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Development Of Computational Schemes For Extracting Device Reserves

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ABSTRACT

The article discusses a number of issues on the extraction of near-field reserves of the Muruntau deposit, in particular the Eastern zone, it is advisable to produce from the existing workings of the +78 m horizon of the "M" mine, since the construction of an underground mine based on the existing infrastructure of the M mine is more cost-effective and less labor-intensive than the construction of a new underground mine.

KEYWORDS

Applied reserves, underground mine, bowels of the earth, minerals, mine, quarry, adit, exit, opening and development workings, development boundary, development contours, combined development, intensive mining.

INTRODUCTION

The world experience in the development of deposits in a combined way shows that 65% of mines develop sub-open-pit reserves, 25% are mining deposits remote from the open-pit, and only 18% are developing near-pit reserves1. Thus, significant reserves of balance ores remain in the near-by-rock massif, the development of which would improve the economic efficiency of the enterprise by means of additional extraction of minerals.Today, all over the world, when extracting near-field reserves, the problems of building underground mine workings and ensuring the stability of the massif are being solved. There is a need to carry out scientific research on the effective development of near-field reserves by promising technological schemes and to determine the stress-strain state of the rock mass. One of the solutions to this problem is the development of a technological scheme for the development of open pit reserves, taking into account the peculiarities of the occurrence of ore bodies.

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To increase the period of effective operation of the mining and processing complex, it is necessary to expand the traditional boundaries of field development and reduce the requirements for mineral resources in the subsoil [1].

The systematic intensive development of the deposit's reserves, accompanied by a natural increase in the depth of mining operations against the background of the volatility of gold prices on the international market, requires the search for optimal ways of adapting the enterprise to work in a free market environment. The possibility of successfully solving this complex multifactorial problem is based on the presence of significant reserves of gold-bearing rock mass, which are not currently involved in development.

MATERIALS AND METHODS

During the development of the steeply dipping Muruntau deposit with a complex structure over a long period of operation, as mining operations developed in time and space, the mining situation significantly deteriorated and the economic risk increased. The situation can be alleviated by introducing less costly mining technologies [2]. In this regard, the strategy for the further effective development of the Muruntau gold-mining deposit was substantiated, which provides for the maximization of the extraction of mineral raw materials as a result of the development of reserves by an open-cut method with a predicted pit depth of up to 900-1000 m and the use of an open-pit method for the development of reserves outside the edge of the open pit, etc. ... [3].

The development of out-of-the-way areas provides for the possibility of efficient use of the mined-out area of the open pit for opening ore zones by horizontal or inclined workings with the combination of open-pit and underground mining cargo flows into a single cargo flow. At the same time, the transition to the open-underground method of mining a part of the boundary near-field reserves makes it possible to compensate to a large extent the natural drop in gold production due to the open-pit development of a deepening open pit. The known factors of a decrease in economic indicators, in addition to the often possible natural depletion of deposits with depth, consist in an increase in the current stripping ratio, an increase in the cost of transport of rock mass due to an increase in distances, etc.

Due to the fact that 15-20% of the total reserves remain outside the quarry contours, it is advisable to develop the deposit in a combined way with simultaneous parallel open-pit and underground work in the initial period.

The following technological schemes for the development of mining operations are recommended for further development of the deposit with combined development:

1. Full combination of open-pit and underground mining in time (simultaneous development) with a combination in the horizontal and vertical planes with close technological interconnection of open-pit and underground mining with a joint solution to the issues of opening and working out open-pit and mine fields.

2. With partial overlapping (sequential-parallel development) of open-pit and underground mining in time with overlapping in the horizontal plane with an average degree of technological interconnection of open-pit and underground mining with partial overlapping of open-pit and mine fields opening and development schemes.

The first direction involves the use of an integrated scheme for opening open pit and

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mine fields using underground workings, while the change in the volume of capital investments due to the use of certain technological features of the combined development is determined taking into account the efficiency coefficient of the technological relationship.

The type and location of the main underground workings depend on the combination of works in time and space [3,4,5]. The commissioning of the underground section of the mine, developing the northeastern (with backfilling of the worked-out space) and eastern (with forced collapse) zones at horizons from +300 to +45 m is possible in 2-3 years after the start of construction of a complex of underground opening and preparatory workings. This scheme provides for the delivery and addition of ore to the general open-pit cargo flow. Several options for the opening of near-site ore deposits have been considered and proposed for a detailed design assessment (Fig. 1-4).

