Chapter 20

UNIFIED CRITERIA OF CLASSIFICATION SYSTEMS AS A TOOL FOR RESOURCE MANAGEMENT AND INVESTMENT ANALYSIS OF MINERAL DEPOSITS (SUBSOIL AREAS)

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INTRODUCTION

There is a significant amount of classifications for mineral reserves and resources of various jurisdictions, which use their own terms and definitions that inhibits information exchange and significantly complicates activities of international mining and financial companies. Additionally, the use of different classification systems does not contribute to sustainable development and resource management at the global and regional levels.

After analyzing the global mining sector[1][2][3][4] several groups of classification systems containing an identical or similar list of categorization features, terms, definitions and concepts have been objectively distinguished.

The following classifications of solid mineral reserves and resources should be highlighted:

– The CIS mineral reserves and resources classification system (based on the 1981 USSR Classification);

– IAEA classification system (NEA/IAEA Classification);

[1] Camisani-Calzolari F.A. National and international codes for reporting mineral resources and reserves: Their relevance, future and comparison. *The Journal of The South African Institute of Mining and Metallurgy*. 2004. P.297-305.

[2] Wagner M., Bide T., Cassard D., Huisman J., Leroy P., Bavec Š, Ljunggren Söderman M., Amund N. Løvik, Wäger P., Emmerich J., Sperlich K., Baldé C., Schjøth F., Tivander J., Brown T., Petavratzi E., Whitehead D., Tertre F., Mählitz P., Nikolova V and Horváth Z. Optimising quality of information in RAW materials data collection across Europe (ORAMA). *Technical Final Report & Recommendations*, Brussels, Belgium, 2019. 79 p.

[3] Reichl C., Schatz M. World Mining Data 2022. Minerals Production Vienna. *Federal Ministry of Agriculture, Regions and Tourism*. 2022. Vol. 37. P. 31-199. URL: https://www.world-mining-data.info/wmd/downloads/PDF/WMD2022.pdf.

[4] Minventory metadata portal. National reporting. Data harmonisation and standardisation. *European Commission database*. 2023. URL: https://ec.europa.eu/assets/jrc/minventory/national-reporting26c9.html?field_cs_country_lexique_tid=.

– United Nations Framework Classification (UNFC);

– Template of the Committee for Mineral Reserves International Reporting Standards (CRIRSCO).

Considering the narrow uranium specialization of the IAEA classification system[5], the UNFC[6], CRIRSCO[7] and CIS classification systems[8] have been used for further research.

Each specified classification system has its own history of development and formation. In 2019, updated versions of the UNFC and CRIRSCO were released. It should be noted that they are based on the 1981 USSR Classification and contain minor changes associated with adaptation to national legislation in the field of subsoil use.

UNFC. The UNFC development was initiated by the UNECE Working Group on Coal considering the fact that the significance and necessity of developing an internationally acceptable classification for reserves/resources became especially relevant in the process of the market economy transition of Central and Eastern European countries. The updated UNFC is designed to meet the needs of various raw material sectors and application areas, as well as to bring the classification into full compliance with principles of sustainable resource management following the 2030 Agenda for Sustainable Development. This updated version does not entail changes of the classification system and, therefore, does not affect current UNFC users. The updated text should simplify the UNFC application for its users.

UNFC is a universal global level system based on which reserves are classified based on three fundamental criteria: 1) economic and social viability of a project; 2) status and feasibility of a field development project; 3) geological study using a digital code system. Combinations of these criteria create a three-dimensional system of codes. As a result of the subsequent regulatory and targeted explanatory work of the UNECE and national working groups, the UNFC has gained further dissemination and recognition. Currently, the UNFC is used as the primary Classification (China, India, Ukraine, Romania, Mexico, etc.), or there are adapted (harmonized) documents with national classifications. Also, the Experts Group on Resource Management of the Sustainable Energy Division is developing the UN Resource Management System (UNRMS) based on the UNFC basic principles.

[5] Classification of uranium reserves/resources (1998). *International Atomic Energy Agency*. URL: https://www-pub.iaea.org/MTCD/publications/PDF/te_1035_prn.pdf. 99 p.

[6] UNFC United Nations Framework Classification for Resources. *ECE ENERGY SERIES No. 61*. 2019. 28 p. URL: https://unece.org/sites/default/files/2020-12/E_ECE_ENERGY_109_WEB.pdf1.

