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Hydorgeologıcal Conditions of The Coal Basın of Kosova Coal Deposit of Sibovci

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Abstract

The coal basin of Kosova has a huge coal reserves, they are the main power sources for thermo power stations of Kosova. At 14.700Mt, Kosova possesses the world's fifth-largest proven reserves of lignite [1]. The lignite is distributed across the Kosova, Dukagjini and Drenica Basins, although mining has so far been restricted to the Kosova Basin [2]. The first systematic records of lignite exploitation since 1922, when a small-scale, shallow underground room-and-pillar mining commenced in the Kosova Basin.

This case of study presents the hydrogeological conditions of the coalfield Sibovc, which is a part of coal basin of Kosova. The study of the natural hydrogeological conditions and the relation of the coalfield with the flow of Sitnica River, are one of the basic elements for the normal exploitation of the coal reserves (Figure 1). For studying of the hydrogeolocial parameters in this field close the river Sitnica four wells have been drilled, which are used for testing and monitoring of the groundwater level. From testing of these wells we have these hydrogeological parameters: porosity 20%, filtration coefficient 3.27 x 10-3 (m/s) and specific water flow 2.54 (l/s). The gained results will be useful to avoid the flooding of the coal deposit by surface and groundwater from the river Sitnica that flows close to the mine. Further development of lignite mining in the medium term will continue with exploitation of the Sibovc field in the northern part of the Kosova Basin.

Key words: alluvial, porosity, coal deposit, river Sitnica, water, hydro geological conditions.

INTRODUCTION

The geological studies of this coal basin began in fifties (50) of the XX century. The tectonic movements at the end of Lower Miocene have originated the depressions of Kosova, Dukagjini and Drenica basin (Figure 2). The coal basin of Kosova, including its periphery zone, consists of deposits of Palaeozoic, Mesozoic and Cenozoic (Tertiary and Quaternary) [3]. The lithology of deposits is important for hydrogeological purposes.

The deposit of Quaternary includes the whole area and normally overly the clay and coal of Neocene. The area of the coal deposit of Sibovci, is composed of alluvial-proluvial deposits of Sibovci River (Q4al, Q4pl), and filled up with gravels of river terraces (Q1–3) clays (Q4d) that cover the greatest part of the coal deposit.

The alluvial deposits (Q4al) consist of gravels and heterogeneous sands filled up with water. They are the main feeders for the coal series.

The alluvium (Q4pl) of numerous streams that flow on the coal area consist of clastic angular materials, often filled up with clayey material and waterproof [4]. Their water keeping is less important in comparison with the groundwater of the alluvial gravels.

The alluvial deposits (Q4d) are silts and sands. They cover all the slopes of the hills and their thicknesses vary from 1– 4m (Figure 3). In the steep slopes, when these deposits are filled with water, they become unstable and somewhere they slide [5]. Their filtering coefficient is below 1 x 10-6m/s.

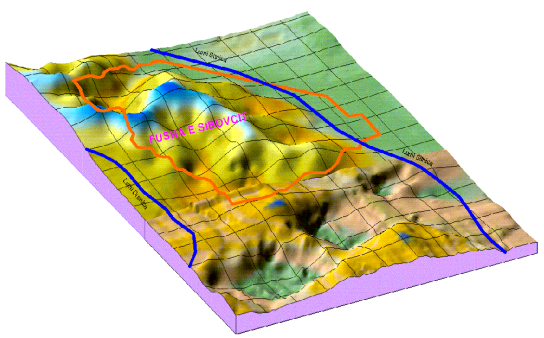

Figure 1. 3D of Sibovci coal deposits

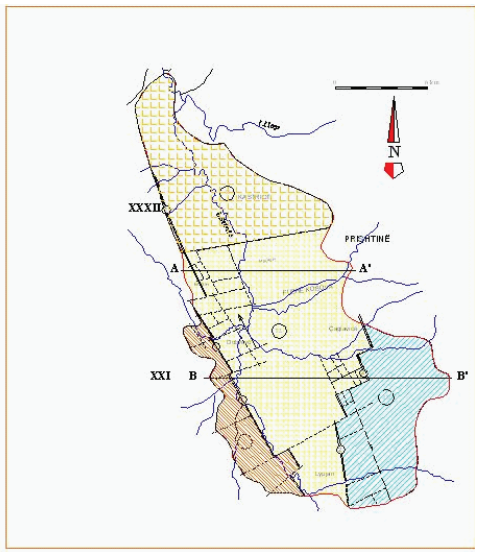

Figure 2. Tectonic map of Kosova coal basin

The central sector is called "coal basin of Kosova" and it includes an area of 300km2. Following the lithology, several series are identified:

a) floor series of this area consists of green clays of Neocene, with intrusive of fine grain sandstones, with carbonated cementation, and often with coarse sandstones and conglomerates well cemented. The thickness of this series is up to 250m.

