EXPLOITATION OF COAL DEPOSITS IN THE BERBEŞTI MINING BASIN

Dumitru FODOR, Nicolae DICAN***

Abstract: In this paper is made a short presentation of Berbeşti mining basin, where the coal exploitation, at the beginning was made in rudimentary forms, and in the past 35 years was made using modern technologies in continuous flow, is attested for over 110 years. It is also evidenced the evolution of mining in time by showing the production capacity, the number of staff, the economic results obtained and the perspectives for further economic exploitation of coal in the area.
Keywords: prospects, development, preparation, exploitation, coal face, mechanized complex, continuous flow, production capacity.

1. Introduction

Berbeşti mining basin, along with the other mining basins like: Mehedinți, Jilț, Motru and Rovinari have the largest lignite deposit in Romania, wherefrom at this time is exploited an amount of over 29.5 million tons of coal annually, representing 89% of Romania's coal production. The amount of coal extracted annually, can easily be increased to 35 million tons, if the situation requires more energy. Geographically, the mining basin is located in the Getic Piedmont, along the parallel of 45° North, at the confluence of the Gorj and Vâlcea counties, being bounded on the West by the Gilort River, and to the East of Bistrița River. Having a length of more than 45 km and an inclination of 2.5÷5 km, the lignite deposit was divided into four mining perimeters. Within each mining perimeter were outlined several mining fields that have been the subject of exploitation in mines or open pits. Their delimitation, [3] was performed by taking into account the geological, geographical and economic criteria (Figure 1).

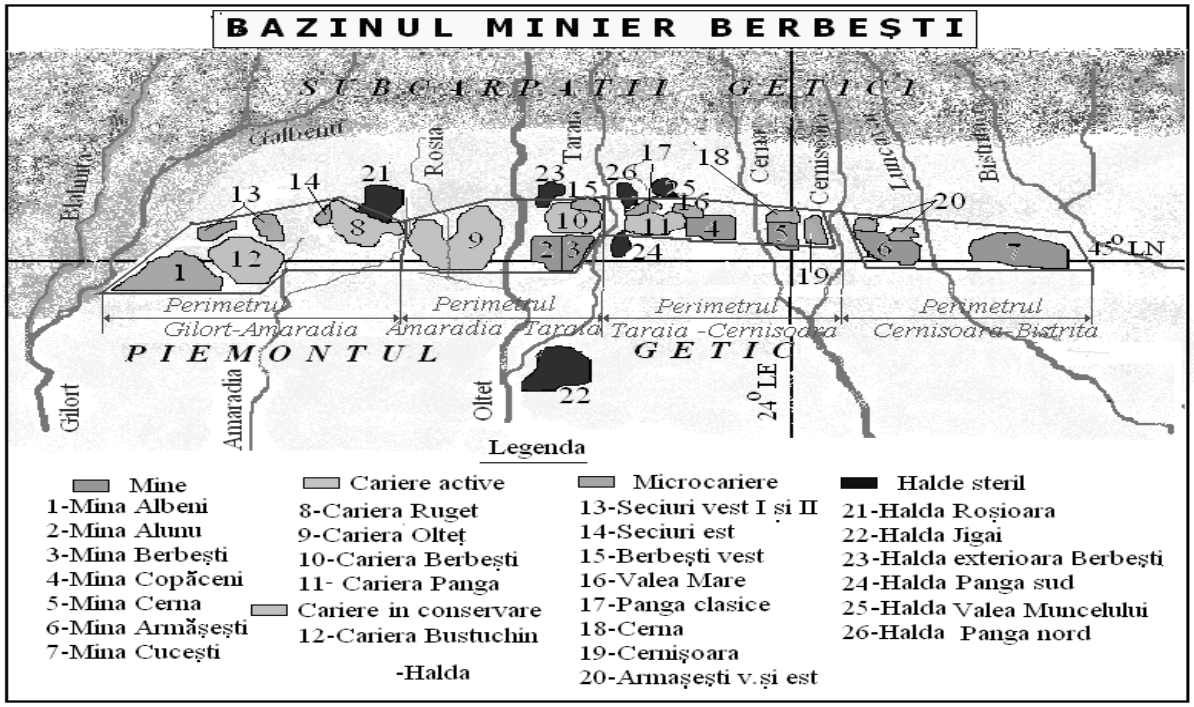


Fig 1 *Berbeşti mining basin*

The Berbeşti mining basin represents the sedimentary continuation to the East, of Rovinari mining basin, but in regular tectonic conditions, peaceful, lacking of major faults. The deposit takes the form of a trap oriented East-West with a North-South inclination of 2-12°. The Carpathian hills with moderate heights are crossed by a strong hydrological network oriented North-South (Fig. 2).

