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Relations between: Rational Subsoil Use, Ultimate Recovery and Commercial Efficiency of Mining Mineral Deposits

The article provides a view on reasonable limitation of requirements to ultimate recovery of deposit's reserves and offers approaches to definition of possible measures to improve subsoil users' fair practices and provide reliable information.

Ключевые слова: economic effect, deposit, investment opportunity, national interests, socioeconomic effect, rational subsoil use, ultimate recovery, selective mining.

In his works, the author of the article repeatedly reviewed the role of the state in regulation of the subsoil use, geological and economic evaluation of mineral deposits and monitoring of the rational subsoil use. A position that public benefit should be duly considered, and selective mining of reserves is unacceptable was advocated many times. It was pointed out that the effect of deposit mining is more comprehensive for the state than for a private investor and includes:

- Dealing with unemployment issues and issues of growth of citizens' well-being.
- Revenues from tax, customs duty, environmental charge and other duty and fee receipts at different budget levels.

- Building of infrastructure that can be used by other enterprises.
- Ensuring capacity utilisation of the adjacent sectors as well as industries manufacturing high value-added final products.
- Supply of raw materials to industries strategic for the state (incl. defence industry), thereby implementing full economic and political independence of the country.

All the above undoubtedly requires state control in the area of the subsoil use from the perspective of maximum socioeconomic effect on the project area and the country in general, with this certain discord in the subsoil user and state purposes taken into account. As often as not, an investor will prefer higher-IRR rather

than higher-NPV projects, which, in some cases, can be achieved through selection of higher-grade areas for mining with permanent loss of areas less profitable for mining. Building of a cash flow model in the process of recording reserves on the state balance is at a discount rate of 10% (in real terms) and on condition that $NPV \geq 0$. At the same time IRR at a level of 15-20% and a payback period of no more than 5-7 years is a traditional criterion for a private business to enter a project. In a number of cases an investor may enter tougher conditions of return on investment; however, this is an exception rather than the norm.

As has been repeatedly mentioned, the influence of deposit mining on the national economy is often underestimated, and this is not only budget efficiency (that traditionally takes into account only direct tax receipts from deposit mining after it is recorded on the state balance) but also budget revenues from utilization of the adjacent sector capacities and strategic supply of raw materials to the state. Decommissioning of this or that deposit mining directly necessitates replacement of the processing company feed by an alternative source. In this sense it is indeed critical for the state to ensure maximum resource base, life of mine and annual production as well.

However, in this article the author attempts to defend common sense and make mineral reserve balance inventory, exploration parameters and interpretation of ultimate reserve recovery free from some individual excesses. Being aware of the current work under way to change over to a new reserve classification system associated with some revision of terminology and methodological approaches, the author believes that the addressed issues dealing with practical applicability of the classification system and recommended mineral reserve estimate practices will still be of importance in future.

Not always, but in some cases, the term «reserve ultimate recovery» is misinterpreted, namely, it is understood as maximization of the resource base by means of extension of clearly unprofitable mineralization. And the rational subsoil use is equated with maximization of the extracted mineral, without considering economic profitability of its involvement into economic turnover. The following may serve as examples of similar approaches:

1. Involvement into mining of ore body areas with parameters below the break-even;

2. Involvement into mining of coal seams with parameters below the cut-off and in occurrence conditions not allowing efficient mining (e.g., steeply dipping coal seams in underground mining).

3. Involvement into mining of ore levels and coal seams with access and mining costs exceeding final product sales revenues produced by these quantities of the mineral.

4. Involvement into mining of extraction panels, wings, etc. with quantities of reserves not allowing repayment of investment for their development and mining.

5. Involvement into mining of underground areas (below the open-pit mining boundaries) with access and mining costs exceeding final product sales revenues produced by these quantities of the mineral.

6. Extensions beyond the open-pit mining boundaries to include reserves with incremental stripping ratio markedly higher than the economic stripping ratio.

7. Involvement into mining of local open-pit mining areas with reserves not repaying investment in their development and mining.

In all the above cases, balance inventory of the extended reserves is supported by an arithmetic operation of addition of reserves unprofitable for mining and reserve with positive profitability (adjacent profitable sites, seams, open-pits, extraction panels, simultaneous open-pit mining and unprofitable part of underground mining etc.) producing total positive profitability per averaged tonne of mineral mined.

The above cases should not be confused with mining of a **by-product mineral (mineralization volume)** that does not require significant additional access and mining costs (e.g., a mineral in overburden etc.). In this case we don't mean the reserves that, when excluded, may make it impossible to mine major reserve share either. E.g., it is not always advisable to exclude a local open-pit extension that is characterized by incremental stripping ratios higher than the economic stripping ratio, when the underlying ore-bearing (coal-bearing) conditions significantly change to lower incremental stripping ratios or higher economic stripping ratio (higher mineral grade/quality etc.). All the above cases include the subsoil sites that may be considered as independent extraction units (reserves to be extracted using a different mining system, technological unit etc.) or with a possibility of conservation of reserves to be extracted in the long term.

