

"HYDROGEOLOGICAL CONDITIONS ASSOCIATED WITH THE FUTURE EXPLOITATION OF LIGNITE MINE IN POTAMIA BASIN, THESSALY, CENTRAL GREECE",

E. VASSILIOU¹, I. KOUMANTAKIS¹ and D. DIMITRAKOPOULOS²

¹National Technical University of Athens, School of Mining Engineering and Metallurgy, Department of Geological Science, Heron Polytechniou 9, 15780 Zografou, Athens, Greece; :mmgpev@central.ntua.gr

²Public Power Corporation of Greece, Mining Engineer, Kifisou&Dirahiou 89, 10443 Athens; Greece

Abstract: In Potamia basin, in central Greece, two deposits of 160×10^6 tn of lignite, have been found. The exploitation process of the future open lignite mines is highly connected to the existence of surface and ground water in the area. In this paper the hydrogeological conditions and the hydrodynamic status of ground and surface water of the basin are described. A water management system of the water coming from dewatering process is suggested.

Key words: Lignite deposits, dewatering, open pit exploitation, water status.

Introduction

Potamia basin is located in central Thessaly, Greece. Two lignite deposits, Domeniko and Amourio, of 160×10^6 tn, have been found there (Dimitriou D. 1997). The basin of Potamia is crossed by the Titarisios river, which drains an area of 85 km^2 . The existence of Titarisios river with its often destructive floodings, combined with the indications of an important groundwater-bearing strata in the basin, made necessary the investigation of the hydrologic and the hydrogeological conditions of the basin, within the framework of preliminary studies concerning the exploitability of the deposits. The aim of this study is to determine the degree to which the future mine will be influenced by the existence of ground and surface water.

Geological settings

The basement of the Neogene basin of Elassona geotectonically belongs to the "Pelagonian Zone". It is consisted of :

⇒ Marbles of the middle Triassic, which form the north outcrops near Evagelismos and Paleokastro and part of the south-east boundary of the basin, near

Domeniko. They also have been penetrated by some boreholes in the basement of the basin.

⇒ Schists, gneiss-schists and gneisses, which underlay and form a "ring" around the above mentioned karstified marbles.

⇒ The paleozoic gneiss with acid intrusions of granites, which forms the western boundary of the basin.

The Pelagonian zone is overthrust over the mesozoic marbles of the autochthonous series, which form the northeast boundary of the basin near Kefalovriso (Fig. 1).

The lignite deposits have been formed in the Neogene formations and represent a river regime. In Domeniko area the lignite deposit is overlain by alterations of Quaternary fine sands, clays, marls and conglomerates of fluvio lacustrine genesis. The Amourio lignite deposit is located west of the paleoflume of Titarisios. The overburden is consisted of recent sediments of pebbles, gravels and fluvial terraces.

Lignite Characteristics

According to the preliminary results of the research, (Zeppos I.1996) Domeniko deposit consists of 12-15 lignite layers varying in thickness from 1m up to 90m, alternating with waste materials. The roof of the lignite-bearing strata was found from drills at a depth 10m to 90m and its bottom at a depth 60m to 130m. The geological deposit was estimated at 146.7×10^6 tn and average ratio 6.87:1 m³/tn. The Amourio deposit is much smaller, that is 15.4×10^6 tn , with an average ratio 7.4:1 m³/tn.

Hydrogeologic and hydrologic conditions

Potamia basin is more or less surrounded by impervious formations, schists, gneiss-schists and gneisses, which form impermeable boundaries. The overlaying marbles of the Pelagonian series are of limited extend and thickness, especially in the area of Evagelismos and in the basement of the basin. So they are of minor importance concerning their water storage capacity. In the same formation, south of Domeniko, groundwater flows mainly to the east and has a discharge point out of the basin.

The only karstic formation of major importance is the one of the autochthonous series north of Kefalovriso. The springs at Kefalovriso with an average flow of 9.65 m³/sec is the main discharge point of the above mentioned karstic aquifer. These marbles as well as the Titarisios river are the main sources of recharge for the aquifers of the filling of the basin at the northern boundaries of it.

Logs of approximately 100 drill holes, data from 21 pumping tests (Tsouflidou and others 1999-E.Vassiliou 1997) and monitoring of many piezometers indicated that the confined aquifer in the overburden of the future lignite mine in Domeniko (fig.2) has low transmissivity ($8 \times 10^{-5} \text{ m}^2/\text{sec}$). But the second lignite deposit in Amourio is crossed by the Titarisios river and there are aquifers of significant capacity in the overburden, which are expected to influence severely the future mine.

