Research on Reserve Classification of Solid Mineral Resources in China and Western Countries

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Abstract. Combined with the development and application of mining markets at home and abroad, the following understandings are obtained through comparative analysis of GB/T 17766-1999 Classification for resources/reserves of solid fuels and mineral commodities, GB/T 17766-2020 Classification for resources/reserves of solid fuels and mineral commodities and JORC Code. 1) GB/T 17766-2020 is more concise and efficient, focusing on the objective evaluation of economic value; 2) Since the form and connotation of GB/T 17766-2020 is similar to JORC Code and other Western norms, the implementation of GB/T 17766-2020 will be conducive to international integration; 3) A variety of factors caused the low recognition of domestic reports and small market influence. However, according to GB/T 17766-2020, we can gradually improve the recognition and influence by means of strengthening process management and responsibility to natural persons.

Keyword: Mineral resources, mineral reserves, JORC.

1. Introduction

Many experts and scholars have studied reserves classification of mineral resources, which is the foundation of mine development. It is generally believed that the traditional classification standard is not highly market-oriented (Zhao, 2010; Yang, 2016; Tang et al., 2013; Shi et al., 2020; Fan, 2014; Zhang, 2016; Li, 2018; Li, 2013; Li, 2014; Tan, 2014). The Ministry of Natural Resources, PRC launched GB/T 17766-2020 Classification for resources/reserves of solid fuels and mineral commodities in 2020 to replace the 10-year-old GB/T 17766-1999 Classification for resources/reserves of solid fuels and mineral commodities. Compared with the 1999 edition, the new one has made significant changes in theory and concept, mainly in the introduction of JORC and other typical Western similar norms, which can be seen as the efforts made by the mining industry to integrate with the international standards and for Chinese enterprises to go global. This paper makes a comparative analysis on GB/T 17766-1999, GB/T 17766-2020 and JORC Code, so as to provide reference for better development of domestic and foreign mines.
2. The differences between GB/T 17766-1999 and GB/T 17766-2020
Compared with GB/T 17766-1999, the main changes of GB/T 17766-2020 are as follows: 1) the exploration stage of solid mineral resources is adjusted from the original four to three, i.e., from pre-survey, general investigation, detailed investigation and advanced exploration into general investigation, detailed investigation and advanced exploration; 2) the basis for classification of mineral resources/reserves is modified, and economic axis, feasibility axis as well as geological axis are no longer taken as the basis for classification; 3) the division of economic meaning is simplified, the definitions of marginal economy, sub-marginal economy and intrinsic economy are deleted, and only the concept of economy is reserved; 4) the types of resources and reserves are simplified, and the corresponding types of potential mineral resources, predicted resources and basic reserves are deleted, and only five types of resources and reserves are retained; 5) the market economy attribute of resources is highlighted in GB/T 17766-2020, that is, reserves are resources with economic value. In other words, reserves are superior to resources, and reserves and resources can be converted. When the market performs well, resources can be converted into reserves, indicating that economic benefits can be obtained from mining ores. Nevertheless, when mining is unprofitable, the resources cannot be converted into reserves; rather, the resources that have been converted into reserves should be relegated to resources.

3. Comparative analysis between GB/T 17766-2020 and JORC Code
JORC is the abbreviation of the Australasian Joint Ore Reserves Committee (the JORC Committee) composed of the Minerals Council of Australia (MCA), the Australasian Institute of Mining and Metallurgy (The AusIMM), and the Australian Institute of Geoscientists (AIG). It sets minimum standards, recommendations and guidelines for the public reports of exploration results, mineral resources and ore reserves in Australia and New Zealand, in conjunction with securities market documents. GB/T 17766-2020 is very similar to JORC Code, but there are certain differences between the two.

3.1. Differences in industry background
The western countries have relatively mature and developed securities markets, and professional institutions independent of the government, so they can make professional and independent judgments in accordance with the regulations. Technical reports are only part of the instruments in financial market system. For example, NI 43-101 consists of three parts, that is, National Instrument for the Standards of Disclosure for Mineral Projects within Canada, Companion Policy, 43-101CP and Form 43-101F1. It is formulated by the Canadian Securities Administrators (CSA) and implemented in the Toronto Stock Exchange (TSX). In addition, The Industry Guides 7 is formulated by the US Securities and Exchange Commission (SEC) and is only part of the securities market management documents.

China's industry regulations are formulated by its corresponding ministries and commissions, with government management functions. The former planned economy saw that the association accumulated a certain degree of mature technical norms. However, due to the lack of independence and professionalism, the supporting policies and credibility of the operation are not as good as those of Western professional institutions, resulting in weak market adaptability and more administrative intervention. Further efforts are needed as the concepts, correction factors, format, and credibility of technical reports under the current specifications have not been recognized by foreign counterparts.

