NOVAKY COAL DEPOSIT AND ITS RELATION TO BOJNICE THERMAL WATERS

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ABSTRACT

Continuous long term drainage on Novaky coal deposit has influenced hydrogeological conditions in vicinity of the deposit. These changes of hydrogeological conditions can unfavourably influence Bojnice thermal springs with total discharge of 36 lps and temperature 45°C. These are located in close vicinity. Authors have evaluated 17 years longing hydrogeological observations and made conclusion, that no any unfavourable effect has been caused by mining in coal deposit on Bojnice thermae. However, possibility of unfavourable influence in the future can not be excluded. Protective measures, established for coalmining and exploitation of thermal water in 1972 has been modified and some new protective precautions were proposed. Some new investigations and observation objects has been proposed too, these will give us new data about geological conditions and hydrogeological relation between thermal waters and underground water of coal deposit. The data obtained by observation will be yearly evaluated and protective measures will be modified if necessary.

INTRODUCTION

Slovakia occupying the part of West Carpathians is rich in mineral and thermal waters. These give pleasure to the people and often recovery their health. On of the most famous springs of thermal waters are Bojnice thermal springs. Their total discha-

rge is 36 lps and temperature 45°C. Thermal water is used for medical treatment of deseases of mobility and for recreation purposes too. In close vicinity of Bojnice spa there is Novaky coal deposit (Pl.1). The mining started in 1940 and water has to be drained from mining area. The discussion of possible danger of unfavourable influence of coalmining on Bojnice thermae became very sharp when in 1954 inrush of water into mine took place. Discharge of inrush was 10 lps and water temperature 25°C. After a half of year a total discharge of Bojnice springs decreased from 36 lps to 15 lps. It is supposed that these two appearences are one another in connection although this was no proved.

Hydrogeological investigations have been carried out since 1960 till 1968. According to the results of these investigations the protective measures were proposed. These have been by government of Slovac socialist republic legalized as a law for protection of Bojnice thermal springs. In law were determined protective zones of Bojnice thermal waters, decrees for coalmining and for exploitation of thermal water too.

Authors of paper have evaluated the results of hydrogeological observations since 1968 till 1984. According to this evaluation they have proposed some new measures and some new hydrogeological investigations too. These should make better the protection of Bojnice thermal waters.

GEOLOGY AND HYDROGEOLOGICAL CONDITION

The area could be divided into two tectonic units (pl. 2):

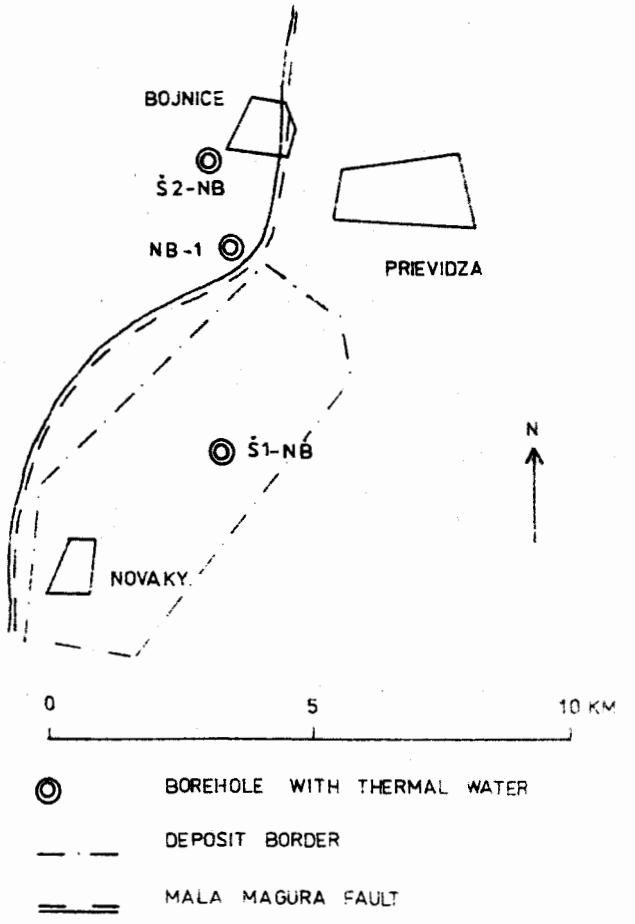
- Bojnice elevated block
- Horna Nitra depression (its part is Novaky coal deposit)

These tectonic units are separated by the Mala Magura fault of post-Paleogene age.