THE MAIN PART

Each of the near-site areas for underground ore mining must have at least two workings for opening the corresponding ore body: a horizontal adit built from the pit of the open pit, and as a second development, depending on the conditions of the ore body, a specially constructed vertical shaft (pit) can be used. or another adit built from the second horizon. Thus, this area will be provided with two necessary independent exits to the surface. Obviously, one opening adit will serve as the main excavation for transport, laying communications, as well as supplying fresh air. The outgoing air stream is passed through the second tunnel, which also serves as an emergency exit.

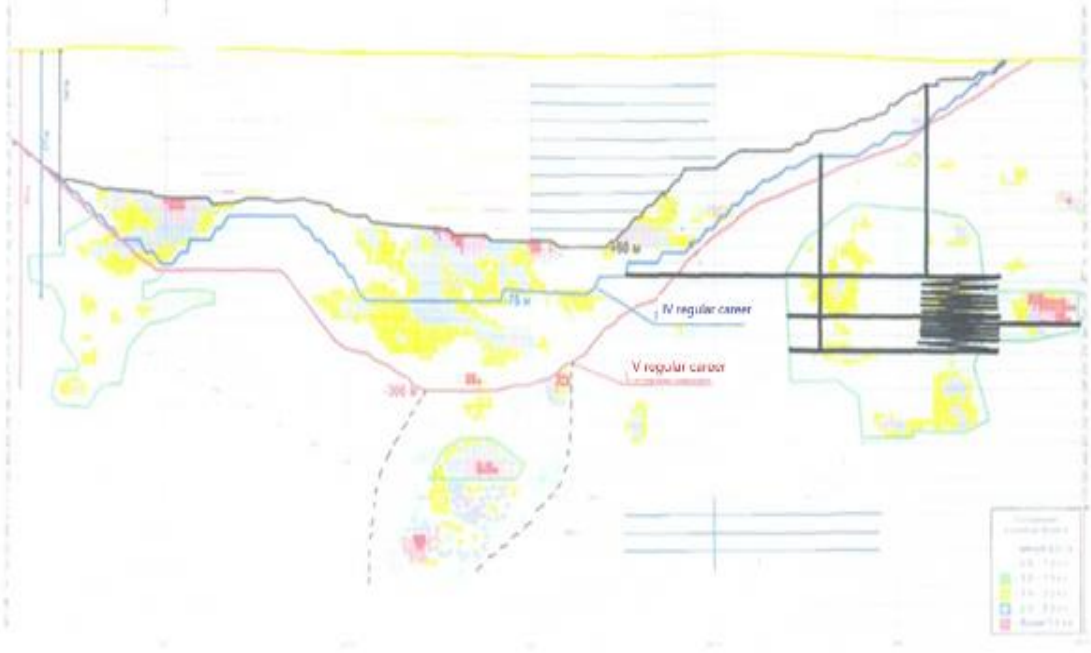

Fig. 1. Diagram of the opening of the near-site ore body of the adits from the open pit ledge in combination with vertical shafts and a spiral ramp

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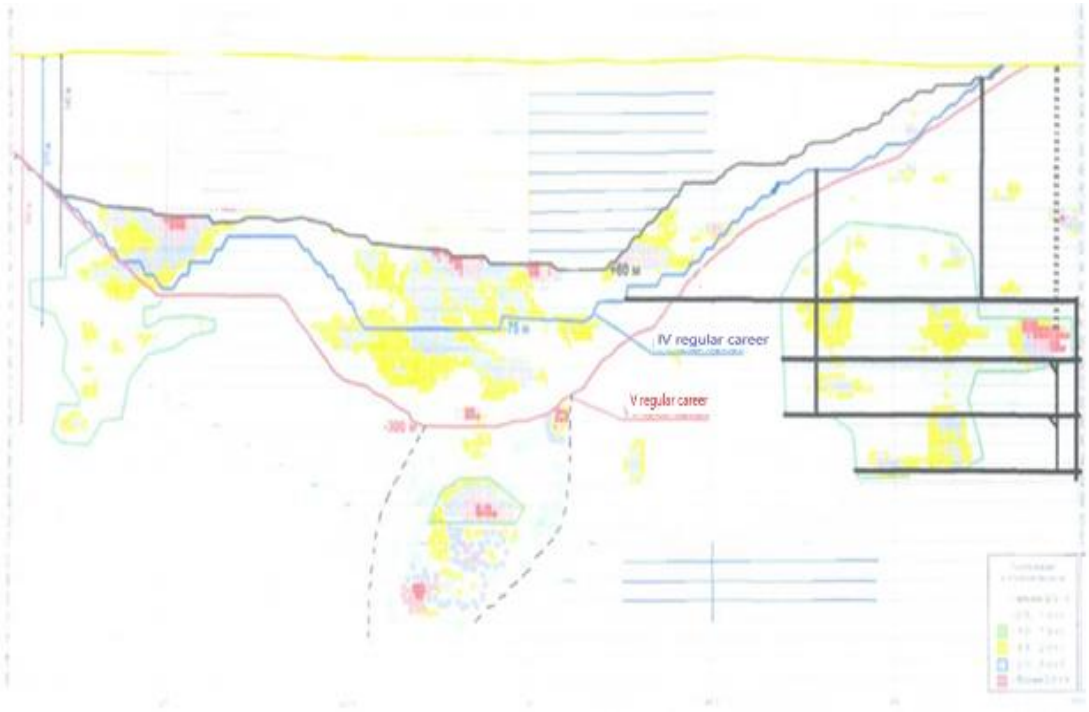

