

Geological modeling of shaft pillars parameters during mining operation of rich iron ores deposits under pressure aquifers

O. Plotnikov (Kryvyi Rih National University), M. Kurylo (Taras Shevchenko National University of Kyiv), V. Stapay (Kryvyi Rih National University), R. Kolotiiievskiy (Zaporizhzhya Iron Ore Plant)

SUMMARY

Mining companies are increasingly forced to involve in the exploitation deposits with unfavorable geological especially hydrogeological conditions in order to maintain production capacity. An example of this is start of mining operation of the Pereverzivsky rich iron ore deposit at the Zaporizhzhya Iron Ore Plant. The ore bodies within this deposit are covered with a thick layer of sedimentary rocks, which contain pressure aquifers. Safe and complete mining of the deposits depends on the correct choice of shaft pillars parameters taking into account geological factors. A method for calculating shaft pillars parameters for the safest and most complete deposits development under aquifers has been determined. The technique is based on the results of three-dimensional models of rock complexes and ore bodies. The technique has been tested in difficult mining and geological conditions of the Pereverzivske rich iron ores deposit. According to the calculations, the minimum thickness of the protective layer will be: Option 1 camera width 15m - the worst conditions - 27.8 m; the best conditions - 3.6 m; average conditions - 10.1 m. Option 2 camera width 30m - the worst conditions - 54.3 m; the best conditions - 4.3 m; average conditions - 16.5 m.



Introduction

Ukraine is one of the world's leading producer of iron ore commodities, has very large reserves resources, but most of deposits are exploited in difficult geological and mining conditions. The best reserves with the most favorable mining conditions are almost exhausted. Therefore, mining companies are increasingly forced to involve in the exploitation deposits with unfavorable geological especially hydrogeological conditions in order to maintain production capacity. (Dobrokhotov, 1960; Plotnikov and Petrusenko, 2001).

An example of this is start of mining operation of the Pereverzivske rich iron ore deposit at the Zaporizhzhya Iron Ore Plant. The ore bodies within this deposit are covered with a thick layer of sedimentary rocks, which contain pressure aquifers. safe and complete mining of the deposits depends on the correct choice of shaft pillars parameters taking into account geological factors.

Existing methods of shaft pillars parameters calculation take into account primarily the geotechnical properties of the rock mass and the applied technology and mining method. Also there are known methods for determining shaft pillars taking into account the attenuation factor of solid mass. However, each deposit is unique even within one genetic type.

The main goal of the study was to develop optimal geological models for determining the size of shaft pillars in order to provide mining system safety on the example of rich iron ores Pereverzivske deposit, where orebodies lie below the Buchak aquifer.

Research results

The Pereverzivske deposit occupies the southern part (6.1 km²) of the northern half of the western Central (Pereverzovskoye) syncline limb, 12 km long subdiagonally. To the north it is in contact with the Pivdenno-Bilozirske deposit in the area of the iron ore horizon flexural bend between profiles 40-450 and 41st, to the south of profile 50 - perspective rocks of iron ore subsuite. The rocks of the iron ore stratum within Pereverzivske deposit lie from the earth's surface at a depth of 271-360 m (average 300 m) (Dobrokhotov, 1960; Plotnikov and Petrusenko, 2001).

In order to obtain the initial data for the calculation of the shaft pillar parameters, the properties of overburden rocks above the productive stratum of the Pereverzovske deposit (Buchak, Cretaceous complexes and the crystalline rocks surface) were studied with three-dimensional modeling (Fig. 1-4).

Determining the shaft pillar parameters for the rich iron ores Pereverzivske deposit under the Buchak aquifer was based on the experience of mining operation with complex hydrogeological conditions, for which we need to use backfilling systems with hardening mass and leaving shaft pillars. Development of deposits with the use of such backfilling systems in difficult hydrogeological conditions can reduce losses and ore dilution by 2-3 times.

The priority was to detail the engineering-geological and hydrogeological conditions based on the results of previous studies and actual data obtained during the mining of ore body №4, in particular: clarification of physical and mechanical rocks characteristics; study and assessment of fracture; assessment of the ores flooding degree; clarification of morphology, lithological composition and flooding of the crust of weathered crystalline rocks; detection of fractured tectonic faults, zones of fragmentation and increased fracture.