* *Prof. eng. Ph.D University of Petroşani*
** *Eng. Ph.D E.M.C. Berbeşti*

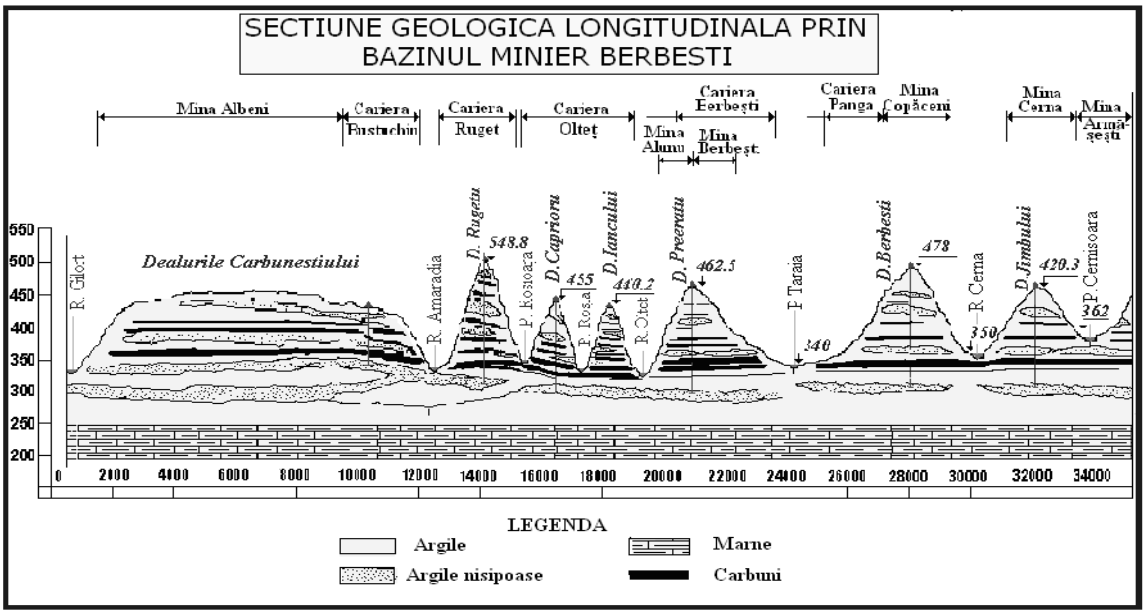


Fig. 2 *Longitudinal geological cross-section through Berbeşti mining basin*

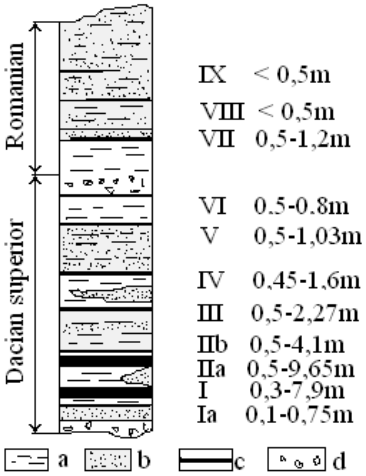
Their erosion over time under the action of external agents, it has configured the form of an area with decreasing heights from East to West and from North to South.

2. Research of deposit

The coal appeared at land surface in river beds and streams slopes, beginning to be used sporadically, for the first time for house utility since 1902, the year in which it is first attested the Cuceşti mine in Oteşani village, Vâlcea County. The presence of lignite, between Gilort and Luncavăț valleys it is shown in the papers of T. Ionescu Argetoaia (1918), H. Grozescu (1924), Otto Protescu (1932) and I.P.Voiteşti (1945), [4]. And also has been confirmed the presence of lignite between Tărâia and Gilort valleys, beeing shown in the reports of Gr. Popescu (1951), I.C.Motas (1951), D. Ilie (1954), [11]. But the exploration works by drilling begin in 1953 and are executed by the ISEM (IFLGS).

