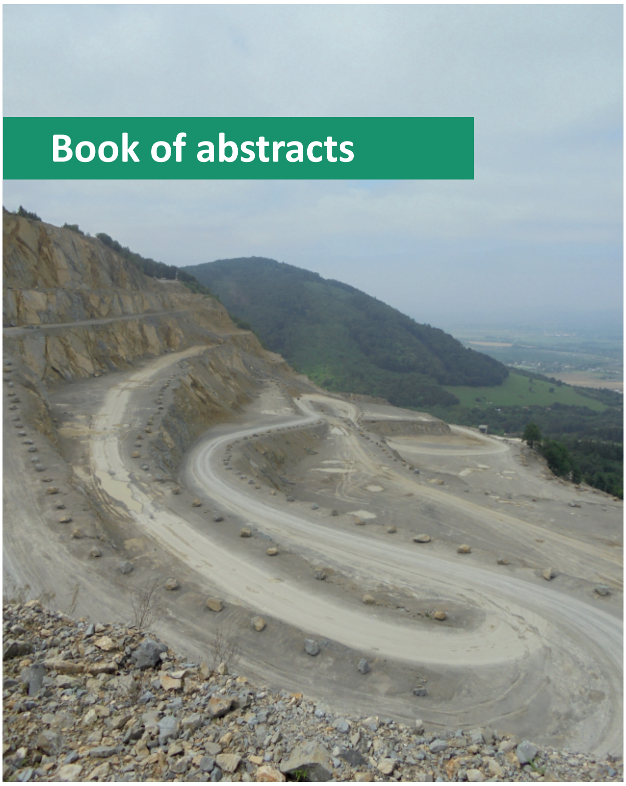
Book of abstracts



Mineral and Energy Economy Research Institute
Polish Academy of Sciences

NAWA
POLISH NATIONAL AGENCY FOR ACADEMIC EXCHANGE

International Conference

Mineral deposits safeguarding as a basis of mineral raw materials safety

10–11 May 2022
Kraków, Poland

Publishing House MEERI PAS
Kraków

Mineral and Energy Economy Research Institute
Polish Academy of Sciences

POLISH NATIONAL AGENCY FOR ACADEMIC EXCHANGE

International Conference

Mineral deposits safeguarding as a basis of mineral raw materials safety

Book of abstracts

10–11 May 2022
Kraków, Poland

Publishing House MEERI PAS
Kraków 2022

SCIENTIFIC COMMITTEE

Krzysztof Galos – Mineral and Energy Economy Research Institute PAS (Poland) – Chairman
Vitor Correia – International Raw Materials Observatory (Belgium)
Magnus Ericsson – Luleå University of Technology (Sweden)
Katharina Gugerell – University of Natural Resources and Life Sciences (Austria)
Pavel Kavina – Ministry of the Environment (Czech Republic)
Alicja Kot-Niewiadomska – Mineral and Energy Economy Research Institute PAS (Poland)
António Mateus – University of Lisbon (Portugal)
Peter Moser – University of Leoben (Austria)
Marek Nieć – Mineral and Energy Economy Research Institute PAS (Poland)
Vladimir Simic – University of Belgrade (Serbia)
Slavko Solar – UNECE Expert Group on Resource Management (Switzerland)
Krzysztof Szamałek – University of Warsaw (Poland)
Michael Tost – University of Leoben (Austria)
Linda Wårell – Luleå University of Technology (Sweden)

ORGANIZING COMMITTEE
MEERI PAS The Division of Mineral Policy

Alicja Kot-Niewiadomska – Chairwoman
Krzysztof Galos
Anna Burkowicz
Katarzyna Guzik
Jarosław Kamyk
Ewa Lewicka
Jarosław Szlugaj
Hubert Czerw
Beata Figarska-Warchoł
Andrzej Gałaś

This conference has been supported by the Polish National Agency for Academic Exchange under Grant No. PPI/APM/2019/1/00079/U/00001

CORRESPONDENCE ADDRESS
Mineral and Energy Economy Research Institute of the Polish Academy of Sciences
J. Wybickiego 7A, 31-261 Kraków, Poland
tel.: +4812 632 33 00; fax: +4812 632 35 24

Linguistic Editor: Michelle Atallah
Publications Editor: Emilia Rydzewska-Smaza
Technical Editor: Barbara Sudoł
Cover design: Beata Stankiewicz

© Copyright by Mineral and Energy Economy Research Institute PAS

Kraków 2022
Printed in Poland
ISBN 978-83-964171-5-2
eISBN 978-83-964171-6-9

Contents

BALÁŽ PETER, KRAWCEWICZ ARTUR

Interoceanmetal Joint Organization, Poland; e-mail: p.balaz@iom.gov.pl

Critical metals in the IOM Deep Sea Deposit (Clarion-Clipperton Zone, Pacific)

Keywords: critical minerals, deep-sea minerals, cobalt, rare earth elements

Mineral deposits on the seabed are a large but least explored source of critical metals on Earth. Recently, increasing attention has been given to the potential supply risks of critical metals, such as cobalt and REE. With increasing technological advances, the demand for these critical metals has increased, raising concerns for resource sustainability. The exploitation of seabed mineral resources such as polymetallic nodules have been identified as possible critical metal sources.

The European Commission periodically reviews the list of critical raw materials for the EU. Economic importance and supply risk are the two main parameters used to determine criticality. Cobalt and REEs are listed as critical raw materials from the first assessment in 2011 and their importance is permanently growing.

Cobalt world reserves are estimated at 7.6 Mt. Primary production (145 kt) was the main source of cobalt supply (80%) in 2020. The Democratic Republic of Congo (DRC) accounted for 66% of global supply. Batteries accounted for 57% of total cobalt consumption. The global cobalt demand increased by more than 5 times between 1995 and 2019. To ensure global e-mobility ambitions boosting of primary cobalt supply is necessary. A cobalt shortage, anticipated between 2028 and 2033, appears inevitable, even under the most optimistic scenario. Primary supply is found to be essential to achieve the supply-demand balance.

World reserves of the rare earth elements (REE) are estimated at 120 Mt. Primary production (243 kt) was the main source of REE supply in 2020. China accounted for almost 60% of global supply. Permanent magnets and catalysts accounted for 61% of the total REE consumption. Rare earths remain critical in various applications with future demand expect to remain strong driven by the clean energy economy (especially electric vehicles industry). The recycling rate of REEs is around 5% at present.

The IOM deposit resources estimation is based on data collected during scientific expeditions carried out by IOM. So far, four reports using geostatistical data analysis have been prepared (2007, 2011, 2015 and 2020) and two validations performed by the Competent Person (2016 and 2020). In the IOM´s exploration area the following resources of polymetallic nodules were estimated: 12 Mt of Measured resources, 77 Mt of Indicated resources and 183 Mt of Inferred resources, total 272 Mt of wet polymetallic nodules. In total, cobalt resources represent 335 thousand tons of metal, REE resources are 6 thousand tons of metal contained in the geological resources of the IOM deposit.

BARCELO ERNEST[1], SHTIZA AURELA[2]

[1] *Industrial Minerals Association-Europe (IMA-Europe), Belgium;
Aalto University, Finland; Omya International AG, Switzerland; e-mail: ernest.barcelo@omya.com*

[2] *Industrial Minerals Association-Europe (IMA-Europe), Belgium*

Circularity and primary raw materials: how do they synergize toward societal needs?

Keywords: minerals, sustainability, management system, life cycle of extractive sites, permitting

Even though everything that surrounds us comes directly or indirectly from mines, the mining sector has a negative reputation in today's society. These pre-conceived perceptions create issues in engagements with local stakeholders.

The legislative framework that is in place requires that management and restoration plans be put in place by the developer in close cooperation with the authorities and the local stakeholders even before the extractive operations are allowed to start. These plans cover all the life-cycle stages of extractive operations and the principal aim is to minimize the environmental impacts and disturbance for inhabitants. This contribution will illustrate how the management systems and the site operations are working towards the valorization of the extractive sites during the operations and at the end of operations. Innovative developments that the mineral sector is bringing forward include the circular economy during extraction and use of the minerals, biodiversity enhancement during the operations, forestation during and after operations, the creation of wetlands that act as carbon sink, the generation of renewables in former mining sites and the reconversion of former mining sites in tourist attractions and nature reserves. All these initiatives are developed in the frame of management systems and sustainability initiatives developed by various companies and provide qualitative and quantitative evidence that the sector is contributing to address the societal challenges and improve the overall perception of the mining sector.

BARCELO ERNEST[1], SHTIZA AURELA[2]

[1] Industrial Minerals Association-Europe (IMA-Europe), Belgium;
Aalto University, Finland; Omya International AG, Switzerland; e-mail: ernest.barcelo@omya.com
[2] Industrial Minerals Association-Europe (IMA-Europe), Belgium

Why does mining in Europe still matter?

Keywords: minerals, sustainable resource management, challenges, opportunities, dialogue, EU

The Commission roadmap for Recovery (2020) explicitly calls for a dynamic industrial policy that ensures the strategic autonomy of the EU and the pressing need to produce critical goods in Europe, to invest in strategic value chains and to reduce over-dependency from other countries. The European Council reaffirms that it is of utmost importance to increase the strategic autonomy of the Union and produce essential goods in Europe. The new Industrial Strategy (2021) report highlights six strategic areas where the EU has major dependencies, two of which are the:

- raw materials,
- batteries.

Even if the policy it is aiming to address the issue of accessing raw materials on the high policy level, there are issues to access the resources within EU notably due to trends such as: Not in My Back Yard (NIMBY), Build Absolutely Nothing Anywhere Near Anything (BANANA), or the most recent one 'Not In My Nature'.

Minerals, surround us daily is a (in)visible manner. Applications such as: glass, paper, plastic, steel, water treatment, sludge treatment, infrastructure, rely on multiple minerals with different functionalities. Even through the industrial minerals sector has a track record of operations that are sourced locally and are delivering services and goods to EU society, the trend observed in obtaining new permits and or extending existing permits is becoming a challenge. This contribution will detail some of these challenges and as well as some solutions on how to overcome them and continue to supply locally. Putting the burden on developing countries or transporting minerals across the globe is neither a viable nor a sustainable solution. The solution lies between the constructive dialogue between the different concerned stakeholders towards workable solutions of sourcing and delivering locally when these deposits are available in EU.

BURLAKOVS JURIS[1], VINCEVICA-GAILE ZANE[2], KRIIPSALU MAIT[3], GRINFELDE INGA[4], WDOWIN MAGDALENA[1]

[1] *Mineral and Energy Economy Research Institute PAS, Poland; e-mail: juris@geo-it.lv*

[2] *University of Latvia, Latvia*

[3] *Estonian University of Life Sciences, Estonia*

[4] *Latvia University of Life Sciences and Technologies, Latvia*

Critical elements in geosphere – PGE and REE markets, ecosystems, sustainability in the circular economy

Keywords: PGM, REE, recycling, critical elements, circular economy

Critical elements have an important industrial demand and are strategic commodities traded in markets. Markets of critical elements in a circular economy frame are analyzed from legislative and strategic as well as classical supply/demand questions. We should also consider irrational and geopolitical problems with linked sanctions for different parts of globe critical commodities availability. High costs and limited availability drive the recycling markets for, e.g., PGEs (platinum group elements), however the diversity of application and specific chemical properties of PGEs marks recycling as complex problem. The processing approach depends on the waste material composition and amount. The use as catalytic converters in the frame of stricter emissions requirements is increasing the demand however, greater use of electric cars in the market share may fluctuate the demand. Social and/or political reasons are important as just several countries are the largest producers. At present Pt and Pd have become investment grade objects as safe heaven metals, thus being in conflict with the economic slowdowns in industrial demand might provide a mixed valuation bias. Other elements for renewable technologies such as rare earth elements are also sensitive to gepolotics and supply/demand. Currency markets play a significant role in pricing as USD is usually a comparative measure for market analysis. The exploration of new mines is dependent on general metal commodity prices (mines contain various metals) affecting production cycles and the long-term supply of metals through geological availability.

Another opportunity for the future is long time buried waste that we may consider as relatively rich with polymetallic ingredients (in some cases) as the “ideal solution” for keeping and storing waste over the last century was landfilling (dumping). Thus, historical dumps became potential resource collectors. As the waste contains valuables including metals, critical and Rare Earth Elements (REEs) – the content of dumps can, in the future, become fundamental in economic terms and essential for developing industrial technologies of recovery through landfill mining (LFM). This all happens at a time when resource depletion is comparably near.

Research in Baltic landfills provided results on fine fraction in landfill waste containing potentially recoverable metallic, critical and REE resources. The amount of REEs with the remediation of landfills and degraded industrial soils projects can be applied simultaneously. Although the concentration of critical and REEs is significantly lower than in mining and secondary resources monolandfills (industry dumps) areas; the concentration of elements such as Fe, Al, Cu, Pb, Ni and others might be of interest for extraction in the nearest or farther future. Studies on the speciation of these elements are in progress and the potential hydrometallurgical approaches for the extraction of metals are to be considered if the process appears on a pilot scale. Only a small portion of, e.g., REE deposits can be exploited using existing technologies and therefore these can be referred as "reserves or bank account". For environmental purposes it is a benefit to reconsider metals, metalloids, critical and REEs that exist in landfills and return them to the economic loop thus saving resources and removing from the biogeochemical anthropogenic cycle. The economic cost however, is still too high, but – other aspects, such as ecosystem services restoration and real estate land reclamation, can add feasibility to the LFM projects in a circular economy perspective.

Studies as well as market analysis led to the conclusions that critical elements, particularly PGEs and REEs exploration and recycling projects apart from classical supply/demand ratios are mainly sensitive to:

- prices,
- the Forex rates,
- general market sentiment,
- large Capex requirements for new mining initiatives.

The role of PGMs and REEs as critical elements for industry will increase in the future requiring sustainable exploration, mining and recycling in the frame of a circular economy.

The work was supported by the PASIFIC program GeoReco project funding from the European Union's Horizon2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No. 847639 and from the Ministry of Education and Science.

CARVALHO JORGE M.F.

LNEG – Laboratório Nacional de Energia e Geologia, IP, Portugal; e-mail: jorge.carvalho@lneg.pt

Land use planning: a key factor for mineral developments

Keywords: minerals safeguarding, land use planning

The importance of land use planning to secure the supply of mineral resources was recognized by Pendock (1984) a long time ago. According to this author, to secure the long term supply of mineral resources to society there is a need to protect mineral resources from being sterilized during the land use planning process, i.e., the loss of the option to exploit them. In parallel with this concern, born within the scope of public policies for land use in the United Kingdom, the concept of Minerals Safeguarding emerged. Oftentimes, Minerals Safeguarding is taken in its literal sense, that is, as a strict protection of resources. However, it should be taken as originally formulated: a land use planning act or process of ensuring that areas containing mineral deposits are not needlessly occupied by other uses that may prevent their future extraction, including the places for installing mining/quarrying infrastructures (Carvalho et al. 2019; Knepper 2002; Wrighton et al. 2014). This is a kind of "soft" policy, which is in line with what is expected during land use planning: an equitable weighting of the various involved interests. Furthermore, it is widely accepted that mineral resources with an already known economic interest are those that will supply the society in a near future, and many of the areas where they occur are already protected by some kind of land use restriction (e.g. mining concessions). Therefore, the long-term supply of the society depends on the undiscovered or poorly defined resources (e.g. Briskey et al. 2007; Meinert et al. 2016; Nickless et al. 2015) which will only be mineable if the areas containing them are also protected from unnecessary sterilisation. This means that areas that currently contain non-economic and/or not yet sufficiently studied resources and promising targets should also be taken into account in land use planning in addition to known mineral deposits.

During the so-called mineral resources value chain, two major administrative bottlenecks occur:

- Exploration permit (if such a permit is required, which depends on the individual country);
- Exploitation permit (concession, licensing, or other legal instrument).

An exploration permit allows a mining company to get access to land to conduct exploration works. If these and the mining feasibility studies give positive results, then the awarding of a mining concession depends mainly on the Environmental Permit (a decision making tool), which is obtained through an Environmental Impact Assessment process (a decision aiding tool). This assesses not only the environmental and economic issues, but also the social ones, the latter being strongly conditioned by previous actions taken by the mining company with the local population and local authorities in order to obtain the so-called Social License to Operate.

However, whether or not all of these procedures and actions are carried out depends on the mining companies' access to land, which is decided in the land use planning stage, before the start of any mining development project, that is, before the granting of the exploration permit. In other words, land use planning is the key-process in which decisions whether the mining companies have access to land or not are made. At a later stage, if a mineral deposit worthy of being extracted is found and the respective exploitation permit is requested, this becomes a matter of Environmental Impact Assessment, not of land use planning.

