Draft Russian classification for solid minerals: International format and national traditions

M.N. DENISOV and K.P. KAVUN
Institute for Economics of Mineral Resources and Use of the Subsoil (VIEMS)

Discussed in the paper is the redesigned reserve/resource classification for solid minerals being put forth by the authors to replace the acting Russian classification of 1996. The new version is based on the traditional foundations of former Russian classifications and the principles of the ‘McKelvey box’, both categorizing mineral resources according to the degree of geological assurance and economic viability. Based on these approaches the classification deliberately deals with both reserve and resource categories very similar to those established by the Geneva Accords in terms of definitions implied. The authors proceed from the UN-ECE proposed concept of ‘reserves’ being a part of ‘total resources’ explored in great detail by geological and feasibility studies and economically mineable at the time of reporting. The draft classification distinguishes ‘proved’, ‘probable’ and ‘possible’ categories of reserves depending on the stage of feasibility assessment carried out, i.e. the degree of detail and accuracy with which modifying factors affecting mineability of an orebody are taken into account. The reserves are regarded as a product of feasibility assessment of ‘measured’, ‘indicated’ and ‘inferred’ resources. The portions of them not having been classified as ‘reserves’ are regarded as composed of two classes: ‘subeconomic’ and ‘potentially economic’ resources (or ‘resource base’). All the cells of the classification matrix are provided with traditional for Russia alphanumeric designations and appropriate UNFC codes. The classification scheme recommended is viewed as a step forward in improvement of the State reserves/resources inventories at the regional and national levels thus allowing for assessment and reassessment of the data with both reserve and resource categories very similar to those established by the Geneva Accords in terms of definitions implied. The authors proceed from the UN-ECE proposed concept of ‘reserves’ being a part of ‘total resources’ explored in great detail by geological and feasibility studies and economically mineable at the time of reporting. The draft classification distinguishes ‘proved’, ‘probable’ and ‘possible’ categories of reserves depending on the stage of feasibility assessment carried out, i.e. the degree of detail and accuracy with which modifying factors affecting mineability of an orebody are taken into account. The reserves are regarded as a product of feasibility assessment of ‘measured’, ‘indicated’ and ‘inferred’ resources. The portions of them not having been classified as ‘reserves’ are regarded as composed of two classes: ‘subeconomic’ and ‘potentially economic’ resources (or ‘resource base’). All the cells of the classification matrix are provided with traditional for Russia alphanumeric designations and appropriate UNFC codes. The classification scheme recommended is viewed as a step forward in improvement of the State inventory and reporting mineral resources in market conditions, conducive to cross-border professional collaboration in the field of providing reliable information on the mineral raw materials base of the world’s economy. Besides, it recommends an easy way to get rid of a methodological error in the UNFC classification scheme where consecutive stages of geological exploration are identified with a single inherent degree of geological assurance.

Keywords: mineral resources, mineral reserves, classification, geological assurance, feasibility studies, subeconomic resources, undiscovered resources, competent person.

Introduction

The transition of Russia to a market economy has required to introduce some changes in the classification system for solid minerals adopted in conditions of command/administrative planning and management. The draft document is designed to establish the revised statutory principles of accounting and reporting of reserves/resources for solid minerals. Subject to State accounting and reporting are mineral reserves and resources which are discovered or predicted to exist in the subsoil and of which the quantity and quality, data on their economic viability, mining conditions, environmental and other aspects of their possible exploitation are confirmed by the State audit of validity of data filed by subsoil users. New elements have been introduced to get the classification closer to international standards (UNFC, CMMI codes) and ensure better understanding of Russia’s mineral potential by western mining industries and investment community. The appearance of this project is the result of revived interest of the Ministry of Natural Resources of the RF in the systematization and inventory of the Russian mineral wealth as a major component of the state mineral policy. It has been developed in the Research Institute for Economics of Mineral Resources and Use of the Subsoil (VIEMS) and is based on the authors’ experience and expertise in geological exploration, participation in the UN activities in this field since 1979. The classification is suggested as a universal tool capable of meeting all kinds of existing needs: national and global inventories, reporting to governments and UN, public reporting to the stock market and potential investors.

Making use of Soviet traditions and the ‘McKelvey box’ structural pattern

The classification of which the draft is being presented is supposed to be of multipurpose nature. First of all it is designed to be used when compiling mineral reserves/resources inventories at the regional and national levels thus allowing for assessment and reassessment of the status and structure of the mineral raw materials base of the country. The inventory is thought about as a primary compilation of data which by its content should be understandable not only for geologists and mining people but for potential investors, funding institutions and stakeholders of the exploration and mining business as well.