They unfold in several stages, and the processing and interpretation of results, gives the possibility to establish the geological age of the deposit, stratigraphy, tectonics, coal quality and last but not least, is determined the useful mineral reserve. Thorough research by underground mining work is performed in 1967 by the Câmpulung Mining Company, which opens an adit at Armăşeşti, supported by wooden frames. In 1970 it is opened through two runs dug through perforation-shooting, supported in concrete masonry, the first mine at Armăşeşti, which belonged to the geologic sector of the same mining company, which works up until 1976 and certified the existence of such opportunities to exploit the deposit by underground mining works.

Located in sedimentary rocks of Pliocene and Quaternary, the deposit was made up in Upper Dacian and Romanian. It is divided in two coal layers wherefrom the layers I, II and III are the most important (Figure 3).



a-clays,
b-sands,
c-coal layers,
d- shell rocks level

Fig. 3 *Synthetic litostratigraphic string for Amaradia –Tărâia perimeter (Olteț coal pit).*

The presence of shell rocks level in the floor of the coal layer I, which determine the age of Upper Dacian for the basin's coal, correlate this layer with la layer V from Jilț, Motru and Rovinari mining basin.

The coal layers are separated by sterile interlayers made by clay and sand. By Protodiakonov's clasiffication, all these rocks are part of group VII of soft rocks a rocilor moi, with a strength coefficent f=0,8÷2, [9].

The water-bearing levels located in sand formations are aquifers with vacant level or under pressure, like the water-bearing formation of the coal layer I. The hydrological and geological parameters have low values, (table 1), besides the water-bearing levels of Berbeşti mining perimeter, facilitating the exploitation condition of the deposit.

Table 1. *Hydrological and geological parameters of water-bearing levels from Berbeşti mining basin*

Crt. no.	Interval between coal levellayers	M (m)	Kf (m/24h)		q (m³/day/m)	
			min	max	min	max
1	Roof of layer VII	13-24	0.05	0.07	0.67	0.95
2	Layer VI-VII	3-4	0.01	0.02	0.0114	0.025
3	Layer V-VI	3-5	0.023	0.13	0.45	0.64
4	Layer IV-V	2-5	0.04	0.06	0.12	0.58
5	Layer III-IV	3-10	0-21	095	0.71	2.6
6	Layer II-III	4-17	0.08	1.3	0.65	2.8
7	Layer II-I	6-12	0.10	0.19	2.29	13.6
8	Floor of layer I	20-40	0.11	2.46	0.75	1.23

where: M - thickness of water-bearing level;
K_f - percolation coefficient;
q - specific discharge.

The coal deposit has layer productivity of 10 tonne/m² and the caloricity of industrial reserve is 1885 kcal/kg.

3. Development, preparation and coal exploitation in mines

Industrial activity of coal mining in this basin has a long tradition and began in the Eastern area at Cuceşti in 1902, the year in which it is attested the first mine in "Correspondence of the Mayor of Armăşeşti". Coal mining was done in general for household purposes, not having a continuity over time. Until 1977, labor productivity amounted to a ton of coal per post, and with the passage to coal face operation with individual support pillars and beams, this increased to 4-5 tonnes per post. Mines where coal was extracted by mining method with columns and rooms (Figure 4), changed the location several times along the crop when mining pressure and distance of transport to the day area represented a major factor of economic and technical restrictions.