References

Carvalho et al. 2019 – Carvalho, J., Ardvisson, R., Raaness, A., Dinis, P., Lisboa, J.V., Figueira, M.J., Schiellerup, H. 2019. Safeguarding mineral resources in Europe: existing practice and possibilities (No. Deliverable 2.3), MinLand – Mineral resources in sustainable land-use planning.

Knepper Jr, D.H. (ed.). 2002. Planning for the conservation and development of infrastructure resources in urban areas Colorado front range urban corridor: things planners, decision-makers, and the public should know, U.S. Geological Survey circular 1219. USGS.

Pendock, M.J. 1984. Sterilisation and safeguarding of mineral deposits in Britain. Minerals and the Environment 6, 23 41. DOI: 10.1007/BF02072662.

Wrighton et al. 2014 – Wrighton, C.E., Bee, E.J., Mankelow, J.M. 2014. The development and implementation of mineral safeguarding policies at national and local levels in the United Kingdom. Resources Policy 41, 160 170. DOI: 10.1016/j.resourpol.2014.05.006.

DIETRIECH VALENTINA, MELCHER FRANK

Montanuniversität Leoben, Austria; e-mail: valentina.dietrich@unileoben.ac.at

Mineral raw material supply chain transparency and traceability: does provenance matter in the supply chain?

Keywords: traceability, raw materials, raw material certification, analytical proof of origin

Raw material supply chains are complex systems. They build on the presence of economically mineable mineral commodities that will undergo several steps until they are finally being used as consumer products. Trustworthiness into the transparency of a supply chain is of increasing importance, both to upstream and downstream companies. Any deviation from best-practice and quality standards in mining, processing and production is critically looked at by consumers, especially nowadays. Therefore, certification systems and proof of origin concepts have emerged within the past years, aiming at providing transparency to supply chains. But what is the challenge we are facing with these? There are certification systems for mineral raw materials which apply to a certain commodity (e.g. aluminum (ASI – Aluminum Stewardship Initiative), coal (Bettercoal Code), diamond (Kimberley Process) and gold (WGC – World Gold Council, Fairtrade etc.)). There are other initiatives, which are not corresponding to a certain raw material, but rather than to a specific part of the supply chain (e.g. IRMA – Initiative for Responsible Mining Assurance) for the mining part in the supply chain. A suitable certification system would cover all raw materials, involve the entire supply chain and provide criteria for a complete traceability that guarantees a chain of custody for sustainably sourced raw materials.

The current legislative proposal of the European Union demands that European companies are responsible for protecting human rights and the limit: between 500–800 words (without tables and photos) 2 environment along their entire supply chain. The due diligence obligations to be fulfilled in this law must be appropriate and feasible for the company in a day-to-day practice. For raw materials in supply chains trustworthy and feasible analytical proof of origin (APO) methods used in certification systems will be the key link in the implementation of supply chain laws in the future. The analytical proof of origin methodology for mineral raw materials could be applied as a tool to determine the origin of a raw material and is beneficial in a number of ways. They are regarded as the least corruptible and changeable methods of proof of origin methods since they relate directly to the chemical composition of the raw material. Other methods such as documents, tracers, barcodes, etc. can be falsified in one way or another. How does it work? APO methods always refer to the raw material itself. This could be the chemical or mineralogical composition and it describes analytical methods based on important parameters such as geochemistry (major and trace elements and isotope ratios), crystallography (e.g. characteristic bands in Raman or FTIR spectroscopy) or mineralogy (mineralogical composition, fluid or mineral inclusions) combined with data evaluation processes to trace materials back to their origin.

It is based on the comparison of an unknown sample with a known sample already analyzed and stored in a database. The approach of an analytical proof of origin is a relevant topic, requires discussions with all partners involved and poses challenges in terms of costs, flexibility, cooperation between companies and their willingness to implement. In the long term, we will need these proof of origin concepts for all our consumer goods, not only in the food sector. We have to enable informed decision-making also when it comes to all consumer products in which mineral raw materials are contained.

DYCA BESMIRA[1], CARSJENS GERRIT-JAN[1], GUGERELL KATHARINA[2], TOST MICHAEL[3]

[1] *Wageningen University and Research Street, Netherlands; e-mail: besmira.dyca@wur.nl*

[2] *University of Natural Resources and Life Sciences, Austria*

[3] *Montanuniversität Leoben, Austria*

Understanding the sustainability of extractive industries: the case of the Boliden area, Sweden

Keywords: sustainability, energy transition, Institutional Resource Regime, battery minerals, Boliden area, natural resources

Minerals and metals are playing an increasingly important role in energy transition, which is a crucial step for taming greenhouse gas emissions and reaching the IPCC recommended net-zero global emissions over the next two decades. Fostering the sustainable management of the raw materials of batteries is one of the main challenges posed by this global quest. This research addresses two main objectives. Firstly, building on Institutional Resource Regime (IRR) theory, it develops a novel framework for assessing the sustainability of extractive industries. Secondly, it applies this framework to a case study seeking to examine the sustainability of the extractive industry for battery materials in the Boliden area, Sweden. Building on the premise that there is a causal relationship between the institutional regime and the sustainable management of the resource, this research identifies and analyses the institutional regime which regulates the rivalries between users of different resources overlapping and/or affected by extractive activities in the Boliden area. The analysis includes user rights stemming from formal property rights of resources and rights stemming from policies that regulate and protect the resources involved in extractive activities in the Boliden area. The coherence and extent of the institutional regime is assessed, based on the content analysis of policy and legal documents and of twelve semi-structured interviews with key stakeholders. Results of the evaluation of coherence and extent of the regulatory framework point towards a complex regime in place. These findings are complemented with strategies and good practices which can enable the institutional regime to evolve from a complex form to an integrated form, supporting the conditions for sustainable management of battery materials in the Boliden area and in Sweden. Finally, conclusions discuss the theoretical potential of utilizing the IRR framework for examining sustainability in extractive industries in future research.

This research is a result of the Sustainable Management in Extractive Industries SUMEX) project which has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement no. 101003622.

EEROLA TONI

Geological Survey of Finland, Finland; e-mail: toni.eerola@gtk.fi

Corporate conduct, commodity and place: ongoing mining and mineral exploration disputes and their implications for the social license to operate in Finland

Keywords: mineral exploration, social license to operate, land use, mining disputes

At the middle of 2000's, the Finnish mining industry was experiencing a rebirth thanks to foreign investments and companies. Before that, the Finnish mining industry was entirely national, and state-owned, and it was almost completely extinct at the beginning 1990s. The mining industry was in a recession for more than a decade, and the sudden rush of foreign mining and mineral exploration companies caused disputes. A new environmental protest cycle started in Finland with the uranium dispute (2006–2008). Although it ended quickly when the uranium exploration companies retrieved from Finland due to the 2008 financial crisis, the Finnish anti-mining movement started to develop during it by focusing its attention on projects in which uranium is associated, such as the Talvivaara Ni-Cu-Co-Zn mine, Rompas Au-Co mineral exploration and the Juomasuo Au-Co and Sokli P development projects. Other cases started to appear from 2010 on, such as the Hannukainen Fe-Cu-Au and Sakatti Ni-Cu development projects. However, the Talvivaara polymetallic mine formed the key event of the whole mining dispute in Finland with its gypsum pond leakage in 2012. Those disputes have already been ongoing for years and some new ones have appeared.

The ongoing mining disputes were mapped in Finland by the Geological Survey of Finland (GTK) as part of the EU's Horizon 2020 financed Mining and Metallurgical Regions of Europe (MIREU) Project. Twenty disputes were identified in Finland. Fourteen of the cases are related to mineral exploration, four to development projects and two to mines. The projects under dispute are mainly related to metals (Au, Ni, Co, Cu, Zn, graphite, sometimes associated with U), while one of them deal with industrial minerals (P).

The long-term disputes are mostly located in the northern Finland, namely Lapland (Hannukainen, Sakatti, Rompas, Sokli), Kuusamo (Juomasuo) and Kainuu (Talvivaara). They are related to mines, mine development and mineral exploration projects. The most recent disputes are in Pirkanmaa (Kaapelinkulma Au) in southern Finland and the Lake Saimaa region (e.g. Heinävesi and Tuusniemi, graphite) in southeastern Finland.

The disputes have several common characteristics and causes. Most of them are related with land use issues (nature conservation, reindeer herding, indigenous Sámi homeland, and tourism), which may even overlap, while others have associations with uranium (four cases) or both. In the most recent cases the companies' bad reputation and poor corporate conduct (lack of communication and stakeholder engagement) are evident. The ongoing battery minerals boom started a new contentious cycle towards mineral exploration in the last region.

The mapping of mining disputes and their monitoring in Finland support their further studies, especially regarding their causes, dynamics and involved actors.

The MIREU project received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement No. 776811.

ERICSSON MAGNUS[1], LÖF OLOF[2], LÖF ANTON[2]

[1] *Luleå University of Technology, Sweden; e-mail: magnus@gladtjarnen.se*
[2] *RMG Consulting, Sweden*

Locus of metal mining vs locus of control over mine production – a brief review over 10 000 years

Keywords: mining companies, control of production, locus of control, locus of production, metal mining

This paper aims to briefly analyse and discuss the location and volumes of global mine production of metals during the past 10 000 years and contrast that with locus of control over production. For the period 1985 and 2018 a detailed comparison of locus of production with locus of control is made for six metals: cobalt, copper, iron ore, lithium, manganese and rare earths.

It is a well-known fact that mine production has shifted from the industrialised countries of Europe, North America and Japan to emerging economies in Latin America, Africa and Asia and to Australia during the past 150 years. The lack of self-sufficiency or high import dependence, in particular of the so-called critical metals, has become an issue of political interest in these industrialised countries since 15 years (EU list of critical materials). This study of 6 metals contrasts this picture with an analysis of which companies control mine production around the world and where these companies are based.

Locus of production, including growth of production volumes and number of elements mined. This information is relatively easy to find and our presentation is based on a literature search. Locus of control, is focused on the past 40 years against a background of the preceding years including brief account of the emergence of modern mining companies. Data is more scarce when statistics are to be divided on a company by company basis rather than the traditional geographical division between countries. For the past 40 years we have analysed the locus of head offices (country of registration) of the companies which control production of the six metals studied and discuss the regional differences between locus of production and locus of control over production.

Production might have moved out of the industrialised countries but control over production by companies based in the industrialised countries remain and has even increased between 1985 and 2018. European mining companies have increased their control while mining companies based in North America have lost control. Australian companies have tripled their control in the same period. Control by the industrialised countries (Europe, North America and Japan) has increased to over 40% of these six metals. Companies based in Latin America, Africa and Asia have maintained their control level, roughly a third of the total value of the six metals. Inside this group of countries African share has dwindled from 12 to 2% while Asian companies have more than doubled their share from 5 to 11%. Mining companies based in the republics of the former Soviet Union have reduced their control from 25 to 6% while in the same period Chinese companies' control has almost doubled from 6 to 11%.

Looking at the situation from the point of view of the host countries in the emerging economies of Asia, Latin America and Africa; they are the source of a large part of global mine production but the controlling mining companies are based in the traditional economic and political centres of the world. Whichever perspective is taken it is clear that the balance of power between host countries and producing companies and their host countries is skewed.

FAJFER JOANNA, KOSTRZ-SIKORA PAULINA

Polish Geological Institute – National Research Institute, Poland; e-mail: joanna.fajfer@pgi.gov.pl

Economic considerations of a circular economy based on waste accumulated on the rehabilitation of waste facilities

Keywords: waste re-use, cost effectiveness, rehabilitation of waste facilities, circular economy

The basis of the circular economy concept is the maximum use of manufactured products at every stage of their life cycle until their useful functions are completely exhausted. In accordance with legal regulations as well as strategic and sector documents, the accepted rules of the circular economy should result in a limitation of produced and disposal waste. This concept takes into account the hierarchy of waste management, i.e. waste prevention, preparation for re-use, recycling, recovery and disposal operation, including – as a final action – disposal for waste facilities. The circular economy concept also includes waste accumulated in the rehabilitation of waste facilities (landfills and heaps). This waste is also used as raw materials in production processes. Waste extraction and re-use will contribute to the reduction of environmental pressures and recovery land for other investments.

In 2017, a total of 113,800,000 tons of waste was generated in Poland. The largest amount of waste was generated in the two chapters (according to Commission Decision 2000/532/EC) identified as wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals (chapter 01) and wastes from thermal processes (chapter 10). In total, about 74,000,000 tons of waste have been generated in these chapters. However, about 35,000,000 tons (i.e. about 50%) was disposed of in waste facilities, including about 21,000,000 tons waste from chapter 01 and about 14,000,000 tons waste from chapter 10. The vast majority of them (over 99.5%) were used in installations and devices using D5 processes of disposal operations i.e.: specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.) and D1 processes i.e.: deposit into or on to land (e.g. landfill, etc.). The D1 and D5 processes are presented according to Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. In total, at the end of 2017, over 1.736 million tons of waste was accumulated in landfills and heaps. The data presented above indicates a significant raw material potential of waste accumulated on the waste facilities. The basic condition for the re-use of waste from waste facilities is the cost effectiveness of the process. It may also apply to rehabilitation disposal sites which have been given new functionalities.

Cost effectiveness is a basic criterion of re-using waste accumulated on the rehabilitation of waste facilities. In this case, the costs of the reclamation, and then the costs related to the implementation of the investment and the potential profit that will be generated by the sale of the extracted waste should be taken into account. When calculating the investment costs, including administrative expenses, the costs of laboratory analyses and design costs, direct costs of the project implementation, including in particular: personnel costs, costs of services (e.g. equipment leasing) and/or outlays on tangible fixed assets (purchase of machinery and equipment) should be taken into account. Furthermore the costs of purchasing raw materials and materials (e.g. electricity), costs of distribution of recovered waste, as well as costs of environmental restoration (land reclamation and development) should also be taken into consideration. However, before the cost calculation process, the direction of use of the extracted waste ought to be determined.

In the PGI-NRI statutory project, the simulation of the cost effectiveness of using waste as a source of substitutes for raw materials was carried out for 3 rehabilitation waste facilities. It was based on a financial analysis taking all the factors described above into account. The analysis of environmental and social costs was not included. It was assumed that the profitability condition would be fulfilled when the difference between the sales price of waste and the incurred investment expenditure would be greater than zero. The cost estimates demonstrated that for each of the examined facilities, the unit cost of extracting and preparing waste for sale was lower than the cost of purchasing raw materials. Thus, confirmation of the existence of economic premises determining the conduct of more extensive research on the re-use of waste accumulated on the rehabilitation of waste facilities.

The final editorial work was supported by the PGI-NRI statutory funds (Project No. 61.4104.1801.00.0).

GALOS KRZYSZTOF, KOT-NIEWIADOMSKA ALICJA

Mineral and Energy Economy Research Institute, Polish Academy of Sciences, Poland; e-mail: kgalos@min-pan.krakow.pl

The significance of mineral deposits safeguarding as the backbone of European minerals security

Keywords: mineral deposit safeguarding, mineral security, EU policy initiatives, multi-criteria assessment

The availability of mineral raw materials is of great importance for the development of innovative and competitive EU industry, the integration of sustainable growth and the implementation of any objectives of the Europe 2020 strategy, such as challenging growth and employment opportunities, research and innovation actions, as well as climate changes and energy transition goals. Moreover, there are new strategies and policies that are resetting the scenery and raising the importance of minerals at the EU and global level. The following are worthy or note: the European Green Deal, Industrial Strategy for Europe, the Taxonomy regulation for sustainable financing of mineral projects, and many others, as a set of EU policy initiatives, addressing such aims as energy transition, circular economy, resource efficiency, and final climate neutrality.

The global use of numerous metals and other minerals has been strongly increasing due to advanced technological progress and a fast-growing demand in emerging countries. It is estimated that between 2010 and 2030, the volume of the world's mineral consumption could even double, though in the case of some minerals strongly related to energy transition (e.g. lithium, cobalt), these increases can be many times greater.

A growing concern about the potential limitation of mineral supplies for the EU economy resulted in launching the Raw Materials Initiative ("EU raw materials strategy") in 2008 and the Strategic Implementation Plan (SIP) of the European Innovation Partnership (EIP) on mineral raw materials in 2013. These have been followed by numerous further EU actions as well as a lot of research and innovation actions, particularly those funded under Horizon 2020 aimed at enabling access to minerals from primary resources as well as the development of recycling and substitution options as part of a circular and resource-efficient economy.

Securing access to the mineral deposits in the EU is one of the key factors and actions enabling less dependency in the EU from external supplies, as their supplies from secondary resources are not enough to meet the demand of downstream manufacturing sectors. This is why their availability is strongly relies upon the mining of minerals from primary resources (mineral deposits), which is strictly dependent on access to land that is fundamental for the development of minerals.