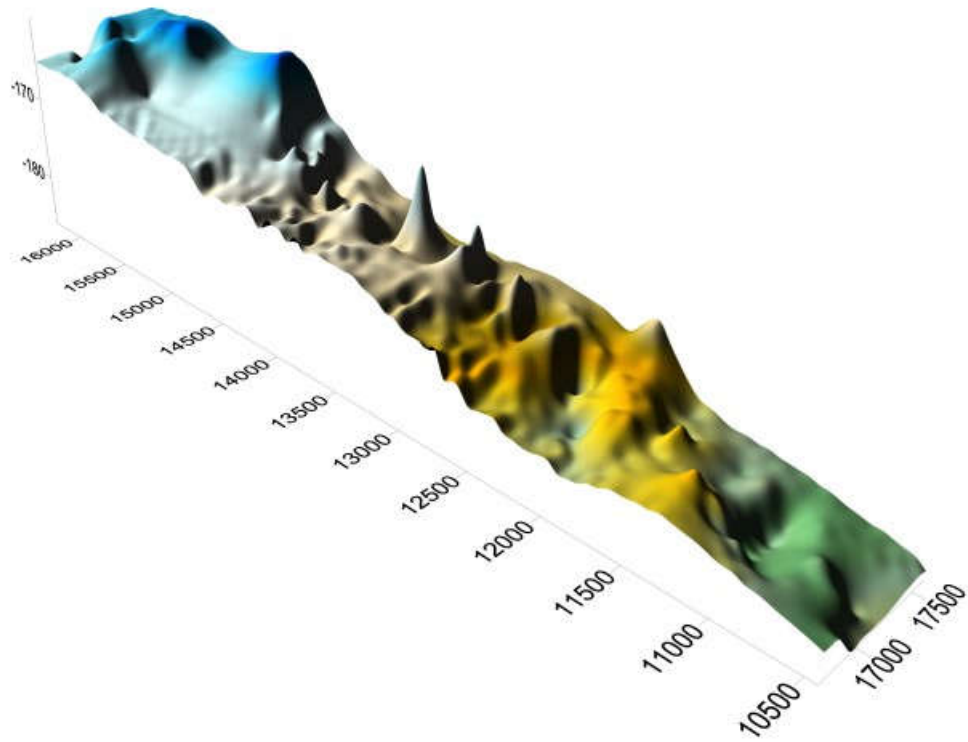


Figure 1 3d model of the surface of the Buchak horizon

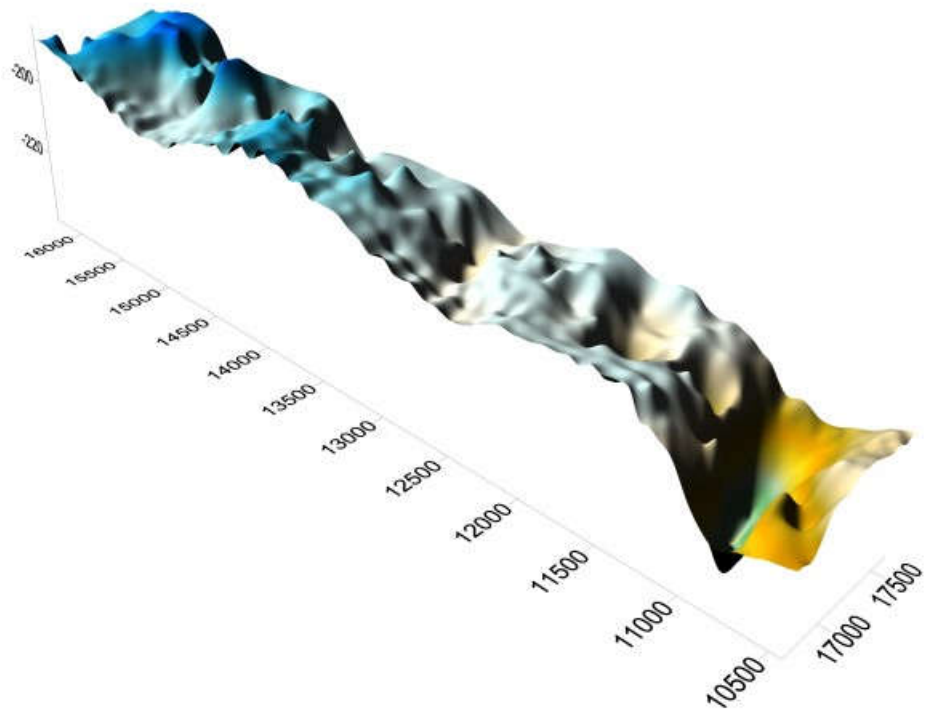


Figure 2 3d model of the surface of the Cretaceous complexes



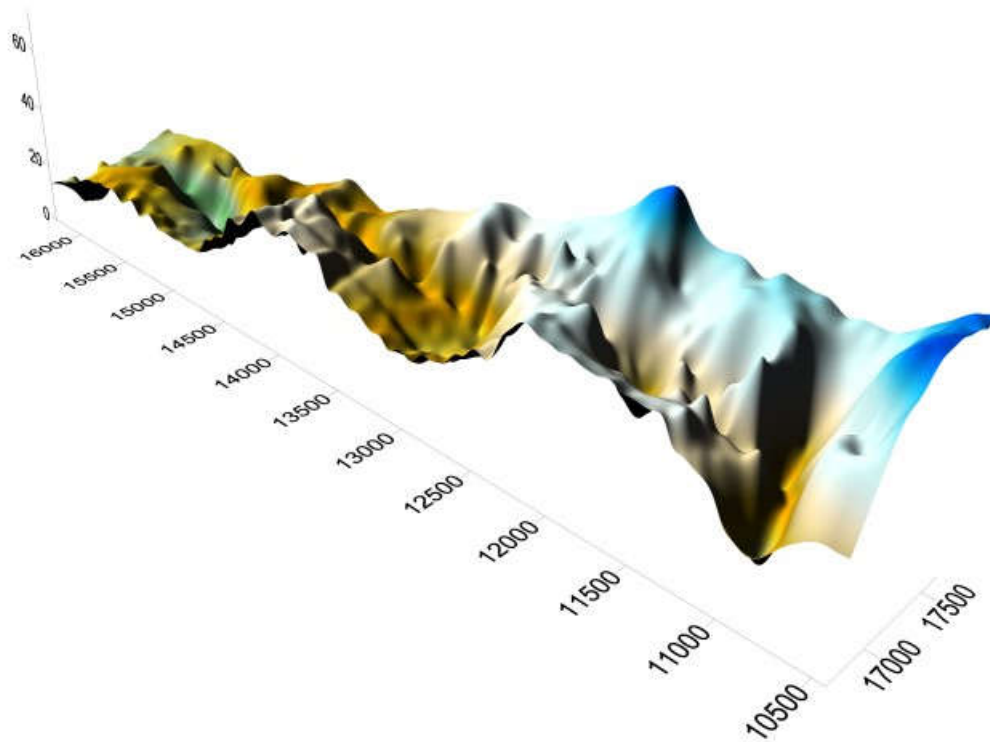


Figure 3 3d model of limestone's thickness of the Cretaceous complexes



Figure 4 3d model of the crystalline rocks surface



Based on the obtained results, the shaft pillars parameters were determined and technological measures (special observations and researches) aimed at safe development of ore deposits under the Buchak aquifer were developed.

According to the calculations, the minimum thickness (m) of the protective layer (Δm) will be:

Option 1 (camera width 15m)

the worst conditions - 27.8 m; the best conditions - 3.6 m; average conditions - 10.1 m.

Option 2 (camera width 30m)

the worst conditions - 54.3 m; the best conditions - 4.3 m; average conditions - 16.5 m.

According to calculations, the maximum height (m) of the formation of the domes will be, N_k :

Option 1 (camera width 15m)

the worst conditions - 35.3 m; the best conditions - 1,0m; average conditions - 9.5 m.

Option 2 (camera width 30m)

the worst conditions - 70.5 m; the best conditions - 1.8 m; average conditions - 18.9 m.

Depth of ore development under the Buchak aquifer (m):

Option 1 (camera width 15m)

the worst conditions - 63.1 m; the best conditions - 4.6 m; average conditions - 19.6 m

Option 2 (camera width 30m)

the worst conditions - 124.8 m; the best conditions - 6.1 m; average conditions - 35.4 m

Given that the calculation of the maximum domes height was done taking into account the ore mass for the width of the chamber 15 m and the strength of the ore f_3 , the required thickness of the safety column - 16 m (according to calculations for average conditions) with a minimum thickness of the safety layer (Δm) 14m to soles of the Buchak aquifer.

Conclusions

A method for calculating shaft pillars parameters for the safest and most complete deposits development under aquifers has been determined. The technique is based on the results of three-dimensional models of rock complexes and ore bodies. The technique has been tested in difficult mining and geological conditions of the Pereverzivske rich iron ores deposit.

References

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