THE RE-EVALUATION OF THE GEOLOGICAL AND HYDROGEOLOGICAL CONDITIONS OF THE NAGYEGYHÁZA COALFIELD BASED ON THE UNDERGROUND DATA

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SUMMARY

The study gives a hydrogeological evaluation of the aquiferous rocks which have been exposed in the drifts or underground drillholes since the initial developments and the commencement of production in the mine.

It presents data about the inflow rates obtained when the different aquifers have been transsected, and tha volumes pumped.

The conclusions of the final report about the surface geological and hydrogeological explorations are compared with the underground field data.

The modes of reducing the water hazard, and the efficiency of the preventive measures against incidental water inrush is discussed.

It is concluded, that the methods used in testing and prevention at the upper seam have proved to be successful. The mining of the lower coal seam and the bauxite needs wider application of the underground geophysical methods.

INTRODUCTION

Since the construction has started, the F-1 vertical shaft, and the West No. 1. and West No. 2. inclines have been completed. The V-1 vertical shaft has been sunk down and the eastern incline has reached 223,0 m depth. The total driveage at 31. August 1981. was 13 739 m.

After the main dewatering station at the -130 m level had been put into operation, the production has started in the upper coal-seam at 24. June 1981. in the D-I-111 longwall /Fig. 1./.

The "Final report of the coal-, bauxite- and hydrogeological explorations at Nagyegyháza" /1976/ has stated that the hydrogeological informations, which have been gathered about the basin, met with the requirements of the detailed exploration stage. The mine was considered as water hazardous, with regard to the prevention. Updip advance has been suggested for the direction of production, to provide protection against the footwall aquifers.

The suspended monorail haulage system has allowed max. 14^{o} slope for drifting.

These conclusions have been incorporated in the planning of the layout of drifts, and water entries were planned near to the haulage drifts at deeper levels. From these water entries the water gravitatively flows through collecting drifts to the main dewatering plants.

THE RESULTS OF THE DRILLINGS AND EXPLORATION WORKS SINCE THE START OF PRODUCTION

Oligocene sands

Before the works of the vertical shafts and the Eastern incline has started, a pre-draining method has been developed to dewater the predicted inflow rates as well as the methods of dewatering.

During the sinking of the F-1 vertical shaft, 350 l/min water has flown in until the permanent lining was finished. The sands were transsected by the No. 1. and No. 2. main roadways too, but the resulted water has remained below 400 l/min. Altogether 290000 m^3 water has been tapped from the sands since the first tappings, calculating with an average 350 l/min flow rate.

It is therefore obvious that the Oligocene sands have continuous supply from the furface waters, through the initial static head at +180 m a.s.l. has been depressed to +130 m a.s.l. level. The gradational drain of the aquifer is evidenced by the slow decrease of flow rates in the earlier underground tapping points. as well as the lack of water in the recently drilled-exploration- or draw holes.

Middle Eocene Alveolina-limestone

This aquifer means potential hazard from two aspects. On one hand the drifts crossing this layer might hit fissures, inducing incidental water inrush. On the other hand cavings caused by the longwall stopes may rupture the limestone layer above the coal seams, the limestone itself can also be fractured, causing abrupt discharge of its stored water. This means a much larger danger.

4-5 m^3/min inflow rates were calculated for the drift crossing this limestone, based on the data of the surface test-wells 2 . The recent calculations have resulted max. 2,7 m^3/min flow rate from one drill-hole with 103/98 mm dia. casing.

The water tapped by a pre-draining hole or a draw-hole is thus flows in a smaller rate, it can be more easily collected and drained. Thus it was decided to make the drifting under the protection of pre-draining hole if the value of the specific protective layer has fallen below 2 m/bar in the drift approaching or crossing the limestone.

The Mining Research Institute has calculated the static water reserves of the Alveolina-Limestone above the southern part of the mine. Calculated by n = 1,5 % porosity, the reserves have amounted 232 000 m^3. Calculating with the data obtained at Csordakut, i.e. n = 1,5 % porosity, the reserves were totalled 134 000 m^3.