Conflicts in relation to natural, economic, societal, and political vulnerabilities and risks are among the major responsibilities and tasks of a state administration and, indeed, the European

Union as a whole. There is no doubt that mining can bring positive benefits and new growth opportunities to host countries and the regional economies and local communities concerned, but mining activities can also come at a cost to the environment, including biodiversity and conservation issues if communication, resources and operations are not managed properly and sustainably. Conducting open, inclusive and ongoing dialogue with local communities throughout the mining cycle is a precondition in order to create strong, transparent, trusting, collaborative and lasting relationships. The fundamental aim must be the equitable distribution of the benefits of development and the minimalization of the negative impact on people and the environment. Sustainable land-use integrates and maximises the multiple benefits related to economic, social, environmental and cultural values. Responsibly navigating this field requires a strong ethical compass.

The societal discourse on extractive activities has to be informed of the systemic costs and benefits of the respective development trajectories. The discourse has also to be informed about potential risk displacement effects to more vulnerable societies if mineral raw materials are predominantly obtained from outside the EU, considering the societal and ethical issues involved when it comes to the conditions of producing operations in some third countries. Exploitation of domestic mineral raw materials for use and consumption within the EU can also help to stabilize economies by making them less dependent on international mineral market fluctuations and more resilient to any disruptions in the supply chain.

Safeguarding access to mineral resources in land-use planning systems plays a crucial role in securing their supply. Despite the existing literature about mineral safeguarding and its conditions, a major question remains: to which mineral resources must access be guaranteed? Which mineral resources (mineral deposits) should be counted as the most important and strategic? The answers can be difficult and ambiguous. Analyses within two recent European-funded projects (Minatura2020 and MinLand) have shown that some multi-criteria assessment schemes should be used to distinguish such mineral objects. Within Europe, some multi-criteria assessment methodologies are either already in use or are intended to be used (e.g. in Austria, Norway, Poland, Portugal and Sweden) while their implementation can be used for the identification of mineral resources that deserve to be safeguarded in land-use planning. Such methodologies are applicable to all types of mineral deposits, making use of an extensive set of assessment parameters grouped into the following criteria: geological, economic, environmental, social and spatial planning. Some methodologies take into consideration potential areas with serious premises for the occurrence of valuable minerals, while the remaining deal only with well-recognized mineral resources. When applied, the methodologies prove to be effective in safeguarding access to distinguished important (strategic) mineral deposits in land use systems, or in other cases to at least draw attention to their existence and significance.

GAŁAŚ SLÁVKA[1], KRZAK MARIUSZ[1], GAŁAŚ ANDRZEJ[2]

[1] *AGH University of Science and Technology, Poland; e-mail: sgalas@agh.edu.pl*

[2] *Mineral and Energy Economy Research Institute, Polish Academy of Science, Poland*

The importance of the mining exploitation fee in the system of mineral deposits safeguarding

Keywords: mining exploitation fee, mineral deposits safeguarding, commune's own revenue

The definition of the exploitation fee in the system of mineral deposits safeguarding is the aim of the paper. The mining exploitation fee is a significant part of the commune's own revenue in the Polish tax system and is showing an upward trend. It is a beneficial phenomenon, due to the higher revenue share, local communes are much more independent and are able to increase inhabitants' needs satisfaction as well as determine stable local development. The assurance of stable and efficient sources of revenue, where some of them should be connected and related to the given area as a derivative of the environmental potential use and the land use in the commune, are in the interest of the communes. Any commune is characterized by its own specificity, including location, natural resources and values, economic nature, population and local initiatives (Sobczyk 2010; Kozera 2017). In some communes, a significant potential is found in mineral resources.

The mining exploitation fee is generally a public imposition, compensating the economic use of the natural environment and recompensing burdensomeness derived from mining activities affecting local self-government communities. The mining exploitation fee is the source of the commune's own revenue in the amount of 60% of the fee, and the remaining part of 40% is the income of local districts, voivodships and the National Fund for Environmental Protection and Water Management (Geological and Mining Law 2011). An entrepreneur who has obtained an extraction license is obliged to submit it, and in the case of a hydrocarbon prospecting and exploration license as well as a hydrocarbons extraction license is also submitted at the stage of investment decision. Overall, the share of the mining exploitation fee in communes' own revenues in Poland ranged from 0.56 to 0.75% in the 2012–2020 periods (Report 2012–2020).

The significance as to whether the mining exploitation fee is or should be the point of interest in the commune budgets preparation and in the land use planning documentation preparation, including the forecast of the financial consequences of adopting to the local land use development plans, has been analyzed in the article. An assessment has been made as to whether the mining exploitation fee may, due to the potential revenue of communes, lead to respect for the presence of proven mineral deposits in the commune area, i.e. their safeguarding against improper management.

References

Sobczyk, A. 2010. Local Development – Specific Problems in Financing. Zeszyty Naukowe SGGW w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej 81, 125–136.

Kozera, A. 2017. The Agricultural Tax as a Source of Own Income of Rural Communes in Poland. Roczniki Naukowe Ekonomii Rolnictwa i Rozwoju Obszarów Wiejskich 104, 2, 76–86.

Geological and Mining Law, Act of June 9, 2011.

Report on the implementation of the state budget for the period 2012–2020. Information on the implementation of the budgets of local government units, 2012–2020, Council of Ministers, Warsaw 2013–2020.

GUGERELL KATHARINA[1], ENDL ANDREAS[2], TOST MICHAEL[3]

[1] *University of Natural Resources and Life Sciences, Austria; e-mail: Katharina.gugerell@unileoben.ac.at*

[2] *Vienna University of Economics and Business, Austria*

[3] *Montanuniversität Leoben, Austria*

The role of minerals safeguarding in land-use planning policy in Austria

Keywords: land-use planning, land-use policy, mineral resources governance, safeguarding, agenda setting

Mineral resources play an important role in the European economy (e.g. in the manufacturing of environmental technologies to tackle climate change) and there are new approaches on how to guarantee their secure, continuous and sustainable supply (European Commission, 2013). Concerning secure supply from domestic sources, several initiatives at the level of the European Union (EU) and EU Member States (MS) indicate increased political salience for the approach of mineral safeguarding. The approach encompasses the protection or 'safeguarding' of known or unknown mineral deposits from sterilization by other land uses (e.g. agriculture, housing, nature conservation, etc.). While public policy and private actors advocate mineral safeguarding, from an academic perspective, there is notable ambiguity of what both the conceptual and practical application entails. Against this background, research on how mineral safeguarding is actually implemented in EU MS public policy is translated into policy tools and instruments and integrated into an appropriate policy mix is modest. During the last decade, however, countries such as Austria, Greece, Spain, Portugal, and Norway have introduced mineral safeguarding and, thus provide the first insights on how the concept translates into policy goals and instruments.

Research and practice show that mineral resource governance and in particular safeguarding is embedded into two policy fields: mineral policy and LUP policy (e.g. Wrighton et al. 2014). This distinction becomes particularly relevant when dealing with the interconnected topic of mineral extraction, in which competing land-use options are weighed against each other in the decision-making process (Bax et al. 2019; Lechner et al. 2017) and social and environmental impacts need to be resolved (Everingham et al. 2013). In Austria, the objective of mineral safeguarding is embedded in the 'Master-Plan Minerals Resources 2030' (BMLRT 2021) and was also a core goal in the previous Mineral Resources Strategy and the broadly celebrated Austrian Raw Materials Plan (Weber et al. 2008). Our contribution investigates how mineral safeguarding is translated into provincial and regional land use planning policy in Austria. Following a comparative approach of nine Austrian provinces via document analysis and interviews with policy makers, the analysis indicates diversity among the forms of implementation. We have identified different degrees of policy uptake and different types and combinations of land-use planning tools and mechanisms for implementation. Given the limited amount of research on mineral safeguarding, our work contributes to a more detailed understanding of its practice in land-use planning and mineral policy. Our study highlights the importance of the setting of political agendas for the development of land-use planning instruments, the need for coordination and communication (between and amongst different levels of public administration in both mineral and LUP policy) in the policy process, and a need to assess the effectiveness of mineral-safeguarding policies. Those results are highly relevant for the implementation of the newly developed Austrian Mineral Resources Master Plan and its future implementation.

References

Bax et al. 2019 – Bax, V., Francesconi, W., Delgado, A., 2019. Land-use conflicts between biodiversity conservation and extractive industries in the Peruvian Andes. Journal of Environmental Management 232, 1028–1036.

BMLRT 2021. Masterplan Rohstoffe 2030. Bundesministerium für Landwirtschaft, Regionen und Tourismus, Vienna.

European Commission 2013. Strategic Implementation Plan for then European Innovation Partnerships on Raw Materials [Part I].

Everingham et al. 2013 – Everingham, J.-A., Pattenden, C., Klimenko, V., Parmenter, J., 2013. Regulation of Resource-Based Development: Governance Challenges and Responses in Mining Regions of Australia. Environment and Planning C: Government and Policy 31, 585–602.

Lechner et al. 2017 – Lechner, A., McIntyre, N., Witt, K., Raymond, C.M., Arnold, S., Scott, M., Rifkin, W., 2017. Challenges of integrated modelling in mining regions to address social, environmental and economic impacts. Environmental Modelling & Software 93, 268–281. DOI: 10.1017/j.envsoft.2017.03.020.

Weber et al. 2008 – Weber, L., Holnsteiner, R., Reichl, C., 2008. Der Österreichische Rohstoffplan. The Austrian Mineral Resources Plan. Joannea Geol. Paläont 10, 79–84.

Wrighton et al. 2014 – Wrighton, C.E., Bee, E.J., Mankelow, J.M., 2014. The development and implementation of mineral safeguarding policies at national and local levels in the United Kingdom. Resources Policy 41, 160–170.

GUZIK KATARZYNA, KOT-NIEWIADOMSKA ALICJA

Mineral and Energy Economy Research Institute, Polish Academy of Sciences, Poland;
e-mail: guzik@min-pan.krakow.pl

Need of deposits safeguarding in the light of the sufficiency of the developed resource base – case of rock minerals deposits in Poland

Keywords: rock minerals, mineral resources, mineral reserves, mineral efficiency, mineral safeguarding

The availability of raw materials obtained in the course of the extraction and processing of rocks from domestic mineral deposits is one of the important pillars of the raw-material safety of each country. Moreover, the key minerals exploited in Poland are an important component in the production of many products intended for export to European markets which constitutes the strength of the Polish economy on international markets. Due to these reasons, the availability and monitoring of data on the volume of mineral resources and reserves, their development and sufficiency both in short- and long-term perspectives is of significant importance. In this context, environmental, spatial and social factors are also important as they can significantly limit access to documented resources.

Poland has recognized a significant resource base of various rocks suitable for building and road construction, ceramics, the production of glass materials as well as many other industrial applications. The exploitation of domestic mineral deposits enable, to a great extent, the meeting of the demand for many rock minerals. According to a recently published yearbook – Mineral resources management in Poland that covers data for the years 2011–2020 (Kraków, MEERI PAS Publisher) – the current demand for many mineral rock materials is mostly covered from domestic sources. It is important to replace gypsum and anhydrite, sand for lime-sand products and cellular concrete, filling sand, limestone for lime and cement industries, mineral aggregates (both crushed as well as sand and gravel), glass and foundry sand, raw magnesite, industrial dolomite, chalk, stoneware clays, dimension stone, feldspar raw materials and kaolin. However, this situation may change in the future, due to the depletion of resources in developed deposits and the deterioration of their quality parameters.

The aim of the work was analyses of the volume of domestic resources and reserves for over twenty groups of rock minerals. The resource base sufficiency was evaluated in the perspective of year 2050, taking into account the volume of extraction in the last year for which data was available.

On the basis of conducted analyses, the groups of rock minerals which require the development of new deposits in the next few years in order to meet a demand of domestic industry were indicated. However, this requires access to these deposits for the future exploitation purposes. Conducted in 2013, multicriterial valorization of unexploited industrial rock deposits in Poland (based on methodology developed by Nieć, Radwanek-Bąk), revealed significant spatial, environmental and social constraints in the case of many analyzed mineral deposits. Despite the existence of an available resource base, there are concerns on the industry side that competing land uses and environmental and social issues will lead to supply problems for some minerals when mining needs to be expanded. This may be particularly true of rock mineral deposits. The avoidance of such a scenario requires complex regulations concerning protection of deposits, which currently in Poland do not guarantee protection of the most valuable mineral deposits in the country despite the existence of relevant legal provisions.

JELONEK IWONA, KUŚ SEBASTIAN, JELONEK ZBIGNIEW

University of Silesia, Poland; e-mail: iwona.jelonek@us.edu.pl

Raw-material use of bottom sediments – a case study of the 'Sosina' Reservoir

Keywords: bottom sediments, toxic metals, optical analysis

The use of silt from water bodies, rivers and streams has been practiced by man since the transition from a hunter-gatherer lifestyle to an agricultural lifestyle. The natural flooding of rivers and the local drying up of reservoirs have enabled farmers to obtain silt and sludge to fertilize soils in the past and thos remains the case today. Currently, apart from natural reservoirs, many reservoirs have been created due to mining exploitation. These reservoirs usually have low surface recharge flows, small sub-surface inflows, and relatively short silt and sludge deposition times. These sites are relatively young and if created by sand mining, shallow, are typically up to 3 m deep.

The studied sediments were collected during the reclamation of the Sosina reservoir located in the southern part of Poland and are an interesting object of study due to their known genesis and time of deposition. The determination of their physicochemical composition and solids based on petrographic examination proved the usefulness of these sediments in agriculture as an economically valuable mineral. Also, the chemical analysis did not show excessive contamination of the studied material with toxic metals, making it possible to use it for soil fertilization.

In addition to the physicochemical and petrographic analyses of bottom sediments, a model for the recovery of this type of sediments from post-mining reservoirs and a scheme for the disposal of silts with the benefit of maintaining water reservoirs in a usable condition was developed. In the analyzed case of the Sosina reservoir, the facility's structure and the water quality for recreational purposes were preserved.

KACZAN WOJCIECH, WIRTH HERBERT

Wrocław University of Science and Technology, Poland; e-mail: wojciech.kaczan@pwr.edu.pl

The proposition of a systematic approach in the method of historical prospecting and exploration of anthropogenic deposits

Keywords: tailing piles, critical metals, method of historical prospecting and exploration, circular economy

Due to technological development, particularly in high-tech fields like renewables, electromobility, battery production, and telecommunications, there has been a significant increase in the demand for raw materials. This situation is also exacerbated by the geopolitical situation related to the significant influence of China on the supply of these raw materials. In response to this problem, the policy of the EU and Poland is directed to alternative sources of raw materials, endowed with a lower risk of interrupting supplies than imports from non-EU countries. Among potential sources, the waste from the mining process and the waste already deposited in tailing piles and ponds are distinguished.

However, the determination of the raw material potential of tailing piles and ponds is difficult due to numerous barriers such as:

- ➡ The internal structure of the tailing piles is difficult to define (due to various methods of tipping/storage),
- ➡ E elements occur in various chemical and mineral forms (due to the method of processing the mineral, secondary weathering processes),
- ➡ Tthe content of the elements is very low compared to natural deposits,
- ➡ The objects are usually covered by the infrastructure, green, and woody vegetation,
- ➡ Work related to waste management encounters problems in obtaining social public consent (SLO).

To solve this problem, the authors propose using the method of historical prospecting and exploration of raw materials. The effectiveness of this method depends on the adoption of objective search and recognition criteria, resulting in a response that allows initial resource estimates in the tailing piles and ponds. The paper presents the systematics for this method in terms of the entire life of the geological and mining process for a given raw material, beginning with the exploration, through development, exploitation, processing, smelting, and liquidation until recultivation. The presented method allows for obtaining estimates of the mineralization potential by analyzing the natural deposit to the anthropogenic deposit and the anthropogenic deposit to the natural deposit to be obtained.

The article outlines the raw material situation of the EU and Poland, indicates the potential of secondary deposits, and describes the proposed systematics for the historical prospecting and development method using case studies.

KONDELA JULIÁN, HREUS SEBASTIÁN

Technical University Košice, Slovakia; e-mail: julian.kondela@tuke.sk

Uranium mining restriction in Slovakia from the perspective of actual raw material situation

Keywords: uranium deposits, mining law, critical raw materials, energy raw materials

The issue of energy security of the individual member states is currently being addressed in the EU. Most countries are dependent on imports of raw materials for energy production. Slovakia also belongs to these countries. More than 50% of electricity in Slovakia is produced from radioactive raw materials in nuclear power plants (World Nuclear Association, 2020). Nuclear fuel is imported from Russia, despite the fact that Slovakia has several economically significant sources of uranium mineralization. So far, two different genetic types of focal accumulations have been identified. Infiltration-type stratiform deposits in the Upper Permian sediments form small deposits and occurrences in the chronicle – Kravany, Vikartovce, Spišský Štiavnik and Švábovce (Ferenc et al. 2020; Jacko et al. 2019). Mining has not yet started in any of these deposits. In the eastern part of Slovakia there are two perspective deposits of volcanic-sedimentary origin – Novoveská Huta and Jahodná near Košice. The total reserves of these deposits are calculated at 19,452 t U (Šoltés et al. 2021). This amount of uranium ore has the prospect of supplying the Slovak Republic for more than fifty years (data on electricity production in the nuclear field – World Nuclear Association, 2020).