In the alluvial formations at the central part of the basin, three different hydrogeological units are distinguished, due to the different hydraulic conductivity:

a) coarse-grained materials in the northern part (Magoula-Sikea area) b) beds of sandstone, central and southern part (Amouri area) c) fine grained sand (Pretori-Mesoxori area).

Generally the values of the transmissivity (T) are increased ($5 \times 10^{-2} \text{ m}^2/\text{sec}$) towards the centre and southern boundary of the basin (fig. 3), but at the eastern boundaries in the area of the future Domeniko mine, the values are very small ($8 \times 10^{-5} \text{ m}^2/\text{sec}$).

The shape of piezometric surface (fig.2) confirms that low permeability materials are prevailing in Domeniko mine while higher permeability sediments are expecting in the center of the basin. The main recharge boundary of the aquifers of the loose sediments of the basin is the northern boundary along the line Evagelismos, Paleokastro, but more data are necessary to establish a reliable conceptual groundwater model. The increasing demands for irrigation have led to an over-exploitation of ground water, affecting the piezometric surface and a decline 1.5m has been observed the last 5 years

The annual average rainfall was estimated at 751mm, percolation at 20,3mm, evaporation at 496mm and flow off at 235,06mm (Beloukas S., 1987).

In 1997, E. Vassiliou reported that the precipitation had been reduced, the last 10 years, by 20%, the average temperature was about $14,3^{\circ}\text{C}$ and evaporation was estimated at 333mm.

Titarisios river has an average discharge $3.5 \text{ m}^3/\text{sec}$ in winter, but it is almost dry for long periods, in the summer. The maximum discharge that has been measured is $52 \text{ m}^3/\text{sec}$ but actually it is much higher occasionally and has caused the destruction of the bridges, which connect the villages of the area. The springs at Amourio area with an average discharge of $0.6 \text{ m}^3/\text{sec}$ in the alluvial sediments of the basin, are used mainly for irrigation.

Conclusions

The exploitation of the lignite deposit in Amourio is strongly influenced by the unfavorable hydrological and hydrogeological conditions and the small size of the lignite deposit. The springs discharge in Amourio area and the Titarisios river flow through the lignite deposit. Due to the mentioned destructive floodings of Titarisios river, its diversion, which is inevitable, is expected to increase dramatically the exploitation cost. On the other hand, dewatering of the overburden, which is consisted of highly permeable materials, pebbles, gravel etc. is a necessity. But the hydraulic connection of these geological formations with the paleoflume of Titarisios as well as with its new flow path, makes it a complex and difficult process.

In Domeniko mine, Titarisios and Elassonitikos rivers flow far out of the boundaries of the mine. A small rivulet, which flows through the area of the mine, is rather a nuisance than a real problem. On the other hand, the very low permeability of the overburden and underburden does not permit the flow from the high permeability sediments around Titarisios to the area of the future mine. However, attention should be paid to the artesian aquifers of the area and their influence on the stability of the slopes of the mine. Choosing the proper drainage network will help to control the stability of the slopes (Louloudis.G, 1991).

Water pumped out for the protection of the mines could be used directly for irrigation or for the artificial recharge of the aquifers. In this way the potential of the aquifers will be maintained and increased quantity of water will be available during the irrigation period.