[7] International reporting template for the public reporting of exploration targets, exploration results, mineral resources and mineral reserves. *The CRIRSCO International ReportingTemplate.* 2019. URL: https://www.crirsco.com/template/.

[8] Класифікація запасів родовищ твердих корисних копалин, що затверджена постановою Ради міністрів СРСР від 30.11.1981 № 1128.

CRIRSCO. The CRIRSCO template classification system is the most widely used for solid minerals for public reporting on geological exploration results, resources and reserves of such minerals. The primary document that determines the assessment of the status of mining enterprises' mineral and raw material assets in case of the participation in an IPO (Initial Public Offering), stock quotation, bank loans, etc., there are reports on mineral resources and reserves at the disposal of mining companies.

The template for reporting on geological exploration results, resources and reserves of solid minerals integrates the minimum essential standard requirements adopted in national reporting standards of separate countries with recommendations and explanatory guidelines on the preparation of public reports on geological exploration results, resources and reserves of solid minerals. Primary principles of the Template operation and application are transparency, materiality and competence. A public report on geological exploration results, mineral resources and reserves must be prepared, personally or under the supervision, and signed by the Competent Person. Currently, the CRIRSCO Committee unites fourteen national Codes (Classifications) that have been developed following the CRIRSCO minimum standards: JORC (Australasia), CBRR (Brazil), CIM (Canada), Comision Minera (Chile), CCRR (Colombia), PERC (Europe), NACRI (India), KCMI (Indonesia), KAZRC (Kazakhstan), MPIGM (Mongolia), OERN (russia), SAMCODES (South Africa), UMREK (Turkey), SME (United States of America).

Classifications of the CIS and some Eastern European countries. The 1981 USSR Classification is taken as a basis, and it is used by many countries of the CIS and Eastern Europe. The classification system for mineral reserves and resources of the former USSR established uniform principles for the calculation and state accounting of mineral reserves in the subsoil based on the degree of their study, as well as basic principles of assessment of prognostic resources. It should be noted that the classification was developed to solve state tasks in the conditions of a planned directive economy. Therefore, it is characterized by weak elaboration of economic aspects of the development of mineral deposits, and on the other hand, significant attention was drawn to mineral resources (i.e. the least studied part of mineral reserves) as prospects for increasing mineral raw material base.

1. Primary goals of classification systems

During the selection and formation of classification markers or their groups, attention should be paid to the primary goal of reserves and resources assessment and management system. Classification systems fulfill their tasks at the state (state, union of states) and "corporate" (industrial and financial

groups, mining companies) level by analyzing the history of development, processes and areas of application (assessment, reporting and management).

State level. The assessment system entails a state-based approach, where the main regulators of the classification system application are state organizations. Primary objectives of such regulators are the mineral and raw material base development, the formation and management of the State Balance of mineral deposits and ore occurrences, its reliability, rational and effective subsoil use. Such approaches are used by countries that have a mineral and raw material base with a powerful industrial potential and developed geological institutions of various management ranks.

This approach's characteristic feature is its "auditability", i.e. a comprehensive accounting of available resources and reserves at various stages of projects' development and study. It satisfies the needs of the subsoil owner (state, the people) and serves as the basis for the resource management system. Based on listed criteria, this goal is fully met by the UNFC and the 1981 USSR Classification in terms of calculation and accounting approaches.

"Corporate" level. The second system of mineral reserves and resources reporting standard development is provided by activities of industrial and financial groups (companies, integrated financial groups) whose shares are listed on international stock exchanges, or by companies planning to enter the IPO (Initial Public Offering).

In order to attract funds or make investment decisions regarding projects of company's mining assets, provisions of a national (regional) reporting code (JORC Australasia, NI 43-101 Canada, PERC Europe, SAMREC / SAMVAL South Africa, etc.), which is included in the CRIRSCO Template "family" of codes and corresponds to its provisions and principles, are used following the regulator's requirements.

Unlike the previous approach, regulators of the classification system application are Exchange institutions or relevant bodies that regulate operations with shares of mining companies. This approach involves the assessment of the company's assets to make a reliable decision regarding further investments in the project (development, feasibility study, operation). The key priority of this process consists in production forecasts and determination of net discounted cash flow (NPV).