Unfortunately, poorly set geological legislation from the past does not even allow for a detailed exploration of the deposits. The mining of radioactive raw materials is limited by the Geological Works Act "Mining of radioactive raw materials is prohibited unless the inhabitants of each affected municipality agree to the mining of radioactive minerals in a local referendum". The adoption of incorrect standards at a time of economic growth has made Slovakia completely dependent on imports. In addition, the radioactive raw materials imported so far come from a single supplier. The changing geopolitical situation underlines the importance of energy independence and economic policy based primarily on the use of natural resources.

References

Ferenc et al. 2020 – Ferenc, Š., Mikuš, T., Spišiak, J., Kopáčik, R. and Hoppanová E. 2020. Kremeňovo-karbonátové žily s U-Mo-Cu mineralizáciou v permských intermediárnych až bázických vulkanitoch hronika na lokalite Kravany (Kozie chrbty, východné Slovensko). Bull Mineral. Petrolog. 28(2), 364–384 (in Slovak).

Jacko et al. 2019 – Jacko, S., Bátorová, K., Ščerbáková, B., and Blišťan, P. 2019. Uranium ore mineralization at the Western Carpathians/Slovakia (conditions and social aspects). [In:] E3S Web of Conferences 134, p. 02005. EDP Sciences.

Law No. 569/2007, in the Collection of Laws – Geological Law (in Slovak).

Šoltés et al. 2021 – Šoltés, S, Kúšik, D. and Mižák, J. 2021. Slovak Minerals Yearbook – 2020. Nerastné suroviny SR – Ročenka 2020.

World Nuclear Association 2020. Pocket guide 2020/21 Edition – Nuclear Power, Energy and the Environment.

KOSTKA EWELINA ANNA[1], POLAK ANNA[2]

[1] JURIS Law Firm, Poland; e-mail: ewelina.kostka@juris.pl
[2] Kancelaria Radcy Prawnego Anna Polak, Poland

The influence of the principles of planning and implementing specific investment processes on safeguarding recognized mineral deposits and prospective mineral areas

Keywords: safeguarding of mineral deposits, prospective mineral areas, strategic deposits, investment processes, area management system, special laws

This article is an effort to delve into current and future risks to the safeguarding of recognized mineral deposits and prospective mineral areas through the prism of regulations set forth to condition planning and the implementation of specific investment processes.

The inherent part of the protective measures applied to mineral deposits and prospective mineral areas are the postulate to safeguard access to prospective or recognized and non-extracted deposits by ruling out exploitation of the areas sitting over such deposits and imposing major constraints on carrying out due recognition and extraction, or barring afore attempts.

Implementing the said postulate involves creating a consistent area management system and related collision rules allowing the primacy of one development method over the alternative options to be determined on a specified timeline.

On the one hand, development of a consistent area management system by comprising the need of protection over the recognized, then documented and prospective mineral areas, calls for drafting up general directives on the protection referred to, but on the other, on inclusion of a full range of exceptions, which will form a separate set of rules for planning area development specific to certain types of investments. The rules for deciding on the investment site as well as implementing specific investments are subject to separate regulations, which dismantle systemic cohesion.

It is exactly these dispersed regulations that provide isolated rules for carrying out investments, in particular the renewable energy installations, housing developments or public utility facilities such as roads or railroads, which this paper addresses in the context of the impact exerted on the shape and the extent of the implementation of the principle of mineral areas protection as well as supporting the notion of protection over prospective mineral areas.

A lack of cohesion among dispersed regulations, i.e. the laws originally aimed to integrate area development efforts, infrequently poses a hidden, but a significant risk to conducting, in the broad sense, investment processes connected with mineral deposits. The appearance of allegedly neutral or insignificant investment projects within the boundaries of prospective mineral areas is likely to thwart or stall the future exploitation of fossil resources.

The safeguarding of mineral deposits has been presented in the context of the postulate to sustain access to recognized and prospective deposits by preventing the development of permanent infrastructures onto the areas sitting above mineral deposits. As regards this aspect in particular, the former mandate commences and ends with the delivery of the statutory obligation to post recognized mineral deposits into development planning archives at the municipality and district levels.

The recently drafted and currently enacted provisions of the National Policy on Mineral Deposits and amendments to the Geological and Mining Law Act dated June 9, 2011, are to tighten to applicable laws by including additional protective measures to guard strategic deposits therein. The proposed solutions, in fact, do not provide a complete set of regulations, thus leave several essential issues unregulated.

The model adopted for the safeguarding of mineral deposits does not cover either newly recognized deposits or the prospective areas of mineral deposit occurrence. The protection over both 'potential' areas that possess mineral deposits, and the provisionally recognized resources has been marginalized or basically omitted in applicable laws and planning documents.

Exiting fragmentary regulations relating to safeguarding mineral deposits fail to be consolidated with subsequent special laws on public utility facilities, housing investments, or renewable energy installations. In fact, the "point of contact" at which the need to provide protection over mineral deposits is confronted and which might be involved in the case of handling prospective and prognostic mineral areas – will be, in the broad sense, the stage of the decision-making process behind establishing investment sites, i.e. relevant administrative acts where investment sites and related conditions are established.

During the processing of such administrative permits, verification is typically conducted as to whether the investment is consistent or inconsistent with the planning documents. The verification of planning documentation, presumed recognition of mineral deposits, or an explicit statement of mineral purposes for the land should lead to blocking investments that pose a risk to potential usage of such mineral deposits. Meanwhile, a characteristic feature of special laws is their leaning to facilitate, deformalize or streamline investment processes, including the waiver of the obligation to assure consistency, or at least, a lack of inconsistencies with area development plans. The examples of such regulations will include: the so-called 'special law on housing' (i.e. Facilitating Preparation and Implementation of Housing and Related Investments Act, dated July 5, 2018), the 'special law on building roads' (i.e. Special Rules for Preparing and Implementing Investments in the Area of Public Roads Act, dated April 10, 2003) and the Railway Transport Act of March 28, 2003, among others.

Concurrently, the said regulations include mechanisms which exert a certain impact on the assessment of the extent of fulfilling the principle of protection over mineral resources as well as the potential to create a system to safeguard the areas of prospective mineral occurrence.

One of the mechanisms shall be the obligation to obtain an opinion statement from an authority competent in the field of protecting mineral deposits. It must be noted that the obligations of obtaining an official act regarding the planned investment site are differentiated as based on separate statutes and remain inconsistent and uncorrelated. In some cases, the opinion statement from a competent geological administrative body is only required, but in other ones, an additional arrangement with a competent geological authority must be made. At the same time it must be noted that the proposal envisaged in the draft bill amending land economy planning by inclusion into a number of special acts of the requirement to obtain an opinion statement form Poland's Chief Geologist, in light of the definitions of strategic mineral deposits set forth in the draft bill will be insufficient to meet the objective of being legal safeguards to mineral deposits.

The laws that are imprecise or lacking stringency regarding protecting recognized deposits hinder, contain, or delay the development of effective instruments to provide protection over prospective fossil resources. A lack of gradation of importance between specific mineral deposits, also based on inter-dependencies, as well as a lack of directives on resolving branch and regional collisions both pose a barrier to safeguarding mineral deposits, particularly in the context of prognostic mineral areas, or the prospective occurrence of mineral deposits.

KOT-NIEWIADOMSKA ALICJA[1], ROSSI CLAUDIO[2], GALOS KRZYSZTOF[1]

[1] Mineral and Energy Economy Research Institute PAS, Poland; e-mail: a.kn@min-pan.krakow.pl
[2] Universidad Politécnica de Madrid, Spain

Modern mining technologies as a way to use conflict mineral deposits

Keywords: robotics, stable supply, raw materials, conflict deposits

The events of the last two years force the verification of global supply chains of mineral resources. The current unstable geopolitical situation has disrupted the international trade of many mineral raw materials, including those defined as strategic and/or critical for the EU and individual countries. The supply of mineral raw materials from outside the EU has become highly problematic, both due to their price, the availability of a certain amount, but also invaluable ethical reasons. Simultaneously, mineral raw materials are crucial to Europe's economy. They form a strong industrial base, producing a broad range of goods and applications used in everyday life and modern technologies. Unfortunately, the EU's dependency on the import of mineral raw materials, especially those deemed as critical (Critical Raw Materials – CRMs) is significant. This dependency is particularly high for rare metals and other rare minerals required for high-tech applications and for the green energy transition outlined in the European Green Deal.

The high risk in ensuring a stable supply of mineral raw materials means that Europe should be re-looked at as a potential source of mineral resources from primary sources – mineral deposits. From a geological perspective, Europe has an elevated mineral potential even for many of the CRMs. With the right technology, the political and social agreement each of them can become mining sites, if economically feasible. However, a balance must be kept between economic and social development, while respecting and protecting biodiversity. Therefore, it is necessary to look for modern and minimally invasive mining technologies that will have minimal impact on the natural environment and high efficiency, thanks to which they will obtain social acceptance.

The technology being proposed in the ROBOMINERS project is to be the answer to the above challenges. ROBOMINERS offers a solution to wider problems related to assuring the sustainable supply of mineral raw materials across the European Union, especially addressing the second pillar of the EU Raw Materials Initiative, which is securing a supply from EU internal sources. The ROBOMINERS approach is expected to allow for the reopening of abandoned mines (including flooded ones), without the need for a full recommissioning, and minimizing workers exposure to hazards while substantially reducing environmental footprints. Moreover, this could be a modern and revolutionary solution for the extraction of small but high-grade and ultra-depth mineral deposits which are currently recognized as being uneconomic. ROBOMINERS technology eliminates the need for developing typical mining infrastructures on the surface, which represent significant positive environmental impacts and the cost effectiveness of mining investment. This will allow for the development of mining in conflict areas due to other (non-mining) directions of land use.

Specifically, ROBOMINERS aims at designing and constructing a fully functional modular robot miner prototype capable of performing selective mining, and to study a future mining ecosystem based on this technology. On the robotics side, we are studying scalability, resilience, re-configurability, self-repair, collective behavior and, operation in harsh environments. Regarding selective mining, we focus on novel perception technologies like Mid-range geophysical sensors and in-stream elemental and molecular analysis as well as production methods suitable for the scale at hand.

In conclusion, we envision future mining to be performed by colonies of full autonomous, self-reconfigurable and self-awareness robotics, capable of performing mining autonomously. These will be the basis of a new mining system that will include all the necessary converging technologies on an overall mining ecosystem level, and will have a transformational effect on the mining industry: mining as a high-tech industry.

LIPIŃSKI ALEKSANDER

Jan Długosz University, Poland; e-mail: aleks@pro.onet.pl

Strategic mineral deposits. The drafted method of their protection

Keywords: disadvantages of mineral deposits protection

Since 1980, Polish law has stipulated that mineral deposits are to be protected with a view to their current and future mining. Thus far, due to many reasons, the system of such protection has not been working properly. As a result, real estate located above mineral deposits (or in which spatial limits the deposits are located) are developed in such a way that may make mining impossible or very difficult. The main legal instrument of the above protection should be the system of local spatial development plans enacted by local municipalities. The main problem is that as a rule, the enactment of such a plan is not obligatory, and the local municipalities are often shaping such plans ignoring the needs of mining industries. On the other hand, local communities are reluctant to invest in mining, primarily because of the risk of mining damage and the devastation of the environment.

The draft amendment of the Geological and Mining Act (UD280) provides the possibility of considering the mineral deposit after its recognition as "strategic". This will take place on the basis of a decision of the Chief Geologist of the State (CGS). This decision may determine the restrictions of the land use and has a binding force for the local municipality. It is likely that it will first of all refer to some mineral deposits owned by the State Treasury. The result of considering the mineral deposit as "strategic" will be the obligation of the local municipality to enact (or amend) the "study of conditions and directions of spatial development" and the "local spatial development plan" in the way of making the mining of such deposit possible. This must be performed in the time stated by the draft UD280. The problem is that the "study" is not an act of law; however, it is the main ground of the local spatial development plan. The last one is the act of local law that is the ground of administrative decisions, first of all referring to the land management (designating land for construction etc.). If the local spatial development plan exists, it should be adjusted to the decision of the CGS, in the time provided by the draft. The problem is that the enactment of such a local spatial development plan is not obligatory. Numerous local communities did not enact local spatial development plans. What is more, no one can force the local municipality to enact such a plan. Draft UD280 does not change this rule, even for the mineral deposit considered as "strategic".

The draft does not take into account the possibility that local spatial development plan may decrease the value of the land property, for instance, by introducing the ban for building development or the special construction needs (enforcement of the building etc.). If the local spatial development plan lowers the value of the land or makes its further use impossible or very difficult, the landowners may demand the compensation paid by the local municipality (Local Spatial

Development Act of 2003, Art. 36), but not by the owner of the mineral deposit. It is therefore doubtful that these solutions provided by the draft UD280 will work properly. The reason for drawing such a conclusion is very simple. The designers have not noticed that the costs of such protection will be vested on the local municipalities, not on the owner of "strategic" mineral deposit. The is no rule of law providing that the local municipality may get a refund from the owner of the mineral deposit. As a result, the enactment of the above-described draft UD280 is very doubtful.

That which has been granted by the decision approving the geological report referring to the deposits determined in Art. 10 para 1 of the GMA covers some costs of amendments of the study and the local spatial development plan. It does not refer to the costs of the compensation for landowners. They must be vested by the local municipality.

MARASMI CHRISTIAN, ROMAGNOLI MASSIMO

Emilia-Romagna Region, Italy; e-mail: Christian.marasmi@regione.emilia-romagna.it

The safeguarding of raw materials through the mineral planning process. The Emilia-Romagna Region experience

Keywords: mining plan, mineral safeguarding, spatial planning, MDoPi, restoration

The extraction of non-energy minerals in Italy is mostly focused on industrial and construction minerals such as bentonite, bleaching earth, limestone, marble, granite, clay, sand, gravel, travertine and ceramic minerals (feldspar, kaolin, refractory).

The primary legal basis of mineral extraction activity in Italy was the Mining Law (Royal Decree) No. 1443 of 1927 which divided minerals into two categories (Article 2): 'first' and 'second' category. 'First category minerals' are under the public domain; they include energy minerals (except peat), metallic ores, non-metallic ores of significant industrial importance such as salt and potash, barites and fluorspar, gemstones, garnet, corundum, leucite, fluorite, barium and strontium minerals, talc, asbestos, cement marl and lithographic stones. 'Second category minerals' are extracted in quarries and include peat, materials for building, road and hydraulic constructions (except marl for cement), quartz and silica sand, molars stones, sandstone, igneous rock, limestone, chalk and dolomite, sand and gravel, silica sand, common clay, and other industrial minerals not included in the 'first category minerals'. They are in the willingness of the private holder of the authorization and with the land availability.

With Legislative Decree No. 616/77 (related to second category material), the Legislative Decree 112/98 and the Constitutional Law 3/2001 (related to first category material) all the competences related to planning and management were passed from the State to the Regions.

As a result of this decentralized regime, each region has its own relevant regional laws regulating extraction and environmental permitting procedures.

The Emilia Romagna Region was one of the first regions in Italy to implement a mining law and to develop a wide-area mining planning. In fact, since the regional law 17/91, the exploitation of raw material in Emilia-Romagna is planned through the province mining plan (PIAE).

The Region carries out functions of coordination of the sector and prepares laws, acts of direction and coordination regarding planning tools, authorization measures, supervision and sanctions. It collaborates with local authorities in the study and implementation of projects aimed at a correct management and sustainable restoration of the extractive activities.

The PIAE regulates extractive activities at the provincial level to merge the industry needs with the needs of environmental and landscape protection, soil protection and water resources protection. With this aim it defines exploitation criteria and areas and the quantity of material that can be extracted during the mining plan life. Downward, all the municipalities must apply the province mining plan by developing a municipality mining plan (PAE), where the exploitation and restoration projects are defined.

During the implementation of the mining plan the participation process guarantees the involvement of stakeholders into the approval process. In fact, the mining plan approval foresee a participatory process based on two groups of stakeholders, one with a public body with territorial responsibility and one with local stakeholders.

To safeguard the mineral deposit, PIAE is valid for 10 years during which areas planned for extraction purposes cannot be assigned to other land uses. In the case the exploitation activity doesn't start the area can come back to the previous land use.

In the Region, material extracted are gravels and sands, mainly located adjacent to watercourses, clay for ceramics, limestones for cement and sandstone all extracted in the Apennine area.

