ON THE INFLUENCE OF ROCK MASS FRACTURING ON THE DEVELOPMENT OF MINING AND GEOLOGICAL PROCESSES IN THE ALMALYK ORE REGION (ON THE EXAMPLE OF THE KURGASHINKAN, SARY-CHEKU, KALMAKYR AND YOSHLIK DEPOSITS

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ANNOTATION

The article discusses the mining and geological processes associated with cracking of rock mass, which are one of the leading factors that determine the conditions for the development of a mineral deposit and the development of basic measures to prevent violations of the stability of the sides of slopes and to ensure the safety of work in the mined open pit Sary-Cheku, Kalmakyr and Yoshlik. The article gives recommendations for solving the issues of ensuring the stability of the slopes of the sides of the quarries, depending on the changing mining and geological situation on the need for monitoring by the geological and mine surveying service of mining enterprises for the state of the slopes, ledges of the sides of the quarries.

Key words: mining and geological processes, stability of sides, slopes, tectonic rupture, cracks, faults, fracture voidness coefficient, weathering, deformation, "healed" cracks, mudslide and landslide.

INTRODUCTION

The increase in the share of mining in the Republic of Uzbekistan occurs both due to the commissioning of new capacities, and due to the reconstruction of existing mining enterprises, the use of more advanced technology based on new technology, mechanization and automation of production processes.

A characteristic feature of the current stage of development of mining, especially by opencast mining, is often the involvement of deposits with complex mining and geological conditions.

Modern mining and geological processes are one of the leading factors that determine the engineering and geological conditions of mineral deposits. The study of the patterns of the formation of these processes in the territories of the fields being developed is one of the important problems in connection with the development of the main measures to prevent violations of the stability of the sides, slopes and ensure the safety of work in open pits [1].

The formation of mining and geological processes is associated with the geomorphological structure, climatic and hydrogeological conditions, composition, properties of rocks, especially, the degree of their fracturing fragmentation under the influence of larger tectonic ruptures, and also depends on the establishment of optimal parameters of the slopes for various areas of the mining robot [2].

MAIN PART

Fissures of tectonic and non-tectonic origin have been studied in the rock massifs of the Almalyk ore region deposits. Tectonic cracks develop in igneous, metamorphic and sedimentary cemented rocks within the zone of influence of tectonic disturbances under the influence of tectonic compressive and tensile forces exceeding the ultimate strength of the rocks. Cracks are subdivided into shear cracks, which develop under the influence of shear-shear forces, and shear cracks, which develop under the influence of tensile forces.

Non-tectonic cracks, formed under the influence of internal forces of compression and tension, develop in the rock during a long time of geological development of the region, such cracks are found everywhere, they are diverse in space.

Fissures of tectonic origin are developed within the Kurgashinkan quarry. Tectonically, the field is a large anticlinal fold, into which the entire carbonate strata is crumpled, with an axis oriented in the sublatitudinal direction. The wings fall to the south (at an angle of 40^0) and north (at an angle of 20^0). The folded forms were subsequently broken by ruptured faults [4]. The largest of them are the Sekushchiy and Tsentralny faults, where rock massifs are fragmented, gaping cracks are developed, the formations of which are associated with ruptured faults. Physico-geological processes and phenomena in the form of mudslides and landslides are developed on the sides of the quarry [5]. Due to the development of these processes and phenomena, in 1987, with a mining depth of 340 m, development was suspended. At present, within the eastern, southern, northwestern sides of the Kurgashinkan open pit, they are weathered, transformed into crushed stone-gritty material, which, when moistened by atmospheric precipitation, move down the slope in the form of a mud-stone flow. The width of these streams is 10-20 m, and down the slope from 30-40 m to 80-85 m. The capture depth depends on the thickness of the weathering products and does not exceed 3-5 m (Fig. 1, 2, 3).

