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# *Virtual Coring While Drilling*

## *Rock characterisation for production blasts*

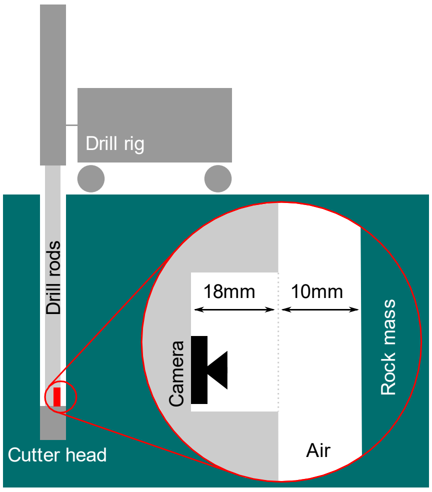


*Fig 1: Sensor position*

*Fig 2: Sensor on drill rig*

*Drilling and blasting is the first excavation step in quarries. If the resulting grain size distribution, also called fragmentation, is too coarse, a lot of energy is necessary downstream to break it down to the desired size. If the fragmentation is too fine, a lot of material is lost, because it becomes too fine to be processed. Blasting is also difficult because loose stones that are launched by explosive energy, also called flyrock, can damage structures, machines, and humans. When designing a production blast in a quarry, blast engineers only have the surface of the rock to inform them about cavities and discontinuities hidden within.*

*Virtual coring while drilling (VCWD) aims to provide inside views of the rock mass. The sensor is mounted directly on the drill rig, see Fig.1 and Fig.2. It has to withstand vibrations, abrasion, dust, and water.*

*The sensor films the rock and tracks discontinuities, cavities, and distribution of rock types. From the video, a virtual drill core is made, that shows these features. If several holes are filmed, the detected features can be connected and reveal the in-situ block size distribution. In Fig.3 the usefulness of virtual cores is illustrated, in 3a, just the rock cores are shown. In 3b, the information is extrapolated to show the complete rock mass and in 3c the ground truth is shown as reference.*

*At the current state of the project, virtual drill cores have been made during laboratory tests, as shown in Fig.4. Field tests of the prototype have been promising but some more work is needed. After some adjustments, a virtual rock core is planned to be created in the field and validated using endoscope measurements.*

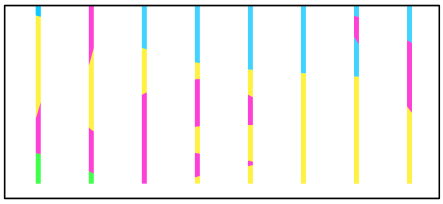

*Fig 3a: Borehole data*

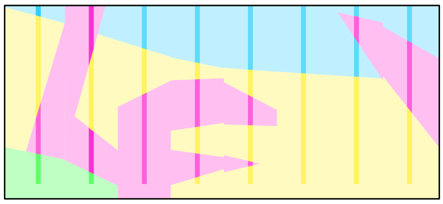

*Fig 3b: Reconstruction*

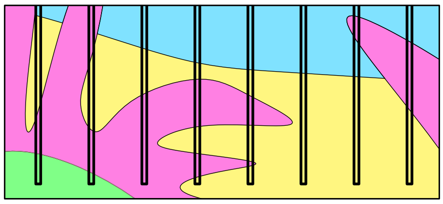

*Fig 3b: Reality*

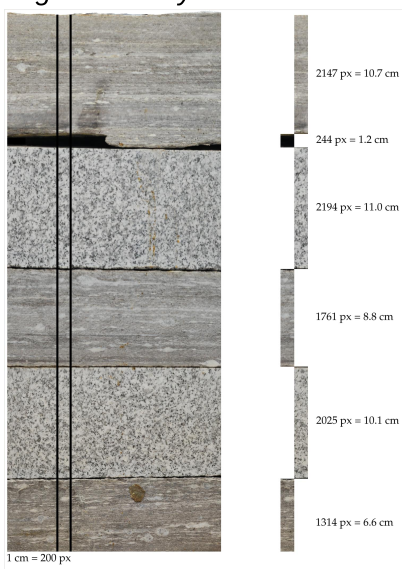


*Fig 4: Virtual drill core*

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DIGIECOQUARRY
INNOVATIVE DIGITAL SUSTAINABLE AGGREGATES SYSTEMS

Horizon 2020 research and innovation programme (Nº 101003750)

# Intelligent rock bolts

## The basic principle of intelligent rock bolts in underground mining

Intelligent rock bolt is a new support and monitoring system currently in early days of development and research. Intelligent rock bolts can be used in mining operations to acquire information on the bolt's status and movements of the rock mass. The future value of this technology resides in optimizing the support layout and increasing safety.

