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ROMANIAN MINING - PAST, PRESENT AND A POSSIBLE FUTURE

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Abstract: *The paper follows the unfolding of the history of Romanian mining in its several major stages: the beginnings until the conquest of Dacia by the Romans, mining in Dacia during the Roman rule, mining activity after the Romans left Dacia until the 10th century, mining activity during the Middle Ages, mining during the capitalist period, Romanian mining during 1948–1990, Romanian mining after 1990, a possible future of Romanian mining and ends with some considerations regarding mining and the environment.*
Keywords: *history, mining, Romania, environment*

1. Introduction

Writing a history of the Romanian mining means writing the history of the inhabitants of these lands, because the extraction and processing of raw materials solid minerals on the territory of Romania had been known and practiced since ancient times, and the variety and importance of mineral resources determined that mining had been an occupation for thousands of years in this area a Europe.

From the review of the stages of mining development over time on the territory of our homeland, the importance of this activity is clearly evident: humans as factors of civilization, progress and well-being of society, as well and the fact that, over time, there were periods of mining flourishing and decline, but never periods of mining disappearance. This truth strongly shows mining importance even for the current times in which we find ourselves in an extensive process of recovery and restructuring of Romanian mining.

As for the future of mining in our country, it must be said that Romania also has numerous and varied deposits of substances on its territory, useful minerals that it will to exploit and make available for the national economy and thus mining will continue on Romania's lands still a long time from now; and so, new and new pages of history will be written about this important activity and about the people who practice it.

2. The beginnings until the conquest of Dacia by the Romans

The humans' need for food and defence made them create a lot of tools, weapons and working means since their first existence on this earth as they had to survive and preserve their lives. The pre-historian humans used stone as raw material for his tools and weapon making as stone could be found in nature, at land surface.

Noticing the particular features of some of the stones, man started to selectthem when making his tools and weapons, and his findings led to the discovery of natural deposits of such stones (silex, quartz, obsidian, etc.)

In the beginning the cave man gathered the useful stones from surface andlater, as these stones could not be found any longer at surface, he started to lookfor them in the underground. This is how the cave man mining activity started and mining was born.

The cave men lived within mountaineering areas and on high plateaus because these places provided good cave shelters, stone and wood for weapons and constructions, fresh drinking water necessary for life, meat food obtained athunting or fishing as well as vegetal food consisting of plants, fruit or miscellaneous roots.

The archaeological investigations performed on the Romanian territory revealed the existence of different mineral and stone mining and processing activity developed by humans since the **Palaeolithic age (1,000,000**

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– 10,000 BC). There are numerous localities (Mitoc, Iosăsel, Valea Dârjovului, Căpuşul Mic, Valea Lupului, etc) where vestiges of the silex, obsidian, quartzite and other rock extraction from deposits situated closer or farther from their processing location, were found [1].

Based on trade exchanges, sometimes the materials to be processed were brought here from remote places, much beyond our country frontiers.

In most cases the useful rocks were extracted from natural surface openings, but also from underground using simple mining methods such as aditsof shallow shafts.

The traces of the oldest mining methods discovered in Romania are more than 15 thousand years old and they were found at Cotul Miculunti of Middle Prut river basin where there were discovered fire places and workshops for silex,reindeer bones and horns processing for making hunting and fishing tools as wellas mining tools.

Among the most important technical achievements of the Palaeolithic age on the Romania's territory it is worth mentioning: hunting tool creation and utilization, construction of boats and fishing practicing; utilization of traps and arch at hunting, etc. Also it is to be underlined the fire control and the beginning of boiled and food consumption; clothes, basket and rope confectioning and finally, the use of miscellaneous rituals and the myth occurrence.

From the point of view of mining, it should be emphasized that in the Palaeolithic and the immediately following **Mesolithic age (10,000 - 5,500 BC**) - the useful materials were obtained by simply collecting the pieces of rock that fell from the natural openings of the hard rock massifs. In many situations, pieces of useful rock were removed from the massif, with the help of suitable rudimentary tools [1].

During the **Neolithic age (5,500-2,000 BC)** the mining activity developed intensively in the sense that other rocks such as granite, basalt, andesite, etc. were also extracted using the same working and exploitation techniques [1].

The rock from the massive was processed and polished under different shapes and the rock boring and fixation on a lever produced the first big step of the production of safer and more efficient tools.

It is also during this age that the beginning of metal extraction and processing was identified. The first metals used were *copper and gold* which in the beginning were used to make decorative items. At first, native copper was used while by the end of Neolithic copper recovered from copper ores was extracted and processed.

Vestiges of the Neolithic gold, silver, copper and lead mines were discovered in Banat within Bocşa – Ocna de Fier – Dognecea zone as well as in Transylvania within Brad zone at Caraci and Musariu.

The mining tools used during those times were made of stag antlers, miscellaneous animal bones and hard pointed rocks were found in numerous mines and quarries of Romania. Also, shovels made of bones or wood and stag antler picks were used. In Romanian, there was found a stone hammer at Caraci mine and a stone axle at Musariu mine, both being from Neolithic.

The oldest gold object discovered until present on the territory of Romania is the anthropomorphic idol stylized from Moigrad – commune Mirsid, Sălaj county -, which archaeologists believe that it comes from about the same period, around 3500BC, with the jewels discovered in Varna, which can be found at the National History Museum Bucharest.