Preserved in the draft classification recommended for Russia are the most important conceptual ideas of the former system (now in use) which is usually presented in...
the form of ‘McKelvey box’ diagram with reserve/resource categories specified according to degree of geological assurance on the horizontal axis and categories of economic viability placed along the vertical one. The main positions which have also been kept as unchangeable fundamentals of the classification are as follows (Figure 1):

- Subject to State accounting and reporting are discovered and evaluated mineral resources of which tonnage and grade, economic importance, mining, hydrogeological, environmental and other conditions are confirmed by the state audit effected in Russia by the State Committee on Mineral Reserves/Resources (GKZ), Ministry of Natural Resources of the RF.
- Potential resources are estimated on the basis of broad geological knowledge, justified analogies and favourable evidence of mineralization, with results of regional studies, mapping, geophysical and geochemical studies taken into account.
- Applied for designation of classification categories of reserves/resources by degree of geological assurance is alphanumeric identification system which is habitual to several generations of Russian geologists and miners.
- By degree of exploration knowledge, mineral quantities explored in the subsoil are subdivided into categories A, B, C1 and C2. The highest degree of geological certainty is ascribed to the category ‘A’, the lowest to the category C2.
- By economic viability, identified mineral resources are subdivided into ‘economic reserves’ and ‘subeconomic resources’; the resources are calculated and recognized as economic or subeconomic in keeping with economically justified cut-off parameters.
- Potential resources are estimated and periodically reported by subsoil users and may be put through expert checking by State and independent bodies.
- Quality (grade) of minerals is studied with due regard to their integrated use, with concurrent investigations of accompanying useful and deleterious components, forms of their presence in ore and specific features of their distribution in concentration and processing products.

The eventual rational degree of exploration is known to be largely dependent on the complexity of geological structure of a deposit. Four groups of complexity have been and continue to be recognized in Russia: from large ore-bodies of simple shape (stratiform and tabular for example), with high degree of continuity as to their thickness, quality and internal structure (group I) to small bodies with numerous dislocations, sharp variability of grade and other geological characteristics, discontinuous nest-like distribution of useful components, etc. (group IV). The classification proposed is intended to assist a subsoil user in finding reasonable degree of detail of exploration of mineral deposits by providing clear definitions of individual categories of reserves/resources according to the criteria accepted. Application of them to particular kinds of mineral commodities and geological deposit types are described in exploration instructions. The latter recommend exploration techniques, the density of exploration grids, spacing of

![Figure 1. Draft Russian classification for reserves/resources of solid minerals](image-url)
sampling and testing points, etc. to ensure tonnage, grade, mineral content, size, shape, metallurgical and geotechnical characteristics be estimated with the degree of detail required for each category. Also recommended are the accuracy of defining geological continuity, distribution of types and grades of mineralized material, methods of outlining orebodies, the extent of use of interpolation and extrapolation, etc.

Two kinds of mineral deposits are distinguished among those having been subjected to geological exploration and taken into account in the national inventory, viz. 'explored' and 'preliminarily evaluated'. Preliminarily evaluated deposits are those which have been studied to the extent allowing to justify further geological investigation and putting a property on-stream. Explored deposits are those of which the tonnage, quality, metallurgy and mining conditions have been studied by drill holes and underground workings with the detail and completeness sufficient for justifying in technical and economic terms a decision on the order and conditions of bringing a mineral property into production, mine design and construction. At the stage of detailed geological assessment, in mineral deposits referred to the I group of complexity all categories of reserves/resources specified by the classification may be obtained, while only C2 is prevailing in calculation results used as a basis for design and construction of mines at the IV group properties.

Referring resources to 'economic' or 'subeconomic' is based on the results of feasibility studies at the basis of which the values of cut-off parameters for calculating reserves are proposed and justified. Quantification of these resource classes is found acceptable not only for 'A', 'B' and 'C1', resources but for 'C2' ("inferred resources") as well. To the mind of quite a number of experts from different countries, such subdivision is justifiable for particular minerals and geological deposit types. The provision is also made for recognizing a special portion of 'subeconomic resources' as 'marginal' with implications of this term widely known and adopted in the world. These are resources which at the time of evaluation are on the verge of economic viability and, for this reason, having high probability of being brought into production in the near future. Sometimes these are some social, political, administrative or environmental factors that are imped ing their development.