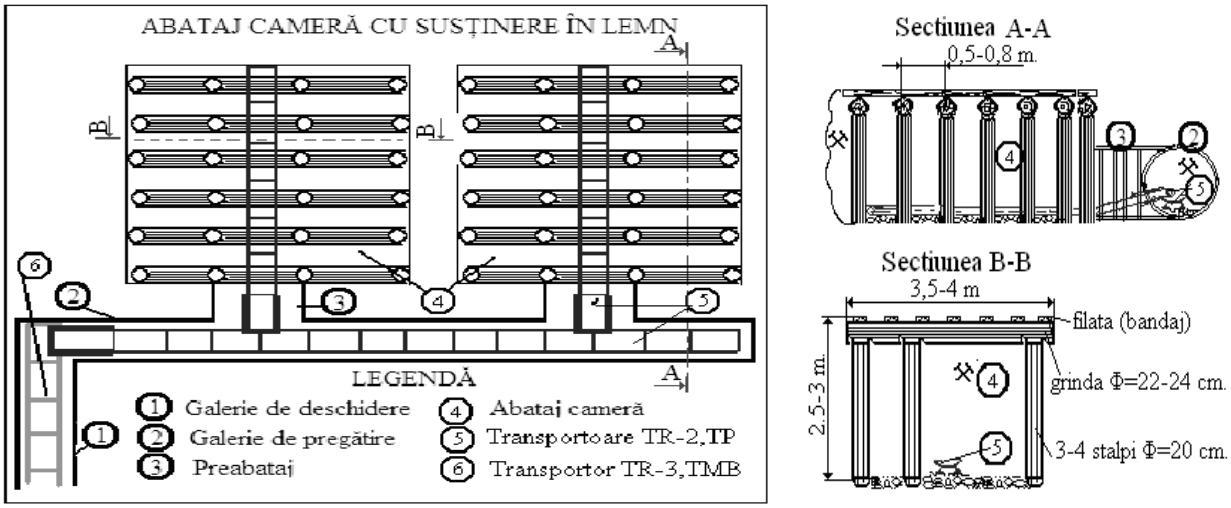


Fig. 4 *Chamber with wooden frame*

The used operating methods have evolved over time, with the implementation of technical progress in the mining industry, but also with the improvement of labor trained in vocational schools and high schools in Cîmpulung Muscel and later in Berbeşti and specialists trained at the Institute of Mines Petroşani.

After the enclosure of Cuceşti mining sector in 1992, the personnel was relocated to the mines from **Armăşeşti** in three different locations. The development of Armăşeşti East, Armăşeşti Centre and Armăşeşti West mines, was made by two runs, dug by a boring-blasting process which made the adits from the stope complex. The stopes were equiped with mechanized complex like CMA-2T type and a shearer type CA-1 with a productivity of 9 tons/post, or CMA-2TE and KŞ-1KG; KŞ-1KGU where the labour productivity was 15 tons/post. In the perimeter of Armăşeşti mine was exploited the coal layer I with a thickness of 2,7 m. As a result of very difficult geological and hydrological conditions from Armăşeşti East mine, in 1996, the mine was closed. At 1 september 1997, along with the redudant making from the mining industry, the Armăşeşti Centre sector is also closed and the Armăşeşti West sector is closed in 1998. The personnel is relocated to Cerna Mining Exploitation or it is made redudant.

The development of exploitation was made by the development of the western part of **Albeni mine** (1977), where was exploied the coal layer I with a thickness of 3,27m. The designed capacity prduction in 1976 was 1.000.000 tons/year but it wasn't reached and the maximum annual production was 637000 tons/year in 1989. The development of Albeni mine was made by two adits I-100 and I-101 to the coal deposit and after that two runs were built I-500 and I-501 and it is developed the panel P1 exploited till 1983. The exploitation in Albeni mining field is made by the main associated roadways I-400, I-401, I-402, I-403 with two parallel runs, both ways (I-502÷I-513) which developed the panels P2÷P9 (Figure 5).

