ABSTRACT

of the dissertation for the degree of Doctor of Philosophy (PhD) in specialty 6D070600 – Geology and Mineral Exploration

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Development of theoretical and practical aspects of geological and economic assessment of the Kusmuryn deposit

Relevance of the topic: The exploration industry is considered as the initial link and the basis for the future uninterrupted functioning of the entire mineral resource complex of the country. A special role in increasing production levels and ensuring the growth of the country's mineral resource base is assigned to Central Kazakhstan. Geological and economic evaluation of deposits is a particular importance during the period of not only transformations, the change of one economic system to another, but also in the context of the complexity of exploration work, when it is necessary to identify objective patterns of development of exploration production as a specific area of economic activity.

The key condition for the transition of Kazakhstan from a raw and transit strategy for the development of regions to an innovative economy is an in-depth study of the laws governing the development of the mineral resource base, based on improving the methodology for a comprehensive (geological and economic) assessment of deposits.

For many years priority has been given to substantiating the effectiveness of exploring proven reserves and reserves of already discovered deposits. As the natural resources of Kazakhstan were depleted, exploration activities moved to hard-to-reach areas and waters, mining and geological development parameters worsened, there was an urgent need for an economic assessment of new territories that have forecast resources, but are characterized by a low degree of knowledge and lacking the necessary transport, energy and processing infrastructure . All this determines the relevance of the topic of this study, its scientific and practical significance**.**

The purpose of the study: is to develop theoretical and practical questions of geological and economic assessment of the deposit based on a detailed study of the geology, mineral composition, technological properties of ores, the level of development of industrial and economic activities of the territory.

To achieve this goal in the study, the following **tasks** were solved:

- studied the features of the geological structure and the material composition of the ores of the deposit;
- the optimal choice of reserves development based on the geological and economic assessment of the Kusmuryn deposit has been substantiated;
- a geological and economic model for the exploitation of the Kusmuryn deposit based on the geological structure has been developed.

The scientific novelty of the study:

- the geological and economic model of the Kusmuryn deposit is developed taking into account the innovative instructional requirements of KAZ RC based on the feasibility study of solid minerals conditions;

- an economically viable option of reserves development was substantiated, taking into account the new results of geological exploration in 2017-2019. in the Kusmuryn deposit.

- on the basis of the analysis of the results of laboratory and technological studies, it was proved the inappropriateness of involving in the processing of associated components (S, Cd, Se, Te).

The validity and reliability of scientific provisions, conclusions and recommendations: is confirmed by the use of analysis of literary and stock materials, the use of correct economic and geological information about the Kusmuryn deposit, carrying out variant calculations and practical testing of the results.

The practical significance of the work.

The obtained results of the thesis complement the scientific basis of the geological and economic assessment of the Kusmuryn deposit are used to improve the scientific basis for predicting GEO-KZ LLP and can be used for the feasibility study of other deposits of Kazakhstan and the substantiation of methods for their development.

The scientific and practical significance of the work is:

–the development of recommendations on the justification of requirements for the quality of raw materials in order to establish specific conditions for the involvement in the development of natural raw materials of excellent composition, the use of various physical, technical and physico-chemical geotechnologies;

- the use of research results and the proposed methodology allows a comprehensive geological and economic assessment of the Kusmuryn deposit, manage reserves during the operation of the field, determine the contours of active reserves according to preliminary exploration, reduce the time spent on technical and economic calculations;

- the proposed methodological approach will allow us to determine the further feasibility of developing mineral deposits, choosing production methods that ensure cost reduction and increase the volume of production of mining products.

Implementation of the results of the work:

- in GEO-KZ LLP (Ust - Kamenogorsk);

- in the educational process of KSTU in the specialty 5B070600, 6M070600, 6D070600 “Geology and exploration of mineral deposits”.

Actual material and personal contribution of the author:

The dissertation, carried out at the Department of Geology and Exploration of the ME of KSTU, takes into account the scientific and research results of the collectives of Kazakhstan (RSE "National Center for the Integrated Processing of Mineral Resources of the Republic of Kazakhstan", Ust-Kamenogorsk; Kazakhmys Exploration LLP, Karaganda; LLP “Kazakhmys Corporation”; Head Design Institute, Astana), with whom the author collaborated and consulted.

The author worked with archival materials on the Kusmuryn deposit in the

department of state balance and geological funds of the Republic state institution "East Kazakhstan Interregional Department of Geology and Subsoil Use of the Committee of Geology and Subsoil Use of the Ministry of Industry and Infrastructure Development of the Republic of Kazakhstan" Vostkaznedra "(Ust-Kamenogorsk, 2018)

Analytical studies on the topic of the dissertation, familiarization with foreign experience on the issue under consideration were carried out by the author during scientific internships in the State Commission of Ukraine on the reserves of cinnamon copalin (State Commission of Ukraine for Mineral Reserves) (Kiev, 2018) and in GEO- LLP KZ "(Ust-Kamenogorsk, 2019).