MAZUREK SŁAWOMIR[1], SZAMAŁEK KRZYSZTOF[2]

[1] *Polish Geological Institute – National Research Institute, Poland; e-mail: slawomir.mazurek@pgi.gov.pl*
[2] *University of Warsaw, Poland*

Proposed rules for determining strategic mineral deposits in Poland and for their safeguarding

Keywords: strategic deposits, deposits protection, critical minerals, spatial planning

Defining a list of strategic deposits is an indispensable activity for preparing the mineral resources policy, a governmental programming and planning document serving to ensure long-term mineral security of the country. Some mineral deposits play a fundamental role in the functioning of the economy and therefore require special protection. Such deposits are referred to under various terms (strategic, key, deficit and critical mineral deposits). Until now, none of these terms has a normative nature in Poland. As of 2019, the Polish Geological Institute – National Research Institute is carrying out the preparation of a list of strategic deposits on behalf of the Chief Geologist of the Country. On the basis of multi-criteria analysis, deposits of local and regional, national and supranational importance and a list of strategic deposits were defined. To accomplish this task, a special methodology was developed (using and modifying previously published studies and proposals and the EU approach to critical minerals).

The methodology was based on the analysis of the archival database of mineral resources carried out in four stages:

1. Analysis of all undeveloped deposits in the MIDAS database,
2. Selecting documented but undeveloped deposits from the entire MIDAS database,
3. Verification of abandoned deposits and deposits with unique parameters or sparse on a national scale,
4. Designation of deposits of national and supranational importance as well as local and regional significance.

5493 deposits were analyzed for their evaluation and protection. Of these, 442 deposits of national and supra-national importance were separated based on the following criteria:

a) deposits under mining ownership of the State Treasury
b) deposits requiring special protection
c) deposits unique on the national scale, i.e. with the number of deposits $n \leq 15$ within a given mineral.

As a result of the analysis, 5051 deposits of local and regional importance were identified.

Special attention was paid to the issue of legal protection of deposits in the system of spatial planning protection. Special plan protection (strategic deposits and those recognized as equivalent) should be extended to 220 deposits out of more than 14,000 documented deposits listed in MIDAS database.

NIEĆ MAREK[1], RADWANEK-BĄK BARBARA[1], KOŹMA JACEK[2]

[1] *Mineral and Energy Economy Research Institute PAS, Poland; e-mail: mark@min-pan.krakow.pl*
[2] *Polish Geological Institute, Poland*

Polish approach to the mineral deposits safeguarding. Experience and problems

Keywords: mineral deposits, protection, geological information, geoenvironmental mapping, mineral policy, Poland

The basis for mineral policy and the safeguarding of mineral deposits is the knowledge of their demonstrated resources or potential occurrences. The said knowledge is based on geological mapping and deposit exploration, as well as the planned land use and environmental protection requirements. In Poland, the standardized mode of reporting of the resources started to be used as early as 1953. It is presented in a uniform manner in "The Geological documentation of deposits". The Polish system is comparable to the JORC Code and UNFC standard. The occurrence of the demonstrated (documented) mineral deposits and prospective areas of mineral resources is presented on geo-environmental maps (1:50,000) prepared for the whole territory of Poland. They visualize possible conflicts of explored deposits and areas of possible occurrence of mineral commodities with areas of protected environment, fertile soils, forests as well as existing housing developments. The valorization of deposits according to their importance on a national, regional or local scale enables the identification of the most valuable deposits, and select these of public importance (MDoPI – Mineral Deposits of Public Importance). The degree of conflict between the mode of land utilization and the requirements of environmental protection are evaluated using a ranking procedure and are later presented on maps. According to the Polish Geological and Mining Law, the location of explored mineral deposits and their boundaries should be presented in a land use plan as the specific elements of the natural environment that should be protected. On the other hand, the planning of mining activity should be combined with the prediction of the possible environmentally friendly use of the area of the deposit after the end of the operation as well as possible environmental benefits by formation of new wildlife habitats and attractive landscapes. The lack of sufficient, appropriate education and insufficient governmental mineral policy results in opposition to mining, provoked by varied, unreasonable anxieties. Such opposition may be mitigated by appropriate teaching at each education level, active CSR (corporate social responsibility) and social dialogue. There is a need to introduce legal measures for the effective mineral deposit protection and to improve social awareness regarding the importance of these problems.

PIESTRZYŃSKI ADAM[1], CIECHULSKI ANDRZEJ[2], FOSZCZ DARIUSZ[1]

[1] AGH University of Science and Technology, Poland; e-mail: piestrz@geol.agh.edu.pl
[2] Dom Górniczy, Poland

Environmentally safe gold recovery from alluvial deposits with the use of original separators based on the adhesive coatings phenomena

Keywords: ecological gold recovery

The presentation concerns the application of the G-ECO™ method for the separation of metallic gold. This technology uses the phenomenon of adhesion, i.e. the process of the physical bonding of materials under the influence of surface free energy (SFE), which causes a negligible impact on the environment. This technology is dedicated to the enrichment of gold from waste and primary (alluvial) deposits with low content, the processing of which using conventional methods of enrichment is unprofitable.

The G-ECO coating, which is based on silicones, contains substances that have an adhesive relationship to gold grains and is chemically neutral. Its three main expected features are:

1. Selectivity – the coating should "bind" grains of precious metals on its surface with adhesion forces and "be indifferent" to grains of other minerals.
2. Bonding strength – the grains of precious metals should be "bound" so strongly that they are not washed away by the water stream of the ore suspension in the separator, but weakly enough so that they can be "released" from the coating in an ecological manner.
3. Durability – the coating should be resistant to water erosion and abrasion by grains of minerals present in the ore (feed).

The key competitive advantages of the G-ECO technology result from the fact that it is neutral to the natural environment. Compared to the gravity method, it allows increasing the efficiency from approx. 20% to approx. 95%, with a unit cost several times lower.

Compared to the chemical method, the initial CAPEX in the case of the G-ECO technology is even several hundred times lower than in the case of the chemical method, and the unit cost of separation is also lower (around 45 USD/ounce in the G-ECO technology compared to around 225 USD/ounce for the traditional chemical method).

The presentation presents the results of the gold enrichment process from a gravel-type deposit with the use of a technological installation equipped with an adhesive separator. Natural fatty substances were used in the separation process, which were patented by Mining Hous (Spółka z o.o.). The amount of recovered gold from the raw material from the vicinity of Złotoryja was 0.701g, which, with the content in the feed below 0.1g/Mg and processing of approx. 8Mg, indicates a very high level of efficiency of over 90%. The currently used gravity technologies for fine gold grains are not so effective and result in the use of very harmful chemical methods.

Chemical methods with exploitation potential are forbidden in many regions, which causes an abandonment of exploitation or large losses of gold in waste. This creates great opportunities for the widespread industrial implementation of the G-ECO technology.

Due to technological parameters, there are two types of deposits:

- primary,
- secondary.

In alluvial deposits (secondary clan), gold is usually released in the form of irregular plates with a morphologically developed surface. The technological process, in a nutshell, consists of screening the material, then –3 mm fractions are fed into the separation water transport cycle. The suspension of sandy material flows through the separator and the gold is washed out on the adhesive surface. The Au concentrate is washed off the adhesive surface and recovered from the filters.

In this way, the recovery of Au by amalgamation and cyanidation methods, which are environmentally harmful, can be omitted. The use of this method will allow the launch of many inactive gold deposits and reduce the impact of processing this metal on the environment.

RAHA MARGUS

Mineral Resources Committee of Estonia, Department of Mineral Resources;
Ministry of Economic Affairs and Communications, Estonia; e-mail: margus.raha@mkm.ee

The mineral policy of Estonia

Keywords: mineral policy, Estonia, georesources, the Earth's Crust Act

The use of mineral resources is aimed at promoting the economic growth of the state, while compensating for the environmental impacts, and providing benefits to people directly affected by the operation and to local governments.

In June 2017, the Riigikogu (Parliament) approved "The general principles of the Earth's crust policy until 2050", which declares: "The Earth's crust and the natural resources found there are explored and used in a way which creates as much value for Estonia as possible, at the same time considering the environmental, social, economic, geological, and security aspects of these activities." Also, this very important Document, which serves as the national mineral strategy, declares that the state's interests related to the field of the Earth's crust must be clearly defined to ensure that the sectoral competence of all the relevant institutions is at an adequate level, and to manage the field based on the relevant principles. The Earth's crust in Estonia contains several resources with considerable economic potential. Considering the environmental, social, and economic impacts related to the use of extractable land resources, the state should have the main competence and initiative in making decisions regarding the use of these resources. To this end, it is necessary to, at the national level, systematically and consistently plan, carry out, and fund research on extractable land resources and their valuation. Also, the location of the use of earth's crust must be reasonable and spatially thought-through; the site must be reclaimed after use in light of the development of the entire region. The relevance of the legislation must be regularly reviewed, optimized and complemented on the basis of the results, if necessary. The legal framework must be purposeful and proportionate, and its implementation for all those concerned must be as minimally burdensome as possible. The general principles of the Earth's crust policy until 2050 will be reviewed and updated every four years, if necessary.

The mining and use of mineral resources is regulated in the Earth's Crust Act. The purpose of this Act is to ensure sustainable and economically efficient use of the earth's crust and to reduce environmental nuisances arising thereby to the greatest extent possible.

This Act regulates:

- geological investigation;
- geological exploration of mineral resources;
- extraction of mineral resources;
- the rights of the owner of immovable property upon use of mineral resources within the boundaries of the owner's immovables;

- reclamation of the explored land and land disturbed by extraction;
- use of the earth's crust not related to the extraction of mineral resources, except in the part regulated by other Acts;
- protection of the earth's crust;
- prevention of environmental threats and a reduction of environmental risks involved in the use of the earth's crust, unless regulated by other Acts;
- organization of state supervision over compliance with the requirements provided for in this Act;
- liability for violation of the requirements provided for in this Act.

The main responsible authority for exploring and granting mining permits is the Environmental Board. The Ministry is advised (in a non-binding way) by the Commission of Mineral Resources on issues of exploration and exploitation of mineral resources, validation of mineral reserves, among other topics. Supervision and monitoring is conducted by the Environmental Inspectorate.

Other important acts are: General Part of Environmental Code Act, Environmental Charges Act, Nature Conservation Act, Building Code, Planning Act.

The Estonian Government has decided to find a complex solution to different problems related to mining and the utilization of georesources. The mining industry of Estonia will continue to focus on reducing CO_2 emissions. The exploration of Estonia's major mineral resources, such as phosphorite, rare-earth metals, black shale (which has a high concentration of uranium, and of other heavy metals such as vanadium, molybdenum and nickel) and iron ore will continue to be carried out by the Geological Survey. At present mainly construction minerals, peat and oil shale are extracted.

New principles of exploiting the mineral resources are currently being developed in the Ministry of the Economic Affairs and Communications together with the Ministry on Environment, including such definitions as concession and concession tender.

In Estonia all bedrock mineral resources belong to the state. Additionally all mineral resources in public waterbodies and on state land belong to the state. Bedrock means a rock created in a preglacial period which is opening on the ground or buried under a quaternary cover. In contrast, the private landowner owns non-bedrock minerals, i.e. only the quaternary sediments (sand, gravel and peat).

RAMBOUSEK PETR[1], GODÁNY JOSEF[1], WERTICHOVÁ BLAŽENA[2], WERTICH VOJTĚCH[1]

[1] Czech Geological Survey, Czech Republic; e-mail: petr.rambousek@geology.cz
[2] Technical University of Ostrava, Czech Republic

Regional raw material conception in the Czech Republic (case study Liberec Region)

Keywords: Raw Material Policy, regional, aggregates, uranium resources

The need for regional raw material policies was expressed in the former Czech national Raw Materials Policy in 1999. In connection to this task, the Ministry of Industry and Trade in cooperation with the Czech Geological Survey prepared during 2003 regional raw materials policies for all regions in the country. However, only a few of them approved those documents as strategic documents by regional governments. An exception is the case of the Liberec Region on the North of the Czech Republic, which is the smallest region (just after Prague – the capital) and borders Poland and Germany.

Regional raw materials policy was approved for the first time as a strategic document of the Liberec Region in 2003. It deals with all mineral deposits within the jurisdiction and proposes its use and development in coordination with the land use plans in the mid-term. The regional policy is based on the tasks of national raw materials policy, and it is a professional basis for decision-making on the protection and use of mineral deposits within the region. Other users of the regional raw materials policy are national and regional authorities concerned, municipalities, the Ministry of Industry and Trade, the Ministry of Environment, and other relevant stakeholders.

The Liberec Region was the only one of all the regions in the country which ran the amendment of its Regional Raw Material Policy. This was done for the first time in 2011 (Česká geologická služba 2011). The need for the second amendment (Godány et al. 2022) occurred due to the changes in mining legislation, the actualization of State Raw Material Policy in 2017 (Ministry of Industry and Trade 2017) out-of-date data about mineral deposits, etc. The procedure of the second amendment of the Liberec Region Raw Material Policy was a very long-lasting process, which is summarized in the following points:

- ➡ 12/2016 – the first expert seminar,
- ➡ 06-08/2017 – field survey (representatives of the Liberec Regional Office, Czech Geological Survey, Ministry of the Environment and concerned municipalities. A total of 32 surveyed localities),
- ➡ 2018-2019 – draft document – comments, discussion, revision at relevant departments of the Liberec Region level,
- ➡ 09-10/2019 – public discussions,
- ➡ 06/2020 – SEA assessment, public discussion, (30 subjects, 114 reminders),
- ➡ 08/2021 – final version (data update, changes in the use of some mineral deposits),

- 02/2022 – approval by the Ministry of Environment,
- 03/2022 – approval process at the Liberec Region level (expert committees, council of the region).

The successful amendment covers several specific issues, such as the protection of deposits of radioactive minerals, sustainable mineral development, the mining of glass sands, and the securing of the sustainable supply of sands, gravels and other aggregates for public constructions (especially the transport infrastructure) within the region. It also touches on the possibilities of saving primary resources by using recycled raw materials in constructions. The policy document includes the assessment of potential conflicts of interests, proposes solutions for its minimization and covers issues of impact of mining from and to bordering regions and countries.

References

Česká geologická služba. 2011. Aktualizace regionální surovinové politiky Libereckého kraje. Praha: Česká geologická služba. [Online] https://regionalni-rozvoj.kraj-lbc.cz/getFile/case:show/id:903914 [Accessed 2022-04-15].

Godány, J. et al. (2022). Aktualizace regionální surovinové politiky Libereckého kraje. Liberecký kraj. [Online] https://regionalni-rozvoj.kraj-lbc.cz/getFile/case:show/id:1107856/2022-03-14%2010:58:03.000000.

Ministry of Industry and Trade (2017). The Raw Materials policy of the Czech Republic for mineral raw materials and their resources. [Online] https://www.mpo.cz/en/construction-and-raw-materials/raw-material-policy/raw-material-policy-minerals-in-the-cr/new-raw-material-policy-for-minerals-and-their-resources---mpo-2017--233052/.

SEKYRA LECH[1], NIEWIADOMSKI MIROSŁAW[1], POMYKAŁA RADOSŁAW[2], TORA BARBARA[2]

[1] *Polska Unia Ubocznych Produktów Spalania, Poland*
[2] *AGH University of Science and Technology, Poland*

Anthropogenic raw materials from coal combustion by-products

Keywords: fly ash utilization, recovery, circular economy

In Europe, nearly 100 million tons of slags and ashes are produced annually, of which up to 10% are recovered ferrous and non-ferrous metals, and as much as 85% are mineral parts that can be used in land reclamation, the cement industry and construction.

The principles of the circular economy impose an obligation on the industry to take care of the optimal use of resources. The economic use of ash and slag from the energy and heating industries definitely fits in with this principle.

Polish power plants and combined heat and power plants produce about 20 million tons/year of coal combustion by-products, including ashes and slags. This means that Poland is the European leader in terms of the quantity of good quality ash. The management of ash and slag from the combustion of fossil fuels and alternative fuels (biomass and RDF) brings added value both for the environment and the economy – the by-products of combustion do not have to be landfilled, and therefore do not affect the environment. However, in many cases they can replace natural resources, such as aggregates, the production of which is expensive and energy-consuming.

In the processes of electricity and heat production as a result of coal combustion, various energy wastes are generated, such as: fly ash, slag, ash-slag mixtures, microspheres, ash from fluidized bed boilers, gypsum from flue gas desulphurization using the wet lime method, waste from flue gas desulphurization using semi-dry methods and dry, etc.

Standard methods for using combustion by-products include:

- ➡ the use of fly ash in the building materials industry,
- ➡ manufacture of Portland cement clinker,
- ➡ production of cements,
- ➡ production of concrete,
- ➡ production of lightweight aggregates,
- ➡ production of construction ceramics,
- ➡ use for reclamation works, macro-leveling.