2. Classification markers

Classification markers in various systems are quite logically grouped by geological, mining-technological and socio-economic criteria despite structural (visual) differences.

Geological. This group includes a set of natural features of reserves and resources. Categorization of reserves and resources is performed based on a certain level of confidence in contouring and determination of quantitative

(volumes, depth and morphology of occurrence, uniformity of mineralization distribution, etc.) and qualitative (content of useful and harmful components, mineral composition, physical and chemical properties of ore and host rocks etc.) characteristics. The network and detail of mine workings' testing (well, pit, trench, etc.) are the key factors in determining the level of confidence of obtained characteristics and, accordingly, the assignment to certain groups and categories.

Mining-technological. Based on markers of this group, mining and technical conditions of development (opencast, underground and combined) and technological schemes of processing and enrichment of mineral raw materials are characterized. The defining classification marker is the stage of project survey (pre-project decisions, approved project, development project) and technological research (laboratory, semi-industrial, industrial).

Socio-economic. Based on characteristics of this group, the classification covers the determination of economic feasibility and efficiency (need and prices for mineral raw materials, tax regime, profitability, sales market, etc.) of extraction, processing, enrichment and sale of the enterprise's commodities. In addition to purely economic features, social and environmental factors associated with various permitting procedures and the environmental legislation play a significant role.

It should be noted that all three groups are directly reflected only in the UNFC classification system, the corresponding groups of categories E (the project's economic and social viability), F (the project's technical feasibility) and G (reliability of geological study).

In the CRIRSCO Template, groups of mining-technological and socio-economic features do not define separate categories, but together they constitute criteria ("modifying factors") for the conversion of resource categories (inferred, indicated, measured) allocated by geological features into reserve categories (probable, proved).

In the USSR Classification, categories of explored (A, B, C_1), previously explored (C_2) reserves, and prognostic and prospective resources (P_1, P_2, P_3) are distinguished based on geological features. Socio-economic characteristics are decisive when allocating balance and off-balance reserves. Mining and technological characteristics are considered during the feasibility study of condition parameters for mineral raw materials.

3. Categories, classes and groups of reserves and resources

According to the abovementioned information, each classification system has a certain set of features, criteria, definitions and principles based on which certain categories and classes are assigned to reserves and resources, or their level of confidence is determined.

As it has been mentioned, the **UNFC** is a universal system where reserves are classified by using a digital code system based on three fundamental criteria: 1) economic and social viability of the project (axis E); 2) the status and feasibility of the field development project (axis F); 3) geological study (axis G). Combinations of these criteria create a three-dimensional system of codes (Figure 1).

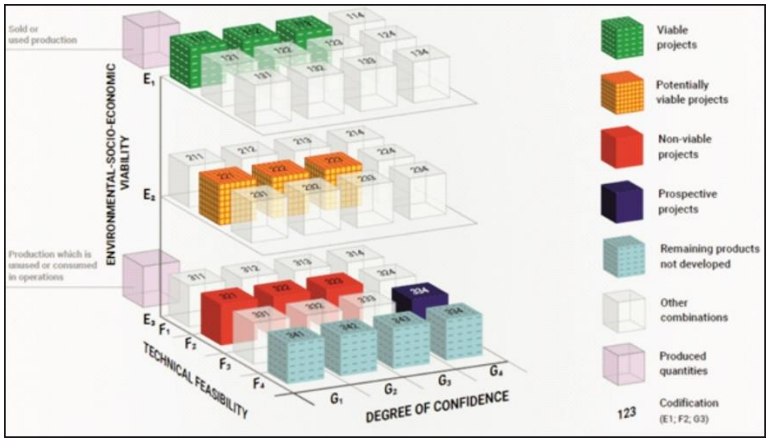

Fig. 1. The UNFC categories and examples of classes

The first group of categories (axis E1, E2, E3) determines the degree of favorability of social and economic conditions to ensure the project's commercial viability. They include market prices, relevant legal, regulatory, environmental and contractual conditions. The second group of categories (axis F1, F2, F3) determines results of the development of technologies, researches and commitments necessary for the project's implementation. They cover the range from initial studies to a developed (current) project and reflect standard principles of production and supply chain management. The third group of categories (axis G1, G2, G3, G4) determines the degree of confidence of the assessment of commodity quantities obtained during the project's implementation. The combination of categories determines the project's class (stage and prospects).

