illuMINEation
THE FUTURE OF MINING

NEWSLETTER

The *illuMINEation* project is a 3-year project funded by the European Commission. Nineteen partners are collaborating in order to develop bright concepts for a safe and sustainable digital mining future. The interdisciplinary consortium has virtually kicked the project off in September 2020. With this newsletter, the *illuMINEation* consortium provides a short summary of some important project activities during the first 6 project months.

SETTING THE SCENE

THE MINING INDUSTRY'S INNOVATION NEEDS & REQUIREMENTS

During the start-up phase and first 6 project months, one of the main foci of *illuMINEation* was to assess the specific needs and requirements of the mining industry in respect to digitalisation and innovation. The core objectives are to improve mine safety, environmental performance and to optimise operations, hence increasing the overall efficiency of the mining process. In this assessment, the mining sector is represented by the five use case consortium partners Minera de Orgiva, RHI Magnesita, KGHM Polska Miedź, Boliden and Epiroc. However, all of the proposed solutions are applicable not only to the *illuMINEation* partners but rather to the entire mining industry.

One important need identified in the assessment is related to the monitoring of rock conditions and stabilities via large sensor networks. The solution proposed by *illuMINEation* features a novel multi-sensor-equipped "intelligent" rock bolt for mass-deployment in mining operations. This approach will provide

geotechnical data in addition to valuable information about atmospheric conditions such as temperature, humidity, gas concentrations, etc.

Another identified requirement is dealing with drilling technologies deployed in mining operations. Here, the so-called Measurement-While-Drilling and Analyse-While-Drilling methods are considered to have great potential to substantially improve decision-making processes with respect to exploitation (e.g. resource grade control), geotechnical aspects (e.g. blast design, fragmentation control and selection of ground support standards) or selecting appropriate ore blending strategies for optimised mineral processing.

Other needs and solutions are related to condition monitoring and predictive maintenance of mining machinery (including battery-powered equipment), advanced stability monitoring of tailings storage facilities and novel devices for environmental monitoring, e.g. ground water quality.

All solutions developed in the course of *illuMINEation* should be as affordable and as easy to install as possible so that the mining industry sector is able and willing to deploy the solutions on a large scale, especially in the case of the "intelligent" rock bolts and devices intended for environmental monitoring.
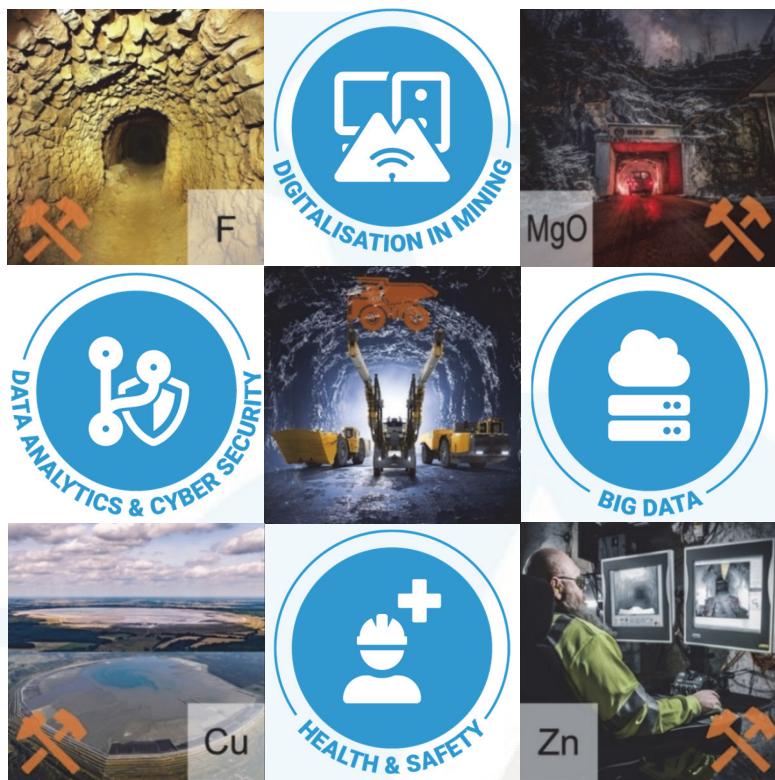
FIELD TEST AT SIERRA DE LUJAR MINE

BOREHOLES IMAGING WITH WHITE AND ULTRAVIOLET LIGHT FOR GRADE CONTROL

Two of the Spanish partners of the *illuMINEation* project, Universidad Politécnica de Madrid (ETSIME-UPM) and Minera de Orgiva (MDO), supported by ALT - Advanced Logic Technology, have tested white and ultraviolet (UV) light sources to assess the fluorspar concentrations.

At the Lujar Mine, fluorite occurs embedded in dolostone and limestone with typical grades in the order of 15wt%. This specific characteristic of the deposit complicates the in-situ ore recognition. Accurate ore designation already at the drilling stage (so-called Analyse-While-Drilling technique) in combination with exact spatial localisation of ore/waste boundaries would encompass important benefits for the mine.