Application of fly ash in underground mining as: filling old goafs, active wall goafs and redundant corridor workings; carrying out explosion-proof dams and suppressing explosions; fire hazard elimination; as well as the release of methane fields to recover methane, preventing air leakage through goafs.

Research on the possibility of metal recovery has shown the possibility of recovery from ash (especially ash from municipal waste metal waste incineration).

As regards the production of high-quality products, works are being developed on the production of microspheres in dry technology and metal concentrates, as well as micro and nano fillers and carriers. Microspheres can be used as a sorbent in liquid chromatography, a medium contrast agent for ultrasound for clinical trials, as sorbents for petroleum products.

Another direction of using fly ash is the production of bio-fertilizers. As part of the FUNash project, scientists from 3 Polish universities, the Lublin University of Technology, the AGH University of Science and Technology in Kraków and the University of Warsaw have created a research consortium. The aim of the consortium is to develop a series of functionalized materials, i.e. with increased usability, based on fly ash. It is a unique, comprehensive approach to the management of fly ash The materials produced thanks to them will be used in construction (cements and biocements), agriculture (fertilizers and bio-fertilizers) and environmental engineering (sorbents and biopreparations for removing water, soil and gas pollutants).

The use of combustion by-products fits perfectly into the implementation of the principles of the circular economy.

SIMIC VLADIMIR, ŽIVOTIĆ DRAGANA, MILADINOVIĆ ZORAN

University of Belgrade, Serbia; e-mail: vladimir.simic@rgf.bg.ac.rs

Mineral safeguarding in Serbia

Keywords: mineral safeguarding, mineral resources, Serbia, mineral policy

Serbia, in relation to its size and population, has significant mineral resources. The most important mineral commodities are copper, lead, zinc, and coal. There is also a relatively large potential for nickel and gold. Non-metallic minerals, the resources of which are not used sufficiently, are also significant. In Serbia all mineral resources (including coal, mineral water, geothermal resources, and hydrocarbon resources) are the public property of the state. Consequently, the legislation for the mineral industry is predominantly defined on state level and the Ministry of Mining and Energy is in charge of most activities. Permits are issued only by the Ministry and for the Autonomous Region of Vojvodina by the Secretary in charge.

In the modern economy the long-term concept of sustainable mining development implies continued economic growth, but such growth that brings not only economic efficiency and technological progress, but also a higher share of cleaner technologies and innovation in the society as a whole and corporate social responsibility, enabling poverty reduction, long-term better use of resources, improved health and quality of life and reduced pollution, prevention of future pollution and preservation of bio-diversity.

Therefore, it is necessary to have a well-established management system related to mineral resources, which means good cooperation between spatial planning and environmental protection on the one hand and mineral safeguarding as a specific protection of the only non-renewable mineral commodities. The mineral policy in Serbia is so far mentioned in the new Law as a set of procedures to be followed according to the Strategy and not as policy itself, and the Strategy on sustainable management of mineral resources is still a draft version. However, Serbia defined strategic mineral commodities in the Law on Mining and Geological Exploration in 2015, which include oil and natural gas, coal, copper and gold, lead and zinc, boron and lithium, and oil shales. Other mineral commodities may be defined as strategic by a separate act of the government based on recommendations of the Ministry in charge. The same Law also introduced protected zones around the existing quarries and mines, which do not allow any other mining activity.

Mineral safeguarding will have several challenges, such as coordinated national/regional/municipal planning of the mineral supply and safeguarding that addresses cross-sectoral interactions and ensures that documents are consistent, integrated planning for primary and secondary mineral commodities that addresses resource efficiency, capacity and competence to address the preceding two problems, and stakeholder engagement and the consultation process to ensure that planning addresses the concerns and needs of all the target groups.

SOLAR SLAVKO VEKOSLAV[1], SABRA GHADI[2]

[1] UNECE, Switzerland; e-mail: slavko.solar@un.org

[2] Politecnico di Torino, Italy

Safeguarding mineral deposits using the United Nations Framework Classification for Resources

Keywords: resource classification, mineral security, mineral deposit safeguarding

The security of mineral deposits is essential to attain the availability of minerals and support sustainable development. The availability of minerals is a fine balance between demand and supply in the short and long term. Demand is determined by the needs of society and the economy, depending on societal preferences expressed in different policies, primarily economic.

The supply of minerals depends on domestic sources and import/export possibilities. Among economic constraints and opportunities in global markets, imports depend on geopolitical issues. Supply depends on the capacity of domestic production that covers domestic demand and export. The capacity of domestic production among many determining factors heavily depends on the extent of discovered and undiscovered mineral deposits. Mineral deposits are determined by the quantity and quality of minerals, while their production is determined also by technical feasibility and environmental-social-economic viability. The confidence in the quantity and quality of minerals, feasibility, and viability are well embedded in the UN Framework Classification for Resources (UNFC).

The United Nations Framework Classification for Resources (UNFC) is a resource project-based and principles-based classification system in which the products of a resource project are classified based on the three fundamental criteria of environmental-socio-economic viability (E), technical feasibility (F), and degree of confidence in the estimate (G), using a numerical coding system.

The UNFC has emerged from the need to have a universally accepted framework for the evaluation of resources. UNFC has been developed to meet, to the fullest extent possible, the needs of applications about a) policy formulation based on resource studies, b) resources management functions; c) corporate business processes and, d) financial capital allocation.

UNFC is adaptable to all kinds of projects such as mining operations, prospective or exploration projects, and historical estimates. UNFC is a robust, coherent, simple tool for resource classification also designed for national, regional reporting scopes incorporating various sources of information.

This tool helps regional/national governments to understand the potential of their mineral endowments and provides sufficient information that facilitates strong decision-making. Reporting in UNFC supports national mineral inventories through clear, easy to communicate, and applicable classification of all-natural resources including water and energy resources such as geothermal energy. As a result, the resources can be compared amongst different countries applying UNFC.

The information documented and reported through UNFC can be used throughout the entire value chain, including the prospective or pre-exploration phase. Information can result in mineral deposit safeguarding as UNFC provides a consistent framework to report the perspectivity of mineral deposit(s).

SPECZIK STANISŁAW, ZIELIŃSKI KRZYSZTOF

Mozów Copper sp. z o.o., Poland; e-mail: sspeczik@miedzicopper.com

Land management recommendations for protecting potential copper and silver mining areas in the Lubuskie Province, western Poland

Keywords: deep copper and silver deposits, Fore-Sudetic Monocline, protection of mineral resources, potential Cu-Ag mining areas, Lubuskie Province

The Lubuskie Province (or Lubuskie Voivodeship) is located in western Poland. It is one of sixteen provinces of the country; its area is almost 14,000 km^2, with a population of slightly more than a million people. In terms of geological structure, its southern part comprises three major geological units: the north-western part of the Fore-Sudetic Monocline, the Żary Perycline and the northern termination of the Fore-Sudetic Block. Both the Fore-Sudetic Monocline and the Żary Perycline are known places of the occurrences of stratiform Cu-Ag sulfides. However, unlike the adjacent Dolnośląskie Province, where the extraction of such ore from the former unit has been continuing since the 1960s, the Lubuskie Voivodeship is still waiting for its first copper and silver ore mine.

Known occurrences of Cu-Ag sulfide ore in this region include four registered ore deposits, three of which were discovered in the recent years, as well as seven prospective areas with a varying level of confidence of their identification (the so-called hypothetical and speculative resources, estimated based on historical geological data). The total resources of the deposits are 19.045 Mt Cu and 55.318 kt Ag, while the combined resources of the prospective areas are estimated at 70.646 Mt Cu and 232.323 kt Ag. There are also six areas of active exploration of copper and silver ore deposits within the borders of the province, carried out based on concessions issued by the Minister of Climate and Environment. All of the abovementioned types of areas constitute the so-called "potential Cu-Ag mining areas" (PMAs), where active extraction of copper and silver ore could possibly be initiated at some time in the future, depending on their further exploration and development.

In Poland, only deposits with resources documented by an investor and then approved by the Minister of Climate and Environment are entered into local spatial development and zoning documents, and as such they are protected to a certain extent by the Polish law. On the other hand, other potential mining areas are not protected whatsoever. Therefore, there is a risk that improper use of land, involving e.g. civil engineering, could render their future extraction impossible.

The protection of potential Cu-Ag mining areas should start much earlier than after the Minister's approval of the documentation of a deposit. The means of such protection should be introduced by way of new or amended legal regulations.

Every concession for prospecting and/or exploration should be protected by local government units starting from the day of its issuance, which marks the beginning of a new exploration project. As for documented deposits, local authorities should avoid such directions of development of these PMAs which might prevent investors from accessing resources once they are documented. As a result, local governments should monitor any activities taking place within the boundaries of such concessions, in order to avoid their undesired spatial development and land management. Moreover, prospective areas of copper and silver mineralization also constitute a type of PMAs, and therefore they should also be protected. This protection should begin on the day of disclosure of such areas in reports presenting prospective mineral resources of Poland – such reports are prepared for the government by the Polish Geological Institute, albeit only once every few years. This frequency should also be improved.

The recommended steps aimed at enhancing the protection of copper and silver ore resources in Poland apply to the whole country. However, the Lubuskie Province has been chosen as an example, due to it being an exceptional region with multiple known areas of copper and silver ore potential and the continuing exploration, but no active mining operations as of yet.

STANKOVA HANA[1], CERNOTA PAVEL[1], CABLIK VLADIMIR[1], TORA BARBARA[2]

[1] VSB TU Ostrava, Czech Republic; e-mail: hana.stankova@vsb.cz

[2] AGH University of Science and Technology, Poland

Forecast extraction and processing of lithium and tin from the Cinovec deposit, Czech Republic

Keywords: lithium, tin, Cinovec Czech Republic, processing

Cinovec is a lithium- and tin-mining project in the Czech Republic. It is the largest lithium resource in Europe and also the world's fourth-largest non-brine deposit.

Most of the industrially available lithium reserves are found in Chile (9 Mt), Bolivia (9 Mt), USA (6.7 Mt), Argentina (6.5 Mt), China (5.1 Mt), and Australia (1.7 Mt). The annual mining of lithium minerals is around 40 kt. Worldwide minable reserves are estimated at 34 Mt of pure metal.

Significant lithium deposits are available in the Czech Republic. The zinnwaldite veins in acid granites near Cínovec and Krupka (the registered Cínovec-south deposit) contain 140,000 tonnes of lithium. Dump heaps and slurry ponds, after previous mining, contain another 5,000 tonnes of metal.

Lithium mining took place in Cínovec between 1953 and 1967. The Cínovec Mine produced a total of 23 kt of Li concentrate. The production of elemental lithium took place from 1957 to 1968 at the Lachema Kaznějov plant.

The Cinovec lithium-tin project is expected to contain ore reserves of 34.5 Mt graded at 0.65% Li2O and 0.09% Sn.

The indicated resources are estimated to be 695.9 Mt, graded at 0.195% Li. Contained reserves are estimated to be seven million tonnes (Mt) of lithium carbonate-equivalent (LCE), 101,635 t of tungsten, and 278,360 t of tin.

The mining district of Krušné Hory/Erzgebirge located along the Czech/German border, is one of the few major metallogenic provinces in Europe characterized by granite intrusion-related ore deposits. For around 800 years, it produced silver, tin, lead, zinc, bismuth, cobalt, nickel and arsenic. From the end of 19th century, it also produced tungsten, fluorite, barite and uranium.

The oldest documented mining activity in the Erzgebirge is the Freiberg silver mining, which dates back to 1168. Silver was later followed by tin mining in the thirteenth and fourteenth centuries.

Initial mining is planned to be carried out at the Cinovec South deposit.

The proposed mining method at the Cinovec lithium-tin project is the long hole open stoping method. The ore body of the underground deposit is flat or shallow-dipping and will be mined with pillar support in addition to cement paste back-fill.

The mine is expected to have a twenty-one-year mine life, with an average processing capacity of 1.68 Mtpa of ore. The projected production of lithium hydroxide from the deposit is 25,267 tpa.

The preferred mining method will utilize pillars for support, avoiding the need for a backfill plant. The largely flat or shallow dipping orebody can be mechanized by long-hole open stope mining.

The Cinovec ore can be processing using single-stage crushing and single-stage coarse semi-autogenous grinding milling.

The magnetic separation method with a lithium metallurgical recovery of 91% is proposed for the Cinovec Mine. The initial test results proved that a wet high-intensity magnetic separation stage would be able to improve the para-magnetic material to form a scavenger magnetic fraction, to be transported again to the beginning of the circuit.

A recovery level of 91% was achieved through a three-stage magnetic separation flow sheet, including a rougher, cleaner and scavenger stage. The cleaner magnetic concentrate underwent re-grinding before being passed over a shaking table for the recovery of the liberated tin while the gravity concentrate and the scavenger concentrate were sent back to the origin of the circuit.

The produced tailings will be filtered and compressed into filter cakes for dry stack impoundment in a tailing storage facility. The tailings will be 1.5 Mtpa of front-end comminution and beneficiation material as well as 0.5 Mtpa of lithium carbonate plant material.

The processing plant will use a two-stage crushing plant, and will be screened in a double-deck vibratory screen.

The run-of-mine ore will then be passed through a comminution plant for resizing to a particle-size distribution ideal for lithium recovery.

The product will then be conveyed to the beneficiation plant, which will produce a lithium-rich magnetic stream (mica-concentrate) through the separation of paramagnetic zinnwaldite. It will also treat the non-magnetics by-product stream using gravity, flotation, magnetic, and electrostatic separation processes to produce tin and tungsten products.

The concentrate will be mixed with limestone, waste gypsum and recycled sodium sulphate before roasting to convert the lithium into a lithium potassium sulphate. The product will then be leached to dissolve the contained lithium sulphate values.

Crude lithium carbonate is then precipitated from the purified leach solution through alum precipitation.

The beneficiation plant will also treat the non-magnetics by-product stream with gravity, flotation, magnetic and electrostatic separation to produce tin and tungsten products.

Potassium sulphate, which is produced as a by-product, will be dried and packed for sale. The battery-grade lithium carbonate will be further processed to produce battery-grade lithium hydroxide.

The Cinovec lithium-tin project is expected to provide 360,000 tonnes per annum (tpa) of mica concentrate to the lithium carbonate and hydroxide plants.

STARÝ JAROMÍR[1], KAVINA PAVEL[2], GABRIEL ZBYNĚK[1]

[1] *Czech Geological Survey, Czech Republic; e-mail: jaromir.stary@geology.cz*
[2] *Ministry of Industry and Trade, Czech Republic*

Critical minerals of the EU (CRM) in the territory of the Czech Republic

Keywords: critical minerals of the EU (CRM), Czech Republic, reserves, resources, coking coal, lithium, tungsten

The Czech Republic is endowed with a minor portion of the critical minerals of the EU (CRM). Only a small proportion of the CRM (coking coal, lithium, tungsten, graphite, fluorspar, barite and germanium) forms exclusive (reserved) deposits with reserves (resources). All other CRMs constitute solely resources, predominantly prognosticated, with only a minor part of them considered potentially prospective. Coking coal belongs to the most important domestic CRM. It is still mined in the Czech part of the Upper Silesian basin. Coking coal comprises about one half of the hard coal total resources within the basin. The mine production of the hard coal in the basin has been gradually decreasing, and it is about 2 million t at the present time. The Czech coke production has been stable in the last decade and annually ranged from 2 to 2.5 million tons, so it is clear that the domestic raw material is gradually being replaced by imports. Lithium is potentially important and its resources in the Czech Republic are almost entirely concentrated in the Cínovec ore district in the eastern Erzgebirge Mountains. Almost 1,128 thousand tons of lithium Cínovec belong to the largest world deposits in the solid rocks. The Cínovec ore district is currently being explored, the subsequent commissioning is expected within several years. In addition to lithium-bearing mica as a main mineral, tungsten is an accompanying constituent of the complex Li-Rb-Sn-W greisen (disseminated) type ores. Wolframite is the main W-bearing mineral, while scheelite is s minor W-bearing mineral. In addition to the Cínovec ore district, the Krásno – Horní Slavkov ore district comprises smaller proportions of the same mineral type sources of tungsten. These greisen (disseminated) type deposits represent around 70% of total domestic tungsten resources. The remaining 30% of the tungsten resources are located at the Kašperské Hory deposit, probably the most prospective domestic tungsten source. Strata-bound scheelite as a tungsten ore accompanies gold-bearing quartz veins which together comprise this deposit. However, further exploration and possible future utilization of this deposit is currently blocked by conservational and environmental restrictions. Natural graphite and fluorspar with barite represent other CRMs with a certain potential. These minerals comprise only small and poor deposits and resources. Their possible utilization is only hypothetical in the present time, due to weak economic importance. Domestic potentially prospective resources of antimony, germanium, indium, cobalt, niobium and tantalum have even less chance of being exploited, because they are small, poor and often insufficiently explored. A majority of other minerals from the CRM list are not located in the Czech Republic. Some products of certain CRMs, which do not have significant resources in the Czech Republic, are of relatively considerable economic importance, at least on the European scale. These include titanium, tantalum, vanadium, PGM etc.

