Abstract

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Clean extractive industry to deliver new products to manufacturing sector –
Introduction to ProMine project
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Abstract

The non-energy extractive industry (NEEI) is a significant contributor to the economy of the EU providing metalliferous and non-metalliferous mineral resources to the society as well as direct and indirect employment. Many industries directly rely on the availability of mineral raw materials. These industries provide direct employment for almost 30 million people, which means that the availability of raw materials plays a key role for the economy of the EU.

Nevertheless current demand exceeds production, and so the EU is heavily dependent on mineral and metal imports leading to an annual trade deficit of about €11 billion. Metallic minerals accounted for 90% of this deficit, while there were also net trade deficits in construction minerals (€456 million) and industrial minerals (€798 million). Another major issue is that the EU is totally dependent on imports for some strategic metals. Important new strategic high-tech metals for the European industry include e.g. cobalt, niobium, rhenium, rare earth elements, platinum and titanium. In the development of state-of-the-art technology and advanced products they have a crucial significance.

ProMine project with the total budget of €18 million is partially funded by the EU´s FP7 Programme, under the theme: Nanosciences, Nanotechnologies, Materials and New Production Technologies, seeks alternatives for imports of metals and minerals to Europe.
Geological Survey of Finland - GTK is co-ordinating the extensive project, which involves a total of 27 partners from 11 EU member states. Its objectives address the Commission’s concerns over the annual trade deficit in metal and mineral imports. Main objective of ProMine is to develop innovative concepts and processes for strategic mineral supply and for new high added value mineral-based products.

ProMine has a strong industrial involvement; consortium covers the entire supply chain from extraction and raw materials manufacturing to mineral products manufacturing and by-product materials utilization, thus the needs of industry are well taken care of. Consortium includes metal mining industry producing about 70% of metals mined within EU. Other industries in ProMine include: Abrasives industry, Constructive industry, Paint industry, Metal industry, Metallurgy and Paper industry.

To redress the deficit imbalance of imported raw materials, a number of measures need to be implemented, including:

- Developing and bringing to market new, high value products based on (nano)scale raw materials (metals and minerals) delivered by the extractive industry.
- Developing better exploitation and modern eco-efficient mineral processing and metal recovery methods, including biohydrometallurgy to enlarge the number of profitable potential targets in Europe and to minimize footprint of mining activities.
- Ensuring that all potential resources (known and predicted) within the EU are fully documented and this information is available to the extractive industry in a GIS-based system, and which is clearly linked to the needs of manufacturing industry.

The ProMine project addresses these measures by working on three main themes:

- Downstream: Following 5 potential, high value, new mineral-based products from extraction, fundamental research to bench scale, and from these, selected products to demonstration scale, including production, testing and evaluation of these materials, with economic evaluation, life cycle cost analysis, and environmental sustainability, and
- Upstream: Developing a GIS-based resource assessment and modelling system for the extractive industry, showing both known and predicted mineral occurrences across the EU, whereby not only metallic but also non-metallic minerals are considered.
- Upstream: Demonstrating the reliability of new technologies (including biotechnology) for an ecoefficient production of strategic metals, driven by the creation of added value on site and the identification of specific needs of potential end-users.

ProMine will also respond to the EC’s Raw Materials Initiative which launched measures for addressing this challenge: Initiative 7 “Encourage better networking between national geological surveys with the aim of increasing the EU’s knowledge base”,
**Initiative 8:** “Promote skills and focused research on innovative exploration and extraction technologies, recycling, materials substitution and resource efficiency” and **Initiative 9:** “Increase resource efficiency and foster substitution of raw materials”. Thus, RMI emphasizes the reduction of the consumption of primary raw materials and an optimal use of natural resources. In fact, this provides new opportunities for the mineral enrichment and recycling industries.

ProMine work packages are the following:
- WP1. Geological mineral resource potential modelling across Europe
- WP2. 4D modelling of mineralised belts
- WP3. New nano-products from mineral exploitation
- WP4. Ecoefficient metal production methods and utilization of secondary materials,
- WP5. Assessment of sustainability and environmental impact
- WP6. Knowledge management and exploitation
- WP7. Project Management

ProMine assesses the real value of European mineral resources. It has been estimated that the hypothetical in situ value of unexploited minerals at a depth of 500–1,000 metres below surface is about €100 billion. Whether these so far unexploited minerals will be exploited depends on the availability of new exploration and mining technologies and global trends in commodity prices. A comprehensive database will be essential to ensuring that these resources can be accessed as efficiently and effectively as possible.

ProMine prepares a model for the mining industry that aims not only to develop production, but also to supply high-tech customised products as new raw materials. The market value of the new mineral products has been estimated at dozens of billions of euros. New products will include: conductive metal (Cu, Ag, Au) fibres for e.g. high performance abrasive products; Rhenium and rhenium alloy powders for aerospace, TGV trains, turbine blades and engines; Nano-silica for construction materials and catalysts; Iron oxyhydroxysulphate for pigments, ceramics and water treatment; Nano-particle based coatings for ink jet paper industry.

ProMine estimates recyclable mining waste and seeks eco-efficient mineral production and recovery methods by, for example, expanding the usability of biohydrometallurgy. In Europe, there is potential of relevant primary and secondary resources in base and high-tech metals but due to their more complex nature, lower grades and smaller tonnages, there is a necessity of developing alternatives and complementary techniques to conventional processing techniques. Potential material resources for biotechnological processing methods are about 4.7 billion tonnes of mining waste and 1.2 billion tonnes of tailing sand from around Europe. The global market value of the new production methods exceeds €500 million.

ProMine aims to extend the exploitable resources or to treat new type of resources and to complete existing process with technologies more flexible in size and with less environmental impact.
For example, application of (bio)technology for metal recovery in mining wastes, secondary resources including very important R&D development on pre-concentration - pre-treatment steps is a reasonable alternative or complementary technique. Integration of bioleaching technology in the current metal production methods (co-processing concept) and use of energy efficient equipment (low duty concept), will be studied.

Sustainability and environmental impact will be assessed in order to evaluate the effect of the products and production method developed within the project on the sustainability parameters environmental impact, economic impact and social impact. New communication strategies will be developed in order to reach the targeted industry and the mineral community and especially to involve stakeholders.

The European mineral industry has already demonstrated its ability to rationally carry out applied research and to bring together stakeholders from the industry, the academic field and the research institutes. This is particularly true concerning the development of bioleaching technologies that was supported by the EC since 1996 through 3 main projects (HIOX, BioShale and BioMinE) achieving major breakthroughs in scientific and technical fields.

Expectations of industry from ProMine include e.g.

- Improving the diversity and volume of European ‘metallic’ resources to be exploited in the future (new resources + mining wastes). Upgrading mining waste to secure and good raw materials
- Making the society understand the new environmental friendly approach of mining due to advanced technology.
- Making the EU and its individual countries understand the importance of mining for further economic development
- Active co-operation/knowledge transfer between geological surveys, industry, other research organizations, universities and SME’s
- Rational pan-European management of metallic minerals production and supply including re-use of by-products and wastes
- Active networking with relevant national and international research activities and programs → New national and international projects
- Finding additives from the mining industry that can give added value characteristics to the products that respond market expectations
- Lowering production costs. Lowering energy consumption (CO₂ load)
- Increase the profits, reduce the metal grades in the wastes minimizing the environmental impact

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