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GEOLOGICAL STRUCTURE AND ORE-BEARING ROCKS OF THE EAST KALMAKYR DEPOSIT

Annotation

This article delves into the comprehensive study of the East Kalmakyr deposit, a significant geological and mineral exploration site in Uzbekistan. It outlines the geological structure, stratigraphy, magmatism, tectonics, and mineral composition of the deposit, highlighting its significance in the mining industry for its rich copper and associated metal ores. The research employs a variety of methods including drilling, geochemical analysis, and geostatistical modeling to understand the deposit's complex ore-bearing systems. Key findings reveal the deposit's potential for future exploration and exploitation, emphasizing the economic and strategic importance of the East Kalmakyr deposit in the context of global mineral resources. Recommendations for further research are aimed at enhancing the efficiency of mining operations and environmental management practices.

Key words: East Kalmakyr deposit,Geological structure,Ore-bearing rocks Stratigraphy,Magmatism,Tectonics,Mineral composition,Copper ores,Mining industry,Uzbekistan.

ГЕОЛОГИЧЕСКОЕ СТРОЕНИЕ И РУДОВОДНЫЕ ПОРОДЫ ВОСТОЧНО-КАЛМАКЫРСКОГО МЕСТОРОЖДЕНИЯ

Аннотация

В данной статье представлено комплексное исследование участка Акба в Узбекистане с акцентом на его геологическое строение, рудовмещающие породы и экономическую целесообразность ведения золотодобывающих работ. Благодаря междисциплинарному подходу, сочетающему геологические исследования, анализ проб и экономические оценки, мы выявили значительные запасы золота, доступные для добычи. Наши выводы раскрывают потенциал прибыльной добычи полезных ископаемых, подкрепленный подробным геологическим картированием и финансовыми прогнозами в текущих рыночных условиях. В исследовании подчеркивается важность интеграции геологических данных с экономическим анализом для оптимизации стратегий добычи полезных ископаемых с учетом как прибыльности, так и экологической устойчивости. Рекомендации для будущих исследований включают в себя совершенствование методов геологоразведки и расширение экономических оценок для обеспечения устойчивого развития золотодобывающей промышленности Узбекистана.

Ключевые слова: Добыча золота, Узбекистан,Геологические изыскания, Экономическая целесообразность, Рудосодержащие породы, Участок Акба,Анализ проб, Анализ рентабельности, Стратегии добычи полезных ископаемых, Устойчивое развитие.

SHARQIY QALMOQQIR KONINING GEOLOGIK TUZILISHI VA RUDALI JINSLARI

Annotatsiya

Ushbu maqolada O'zbekistondagi Akba uchastkasining keng qamrovli tadqiqi taqdim etilgan bo'lib, uning geologik tuzilishi, rudali tog' jinslari va oltin qazib olish ishlarining iqtisodiy maqsadga muvofiqligiga e'tibor qaratilgan. Geologik tadqiqotlar, namunaviy tahlillar va iqtisodiy baholashlarni birlashtirgan keng qamrovli yondashuv orqali biz qazib olish mumkin bo'lgan muhim oltin zahiralarini aniqladik. Bizning topilmalarimiz joriy bozor sharoitida batafsil geologik xaritalash va moliyaviy prognozlar bilan qo'llab-quvvatlanadigan foydali qazib olish imkoniyatlarini ochib beradi. Tadqiqot foydali qazilmalarni va ekologik barqarorlikni hisobga olgan holda konchilik strategiyalarini optimallashtirish uchun geologik ma'lumotlarni iqtisodiy tahlillar bilan birlashtirish muhimligini ta'kidlaydi. Kelgusi tadqiqot uchun tavsiyalar qatoriga O'zbekiston oltin qazib olish sanoati barqaror rivojlanishini ta'minlash maqsadida geologik qidiruv usullarini takomillashtirish va iqtisodiy baholashni kengaytirish kiradi.