This research was supported by the Project No. SS 020 30023 „Rock Environment and Natural Resources" from the Technology Agency of the Czech Republic.

STEFANOWICZ JAN A.

JURIS Law Firm, Poland; e-mail: jan.stefanowicz@juris.pl

Protection of the sources of raw materials in the rock mass in the Raw Materials Policy of the State

Keywords: State Raw Materials Policy, Geological and Mining Law Act, protection of sources, rock mass resources, deposits/prognostic areas, deposits/prospective areas

The paper assesses the legal and procedural aspects of the State Raw Materials Policy (SRMP), in particular as regards planned activities, including the proposed solutions on how to protect the resources of raw materials in the rock mass. The paper focuses on two key aspects: departure from a narrow, literal understanding of the protection of mineral deposits, including only documented ones; and the need for various forms of protection, adequate to the state of exploration of the rock mass and its resources as well as access to them, also taking the economic factor into account.

The paper is an attempt to demonstrate that the assumption that only documented mineral deposits fall under protection, made in the State Raw Materials Policy, is a mistake, and it is necessary to significantly broaden the scope of protection to include prognostic and prospective areas as well as prospective deposits. It is also necessary to protection the heat of the Earth, as a potentially useful resource or an element of the rock mass, and the formations, the structure of which allows for storing substances and energy, as well as hazardous waste. It is pointed out that natural voids, old or liquidated excavations, may be sites for anthropogenic deposits, provided that appropriate regulations are included in the SRMP.

The paper emphasizes the necessity to protect resources which, although they cannot be exploited in the current rock mass, technological and economic conditions, due to high cost or market demand, may constitute a so-called “reserve for generations to come”, and – beyond the horizon of 30/50 years, in the future – it could be decided whether and to what extent such non-renewable rock mass resources could be effectively used, if relevant solutions were planned.

All the above remarks are presented in the context of deficiencies and unsatisfactory solutions proposed in the State Raw Materials Policy, or solutions which are overlooked or underestimated.

SZAMAŁEK KRZYSZTOF

Warsaw University, Poland; e-mail: krzysztof.szamalek@uw.edu.pl

Knowledge about prospective resources as an instrument of mineral deposit protection

Keywords: mineral resources, geological reconnaissance, prospective resources, deposits safeguarding, land use planning

The current knowledge about mineral reserves and resources is permanently changing as a result of conducted research and new discoveries of mineral deposits, introducing new extractive technologies and new geological theories and models concerning the formation of mineral deposits. Advanced knowledge of prospective mineral deposits plays a fundamental role in national economic development planning and land use planning. A geological reconnaissance of the country and gathering knowledge on the occurrences of mineral deposits is a permanent task of geological surveys carried out in cooperation with academia and the mineral industry. In Poland, the knowledge base of prospective resources is obtained by the Polish Geological Institute (PGI) operating as the geological survey. PGI conducts independent prospecting studies, archives geological documentations prepared by mineral companies and verifies geological forecasts. This knowledge allows for the rational protection of the land from its inappropriate development. Mineral deposits safeguarding is a multidimensional activity and is composed of multiple interdependent objectives. Mineral extraction requires a significant amount of space for mine operations (both for the infrastructure of the mine itself, as well as transportation routes, processing plants, waste dumps, etc.). Therefore, it is extremely important to consider future mining activities in land use planning and to introduce adequate protection for undeveloped deposits. It is very important to have free, early access to public geological information and knowledge about the country's mineral potential. The summarized knowledge about Polish geopotential is presented in the form of scientific monographs entitled "The balance of prospective mineral resources in Poland". "The balance of prospective mineral resources in Poland is a unique publication in terms of scope and content, because such data is not published in similar form and with the same scope of geological information in other countries. The data presented in this publication on prognostic and perspective areas, as well as on the documented deposits, is indispensable for country planning of economic development through, among others, the protection of mineral deposits in the process of spatial management of the country. Thanks to this information mineral companies can plan and realize projects to document deposits and then finally develop the deposits. The most important theoretical problems are raised by the question of the feasibility of resource estimation (even preliminary) based on fragmentary and uncertain data. This is particularly true in the initial phases of identifying deposit potential. However, even this preliminary, general information, burdened with considerable estimation error, concerning the possibility of the occurrence of mineral deposits in particular regions of the country, may and should fulfil an important auxiliary and planning function in activities of local government bodies, investors or state institutions. Mineral deposits should be safeguarded on the same legal base as other elements of the environment. This is due to the needs of sustainable development, access to mineral resources for future generations and the needs of the economy. Unfortunately the current legal and planning protection of mineral deposits in Poland still has rather complicated structure and is not very effective. Documented deposits are disclosed in local spatial management plans, but this solution does not fully protect deposits against land development other than for mining purposes. Deposits and perspective areas, which are known in the preliminary studies, are not sufficiently protected by law against land use which would exclude future mining activities.

TOST MICHAEL[1], KOT-NIEWIADOMSKA ALICJA[2], GUGERELL KATHARINA[3]

[1] *Montanuniversitaet Leoben, Austria; e-mail: Michael.tost@unileoben.ac.at*

[2] *Mineral and Energy Economy Research Institute PAS, Poland*

[3] *University of Natural Resources and Life Sciences, Austria*

Mining and Europe's World Heritage Cultural Landscapes

Keywords: cultural landscapes, mining, mineral resources, World Heritage Sites, UNESCO, sustainable land use

Many cultural landscapes in Europe belong to our joint cultural and natural heritage of outstanding universal value. In addition to national governments and other bodies, which might have protected cultural landscapes and their heritage well before, since 1992 UNESCO (United Nations Educational, Scientific and Cultural Organization) acknowledges such landscapes as world heritage, providing an international instrument for their protection and unifying conceptual approaches of nature conservation and the protection of cultural properties. Cultural Landscapes designated as World Heritage Sites enjoy international recognition and protection: however, the implementation of protective measures and instruments and the transposition into national and/or subnational regulations is the responsibility of the respective state and its governmental and administrative bodies. Thus, it can be expected that the institutional design, instruments and practices in countries differ notably. This research investigates the role and handling of mineral resources in UNESCO protected areas within the EU in which extractive activities (e.g., quarries, mining) were either part of the historic land use and landscape patterns or still play a notable role in and for the recent landscape. We examine the four cases of World Heritage protected cultural landscapes in Europe that are characterized by mining (Hallstatt-Dachstein–Salzkammergut (Austria); Nord-Pas de Calais Mining Basin; Montanregion Erzgebirge/Krušnohoří (Germany/Czech Republic) and Krzemionki Prehistoric Striped Flint Mining Region (Poland)) in order to identify the role mining plays today in such cultural landscapes, the legal requirements for their protection, and also the exploration and exploitation in these areas and the differences that exist between the five European countries concerned.

We learned that none of the five analyzed countries have implemented any World Heritage declaration principles into their national mining laws. Germany comes closest, as its mining law almost denies any exploration when public interest–which includes legally recognized nature and monument protection–is concerned. This would support the case of the ICMM asking for stronger support from countries to protect World Heritage Sites from mining. It is also worth pointing out that the definition of public interest in Germany is opposite to the one used in Austria or the Czech Republic; there, a public interest in mining can supersede the protection of nature or cultural heritage (although with compensation measures). All countries protect both cultural and natural World Heritage Sites either directly through the UNESCO convention (Poland) or through national and regional heritage and monument- and environment-protection legislation. From a practice perspective, this means that whilst not explicitly forbidden, it would be next to impossible to explore for and open a new mine within the boundaries of these four sites, except for underground salt mines in Hallstatt-Dachstein/Salzkammergut, and that compromises will be needed to open mines in the proximity. Nature conservation and protection via Natura 2000 designations have also been used in three of the cases to protect the heritage sites, i.e., for the surrounding buffer zones. Once again, differences exist in the national laws if, to what extent, and how any development (including exploration and exploitation) could take place within the Natura 2000 zones.

References

European Commission. EC Guidance on undertaking new non-energy extractive activities in accordance with Natura 2000 requirements; Publications Office of the European Union: Luxembourg, 2011.

ICMM (International Council on Mining and Metals). ICMM Calls for Stronger Legal Protection of World Heritage Sites. [Online] https://www.icmm.com/en-gb/news/2016/icmm-calls-for-protection-of-world-heritage-sites.

Rössler, M., Lin, R.C.-H. 2018. Cultural Landscape in World Heritage Conservation and Cultural Landscape Conservation Challenges in Asia. Built Herit, 2, 3–26, DOI: 10.1186/BF03545707.

Taylor, K., Lennon, J. 2011. Cultural Landscapes: A Bridge between Culture and Nature? Int. J. Herit. Stud. 17, 537–554, DOI: 10.1080/13527258.2011.618246.

United Nations Educational, Scientific and Cultural Organization. 16th Convention Concerning the Protection of the World Cultural and Natural Heritage; UNESCO: Santa Fe, NM, USA, 1992.

United Nations Educational, Scientific and Cultural Organization. Operational Guidelines for the Implementation of the World Heritage Convention; WHC.19/01; United Nations Educational, Scientific and Cultural Organization Intergovernmental Committee for the Protection of the World Cultural and Natural Heritage: Paris, France, 2019.

United Nations Educational, Scientific and Cultural Organization. World Heritage State of Conservation Information System. 2020. UNESCO: Paris, France. [Online] https://whc.unesco.org/en/soc

URBAŃSKI PAWEŁ

Polish Geological Institute – National Research Institute, Poland; e-mail: purb@pgi.gov.pl

Lignite in the context of Poland's energy security

Keywords: lignite, energy security

In the modern history of coal mining and development, a move away from solid fuels due to over-trust in liquid and gaseous fossil fuels has been noted. As it was to later transpire, the world energy crisis of the 1970s and the current geopolitical situation forced world economies to verify their attitudes and return to managing their own hard-coal and lignite resources.

Current and future EU regulations are forcing Poland to reduce the proportion of coal in the energy mix in 2030 and in the more distant perspective, for the significant development of unsteady renewable sources. The stability of the Polish power system will still be based on coal. The presence of lignite in the country's energy mix will reach sixty percent by 2030. In 2040, the proportion of coal is expected to reach thirty percent. The Doctrine of the Polish Energy Policy up until 2040 (PEP 2040) indicates lignite as one of the sources ensuring coverage of the growing demand for electricity. With annual lignite production of 50–55 million tons, reserves of developed deposits are depleting quickly and there is already a serious problem with coal supply to the existing power plants. The currently operating lignite mines in Poland will close between 2020 and 2040. After this period, due to the progressive depletion of lignite deposits, there will be a rapid decline in mining, a reduction in electricity production and the closure of opencast mining. For this reason, conventional power generation should be based on coal while at the same time providing the optimal expansion of renewable sources. When there are outages of solar and wind renewable energy sources, it becomes necessary to use fully available coal sources. The compromise for the current Polish energy mix should be a gradual change, without eliminating any source of energy.

This involves the exploitation of new deposits and the construction of new power plants that will be useful as the reserve for renewable sources. Poland has documented resources with a static sufficiency of over 200 years (with the extraction of 50–55 million tons per year). The future development perspective will be determined by the development of the most economically and geo-environmentally valuable deposits. This should be the key issue in the context of Poland's energy security.

According to PEP 2040, perspective lignite deposits, because of their strategic character, will be secured; however, their exploitation will depend on investors' decisions. A key role in their development will be played by CO_2 emission allowance prices, environmental conditions and the development of new technologies.

Due to the conflict of mining activities, especially large-scale lignite mining by opencast (surface) methods, research on the development of new technologies for the management of lignite resources, previously unused in Poland, are becoming increasingly important. Despite the negative recommendations to date, it seems necessary to identify the resource base in terms of unconventional methods of lignite mining, among which, thermal gasification of lignite in the deposit (underground coal gasification – UCG) is in the foreground. In this case, lignite seams much deeper (>350 m) than those intended for opencast miningand seams with a thickness below that adopted in the balance criteria (<3 m), may be taken into account. The future of underground gasification is still distant as an alternative for traditional exploitation methods. Additional experimental and model investigations are necessary.

Perspective lignite deposits, which have a strategic character, should be strictly protected in the case of the need for the long-term development of the mining industry.

WÅRELL LINDA

Luleå University of Technology, Sweden; e-mail: linda.warell@ltu.se

Analysis of instruments and systems of mineral deposits safeguarding in a European context

Keywords: mineral deposits safeguarding, security of supply of raw materials, access to land, mineral policies in European countries

The growth and competitiveness of European industry requires a sustainable supply of raw materials. However, the dependence on the foreign supply of raw materials have increased in recent decades in Europe, which stresses the vulnerability of European industries in situations of foreign crises. The current situation with Russia and Ukraine, as well as the Covid-19 pandemic, have highlighted this question regarding security of supply regarding a number of important natural resources. At the same time, access to land has become increasingly complex in Europe, this has occurred as a result of, for example, urban sprawl, infrastructure development and nature conservation decreases the available area of land for the exploration and exploitation of mineral deposits. As the supply of mineral raw materials to European industry is identified as important for sustainable supply chains of raw materials, there is an urgent need to safeguard access to deposits of mineral resources in Europe in a systematic way.

Many European countries have as a consequence developed policies directed towards mineral deposit safeguarding (see, for example, studies by Tiess 2010; Gugerell et al. 2020; Gałaś et al. 2021). However, the implementation of these policies are frequently difficult in practice, considering an increase in competing land uses and thus land use conflicts. The aim of this paper is to analyze instruments and systems of mineral deposit safeguarding in selected European countries in order to establish the pros and cons with the systems implemented when applying a so-called SWOT-analysis. A review of previous findings in the Minatura2020 and Minland EU funded projects regarding the systems and instruments of mineral deposits safeguarding of relevant European countries will be conducted in order to identify the pros and cons of the systems implemented.

The review will focus on a number of European countries with established instruments and systems of mineral deposit safeguarding and perform a SWOT-analysis to identify the strengths, weaknesses, opportunities of the systems analyzed as well as the threats posed to them. The results of the paper will be important for other countries that want to design systems of mineral deposit safeguarding, and those that have identified that they need to adjust their current system to handle the increased uses of land and the subsequent conflicts. Even though the jurisdictions differ between individual countries, identifying strengths, weaknesses, opportunities and threats associated with different systems and instruments will be helpful to policy makers at different levels, not least those that in their work need to handle these questions, most often public officials at the local level. This analysis is thus aimed mostly at a practical level, trying to identify ways forward regarding the issue of weighting different land uses at an administrative level.

References

Tiess, G. 2010. Minerals policy in Europe: Some recent developments. Resources Policy 35, 190–198, DOI: 10.1016/j.resourpol.2010.05.005.

Gugerell et al. 2020 – Gugerell, K., Endl, A., Gottenhuber, S.L., Ammerer, G., Berger, G., Tost, M. 2020. Regional implementation of a novel policy approach: The role of minerals safeguarding in land-use planning policy in Austria. The Extractive Industries and Societies 7(1), 87–96, DOI: 10.1016/j.exis.2019.10.016.

Gałaś et al. 2021 – Gałaś, S., Kot-Niewiadomska, A., Gałaś, A., Kondela, J., Wertichová, B. 2021. Instruments of Mineral Deposit Safeguarding in Poland, Slovakia and Czechia – Comparative Analysis. Resources 10(2), 16, DOI: 10.3390/resources10020016.

WDOWIN MAGDALENA, KONECZNA RENATA, CADER JUSTYNA

Mineral and Energy Economy Research Institute PAS, Poland; e-mail: wdowin@meeri.pl

The evaluation of the natural zeolite market in the V4 countries – within the framework of the Visegrad International Fund Project

Keywords: natural zeolites, visegrad countries, International Visegrad Fund, Poland, Hungary, Slovakia, Czech Republic

Zeolite is an industrial mineral with unique properties. The deposits of natural zeolite are irregularly distributed around the world. Its origin depends on the particular geological environment and processes. Natural zeolites have found many applications, e.g. they are added to the production of concrete or they are also used as a soil stabilizer. The controlled release of nutrients such as potassium leads to a greater need for natural zeolites in agricultural and horticultural end uses. The water-holding capacity of natural zeolites also helps fertilizer manufacturers to offer a versatile product to the agricultural sector.

Until now, zeolite market analysis was prepared only in general for the world, focusing on the US, China and India markets. The EU market data is very general, including some rough data omitting smaller deposits. Additionally, the published data refers to the historical years 2014–2017, which requires updating. Some publications only describe the following EU countries: Germany, Great Britain, Italy, France. The V4 countries are considered the "Rest of Europe". In addition, such analyses are rather illustrative and, with a disadvantage, also apply to synthetic zeolites, which are described in more detail than natural zeolites.

