

# THE PROSPECTS OF THE MARJANBULAK ORE FIELD

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## Abstract

This article provides a comprehensive analysis of the geological structure, tectonic-structural features, and placement patterns of the gold mineralization of the Marjanbulak deposit, located in the Jizzakh region. The features of the morphology, size, vertical development, and mineralogical composition of ore bodies are highlighted. The presence of vertical zonality between oxidized and primary (elastic) ores is shown, and a geological and economic assessment of their development methods is provided. Based on revised geological data, the relationship between mineralization and a unified tectonically controlled zone has been substantiated, and practical recommendations have been developed for the development of exploration work and the expansion of the mineral resource base.

**Keywords:** Marjanbulak ore field, gold mineralization, geological structure, tectonic zones, gold-quartz type, vertical zonality, exploration work, mineral resource base.

## Introduction

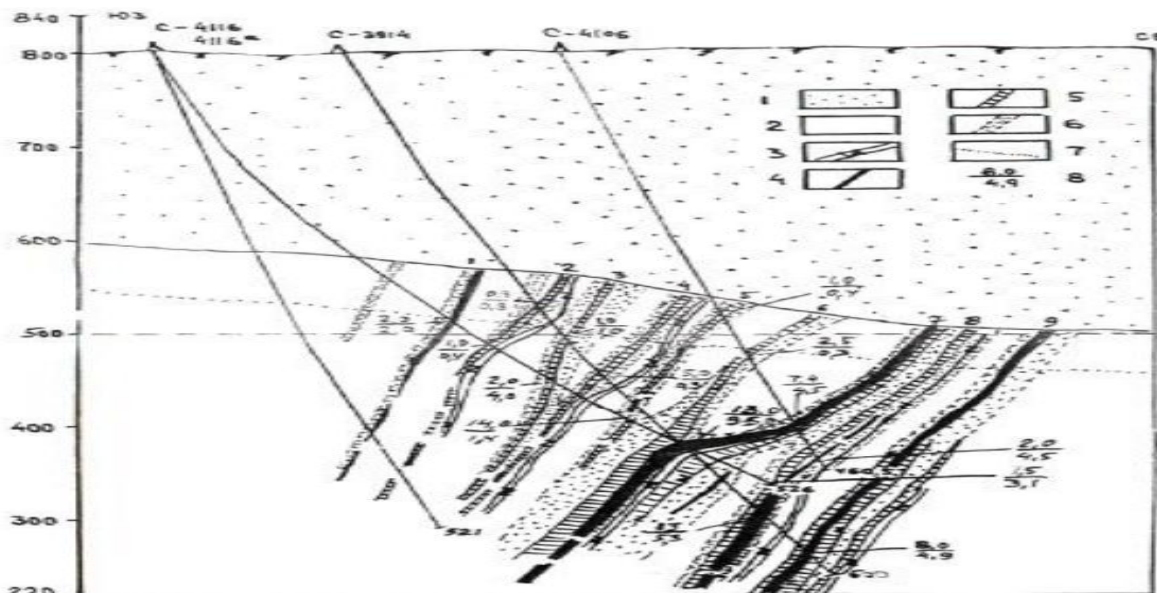
The Marjonbuloq ore field, with an area of approximately 60 km<sup>2</sup>, is located about 40 km southwest of the city of Jizzakh (Figure 1). Geologically, it encompasses the Marjonbuloq ridge (approximately 24 km<sup>2</sup>), which is composed of Lower Paleozoic metamorphic schists and quartzites, as well as adjacent covered areas (36 km<sup>2</sup>). These areas are overlain by Quaternary deposits with a thickness of up to 200 meters. The ore field extends in a sublatitudinal, predominantly northwesterly direction for 18-20 km, with an average width of 4-5 km. The terrain of the area is hilly and slightly dissected. Absolute elevations range from 700 to 951 meters, indicating a relatively uniform relief. Approximately 80% of the Marjanbulak ore field is covered by arable land, as well as alluvial and overlying Cenozoic deposits. The thickness of these deposits varies by location, ranging from 1-2 meters up to 200 meters, which limits the exposure of the underlying Paleozoic bedrock. Therefore, when conducting geological exploration in the area, it is crucial to consider the thickness and distribution of these overlying deposits. At the Marjonbuloq