Regarded as subject to classification and reporting are also undiscovered (potential) resources which are essential for objective evaluation of the mineral potential of any country or regions. The role of this group of resources is most important for strategic planning when choosing principal directions and targets of further geological exploration and elaborating on the foundations of long-term mineral policy of the government. These resources are divided into three categories distinguished by nature and scale of geological bodies being estimated, methods of estimation, degree of their reliability and exactness of predictions. 

The following designations of categories are used: P1—new orebodies 'surmised' at known deposits and occurrences, P2—predicted for known basins, ore fields, regions and knots (known as 'hypothetical') and P3— theoretically predictable on the basis of broad geological knowledge, direct geological evidence and/or geochemical and geophysical data without adherence to any specific exploration targets ('speculative' resources). The latter are normally a result of medium- and small-scale geological mapping.

Meeting the requirements of market economy, globalization and international standardization

Found in the draft are some novelties matching the requirements of market economy and the globalization of the world mining business. First of all, as is already done in classifications of leading mining countries, increased consideration is given to identification of criteria defining market value of reserves being estimated, their capability to ensure appropriate return on invested capital. Hence, the special attention is paid to the requirements allowing to refer a certain parts of resources to 'reserve' class. The authors deem that in the countries with transition economy the availability of 'reserve' categories at a mineral property confirmed by the authority of a Competent Person must always mean high reliability of respective data for banks, investors and sponsors of a mining project, a good basis for investment decisions.

The concept of Competent Person, or Expert, by itself as it is understood in the CMMI countries seems to be new and unusual for Russia but only at first sight. What might be of most concern for many geologists is the attempt to introduce legal regulations of personal and corporative responsibility for reporting false or deliberately forged information on reserves having undergone feasibility assessment and received market value. And this would take some time to get accustomed to if pursued. In fact, the institution of competent experts has been in existence in Russia for many decades, since the time the State Committee on Mineral Reserves/Resources (GKZ) attached formerly to the Council of Ministers of the USSR was established in early 1930s. At the time when all mineral deposits completed by detailed exploration were passed over for exploitation to the respective branches of industry, its main objective is to ensure the highest supervision over the rightness of the exploration methods applied, reserve calculation figures and reliability of evaluation of deposits properly justified, the rules and norms of making deposits prepared for putting on-stream observed. In its work, GKZ has been supported by most highly qualified, competent geologists and engineers of the country (mainly from Moscow) attracted to their expert and consultant activities on a temporary and part-time basis. This is not counting a permanent staff of GKZ which was divided by kind and group of minerals commodities. Except for slight changes in its functions in conditions of market economy (now besides auditing reserves on behalf of the State, it attends to observation of the State regulations on the rational use of the subsurface, and the validity of all kinds of geological information being presented for approval), the main principle of recruiting experts for GKZ remains the same. In our opinion, if the CMMI established conditions for a Competent Expert and his responsibilities be universally approved, the GKZ experts from Russia could perfectly meet the requirements of international mining business community.

Similar to the UNFC, envisaged in the draft classification is a clear-cut division of identified resources into the following classes: (a) reclassified into most reliable ('bankable') 'proved' and 'probable' reserves (according to the results of feasibility studies); (b) subeconomic resources (as established by the same calculations); (c) not yet subjected to detailed feasibility studies and regarded for this reason as 'measured resource base', 'indicated resource base' and 'inferred resource base' categories (the idea of this definition borrowed from Canadian practice).
It is significant that all specified classes of material in the subsoil (including reserves) represent different subdivisions of ‘total identified resources’ by degree of geological assurance. The content and definitions of A, B, C1 and C2 resource classes in the draft classification are accepted as corresponding to those of measured, indicated and inferred resources agreed upon by the Denver Accord. By introducing the terms ‘proved’ and ‘probable’ into the draft Russian classification we’re showing our commitment to raise the standards of these groups of reserves up to the level of CMMI criteria, to link them rigidly to the requirements of the western type of feasibility studies and the idea of raising responsibility of a Competent Person for the evaluation results subject to public reporting.