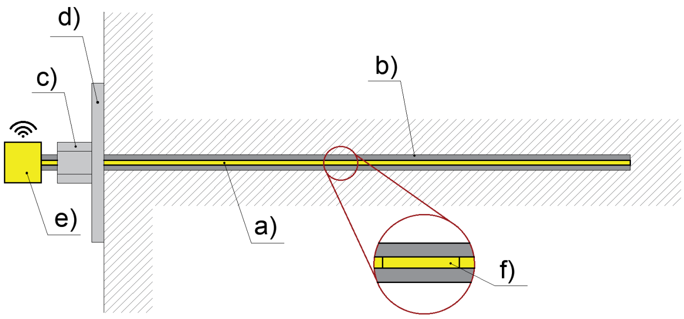


***Figure 1*** *Basic principle of the intelligent rock bolt.*

<u>Basic principle of how intelligent rock bolts work.</u>
The rock mass moves and deforms the intelligent rock bolt. Deformation of the sensor changes its resistance because of the change in thickness. Then the readout unit takes that resistance and sends it to the local database, this step can be done wirelessly or with the wire connection. Then data goes to further processing where it gets visualized and analysed for potential failure zones. Figure 1 shows the system: a) sensor, b) rock bolt, c) nut, d) plate, e) readout unit, f) one sensor segment.

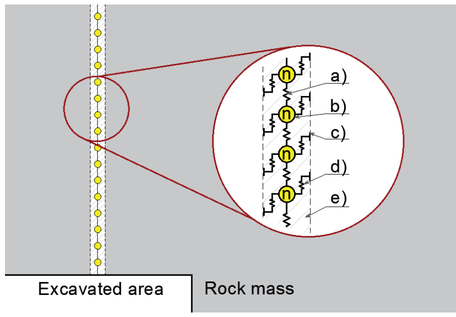


***Figure 2*** *Structure of the hybrid bolt in the numerical simulation: a) axial steel stiffness, b) node point, c) cohesive strength of the grout, d) shear grout stiffness, e) grout*

It is a conventional rock bolt upgraded with the deformation sensor that tells us about the condition of the bolt, and potentially gives us the insight into the structure of the rock mass. In the field of geotechnical engineering and rock mechanics, the accurate assessment and prediction of gravity-driven failures in wedge formations are important for ensuring the safety and stability of underground excavations. To address this critical issue, our research aimed to employ numerical simulation techniques in combination with intelligent rock bolts to capture and analyse these failures accurately (Figure 2 and 3).

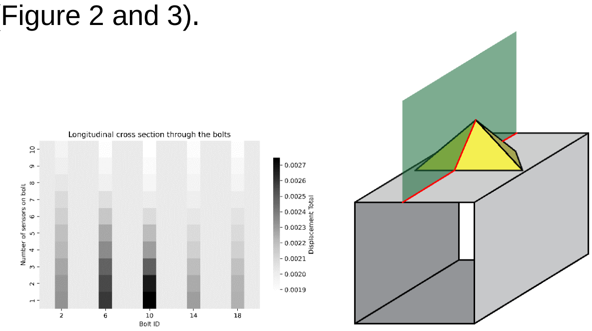


***Figure 3*** *Potential use case scenario – rock mass structure detection.*

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*Research fields:*

*Mine digitalization,*

*Mining engineering,*

*Excavation support.*

mining engineering mineral economics

# Integrating technologies for transparency in raw material supply chains

Paulina Fernández, Valentina Dietrich, Róbert Arató, Michael Tost, Frank Melcher

## Introduction

Facing rising demands for **ethically sourced raw materials**, new regulations aim to boost mineral supply chain transparency and traceability. Despite challenges from supply chain complexities, the **MaDiTraCe Project** emerges as a solution, focusing on certifying materials like **cobalt, lithium, neodymium and natural graphite** via a Digital Product Passport. This initiative addresses transparency through technology, ensuring ethical practices from extraction to recycling, and marks a significant step towards comprehensive supply chain solutions.