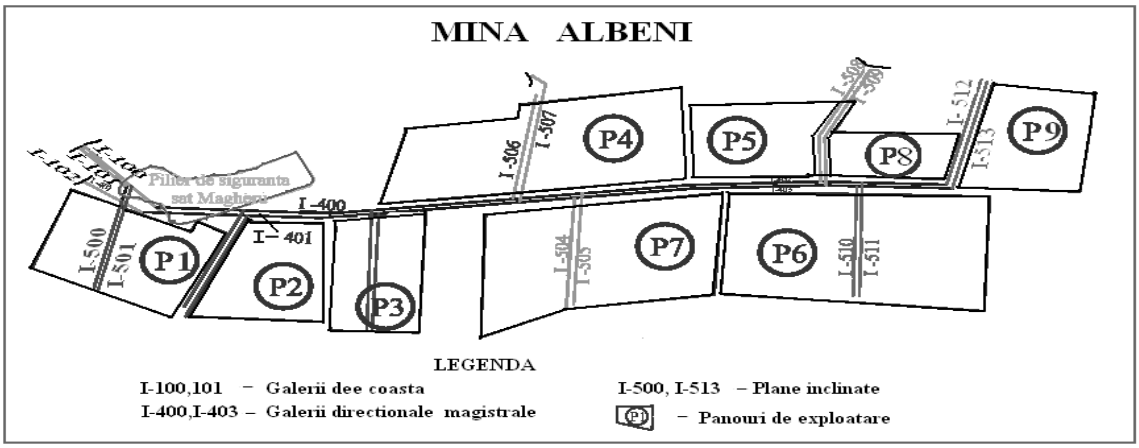


Fig. 5 *Albeni mine – Preparation method by panels use*

Due to the great length of mining field, over 10 km, in order to simplify the transport circuits and to reduce the underground transport distance with more than 5 km, in 1998 are developed others works (I-508, 509) in a new location, opening the panels no. 5, 6, 8 and 9. At Albeni mine was a simultaneously work of one developing work, two mining preparation dug with shearers with point-attack type CI-1M or CI-2 and two coal faces equipped with mechanized complex type CMA-2M. In this activity were engaged a number of 394 employees. 2005 is the year in which the mine Albeni falls to a conservation program and then closing [10], being the last mine in the basin that closes.

Alunu mine was developed in 1979 for a designed production capacity according to PE 901-06, of 700.000 tons/year and according to STE 901-09, of 500.000 tons/year. This capacity wasn't reached, just 350.000 tons/year. Alunu mine was developed by two adits I-400 and I-401 from the crop of coal layer II to the coal deposit direction, from which were made two runs both ways. From this runs were made the coal faces by boring-blasting or shearers CI-1M type. All the mining works were made in coal layer II with a thickness of 3,12 m.

The exploitation method from Alunu mine was the one with long coal face adits, equiped with mechanized complex for adits like OKP-70 type and adits shearers KŞ-3M type (Figure 6).

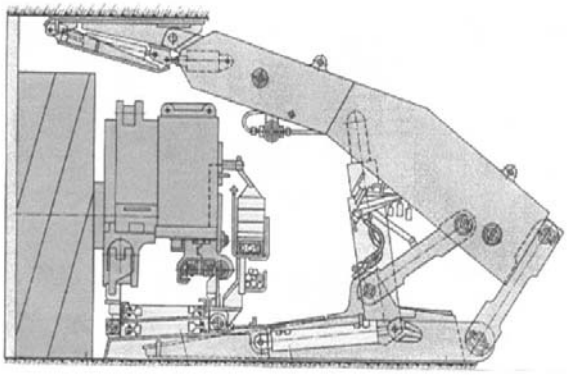


Fig. 6 *Perspective of an adit equiped with a mechanized complex 2OKP-70 type and a KŞ-3M shearer*

2OKP-70 type support "barrier-upholder" and a KŞ-3M shearer

In 1998 the Alunu mine went into preservation and after 2000 being closed; the personnel being relocated to Alunu open pit and Copăceni mine.

Berbeşti mine was developed in 1979 as a first sector of Câmpulung Mining Company and designed for a production capacity of 700.000 tons/year and resized in 1988 to 500.000 tons/year, but this capacity was not reached. The maximum production was 223,4 thousand tons in 1989. In mining perimeter of Berbeşti mine, was exploited the coal layer II with an average thickness of 3,0m and the quality features were: Aanh = 28,33 %; Q_i = 2255 kcal/kg in the coal deposit and: Aanh = 43,62 %; Q_i = 1690 kcal/kg for the industrial reserve.

For roadways digging were used the shearers type CI-1M and PK-3M and for transport of production, were used the conveyors type TR-3; TR-4; TMB-800 mm and TBS-1000 mm [5].

For upholding the coal faces, were used the mechanized complexes OKP-70; CMA-2M; CMA-2S; CMA-4L, and for coal cutting, the KS-1KGU; KS-3M; CA-1 shearers. The Berbeşti mine was developed from two different locations (Berbeşti I and Berbeşti II), but the economical results were negative due to all exploitation time.