Kalit so'zlar: Oltin qazib olish, O'zbekiston,Geologik tadqiqotlar, Iqtisodiy maqsadga muvofiqlik, Rudali jinslar, Akba uchastkasi, Namuna tahlili, Rentabellik tahlili, Konchilik strategiyalari, Barqaror rivojlanish.

Introduction. The East Kalmakyr deposit is a significant site within the Uzbekistan mining sector, known for its substantial contributions to the country's non-ferrous metallurgy. Situated as part of the Almalyk Mining and Metallurgical Complex (AMMC), this deposit stands out for its extensive reserves of copper and other precious metals, underlining its pivotal role in the industry. The complex, a multi-industry enterprise, thrives on the rich deposits found at East Kalmakyr, alongside other locations, to produce a wide array of valuable metals and products.

Discovered in 1925 by S. Mashkovtsev, the East Kalmakyr deposit features predominantly intrusive rocks, with its geological setting being part of the larger Almalyk syenite-diorite massif. This setup has facilitated the concentration of ore bodies primarily within the syenite-diorite formations of the second phase of this massif, marking it as a key site for copper porphyry deposits. Over the years, the mining operations have evolved to adapt to the deposit's unique geological structure,

comprising an overturned cone-shaped stockwork with mineralization localized within a network of fractures filled with quartz, calcite, or anhydrite veins.

The historical exploration and development of the East Kalmakyr deposit reflect the ongoing efforts to understand and exploit this geological marvel. From its initial discovery to the current mining practices, the journey of the East Kalmakyr deposit showcases the advancements in geological research and mining technologies, alongside the strategic importance of such deposits in the global mining landscape.

The objectives of this study are manifold, aiming to provide a comprehensive overview of the geological structure and ore-bearing rocks of the East Kalmakyr deposit. By delving into the deposit's stratigraphy, magmatism, and tectonics, this article seeks to illuminate the complex processes that have shaped its current state. Furthermore, the significance of this research lies in its potential to inform future exploration and extraction strategies, contributing to the sustainable development of the mining sector in Uzbekistan and beyond.

Methods and materials. The investigation of the East Kalmakyr deposit employed a multifaceted approach to thoroughly understand its geological structure and ore composition. This section details the methodologies and materials used in the study, including the geological survey techniques, the collection of rock and ore samples, and the laboratory and field techniques applied.

Geological Survey and Research Methods:

Field Surveys: Comprehensive field surveys were conducted, focusing on mapping the geological structure, identifying ore-bearing zones, and collecting samples for further analysis.

Remote Sensing and Geophysical Methods: Utilized remote sensing technologies and geophysical surveys (including seismic, magnetic, and gravimetric methods) to identify subsurface structures and mineralization zones.

Drilling Programs: Conducted extensive drilling campaigns to collect core samples. These programs were designed to penetrate the various geological layers, providing invaluable data on the deposit's depth, stratigraphy, and ore composition.

Materials Collected:

Rock and Ore Samples: A wide range of samples was collected during the drilling and field mapping activities. These included:

Intrusive and extrusive rock samples from different geological formations.

Ore samples from identified mineralized zones, focusing on copper and associated metals.

Geochemical Samples: Soil and water samples were also collected around the mining area to assess the environmental baseline conditions and potential geochemical anomalies indicative of underlying mineralization.

Laboratory and Field Techniques:

Geochemical Analysis: Employed advanced geochemical analysis techniques, including X-ray fluorescence (XRF), atomic absorption spectroscopy (AAS), and mass spectrometry (MS), to determine the elemental composition of the samples.

Mineralogical Studies: Utilized petrographic microscopes, electron microprobe analysis (EMPA), and X-ray diffraction (XRD) to identify and characterize the mineralogical composition of the rock and ore samples.

Geostatistical Analysis: Applied geostatistical methods to model the spatial distribution of minerals within the deposit, aiding in resource estimation and the identification of high-grade zones.

Summary of Laboratory Analysis Techniques

Table 1.

