ANNOTATION

of dissertation completed by **Kurmangazhina Madina**
on the topic: **«Study of three-dimensional model constructions of Syrymbet ore field deposits as a basis for predicting rare metal mineralization»**
presented for obtaining the Doctor of Philosophy (PhD) academic degree on the educational program **«8D07205 - Geology and exploration of solid mineral deposits»**

General characteristics of the work.

Our country is undoubtedly among the group of world leaders in terms of the wealth of its mineral resources. But despite this situation, replenishing and strengthening the mineral resource base is an important and urgent task of the exploration industry. At the present stage of Kazakhstan's development, a number of priority sectors of the mineral resource complex are highlighted, which require strengthening of raw material bases, which in turn will require the reversal of geological research on a qualitatively new scientific and methodological basis using effective predictive prospecting technologies of a new generation.

Subsoil use and the economy of Kazakhstan are always closely linked, therefore, the well-being of our Republic depends directly on the modern effective approach to conducting geological research. At the government level, the National Project "Technological breakthrough through digitalization, science and Innovation" was adopted, dated October 12, 2021, No. 727, which also covers the geological industry of our Republic, in order to raise it to a new level, which will contribute to the discovery of new mineral deposits. In the same year, the State Program of Geological Exploration for 2021-2025 was adopted, the purpose of which is to create conditions for sustainable replenishment, development and support of competitiveness of the mineral resource base of the Republic of Kazakhstan. These documents determine a new approach to the methodology of geological research and ore objects.

The geological industry knows that one of the most promising and unique areas in Northern Kazakhstan are rare-metal and rare-earth manifestations in the Syrymbet ore node. The creation and research of three-dimensional models of the deposits of the Syrymbet ore field within the framework of the state program for Digitalization of Kazakhstan, which also covers the geological industry of our country, gives us the opportunity to display the most important elements using digital models of deposits and interpret the results of geological research in a new way.

Therefore, this research work is timely and relevant.

The problem of forecasting promising areas for the identification of new ore deposits or areas within known deposits lies in the establishment of ore-controlling factors of ore localization and, accordingly, forecast criteria. At the present stage of the development of geological science, the optimal system of predictive criteria can be based on the results of research work carried out by modern innovative methods (GIS-technology), where stable connections in the spatial distribution of mineralization in geological structural complexes with their certain material types, and features of composition and structure are most clearly revealed.

The purpose of the research is to identify promising areas within the Syrymbet ore field based on the analysis systematization and supplementation of ore-controlling factors of ore localization and forecasting and prospecting criteria.

The object of the study is the Syrymbet deposit, which is located within the eponymous ore field.

The subject of the study is the mineralogical composition of bedrock and weathering crust, the patterns of distribution of tin ore content and associated rare earth mineralization within the Syrymbet deposit.

Main tasks:

- generalization and systematization of complex geological data on the Syrymbet ore field;
- the study of the mineral composition of bedrock, weathering crusts, and the material composition of ores, as well as the isolation of the main minerals-carriers of rare earth mineralization;
- construction of three-dimensional models of the Syrymbet field with visualization of their structural features;
- study of ore-controlling factors and their supplementation with new data;
- identifying promising areas within the studied objects based on the analysis, systematization of ore-controlling factors and three-dimensional model constructions and.

Factual material and research methods.

The dissertation is based on the materials collected and analyzed during the implementation of the project on the topic: BR10264324 "Micro- and nanomineral components of ores as a resource for replenishing mineral reserves of Kazakhstan for the development of technologies for their development" for 2021-2023. The actual stone material was selected by the dissertator during field geological studies, route observations of outcrops and core documentation of exploratory wells, as well as geological materials of other researchers published in the press, both in Kazakhstan and abroad.

