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# The new mineral exploration strategies of selected major mineral-rich countries

## Introduction

The global mining industry experienced a mineral commodity boom in the first decade of the 21st century (Maennling and Toledano 2019). The demand from the rapid urbanization and industrialization of emerging economies dramatically transformed global commodity markets, driving global mineral commodity prices to exceed those in the 1970s (Connolly and Orsmond 2011). According to SNL data, global mineral exploration budgets increased by more than 1000 percent, from USD 1.8b in 2002 to USD 20.5b in 2012 (SNL 2020). Then, the world mining industry entered into three years of adjustment and optimization. Significant cuts in exploration budgets between 2013 and 2016 resulted in an approximately 50 percent decline in total funds, with total global exploration budgets falling below USD 10 billion. During this period, it was not just the large mining companies that adjusted their corporate strategies to focus on reducing their debt ratios and improving their balance sheets (Maennling and Toledano 2019). The mining administrations of the major mining countries also began to make profound adjustments to develop new mineral resource strategies.

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Government support for mining strategies benefits the development of the domestic mining industry and the overall economy (Richard 2018a). The major share of global mineral exploration was conducted by Australia, Canada, Europe and the U.S., each with relatively high exploration budgets (Karl and Wilburn 2017). In 2019 (SNL 2020), the top 10 countries in global exploration investments were Australia, Canada, the United States, Chile, Peru, Mexico, Russia, China, Brazil, and Argentina, accounting for 16.5, 14.1, 10.2, 7.0, 5.9, 4.9, 4.4, 4.2, 2.8, and 2.6% of the global share, respectively. Some of these countries that have a major exploration share have launched new mineral resource strategies.

This paper first describes basic information on the mineral resource strategy reports issued by the world's major mineral resource exploration countries, including publication date, the publishing institution, the publication date of the strategy study, and basic information on the objectives and measures of each strategy. In the second section, some problems found through the strategic reports to be facing current mineral exploration and development are summarized. In the third section, the main aims and visions in the strategic reports are clarified. In the fourth part, the main measures for solving the problems and achieving the goals are discussed.

## 1. Materials

### 1.1. Australia

This paper reviews 5 Australian mineral resource strategy reports. The goal of the Australian mineral resource strategies is to maintain the most advanced and successful mineral resources sector in the world, which creates sustained social and economic development for the future and involves mineral exploration (GWG 2017), mining equipment, technology and services (CSIRO 2017), critical minerals (AG 2019a) and future development opportunities for 2030 (Resources 2030 Taskforce 2018; AG 2019b). Australia has large resource potential in the 2/3 of the continent that remains unexplored (GWG 2017). The strategy's vision is to uncover Australia's hidden mineral resources to attract increased investment, create more jobs, improve environmental stewardship, promote community engagement, and better position Australia is a global leader in the mining industry. The Resources 2030 Taskforce provides six recommendations, including positioning the mining industry for the future, attracting investments, finding new resources, building healthy communities, and improving environmental performance and the workforce (AG 2019a).

### 1.2. Canada

Canada's mineral resource strategy at the federal level has been the Whitehorse Mining Initiative, released in 1994. In 2017, Canada's federal and provincial/territorial ministers of its mining sectors called for the development of the Canadian Minerals and Metals Plan. In 2018, an intergovernmental mining working group comprised of Canada's federal and provincial ministers initiated discussions on the preparation of the plan (NRC 2018), and in 2019, the Canadian Minerals and Metals Plan was formally developed and released (NRC 2019), with the vision of making a greater contribution to Canada's prosperity. The strategy aims to promote the global transformation of mining internationally, enhancing Canadian values such as sustainability and corporate social responsibility. To achieve the vision for this strategy, it sets out six targets, including developing the economy, advancing the participation of indigenous peoples, building an excellent environment, and developing science, technology and innovation, communities, and global leadership.