‘Resources’ may become ‘reserves’ after feasibility studies establish their economic mineability. In Russia, it has always been (and continues to be) the standard exploration practice to conduct technical and economic investigations corresponding by degree of detail and accuracy to underlying geological data, with reporting documents produced in standardized form. It is a mandatory conclusive element of any stage of mineral exploration. On completion of detailed exploration (now designated as simply ‘exploration’), the technical and economic justification (abbreviated as ‘TEO’) of permanent cut-off parameters is developed (corresponding to the final feasibility study in Western terms), of preliminary exploration (now called ‘evaluation works’)—TEO of tentative cut-off parameters (preliminary feasibility study), on completion of prospecting and reconnaissance stages—initial evaluation of mineral occurrences and anomalies based on geological parameters (geoeconomic study) normally takes place.

The degree of technical and economic knowledge about resources which have and haven’t been subjected to feasibility studies in terms of ‘modifying factors’ is quite different. And this predetermines differences in approaches to their additional examination and evaluating their economic viability in the future. That is why we find it reasonable to take separate account of subeconomic resources defined as such pursuant to the results of feasibility studies and ‘potentially economic resources’ (measured, indicated and inferred ‘resource base’) evaluated only on the basis of geological study.

CMMI countries do not recognize ‘subeconomic resources’ as a subdivision of their generally accepted classification scheme. Underlying reasons for it are quite understandable: mineral assets which may be involved in feasibility studies only: ‘measured’, ‘indicated’ and ‘inferred’ used for those after reclassifying some of them into bankable generic groups of identified resources and the remaining ones after reclassifying some of them into bankable categories.

It is often a question of bringing a mineral deposit into production have always been made on the basis of total amount of reserves within the area of exploration completed and feasibility calculations fulfilled which determine economic characteristics of a project. And there is a rule that despite the availability of reserves/resources with different levels of geological confidence therein, when preparing a mineral deposit for exploitation, the degree of knowledge about geotechnical and metallurgical properties of all reserves must be studied to the extent of requirements imposed upon resources of higher categories being present in the deposit, thus determining the conditions of bringing the whole deposit into production. The reliability of information obtained is dependent on degree of detail of a feasibility study carried out. On completion of exploration stage, the grade, mineralogy and metallurgical properties of all the reserves are explored, their hydrogeological, geotechnical and other mining conditions are studied with detail sufficient for generating a mine design. In other words, the reserves calculated in C1 category are also regarded as an object of detailed feasibility study with the same high level of accuracy as required for reserves categorized as A and B. The ratio between reserve/resource categories differing in confidence level was formerly established in connection with belonging to a deposit of a certain group of geological complexity and rather strictly regulated by special instructions. Now it is established by subsoil users themselves taking into account specific geological features of a mineral property and conditions of funding a project, upon considering the degree of inherent risk.

Proposed to be introduced as additional designations for reserve/resource categories in the official format of new Russian classification are English language terms and definitions agreed upon between UN/ECE and CMMI countries by the Denver Accord or their Russian equivalents interpreted in a rather exact way (if possible). This refers firstly to the gradations of geological assurance, viz. ‘measured’, ‘indicated’ and ‘inferred’ resources, then to the degrees of detail of technical and economic assessment: ‘prefeasibility study—TEO-2’ and ‘feasibility study—TEO-1’ and the reserve categories reflecting the highest degree of economic viability data, viz. ‘proved’ and ‘probable’. Some of the definitions agreed in Denver are of conceptual importance and hence exert decisive influence on understanding the essence and relationship of respective terms (‘resources’ and ‘reserves’). The introduction of English terms in the official statutory document might contribute to better understanding between Russian and foreign geologists, miners and economists dealing with mineral resources classification schemes, between the Russian State as the owner of mineral wealth and foreign investors.

One can see that two semantically different sets of terms have been used to designate individual categories of identified mineral resources, both being widely used in world practice and identified by any geologist with diminishing degree of geological assurance. One set of terms is intended for reserves and resources covered by any type of feasibility studies (preliminary or final): ‘proved’, ‘probable’ and ‘possible’ (as in the CIM Code), another for mineral quantities evaluated on the basis of geological studies only: ‘measured’, ‘indicated’ and ‘inferred’ used for generic groups of identified resources and the remaining ones after reclassifying some of them into bankable categories.
Compatibility with UNFC

What is continued to be recognized in the draft is the difference between 'the objective of a stage of geological assessment' and 'the requirements for a certain category of reserves/resources (A, B, C1, C2 and prognostic estimates) which presupposes a certain, pre-established (or more or less standardized) degree of a detail of study, geological assurance and accuracy of reserve/resource estimation of an individual part of a deposit (with the complexity of geological structure and variability of geological characteristics taken into account). Sometimes these notions are confused.