Novaky coal deposit is built by Tertiary sediments. Pre-Tertiary basement is represented by Mesozoic carbonates with thermal water. This water is in hydraulic relation with thermal water of Bojnice elevated block.

The oldiest sediments on deposit are "flyschoid" Paleogene se-

PL.1 SCHEMATIC MAP OF BOJNICE ELEVATED BLOCK AND OF NOVAKY COAL DEPOSIT



diments (flysch, claystones and marginal litofacies), their thickness was to found 653 and 998 m. This sediments act as a generally impermeable interlaver between thermal waters of Mesozoic basement and groundwaters of "underlying tuffites". But this complex includes permeable layers and faults are permeable too. In Bojnice elevated block are faults pervious to a depth of about 300 m. By experience from other similar regions it is supposed permeability of faults to a depth of 300 m.

Egenburgian sediments cover Paleogene, these are sandy clays which has very low permeability. Thickness is about 250 m. Badenian "underlying tuffites" consist tuffites, tuffs and clayey tuffs. Thickness is about 350 m. The permeability of tuffites is weak (10^{-5} - 10^{-9} mps). Groundwaters of underlying tuffites are drained and after 45 years of drainage maximum depression cone has been developed to 400 m. In the course of mining to the north (to Bojnice thermal springs) cause that depression cone will develop wider and deeper. By mathematical modelling was made prediction of development of depression cone till year 2000. In the year 2000 will be on Mala Magura fault depression cone of about 150-200 m. Tuffites are dissected by two system of faults into horsts and blocks. The main tectonic system trends NW-SE, this is perpendiculary to the Mala Magura fault. Fault in "underlying tuffites" are permeable and impermeable too.

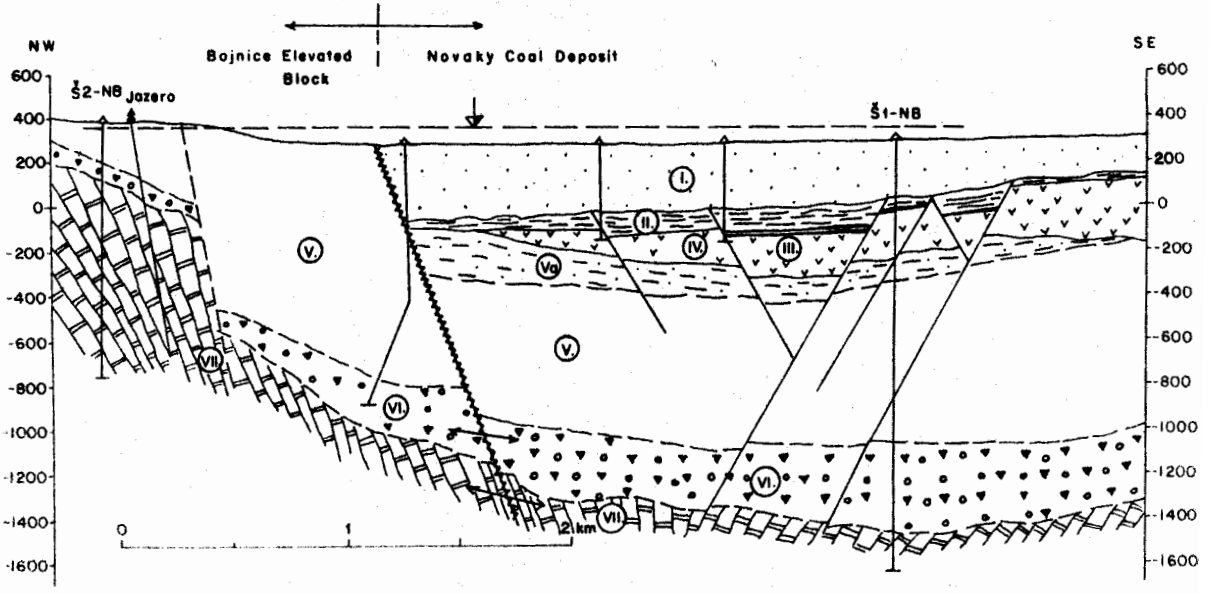
Tuffites are covered by Sarmatian coal seam (thick about 10-15 m) and Sarmatian impermeable clay (maximum thickness 410 m). Clay acts as impermeable interlayer between groundwaters of tiffites and groundwaters of Pliocene detrital-volcanic formation and Quaternary fluviatile gravels.