An Atlas Copco 282 jumbo drill rig, equipped with an in-house Measurement – While – Drilling (MWD) system that has been developed in the course of the Horizon 2020 SLIM project was used to drill seven pseudo-horizontal holes at the level 345 of the Lujar Mine, in Southern Spain. Each hole has a diameter of 102mm and has been drilled to a length of 4m. The locations of the holes were selected by the mine's geologist in order to sample typical lithologies that are present at the mine, covering the full spectrum from high ore grade (up to 40wt%) to waste zones. Drilling chips were collected every 50cm to prepare pellets for chemical analysis, conducted via an X-ray Fluorescence (XRF) Thermo Scientific ARL OPTIM'X WDXRF analyser. The XRF results will serve as
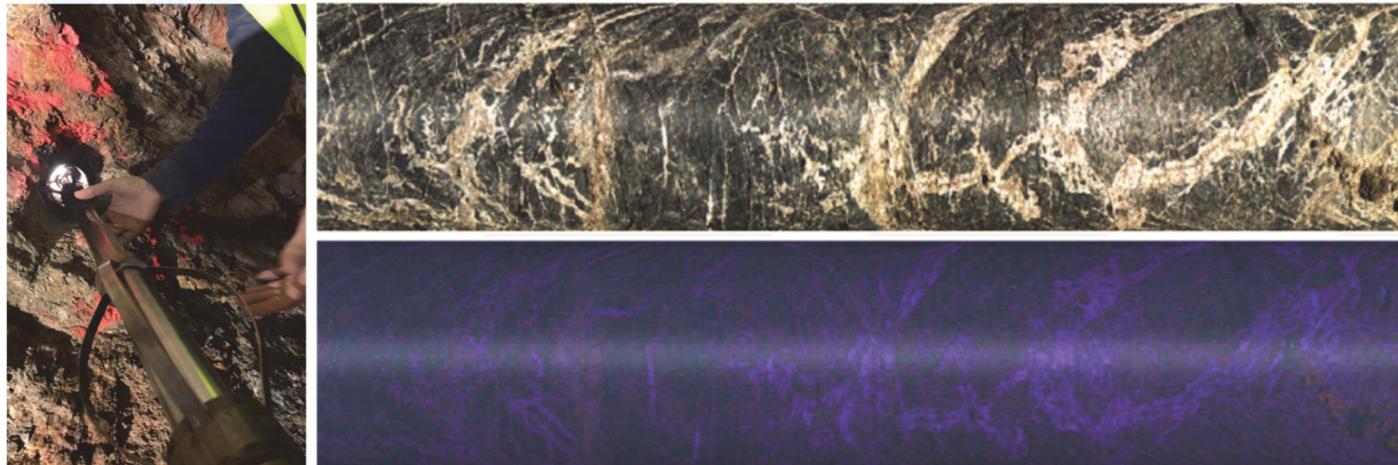

Figure 1: Logging of borehole #22 and section of reconstructed cores with white and ultraviolet light at depth 0.5 - 1.5m.

calibration for the optical televiewer results. After drilling, the holes were flushed with water to remove as much dust on the borehole walls as possible in order to increase the fluorescence response of the ore in the visible spectra. The holes were subsequently logged with an optical televiewer equipped with white and UV LED lights of 365 nm wavelength. An example of the logging results is depicted in Figure 1.

Machine learning techniques will be deployed to assess the fluorite content along the holes from the images of the wall. The influence of different lithologies and discontinuities encountered during drilling are recorded by the MWD system installed on the jumbo. The different responses apparent in the MWD data will be studied in combination with the televiewer results. Further tests are scheduled in near future to increase the representativeness of the logging results.

DISSEMINATION AND EXPLOITATION ACTIVITIES

In the last 6 months, the *illuMINEation* consortium had the opportunity to participate in some international events, presenting the project. The following list should give an impression of what these activities looked like.

The first opportunity arose right at the start of the project back in September 2020, when our project partner DMT gave the talk "Monitoring the mining ecosystem" at the EIT Raw Materials Summit 2020.

Subsequently, *illuMINEation* was presented at the International Joint Conference on Artificial Intelligence – Pacific Rim International Conference on Artificial Intelligence by our project partners KGHM CUPRUM and GEOTEKO with the paper "Clustering algorithms in the inclinometers readings anomaly detection issue on the example of tailings storage facility", January 2021.

In March 2021, the consortium was invited to present *illuMINEation* at the EU virtual booth at the Prospectors & Developers Association of Canada virtual convention.

The *illuMINEation* Exploitation and Dissemination Committee was established with representatives from all project partners. The main task of this internal project body is to participate in, foster and promote activities and materials related to the dissemination and exploitation of knowledge created by the project. The committee will also assist the project coordinator in the management of the Intellectual Property Rights generated in the project and support all communication, dissemination and exploitation actions undertaken by the consortium partners.

Check out our project website and follow us on LinkedIn and Twitter to find out the latest news and stories from the project!