Consideration of both unprofitable and profitable reserves in one 'pot' distorts the term 'balance reserves' itself that implies positive economic efficiency of mining. Thus, according to "Classification of Solid Mineral Reserves and Prognostic Resources" (order of the Ministry of Natural Resources of the Russian Federation dd. 11 December 2006 N 278), the balance (economical) reserves include reserves, mining of which, according to technical and economic calculations, **is economical in competitive market environment** at the time of reserve estimates using mineral mining and processing machinery and technologies ensuring compliance with rational subsoil use and environmental protection requirements".

The generally accepted interpretation of the term *rationality* (without reference to a specialized area of human activities) implies reasonableness, sense of purpose, opposite to irrationality. Art. 123 of the Model Code “On Subsoil and Subsoil Use for CIS Member States” provides the following definition of the rational subsoil use: “The rational subsoil use is understood to mean implementation of such a package of technical, technological, legal, organisational, financial and credit, taxation and other measures that on meeting the subsoil limitations, norms, standards and rules in the process of the subsoil resource study, mining and use give the state and society the highest socioeconomic effect from use of the natural resource of the site under review”. It should be taken into account that socioeconomic effect of mining of a priori unprofitable reserves is negative and causes the following damage to society:

- Combining of negative profitability “reserves” and positive profitability reserves causes minimization (down to 0) of the profit tax (20%) that forms one of the main fiscal revenue items in subsoil use.
- In fact, the investor interest in the project is lost or minimized, which prevents the national economy from development and most negatively impacts raw materials security, population employment etc.
- Considering high capital expenditures in construction of mining operations, as a rule, high share of borrowed capital in the mining project funding structure as well as volatility of mineral prices, economic stability of the project goes down.
- This causes reasons for objective criticism as to the quality of the Russian system of geological and economic site evaluation and objectivity of the reserve expert review.

As a result, many subsoil sites may become unclaimed and will not find a real investor intending to mine them. Meanwhile, as has been repeatedly mentioned, the state is interested in the earliest possible start of deposit mining attracting capital in this area, which causes consideration of business interests as well.

Moreover, there is a number of mechanisms to exclude the “imposed” reserves in the process of subsoil use – managing the deposit mining sequence through use of technical project solutions, obtaining an opinion report on sequence of mining seams in a series (levels of ore) by a specialized organization and excluding some sites from initial mining due to mining safety factors etc.

Therefore, there is no doubt that the interest of the state is to maximize the mineral quantities, to avoid selective reserve mining, however, involvement into mining of essentially “barren rock” is irrational and inflicts damage to the national economy. It can be said that the state is interested in avoidance of economical reserve

selective mining but not only due to commercial project success, maximization of socioeconomic effect of deposit mining. **However, ultimate reserve recovery ≠ maximization of “mineralization” that is recorded on the state balance.**

Generally speaking, the following set of justification (non-justification) criteria for involvement of additional “mineralization” into mining can be pointed out:

- It is impossible to mine it as an independent extraction unit or it is impossible to exclude it from mining without loss of the remaining mineral base.
- Operating profit per 1 tonne of the additionally extracted mineral base is ≥ 0 .
- Significant capital expenditures are not required.
- The project NPV grows or remains at the same level.

This approach does not contravene para 5, art.23 of the Law of the Russian Federation “On Subsoil” dd. 21 February 1992 N 2395-1 containing a requirement “to ensure ultimate recovery of primary and associated mineral and by-product component reserves”, provided that it is the economical part of total mineral resources that is understood by reserves, which in terms of terminology is essentially equal to balance reserves in their classical definition.

Therefore, the ultimate recovery of minerals should be understood as a component of the term ‘subsoil use rationality’ subject to a combination of requirements for balance reserves. It is advisable to take account of part of mineralization that could be considered as economical ore mass in tax concession scenarios (MET etc.) as a separate item, e.g., getting the term ‘potential balance (marginally profitable) reserves’ back, which will allow adopting informed government incentive approaches (when applicable). In by-product mining, stricter requirements for consideration of extraction and individual stockpiling options, in case if there is a technical capability not associated with significant growth of operating expenditures, are quite justified for this part of mineralization.

It should be noted that in some cases the “subsoil user” itself insists on involvement into mining of “reserves”, to put it mildly, of little promise for profitable mining, which can be achieved through blatant misinterpretation of the deposit mining project expense and revenue sides provided in TEO (Technical and Economic Characterization) of parameters or through addressing to unproven mining and processing technologies. In some cases, we may even speak of a direct statement of desire for mining really unprofitable reserves. The pursuit of this aim can be caused by:

- A desire by the authors of the TEO of parameters to make going through expert review

simpler by means of stating the most ultimate recovery of reserves.