### 1.3. United States

The contents of the U.S. mineral resource strategies are all closely related to critical minerals. On December 20, 2017, the U.S. government issued Executive Order 13817 (EOP 2017) on A Federal Strategy for Ensuring the Security and Reliable Supply of Critical Minerals, a mineral resources strategy (DOC 2019) with more clear directions on the latest federal strategy regarding mineral resources in the U.S. On June 4, 2019, the U.S. Department of Commerce released the federal strategy report, including 6 calls to action, 24 goals, and 61 recommendations for a specific implementation of Executive Order 13817.

### 1.4. Other countries

Since 2017, the EU's Horizon 2020 program has been releasing two research reports: Research & Innovation Roadmap 2050 (VERAM 2018) and Innovative, Non-invasive and Fully Acceptable Exploration Technologies (INFACT). These reports aim to contribute to the EU's mineral raw material security by revitalizing Europe's mineral exploration activities. In 2019, the Russian government released its Strategy for the Development of the Mineral Resource Base of the Russian Federation until 2035 (MNRE 2019), such as priorities, goals and tasks for geological work carried out for the economic and social development of Russia between 2019 and 2024, including the need to supply mineral resources sustainably. The goal is to increase the exploration reserve. In 2019, India launched the National Mineral Policy of India, which has been integrated into India's overall economic development strategy to promote the domestic mining industry, reduce import dependence, and promote the Make In India initiative.

Table 1. The new mineral resource strategies of major exploration countries for the years 2016–2019

Tabela 1. Nowe strategie poszukiwania surowców mineralnych w wybranych krajach w latach 2016–2019

| | Name of reports/papers/projects | Publication Year | Issuing Agency | Countries Studied |
|---|---|---|---|---|
| 1 | Australia Minerals 2017–2022 National Mineral Exploration Strategy | 2017 | Geoscience Working Group | Australia |
| 2 | Mining equipment, technology and services: a roadmap for unlocking future growth opportunities for Australia | 2017 | CSIRO | Australia |
| 3 | Australia's Critical Minerals Strategy | 2019 | Australian Government | Australia |
| 4 | National Resources Statement | 2019 | Australian Government | Australia |
| 5 | Australian resources-providing prosperity for future generations | 2018 | Resources 2030 Taskforce | Australia |
| 6 | Mining Ideas for the Canadian Minerals and Metals Plan: A Discussion Paper | 2018 | Natural Resources Canada | Canada |
| 7 | The Canadian Minerals and Metals Plan | 2019 | Natural Resources Canada | Canada |
| 8 | A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals | 2017 | The United States Executive Order 13817 | The United States |
| 9 | A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals | 2019 | The U.S. Department of Commerce | The United States |
| 10 | Research & Innovation Roadmap 2050 – A Sustainable and Competitive Future for European Raw Materials | 2018 | VERAM | EU |
| 11 | The future of mineral exploration in the EU-Innovative, Non-invasive and Fully Acceptable Exploration Technologies | 2017 | INFACT project | EU |
| 12 | On the approval of the action plan for the implementation of the strategy of development of the mineral resource base of the Russian Federation until 2035 | 2019 | The Ministry of Natural Resources and the Environment of Russia | Russia |
| 13 | National Mineral Policy of India | 2019 | Government of India | India |

## 2. Issues in the development of the mining industry

According to data from S&P Global, total global exploration investments were USD 177.2 billion from 1999 to 2019. Annual exploration budget investments soared from USD 1.8 billion in 2002 to USD 20.5 billion U 2012 and then declined until it rebounded in 2016. Global exploration investments in 2019 were USD 9.3 billion (Figure 1). Large-scale mineral development was built based on several world-class deposits discovered deca-