Because of the difficult geological and hydrological conditions, there were failures to the joints of the mechanized complexes with the adits and because of that, in 1995 the mine was proposed for closure. The personnel was relocated to the coal pits from Berbeşti and Cerna Mining Exploitation. In 1998, ICSITPML Craiova drew up the „Technological plan of enclosure", symbol 901-640.

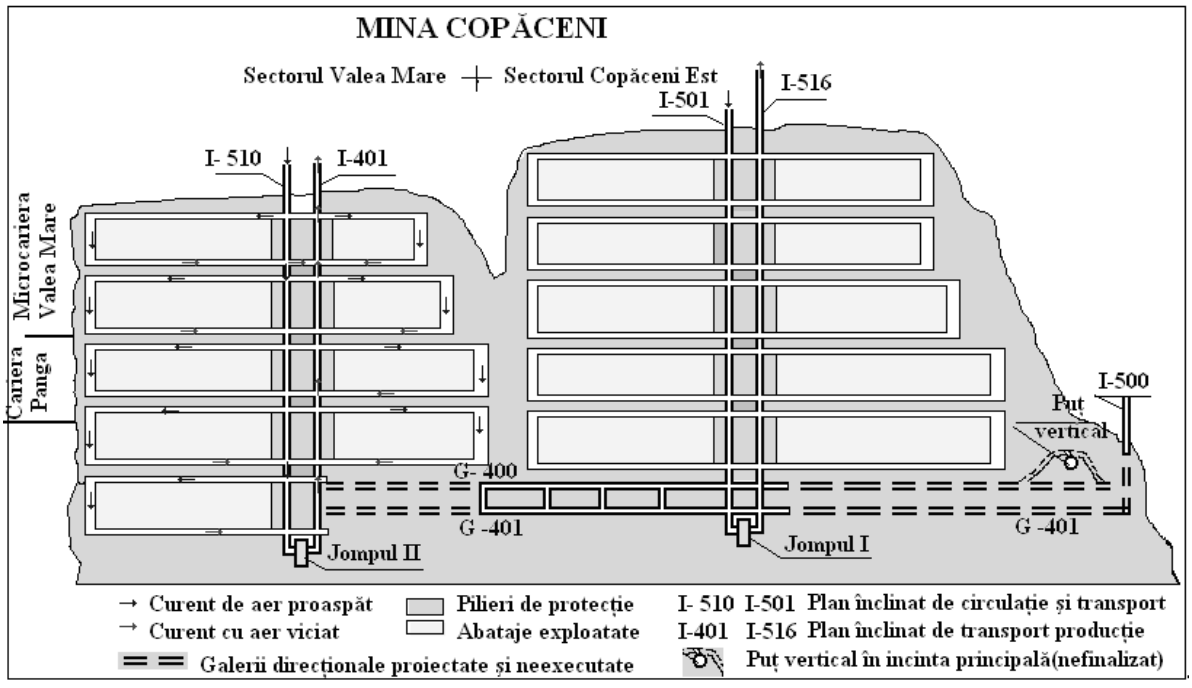


Fig. 7 *Copăceni mine*

Copăcei mine (Figure 7) was developed in 1983 in Tărâia - Cernişoara perimeter by a technical and economical specification „Development and exploitation of Tărâia - Cernişoara mining field to a capacity of 2.800.000 tons/year", symbol 902-14, aproved by Decision number 16 from 17 January 1985. The design capacity was 500 thousand tons/year, but the use ratio of its capacity of 83%.

From the eight coal layers from Copăceni mining perimeter, the most important was coal layer I with thickness between 0,8 and 5,6 m and an average of 3,9 m. The quality features of coal layer I were: Aanh = 22,76 %, Q_i = 2448 kcal/kg into the coal deposit and: Aanh = 37,77 % ;Q_i = 1828 kcal/kg, for industrial reserve.

The coal deposit was developed in two areas located on the left and right side of Cerna river.

Cerna division, located in the eastern side, was developed by two adits dug to the first coal layer. From this two adits, were dug uphill runs parallel to deposit inclination, which have divided the panel in parts. The economical result achived to the Cerna mine, were negative au fost negative and up to 1994, when the activity was stoped, but the enclosure came up after eight years later.

Copăceni East division was developed by two runs I-516 and I-501 and for the extenion to West, in 1991 were dug another ones to **Valea Mare** as I-510 and I-401. In this way each panel was out to day.

