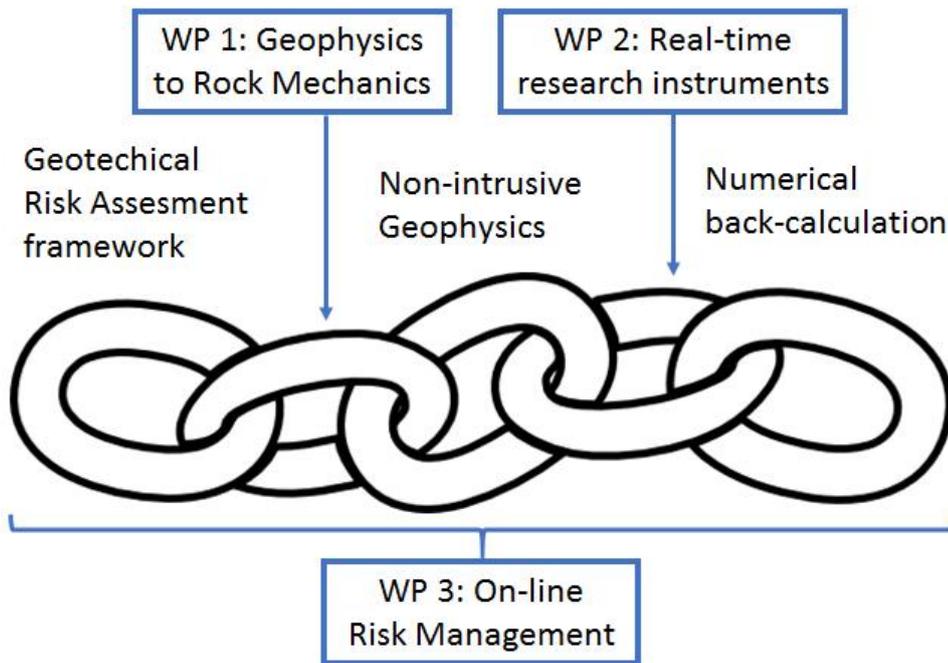
Figure 1. Work packages in the On-line Risk Management in Deep Mines research project

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Research website

ORMID http://buildtech.aalto.fi/en/research/