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Research Article

HYDROGEOLOGICAL AND ENGINEERING STUDY OF THE GEOLOGICAL CONDITIONS OF THE GUZHUMSAY DEPOSIT

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ABSTRACT
In the article, hydrogeological and geotechnical conditions were studied at the Guzhumsay field region. The main reason for the failure of mining in this region was found related to the action of dynamic forces arising from the explosion and the work of mining vehicles. This was accompanied by unloading of overlying lithological differences of rocks and the removal of the stop mining works. During the mining process, the water inflow is increased by the inclination in the mountain region.

***Keywords**: Water inflow, Groundwater Level, Water Discharge, Collapse, Fall, Failure, Tectonic Crack*

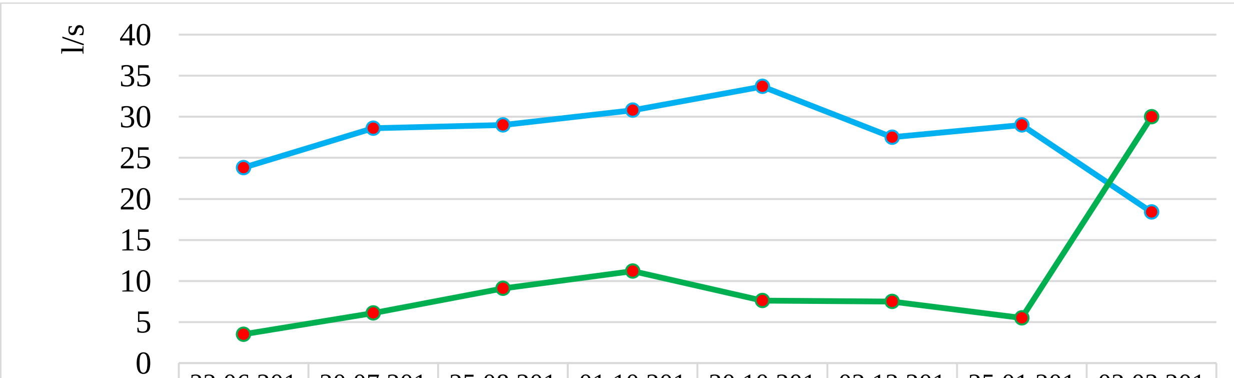
INTRODUCTION
In recent years, one of the tendencies in the development of the mining industry around the world is the involvement of complex engineering and hydrogeological techniques in the exploration of mineral deposits particularly located in the deepest horizons.

MATERIALS AND METHODS
When studying and predicting engineering-geological processes at deposits of solid minerals, we proceeded from the following position: identifying predicted elements of the proposed type and type influence on the state of the rock mass, and technological processes. All types of geotechnical processes are multi-parameter systems, and their foundations (roots) are identical, that is, all types of IHP are confined to disturbed, altered, weakened zones, differing in parameters and location relative to mine workings.

RESULTS AND DISCUSSION
The Guzhumsay runoff directly depends on the amount of precipitation, the main runoff falls on the winter-spring period. According to Gujumsai, the maximum flow rate is 1446 l/s (April), the minimum 9,7 l/s (August), in 2017 the average annual flow rate is 50 l/s.
The geological structure of the Guzhumsay deposit includes intrusive rocks of the Paleozoic and overlying loose Neogene-Quaternary deposits up to 100m thick. Intrusive rocks are represented by granosyenites, syenites, granites, Upper Pliocene - siltstones, clays with interlayers of gravelites and conglomerates. Quaternary formations overlap the Neogene rocks and are represented by alluvial-proluvial rubble sediments with fine earth (Isokov *et al.,* 2013).
According to the conditions of feeding, distribution, circulation and discharge within the field, the fracture waters of the Upper Paleozoic rocks and the fracture-vein waters of the zones of tectonic faults are mainly distinguished.
Hydrogeological studies of underground mine workings of mine 1 (regime monitoring of water inflows) showed that the main ways of groundwater inflow into the workings are zones of tectonic disturbances, zones of crushing and increased fracturing. As a result, fissure-vein waters are formed.
According to the data of regime observations, well 1305 is located in the south-west of mine 1 at 1000-1500 m, the groundwater level varies from 41.0 to 62.0 m.
At the horizons +780 m, +720 m, +660 m, +600 m along mine 1, observations of total water inflows are from 35.7 to 136.0 l/s.

At the horizons +660 m, +600 m, along the NTS-5G mine, the observation period in 2017 into the water inflow was: horizon +660 m from 23.8 (June) to 18.4 l/s (March); horizon + 600 m from 3.5 (June) to 30 l/s (March) (Fig. 1).

According to the classification of N.I. Plotnikov, the Guzhumsai field belongs to the category of medium complexity in terms of the degree of complexity of hydrogeological conditions, which is also due to the thick stratum of flooded Neogene-Quaternary sediments, the presence of numerous tectonic disturbances, the predominant distribution of fractured-ground and fractured-vein waters, the proximity surface watercourse (Plotnikov *et al.*, 1957).



	22.06.2017	20.07.2017	25,08.2017	01.10.2017	30.10.2017	02.12.2017	25.01.2018	02.03.2018
660m	23.8	28.6	29	30.8	33.7	27.5	29	18.4
600m	3.5	6.1	9.1	11.2	7.61	7.5	5.5	30

Figure 1: Changes in the flow rate of water inflows into mine workings horizon + 660m, + 600m.