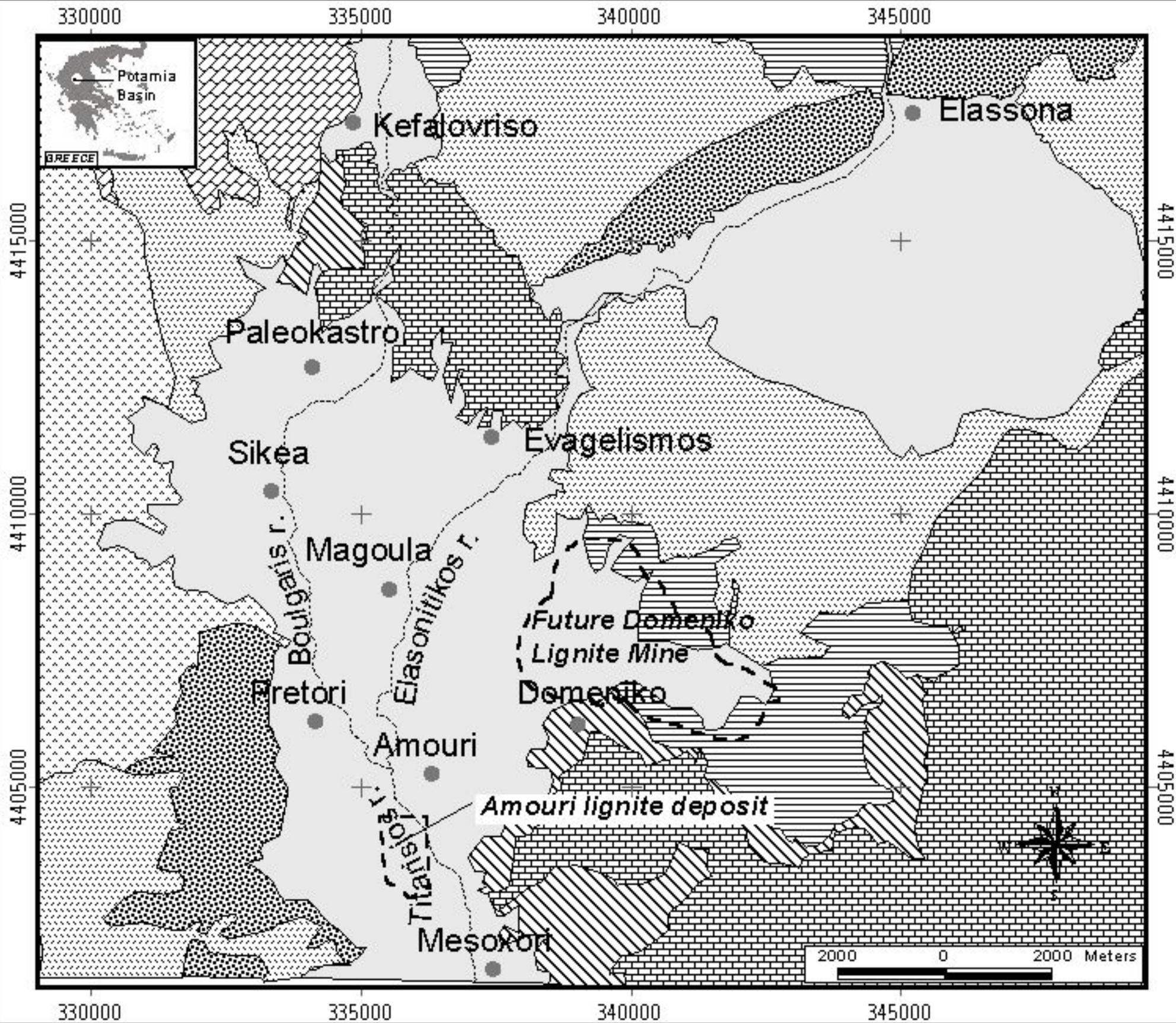
References

- Belouka S.: "Hydrogeological study of Potamia Basin in Elassona –Phase B", January 1988, Larissa.
- Dimitrakopoulos D., Louloudis. G, Koumantakis I.:" Environmental problems associated with the ground waters in lignite mines of Public Power Corporation of Greece". Athens 13-15 December 1989
- Dimitriou D.:"The lignite deposit of Domeniko and its importance in energetic economy of our country ", IGME Athens 1997
- Louloudis.G : "Hydrogeological conditions of South lignite field of Ptolemaida -Problems of ground waters and managing them during exploitation". Phd thesis in NTUA 1991.
- Marinos P.: "Hydrogeological regime of Amourio springs", Athens 1987.
- Panagopoulos A.:" A methodology for groundwater resources management of a typical alluvial aquifer system in Greece" Phd thesis in University of Birmingham, 1995
- Tsoufidou S., Dimitrakopoulos D. Louloudis G., Terzopoulou E.: "Study for the protection of Domeniko lignite mine from ground water", PPC, Athens 1999
- Vassiliou E.:" Problems associated with surface and underground waters in the future lignite mines in Elassona and ways of solving them" , Diploma thesis in NTUA, Athens 1997
- Zeppos I.:"The lignite deposits in Elassona", PPC Athens, 1996

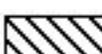
Figure 1: Simplified geological map of Potamia Basin

Figure 2: Piezometric map of February '98

Figure 3: Transmissivity map of Potamia Basin ($T\text{-m}^2/\text{sec}$)



LEGEND

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|  Alluvial deposits |  Triassic marbles |  Neopaleozoic-Lower-Middle Triassic gneiss-schists |
|  Quaternary marls |  Neopaleozoic-Lower-Middle Triassic schists |  Paleozoic gneisses |
|  Quaternary fluvio-terrestrial deposits |  Mesozoic marbles | |