The UNFC contains additional typical subclasses based on full detalization by additional subcategories (Table 1) for the purpose of greater transparency during the global exchange of information.

Table 1

The UNFC classes defined by categories and subcategories

Total output	Extracted / produced	Sold or used commodities				
		Commodities that are not used or used during operation (mining)				
	Class		Subclass	Categories		
				E	F	G
	Known sources (deposits)	Viable projects	Active	1	1.1	1, 2, 3
			Approved for development	1	1.2	1, 2, 3
			Justified for development	1	1.3	1, 2, 3
		Potentially viable projects	Development pending	2[b]	2.1	1, 2, 3
			Development is on hold	2	2.2	1, 2, 3
		Non-viable projects	Development is unclarified	3.2	2.2	1, 2, 3
			Development is non-viable	3.3	2.3	1, 2, 3
		Residual commodities that are not developed within identified projects		3.3	4	1, 2, 3
	Potential sources (deposits)	Prospective projects (geological exploration projects)	[No subclasses are defined]	3.2	3	4
		Residual commodities that are not developed within prospective projects		3.3	4	4

[b] *Pending projects may be eligible for the category E1.*

When characterizing the UNFC classes and categories, it should be noted that this paper analyzes the 2019 version (Publication Series № 61, ECE/ENERGY/125). This version is an update of the 2009 version (Publication Series № 42, ECE/ENERGY/94) developed for fossil energy and mineral reserves and resources. Due to the application scope expansion (renewable and anthropogenic sources of resources) and the universality of this classification, the UNFC-2019 changes its name to "United Nations Framework Classification for Resources". The current updated version does not change the classification system and, accordingly, does not affect the UNFC-2009 users.

The basis of the **CRIRSCO** Template system for the classification of the quantity and quality estimates for minerals in the subsoil to establish different levels of geological confidence and different degrees (depths) of the technical and economic assessment is illustrated in Figure 2.

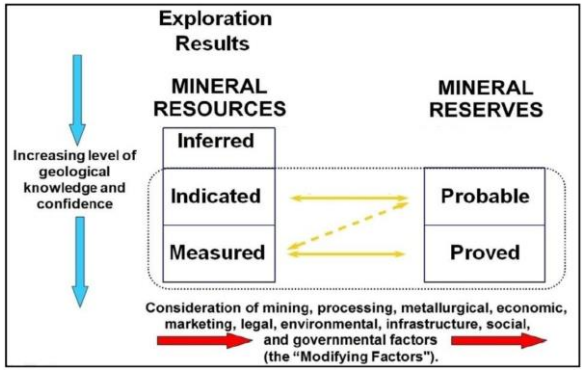

Fig. 2. The categories CRIRSCO Template (2019)

In each specific case, the allocation of reserves/resources to certain categories is performed by Competent persons (competent experts). According to established requirements, the Competent Person is responsible for all required documentation related to the preparation of public reports issued based on the countries' reporting standards of the CRIRSCO family.

According to the CRIRSCO family of reporting codes, resources should be classified in order of increasing degree of geological knowledge and confidence by three categories:

1) ***inferred resources***;

2) ***indicated resources***;

3) ***measured resources***.

Reserves are divided into two categories in order of increasing detail of their assessment – geological knowledge and the degree of detail of modifying factor accounting (mining-technical, technological, economic, conjunctural, legal, ecological, social and administrative features):

1) ***probable reserves***;

2) ***proved reserves***.

According to the CRIRSCO Template, the justification of "reserves" requires consideration of modifying factors – integral terms covering mining-technical, technological, economic, conjunctural, legal, environmental, social, administrative and management aspects of analysis and assessment.

Key terms and definitions of the 1981 USSR Classification, as it has been mentioned above, are widely used by countries of the former Soviet Union. To highlight and better understand the specificity of features on which the classification is based, the classification system of the Russian Federation will be used, which has been harmonized with CRIRSCO and UNFC at the state level.

The classification and methodical guidelines on its application are a fairly complete systematic description of all primary methodical principles of conducting geological exploration, assessment of reserves/resources and their categorization by the degree of geological knowledge, economic significance and preparedness for commercial development. The classification defines uniform principles of state accounting of reserves, the quantity and quality of which together with economic significance, mining-technical, technological, hydrogeological, ecological and other mining conditions are confirmed by state expertise.