During the **Bronze age (1900-1150 BC)**, besides the rock extraction and processing, bronze (copper + tin) production started; bronze is an alloy with better hardness and more usage than copper and gold [1].

Bronze was used first to make tools and weapons. The most important localities for copper extraction were from Transylvania. But the same metal was also extracted in Oltenia, Dobrogea and Banat in Dognecea – Bocsa zone where vestiges of copper exploitation of those times were found.

Near Sibiu, at Sighişoara and other localities, such as Deva, Uioara de Sus, Sapalnaca, Persinari and others there were found impressive deposits of copper and bronze made items weighing more than 1000 kg. Such objects originating from Transylvania were found East and South of Carpați and at other different locations from Central and Western Europe [2].

In Romania, within Ocna de Fier zone, there were discovered the remaining of a bronze cast workshop. Also, there was found a slag dump containing lead and copper and at Carnic-Resita a bronze axle of the 1100 BC was found. For mining purpose, there were made bronze chisels, picks, axes, hammers and thus, the work efficiency and mined out ore tonnage increased as well as the processed and manufactured bronze amount.

During the same period, gold, silver, amber, salt and other harder rocks were also mined out in different regions of Romania.

Throughout the **iron age (1150 BC-100 AD)** copper continued to be mined out and used for bronze production. There were discovered numerous bronze items in our country, particularly in Transylvania region and some these deposits weighed more than 4,000 kg.

It was thus concluded that it was about parallel development of the society during this epoch in the Romanian provinces. The production of same type of tools and weapons made of bronze was a proof of such parallel development.

Iron was the new metal of the epoch and it was used ever since its discovery as objects, tools and weapons like those made of bronze.

A series of discoveries from early **Hallstatt** confirmed that the Carpathian – Danube – Pontic region was among the first zones in Europe where iron was produced and processed.

The iron mining and processing determined significant modifications in the field of production means as an ever larger number of tools were manufactured and there existed enhanced possibilities to purchase raw materials. Unlike other zones of the world and of Europe, the **Iron Age** on the Romanian territory started around the year 1100 BC.

Several years ago, there were found vestiges regarding the iron extraction from ores of Carpathian – Danube zone. Also, in Dobrogea, there existed two Hallstatienne localities, namely Babadag and Dervent of the IX and VIII centuries BC where slag pieces resulted at iron melting and ore traces from ore reduction process were found. The laboratory assays indicated that the ore was from the ore deposit of **Iulia** located in the neighbourhood and developed at surface being easy mineable.

These findings represented the confirmation of the oldest iron extraction and processing operation existence of Romania.

Gold mining during the Iron Age, particularly in Transylvania flourished and it ranked first among precious metals extracted and used, but later it ranked second as silver came first.

The group of anthropomorphic statues discovered at Baia de Criş – Transylvania dated back in the Iron Age, the VI – VII centuries BC and represent miners with their pick – hammers fixed below their belts and with basket or bag on the back to transport the ore. **According to our knowledge these are the first statues in the world representing miner's job** [3].

In Transylvania, the Gets- Daces mined out iron ore at Almaşul Mare, Ghelar, Teliuc, at Petris near Deva as well as in Banat. Steel plant centres such as Hunedoara, Sebesel, Cugir and iron processing workshops were certified by the documents and they were located close to the iron deposits. Near the steel plant centres or independently from them there were operating large forge workshops such as those of Poiana in Moldova and Sarmizegetusa, Deta, Bocşa and Ocna de Fier of Banat.

Within Hunedoara zone, further to archaeological investigations, there were discovered several furnace chimneys used for iron melting. Based on the analysis performed on metal blooms, ash and slags, it was concluded that they belonged to the Hallstatt age and that Daces knew the method to obtain iron and even hard iron.

Many processing objects and traces of chemicals used as fusing agents for the reduction process, that is lime and limestone, were found in the iron processing workshops situated both outside and inside the Carpathian arch.

The processing tools and objects allowed the identification and reconstitution of materials, tools, weapons and other objects produced and used by the Daces.

Fragments of iron anvil with gold, silver and copper traces indicate that the Daces largely processed these metals, too.

The iron objects produced during those times on Romanian territory were: anvils, hammers, nails and tongs, axes, chisels, axes, hatchets, short blade reaping hook, hoes, rakes, saw, scythe, needles, knives, jointers, pruning knives for cutting the vine which growth in Dacia began in the VII century BC.

The amber, salt and other metal extraction continued while the utilization of stone for the tools and weapon production stopped almost completely.

The second period of the Iron Age definitely confirms iron as the most important raw material within the Getic – Dace.

The mining activity developed for more than two millenniums on the Romanian territory BC was carried out only by natives and in this sense, it can be said that **Thracian** were the bronze age miners while the **Gets and Daces** and later on the **Daces** were the iron age miners who much improved the useful mineral extraction and recovery.

The extraction and recovery of iron as well as of copper, gold, silver, lead, etc. flourished during the last centuries before Christ and during the first centuries After Christ.; this activity was supported by the development of some steel plat and metallurgical own facilities. The Archaeological investigations led to the discovery in Romania, of numerous fragments of iron reduction furnaces, iron blooms, heaps of lime used as fusing agent etc.