- A desire to form a fictitious large resource base for further “packaging” in a smart cover and resale to third parties, additional company capitalization by recording reserves in the books, creation of a favourable picture for IPO etc.

In this case it should be understood that a “paper” project with virtual reserves will bring the same socioeconomic effect. The state is interested in the earliest possible subsoil site development and annual production maximization, which is not possible with “imaginary” reserves. Moreover, this challenges reliability of reserves recorded on the state balance on the part of both Russian and international investors. In this context an impartial GKZ assessment shall set both maximum objective interests of the state in subsoil use and ensuring reliability of real reserve balance inventory data and allowed assumptions in the provided substantiations as a goal. At least all risk factors or doubts in realistic project implementation with the provided assumptions (substantiations) shall be clearly reflected in the summary part of minutes for review of the TEO of parameters.

The probabilistic nature of data on mineral quantity and quality, geological and mining conditions of the deposit exploitation results in high investment risks, which imposes additional requirements for both geological and economic assessment data reliability and confidence. Besides, confidence in input data can be additionally supported by deliberate distortion (mystification) by the subsoil user of the basic input data, including:

- Geological exploration data – actual scope of exploration, findings etc.

- Data on mineral washability and metallurgical ore properties.

- Results of studying the deposit’s geological and mining conditions.

- Data of the actual operation and current status of mining at the mineral property (selective mining with unaccounted excessive losses, not approved stockpiling at mineral deposit areas, production with violation of mining boundaries not reflected in the provided graphic and text materials etc.).

In spite of the fact that these actions can be considered as fraud acts even according to the Law in force, it makes sense to speak of the necessity of introducing additional legal responsibility fixed in the law for deliberate distortion of data on geological and technological knowledge of the deposit, distortion of statistical reporting data, incompliance with design solutions resulting in damage done to the state, with an adequate compensation and undertaking legal actions against people guilty of distortion of information. Considering that GKZ works with submitted data and cannot always directly trace (prove) their correctness and veracity, the control may be implemented by initiation of extraordinary special-purpose inspections by Rostekhnadzor and Rosspirodnadzor bodies in cases, when significant reserves are written off.

By way of conclusion, it should be noted once again that the role of the state must be related not only to monitoring and punishment functions in the area of meeting license obligations and requirements in the area of subsoil use but also laying of comfortable groundwork for investment opportunities, investor protection from fraud or arbitrariness of officials, economic project incentives. **XXI**

Литература

1. A.D. Trenin, A.I. Ezhov, A.A. Tverdob, S.E. Matveichuk. Man-Made Raw Materials in the Area of Solid Minerals as a Most Important Resource in Development of New National Economy. M: “Nedropolzovanie- XXI Vek”, № 46, 2020.
2. A.A. Tverdob, A.I. Ezhov, A.D. Trenin, S.B. Nikishichev. Important Tasks on the Agenda of Involvement of Man-Made Deposits in National Economic Turnover. M: “Nedropolzovanie- XXI Vek”, № 4, 2017.
3. S.B. Nikishichev, A.A. Tverdob, A.V. Zhura. Specifics of Investment Opportunities in Mining Projects. M: “Mineral Mining & Conservation”, №2-3, 2019.
4. A.A. Tverdob. National Economic Significance of Mining Mineral Deposits. M: Mine Surveying and Subsurface Use, № 3 2017.
5. A.A. Tverdob, A.V. Zhura, S.B. Nikishichev. Mining Project Risks. Assessment Objectives and Methods, M: “Russian Mining Industry Journal”, № 2 (114) 2014.
6. A.A. Tverdob, A.V. Zhura, S.B. Nikishichev. Investments in Mining Projects: Types and Instruments of Investment Attraction. M: “Banks and Business World” September, 2013.
7. A.A. Tverdob, A.V. Zhura, S.B. Nikishichev. Improvement of Budget Efficiency and Socioeconomic Effect Assessment Methods in Deposit Mining. M: “Nedropolzovanie- XXI Vek”, № 3, 2013.
8. A.A. Tverdob, A.V. Zhura, S.B. Nikishichev. Support to New Mining Projects in Kazakhstan at Greenfield Stage. “Mining Journal of Kazakhstan”, November, 2011.
9. A.A. Tverdob, A.V. Zhura, S.B. Nikishichev. Valuation of Mining Companies: International Aspect. M: M: “Nedropolzovanie- XXI Vek”, № 5 “International Reserve Reporting Practices”, November, 2011.
10. A.A. Tverdob, A.V. Zhura, S.B. Nikishichev. Valuation Methods of Reserves Contributing to the Mining Company Value. M: “GLOBUS”, № 5 (18) September, 2011.
11. A.A. Tverdob, S.B. Nikishichev, A. V. Zhura. Use of Income Valuation Methods in Mining Company Valuation for Different Reporting Purposes. Krasnoyarsk: “GLOBUS”, № 5 (18) September, 2011.