Fig.1. Quarry Kurgashinkan

Fig. 2. Sary-Cheku quarry

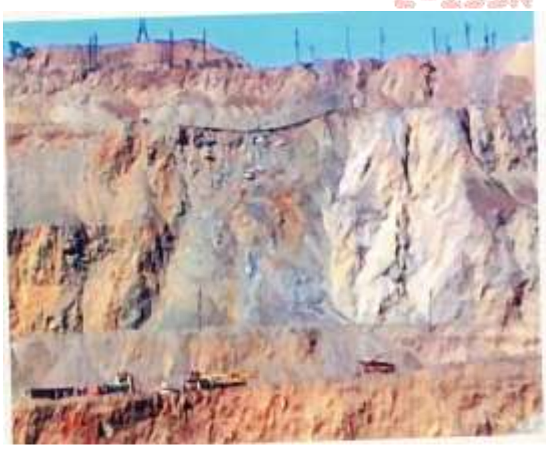

Fig. 3. Kalmakyr quarry

Fig. 4. Physico-geological processes in the mountains of the region

The study of fracturing in massive rocks of the Sary-Cheku, Kalmakyr, and Yoshlik deposits showed that in syenite-diorites the specific fracturing was 5-7 fractures per square meter, fracture width 2-10-12 mm, length 40-135 cm, fracture void ratio 0,03-0.06 and an angle of incidence 15^0-85^0, with an azimuth of 150^0-180^0.

In diorites, the specific fracturing was 4-5 outside the fault zones, less often 7-9 fractures per square meter, in the crushing zones 70-80. The coefficient of fracture voidness is 0,001-0,175, the length of the cracks is 70-140 cm, the width is 3-13 mm, the angle of incidence is 15^0-86^0.

In granodiorites, the coefficient of fracture voidness is 0.006-0.09, the specific tension per square meter of area is 0.007-0.008, the width of the cracks is 3-9 mm, and the length is 60-130 cm.

In weathered rocks, cracks are often less pronounced. There are a lot of weathering microcracks, invisible to the naked eye, but contributing to the destruction of rocks under the influence of weathering.

The process of physical weathering occurs most intensively on the slopes and tops of the mountains surrounding the deposit, which are composed of syenites, diorites, and limestones (fig. 4). A sharp fluctuation in temperature during the day, freezing and thawing of water in cracks and microcracks in rocks contributes to their destruction. In the processes of these influences, many different cracks appear and the sizes of the previously and newly formed ones gradually increase. This process proceeds in different ways in different lithological complexes of rocks, depending on their location in the zone of influence or outside the zone of influence of tectonic faults. In the zone of influence, these rocks are characterized by very strong fracturing and, under the influence of physical weathering processes, are destroyed into fragments with a diameter of 5-10 cm to 10-20 cm. On the watersheds of the described mountain structures, single detachments and single blocks with a volume of 5-6 m^3 to 10 m^3 appear.

These detachments occur along the planes of tectonic fractures.

Within the described deposits, all rocks have, basically, four systems of fractures, typical for all geological differences of rocks, strike azimuth 210^0-250^0, dip angle 30^0-60^0, and strike azimuth 150^0-180^0, dip angle 50^0-70^0.

The first of these systems of cracks is more pronounced and, in most cases, it is taken as the main system of cracks.

In syenites and syenite-diorites, 65-70% of cracks are oblique and 30-35% are normal-secant with respect to the main ones, i.e. major fracture systems. In the rest, the ratio of oblique and normal-secant fractures is approximately equal.

In relation to the plane of the ledge, the sides of most of the crack systems (about 80%) are located diagonally, the rest are transverse. The exception is the limestones of the Hercynian structural stage, where the ratio of diagonal and transverse cracks is even.

Syenite-diorite and syenite, which mainly have five systems of cracks, form blocks of parallelepipedal shape.

Based on the shape of the blocks, the benches in syenite-diorites and syenites are less stable than those in other rocks.

RESULTS AND DISCUSSION

The study of the nature of deformation of large masses of slopes of the described deposits shows that the occurrence of non-continuous cracks does not affect the deformations. As for solid ones of considerable length, their occurrence can have a decisive effect on the stability of slopes. In the quarries of Sary-Cheku, Kalmakyr, many cracks are found, the sizes of which reach 8-10 m, sometimes up to 10-35 m along the strike and dip. Along such cracks, the slope of benches with a height of 10 m, and 15 and 20 m usually occurs. About half of these cracks fall towards the massif or diagonally to the strike of the sides.

The study of the fracturing of the rock mass taking into account the geological and tectonic structure of the deposit shows that the weakened zones include large and small tectonic faults, adjacent areas, i.e. transition zones and large cracks.