In Bojnice elevated block is aquifer of thermal waters Mesozoic carbonates, these are covered by impermeable Paleogene sediments. The thermal waters are discharged along faults in Paleogene sediments. Intake areas of Bojnice thermae are two:

- main intake area is in Mesozoic 15 km to NE
- subsidiary occurs in the vicinity of the thermal springs

The bigger part of thermal water comes from Horna Nitra depression (26 lps from total 36 lps).

Pl. 2 TRANSVERSAL SCHEMATIC HYDROGEOLOGICAL GROSS - SECTION



THE POSSIBILITIES OF BOJNICE THERMAL WATER DISTURBANCES

According to the contemporaneous data Bojnice thermae may be disturbed in following three cases:

- inrush of thermal water from the Mesozoic substratum along the faults into the mine
- sucking of thermal water along the faults into the depression cone of "underlying tuffites" aquifer
- filtration of thermal water through Mala Magura fault from Bojnice elevated block into "underlying tuffites" aquifer.

According to the evaluation of 17 years hydrogeological observations we can conclude, that coalmining did not cause disturbance of Bojnice thermal waters. However, such a disturbance can not be excluded and for this reason are proposed protective measures for Bojnice thermae.

PROTECTIVE PRECAUTIONS FOR BOJNICE THERMAL WATERS

According to the hydrogeological investigations since 1960 till 1968 protective precautions were proposed. These have been by the government of Slovac socialist republic embodied in law for protection of Bojnice thermal waters. These protective measures included:

A. Determinetion of protective zones of Bojnice thermae
B. Determinetion of precautions for exploitation of thermal waters (permissible discharges of springs, measurement of discharge and temperature daily)
C. Determination of precautions for coalmining:
   - coalmining must to be carried out in northern part of deposit from S to N, mining in the area close to Mala Magura fault was restricted
   - pre-boring of faults to ascertain whether they are permeable or not
   - discription of all inflows to the mine (the yield and temperature)
   - regime observations of all inflows bigger than 1 lps

- water table regime observations of "underlying tuffites" aquifer
- measurement of pressure head on the borehole BI-HB II, which tap the Mesozoic thermal water aquifer on the coal deposit
- determinetion of limiting values for inflows into the mine in order to evaluate possible disturbance of thermal waters:
  1. waters the pressure of which exceeds the value shown by isopiestic line constructed from the observation of the water level in "underlying tuffites"
  2. water of higher temperature than that calculated for the water at a given depth of inflow according to the geothermal degree of 17 m, after subtracting mean annual temperature 8.5°C within the 25 m neutral zone
  3. water with chemical composition differing from that corresponding to the sodium-bicarbonate up to calcium-sodium-bicarbonate types of water from "underlying tiffutes".

D. For protection of Mala Magura fault the protective pilot was established.

According to the evaluation of 17 years observations could be concluded, that coalmining did not unfavourably affected Bojnice thermal waters and protective precautions have acted well. Therefore we have just supplement protective precautions and we have proposed some new investigations. These include:

- coalmining in northern part of deposit was conceded in limited range
- establishment of continuous measurements of yield, pressure head and temperature on thermal springs
- performance of new observation wells which will tap tuffites aquifer in the area of Mala Magura fault in order to obtain data about the depression cone
- application of mathematical modelling for prediction of depression cone development
- performance of new well in coalmining area which will tap the Mesozoic thermal water aquifer for indication of pressure head changes

- performance of new observation (indication) wells in Bojnice elevated block which will tap Mesozoic thermal water aquifer and Paleogene too.

These precautions must to improve the quality of the protective system for Bojnice thermae. All the data obtained will be yearly evaluated and if necessary the precautions will be supplemented.

The precautions accepted for protection of Bojnice thermae have great social and economic importance. They do not limit the mining of coal, which is till important energy source and also secure the protection of thermal waters, which are significant in medical treatment and recreation of the people too.

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