b) coal series with gradual transition towards the green clays of the floor and the grey clays of the ceiling. This series has a centroclinal dipping and is separated by block tectonic faults as steps immerse towards the central part of the coal basin (fig. 4). The coal of Kosova basin belongs to the lignite type.

c) ceiling series represents the covering of the coal and it consists of different lithologies: grey and yellow clays, gravels and silts with organic material and silty sands. The grey clays contact directly the coal series and it has a wide expansion from Sibovci to Prelez. Their thicknesses is up to 60m.

From the morphological point of view, the coal basin of Kosova is in a mountainous plane, where the difference between the lowest and the highest elevations is less than 80m above the sea level. The basin is divided into two parts: the central plain that consists the area around the Sitnica River and the hilly part around the mountains of Çiqavica, Goleshi, etc.

Figure 3. Hydro geological maps of Sibovci deposit coal.

MATERIALS AND METHODS

Field and laboratories are used to explore the hydrogeological parameters. From each drilled wells are taken samples and have been send to the laboratory for the analyses. Pumping methods are used for testing in each drilled well in the field. The gained results from general analyses are given in the table 1.

These wells are used for the monitoring of the ground water quality and level.

Application of these methods will help in solving of these objectives:

- to determine the limit of the area consisted of alluvial gravels;
- lithology of quaternary gravels and silts and other deposits layers of coal.
- monitoring the water table of the alluvia's, water sampling for the analysis of its quality.

RESULTS

The heterogeneous alluvial gravels have different porosity and filtration coefficient [6]. The porosity is determined in laboratory and varies from 20 - 30%; in the reserve calculation, it is considered to be 25%.

The filtration coefficient of alluvial gravels is estimated based upon their granulometry composition and it is calculated by experimental workings with the pumping wells [7]. The values of the filtration coefficient are given in the following table 1.

The results obtained by pumping in the Sibovci coalfield show that the alluvial in the eastern part, near Sitnica River, have higher filtration values (below 10-3m/s) than the ones of the western part, far from the river. In most of the alluvial area [8], the value of filtration coefficient is 0.5 – 2 x 10-3 m/s, and this shows for their good filtration features.

The pumping in these deposits shows that the yields of the wells vary from 4 – 14 l/s, with specific flow (qs) 2.3 – 2.64 l/s. The zone of influence of the pumping wells is 45m.

The biggest water collector is Sitnica River, which flows along the entire area approximately 2867.4km2[9], from the southeast to the northwest of the coal basin. It is a river with a flat riverbed and a low hydraulic gradient. During the dry periods of the year, the river has low water quantities.

The results of the studies are the base for the successive and more detailed studies on the exploration and for coal mining. The greatest part of coal deposits lies in the alluvia's of Sitnica River, the knowledge of the collector features of the alluvium gravels, the main hydraulic parameters of these gravels and the coal layer, is necessary.

The groundwater related to the coal that originates by the infiltration of the water of alluvial gravels through the faults inside the coal [10]. Following the completed studies in the area of Sibovci coal deposit, the following types of the groundwater are identified:

Table 1. The values of the filtration coefficient

No drilling	Coefficient filtration (m/d)	Granulometric composition (m/s)	Coefficient filtration (m/s)	Pumping (m/s)	Sampling depth (m)	Specific water flow (l/s)
E-I	651.5	7.5×10^{-3}	6.51×10^{-3}	5.1×10^{-3}	2.8	2.3
E-II	198	2.2×10^{-3}	1.98×10^{-3}	1.4×10^{-3}	3.0	2.6
E-III	504	5.8×10^{-3}	5.04×10^{-3}	2×10^{-3}	2.8	2.64
E-IV	137	1.6×10^{-3}	1.37×10^{-3}	1.3×10^{-3}	3.4	2.4
Average	372.6	4.3×10^{-3}	3.72×10^{-3}	2.4×10^{-3}	3.0	2.48

l.

a) groundwater related to the alluvial gravels.