During the office period, the Adam Mickiewicz University (Poland, Poznan) and the Institute of Geological Sciences named after K.I. Satpayev analyzed and described transparent (more than 50 pieces) and polished (more than 70 pieces) sections. Sample preparation (crushing, abrasion), preparation of thin sections and thin sections, spectral, atomic absorption analysis, electron probe microanalysis, X-ray analysis to study the material and elemental compositions of the selected stone material were carried out at the laboratory base of the Institute of Geological sciences named after K.I. Satpayev.

Based on this, the structural and tectonic structure of the ore field, the patterns of spatial distribution of mineralization, the main parameters of the formation of the deposit were studied: the material composition, technological properties of ores. The main mineral associations and types of ores were studied by mineralogical, petrographic and geochemical methods.

After summarizing and analyzing the materials of previous work carried out by geological production and scientific organizations, three-dimensional models of the Syrymbet deposit were built at these facilities using the computer program Micromine end Leapfrog Geo in order to identify the most promising areas for exploration.

Indemnified Provisions:

1. In the Syrymbet ore field, rare-metal-rare-earth deposits of endogenous and exogenous origin are genetically and spatially connected with intrusive massifs, where endogenous deposits are localized in their apical parts, and exogenous ones in their weathering crusts;
2. At the endogenous rare-metal deposit Syrymbet, the carriers of rare metals are - cassiterite, scheelite, the chemical composition of which includes rare and trace elements in the range from 10 to 30%, in the accessory mineral zircon, the content of trace elements reaches up to 50%.
3. Each ore area of the Syrymbet deposit has its own pattern in terms of the spatial distribution of tin content: in the South-Western area there is an increase in tin content with depth, in the Central area - high tin content in the entire direction, in the North-Eastern area - a decrease in tin content to the north, as well as with depth.
4. The digital geographic information system, the material composition of tin ores and the 3D model of the Syrymbet deposit make it possible, based on the identified ore-controlling factors, to determine predictive prospecting criteria and recommend promising sites for prospecting.

Scientific novelty.

At present, scientific geological studies carried out by innovative methods make it possible to supplement the system of ore-controlling factors with new

predictive criteria. In this regard, for the first time, we consider those criteria that are based on computer model constructions as additional criteria for predicting rare-metal mineralization, since they are very informative. Therefore, a digital geoinformation database was created using complex geological and analytical materials and a three-dimensional model of the Syrymbet field was built.

In addition, mineralogical studies were carried out to determine the mineralogical composition of bedrock and weathering crust, as well as the chemical composition of samples from the Syrymbet deposit was studied using a scanning electron microscope SEM S-3700N and microprobe analysis. As a result, for the first time, the qualitative chemical composition of ore minerals (cassiterite and scheelite), as well as secondary and accessory minerals of this deposit, was obtained.

Personal contribution of the author.

It consisted in collecting, processing, systematizing, summarizing and interpreting factual materials of geological and mineralogical directions, in building three-dimensional computer models of the Syrymbet deposit, in conducting mineralogical research, as well as in improving and systematizing forecasting and prospecting criteria for rare metal deposits in Northern Kazakhstan.

Practical significance.

Within the boundaries of the Syrymbet deposit, promising areas for rare metals have been allocated. They can be recommended to subsoil users and authorized state bodies for further exploration work.

Approbation of research results.

The main provisions of the dissertation were discussed at the meetings of the Departmentof Geological Survey, Prospecting and Exploration of Mineral Deposits of the Institute of Geology and Oil and Gas Engineering named after K. Turysov of Satbayev University, reported. The results of mineralogical studies are reflected in the scientific report on the Program: "BR10264324 "Micro- and nanomineral components of ores as a resource for replenishing mineral reserves of Kazakhstan for the development of technologies for their development" (2021-2023).

Publishing.