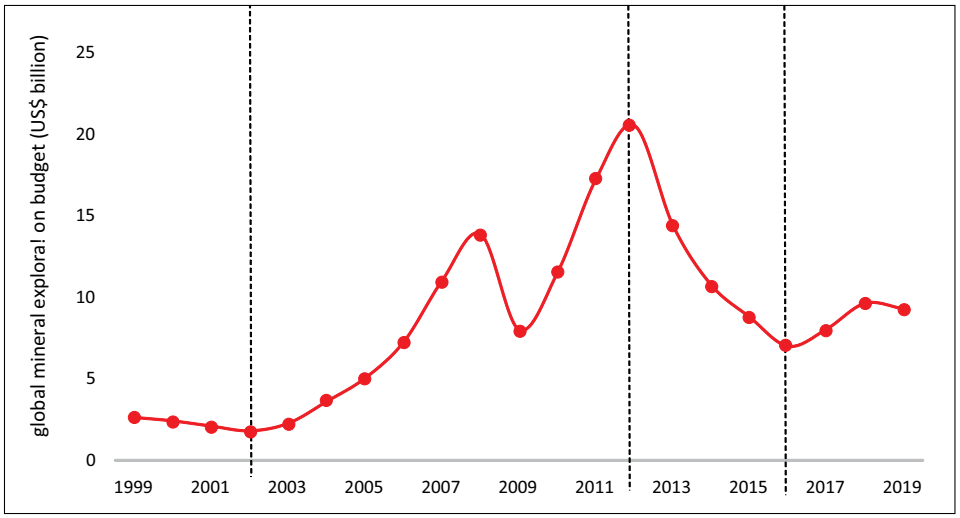


Fig. 1. Trend in total global mineral exploration investments from 1999–2019
Source: SNL 2020

Rys. 1. Trend globalnych wartości inwestycji poniesionych na poszukiwanie złóż surowców mineralnych w latach 1999–2019

des ago and is nearing the end of its life cycle. Regarding the global mineral exploration input-output situation, from 2005 to 2014, mineral exploration expenditure was approximately USD 140 billion, but the discovered mineral resources were worth only USD 93 billion. In particular, the decline in "grassroots exploration" is a cause for concern (Manalo 2018). The Australian study cites the lack of discovery of tier-1 quality deposits, increased exploration costs, and declining quality tonnage. Twelve world-class deposits were discovered globally between 2007 and 2016, but none were located in Australia (Richard 2018b). Discoveries in Australia are small and junior exploration companies with generally inadequate resources working in known mature mineralized zones (Richard 2016).

### 2.1. Increased access to land and permitting

Land access is a precondition for the smooth development of mineral exploration and development activities. Regarding land access, the most intense restrictions and conflicts are the most prominent, mainly involving three features of the problem. Permitting and land management regulations have inhibited access to and the development of domestic critical minerals (DOC 2019).

Firstly, mineral exploration and other land-use patterns involve competition and conflict. Land may be set aside as a reserved or protected area or may be used for afforestation, farming, or tourism. The current contradiction is prominent because there is less and less land

available for development. If mineral exploration is not an allowable use of land, then all mining activity will dry up. National studies have mentioned the concern that governments may decide to withdraw mining exploration activities from protected areas and the challenges that this would create.

Secondly, potential prospecting right holders and landholders have coordination problems. Given that exploration activities are a competitive use of land, potential prospectors and landowners must reach an agreement on the manner of and conditions for access, as well as compensation.

Thirdly, the access conditions and regulations for mineral exploration are complicated. In the specific areas where the exploration work is to be carried out, the relevant aspects of the obligations that must be complied with include a range of issues related to the economic development of the community, the promotion of local employment, the procurement of local goods, the improvement of infrastructure development, and the requirements for ecological and environmental protection.

### 2.2. Disincentives to obtain precompetitive geoscience information

Public interest geological survey information is a fundamental element in reducing the risk related to mineral exploration. “Precompetitive geoscience information”, which is geological survey information gathered before prospecting rights are granted, plays a significant role in geological prospecting. The reliability, discipline specificity, and timely delivery of precompetitive geoscience information mainly involves four issues. Firstly, former competitive geoscience information has not been updated regularly. For example, the medium-scale geological mappings of some U.S. states through public interest geological surveys have not been updated for up to 20 years, and there is high risk when relying on these outdated geoscience information materials. Secondly, the geological survey work for evaluating mineral resource potential has decreased. For example, 80% of mainland Australia is unexplored or underexplored. Thirdly, geological survey work provides limited targeted information. For example, in Europe, almost no relevant work was carried out in the last decade of the 20th century, and only after the launch of the Raw Materials Initiative in 2008 was targeted precompetitive geoscience information gradually provided.