Also, the vestiges found over the entire Romanian territory indicate that both ore reserves of important and well known deposits and some sedimentary- alluvial useful mineralization spread over almost the entire Romanian territory has been mined out and recovered. The sedimentary mineralization was mostly mined out in Moldova and Wallachia where there were no other deposits. The existence of ore reserves led to the establishment of Getic – Dacian metallurgical centres in Transylvania (Hunedoara, Covasna, Mureş), Moldavia (Botoşani, Tecuci, Bacău) and Wallachia (Mehedinţi, Argeş, Teleorman, Prahova).

The occurrence of the powerful Dacian state within Carpathian Mountains region is closely related to the development of iron processing trace. The iron ore was mined out in open pits and underground mines situated in Poiana Ruscăi Mountains at Teliuc and Ghelar and in Banat in Ocna de Fier zone. At Sarmisegetusa and its surrounding areas there existed the biggest metallurgical workshops of the European territory left outside the Roman Empire borders.

It was also during that period that particular attention was paid to gold and silver processing and mining. Based on the investigations of the objects discovered during archaeological works and on the analysis of other vestiges of that epoch, it was noticed that the Daces used three methods to recover gold: collection of gold sands from local rivers and streams; digging some holes in the massive to extract the gold; and underground galleries sometimes multi-level branched galleries following the gold veins.

Today, there exist obvious proofs that Daces used underground works to mine the gold veins of Roşia Montană, Apuseni Mountains earlier than 1st century BC. Under Burebista and Decebal reign gold and silver mining and processing flourished.

Salt and amber extraction continued based on almost the same principles and systems like in the previous century. The quarries were used to extract different types of stones required for big civil, military and defence constructions.

The activities and achievements of Gets-Daces during the Hallstatt and Latène periods (450 BC-100 AD)indicated that the people had got advanced technical knowledge both in mining itself, metal metallurgy and processing, urbanism, fortress and castle construction, bridges, roads, fortifications, dwellings, using sometimes, original methods and in the field of farming where they invented and used miscellaneous agriculture machines, inclined platforms, pulleys, levers to make the work easier for the miners and they had also good knowledge in the field of military technique.

3. Mining in Dacia in the time of Roman rule

As for the underground wealth, the Roman conquest of Dacia in the year 106 AD led to the significant increase of the production and diversification of mineable minerals.

The Romans took over the old mines from the Daces and enhanced and modernized the production in accordance with their knowledge levels. The reveal of iron, copper, lead and particularly of gold and silver ores was significant. Numerous archaeological artefacts and documents (mining tools, lighting lamps with inscriptions on them, different objects belonging to miners, fragments of ore reduction furnaces, ore processing installations and metal treatment) as well as written proofs (waxed plates, Roman writers' papers, etc.) confirmed the intensity of the metal mining in Roman Dacia [4].

The main mining locality of Roman Dacia was **Alburnus Maior** (Roşia Montană) while the administrative centre was in **Ampellum** (Zlatna).

Besides gold, silver and lead were also mined out within the same region. Copper mines could be found at Micia (Veţel-Deva) while the iron was extracted from Ghelar and Teliuc.

Throughout the Roman reign, mining activity also developed in Banat around Ciclova, Sasca, Oraviţa, Moldova Nouă, Maidan and Resiţa localities where traces of the old mining exploitation, such as fragments of melting furnaces as well as mining and metal processing tools were found.

North from Southern Carpathians, stones and salt were still extracted at a large extent as Dacia had significant salt deposits. The labour force consisted of both Dacian workers and miners from the colonies of the Roman Empire who were highly skilled in the field of ore mining and particularly in gold and silver mining. The archaeological investigations revealed many Dacian and colonial miner localities. Pieces of iron ore were found in their tombs representing the dead's job. During that period, in Dobrogea, construction stones and iron and copper ore deposits from many localities were also intensively mined out. There existed metallurgy and pottery workshops in all Dobrogea cities. An enhanced mining activity also developed within the provinces situated East and South from Carpathians outside the Roman Empire borders. The investigations demonstrated that mining continued throughout the entire Roman government of Dacia.

The Roman conquest brought a new civilization in Dacia; from technical point of view that new civilization was much more advanced than the local one. Several Roman and other nationality masters implemented new technologies. As a result of the competition between the two technologies, the one which provided more technological gains won.

There are numerous traces of the Dacian-Roman mining activity developed on the Romanian territory. It was during the Roman times that the gold mines of Baia de Arieş, Roşia Montană, Bucium, Vulcoi, Corabia, Poiana, Techereu, Zlatna, Stănija, Băiţa, Musariu and Măgura were started up [5].

In all the above mentioned localities there were found many vestiges such as galleries and underground excavations comprising well preserved objects, instruments and working tools: chisels, hoes, picks, hammers, iron levers, rush light, troughs for transporting the ore, etc, all these indicating the organization and methods used to mine out gold at those times. Some of the mining works carried out during the Dacian-Roman times still maintain their initial shape and it can be noticed they were completed using the hammer and the chisel as working tools. Such mining works have been identified at Ruda-Brad, Roşia Montană, Băiţa, etc. [6].

Also, there were found household goods, jewelleries, gold and silver coins, churchyards and inscriptions in Apuseni Mountain region. But the most significant vestiges worth to be mentioned are the **famous waxed plates** from Roşia Montană, which represent the oldest, and the most precious documents certifying the existence of the Dacian –Roman population during the 2nd century AD and indicate the social and private relations of the people living in Dacia Traiana province.