A plan was made to dewater the limestone, based on the calculated maximum flow rates obtainable from one drill-hole, and the superponed water volumes considering the decreasing flow-rated during the discharge of the layer. It was planned to draw 695 000 m^3 water from 22 drill-holes in 165 days. This volume was 5,2 times /at n = 1,5 %/ or 3 times /at n = 2,6 %/ larger than the calculated static reserves. The No. 1. and No. 2. inclines have started from Triassic rocks, and reached the Alveolina-limestone at +124 m a.s.l. after transsecting a N-S striking fault. The inclines advanced 80 m within the Alveolina-limestone until the underlying fossiliferous marl has not been reached, at the +103 m a.s.l. level. No water was tapped during the advance on this section. In this place the main karst water level was at +100 m a.s.l. level, i.e. beneath the interface of the limestone and the drift. It can be suggested, that on the western edge of the area the dolomite taps the Alveolina-limestone aquifer.

The northern main haulage drift has intersected the limestone between the +46 m a.s.l. and the +59 m a.s.l., in 140 m length. The pre-draining holes have not penetrated fissures, but two water inflows have occured during driftung, each with 30 l/min flow-rate. When the drift has crossed an E-W striking fault with 50 m throw, a hole was drilled to reveal the position of the limestone, with 59 mm diameter. 1200 l/min of water was got through this hole. This rate has been decreased to 180 l/min after 10 days, then fell down to 20 l/min after the next 10 days and finally stopped. The total volume obtained was 6250 m^3.

On the southern area 15 draw-holes have been drilled in 400 m total length to protect the longwalls. The average flow rate was 30 l/min, with 200 l/min maximum but even the hole with maximum flow rate has stopped within 7 days.

In the northern area additionally five draw holes have been drilled from a crosscut. Thus 11.670 m^3 water has been drawn in the two areas from the Alveolina limestone through drill--holes. This volume is not even one-tenth of the predicted value for stored water. This deviation can be attributed to the the variability of the hydrogeological data used for the calculations as well as the random nature of the fissurization, which has decreased the efficiancy and accuracy of the evaluation of drill hole data. As an example, a roof rupture has produced 1000 l/min inrush at the 59,5 m of the advance of the longwall stope. After 1920 m^3 water has been discharged, the inrush has stopped in three days. In this area only one from the six drill-holes had produced water from the Alveolina limestone, with 17 l/min flow rate.

Middle Eocene travertine limestone

The greatest difference between the predicted and the observed hydrogeological data has been experienced in the case of the travertine, which is intercalated between the upper and lower coal seams.

The +30 m a.s.l. horizont has been first reached by the No.1. main haulage after transsecting a N-S striking fault zone, which has 180 m vertical throw. Several drill-holes from the development drifts of the upper seam has reached the limestone, and advanced 0,5 m in this layer, but no water has been observed.

The development drift of the D-I-111 longwall has reached the upper surface of the travertine after crossing through a fault with 8,5 m throw. It has advanced 14,0 m in this layer. Here the limestone was banded, and compact. Only the fault zone has produced water in 10 l/min amount.

In the northern panel the clay-marl protective layer between the upper seam and the travertine is only 2,5 m thick, compared to the 8,0 m thickness in the central parts.

Due to this thin protective layer, altogether 1100 l/min water was tapped during the development of the 520 m long E-I-111 airway, as a sum of several 50-100 l/min inflows got along smaller faults and other structural elements. The chemistry of the water is comparable with the waters of the basement aquifer, through it has higher Na^+ and K^+ cation and SO_4^{2-} anion content owing to its migration through the lower seam and the travertine.

Owing to faults and variations in bedding, the E-I-111 airway and the northern haulage cross-cut has intersected a non-typical occurence of the travertine, 3,5-4,0 m below the upper seam.

This rock was very similar in appearance, texture, to the Triassic dolomite. This rock type shows gradational transition to the draker, banded typical travertine, along a 2-3 cm thick nixed layer. Its bedding is different from that of the overlying clay-marl.

This non-typical travertine has also been fornd in other placessin the northern panel, in a few meter thickness. It does not form a continuous layer, only isolated lenses in the northern part of the Nagyegyháza basin.

This rock type has more favourable hydrogeological properties than the typical travertine. More compact, less fissured and has larger strength than the banded travertine. Only 30 l/min water was produced from this layer, this inflow rate has not changed. The midele and lower part of the travertine is known from three underground drill-holes. The layers immediately above the lower coal seam are more fissurized, 5-10 l/min water was got in the drill-holes.

A pre-draining hole /38 mm dia./ was drilled from the water entry at the -130 m a.s.l. level. This has reached the travertine at 27,5 m depth, and produced 500 l/min water. After the drill-rods have pulled out, the face have failed, and the flow rate decreased to 200 l/min.

The draw-holes which were aimed to tap the limestone, have produced 360-2400 l/min water. Through the holes were choked several times, and re-drilled, they are producing 2400 l/min water recently.