### 2.3. The need for urgent improvements in exploration technology

Exploration technology is a critical element in improving the success rate of mineral exploration. Improving current global mineral exploration technology mainly involves three issues.

First, the difficulty of discovering minerals has increased. Global mineral exploration has moved to deeper, more remote, and more complex areas. The existing technology has

not yet adapted to this requirement. Eighty percent of Australia has the potential to be explored and developed, but these areas have massive cover (UNCOVER 2020). Hence, the Australian studies suggest that exploring under this cover is the most significant technical challenge, and uncovering the potential of these areas is the biggest development opportunity for Australia.

Second, there has been a change in the target mineral species. Industrialization is driving increased demand for critical minerals for telecommunications, military, medical technologies, and traditional renewable energy technologies. The supply of strategic and critical minerals is critical to economic growth, national security, technological innovation, manufacturing, and agricultural supply chains. For example, Canada and the U.S. have focused on prioritizing critical minerals where resources are scarce and competitive (NRC 2019; DOI 2018). Traditional exploration techniques do not apply to the exploration of these minerals, requiring significant innovation in new theories and search methods.

Third, the ecological environment requirements have improved. The "ecological footprint" of mineral resource exploration and development activities should be reduced as much as possible (INFACT 2020). This change has affected geological prospecting activities in environmentally sensitive areas and relatively densely populated areas to a certain extent.

## 3. The visions and aims of the new strategies

The assumption underlying the development of new national mineral resource strategies is to generate the next new mining cycle, marked by establishing a new mining image. Strategic measures include advancing new mineral exploration actions to increase resource reserves, and mineral objectives not only include precious metals and bulk base metals but also focus on the critical minerals needed for high technology. Mining science and technology innovation have become more focused on environmentally friendly, nonpolluting, and noninvasive technologies.

### 3.1. Benefiting the current and the next generation across nations

The mining industry plays a vital role and makes significant contributions to economic and social development in the countries studied, with considerable mineral exploration investments. These countries are rich in mineral resources and are global leaders in exploration and development technology, management, and mining finance. In 2017, according to data released by Natural Resources Canada, the mining industry accounted for 19% of Canada's total exports and 5% of its nominal gross domestic product (NRC 2018).

In Australia, the mining industry plays a vital role in economic prosperity, accounting for 28% of Australia's GDP growth in 2019, 8.7% of GDP in 2019, and over 250,000 people employed (DISER 2020). Australia (AAS 2018; AG 2019b) emphasizes the role of mining as

a support to the economy and proposes the provision of long-term support to communities and people. Therefore, the Australian government has developed a strategy to promote continued community investment in mineral exploration, to stimulate major new discoveries, to generate new mineral resource exploration opportunities, and to guide the application of exploration knowledge and useful technologies in frontier regions.

The United States has emphasized that the mining industry is critical to the economic well-being, national security, and continued technological advancement of the United States. The mining industry provides essential metals and minerals for the nation's industries, including agriculture, telecommunications, construction, health care, manufacturing, transportation, and renewable energy, and provides the raw materials needed to rebuild America's infrastructure. In 2019, the estimated total value of nonfuel mineral production in the United States was USD 86.3 billion (USGS 2020). Canada's Minerals and Metals Plan mentions positive impacts in terms of job creation and leveraged value.

From a demand perspective, through population growth and urbanization, Asia and Africa are expected to account for nearly 90% of the 2.5 billion people added to the world's urban population by 2050 (UN 2014). Most of the new mineral resource strategies are oriented towards 2030 or 2050. Such strategies include, for example, the Australian Department of Resources and the North's Resources 2030 Working Group Report entitled "Ensuring Prosperity for Future Generations", South Africa's "Towards a Mining Vision 2030" (Netshitenzhe 2019), "Indian Mining 2030 and its Long-Term Vision" (Sharma 2017), and the EU's Vision and Roadmap for European Raw Materials 2050. The new mining cycle will not end until 2030, and mineral resources will continue to play a prominent and dominant role in economic and social development until 2050.