As shown above, during the Roman conquest of Dacia, mining techniques were highly modernized as the Romans implemented most advanced mining methods of those times, methods that were used in other regions off the Empire, too. Both the gallery mining and the ore stope mining methods were much improved as well as the water discharge, ore transport and mine lighting systems, etc.

One of the greatest wealth of Dacia were the salt mines intensively exploited during the Roman times. Salt mines like Ocna Mureş, Ocna Dej, Sic, Cojocna, Rupea, Turda, Ocna Sugatag, etc were in operation at that time.

It was also during the Roman times that stone quarries developed to provide raw materials for road construction, military and civilian constructions as well as for different sculpture or epigraph monuments. Most of the largest stone quarries were located in the neighbourhood of big cities. Also, a stone quarry must have existed close to any Roman camp.

4. Mining activity after leaving Dacia from the Romans to the 10th century

The withdrawal of the Roman troops and administration from Dacia in the 3rd century AD (year 271 AD) determined the official mining activity cessation. Comparing the systematic and organized underground ore mining activity developed by the Roman authority, the mining activity developed by local people after the III century diminished significantly as a result of the migrating people invasion on our country territory between the years 395 and 1095 AD. However, the discovery of some mining work vestiges, after the 3rd century, at almost same locations where previously there had existed mines and metal processing un its **indicate with no doubt the same concerns of the same population which despite all the historical vicissitudes lived and continued to live where they ever lived.**

The archaeological investigations of the last decades carried out in several localities of Romania revealed stable settlements where the Dacian –Roman population of the ex- Roman province continued the metal ore extraction to obtain metals for the production of agricultural tools, weapons and household goods.

The archaeological investigations demonstrated that during the III – VIII centuries AD the secondary ferrous ore mining, particularly open pit mining developed significantly and the underground mining was almost completely abandoned due to the fact that there were no political and economic structures which could support such activity and due to the withdrawal of skilled miners in the region situated South from Danube.

Similar preoccupations had the inhabitants of the regions located outside the Carpathian arch whether they were part of the Roman Empire or not.

Also, it was obvious that during the III – X AD salt was exploited in almost all the country regions.

Among the mines which were in operation over the Romanian territory between the III and X century and confirmed by documents are: Agadici, Brădişorul de Jos, Ciclova Română, Fizeş, Topleţ, Cojocna, Sic, Turda, Ocna Mureş, Ocna Dej, Praid, Ocna Sibiului, Ocnele Mari, Rodna, Zlatna , Ruda-Brad, Baia de Aramă etc.[7].

5. Mining activity in the Middle Ages

During the **Middle Ages** (1095 -1848) the mining and processing of underground mineral wealth of Romania was in progress except for the times when difficult historical circumstances determined the temporary cessation of the mining activity or the diminution of it. More copper and iron ore deposits were put in exploitation during that period compared to the previous one in order to produce working tools and particularly agricultural tools.

As the significant commercial exchanges involving mined out ore transport at remote places, the low-grade sedimentary-alluvial mineralization were processed almost everywhere in Romania and particularly in Moldavia and Wallachia. The local communities close to each such deposit included their own skilled miners who mined out the ore and processed it in their own furnaces to obtain iron which was to be used by the community.

In Transylvania where large iron deposits were located, their exploitation was enhanced as the state rulers brought foreign colonists highly skilled in the field of mineral extraction. They introduced the modern and efficient mining methods at the iron mines of Transylvania.

Once the commercial exchanges enhanced, particularly in the 15th century, the mining activities concentrated within areas comprising iron metamorphic deposits that is in Transylvania and Poiana Ruscăi Mountains and low grade sedimentary – alluvial mineral resources mining was almost completely abandoned.

The mining activity was diversified, and several deposits which had been less mined out or known so far, were put into operation and rendered valuable. Besides iron, copper, gold, silver, lead and salt, there were mined out mercury, antimony, sulphur and other useful minerals using techniques more efficient than centuries ago. The investigations carried out throughout the centuries and particularly the archaeological discoveries indicated the preoccupations of the people during the Early Middle Ages among which metal ore mining and processing had a significant impact on their life and activities. During those times, the precious metal mining constituted one of the basic jobs of many Transylvania inhabitants particularly for those from Apuseni Mountains. The mines of that area such as Baia de Arieş, Baia de Criş, Caraci, Ţebea, Roşia Montană etc. were put into operation. Also, at the Northern part of the country, at Baia Mare and Baia Sprie major gold mines were in operation.

Throughout the developed Middle Ages the known deposit mining continued, but new deposit were also discovered and put into operation. The production process included improved methods and equipment compared to the previous periods. New mining and processing methods were looked for, the tools were modernized and hydraulic power was used for ore processing.

The iron ore mined out at Ghelar, Teliuc, Birtin, Beius, Căpusul Mic, Rodna, Remetea mines of Transylvania as well as the ore from several lens deposits or iron oxide pockets from Pliocene formations developed on river banks and hills were mined out in small scale open pits from Moldavia and Wallachia.

During Late Middle Ages the useful mineral extraction and ore reduction was subject to several transformations due to the adoption of new advanced technical procedures determining the continuous increase of production rate to meet the society requirements.

By that time, several open pits and underground mines were in operation in our country and precious metals, iron, manganese, construction materials, salt, copper, mercury, lead, sulfur, salpetre were extracted.

By the end of the XVIII century the exploitation of collieries of Banat started and it continued and developed until the contemporary era.