The V4 region is of great importance in the production of zeolites. The potential to expand the zeolite market in the V4 countries is still huge. Still, the supply of natural zeolite is higher than the demand. We suppose that the main drivers of the slow market growth are marketing – accordingly, potential new consumers do not trust zeolite products; partially the competition of synthetic zeolite (its purity and quality is higher than that of natural zeolites, but the price is higher – for synthetic zeolite in the range of EUR 300–2000 per ton vs natural zeolite EUR 40–250); and other natural substitutes (e.g. bentonite, perlite).

The aim of the article is to analyze the natural zeolite market in the V4 countries. Slovakia is in the Top 4 of the world's zeolite producers and covers 10–15% of the world's production. Hungary also produces zeolite. Poland and the Czech Republic are large recipients of this product. The article also analyzes the interest in the natural zeolite market in the V4 countries by preparing a detailed case study for zeolite resources in Slovakia and Hungary. The completed case study is a detailed economic analysis including a cost-benefit analysis, SWOT and PEST analysis. Such a study will show the potential development in the V4 countries on the natural zeolite market, in the case of a positive economic analysis, it may increase the expansion of the zeolite market for the V4 countries and increase the number of jobs in this industry.

WDOWIN MAGDALENA, KUNECKI PIOTR

Mineral and Energy Economy Research Institute PAS, Poland; e-mail: wdowin@meeri.pl

Synthesis of zeolites from rich silica sources as a way of mitigating the usage of natural zeolites deposits

Keywords: fly ash, synthesis of zeolite, circular economy, waste management, minerals

Zeolites are aluminosilicate minerals with a specific spatial internal crystalline structure. The structures are basically made of TO4 tetrahedrons called PBUs (Primary Building Units). The T atom position may be occupied by elements as silicon or aluminum and the specific relation between Si and Al gives the zeolite structure a charge: as the aluminum content increases, the structure charge is more negative, what gives them many specific applications as: ion exchangers, molecular sieves, catalysts. Taking natural sources of zeolites into consideration Poland don't have natural zeolites deposits. Only Slovakia and Ukraine have significant sources of clinoptilolite (the most popular zeolite). Going through the sustainable development of source searching for the artificial substitution of natural zeolites is strongly recommended.

One of promising way is the synthesis of zeolites from waste sources rich in silica and aluminum, creating a circular economy solution. Coal Combustion Products obtained in the energy sector are the most promising subtract in the hydrothermal synthesis of zeolite structures. So far three types of fly ash were tested for the synthesis of zeolites:

a) Class F fly ash – obtained during the hard coal combustion process
b) Class C fly ash – obtained during the lignite coal combustion process
c) Rich in silica fly ash obtained during the combustion of biomass (coconut shell and sunflowers).

Zeolites were also obtained from natural resources occurring in the environment in a larger amount than zeolite such as kaolin.

For all types of ashes and kaolin a hydrothermal synthesis was carried out using different condition of reaction (time, NaOH concentration as well as temperature). The obtained materials were characterized using chemical-mineralogical methods such as X-ray fluoresce, X-ray diffraction and scanning electron microscopy in order to establish the extent of zeolite crystallization.

Results have shown that depending on the conditions of transformation in each cases zeolites type A and X were obtained. However in the case of Class F fly ash synthesis reaction was most effective.

The worst result was obtained in the case of fly ash from biomass. The obtained zeolite created well-formed cubic crystals. The best crystal form and the most effective reaction were observed in the case of kaolin.

Chemical analyses have shown that the obtained product consists mainly of silica (form 35–55 wt. %) and aluminum (from 18–25 wt. %) as well as a small amount of potassium, calcium and magnesium and sodium.

To summarize it can be state that depending on the sort of substrates (sources of silica) a different synthesis condition should be established in order to achieve the best formed zeolite crystals as well as the highest extent of reaction (lower content of residuum).

The obtained materials can be used as a sorbent of many environmental solutions as: removal of heavy metals and ammonia pollution from wastewaters, purification of gases, removal of BTEX and many others.

WERTICHOVÁ BLAŽENA[1], WERTICH VOJTĚCH[2], RAMBOUSEK PETR[2], GODÁNY JOSEF[2]

[1] VŠB – Technical University of Ostrava, Czech Republic; e-mail: blazena.hamadova@vsb.cz
[2] Czech Geological Survey, Czech Republic

Assessment of the Czech concept of mineral safeguarding in European good practice context

Keywords: mineral deposits safeguarding, Czech Republic, good practice, land use planning

The overall aim of mineral safeguarding is to prevent the unnecessary sterilization of mineral deposits (Wrighton et al. 2014). This means avoiding a situation in which minerals cannot be exploited because of other types of economic activity or land development on that site. This objective could be achieved using different instruments. Practices in Europe differs by:

- the form of protection (territorial protection or zoning),
- the scope by type of minerals or stages of mineral development,
- approaches to the identification of mineral deposits to be safeguarded including the potential application of the assessment methods,
- the type of implementation (law, policy, mixed), and other characteristics.

European good practices in mineral safeguarding have been studied in Horizon 2020 projects, such as MINATURA 2020 and MinLand. In the MinLand project several good practice aspects in relation to sustainable land use planning have been identified and analyzed e.g., data assessment and use in policy and land use planning, the identification of actual and potential land uses, integration between minerals and land use policies, etc. (Endl et al. 2019).

The Czech Republic implemented a concept of mineral safeguarding of those minerals which are state-owned, so-called "reserved minerals" in the law. Reserved minerals are explicitly listed in the Mining Act (Law No. 88/1988 Coll as amended) and include uranium, fossil fuels, metallic ores and several industrial minerals. Minerals that are not listed are non-reserved and their ownership is connected to the land. In 1988, the Czechoslovak Government introduced the legal concept of "Protected Deposit Areas (PDAs)" into the Mining Act which represents a form of territorial protection of reserved minerals. In PDAs, objects not related to mining operations cannot be placed, only if an exception is applied. The PDAs are delimitated by the Ministry of Environment and assume the identification of mineral deposits by mineral exploration. The reporting of exploration results is obligatory and regulated and includes mineral reserves estimation according to the national classification standard. This information is submitted to Geofond, the part of the Czech Geological Survey (CGS) which operates the SurIS geological database. The database is connected to spatial data in the GIS format and some basic information on mineral deposits is publicly accessible through the online web application. It covers exploration areas, PDAs, mining areas and perspective areas as well as non-reserved mineral deposits.

The land use planning system in the Czech Republic is three level and top-down. The CGS provides information to land use planners for reserved mineral deposits. According to the Mining Act, the presence of reserved mineral deposits must be respected by land use planning. Another requirement for consideration regarding discovered mineral deposits and perspective areas is mentioned in Geological Act (Law No. 62/1988 Coll. as amended). In practice, the forms of interpretation of the law are quite diverse.

A new national raw materials policy was issued in 2017 (Ministry of Industry and Trade 2017) and by the last amendment of the Mining Act in 2021 it was established as one of the strategic documents of the state with an explicit interconnection to the spatial planning policy and other documents. Attention is also focused on mineral safeguarding. Regional policies should soon be updated accordingly. To this end a project of the Technological Agency of the Czech Republic led by the CGS ran between 2020–2021 to prepare the methodology and standardization for the development of regional raw material concepts. In this project, a review of European good practices was provided and several recommendations for their potential implementation in the Czech legal context have been included.

In the eyes of the knowledge of good practices from other European countries an assessment of the Czech concept of mineral safeguarding will be presented.

References

Endl, A., et al. 2019. WP6 Working Group. Final Manual for Good Practice on Mineral Resources in Sustainable Land-use Planning. Horizon 2020 Project Deliverable. MinLand (776679).

Godány, J., et al. 2021. Methodology and standardization for periodical actualization of Regional Minerals Policy and application of the results to two model regions (in Czech). Non-published. TA CR. Praha

Law No. 44/1988 Coll. on protection and use of mineral wealth (the Mining Act), as amended.

Law No. 62/1988 Coll. on geological works and state geological administration (the Geological Act) as amended.

Ministry of Industry and Trade (2017). The Raw Materials policy of the Czech Republic for mineral raw materials and their resources. Available at: https://www.mpo.cz/en/construction-and-raw-materials/raw-material-policy/raw-material-policy-minerals-in-the-cr/new-raw-material-policy-for-minerals-and-their-resources---mpo-2017--233052/.

Wrighton et al. 2014 – Wrighton, C.E., Bee, E.J., Mankelow, J.M. 2014. The development and implementation of mineral safeguarding policies at national and local levels in the United Kingdom. Resources Policy 41, 160–170. DOI: 10.1016/j.resourpol.2014.05.006.

WOJTACHA PIOTR, MGŁOSIEK JAROSŁAW

State Mining Authority, Poland; e-mail: p.wojtacha@wug.gov.pl

Management of mineral deposits in the process of their extraction as part of the protection of developed deposits

Keywords: mineral-deposit management, mining facility, geological service, mining supervision

The article presents the role of mining supervision authorities in the management of mineral deposits in the extraction process as one of the elements of their protection – a requirement which is enforced under the Geological and Mining Law and secondary legislation. The mining supervision authorities of Poland are: the President of the State Mining Authority (WUG), the directors of district mining offices (OUG) and the director of the Specialized Mining Authority (SUG). The location of mining supervision bodies within the structure of mining projects is presented in the form of a block chart covering the various stages of their activities. Apart from geological administration bodies, mining supervision authorities are in fact the only state administration bodies whose competencies directly include issues related to the protection of mineral deposits. The main tasks of mining authorities include the supervision and control of: the management of mineral deposits in the process of extraction, the decommissioning of mining facilities, environmental protection and deposit management, including according to the criterion for the fulfillment of the obligations specified in or on the basis of separate regulations by the company.

Control over the management of mineral deposits in the process of their extraction pertains to managed deposits (i.e. those in which mining and geological activities are currently carried out) which consists of the execution of geological operations related to the exploration and identification of mineral deposits, the extraction of minerals and the decommissioning of mining facilities. The implementation of supervision and control concerns, which include issues related to: designing and planning mining activities covered by mining plant operations plans, including plans for the operation of decommissioned mining facilities and projects (supplements) for deposit development, activities of geological and surveying services in the mining facility, the preparation, supplementation and updating of surveying and geological documentation and the preparation of records of mineral resources. This article describes the main tasks of geological services, particularly types of mining facilities concerning geological operations performed as part of the operation of these facilities. Moreover, the manner of exercising supervision and control over keeping records of mineral resources was described as an element of updating the national balance of mineral resources in Poland. The tasks of mining supervision authorities are also in line with other directions of protection of mineral deposits in Poland, including those carried out by other administrative bodies. For instance, the Act on Spatial Planning and

Development states the requirements for assessing and approving, with regard to mining areas and any draft documents. These requirements are a study of the conditions and directions of spatial development of municipalities and zoning plans (mpzp), and in the case of mining areas not covered by final zoning plans, approving all land development conditions for investments carried out within their limits. Therefore, mining authorities have a certain impact on the content of planning documents at municipal level, which enables the harmonization of land development and rational deposit management. Similarly, for investments in mining areas covered by effective zoning plans, the mining regulators issue information on geological and mining conditions, thus enabling them to be designed in such a way that their existence does not conflict with the needs of the future exploitation of deposits and thus the rational use of mineral resources. The harmonization of the protection of mineral deposits and mining sites is also one of the responsibilities of the Commission for Surface Protection with the State Mining Authority, which assesses planned investments in mining plants in terms of their feasibility, particularly in terms of mining and construction prevention which is necessary to ensure the safe and correct execution of construction works within the boundaries of protective pillars and protected areas. Cooperation with local authorities also serves this purpose. The work of so-called communication teams is its dominant form. Their task includes the creation of a platform for the implementation of the conditions of sustainable development of mining municipalities and enables the exercise of the entrepreneur's rights under the concession, including the maximum use of mineral resources. However, the assessment of the possibility of re-exploitation of deposits which were decommissioned earlier and the impact of excavations of decommissioned mining plants on general safety and the possibility of development of post-mining areas are the responsibilities of the Surveying-Geological Documentation Archives with the State Mining Authority. Furthermore, it should be stressed that one of the statutory tasks of the President of the State Mining Authority is also to initiate scientific and research works and take measures in the field of the rational management of mineral deposits. This is the reason for the importance of regular cooperation between the State Mining Authority and research and scientific centers.

WORSA-KOZAK MAGDALENA

Wrocław University of Science and Technology, Poland; e-mail: magdalena.worsa-kozak@pwr.edu.pl

Geothermal brines as a carbon neutral source of CRM – BrineRIS Project Study

Keywords: lithium, brines, groundwater, zero emission, critical raw materials, sustainable production

Limited access to critical raw materials (CRM) is the main obstacle to developing the high-tech and battery sectors. However, thanks to the striking development of efficient soluble element recovery technologies, highly mineralized water (brine) is a potential unconventional source of metals. Usually occurring at great depths, under conditions of high pressure and hot temperatures, brines mineralized up to 300–350 g/L may contain economic concentrations of metallic elements, such as CRM from the EU 2021 list (Li, Mg, Sr), Na, Ba and others. Therefore, exploring non-obvious metals resources (such as geothermal brines) and innovative metal recovery technologies is necessary to ensure a sustainable and secure European supply of battery metals. It also supports the European Raw Materials Alliance (ERMA) vision to "secure access to critical and strategic raw materials, advanced materials, and processing know-how for EU industrial ecosystems".

The technology needed to recover metallic elements from brines is under development in several KAVA projects, e.g., EuGeLi or Morecovery. However, the location of brines with reliable and stable sources of metals is still an open question. Our BrineRIS project will locate brines in Europe suitable for economically feasible metal recovery and test the emerging recovery technologies in the lab. Focusing on RIS countries of the Iberian Peninsula and Visegrad Group, whose thermal brines resources are proven, the BrineRIS project will deliver verified information on brines enriched in Li and other valuable elements. Special attention will be paid to existing mine water inflows and operating geothermal wells.

BrineRIS intends to achieve three key objectives:

1. To increase awareness of geothermal brines metallogenic potential in RIS countries by mapping brine resources and estimating the abundance of CRM and other valuable elements with specific attention to lithium. This activity will cover six RIS countries – Poland, Hungary, Czech Republic, Slovakia, Spain and Portugal.
2. To build the capacity of RIS countries in low-carbon metals mining technologies related to geothermal brines by sharing experience in developing innovative recovery solutions and knowledge exchange with key players in geothermal recovery from non-RIS countries. Through the education and training of students and specialists from RIS countries, BrineRIS will increase the competitiveness and innovativeness of the RIS workforce. These activities will be directed to partners' countries and also stakeholders from other RIS regions (Baltic, Balkans, Ukraine) offering them free participation to widen the project's impact.

3. To attract investors to RIS countries by developing an interactive platform of potential geothermal brine projects and preparing at least one investment case for the ERMA. This way, we increase the Project's geographical coverage to worldwide stakeholders. This aim will be supported by close cooperation with the Business Advisory Board (BAB).

Nine partners from six countries representing five CLCs and the three sides of the Knowledge Triangle are involved in our consortium. A diverse consortium composed of RIS and non-RIS partners is focused on knowledge transfer from non-RIS partners to RIS countries and on building the geothermal lithium resource capacity in the ESEE region (Visegrad Group) and the Iberian Peninsula.

BrineRIS is led by Wrocław University of Science and Technology (WUST) (Poland) and partnered by The Spanish National Research Council (CSIC) (Spain), University of Miskolc (UM) (Hungary), Ghent University (UGent) (Belgium), Technical University Bergakademie Freiberg (TUBAF) (Germany), The European Lithium Institute (eLi) (Belgium/Germany), Geological Survey of Finland (GTK) (Finland), Redstone Exploration Services sp. z o.o. (RED) (Poland) and KGHM Polska Miedz SA (KGHM) (Poland).

Honorary patronage

Jacek Sasin
Minister of State Assets

MINISTRY OF STATE ASSETS

Piotr Dziadzio - Undersecretary of State, Chief National Geologist, Government Plenipotentiary for the State's Raw Materials Policy

Ministry of Climate and Environment

Witold Kozłowski - The Marshal of the Małopolska Region

MAŁOPOLSKA

Polish Geological Society

Media patronage

Wydawnictwo Gospodarcze

netTG.pl GOSPODARKA · LUDZIE

Trybuna Górnicza

WĘGIEL BRUNATNY

energia press

kruszywa PRODUKCJA ◆ TRANSPORT ◆ ZASTOSOWANIE

surowce i maszyny budowlane

INŻYNIERIA MINERALNA CZASOPISMO POLSKIEGO TOWARZYSTWA PRZERÓBKI KOPALIN

ISBN 978-83-964171-5-2