The dissertation includes the material of a seminar on the implementation of the international reporting standard CRIRSCO on solid mineral reserves and SPE PRMS on hydrocarbon reserves (Astana, 2017), in which the author took part.

Testing the work:

The key provisions of the thesis were reported at the international symposium and conferences: XXII International Scientific Symposium of students and young scientists. Academician M.A. Usova "Problems of geology and subsurface development", (Tomsk, 2018); Republican Student Scientific Conference "The Contribution of Youth Science to the Implementation of the Kazakhstan-2050 Strategy" (Karaganda, 2018); International scientific-practical conference "Integration of science, education and production - the basis for the implementation of the Plan of the nation" (Saginov readings No. 10) (Karaganda, 2018); 14th International Conference on Mining, Construction and Energy (Tula-Minsk-Donetsk, 2018); All-Russian scientific conference dedicated to the 70th anniversary of the founding of the Ural branch of the Russian Mineralogical Society "VII Readings in memory of corresponding member RAS S.N. Ivanova "(Yekaterinburg, 2018); VIII All-Ukrainian Youth Science Conference, (Kyiv, 2019); International scientific and practical on-line conference "Integration of science, education and production - the basis for the implementation of the Plan of the nation (Saginov readings No. 12) (Karaganda, 2020).

A patent of the Republic of Kazakhstan "Method for nuclear-physical analysis of a geological core" (co-authored) was obtained.

Two internships were completed: the problem was carried out by the author during scientific internships in the State Commission of Ukraine on the reserves of cinnamon copalin (State Commission of Ukraine for Mineral Reserves) (Kiev, 2018) and in GEO-KZ LLP (Ust-Kamenogorsk , 2019).

Publications. On the topic of the dissertation published 6 works, 4 of them in journals recommended by KKSON MES RK (University Proceedings, Bulletin of EKSTU, Industry of Kazakhstan); 2 articles in journals included in the Scopus database and the Web of Science Core Collection (Sustainable Development of Mountain Territories (RF), Naukovi Visnik Natsionalnoho Hirnychoho Universytetu (Ukraine); one monograph co-authored and 5 reports in materials of international scientific conferences.

The structure and scope of work.

The dissertation includes an introduction, four chapters, and a conclusion. The

total volume of the dissertation is presented on 126 pages contains 18 drawing and 38 table. References consist of 109 items.

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Findings:

1. The exploration industry is seen as the initial link and the basis for the future uninterrupted functioning of the entire mineral resource complex of the country. A special role in increasing production levels and ensuring the growth of the country's mineral resource base is assigned to Central Kazakhstan. At the same time, the economic side of geological exploration is not well understood. Economic indicators of the industry are reduced to an increase in reserves and the dynamics of the physical volume of work. At the same time, geological and economic evaluation of deposits is of particular importance during the period of not only transformational transformations, the change of one economic system to another, but also in the context of the complexity of exploration work, when it is necessary to identify objective patterns of development of exploration production as a specific area of economic activity.

2. The conducted studies allowed us to classify the ores of the Kusmuryn deposit as the pyrite industrial type of copper ores and to distinguish two technological varieties, primary sulfide ores and mixed ores by the content of secondary and oxidized copper compounds. Due to the limited prevalence of solid ores and the vagueness of their borders with vein-disseminated ores, it is economically proved inappropriate to separate these ores into independent technological varieties, rich ores, for zinc and precious metals, can be worked out in a combined way, mining by horizontal layers with a tab is recommended.

Performed by alternative calculation of reserves, using the developed theoretical and methodological requirements based on the choice of a single criterion and the temporary nature of the economic assessment.

3. It has been proved that it is economically feasible to conduct underground mining, since the main reserves of polymetallic ores are concentrated below a horizon of 600 m.

4. A field operation model has been developed for the option of an on-board copper grade of 0.7%, with open-pit mining at stage 1 of the reserves. In the subsequent transition to underground mining, with the transportation of ore by road to the Karagailinsky PF (210 km).

5. The methodological approach to assessing the expected efficiency from investments has been improved, it has been shown that the cash flows arising from the development of a mineral deposit must be adjusted for the amount of cash flows associated with the sale of extracted associated minerals.

6. For the first time, a geological and economic model was developed that took into account economic indicators of the extraction of associated components, calculated the cost of all valuable components in copper concentrate, taking into account their possible extraction in the metallurgical industry, recommended Kazakhmys Corporation LLP to transfer economic inactive balance reserves of associated components (selenium, cadmium, tellurium, sulfur), accounted for in categories C1 and C2, in off-balance reserves.