

# Economic and Mathematical Modeling of Rational Development of Small-Scale and Man-Made Gold Deposits

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**Abstract:** Based on the developed methodology, a computer-based calculation program has been compiled to select the optimal options for developing small-scale deposits. The source data includes the distances from the deposits to the base plant, the content in the ore and concentrate, extraction at the plant and in the quarries during heap leaching, the cost of extracting metal from the ore at the plant and processing the concentrate, the cost of heap leaching during the technological process and losses due to under-extraction of gold in this method.

**Keywords:** Rock mass, open-pit mining, quarry, parameters, technical and economic parameters, mining conditions, gold recovery, technogenic deposit.

## Introduction

As a result of calculations, distributions of small-scale deposits by their development options were determined. For options that differ in the difference in gold recovery, respectively, in the conditions of the plant and on the quarry site during the heap leaching process, the extreme indicators for metal recovery are taken. In the first case, this difference is 15%, in the second-40%. That is, when 95% of the gold is extracted at the plant, in the quarry, respectively, in the first case, 70% is extracted, and in the second, respectively, 55% [2].

The third option was also calculated using new principles for processing ore on site. In this case, the difference in extraction at the factory and in the field is reduced to 0%. This option differs in that the ores of small-scale deposits are processed on-site using simplified or incomplete technological schemes.

Thus, it is established that for small-scale deposits of Espanto, Bolik, Triad it is necessary to apply the technological process (a), providing for the transportation of all ore mined to the base of the plant, i.e. iron ore is then transported to HMP-2 without prior treatment in full. With a decrease in the difference between the degree of recovery at the plant and in the quarry, the number of small - scale deposits of Balpantau, Tamdybulak, whose Aristantaurud is more profitable to process into a concentrate by heap leaching-process (b) increases [3].

With different values of the difference in gold recovery at the base plant and at the site of occurrence, it follows that with a decrease in the difference in extraction, the distance at which it is profitable to transport the concentrate to the base plant, rather than the ore mass, is reduced. When the metal content in the Deposit increases, the boundary increases when the ore is delivered to the base plant in the form of a concentrated product.

## Material and Methods

The justification for the construction of modular mobile processing plants within the zones of influence of the base plants is methodological in nature and does not have the purpose of strict reference to geographical locations due to the mobile nature of the modules. In addition to the characteristics of small-scale deposits themselves, data on the location of power lines and water pipelines, transport arteries and residential settlements containing a certain potential of labor resources in the structure of NMMC's mining branches were used to justify the construction sites of mobile modules [4].

In General, for the MMC of Uzbekistan, which are characterized by a high resource intensity of the work performed, the problem of resource saving when implementing innovative equipment and technology in open-pit mining is of paramount importance. In this regard, the justification of ways to effectively develop deposits that ensure resource conservation in open-pit mining in the Republic is an urgent scientific and technical problem. The urgency of its solution is due to the growing demand for products that are in stable demand on the international market and have significant national economic significance for the Republic of Uzbekistan. Each natural-technological area of this object by the volume of the developed mountain weight, the amount of extracted metal and its reserves in the subsoil used for the mining and transport equipment and opening schemes of work space distance from each other and the processing plant can be considered as an independent field. The quarry is divided into natural and technological zones, and zones are divided into dredging blocks according to the General functional purpose: overburden operations, mining operations with associated and main production, targeted work.

Thus, within the zones of influence of the GMZ-2 base plant, it is recommended to construct mobile modules in the area of the Tamdybulak Deposit for crushing ore and preparing concentrate from the Small-scale tamdybulak and Balpantau deposits, which are an additional raw material base of the Muruntau mine [5].

The variety of technological properties of ores in small-scale and man-made gold deposits makes it necessary to use compact processing complexes with wide technological capabilities. At the same time, it should be taken into account that when developing gold deposits, in addition to commercial ore sent for processing to the base plant, there is a significant amount of off-balance sheet ore, the processing of which at the base plant is economically impractical. Such ore should be processed to semi-finished products directly in the mining area, using modular installations and complete processing lines for this purpose.

### **Results**

In General, a mathematical model has been developed for selecting the most optimal options for developing small-scale gold deposits that differ in the method of processing the extracted ore. The following options are offered:

- the extracted ore from the quarry is delivered in full to the plant without preliminary processing on site;
- after mining, the ore is sent to the nearest intermediate modules, where it is enriched according to incomplete technological schemes, then the resulting concentrate is delivered to the plant.

### **Discussions**

Changing the priority and significance of natural and technological zones over time requires periodic adjustment of their development plans, and the presence of heterogeneous cargo flows requires coordinated mining operations. To solve these problems, the Muruntau quarry uses the method of continuous design and planning of mining operations.

As a result of calculations, the following parameters are set:

- technical and economic parameters of small-scale field development;
- distribution of small-scale deposits by their development options;
- the distance between the base plant and the deposits depends on the metal content in them, with different values of the difference in gold extraction at the plant and on the ground [6].

With a decrease in the difference in extraction, the distance at which it is profitable to transport concentrate to the plant rather than ore mass is reduced, while with an increase in the metal content in the field, the border of ore delivery to the base plant in the form of concentrate increases;

- the conditions for the use of compact processing modules are determined, which are selected taking into account specific mining-geological and mining engineering conditions and factors. Recommendations are given on the most optimal place for the construction of processing modules.

### **Conclusions**

Thus, a mathematical model has been developed for selecting the most optimal options for developing small-scale gold deposits that differ in the method of processing the extracted ore. Set: techno-economic parameters of development of small-scale and man-made deposits; distributed small-scale and man-made deposits according to the options of their development; the relationship of the distance between the base and plant mines from the content of the metal at different values of the difference in the gold recovery at the plant and in the field [7].

### **Acknowledgements**

With a decrease in the difference in extraction, the distance at which it is profitable to transport concentrate to the plant rather than ore mass is reduced, while with an increase in the metal content in the field, the border of ore delivery to the base plant in the form of concentrate increases; the conditions for using compact processing modules, selected taking into account specific mining and geological conditions and factors. Recommendations are given for the most optimal place for the construction of processing modules.

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