deposit, gold mineralization of the gold-quartz type is genetically linked to several steeply dipping tectonic zones, extending primarily in sublatitudinal and northwestern directions. Morphologically, the ore bodies are mainly expressed as steeply dipping linear forms trending to the southwest and, in rare cases, to the northeast. They consist of thin quartz veins and veinlets with a thickness of 0.01-0.5 m, and partly of separate quartz veins. These veins contain 0.5-5.0% sulfide minerals, primarily pyrite and arsenopyrite, within which gold is observed to be disseminated as separate fine grains. The length of the ore bodies varies from 50 to 600 meters, and their thickness ranges from several meters to 30 meters. The vertical extent of development is typically 50-300 meters, reaching up to 500 meters in some cases. These geological-structural and morphological features indicate that the mineralization was strictly controlled by tectonic factors and formed as a result of hydrothermal processes. Within the Marjonbuloq ore field, gold mineralization is unevenly distributed within grains of pyrite, arsenopyrite, quartz, and carbonaceous matter, which demonstrates the complex mineralogical composition of the mineralization. Currently, about 45 ore bodies have been identified within the area. The ores located at depths of 80-100 meters belong to the oxidized type and contain high-grade free gold. These oxidized ores are currently extracted by the open-pit method at the Marzhanbulak deposit of the Navoi Mining and Metallurgical Combine. In the deeper horizons, primary, non-oxidized "stubborn" ores are widespread, characterized by the complexity of their mineralogical composition and the association of gold with sulfide minerals. Since the development of such ores is not suitable for the open-pit method, their extraction in the future can be carried out by the shaft method. This circumstance indicates the presence of vertical zonality of mineralization at the Marzhanbulak deposit and the need for complex and phased development of the deposit. The Marzhanbulak ore field has been studied geologically several times since 1964, and its gold mineralization has been widely described in the scientific literature [1-4]. By the beginning of 2005, the projected gold mineralization was identified in eight areas, and in another fifteen areas, the presence of ore bodies with a high gold content was established. Oxidized gold ores in the Marjanbulak region have been produced on an industrial scale for more than 20 years. Currently, the remaining reserves of oxidized ores can provide production for a maximum of 4-5 years under the conditions of the existing production capacity of the deposit. At the same time, the issue of transitioning to the underground method is assessed as economically unprofitable due to the relatively small parameters of ore bodies, their widespread distribution along the depth, and the long-distance extension of tectonic zones. Therefore, the issue of expanding the mineral resource base and identifying additional reserves is one of the most pressing geological and economic tasks for the Marjanbulak deposit in the coming years. Ensuring the long-term stable operation of the deposit is directly related to the identification of new ore areas, the transfer of forecast resources to the reserve category, and the intensification of exploration and prospecting work.



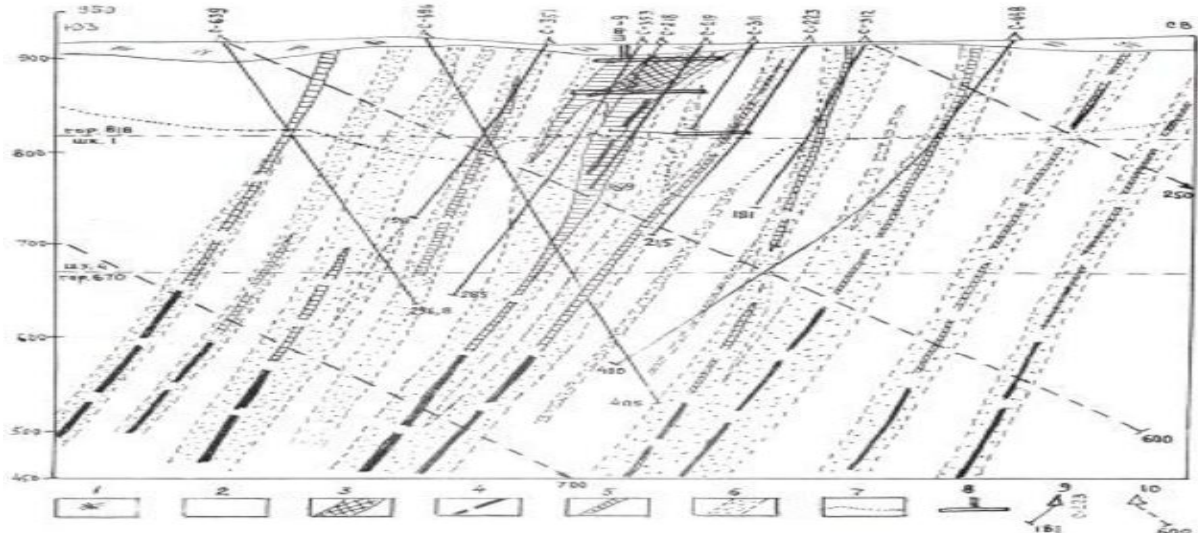
development of ores. Most of the gold-bearing ores of the Marjanbulak ore field have not yet been fully studied, since their exploration and evaluation work was carried out mainly in 1967-2003. At that time, the most important and high-gold-containing seams were considered priority. At the same time, in the Ukrainian, Western, Sarykbel, and Tangi I and II areas, ore bodies and zones were considered vertical. In 1983, research conducted by P.F. Ivankin and N.I. Nazarova confirmed the presence of a property decline in ore-bearing zones in relation to the Southwestern direction. In subsequent years, in particular in 2002-2004, reinterpretation work at the Salina (Fig. 2), Ukrainian, and other sites made it possible to determine the geological and mineralogical features of gold-bearing zones and to better assess their distribution (Fig. 3). The northeastern part of the Marjanbulak ore field is dissected by steep inclined faults following a series of ore bodies, which intersect sublatitudinal ore zones and bodies and can shift them by tens of meters. Such a geological feature often leads to the loss of ores or the transition of valuable minerals into local condensation.