### 3.2. Green development in the mining industry

Green development is a new development model that takes environmental protection as an essential pillar in achieving sustainable development under the constraints of ecological and environmental capacity and resource carrying capacity. We should consider environmental resources to be an inherent element in social and economic development, set the sustainable development of the economy, society and the environment as the goal of green development. Some exploration and development technologies are green. For example, Vale's biodiversity project established the regreening and recycling of mines and the restoration of badly damaged lands and rivers in the mining area to increase biodiversity in the project area (Vale 2020). The utilization of a green development transition generally reduces the "footprint" of their mineral resource exploration and development activities. VERAM (2018) mentioned that securing the European raw material industry would foster synergies between and across different value chains, from primary suppliers to those that close material loops, by maximizing the recycling of products, buildings and infrastructure.

### 3.3. Becoming a high science and technology industry

Innovation is the driving force behind the development of the mining industry, and talent is the basis for that development. At present, big data, Artificial intelligence (AI), the mobile Internet, cloud computing, and the Internet of Things have been fully utilized in mineral resource exploration and development. In 2017, the Australian strategic report summarized the science and technology measures that would enable five growth opportunities (CSIRO 2017). Canada's Minerals and Metals Plan focuses on science, technology, and innovation, which would transform the mining industry into a modern and innovative industry supported by world-leading science and technology across all phases of the mineral development cycle.

### 3.4. Increasing global competitiveness

Countries such as Australia and Canada, as established mineral exploration, development, and export powers, are already leaders in the global bulk mineral resources market. In the face of new global demand, new mineral resource strategies involve sustainably increasing global competitiveness.

As mentioned in section 2, global mineral exploration investment has decreased, and the local share of the global budget has been low over the past two decades. The most frequent national mineral resource strategy is competitiveness in which market operations are significantly affected by global economic forces and price fluctuations. Therefore, the competitiveness of the mining industry is crucial. This can be accomplished through adopting a recognized technology certification system, maintaining sufficient high-grade mineral reserves, supporting dynamic mineral exploration companies and large mining companies, and establishing a way to finance mineral exploration and development to attract global corporate investment (VERAM 2018). The first strategic direction in Canada's Minerals and Metals Plan (NRC 2019) is competitiveness, with the goal that the business and innovation environment in Canada's mining sector be the most competitive and most attractive for investment in the world.

At same time, there is a critical need for new green and high-technology industries, and therefore there has been an increase in the demand for mineral resources, especially for the following elements: Cu, Cr, Ni, Zn, which are used in manufacturing wind turbines; Pb, Cd, Ga, In, Ag, and Te, which are used in manufacturing solar photovoltaic goods (Hodgkinson and Smith 2018); Li, Co, and REEs, which are used in electric vehicles (Nicholas LePan 2018); and Ta, Be, and Nb, which are used in the aerospace industry (Silveira and Resende 2017). For example, the legacy of the historical silver mining boom from 1903 to the late 1920s in Cobalt, Ontario, Canada (Cobalt Historical Society), has led to Cobalt becoming a hot spot for exploration again because of cobalt's use in the development of lithium batteries (Marina 2020). To discover cobalt, a large number of mining companies injected capital into the areas near the old mines, resolving the historical legacy of environmental problems.

## 4. Research on new measures and actions

Given these common problems, there are also apparent commonalities in the strategic measures and strategic responses of the world's major countries in terms of mineral resources.

### 4.1. Strengthening domestic mineral exploration

First, land access and land use for mineral exploration have been increased. The protection of mineral rights has also been increased, the approval process to obtain mineral rights has been simplified, and easy access to mineral rights has been ensured. For example, some mineral resource firms in the United States can enter protected areas for exploration, as call-to-action five (DOC 2019) is to improve access to domestic critical mineral resources on federal lands, including revising the land-use planning process and reviewing existing withdrawals to reduce unnecessary impacts on exploration, development and other mining activities. Canada's Minerals and Metals Plan (NRC 2019) explores ways to provide increased clarity around land use and land access where it does not exist.