Fig. 2. Diagram of the opening of the adit ore body of the adits from the open pit ledge in combination with vertical shafts and ore passes

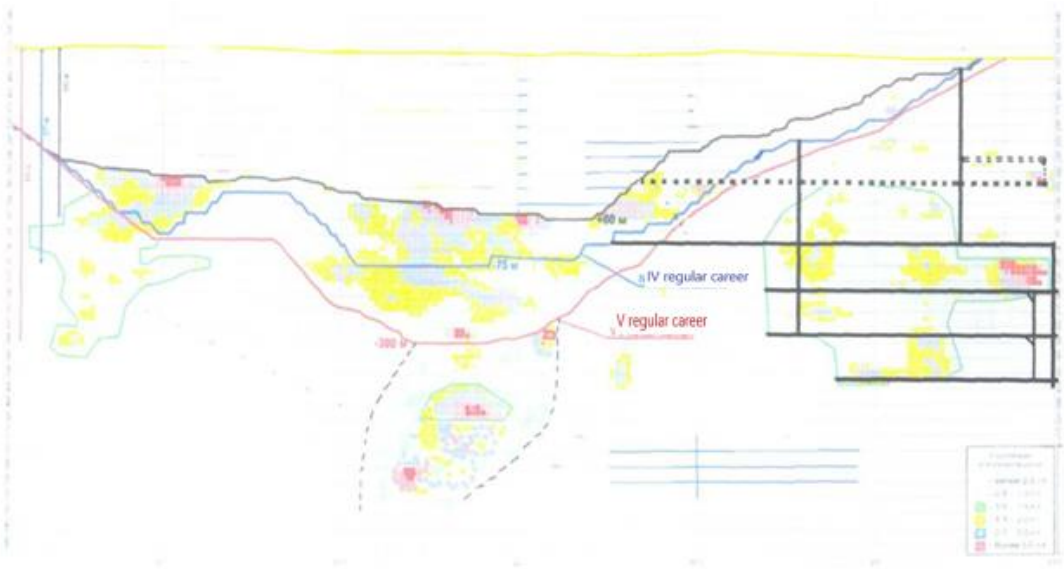

Fig. 3. Multi-horizon scheme of the opening of the adit ore body from the open pit ledge in combination with vertical shafts and ore passes

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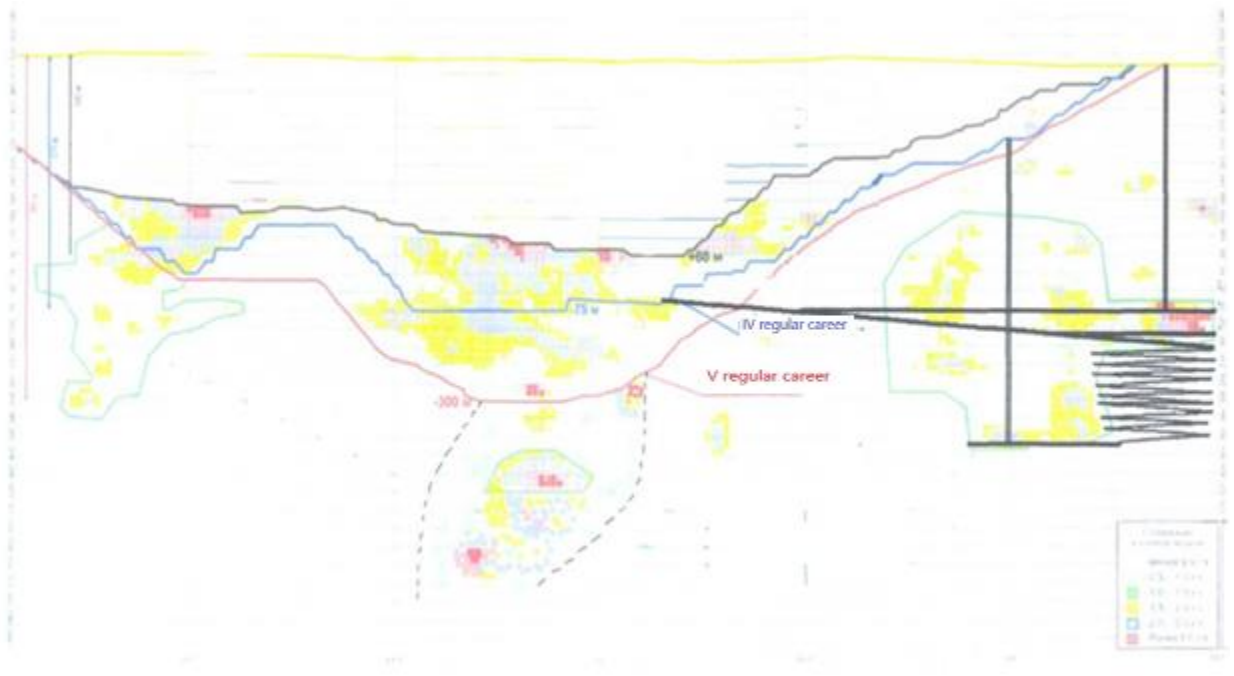