In a diagrammatic way, the draft classification scheme may be presented as a 3-D model with its volumetric cells defined by the same 3 digital code designations as accepted in the UNFC to refer reserve/resource classes to particular gradations (categories) along each classification axis. It is easy to verify that the two documents in question are very similar. Compatibility is easily achieved along axes 'E' (the degree of economic viability) and 'F' (the stage of feasibility assessment) of the UNFC. Economic viability of reserve/resource categories is determined in Russia by results of TEO calculations and is where the numerical index along axis 'E' is defined. As to the 'F' dimension of UNFC, it is already mentioned that implicitly the criterion of the level of feasibility studies fulfilled has always been present in all domestic classification systems. That is why to designate this level at any exploration target at a certain geological assessment stage as a separate classification attribute would not be a problem at all.

As to the main geological criterion of categorizing reserves and resources along axis 'G', serious difficulties arise. As it is evident from all the documents referring to elaboration and trial implementation of the UNFC, the UN/ECE experts regard the stages of geological assessment as closely and primarily related to the assurance of data obtained. This characteristic is a decisive one in the Russian classification (and, say, Chinese) as well. But the difference is that only one respective category is assigned to each stage of geological assessment in the UNFC. The Final Version of the document and the Guidelines to it circulated worldwide suggests that the four stages specified 'conveniently provide four categories reflecting increasing degree of geological assurance'. The experts assumed that each stage of geological assessment 'produce resource data with a clearly defined degree of geological assurance'. In our opinion, these statements are not in agreement with the standard exploration practice. With any degree of knowledge about the deposit (or target area) attained on completion of individual stages of geological exploration, the end result, as a rule, is an information product consisting of parts characterized by different degrees of geological assurance. Depending on the size of mineral property and the objective of activities conducted, the detail of study of individual portions of the subsurface plot may be quite different.

In understanding the essence and content of the criterion of reserves/resources categorization along 'geological' axis, the draft classification (as those now in use in Russia and most classifications all over the world) substantially differs from the UNFC. In the UNFC, it is the degree of geological knowledge of the deposit reflected by the stage of geological exploration, in the Russian and similar schemes the degree of geological assurance in reserve/resource values as itself. In our opinion, erroneously identifying a geological exploration stage with only one single category of geological assurance (as it is done in the UNFC) may lead to distortions in reporting exploration results and misunderstanding of the degree of geological knowledge about the deposit required at the stage of detailed exploration.

Conclusions

In our conclusions we would like to stress that in conditions of the globalization of the mining industry and cross-border activities of financial institutions, it makes sense to continue efforts in elaborating on international documents like the CMMI World Code aimed at finding a uniform pattern of reporting exploration results, mineral resources and reserves for commercial needs, and a single, more generalized Framework Code (of the UNFC type) to be used in long-term planning, economic forecasting and for other strategic purposes. The UNFC and the JORC-type CMMI Codes are not competitors. So far they serve different needs, each having raison d'être of their own. Because of the same subject and related classification criteria, there should be as much harmony and common ground as possible between them and this is where our joint efforts should be aimed.

In the opinion of the authors, the draft Russian classification presented could be regarded as a compromise between domestic requirements as to accounting and reporting mineral reserves/resources (for different needs) and international ones focusing on the generally recognized need for a Framework Classification to be developed. And we hopefully find it to be the way to follow if there is really a wish of creating an internationally applicable scheme for classifying and reporting of mineral reserve/resource data. It does not demand too much: only availability of good will and lack of false ambitions (as it seems to us). A single multipurpose classification serving all reasonable needs of the world geological, mining and investment communities may, and has all reason to, be created. One could imagine that specific sets of this alleged classification cells be chosen to be used for specific needs: the least number of them (with most reliable quantitative information) for shareholders, the fullest sets of data covering other classes of less assured identified and predicted resources for national inventories and strategic planning. Mergers of interests are possible here as both inferred reserves and mineral prospects may acquire market value in the future.

This concept was the main drive for the authors who have undertaken a rather novel attempt at the creation of a draft classification scheme which will hardly be easily endorsed by the governmental bodies as being perhaps too biased towards Western approaches and terminology (including English scripts of the terms). But this is the only way to arrive at reliable and internationally comparable information on reserves/resources to ensure global understanding of the Russia’s mineral potential and promote financing of mining projects in this country.

References


2. UN-ECE. United Nations International Framework Classification for Reserves/Resources—Solid Fuel
98