Second, funding for public interest precompetitive geoscience surveys and exploration has been increased. The earth science community is expected to develop a deeper understanding of various interaction processes and develop a comprehensive 4-dimensional model of the Earth (AAS 2018). For example, in Australia, to form new and better precompetitive, integrated geoscience data, Australia has set the UNCOVER initiative as its main strategy, supplemented by Exploring for the Future initiative, with an investment of AUD 100.5 million in 2016 and an additional AUD 125 million in 2020, and has invested in the next generation of drilling technology with an investment of AUD 218 million in the MinEx Cooperative Research Centre (AG 2019a). Such programs and initiatives help identify areas with resource potential, reduce the risk in exploration investments, and improve exploration programs' efficiency, particularly by incorporating critical minerals into relevant exploration programs to identify areas with potential for extracting critical minerals. The U.S. strategy (DOC 2019) calls for improving and publicizing the topographical, geological, geophysical, and bathymetric mapping of critical minerals to support private sector explorations for critical minerals. Public geoscience information services have been defined more broadly to include not only geological, geophysical, and geochemical data, maps, and knowledge, among other types, but also a range of public and private interests beyond mineral exploration.

Third, innovations in management policies and regulation have been developed. Some countries have started to amend their mining laws, such as India (GI 2019) and South Africa (Netshitenzhe 2019). Some countries have set up domestic mineral explorations, special projects, or initiatives. The governments of the primary exploration countries should recognize and mineral exploration and development, create regulations that encourage such activities, and reduce federal permitting timeframes. For example, an online application

system to track timelines for mining projects should be established. Furthermore, NEPA processes and other regulations regarding the environment in the U.S. should be updated (BLM 2017).

### 4.2. Increasing coordination between mineral exploration and ecological environmental protection

First, the "environmental footprint" of mineral exploration and development has been minimized. For example, the EU has improved geochemical and geophysical exploration methods, has researched and improved its blasting processes, has optimized the use of explosives, and has minimized environmental impacts (INFACT 2020). The automation of quarries and mines has been improved, rock transportation and energy consumption for transportation have been reduced, fossil-free mine production has been promoted, and waste emissions from mining and quarrying activities have been reduced.

Second, continually improve the exploration and development activities of mineral resources in protected areas. For example, Tasmania in Australia has established an interdepartmental committee, the Mineral Exploration Working Group, which evaluates the impacts of mining exploration activities in protected areas and areas of cultural value to provide feedback and recommendations to the Tasmanian Mineral Resources Authority (Bacon and Pemberton 2012). This committee clears ecologically sensitive areas for exploration before mineral exploration activities can be undertaken, ensuring that state and federally listed endangered flora and fauna species, geological reserves, aboriginal areas, European cultural sites, and private conservation areas will not be permanently affected.

Third, post-closure mines are being planned for. For example, The Innovation Roadmap 2050 in the EU (VERAM 2018) has developed a process for long-term, continuous land-use planning for mining operations' full life cycles. Value-added mine rehabilitation has resulted in an increase in biodiversity and improved heritage sites and has generated other industrial possibilities by preparing a comprehensive intra-EU database of primary resources for minerals and assessing the economic value of the resources identified.

### 4.3. Strengthening the life cycle management of the industrial chain

The whole mining industrial chain includes exploration and development, processing and refining, manufacturing and use, recycling, and substitution. Mineral resources are raw materials used in the industry, directly sourced from the natural environment, and fed into the supply chain for the first time. As part of the circular economy, secondary raw materials are becoming an increasingly important component in material consumption. Secondary raw materials are processed for reuse, such as mining waste, industrial and household waste, and end-of-life products. They also include processing residues from nonenergy raw

materials, such as tailings, slags, and dust, as well as equipment, technology, and services. Mineral resources are used in the industrial chain from source to intensive conservation to reuse, strengthening the industrial chain and enhancing the value chain. If viewed from the perspective of the entire value chain, with value added increasing from mining to manufacturing, mining should increase opportunities (Barakos 2016). The European Commission's Towards a Circular Economy 2015, the 2017 Report on EU Action on the Circular Economy, and the 2018 Report on Critical Raw Materials and the Circular Economy are all circular economy studies. The EU's Research & Innovation Roadmap 2050 (VERAM 2018) suggests that the raw materials sector is a critical component in Europe's circular economy and the primary driver of Europe's symbiotic industrial environment.