Fig. 4. Scheme of the opening of the near-site ore body with a transport slope from the open pit ledge in combination with vertical shafts and a spiral ramp

With multi-horizon preparation of the ore body, the transport adit is located at the level of the lower concentration horizon of the underground area. If it is necessary to intensively develop the site and increase the traffic flow, the number of transport adits can be more than one - from two (or more) different horizons. The mode of transport in the adit can be justified and selected from the following nomenclature: automobile, conveyor or rail. The most attractive is in-line transport from the underground storage bunker to the reloading and sorting point, equipped on the open pit ledge, from where the cargo is poured into the general open pit cargo traffic.

When opening ore bodies located on the upper horizons close to the surface and far from the contour of the open pit, a vertical shaft can be constructed as a second opening, which will also be used for ventilation. In this case, in order to facilitate the construction technology, the vertical shaft can be passed from the horizon of the adit from the bottom up with the release of the rock through the adit. This option of constructing a vertical shaft without the use of special tunneling equipment will significantly reduce the time and cost of construction. An exception may be the construction of a part of the trunk located below the adit elevation. Therefore, it is advisable to locate the transport adit at the level of the lower elevation of the mined horizon of the near-site underground section, or, if necessary, it is possible to provide for the possibility of issuing rock using the transport scheme of the "M" mine.

With the introduction of a combined automobile-conveyor transport, the sides of the quarry have not yet reached the limiting contour [6], therefore, one of the most convenient possible technical solutions is the

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construction of an inclined conveyor shaft. The inclined shaft will naturally be located outside the prism of possible displacement and taking into account the stress concentration zone at the base of the pit wall. After the organization of a single underground transport complex according to this scheme, all ore from the open pit and underground section will be discharged along the inclined shaft. The use of underground workings, including an inclined conveyor shaft, for transporting ore from a quarry will reduce the length of transportation by about 2-2.5 times, with the maximum use of the advantages of cyclic-flow technology. According to this scheme, ore from the open pit will be fed through the ore pass and further into the crushing plant, and then by conveyor transport it will be delivered along the inclined shaft to the surface [7,8].

When constructing an inclined shaft, it is necessary to organize its sinking from the bottom up with the release of rock in the lower part through the "M" shaft, and in the upper part - above the level of the open pit bottom - an auxiliary construction adit can be used to deliver materials and equipment to the face, as well as to release rock from downhole in a quarry. Organizationally, it is necessary to provide for the beginning of the construction of the inclined shaft in such a way that the release of rock from the bottom of the shaft under construction can be added to the main quarry cargo flow.

The construction of the inclined shaft also allows starting the development of the western near-side ore zone, where it is possible to use the development system with full caving. Further, when the quarry reaches its maximum depth (850-1000 m), an open-underground tier is organized under the bottom of the quarry.

In addition, it is possible to create an open-underground layer between horizons -75 and -315 m, which will reduce stripping work, refusing to deepen the open pit here. At the same time, real cost savings are achieved as a result of reduced stripping volumes.

CONCLUSION

As a result of the studies carried out on the development of calculation schemes for extracting near-field reserves, it was found that the following combinations of elements of open and underground mining were taken as the basis for the formation of options for technological schemes for developing near-field reserves:

- Joint use of transport and opening mine workings, as well as quarry space as an auxiliary opening workings;
- A single cargo flow of open and underground operations, which additionally allows you to control the quality of ore.

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