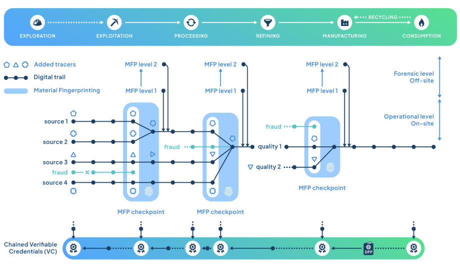


**Figure 1** Conceptual summary of the MaDiTraCe Project.

## *Due diligence and traceability*

**Due diligence** identifies and mitigates adverse impacts, complemented by traceability, which tracks the origins and journeys of products. This synergy underpins the foundation for responsible and sustainable business practices. These processes are reinforced by:

- OECD Guidance
- European Battery Regulation,
- Dodd-Frank
- National legislations from the Netherlands, USA, and Germany.

## *Approaches to traceability*

### *Analytical fingerprinting approaches*

The MaDiTraCe project aims at revolutionizing traceability of battery raw materials by introducing **Material Fingerprinting (MFP)**. MFP utilizes unique material based properties, such as trace elements, isotope ratios as well as mineralogical and crystallographic parameters of the respective mineral raw material. At MUL, a holistic approach to analytical provenance is being developed for **graphite** based on trace elements, stable carbon isotopes and the crystallinity of the material. The sample collection includes all global players of the world market with a main focus on traded graphite concentrates.

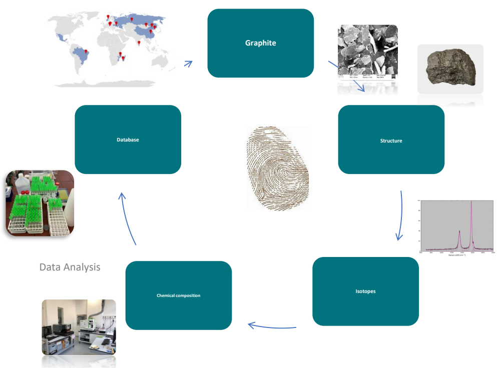


**Figure 2** MFP concept for graphite.

### *Instrumental analytics & data analysis*

The project exploits the innovative instrumental opportunities at MUL. The generated datasets are subjected to data analysis to obtain a definite fingerprint for individual graphite deposits. Simultaneously, the nature and composition of graphites is better understood.

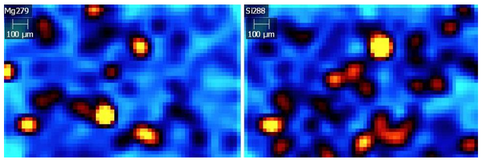


**Figure 3** Mg and Si impurities in graphite concentrates.

### *Digital and certification approaches*

The MaDiTraCe project harnesses CERA 4in1 certification for traceable, environmentally and socially responsible raw materials. Utilizing AI, IoT, and blockchain for data digitization, it integrates into a **Digital Product Passport**, aligning with the EU's battery passport. This modern strategy secures stakeholder data sharing, bolstering supply chain transparency and sustainability.


**Figure 4** Standards of CERA4in1 for each stage of the value chain.

## *Conclusions*

The MaDiTraCe project:

- Addresses due diligence gaps in raw material sourcing.
- Develops technologies for transparent and sustainable supply chains.
- Enhances compliance verification and boosts consumer trust.
- Integrates analytical fingerprinting and artificial labeling for traceability.
- Implements a certification system for a digital product passport.
- Promotes sustainability, corporate responsibility, and transparency.