The ore mining continued at mines and localities already known.

6. Romanian mining in the capitalist period

During **the capitalism** the mineral exploitation enhancement continued in the whole country.

Industries which used minerals as raw materials knew a spectacular progress. During those times, production was concentrated and new workers' localities developed and got modernized.

After the year 1850, Transylvania provided half of the salt production of the Austrian –Hungarian Empire and 2/3 of the gold for the dual monarchy while the gol production was concentrated in Apuseni Mountains and Baia Mare basin. In 1863, the mines of Banat and Poiana Ruscă Mountains provided more than 90% of the iron production of the whole Transylvania region. The production was concentrated at Ocna de Fier and Dognecea mines in Banat region but also at Ghelar and Teliuc mines from Poiana Ruscă Mountains. In Bucovina, the iron ore mining stopped and the manganese ore mining developed obtaining as final product which was essential for producing special steels.

Among the useful non-metal minerals, a special mention should be made on mineral coals used in different sectors of activity, but most particularly in transportation and large-scale industrial units. Coal mining in Banat and Valea Jiului and lignite deposit from different regions of the country were highly developed.

Since the beginning of the 20th century, the mineral raw material requirements had been ever greater. Particularly in the field of machine construction and chemical industry these requirements determined an ever-greater development of mining and the mining activity focused on known useful mineral deposits as well as on the new ones discovered and investigated by prospecting and exploration works.

The important achievements were obtained in the Romanian coal industry where mining methods and processes specific to thin, medium and even thick layers were applied. Some of the achievements obtained had priority at European and even world level.

Since the 3rd decade of the 20th century the systematic mining and processing of non-metal ores and useful and decorative rocks like granite, andesite, lime, travertine, polychrome lime, marble started.

In 1938, the production of mined out and processed ore from mines of the Apuseni Mountains tripled as compared to the production of the ’28 and thus, the largest amount of precious metals ever produced in an European region, was obtained.

In conclusion, it can be said that between the two World Wars mining in Romania advanced a lot as several technical achievements were obtained: mechanical – electric rotation and pneumatic percussion drilling both for ore and coal mines; large trapezoidal chamber mining of salt deposits and introduction of slat cutters; long face and stope coal mining at mines of Valea Jiului; stope coal mining using cutters and drilling-blasting operations; utilization of oscillating chutes and scraper conveyors for ore transport to the stope; ring and prefabricated wall support of the galleries and metal pillar support of stopes; ore stockpiling mining method; construction of modern coal processing plants at mines of Valea Jiului and gold ore cyanidation.; introduction of electro-magnetic separators at iron ore concentration; utilization of intermittent excavators in open pits, etc. [8].

New useful mineral deposits were known and put into operation. New mining systems and working methods have been introduced gradually as well as several innovations of Romanian, Hungarian and German miners. On the other hand, working conditions became more and more difficult. The miners’ salaries were not sufficient to cover their family needs. The social contradictions became more obvious and working class fight turned into new manifestations. The fight against capitalism determined the miners to get organized and to act like an important social power, like a powerful component off the fight against capitalism.

7. Romanian mining in the period 1948-1990

The **socialist/communist regime** instauration in Romania after the second World War determined the most rapid development of the mining industry of the whole Romanian history.

Within the industrialization frame of Romania, the mining industry became one of the basic economic branches. It is to be noted that both useful mineral underground and large open pit mining developed obtaining hundreds of thousands and even millions tons of ore per year.

A special attention was paid to the knowledge and enhancement of the mineral raw material base.

To this aim, between 1950 and 1990 thousands meters of drilling were completed totalizing one million meter of drill holes from surface. The drill holes together with the geological investigation works performed at surface and in the underground provided sufficient data for a better knowledge of the country underground and resources.

As for the ores, the basic orientation was focused on the systematization and development of the existing mines and the opening of new ones. Thus, besides the systematization of the old mines from Baia Mare, Apuseni Mountains, Banatului Mountains and Dobrogei Mountains, there were opened new mines at Suior, Baia Borsa, Ilba situated to the North-Western part of the country; Veţel, Deva Muncelu Mic, Hunedoara mines and two other important basins Moldova Nouă in Banat and Lesu Ursului – Fundul Moldovei in Moldavia were opened.

The metal ore processing plant designs provided large capacities and technologies which ensure metal high recovery rates. It was also during that period that the processing plants of Flotaţia Centrală Baia Mare and of Deva, Bălan, Baia de Arieş, Moldova Nouă, Lesul Ursului, Fundul Moldovei were built. In the field of high grade coal the production rates of the existing mines reached 1.0 - 2.0millions tons per mine and year and new mines were opened at Uricani, Bărbăteni, Livezeni, Câmpul lui Neag etc. Thus, in 1988 the mines of Valea Jiului produced almost 12millions tons of coal representing the largest coal production ever obtained in this mining basin.

As for the lignite production, it developed very rapidly and the activity focused on Oltenia zone in open casts provided with continuous technological flow-sheet.

The continuous growth of the mining production and the improvement of its beneficiation determined the harmonious development of the Romanian mining industry. Between 1950 and 1990 the overall production increased more than ten times while the number of employees increased only by three times according to records.