The first step in strengthening life cycle management. The Innovation Roadmap 2050: A Sustainable and Competitive Future for European Raw Materials increase the value chain from geoscience research and geological surveys to exploration, mining, and processing recycled and manufactured goods to improve the security of resource supplies.

The second step is data collection, analysis, and integration, including life cycle assessments (LCAs), environmental footprints, and material flow analyses. For example, the EU has built comprehensive mineral and metal resource databases to assess the economic value of identified resources. Another step is improving the information systems that collect and predict ore and rock bodies, developing methods to monitor, control, and improve the working environment for miners, and using big data to improve the accessibility of mineral resources in the EU.

### 4.4. Playing a significant role in science and technology innovation

Science and technology innovation is a part of the mineral resource strategies of major countries. The EU has proposed the Innovative, Non-Invasive, and Fully Acceptable Exploration Technologies (INFACT 2020) program, a scientific and technological innovation project with high standards for environmental requirements and for community conditions. Australia has implemented the UNCOVER and Exploring for the Future programs, Canada has implemented the "Geo-Mapping for Energy and Minerals," and the United States has implemented the Critical Minerals Strategy and established the Battery Recycling R&D Center (DOE 2019). The mining sector's technology centers have been established throughout the process of technological innovation. The Australian Geoscience Plan proposes to observe and monitor big data and develop forecasting capabilities. Australia (CSIRO 2017) identified five technological development opportunities in the Australian METS sector. These opportunities include data-driven mining decisions, social and environmental sustainability, exploration under cover, advanced extraction, and mining automation and robotics, which extend to the deep earth and to more remote and cold places or environmentally vulnerable areas. Data should be used to develop sensors, the Internet of Things, analytics, optimization, visualization, and cybersecurity. More in-depth exploration should involve

next-generation drilling technologies, expanding the exploration of knowledge and processes. Advanced extraction should start with advanced drilling and cutting technologies, advanced sensors and ore sorting, integrated beneficiation technologies, mining automation, robotics, machine vision, materials, control systems and algorithms, and virtual and augmented reality.

### 4.5. Paying close attention to significant shifts in the focus on critical minerals

In the major countries' mineral resource strategies, the role of critical minerals in economic and social development given the new situation is emphasized, as is the fact that emerging technology industries require more mineral resources, especially critical minerals, as raw materials (Yu Yun 2020). In 2018, the U.S. announced a critical mineral catalog with 35 mineral commodities (DOI 2018). The Resources 2030 Taskforce mentions that Australia is the largest producer of three minerals on the U.S.'s critical minerals list and has significant identified reserves of another 14 minerals. The British Geological Survey identified a supply risk for 40 minerals in 2015 and recommended strategies to promote promising battery industries and domestic value added for critical minerals (BGS 2015).

## Conclusions

At the end of 2016, the global mining industry went through a deep three-year adjustment period, and the trend in mining exploration investments is starting to recover. During this period, the large mining companies and the mining administrations of the major mining countries both adjusted the mineral resource strategies.