The alluvial gravels (Q4d) in the coalfield of Kosova compose the main water – bearer level in the area. They are characterized by low static water reserves and huge dynamic ones [11]. This water - bearer level is of the type with free level and overlies directly the coal series, playing an important role on the water feeding of the coal itself and on the watering of the coal deposit. The aquifer of the alluvial gravels extends in both flanks of Sitnica River. Based upon the granulometry content, the gravels have heterogeneous composition and the fraction of sizes from 0.25 - 2mm, predominates 40 - 50% of their total. The sandy fraction is different, and the sands of the size lower than 0.25mm, predominates.

The static reserves of the water–bearer gravels in the boundaries of the mine are calculated to be 3–4 million m3 of water. The dynamic resources of the groundwater that move towards the river from the western border to the eastern one with 1 km length of the feeding front, are estimated to be 82– 85 l/s.

b) groundwater related to the coal series

The potential layers of the coal series, that in natural conditions are waterproof, due to the faulting within the coal itself, become permeable. Their biggest water- bearing occurs at the sectors where the coal contacts with the alluvial aquifer with high filtration features and high water potential (Figure 4).

Based on the results of the study the coal deposits of Sibovc basin are characterized by:

- the presence of several free water levels, related to the porous and friable collectors of Quaternary and the coal series with well developed tectonics and cracks;
- groundwater with low static and huge dynamic reserves [12], related to the continuous feeding of the collectors by the surface waters of Sitnica River and the infiltration of rainfalls.
- the water of Sibovci coal deposit depends on the presence of the river alluvial deposits, the big effect of the river Sitnica that pass over the coal series, the ratio of the circulation of the ground waters with the river before and after the mine opening.

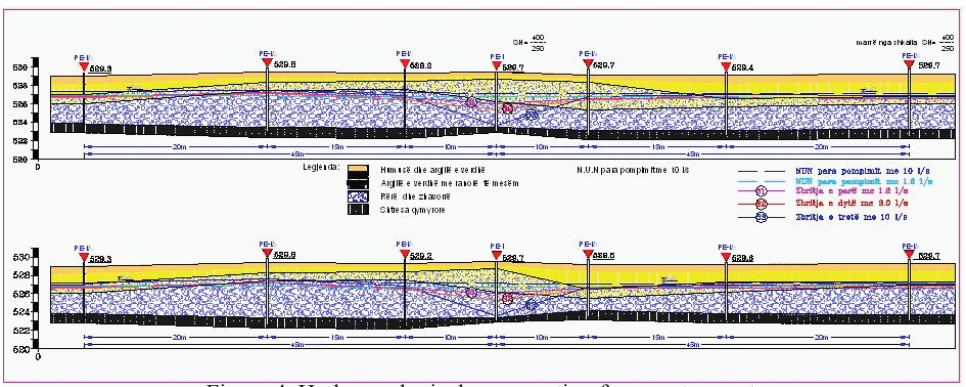

Figure 4. Hydro geological cross section from east – west.

CONCLUSIONS

Based on obtained results from the case study we conclude the following:

1. Recognition of the natural hydrogeological conditions plays an important role on the watering of Sibovci coal deposit. The presence of Sitnica River near the coal deposit and the alluvial aquifer above the coal layers, will condition the estimation of water discharges into Sibovci coalfield and the effective measures to avoid the flooding of the mine by the waters of Sitnica River and the groundwater related to the river alluvium.

2. The estimation of the hydrogeological conditions of the coal deposit is based upon numerous hydrogeological wells that have allowed the determination of the filtration features of gravels and coal, monitoring of the water table regime [13] and the quality of the ground waters.

3. Based upon the most advanced world practice of the open pit deposits, as the most suitable methods for the draining of the river waters and the alluvial ones in the given case we recommend the following:

- horizontal drainages for each exploitation level in the coal series,

- construction of a protection waterproof screen parallel

to the riverbed with depth up to the coal floor,

- the method of the possible displacement of Sitnica River in this case is not suitable.

The methods used for the draining of the surface and groundwater from the area of the designed mine depend on their designing cost and the technical and technological conditions of their application [14]. For the eastern part of the coal deposit, the most suitable way for the draining of the alluvial waters from the mine area, would be the construction of a surface

basin with capacity 30.000m3.

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