The Romanian specialists who worked in mining field during those times contributed to obtaining significant achievements among which it is worth mentioning; new mining fields opening and putting into operation; designing and application of new mining methods ensuring higher production rates and efficiency; designing and construction of new machines and equipment for mining purposes such as; stope shearers, mechanized supporting equipment new transport systems and equipment, large capacity drill rigs, bucket shovels, rotor and cutting bucket shovels, etc. Also, there were investigated and found new processing and higher beneficiation methods which were implemented in the field of all useful minerals.

During socialism society, there were found, investigated and put into operation several ore deposits spread over the Romania's territory and there were obtained the useful mineral higher rates of ever. In 1987 Romania produced more than 170 million of different mineral fuels and metal ores and it used to be considered one of the European countries where mining activity was much advanced. By the end of the '80 Romania's mining industry was based on the newest technologies and implemented the latest scientific and technical findings.

The territory of Romania, with a total area of 237,500 square kilometres, it has a very complex geological structure. Most of the territory is part of from the area of the alpine orogen with tertiary and current volcanism made up of mountains young people, hills, plateaus and plains interspersed in tectonic depressions containing, as a whole, rich and varied deposits of mineral substances and useful rocks, exemplified by: mineral fuels, metal ores precious, ferrous, non-ferrous and rare metal ores, non-metallic substances etc., as can be seen in Fig.1.

Fig.1. Territorial distribution of mineral resources exploited in Romania
(Source: National Mineral Resources Agency)

1-Alabaster; 2-Amphibolite; 3-Industrial andesite; 4-Ornamental andesite; 5-Andesite; 6-Anhydrite; 7-Balneotherapeutic waters and CO_2; 8-Geothermal waters; 9- Carbonated natural mineral waters; 10-Non-carbonated natural mineral waters (flat); 11-Therapeutic mineral waters; 12-Mineral waters; 13-Thermo-mineral waters;14-Slate; 15-Kaolinous clay; 16-Common clay; 17-Fireclay; 18-Basalt; 19-Bentonite; 20-Wreck; 21-Industrial limestone; 22-Limestone with marne; 23-Ornamental limestone; 24-Limestone; 25-Calcite; 26-Brown coal; 27-Quartz; 28-Industrial dacite; 29-Dacite; 30-Diabase; 31-Diatomite; 32-Diorite; 33-CO_2 mofetic; 34-CO_2; 35-Dolomite; 36-Felspar; 37-Gypsum; 38-Granite for construction; 39-Granite; 40-Industrial granodiorite; 41-Granodiorite; 42-Sandstone; 43-Energy hard coal; 44-Hard coal; 45-Lignite; 46-Loess; 47-Marble; 48-Marne; 49-Mica schist; 50-Ore with bismuth; 51-Ore with tungsten; 52-Low-content copper ore; 53-Copper ore; 54-Manganese ore; 55-Molybdenum ore; 56-Uranium ore; 57-Polymetallic ore; 58-Gold-argentiferous ores; 59-Polimetallic and gold-argentiferous ores; 60-Sapropelic sludges; 61-Therapeutic sludges; 62-Kaolin sand; 63-Sand for building materials; 64-Sand and gravel; 65-Siliceous sand (for glass and metallurgical industry); 66-Pegmatit feldspatic; 67-Perlite; 68-Porphyry; 69-Mining waste product; 70-Rock salt; 71-Serpentine; 72-Green schist; 73-Scarn wolastonic; 74-Travertine; 75-Industrial tuffs; 76-Tuffs; 77-Peat.

The greatest riches of the Romanian underground are formations of Neozoic age, followed by deposits related to pre-Hercynian and Hercynian age tectonics Paleozoic. The fewest of the deposits that are known to date are of Mesozoic age.

The deposits of useful mineral substances in Romania are large small or at most medium, not meeting large and very large deposits higher than in the case of deposits of salt and useful.

8. Romanian mining after 1990

The passage from the socialist economy to the free market one at the beginning of the tenth decade of the 20th century determined significant changes in the field of mineral industry, too. At the end of 1989, in Romania there existed 278 mines and open pits in operations, 70 processing plants of which 30 in the field of metal ores, 34 for non-metal ores and 6 for coal preparation, spread over the 41 mining basins located in 23 counties. By that time, the mining sector produced 150millions tons per year of coal, metal ores, non-metal ores and salt and the mining activity ensured the daily living of more than 10% of the country population.

In Romania, the mining activity, after the passing of the country to the market economy, continued in the same economic units, using further on the same working methods and technological equipment.

Because no more investments were made and the technical endowment remained the same, used previously for years, at all the units the production and labour productivity began to sensibly decrease from year to year.

Even if the Romanian State sustained the mining from country with high expenses, due to the internal and external conjuncture, the stringent necessity to analyse all the mining units occurred and their selection in order to remain only the operational and profitable units, which assure a competitive product from qualitative and free market price point of view.

Based on the conclusions of the performed analyses, the basic restructuration of the system of Romanian mining industry was implemented consisting inter alia of:

- Technological and production restructuration;
- Organizational and managerial restructuration;
- Personnel's restructuration, namely its massive reduction;
- Restriction or cessation of the productive activity at some mines with geological reserves in course of depletion, as well as with particularly heavy geological-mining conditions, which had high and very high production costs.

Beginning from 1997, 10 (ten) Government Decisions approved the definitive closing, preservation and post-closing monitoring of the environment factors in more than 1000 sectors of activity, mines and open pits, processing plants, factories and workshops for the manufacturing and repair of the mining equipment, from entire country.