3.2. Differences in usage patterns
China's technical reports focus on the degree of geological control, which is still a continuation of the planned system. The amount of information needed by investors is far from enough in the reports, and the application of 3D software and geostatistics is still not popular, which are even not accepted by Chinese geologists of older generation. On top of that, the management of resources and reserves is still in the static stage. The chapters of the report are quite different from those in the West.

Reports in western countries are the result of mature market system. Meanwhile, almost all the reports use 3D software and geostatistics to establish ore body model, which is intuitive and easy to
adjust parameters. As a result, the dynamic management of resource reserves is achieved. Moreover, western reports take full account of the information of correction factors, and add the content of data verification and review by geostatistics method, which are quite different from the Chinese report chapters. In addition, the Chinese people pay attention to the general discourse, while the Westerners pay attention to the details and figures, so there are great differences in the report style. As a public reporting specification, JORC code does not specify how a Competent Person can predict mineral resources or ore reserves.

Both GB/T 17766-2020 and JORC Code emphasize the market economy attribute of mineral resources, that is, after economic feasibility assessment, reserves are resources that can be exploited and economic benefits can be obtained, while resources focus on geological confidence.

3.3. **Difference in reserve calculation and economic evaluation**

Through pre-feasibility study and feasibility study, GB/T 17766-2020 reserves are determined by the economically recoverable part of measured and indicated resources. JORC emphasizes that JORC's key issues must be clear, for example, the reference point for reserve definition must be stated, usually when the ore is shipped to the processing plant; the basic assumptions and key results of the prefeasibility study and feasibility study must be disclosed when the new or published ore reserves are reported to have substantial changes according to market changes; the estimated ore quantity and grade obtained by applying the correction factor can be used as the basis of an economic and technical feasible project. In the absence of mine design or mine planning, it is unacceptable to get ore reserves only by considering various factors of mineral resources. For instance, due to the failure to achieve the original commercial production date, a West African iron ore mine of Rio Tinto has announced that the approximate reserves have been cancelled and re announced as resources. Note that the mine planning here is detailed, equivalent to the preliminary design in China. "Economically recoverable" means that under reasonable financial assumptions, its connotation varies with the deposit type, research level and financial standards of individual companies. In other words, there is no fixed definition. But the financial model of financial assumption is detailed and executable.

GB/T 17766-2020 requires analysis of mining, processing, metallurgy, infrastructure, economy, market, law, environment, community and policy for mineral resources development projects, so as to study the technical feasibility and economic rationality of the project in details. However, it does not make detailed provisions on the indicators, leaving much room for maneuver. At the same time, there is a lack of effective measures against the improper use of indicators or fraud. Therefore, although GB/T 17766-2020 seems to be in line with the international standards in form, yet, in actual operation, it is likely that there will still be the same assessment as the previous reports: "almost all mines are economically valuable and worth mining".

3.4. **Significant differences in market influence**

JORC code emphasizes three principles, i.e., transparency, substantiality and competence, which are the soul of JORC code. Transparency requires the public report to provide sufficient information and clear expression so that readers can understand and won’t be misled. Substantiality requires that the public report contains all the relevant information required by investors and their professional advisers, so as to make a reasonable and balanced judgment. Where no relevant information is provided, the reasons for not including the information must be explained. Competence requires that the person in charge of the public report must be a competent person, which is not only written on paper, but also implemented in action. The report information provided by the competent person is not allowed to have any lack of information, which will affect the public perception of the occurrence of minerals, or keep any silence on the material of its value. JORC has extremely high requirements for competent persons. They must be certified members, obtain work qualifications, and have several years of work experience in the field of mineral deposits evaluation. Under these conditions, all parties can obtain satisfactory and credible public reports without questions. These are the reasons why Western reports such as JORC are widely accepted.
As for China's specifications, due to the large reserved space and lack of consideration of correction factors, there is a big gap between China and the West in terms of fineness and professionalism of economic evaluation; the reports are often not rigorous enough to state the shortcomings in a realistic way. The responsibility for the preparation of the report is in the order of administrative level, not given to the report author. Given the large man-made maneuverable space, almost all the reports concluded that it has mining value, which is obviously inconsistent with the facts.

Generally speaking, although GB/T 17766-2020 is very similar to JORC in form, due to various reasons, a large number of reports are difficult to be trusted by investors in a short period of time.

4. Conclusion
The following conclusions are drawn through comparative analysis: 1) GB/T 17766-2020 is more streamlined than the previous edition. It highlights the market attributes of mineral resources so that it can more effectively guide the development of mineral resources; 2) GB/T 17766-2020 and JORC are very close in form and definition, so they can be effectively compared. GB/T 17766-2020 is the embodiment of China's mining development standards in line with international standards, and it can better guide mine development at home and abroad; 3) Due to various reasons, the credibility of domestic reports needs to be greatly improved compared with JORC and other Western standards. In view of the extremely low effective guidance for mine development, it can be gradually improved by means of strengthening the process management of mineral resource exploration, conducting scientific and rigorous economic feasibility assessment, and assigning responsibilities to natural persons.

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