Based on this Classification, reserves of categories A, B, C_1 and C_2 are determined by the degree of exploration, and prognostic resources of categories P_1, P_2 (P_3) are determined by the degree of confidence, and groups of deposits (sites) are determined by the degree of geological structure complexity, which directly affects the allocation of categories of reserves.

Balance and off-balance reserves are distinguished based on the commercial significance (Figure 3).

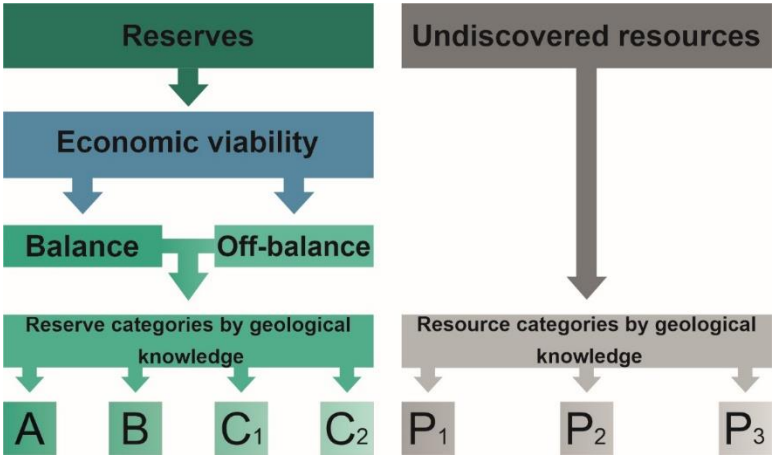

Fig. 3. The 1981 USSR Classification of reserves and prognostic resources of solid minerals (with amendments)

Based on the economic significance, reserves are divided into two categories/groups – "*balance*" (development is cost-efficient) and "*off-balance*" (marginal or potentially cost-efficient). Simultaneously, reserves of both groups of exploration are reclassified into balance reserves or off-balance reserves only based on results of the state expertise, after which they are subjected to accounting in the State Balance.

4. Comparability (harmonization)

Characterized classification systems have their differences due to the history of classification development, purpose, jurisdiction and application. Despite all the differences, the analysis of geological exploration phasing, the technological and assessment process allows us to identify common features and criteria for correct comparison and harmonization.

Works on harmonization and comparability of different classification systems are conducted at the international and expert levels. Exemplary studies conducted within the framework of the Expert Group on Resource Management of the UNECE Sustainable Energy Division have resulted in the bridging documents for comparison and harmonization of leading

classification systems[9][10][11][12]. Considering these works, as well as our own research, a comparison of primary categories, classes and groups of various classification systems has been performed based on relevant features (Tables 2–5).

Table 2

Comparison of classification systems by geological features

Level of confidence	UNFC	CRIRSCO		USSR Classification
		resources	reserves	
highest ↑ lowest	G1	measured	proved	A, B, C_1
	G2	indicated	probable	C_2 (sometimes C_1)
	G3	inferred	–	P_1 (sometimes C_2)
	G4	–	–	P_2 (P_3)

Table 3

Comparison of classification systems by mining and technological features

Level of confidence	UNFC	CRIRSCO		USSR Classification (partly)
		resources	reserves	
highest ↑ lowest	F1	–	proved feasibility study	Feasibility study of permanent conditions
			probable pre-feasibility study	Feasibility study of temporary conditions
	F2	measured indicated inferred	scoping study	geological exploration conditions
	F3	–		
	F4	–		

[9] Литвинюк С., Курило М., Віршило І., Братах М.. Базові ознаки класифікаційних систем як інструмент управління та інвестиційного аналізу проєктів надрокористування. *Вісник Київського національного університету імені Тараса Шевченка. Геологія*, 2023. № 3 (102). С. 63-72. DOI: http://doi.org/10.17721/1728-2713.102.08.

[10] Bridging Document between the Committee for Mineral Reserves International Reporting Standards Template and the United Nations Framework Classification for Resources. *UNECE*. 2019. 20 p. URL: https://unece.org/sites/default/files/2024-04/CRIRSCO_Template_UNFC_BD_ECE_ENERGY_GE.3_2024_5_ENG.pdf)

[11] Bridging Document between the Committee for Mineral Reserves International Reporting Standards Template and the United Nations Framework Classification for Resources. *UNECE*. 2015.7 p. URL: https://unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/UNFC_specs/Revised_CRIRSCO_Template_UNFC_Bridging_Document.pdf.