In them, the development of various deformations such as landslides, landslides and debris is possible, which complicate the process of exploiting the field with an increase in the depth of the open pit (Fig. 1,2,3).

Within the described ore region, the Karabulak fault and the Kalmakyr upthrust strike-slip, passing in the latitudinal direction, are the largest weakened zones. A large tectonic block is formed between them, broken by faults of a smaller order into massive areas with various configurations of large cracks. The Karabulak fault falls almost vertically (80^0-90^0) The thickness of the crushing zone (with large fractures) reaches 90-95 m in places. And the Kalmakyr upthrust strike-slip at an angle of 65^0 falls to the south. The thickness of the crushing zones reaches 30-40 m. In addition, the Central Fault extends in the northeastern direction, which has a southeastern dip at an angle of 80^0-90^0. The fractured zone of the fault is expressed by highly frayed rocks and thin layers of clay-friction. This zone is clearly distinguished by its blackish-gray color against the background of limonitized rocks. In addition to these regional tectonic faults, within the ore region, a large number of faults of local importance were found, having predominantly sublatitudinal and northeastern striking, falling at angles of 50-800, the thickness of the crushing zones of these faults is up to 20-30 m. The zones of crushing of tectonic faults are characterized by low strength properties of rocks and a high degree of their fracturing. An increase in the size of rock fragments is noted with depth. The value of specific fracturing reaches 80^0 and more.

In the described quarries, the weakened zones are associated with the bulk of small talus, landslides-landslides, which were formed in cases where rupture faults or large cracks developed parallel to the sides and fell at angles of 30^0-70^0 towards the bowl of the quarries. They cover the transition zone. The following types of mining and geological processes and phenomena are widely developed in the investigated territory: surface runoff, mudslide, landslide - flow, landslide landslides. These types are confined to different rock complexes, to areas with different tectonic conditions and morphological structure of quarries (Fig. 2,3,4).

Landfalls are mainly formed when the axis of the fault is perpendicular to the edge of the quarries or directed at an angle to it. Screech-landslide-stream, mudslides are encountered very often. The main reason for their formation is the physical weathering of fractured rocks. Usually, the rate of shedding depends on the time factor, i.e. bench update time, climatic factors and slope angles. The largest talus, mudslides, landslide flows are confined to the weakened zones [6].

Thus, it should be noted that as a result of development, the height of the pit walls is increasing. Mining factors that negatively affect the stability of the ledges include rock fracturing and inaccurate selection of the slope angles of the ledges. Massive explosions create a zone of partial crushing of rocks, extending 40-60 m from the well.

An increase in rock fracturing is noted near the zones of tectonic faults and at the contacts of rock varieties. In addition to natural (tectonic and non-tectonic) cracks, artificial cracks associated with unloading rocks, as well as blasting operations, will form during field development.

The parameters of these cracks will change over time. Opening of "healed" cracks is noted on the stationary sides of the quarries. The opening width in some places reaches 2-3 mm. A similar change in fracturing can be observed as the quarries deepen [7].

CONCLUSIONS

With further deepening of the quarries, the stability of the loosened areas of the scarps will decrease, especially in areas composed of highly fractured rocks, prone to intense weathering or having unfavorably oriented tectonic, non-tectonic cracks and faults, as well as when water (underground and atmospheric) is replenished by igneous igneous rocks. Within the studied territory of the described deposits, a quantitative assessment of the degree of fracturing of rocks shows that in a vertical section, based on materials from exploration wells to a depth of 800 m, fracturing will hardly change, i.e. the regularity of changes in fracturing with depth has not been established.

With the modern achievements of mining science and technology, it seems possible and economically feasible to conduct open pit mining at depths of 500-700 m and more.

However, along with an increase in the depth of open pits, the service life of their sides and ledges, consisting of fractured rock massifs subject to weathering, also increases, and therefore the solution of issues of ensuring the stability of slopes in open pits, the timely prevention of various types of deformations, depending on the changing mining and geological the situation is impossible without constant monitoring by the geological service, i.e. engineering-geological and mine surveying monitoring of mining enterprises over the condition of the slopes of the ledges, the sides of the quarries.

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