The travertine is therefore considered as protective layer for the upper seam, even along fault zones of 10 m throw, if these are not open-faults. However, preventive holes have to be drilled ahead of the face to explore if the limestone is fissurised or the faults are filled with gauge.

Reworked dolomite

No dolomite or reworked dolomite has been intersected by underground openings since the developments started.

The longer underground drill-holes which have reached the re-worked dolomite, always produced water in 200-1600 l/min amounts. When the water entry has got water through the travertine, the water level has decreased 3,74 m in the Me-91 karst water observation hole, 70 m distance from the place of inflow.

This observations show good agreement with the prognostic hydrogeological evaluations based on the data the surface explorations. The pumping rate of the mine at present is 4 m^3/min, which agrees well with the prediction made by the BKI in 1980.

The relatively large deviations of the drill-holes have caused the greatest problem in making the tectonic map and the footwall relief map. In the early stage the drill-holes were not surveyed, and some other holes have been surveyed without measuring the-seam was 26,0 m. Three cemented sasings have been exposed by drifts. The cement around the casing was in all cases inadequate. The water from the higher aquifers has flown into the underground openings, thus the specific protection conditions become worse in the critical areas.

The uniaxial strength of the fossiliferous marl above the upper seam is /70-90/ 10^5 Pa, similar to the low strength clay-marl in the footwall. These rocks, tend to heave when affected by water, and, as was observed in the water entry, these rock might exhibit creep too.

Based on these field data, the drilling of tihe pre-draining holes to be drilled ahead of the face have to be modified.

The smaller hand-drills are suitable to make small diameter holes to explore smaller faults or cavities and protect the drifts from incidental water inrush. At greater depths, however, the water can not flow freely in the 38 mm drill-holes through the low strength footwall clay and the moistened clay-marl can be pressed into the drifts by the water pressure.

Thus the use of cemented leading pipes in the pre-draining holes are suggested in those drifts, which are approaching either the travertine or the reworked dolomite.

PREVENTION METHODS AGAINST INCIDENTAL WATER INRUSH

The mine has its own geological staff, which has the following duties:

1./ The determination of the accurate location of coal-seams, aquiferous rocks, faults by small diameter underground holes;

2./ The drilling of preventive pre-draining holes, where it is considered necessary;

3./ The drawndown of the stored waters from the footwall and hanging-wall aquifers.

4./ The filling of the cavities of the fissurized aquiferous rocks.

The drilling crew works in close co-operation with the development drifting. The pre-draining holes and the exploration holes can only be drilled when the pump system has been installed in the drill-site. In drill holes larger than 60 mm diameter cemented leading pipe has to be installed.

In the downdip drifts two pipelines with 200 mm diameter were laid down to facilitate the drainage and pumping of water with the pumps located at the face. These pumps have adequate head and capacity to meet the local requirements.

Preliminary rock-injection /filling/ has been carried out from four drill-holes from the surface to protect the drifts approaching the reworked dolomite. Since these operations began, 10.144 m^3 filling slurry has been injected into the rocks.

The first injection drill-hole, T-N-105 was used to inject the fissures of the reworked and compact dolomite around a fault zone of 180 m throw ahead of the main roadways. 2520 m^3 filling slurry had been injected, when the filling clay appeared along a smaller fault in the No. 1. main roadway. When the injection has been finished, 100 l/min water inflow has been remained on the site where the filling material has appeared.

The T-N-117 and T-N-118 drill-holes were planned to inject the dolomite behind a fault-zone in the path of the No. 1. incline. After 297 and 170 m^3 slurry had been pumped into the holes, the filling material has again appeared in the No. 1. main roadway. During further periodical injections the 100 l/min inflow rate in the main roadway has increased to 350 l/min.

It was observed, that during the repeated injections, which were carried out to eliminate the effects of rupture occured in the rocks influenced by the approaching drifts, the filling material has appeared in the drifts, before the pressure calculated for the rupture was attained.

Since the rupture has taken place before the whole pore-system has been injected, the repeated injection have not completely sealed even those fissures, which were opened towards the drift.

These observations have been used when the two additional injection holes, T-N-120 and T-N-122 were drilled and injected. 7 157 m^3 slurry was successfully injected into the basement karst aquifer through these holes.

The drawdown of the waters stored in the upper seam has to be carried out ba draw holes before the production in the longwall stopes starts. The fault zones ahead of the development headings were located by exploration and pre-draining holes in 60 m distance ahead of the actual face. Based on these data, the slopes of the drifts could have been modified well in advance in order to avoid full-face transsection of aquiferous rocks and faults.