[12] Bridging Document between the Organisation of Economic Co-operation and Development Nuclear Energy Agency/International Atomic Energy Agency Uranium Classification and UNFC-2009. *UNECE*. 2014. 9 p. URL: https://unece.org/fileadmin/DAM/energy/se/pdfs/comm23/ECE.ENERGY.2014.6_e.pdf.

Table 4

Comparison of classification systems by socio-economic features

Level of confidence	UNFC	CRIRSCO		USSR Classification
		resources	reserves	
highest ↑ lowest	E1	–	proved	balance reserves of categories A, B, C_1
			probable	balance reserves of categories A, B, C_1 (sometimes C_2)
	E2	measured	–	off-balance reserves of categories A, B, C_1
		indicated		off-balance reserves of categories C_2 (sometimes C_1)
	E3	inferred	–	prognostic resources P_1, P_2 (P_3)

When analyzing Tables 2-4, it should be noted that there is a fairly reliable comparison of all classification systems by geological features, which is associated with similar stages of study and the geological exploration process methodology. As for other classification features, their comparison requires caution and additional detalization, especially regarding groups of categories of the USSR Classification.

Table 5

General scheme of comparison of classification systems

Level of confidence	UNFC					CRIRSCO		USSR Classification		
	Class	Subclass	Categories E	F	G	Reserves	Resources	Balance reserves	Off-balance reserves	Resources
highest ↑ lowest	Viable projects	Active	1	1	1	proved		A, B, C_1		
		Approved for development	1	1	2	probable		A, B, C_1 (sometimes C_2)		
	Potentially viable projects	Development is pending	2 (3)	2 (3)	1		measured		A, B, C_1	
			2 (3)	2 (3)	2		indicated		C_2 (sometimes C_1)	
			2 (3)	2 (3)	3		inferred			P_1
	Non-viable projects	Development is unclarified	3	3	3, 4					P_2 (P_3)

Difficulties of comparability are related to many factors including differences in definitions and requirements (criteria) of allocation to categories (group of categories). For example, criteria for determining reserves and resources differ in all classification systems. The consideration of modifying factors is decisive in the CRIRSCO Template, while the degree of geological knowledge (exploration) is decisive in the USSR Classification. In the latest version of the UNFC, the definition of reserves and resources is

used in a general sense (resources as quantities of commodities). Additionally, another circumstance that should be considered is that the "auditability" of the UNFC and the USSR classification systems allows us to allocate additional categories for the results of geological exploration works. In the case of the CRIRSCO Template, the inadmissibility of determining the quantity and quality (content) based on geological exploration results has been established.

CONCLUSIONS

The information component of the world's mining industry contains a huge volume of analytical reports, balance sheets and cadastres of various levels regarding quantitative and qualitative characteristics of fossil and renewable resources. Compilation, preparation and classification of such information are conducted in accordance with the regulatory sphere of the country or region (administrative, political, financial), where various methodological and legal approaches to the classification of mineral reserves and resources are introduced. Specified circumstances introduce complications during the formation of strategies (systems) of different levels for resource management.

Stated results of research on the comparability and harmonization of various classification systems are designed to propose unified and standardized criteria (characteristics, concepts, terms) for methodological approaches to harmonization, as a toolkit for resource management and investment analysis of deposits (subsoil areas) of solid (metallic and non-metallic) minerals.

The conducted analysis of definitions of key categories (classes, groups) of various classification systems allowed us to identify and characterize features (criteria) with a sufficient level of comparability and harmonization.

Primary differences of classification systems are related to the purpose and scope of their application, which is reflected in the number of categories and their definitions, and requirements for the availability of permit documentation of various levels (approved project, land, ecology, etc.).

The UNFC analysis has revealed that the specified classification system contains the most complete list of classes, subclasses and categories of mineral and other resources. This allows the UNFC to be a bridging tool for comparison and harmonization of various classification systems. There is definitely a need for a comprehensive future approach to adjustment of the terminology and definitions of compared systems. This way will lead to the creation of a universal classification system understandable for all stakeholders (state, investor, society) with optimal detail for decision-making in the sphere of resource management at all levels.

