DINAMINE

DIGITAL AND INNOVATIVE MINE OF THE FUTURE

DINAMINE technology demonstration at project pilot sites continues

The DINAMINE project has developed nine technology modules supported by sensors that collect data in real time. The technologies are being validated in an operational setting at both project pilot sites in Norway and Portugal and include cloud software, drilling machinery, vehicle tracking and connected sensors at the mine and processing plants. Together, the technologies demonstrate DINAMINE's unique approach to holistic mine management from mine to product.

DINAMINE's cloud-based software solution provides mining engineers, managers and technicians up-to-date monitoring of the mine productivity from mine-to-product and optimisation of processes and settings on a shift-by-shift basis. The solution provides updateable geological and geotechnical data management and provides the user access to a production management tool, for short-term and long-term scheduling of mine activities. The software's web-based user dashboard provides a unified interface for operational, sensor, laboratory, environmental, and economic data, providing mine personnel direct access to both real-time information and historical analytics. The dashboard offers a solution for tracking financial parameters and generating forecasts, exploring live sensor data and historical time series, and uploading laboratory results. A dedicated Life Cycle Analysis module visualizes environmental impacts from mining operations, allowing users to assess emissions, energy use, and other impact categories over time. Finally, the weekly reporting module compiles key operational, economic, and environmental insights into easy-to-share summaries. Collectively, the dashboard provides a consistent, data-driven foundation for operational awareness and decision-making across the mine.

Skaland Graphite Project Pilot

At the Trælen underground mine, the project team has continued to validate the DINAMINE drilling jumbo, developed by project partner AMV, which uses automated boom guidance to drill at the tunnel face in the mine development. In several dedicated drilling campaigns, the team achieved automated drilling of plans developed by a geological and geotechnical mapping system developed in the project. In addition, a predictive maintenance module is being developed for the jumbo. Multiple project partners, including SINTEF Nord, AMV, and NGI performed in-situ experiments related to the pressure accumulator of the percussion unit of the drill. The collected data will be used by SINTEF Nord to develop and validate a predictive maintenance module for the percussion unit of the jumbo.

The boom of the DINAMINE jumbo during test drilling at the Skaland Graphite mine.
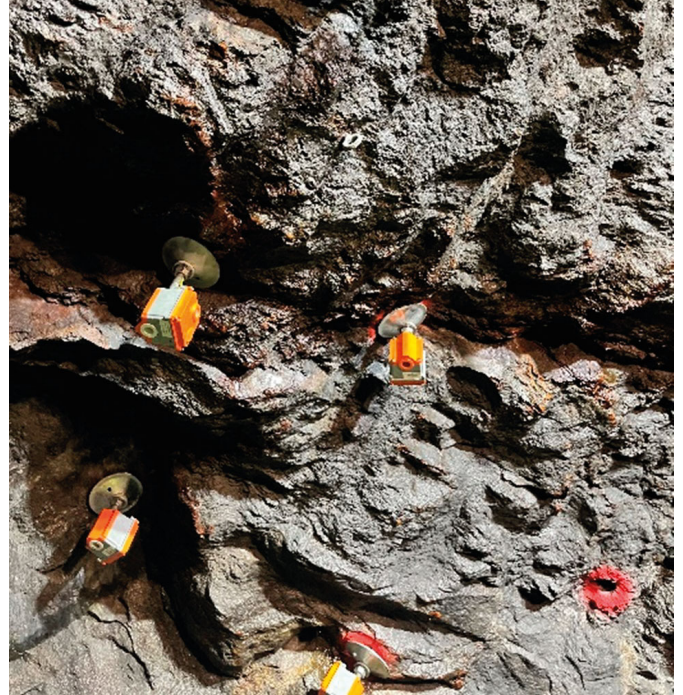
23 instrumented bolts, developed by ThingWave (Sweden), were successfully installed in the mine.

Meanwhile, the project team installed a set of instrumented bolts. The bolts communicate real-time displacement data through the mine's underground wireless access points along with the other installed sensors including air quality monitoring equipment.

At the Skaland processing plant, sensors have been connected to the DINAMINE system, including chemical analysers at the input feed conveyor belt and in the laboratory, systems in the control room that measure electrical power and liquid natural gas consumption, and real-time status of ore and product silos.

Felmica Minerais Industrias Project Pilot

At the Felmica processing plant, the project team installed several new remote monitoring technologies, which play an important role in monitoring product feeds, energy consumption and improving operational workflows. Project partners Worldsensing and Felmica deployed wireless technologies to remotely capture real-time data on engine temperature, pressure, and vibration levels from a conical crusher, as well as water consumption, providing essential information for the mine's life cycle assessment and carbon-footprint reporting. The combination of these tools enables reliable data acquisition and supports predictive maintenance, particularly in areas where installing cabling would be impractical, costly, or disruptive to normal operations. Preliminary results from the predictive maintenance module show promise for early detection and warning of oil pressure level drops. These developments highlight how adaptable IoT technologies can contribute to collecting key operational data enabling more efficient and safer process management.

Weather station, monitoring ambient temperature, relative humidity and rainfall

Project partner Spectral Industries installed two laser-based chemical sensors on the product input feed conveyor belt and in the laboratory. The conveyor belt system measures element concentrations in the input feed, while the Lab analyser provides measurement in the subsamples of product stream collected over a shift. The sensors provide data for the DINAMINE mineral processing model, which uses real-time sensor data for water consumption, electrical and energy consumption, mass of material streams and elemental content on the input feed, waste, and products within the mining process. The model provides the operator with a summary of the total water consumption, greenhouse gas emissions, mass balance and recovery rate for the current processing state, which can be used by the DINAMINE mine management system to optimise energy and resource consumption during processing.