Field tests have been carried out to investigate the efficiency of geophysical methods to make seismic profiles between development drifts and determine the location of faults. Surface seismic survey has been successfully used to locate faults with more than 5 meter throw in the Alveolina limestone and the upper coal seam.

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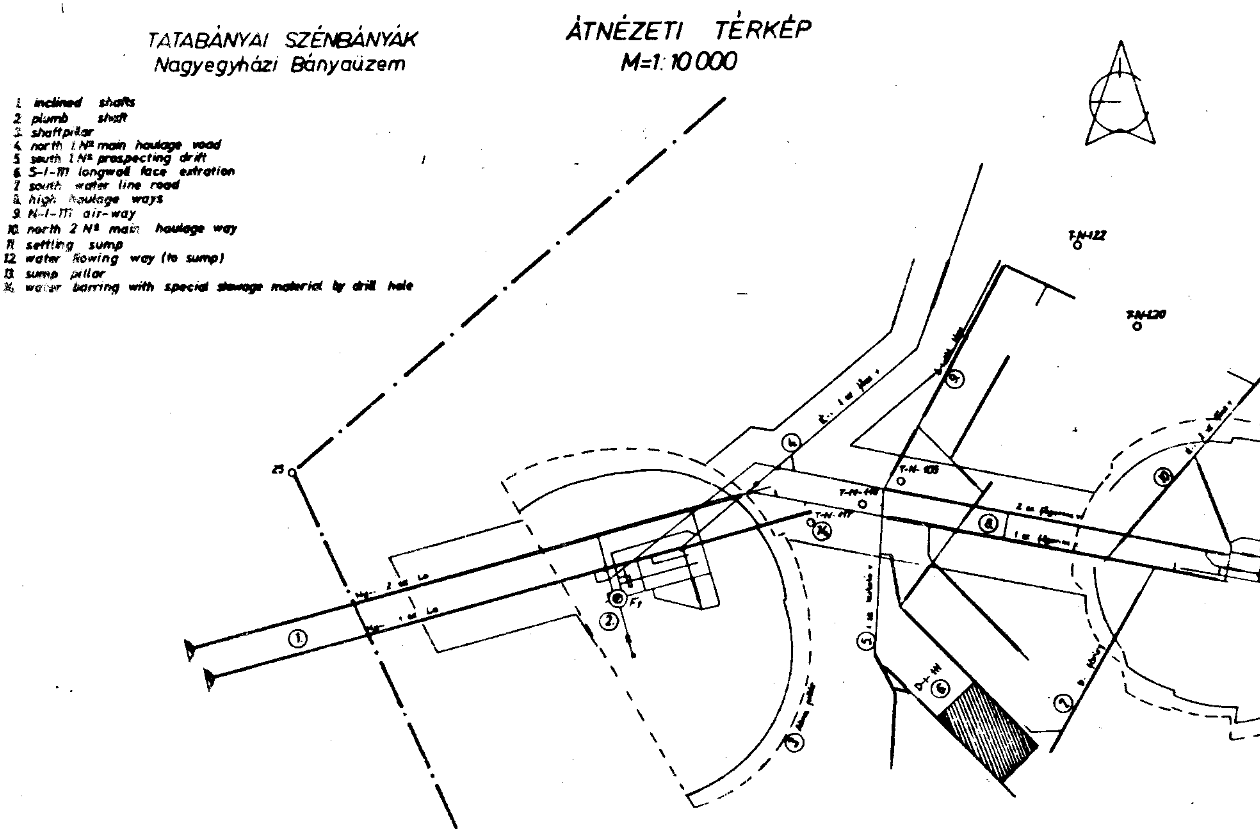
LIST OF FIGURES


TATABÁNYAI SZÉNBÁNYÁK
Nagyegyházi Bányaüzem
ÁTNÉZETI TÉRKÉP
M=1:10 000
1 inclined shafts
2 plumb shaft
3 shaftpillar
4 north 1 N² main haulage road
5 south 1 N² prospecting drift
6 S-I-III longwall face extration
7 south water line road
8 high haulage ways
9 N-I-III air-way
10 north 2 N² main haulage way
11 settling sump
12 water flowing way (to sump)
13 sump pillar
14 water barring with special stowage material by drill hole
T-N-122
T-N-120
T-N-105
T-N-116
T-N-117
25
F1