**Figure 2. Geological section along the Salin section (according to L.N. Grigorieva, 1998):** 1. Porous deposits of the Quaternary period. 2. Lower Paleozoic slates layer. 3. Dyks of diabase porphyrites and lamprophyres. 4. Ore bodies ( $Au \geq 3$  g/t). Ore-bearing zones ( $Au=0.3-2.9$  g/t). 6. Primary gold rim ( $Au=0.3-0.05$  g/t). 7. Contour of the oxidation zone. 8. Parameters of ore sections along the core of drilling wells: in the numerator - capacity, m; in the denominator - gold content. Data from the Vostochny site, documentation of underground mine workings, and well sections from other sites indicate that steep post-ore faults not only disrupt the continuity of ores but also complicate their geological and mineralogical morphology. This circumstance serves as an important factor in the planning of prospecting and mining operations, since additional analysis is required to maintain the continuity of ore bodies and accurately assess reserves. In the Western, Ukrainian, Tangi I and II areas, not only a number of parallel ore bodies were observed (Fig. 3), but some ore bodies may also be connected in a different way. These types of connections influence the concentration of local minerals and the amount of reserves, changing their industrial significance. This assumption can be confirmed by testing and drilling operations, which will allow increasing the reserves of ores and determining their attractiveness. Thus, the value and effectiveness of the Marzhanbulak ore field for underground mining will be assessed, and a reliable



geological basis for the long-term exploitation of the deposit will be created. Until the beginning of 2005, the study, prospecting, evaluation, and industrial development of ore zones of the Marzhanbulak ore field were carried out in various tectonic structures at a distance of about 10-12 km. As a result of these studies, only about 10% of the lengths of eight ore zones were determined. At the same time, there are many parallel gold veins in the isolated ore zones, which are found, in particular, in the Guzhumsay and Zarmitan areas.



**Figure 3. Geological direction along profile 82, passing through the Ukrainian area:** 1. Alluvial deposits. 2. Lower Paleozoic shales. 3. Certain ore bodies. 4. Estimated ore bodies. 5. High gold content zones (0.3-2.5 g/t). 6. Primary gold margins (0.05-0.3 g/t). 7. Oxidation zone. 8. Underground mine workings. 9. Drilled wells, their numbers and depths. 10. Recommended exploration wells and their depths

Therefore, it is advisable to start mining operations early in the upper parts of Salin at a depth of more than 250 meters and in the mining area, since these parallel sedimentary and deep structures influence the horizons and widths of ore zones, which is important for preserving their geological and economic value. As priority objects, deep exploration should be carried out in the ore zones of the Sariqbel and Tan-Gin ranges, including the explored and thoroughly studied Western, Ukrainian, Tangi I and II, and Sariqbel sections. During these operations, individual sections of ore zones are identified through drilling, mine workings, and column hammering, and their reserves are optimally assessed. Thus, geological exploration work should be carried out over several years, and after the confirmation of forecasts, within the next 5-10 years, the explored reserves of the Marjanbulak ore field can be fully provided and effectively exploited.

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