LIBS Lab analyzer installed at the lab of Felmica processing plant for the monitoring of elemental concentration in the primary product.

At the Felmica mine, the NGI and Felmica teams completed the final geophysical exploration campaign in the project. The campaign focused on the near-surface and deposit-scale exploration. Ground-penetrating radar (GPR) and ground magnetic data were collected at several sites near the mine. In total, about 30 GPR measurement profiles were collected using low, intermediate and high frequency antennas to better delineate the shallow granite-pegmatite contacts and alteration halo around the contacts. Magnetic data contributes to modelling of the subsurface down to larger depths. Besides known pegmatite deposits, additional magnetic data was also collected in unexplored parts of the mine to investigate the potential for occurrences of pegmatites. The results after processing and modelling, will be used to update the current geo-model of the mine.

The final DINAMINE exploration campaign used GPR and ground magnetic geophysics for near-mine mapping of pegmatite deposits

EVENTS

DINAMINE was represented at several key events this autumn!

The project was presented at MINEX Europe Mining & Exploration Forum 2025 in Lisbon, where technical lead Mahdi Shabanimashcool presented the project's mine management solution and how it will address the needs of small and medium-sized mining operations. The MINEX Forum has become one of the most authoritative international events in Europe and brought together leading industry professionals, policymakers, and investors under the crucial slogan, *"Made in Europe": Securing Critical Raw Materials for Sustainable Future.*

DINAMINE was also represented at Raw Materials Week 2025, organised by the European Commission in Brussels. The annual event brings together stakeholders from European institutions, industry, governments, academia, and civil society to discuss the latest developments in raw materials policy and innovation in the EU and offers a unique opportunity to explore the strategic importance of raw materials, share knowledge, and network with key actors in the field. The project coordinator participated in two side-events, the EXPLORING TOGETHER event, and the Smart Mining Futures event, together with other EU-funded projects and members of the European Sustainable Mining & Innovation Network.
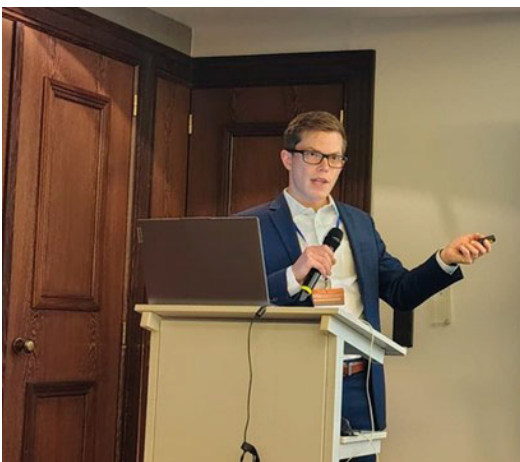
Project partner Worldsensing presented the project at the VII Congreso Nacional de Áridos in Córdoba, Spain, as part of the digitization and standardization best-practices task. The 1.5-hour session brought together several EU-funded projects to discuss their challenges related to standardisation, with a focus on how the technologies developed within these projects contribute to, support, or help shape emerging standards.

Project Meetings

In July, the DINAMINE team met in Norway for its second formal review meeting. The team provided a comprehensive review of the project progress at the two-and-a-half-year mark.

Following a full day of presentations, the project team visited the Skaland Graphite mine and processing plant to demonstrate many of the already-installed technologies.

In October, the project team met in Portugal to visit the Felmica project pilot, where the DINAMINE team was able to review the progress towards demonstrating the technology modules, and inspect the installed sensors that provide data at key points of the value chain for the extraction, transportation and processing of mined materials.

Publications and project deliverables

Two scientific publications were published in the last months, which included a paper about a method used for digital rock mass mapping and identifying rock block size distribution in intact rock (link), and a comprehensive review of 170+ studies and industrial projects, mapping the latest advances in hydrogen production, storage, transport, and deployment across mining (link).

The DINAMINE team completed several technical deliverables in line with the final milestone of the project, including a comprehensive assessment of the engineering, environmental, and valorisation characteristics of mine tailings and waste rock from the project pilot sites. Tailings and waste rock remain among Europe's largest underutilised secondary-resource streams, yet their strategic relevance is increasing under the EU Critical Raw Materials (CRM) policy. Robust understanding of their mineralogical stability, leaching behaviour, mechanical performance, and reuse potential is essential for future low-carbon construction materials and circular resource flows. Given the EU's growing focus on CRM recovery and extractive-waste valorisation, the project pilot site residues represent credible secondary raw materials that can help reduce reliance on virgin extraction and lower environmental footprints across mining regions. Insights from broader European practices reinforce these conclusions: silicate-rich tailings and waste rock similar to those assessed here already support a wide range of industrial-symbiosis opportunities, including secondary aggregates, fillers, cement extenders, and low-carbon construction materials. Their compatibility with circular-mining strategies and their alignment with key EU policy instruments such as the Circular Economy Action Plan, the Critical Raw Materials Act, and the Extractive Waste Directive strengthens their role as practical contributors to Europe's shift toward resource efficiency and reduced environmental impact.

NGI

MRC | SKALAND GRAPHITE AS

FELMICA Minerais Industriais, S.A.
Uma empresa do Grupo
MCS PORTUGAL

WORLD SENSING

SINTEF

KEMIJSKI INŠTITUT

AMV EST. 1860

PNO INNOVATION

SPECTRAL INDUSTRIES

Stay tuned for more updates as we continue on our mission to create a mining industry that is greener and more sustainable!

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