The two areas had to be united by the roadways G-400 and G-401, but the works have been stopped because of the pressure to SG-23 with a rainforcement of 0.33m, and on the other hand, because of the expensive transport cost from underground to day. The coal faces from the eastern side were equiped with coal face shearers KS1-KGU and CA-1. Because of the difficult mining conditions to the roadways (G-400 and G-401) caused by the thickness of the above-ground of 170 m, which lead to an increase of exploitation cost, it hasn't been used anymore the panels and starting to 2004 the last division Valea Mare went to preservation and then to closure; the personnel was relocated to Berbeşti and Alunu coal pits or they went to redundant.

Conclusions

The coal deposit development was made by adits or runs and the vertcal shafts from Copăceni and Berbeşti being derelicted because of the hydrological and geological conditions and also because of the money necessary for the special methods crossing the water-bearing rocks by freezing them,[7].

According to the „Album of standard mining profiles" the most used types of development works were:

- for roadways:

- double roadway, with enclosure floor, uphold with metallic rings G.D.M. – 8,0;
- double roadway with wedge bricks G.D.Z. – 9,7;
- concreted double roadways, G.D.B. – 9,7;

- for runs:

- uphold run by wedge bricks P.L.S.Z. – 6,2;
- uphold concrete run P.L.S.B. – 6,2;
- uphold run by metallic rings P.L.I.M. – 8.0.

From the runs, were made development works consisted in digging the conjugated roadways like:

- circular simple roadway upholded bymetallic rings G.S.I.M. – 6,2;
- double roadway upholded by metallic rings G.D.M. – 8,0.

The distance between the two **development works**, represent the length of the coal face. Up to the technical features of the machinery, the coal face line values was 60 to 100 m.

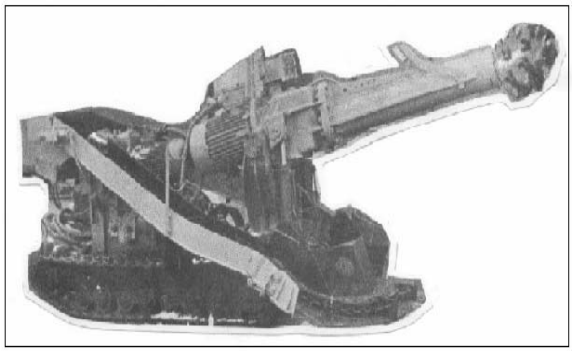


Fig. 8 *Advance shearer CI-1M*

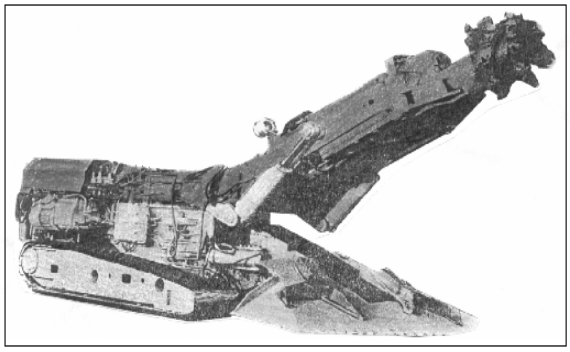


Fig. 9 *Advance shearer 4PU*

The length of a coal face was 500 m to 1000 m and the limits were made by digging a coal face upholded six or eight metallic sections „S.G.-23" used for the operation of the mecahnized complex of cutting, upholding and transporting. Step by step, the digging technology by boring-blasting is shifted by the continuous flow techology with the CI-1, CI-1M romanian shearers (Figure 8), or 3PK, 4PU (Figure 9), russian shearers. The speed values increase from 30-50 m per month, to 80-120 m per month, which is not much if we compare it with the other speed over the world and with the ones from Motru mining basin, which are 1100 m /month, being coordinated by PhD. Eng. Emilian Matacă [6].

The main exploitation method was the „exploitation with long props on direction", retreating [1]. Sthe single upholding by „GS" props and „Republica" bars used in the 1970's coal faces, with a productivity of 4,5-5 tons/post, was shifted step by step by mechanized upholding like: CMA-2M, CMA-2T, CMA-2TE, CMA-2S, CMA-4L, OKP-70 and 2OKP-70, which were used with the CA-1L, KS1-KG, KS1-KGU, KS-3M shearers used for cutting and coal loading on the TR-4A, CMA or „SP" scraper.