The mining objectives in process of closing-rendering ecological consist of 78 tailing ponds and 675 waste dumps, which occupy more than 10,000 hectares of terrain and accumulate more than 700 million cubic meters of mining waste.

Now, the Romanian mining still operates in three sectors of activity:

- Exploitation and valorisation of the deposits of energetic substances;
- Exploitation and valorisation of the deposits of metallic ores;
- Exploitation and valorisation of the deposits of non-metallic ores and utile rocks.

In the last 30 years in all the three mining sectors, in the units which operated and still operate, no kind of investments were made, the technical endowment remained at the level of 1980, and the activity takes place at minimum level.

Romania, in the actual economic and international conjuncture, must adapt its industry to the own needs and to its geographical position. If there were political will and support, the Romanian mining in its entirety could be revitalized.

For the mining industry, a durable development must be assured, corresponding to the actual necessities, without compromising the possibilities of the future generations to satisfy their own necessities.

The sustainable development should assure the economic increase, social progress, protection of the environment and natural resources.

Through the implementation of the ***Strategy of Romanian Mining 2017- 2035***, approved by the Management Authorities of the Romanian State, the restructuration of the mining will be finalized, so that along with the entire Romanian industry and economy to be integrated as soon as possible and efficiently in the European economic space.

9. Mining and the environment

The mining industry exerts special influences on the environment which manifests itself in all phases of technological exploitation processes and preparation. Regardless of the method applied, for the exploitation of a deposit numerous physical and chemical operations and processes are necessary, following which it results on the one hand the useful mineral substance, and on the other hand, the matter waste extracted from the deposit together with the useful.

The entire mining activity produces, due to its specificity, multiple negative effects on the environment.

It must be specified that even after the cessation of mining activity in an area its negative effects do not disappear completely.

If the negative influence of the mining industry on air and water se decreases sharply or even disappears completely when the mining activity stops from the area, the impact on the territory (landscape, soil, flora, fauna), caused by the construction of landfills, settling ponds and industrial installations, has a high intensity and is sustainable over time.

In general, in the case of all anthropogenic activities stopped, they remain, may more or less, residual negative effects over a certain period, in depending on the self-purification/self-regulation capacity of the components environment and the speed with which those in charge act for remediation these effects.

The ecological effects of mine closure are much more complex and call for a careful approach through monitoring, mostly times, long lasting.

Underground, in the spaces affected by mining, abandoned after closure, physical-mechanical and chemical processes can occur, which no longer exist they are controlled by humans and which, over time, can amplify and transmit to the surface through subsidence phenomena.

Until the second half of the 20th century environmental problems in mining Romanian were treated very easily or were not treated at all. That as a result of this, today in Romania there are many problems of environment caused by the mining industry, which come from that period.

The emphasis in the past on achieving high levels of production and the neglect of the ecological impact of the mining industry as a whole have determined the accumulation over time of serious damage to the environment which we must deal with now and remove.

Until now, the situation in Romania is as follows [3]:

• From the point of view *of occupying land surfaces and degradation soil*:

• The total area affected by the mining industry is approximately 1% from the arable surface of the country. A special situation exists in Gorj County where mining occupies 35,000 hectares, i.e. 18% of the county's surface.

• About 10,000 hectares are occupied in Romania's coal sector with mining premises, 2,500 hectares with industrial and civil constructions and 8,000 hectares with quarries.

They resulted from the coal mining activity 137 dumps and 6 settling ponds, which store a total volume of about 2,000 million sterile cubic meters and occupies an area of over 3,600 hectares.

Until now, due to the opening and expansion of lignite quarries, they have 2,200 private households, 40 social constructions and cultural, 5 churches and 6 cemeteries.

On the date of exhaustion of lignite reserves from the Oltenia coal basins, 56 localities will be affected by mining, of which 14 in totality.

• In the sector of exploitation of ore deposits and non-metallic substances the occupied surface is 8,200 hectares. This sector manages 577 dumps with a volume of stored rocks of about 200 million cubic meters that occupied an area of over 800 hectares.

• In the processing sector (preparation, utilization) were built, for example over time, as a result of mining activities, 65 settling ponds with an area of 1,350 hectares, storing over 360 million cubic meters of sterile material.

Air pollution in mining areas is caused by dust emissions and gases in the atmosphere from the ventilation stations of the mines, from the dust in suspension from the operations of shooting in the quarries, from the operations of loading-unloading waste and useful, from ore crushing, from technological transport etc. Thus in the mining units of Maramureş and the Apuseni Mountains, were issued annually in atmosphere over 120 000 tons of sediment suspensions having 2–3 times of silicogenic dust concentrations, both underground and at surface.

Water pollution in mining areas is the result of extraction processes and processing of useful mineral substances in the preparation plants. The mining industry with its exploitation and preparation branches (through various methods such as flotation, cyanidation, etc.) is a large consumer of water industrial, contributing to a very large extent to the pollution of receptors
natural from the area. The amount of water discharged from the underground ranges between 1.5 and 8 cubic meters/ ton. These waters are loaded with solid suspensions; they have a very acidic character and a very high content of metal ions (copper, zinc, iron).

The mining industry in Romania, in its long existence, has affected considerably all environmental components, which is why it is imperative today the problem of their rehabilitation, the use of mining waste for various purposes and the restoration of degraded lands in the economic circuit. Based on the legislation in force, which is very explicit, exact and categorical, the companies and the national companies that control the activities in the field of extraction and the valorisation of deposits of useful mineral substances will have to intensify future concerns for the protection and restoration of the components of environment, in which sense a series of solutions must be considered [9].