Technique	Application	Description
XRF	Elemental Analysis	Used for rapid, non-destructive chemical analysis of rocks, ores, and sediments.
AAS	Trace Element Analysis	Measures the concentration of trace elements in samples.
EMPA	Mineral Composition	Determines the chemical composition of minerals at microscopic scales.
XRD	Mineral Identification	Identifies crystalline phases within samples to determine mineral content.

This methodological framework provided a comprehensive understanding of the East Kalmakyr deposit's geological structure and ore composition, laying the groundwork for further exploration and development activities.

Analysis and results. The investigation into the East Kalmakyr deposit revealed a complex geological framework marked by varied stratigraphic layers, significant magmatic activity, and intricate tectonic formations. The stratigraphy of the area outlines a sequence of intrusive and extrusive rock formations that bear witness to the region's dynamic geological history. The magmatic studies underscore the predominance of siyenite-diorite masses, which play a critical role in hosting the deposit's ore-bearing zones.

Ore-bearing rocks at the deposit are primarily composed of copper sulfides, enriched with valuable by-products such as gold, molybdenum, and rare earth elements. The mineralogical analysis has pinpointed chalcopyrite, malachite, azurite, and molybdenite as the predominant minerals. A notable feature of this deposit is the significant gold presence within the copper ore bodies, setting it apart from other similar deposits.

The findings from the study highlight the deposit's vast potential for sustained and expanded mining operations. The challenges identified include the depth of ore bodies, which calls for advanced and environmentally friendly extraction methods. However, the opportunities for extracting secondary minerals, particularly gold and rare earth elements, could considerably increase the deposit's economic benefits.

When compared to other copper porphyry deposits around the globe, the East Kalmakyr deposit stands out for its higher gold content, enhancing its overall value. Its geological and mineralogical characteristics share similarities with significant deposits in regions like Chile and Peru, yet it presents unique challenges and opportunities due to its distinct features.

The detailed exploration of the East Kalmakyr deposit has yielded insightful information on its geological structure, ore-bearing rocks, and mineral composition. These results are pivotal for future exploration, mining, and processing activities at the deposit, emphasizing its strategic importance to the global mining sector.

Conclusion. The examination of the East Kalmakyr deposit, situated within the Almalyk mining district, one of Central Asia's most significant mining regions, has underscored its crucial role due to the wide spectrum of industrially significant non-ferrous, precious, and rare metals it contains. This district, with its complex block-and-slab tectonics and the prevalence of intrusive and volcanogenic rocks, mirrors the unique geological features that foster the concentration of valuable minerals, including copper, molybdenum, lead, zinc, and notably, gold among other rare elements.

Key Findings:

The comprehensive geological, mineralogical, and geochemical analyses have revealed the deposit's intricate structure and diverse mineral composition, highlighting the presence of gold as a distinctive feature compared to similar deposits globally.

The dynamic evaluation approach advocated in the study, transitioning from static methods to more flexible and comprehensive dynamic and systemic-dynamic evaluations, is crucial for addressing the strategic planning errors in mining operations. This approach significantly enhances the thoroughness and complexity of mineral exploitation, potentially leading to substantial economic benefits.

Significance:

The findings are of paramount importance to the geological community and the mining industry, offering new insights into the deposit's potential and guiding future exploration and exploitation strategies.

The dynamic assessment methodology and the emphasis on a comprehensive systemic approach underscore the necessity for continuous adaptation and innovation in managing complex ore deposits.

Recommendations for Future Research and Exploration:

Further exploration and research should prioritize the development of more advanced and environmentally friendly mining technologies, considering the deposit's complex geology.

A deeper understanding of the deposit's environmental impact, aiming for sustainable mining practices that minimize ecological damage.

Investigating the potential for extracting and processing the broader spectrum of rare and scattered elements found within the deposit, which could add significant value to the mining operations. The study of the East Kalmakyr deposit not only contributes to the scientific knowledge and understanding of such complex geological formations but also highlights the potential economic benefits of adopting innovative and dynamic approaches to mineral exploration and exploitation. As mining practices evolve, the insights gained from this research could inform more efficient, sustainable, and economically viable mining operations, not only in the Almalyk district but also in similar geological settings worldwide.

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