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Stress monitoring versus microseismic ruptures in an active deep mine

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Nowadays, underground mining industry has developed high-technology mass mining methods to optimise the productivity at deep levels. Such massive extraction induces high-level stress redistribution generating seismic events around the mining works, threatening safety and economics. For this reason mining irregular deep ore bodies calls for steadily enhanced scientific practises and technologies to guarantee the mine environment to be safer and stable for the miners and the infrastructures.
INERIS, within the framework of the FP7 European project I2Mine and in partnership with the Swedish mining company Boliden, has developed new methodologies in order to monitor both quasi-static stress changes and ruptures in a seismic prone area.
To this purpose, a unique local permanent microseismic and stress monitoring network has been installed into the deep-working Garpenberg mine situated to the north of Uppsala (Sweden). In this mine, ore is extracted using sublevel stoping with paste fill production/distribution system and long-hole drilling method.
This monitoring network has been deployed between about 1100 and 1250 meter depth. It consists in six 1-component and five 3-component microseismic probes (14-Hz geophones) deployed in the Lappberget area, in addition to three 3D stress monitoring cells that focus on a very local exploited area. Objective is three-fold: to quantify accurately quasi-static stress changes and freshly-induced stress gradients with drift development in the orebody, to study quantitatively those stress changes versus induced detected and located microseismic ruptures, and possibly to identify quasi-static stress transfer from those seismic ruptures.
Geophysical and geotechnical data are acquired continuously and automatically transferred to INERIS datacenter through the web. They are made available on a secured web cloud monitoring infrastructure called e.cenaris and completed with mine data. Such interface enables the visualisation of the monitoring data coming from the mine in quasi-real time and facilitates information exchanges and decision making for experts and stakeholders.
On the basis of these data acquisition and sharing, preliminary analysis has been started to highlight whether stress variations and seismic sources behaviour might be directly bound with mine working evolution and could improve the knowledge on the equilibrium states inside the mine. Knowing such parameters indeed will be a potential solution to understand better the response of deep mining activities to the exploitation solicitations and to develop, if possible, methods to prevent from major hazards such as rock bursts and other ground failure phenomena.