We observed new national mineral resource strategy reports released by major global mineral exploration countries, such as Australia, Canada, and the United States. This paper first reviews the main issues that the new reports consider to be factors that affect the mining industry's development. By reviewing these mining strategies, we identified certain mining issues, such as increases on land access and permitting, disincentives to obtain precompetitive geoscience information, and the urgent need for improvements in exploration technology to adapt to new demands. Then, by studying the visions and aims of these new mineral resource strategies, this paper found that their strategic goals have something in common: to display a new image of mining development through sculpting and reshaping its old image. The new mining development image is an image of advanced mining that focuses on green development, ecological protection, technology intensity, sustainability, and social acceptance, consolidating the primary position and foundational role of mineral resources and mining development in economic and social development. It creates a favorable development environment for the rational use and adequate protection of mineral resources. After that, a summary of the measures taken to achieve the objectives is provided.

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**THE NEW MINERAL EXPLORATION STRATEGIES OF SELECTED MAJOR MINERAL-RICH COUNTRIES**

Keywords

mineral resource strategy, visions, aims, measures

Abstract

This paper first describes basic information on 13 mineral resource strategy reports issued by the world's major mineral resource exploration countries and regions, including Australia, Canada, Europe, the U.S., Russia, and India. Through these strategic reports, we identified the problems facing current mineral exploration and development, such as mining issues, increased on land access and permitting, disincentives to obtain precompetitive geoscience information, and the urgent need to improve exploration technology to adapt to new demands. Then, by studying the visions and aims of the new mineral resource strategies, this paper found that the strategic goals have something in

common: to display a new image of mining development. The new image of mining development is an image of advanced mining through green development, ecological protection, technology intensity, sustainability, and social acceptance, consolidating the primary position and foundational role of mineral resources and mining development in economic and social development. The new image creates a favorable development environment for the rational use and adequate protection of mineral resources. After that, a summary of the measures taken to achieve these objectives, which include strengthening domestic mineral exploration, increasing coordination between mineral exploration and ecological environmental protection, strengthening the life cycle management of the industrial chain, playing a significant role in scientific and technological innovation, and paying close attention to significant shifts in the focus on critical minerals, is provided.

## NOWE STRATEGIE POSZUKIWAŃ ZŁÓŻ SUROWCÓW MINERALNYCH W WYBRANYCH KRAJACH POSIADAJĄCYCH TAKIE SUROWCE

Słowa kluczowe

strategia zasobów mineralnych, wizje, cele, mierniki

Streszczenie

W artykule opisano podstawowe informacje zawarte w 13 raportach, dotyczące strategii zasobów surowców mineralnych, wydanych przez wybrane najważniejsze kraje i regiony zajmujące się poszukiwaniem złóż surowców mineralnych, w tym Australię, Kanadę, Europę, Stany Zjednoczone, Rosję i Indie. Dzięki tym raportom strategicznym zidentyfikowano problemy jakie towarzyszą obecnie poszukiwaniom i zagospodarowaniu złóż, a mianowicie: trudności z wydobyciem, zwiększone zapotrzebowanie na grunty, trudności z uzyskaniem pozwoleń i informacji geologicznej. W związku z tym konieczna jest potrzeba ulepszenia technologii poszukiwań, aby dostosować się do nowych wymagań. Następnie, badając wizje i zadania nowych strategii dotyczących surowców mineralnych, w artykule stwierdzono, że mają one wspólny cel: ukazać nowy wizerunek rozwoju górnictwa. Nowy obraz górnictwa to: zaawansowany rozwój zielonego górnictwa, ochrona ekologiczna, efektywność technologii, zrównoważony rozwój i akceptacja społeczna, utrwalenie podstawowej pozycji i fundamentalnej roli surowców mineralnych w rozwoju gospodarczym i społecznym kraju. Nowy wizerunek stwarza korzystne warunki rozwojowe dla racjonalnego wykorzystania i odpowiedniej ochrony zasobów surowców mineralnych. Dokonano podsumowania działań podjętych w celu osiągnięcia tych zamierzeń, które obejmują zwiększenie: poszukiwań surowców mineralnych, koordynacji między poszukiwaniem złóż i ekologiczną ochroną środowiska, wzmocnienia zarządzania cyklem życia łańcucha przemysłowego, znaczącej roli w innowacjach naukowych i technologicznych, jak również zwracanie bacznej uwagi na zmiany zainteresowania krytycznymi surowcami mineralnymi.