Based on the results of the scientific research, 6 articles and reports were published, including 3 papers in an international scientific journal included in the Scopus database and having a percentile above 35

- L. Issayeva, K. Togizov, A. Duczmal- Czernikiewicz, **M. Kurmangazhina**, D. Muratkhanov. Ore-controlling factors as the basis for singling out the prospective areas within the Syrymbet rare-metal deposit, Northern Kazakhstan (article). Mining of Mineral Deposits. Volume 16, Issue 2, Dnipro (Ukrainian) 2022y. P.14-21. ISSN 2415-3435. https://doi.org/10.33271/mining16.02.014 (General Engienering/procentile 70).

- Z.Ablessenova, L.Issayeva, K.Togizov, S.Assubayeva, **M. Kurmangazhina**. Geophysical indicators of rare-metal ore content of Akmai-Katpar ore zone (Central Kazakhstan). Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu. 2023, (5): P.34-40, ISSN 2071-2227. https://doi.org/10.33271/nvngu/2023-5/034 (General Engienering/procentile 41).

- K. Togizov, L. Issaeva, D. Muratkhanov, **M. Kurmangazhina,** Maciej Swęd, , A. Duczmal- Czernikiewicz. Rare Earth Elements in the Shok-Karagay Ore Fields (Syrymbet Ore District, Northern Kazakhstan) and Visualisation of the Deposits Using the Geography Information System (article). Minerals, Volume 13, Issue 11, 2023. P.1-17 ISSN 2075-163X. https://doi.org/10.3390/min13111458 (Geology/procentile 70. Q2).

Articles in scientific journals recommended by the Committee for Quality Assurance in the Field of Science Higher Education of the Ministry of Science and Higher education of the Republic of Kazakhstan.

- **M. Kurmangazhina**. Some features of the formation of tin ore mineralization at the Syrymbet deposit. Proceedings of the University (KarTU). 2023. №1 (87). pp. 95-99 https: //DOI 10.52209/1609-1825_2023_1_95.

- **M. Kurmangazhina**, Y.K. Arshamov, A.A. Antonenko. Tin deposits of the Kokshetau ore region and prospects for expanding the mineral resource base of tin in the region. Proceedings of the University (KarTU). 2023. №3 (87). pp. 199-205, https://DOI 10.52209/1609-1825_2023_3_199.

Materials of international scientific and practical conferences:

M. Kurmangazhina. The Syrymbet and Shokkaragai deposits are reference objects of the rare-metal and rare-earth type of mineralization in Northern Kazakhstan. Satbayev readings – 2021, Volume 1. pp. 117-121. 2021. ISBN 978-601-323-246-1.

Scope and structure of work.

The dissertation consists of an introduction, five chapters and a conclusion and contains 132 pages of printed text, 28 tables, 41 figures and photographs, as well as a list of references of 94 titles.

The author expresses special appreciation and gratitude to my supervisors PhD, Professor Togizov K.S. and and candidate of geol.-min. sc. Professor Arshamov Ya.K. for the materials provided, the guidance of scientific work, the discussion of the results and recommendations for the approbation of intermediate and final research results.

The author expresses her sincere gratitude to foreign supervisor PhD, Agata Duczmal-Czernikiewicz (Adam Mickiewicz University in Poznan) for the opportunity to undergo a foreign research internship and consultation in the performance of mineralogical and chemical research.

professor Baybatshe A.B. – for assistance in writing a dissertation in Kazakh during the work on the dissertation, as well as Dr. of geol.-min. sc. Bekenova G.K. and Yusupova U. – for support in carrying out mineralogical research and candidate of geol.-min. sc. Asubaeva S.K. – in carrying out model constructions.

The author thanks the director of the K.I. Satpayev Institute of Geological Sciences, Dr. of geol.-min. sc., Professor G.Zh. Zholtaev and the staff of the Institute for their invaluable assistance in carrying out laboratory and analytical work.

The author expresses gratitude to the head of the Department of Geological Survey, Search and Exploration of mineral deposits Bekbotaeva A.A. and the staff of the department for their support and recommendations during geological research on the topic of the dissertation.