The complexity and scope of the works to restore the ecological system from Romania's mining areas must be included in a well program structured, carried out at the national level and for which the investment efforts are will amount to hundreds of millions of euros.

Following the underground exploitation of useful mineral substances remain mining works that make up a system of underground voids/cavities. Of usually the mining sectors that generated and manage the void system/ underground cavities enter the *normal* process of closing and greening an area, with the aim of rendering the land related, as far as possible, to the agricultural circuit or forestry.

Reuse of mining spaces for different applications – such as: storage various oil and natural gas products, weapons and armaments, products food and agricultural, storage of radioactive or toxic waste, as well as other civilian uses such as: museums, safe depositories for documents, bank vaults, research centers, offices - it can be an opportunity [10].

10. A possible future of Romanian mining

A statistic of the quantities of the main useful mineral substances extracted over time up to percentage from the territory of Romania can be summarized as follows [2]:

• The total amount of gold obtained through the exploitation of gold deposits in the Romanian territories amounts to over 2,000 tons of pure gold;

• The quantity of superior coal extracted from the mines of Valea Jiului, from 1868 until now, is more than 400 million tons of superior coal;

• The amount of lignite in Oltenia, since the beginning of the mining activity, after 1950 and until now, is over 1.2 billion tons of coal - over 1.0 billion tons of lignite extracted through quarries equipped with discontinuous flow technologies, but especially in continuous flow and over 200 million tons extracted through underground works. At the same time, a waste volume of over 6.0 billion m^3 was excavated corresponding to the mentioned production.

Romania, in the current international situation, must adapt the industry, including the defence industry, to its own needs and to its geographical position.

If there will be political will and support, Romanian mining in its whole can be revived.

It will be necessary to ensure the mining industry a sustainable development that corresponds to the needs of the moment, without compromising the possibilities of future generations to satisfy their own needs.

For the future, Romania must concentrate its investment efforts in the field of mineral resources, in particular for [3]:

• Development of deposits with poor contents, but with volumes large reserves, which lend themselves to exploitation in quarries, such as: Roşia-Poieni, Moldova Noua, Valea Arsului–Brad, Valea Morii–Brad, Bolcana, for copper and Aurum (Borzaş), Dniester (Galbena-Lăpuşna), Certej, Roşia Montană, for gold and silver.

• Reprocessing of mining residues from dumps and settling ponds, with metal content, such as the Bozânţa pond (Remin), the Central Flotation pond – Vechi (Remin), Rovina–Brad pond, Ribiţa Curteni–Brad pond and others.

• Reopening reserves that can be economically exploited through methods underground extraction, at the Cavnic, Baia Sprie, Turţ-Ghezuri, Șuior and other, who hold significant amounts of exploitable reserves and for which they have exploitation licenses.

• Reopening reserves with accompanying mineral elements, which have become in the current technical-economic context of great interest.

• Amplification of the production of salt in lumps and in solution, the production of materials constructions and various non-metallic substances needed by some sectors of activity, as well as the production of useful rocks needed for the large construction sites opened on the territory of the country.

• Continued exploitation of coal deposits, at a production level absolutely necessary for the national economy.

• Bringing the deposit from Tulgheş into the circuit Grinţieş, where a new processing and refining capacity can be built, but also the introduction of uranium into the economic circuit from secondary reserves: tailings dumps and weakly radioactive settling ponds, and mine and waste waters.

As actions of the future, of general interest, for Romanian mining mention only a few:

- ensuring an appropriate legislative and institutional framework for the functioning of the mining sector, funding sources and institutions responsible;
- the establishment an institutional entity to administer, coordinate, the whole activities related to geological reserves of mineral resources, extraction and capitalizing on these resources;
- the establishment of a national mining inspection service, to watch over rational exploitation of mineral resource deposits;
- the resumption of the geological research activities of the deposits, in view reconfirmation of reservations;
- preparation of pre-feasibility studies for the establishment the technical and financial conditions necessary for the resumption of the mining activity opening, preparation and exploitation in the perimeters with deposits of substances useful minerals.
- the search for new resources useful mineral substances such as for example the extraction of useful minerals from deposits with contents reduced and even from the eruptive rocks, which our country does not lack, and which contain a great diversity of useful elements (Fe, V, Ti, Mg, P, Al, K, Na, etc.), in percentages not without interest.

11. Conclusions

Mining has fully contributed to the development of national economies and implicitly the global one, both through the supply of mineral raw materials necessary for the development of industrial branches, as well as a field suitable for the application of the latest scientific and technical achievements, thus influencing the way decisively the development of some regions, countries and geographical areas on the world map.

From the review of the stages of mining development over time on the territory of our homeland, the importance of this activity is clearly evident human as a factor of civilization, progress and well-being of society, as well and the fact that over time there are periods of flourishing and decline mining, but never periods of its disappearance. This truth it completely retains its importance even for the current times in which we find ourselves in an extensive process of recovery and restructuring of Romanian mining.

Taking into account the increase from year to year in the consumption of metals and minerals per capita, as well as growth at a fairly accelerated pace of the population of the world map, it can be stated that a nation has a level of welfare the higher the more it processes and runs in the economic circuit - both quantitatively and qualitatively - more useful mineral substances.

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