The working productivity from the coal faces increased, according to the performance of the mining conditions and mechanized complex, so that in 2003 to the Copăceni mine get closed (Valea Mare); it was 25 tons/post for a coal face equiped with a CMA-2S mechanized complex and a KS1-KGU shearer and the average advance speed was 40 - 45 m/month. The total coal amount extracted from the coal faces and preparation works of the mines was 17,24 millions tons of lignite. The maximum production of 1,159 millions tons/year was recorded in 1996 (Figure 9).

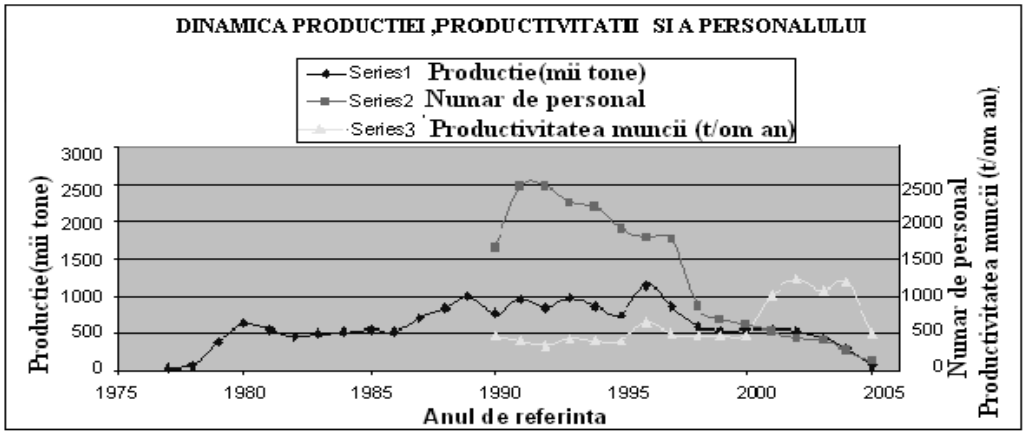


Fig. 9 *The production ratio, labour and personnel productivity on underground activity*

With all these, the economical results of the mines could not succed in decreasing the total cost unde 1100 lei/1000 lei material production, the difference being supported by the Gouverment and than by the new developed coal pits.

As a conclusion, it can be said that during the underground activity, it was a concern for implementation of modern techniques of development and preparation workings. It has been bought russian or romanian made mechanized complexes, for coal faces and the results were the same like the others mining basins with an old tradition. The coal was used in Doiceşti, Giurgiu, Bacău, Craiova II steam power plants or recently in Govora steam power plants. The decrease of electricity use has imposed a new strategy which has a result the enclosure of mines from the mining basin and the whole production was concentrated in the coal pits.

References

1. Almăşan B.
Exploatarea şi Valorificarea Zăcămintelor de Substanţe Minerale Utile Solide, Editura Didactică şi Pedagogică Bucureşti , 1982;

2. Covaci Șt.
Exploatări Miniere Subterane, Editura Didactică şi Pedagogică Bucureşti , 1983;

3. Fodor D., Baican G.
Impactul Industriei Miniere Asupra Mediului, Editura Infomin Deva, 2001;

4. Huidu E., Scorțariu V. O.
Monografia Mineritului, Vol IV, Editura Măiastră Tg. Jiu, 2008;

5. Marian I.
Utilaje de Încărcare şi Transport Minier, Editura Didactică şi Pedagogică Bucureşti, 1984;

6. Matacă E.
Tehnologii noi în extracția cărbunelui energetic Editura Tehnică, Bucureşti, 1987;

7. Popa A., Fodor D. ş.a.
Manualul Inginerului de Mine. Vol III, Editura Tehnică, 1986;

8. Petrescu I. ş.a.
Geologia zăcămintelor de cărbuni, Editura Tehnică Bucureşti, 1987;

9. Teodorescu A.
Proprietățile Rocilor, Editura Tehnică, 1984;

10. ICSITPML Craiova
Plan Tehnologic de Încetare a Activității Minei Albeni, 2005.

******* www. Societatea Națională a Lignitului Oltenia