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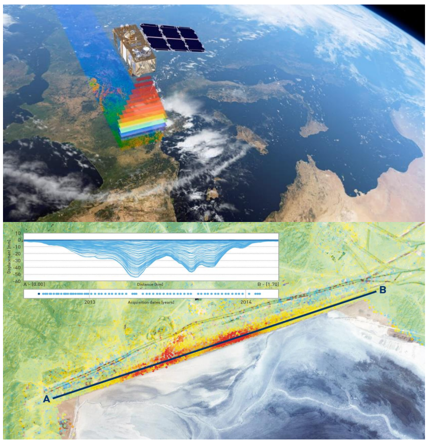
# Public perception study around mining and remote sensing technologies in Austria

Maria Mavroudi

## *Introduction*

The Horizon Europe S34I project, lasting 30 months, aims to utilize new data-driven methods for analyzing earth observation (EO) data like satellite, drone and mainly other airborne data. Its objective is to strengthen the European autonomy in raw materials by facilitating systematic mineral exploration and by continually monitoring extraction, closure, and post-closure activities.

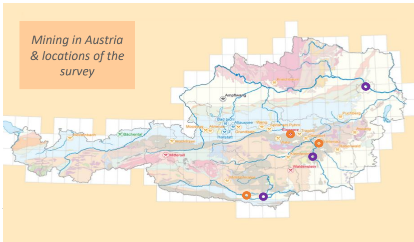
Multi-scale and multi-platform EO data and integrated processing methodologies will be optimized, demonstrating the potential of new remote sensing applications by developing new methodologies and upgrading the existing ones.



In addition to the innovative methods for analyzing EO data, the S34I project examined the contribution of EO tools in terms of transparency, social responsibility, and communication among stakeholders. The perception of mining and the application of industry-integrated EO tools was assessed in Austria.

## *Methodology*

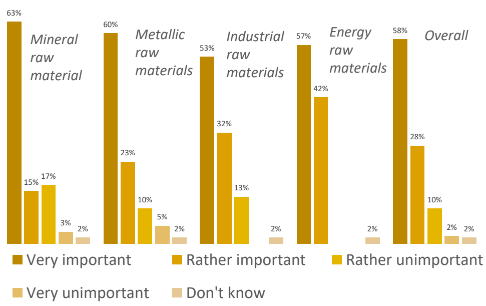
In this study 60 telephone questionnaires assessed the opinion of the local citizens of mining (TRM) and non mining (NMR) regions equally distributed, towards mining and the potential use of EO tools. The main aim was to assess how EO technologies could function as a tool for increasing the social acceptance of the sector.




## *Results*

- The respondents understand the necessity of the sector.
- Most disturbing factors are noise and dust.
- Sports and recreation the best option for rehabilitation purposes.
- University is the most reliable provider for EO data and information.
- Understanding and opinion on mining remain the same with the integration of EO tools.

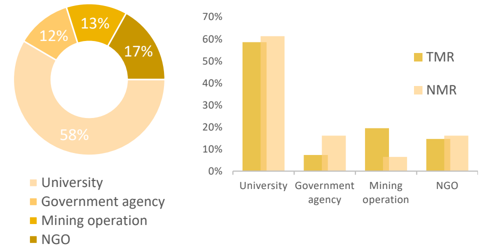
Importance of raw materials extraction



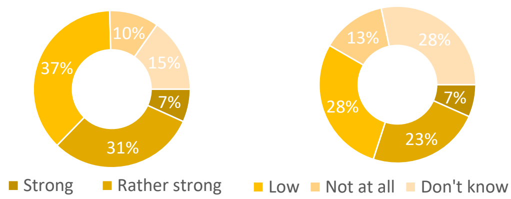

Additional comments:

- Need for clear and understandable communication in raw materials.
- Preoccupation for a secure domestic supply chain.
- Current tensions in the national extractive sector were mentioned by the public.

Most trusted provider of EO data




Implementation of EO tools: change in understanding (left) & opinion (right)




## *Conclusions*

- Austrians are friendly subject to mining. People living close to mine sites trust more the mining company than the rest. Nevertheless, doubts and concerns still exist.
- EO tools and their potential in implementing them in the extractive industry are mostly unknown and do not interest the public.
- Awareness and understanding will help promote and implement these technologies in the industry.

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S34I

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