Fissure and fissure-vein waters of Paleozoic rocks are involved in the watering of underground mining region. The groundwater of Neogene-Quaternary sediments is also involved in the watering of mine workings, but due to the low values of the filtration coefficients of the bedrock, despite the significant reserves of groundwater, their flow into the mine workings is limited. It enters mainly through the zones of tectonic faults with higher filtration coefficients.

Tectonic fractures are mainly developed at the Guzhumsai field. In addition, there are unloading cracks of artificial origin. Tectonic cracks are represented by shear cracks, they are steeply inclined, vertical, and contribute to the formation of rock falls.

Most of them are made of quartz, chlorite, iron oxides, or ground material. Artificial (man-made) cracks have arisen under the influence of blasting and rock pressure. They are usually flat, horizontal with an angle of incidence of 40-45°.

Based on the results of fracture measurements, histograms were built. In the underground mine workings of mine 1, horizon +720 m, four systems of cracks are identified on the histogram:

I - dip azimuth 10-60 °; II- dip azimuth 80-140 °

III - dip azimuth 180-280 °; IV - dip azimuth 310-360 °.

Engineering and geological properties of rocks determines the features of the values of strength indicators of properties, stability and behavior in mine workings.

Analysis, generalization, and a comprehensive study of the hydrogeological and engineering-geological conditions of the field, allows to establish and identify an increase in water inflows into underground production adit horizons, to take the necessary safety measures in advance for mining operations in the mining massif.

During underground exploration and development of mineral deposits, the formation of collapse and fell out widely developed. Collapse by confinement is inherited to horizontal and inclined mine workings and is formed: collapse of the roof of mine workings, which are formed in a domed shape.

The sinkholes of the funnel are formed by shallow horizontal mine workings passing along the zone of crushing faults, steeply lying ore bodies and in the presence of faults in the upper parts. In the processed ore zones, sinkholes are formed, further development of which in deeper horizons undergoes subsidence of individual block structures. Weak zones are tectonic ruptures and large cracks, as well as inter-contact layers. They are mainly located vertically or at an oblique angle relative to the goaf.

Various types of deformation and type of displacement develop on the surface of the deposit. These are dips of rocks, sinkholes are interconnected, and they can develop sequentially. Dips of rocks are formed in those areas where mine workings are laid on small depth along the zones of crushing faults above the upper part of the worked-out vein zones causing craters of collapse. These further develop within the faults and forms deep horizons, cone-shaped dips (Miraslanov and Zakirov 2015).

On June 17.2017, in the area from mine No. 1 of the Guzhumsay deposit 300-400m, a sinkhole appeared. The signs of the manifestation of which were the formation of cracks on the surface in the thickness of loess-like loams with a diameter of 30-35 m, a depth of capture to the second horizon of 245-250 meters.

Over time, arcuate cracks began to form outside the funnels; and with time, the mouth of the funnels began to collapse. The identification and assessment of the conditions for the formation of the existing sinkhole craters, the places of its development, as well as the study of the geological-tectonic block structure of the ore zone and other areas in general, makes it possible to assume that in similar areas during mining operations, large deformations are possible in the form of sudden subsidence large volume on the area of rock masses.

On September 18, 2018, the second sinkhole formed at a distance of 10-15 meters, and the first sinkhole expanded by 35-40 meters (Miraslanov and Zakirov 2015).

Parameters of the second funnel, diameter was 45-50m, with a capture depth of up to 240m.

Observation and study of the failure funnel as of 04.18.2019. According to the parameters of the first sinkhole, the funnel expanded by 2-3m, the diameters were 40-43m. The second sinkhole widened 4-5 m; diameters were 55-65m, at a distance of 6-8 meters.

The technology for the development of this section is carried out by a chamber-and-pillar system, leaving the pillars without laying the worked-out space for working out the interlock pillars, they are loosened by means of an explosion. Such a mining system causes a redistribution of stresses in the massif, which, depending on the depth and size of mining, the heterogeneity of the massif and the complex geological-tectonic structure, favored the sinkhole, and the cause is massive explosions and earthquakes, as well as the section of the sinkhole are directly located in the zone of tectonic faults which lie almost vertically 70-800m.

Thus, the assessment of the conditions for the formation of the existing collapse of the place of its development, as well as the study of the geological and tectonic conditions of the ore zone and other areas, in general, makes it possible to assume that in similar areas during mining operations, such a manifestation of large deformations is possible.

The main reason for failure is the action of dynamic forces from the explosion and the operation of mining vehicles, as well as the unloading of the overlying lithological rock differences and the removal of the support by mining operations.

Conclusion

Analysis and generalizations show that the horizon + 660m, the total water inflow as of 06.22.18 was 23.8 l/s and on 03.02.18 the water consumption is reduced to 18.4 l/s. Starting from the horizon + 600 m of the transport-inclined adit of water inflow, the water flow rate is increased to 30 l/s, due to the inclination to carry out mining and tunneling works.

In conclusion, it should be noted that the time and place of manifestation of the sinkhole funnels coincides with the development of interblock pillars and their loosening with the help of an explosion.

A significant role on the water cut of the field is played by discontinuous disturbances that are widely developed in the area of the field, large tectonic disturbances crossing the rocky Paleozoic rocks are usually accompanied by zones of crushing and brecciation and serve as conductors between water bearing complexes of the Neogene-Quaternary age of the Paleozoic.

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