SUMMARY

Implementation first classification systems of mineral raw materials reserves and resources appeared in the beginning of the 20th century, which coincided with the mining development in the UK, Germany and the USA.

Modern classifications of mineral raw materials and energy resources, their terminology, definitions and concepts have been developed and improved for more than 40 years.

Separate development of the most commonly used classifications has led to the emergence of various definitions and determinations of characteristics of the same or similar categories of mineral reserves and resources according to geological and technical-economic characteristics.

The primary goal of this work is to initiate the development of methodological approaches of "operational harmonization" (universal classifier) as a toolkit for resource management and investment analysis of deposits (subsoil areas) of solid (metallic and non-metallic) mineral resources based on unified and standardized criteria (characteristics, concepts, terms).

Bibliography

1. Camisani-Calzolari F.A. National and international codes for reporting mineral resources and reserves: Their relevance, future and comparison. *The Journal of The South African Institute of Mining and Metallurgy.* 2004. P.297-305.

2. Wagner M., Bide T., Cassard D., Huisman J., Leroy P., Bavec Š, Ljunggren Söderman M., Amund N. Løvik, Wäger P., Emmerich J., Sperlich K., Baldé C., Schjøth F., Tivander J., Brown T., Petavratzi E., Whitehead D., Tertre F., Mählitz P., Nikolova V and Horváth Z. Optimising quality of information in RAW materials data collection across Europe (ORAMA). *Technical Final Report & Recommendations*, Brussels, Belgium, 2019. 79 p.

3. Reichl C., Schatz M. World Mining Data 2022. Minerals Production Vienna. *Federal Ministry of Agriculture, Regions and Tourism*. 2022. Vol. 37. P. 31-199. URL: https://www.world-mining-data.info/wmd/downloads/PDF/WMD2022.pdf.

4. Minventory metadata portal. National reporting. Data harmonisation and standardisation. *European Commission database*. 2023. URL: https://ec.europa.eu/assets/jrc/minventory/national-reporting26c9.html?field_cs_country_lexique_tid=.

5. Classification of uranium reserves/resources. *International Atomic Energy Agency*. 1998. 99 p. URL: https://www-pub.iaea.org/MTCD/publications/PDF/te_1035_prn.pdf.

6. UNFC United Nations Framework Classification for Resources. *ECE ENERGY SERIES No. 61*. 2019. 28 p. URL:

https://unece.org/sites/default/files/2020-12/E_ECE_ENERGY_109_WEB.pdf1.

7. International reporting template for the public reporting of exploration targets, exploration results, mineral resources and mineral reserves. *The CRIRSCO International ReportingTemplate*. 2019. URL: https://www.crirsco.com/template/.

8. Класифікація запасів родовищ твердих корисних копалин, що затверджена постановою Ради міністрів СРСР від 30.11.1981 № 1128.

9. Литвинюк С., Курило М., Віршило І., Братах М.. Базові ознаки класифікаційних систем як інструмент управління та інвестиційного аналізу проєктів надрокористування. *Вісник Київського національного університету імені Тараса Шевченка. Геологія*, 2023. № 3 (102). С. 63-72. DOI: http://doi.org/10.17721/1728-2713.102.08.

10. Bridging Document between the Committee for Mineral Reserves International Reporting Standards Template and the United Nations Framework Classification for Resources. *UNECE*. 2019. 20 p. URL: https://unece.org/sites/default/files/2024-04/CRIRSCO_Template_UNFC_BD_ECE_ENERGY_GE.3_2024_5_ENG.pdf)

11. Bridging Document between the Committee for Mineral Reserves International Reporting Standards Template and the United Nations Framework Classification for Resources. *UNECE*. 2015. 7 p. URL: https://unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/UNFC_specs/Revised_CRIRSCO_Template_UNFC_Bridging_Document.pdf.

12. Bridging Document between the Organisation of Economic Co-operation and Development Nuclear Energy Agency/International Atomic Energy Agency Uranium Classification and UNFC-2009. *UNECE*. 2014. 9 p. URL: https://unece.org/fileadmin/DAM/energy/se/pdfs/comm23/ECE.ENERGY.2014.6_e.pdf.

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