Arguments for the need of mining education continuity and development in Romania

To cite this article: I Bud et al 2018 IOP Conf. Ser.: Mater. Sci. Eng. 294 012061

View the article online for updates and enhancements.

You may also like

- Regional Inequalities in Romania before and After the EU Accession
  Ibolya Török

- Experiential Learning for Seismic Protection Using Living Lab Approach in Romania
  Daniela Dobre, Claudiu Sorin Dragomir and Emil-Sever Georgescu

- SWOT analysis of the renewable energy sources in Romania - case study: solar energy
  A G Lupu, A Dumencu, M V Atanasiu et al.
Arguments for the need of mining education continuity and development in Romania

I Bud, S Duma, I Pasca and D Gusat

Technical University of Cluj Napoca Romania, North University Center of Baia Mare, Department of Mineral Resources, Materials and Environment, 62A, Dr. V. Babeș street, 430324, Baia Mare, România

E-mail: greenminingteam@gmail.com

Abstract. Mining is considered the oldest conscious man activity. In the beginning, man searched for hard rocks in the outskirts area and used it to make weapons and ornaments. Subsequently, civilizations evolved through the development of infrastructure, buildings and monuments and finally, weapons. For all these it was necessary to have mineral raw materials obtained under increasingly difficult conditions, through increasingly evolved techniques. In this way, the art of mining and metallurgy was born, which led to the formation of scientific bases. The mining activity was equally art and science. The art and the science have been learned and taught in schools since ancient times and continue today in large universities with mining engineering, metallurgy, mining topography, mining environmental protection, and geology. Lately, in Romania, the mining high school has reached a deadlock and the middle and professional school has collapsed. The development of infrastructure, construction, etc. requires the exploitation and valorisation of mineral resources based on specialists. The paper warns against the danger of losing tradition and skills in mining engineers formation and militate for the re-establishment of professional and technical schools.

1. Introduction

The mining activity is considered to be the oldest conscious man activity, a statement supported by the fact that the great divisions of human civilization evolution have received designations related to minerals: Stone Age, Bronze Age, Iron Age, Uranium Age.

At the beginning, man was searching for hard rocks in outcrop areas and they used it for weapons and ornaments. Along the time, both rocks range and their areas of use have diversified. Copper and tin were among the first metals known and used in bronze production, approximately 4000 years ago.

The need for expansion and defense have struggling man to develop weapons and the wishes of beauty made him create jewelries, consequently he has developed the most longest-running activity, exploitation and capitalization of mineral resources. Mining activities have extended from small scale up to large and very large scale and have led to the formation of mining school which has become multi and inter disciplinary.

In Romania mining school has developed up to December 1989 Revolution, continuing in the years 90 which, at the beginning of XXI century went into decline. The paper highlights the risk of losing the frame of training of mining specialists to maximize the capitalization of mineral resources potential available in Romania.
2. Mining activity along Romanian community evolution
The precious metals, gold and silver, have been recovered since ancient time. On the Romanian territory, there are a lot of mining activity traces from the most ancient times and the period the most historically known is before the Roman occupation when the Dacians held important gold and silver reserves. These riches have attracted invaders - the most powerful empire of the time, Roman Empire. After Daco-Roman wars, Trajan armies captured impressive amounts of precious metals which have contributed to the restoration of empire financial situation. The catch of the Roman war has been assessed by some historians to hundreds of gold and silver tons and it is certified that most Rome vestiges were built after Dacia occupation by Romans. After the war, Romans have continued - on a larger scale - the gold exploitation in Dacia. The remainders of this activity are visible today at Roșia Montană.

In Roman period, gold from Dacia was a true "El Dorado" for the populations in the Empire provinces, especially from Minor Asia and Northern Dalmatia contributing to the formation of a new population. The historians estimate that in Dacia mines were used between 15000 and 20000 people obtaining an annual production between 3000 and 5000 kg gold and a double silver production. Accordingly, in 166 years of Roman occupation, estimating a production of only 3000 kg Au/year, from Dacia went outside about 500 t Au and 950 t Ag [1].

This gold odyssey from Apuseni Mountains has continued until our days and has turned into international discord after the estimation of Roșia Montană reserves to about 300 t gold and other valuable items. Because of these disputes mining project is locked with profound consequences on the population in the area, Romanian socio-economic developments and affecting mining education.

Sliding, in time, the situation of Apuseni Mountains in Baia Mare mining area, history repeats, mineral resources capturing the interest of the great world powers. Country mineral riches have attracted along the time the interests of powerful countries, a situation which are repeated even today. The departure of these riches over the borders privates the population of its development potential, the employment places, the source of income and prosperity. Without finding occupations, most of young and adults people, with work power, have taken the foreigners path, searching for the everyday life stability and security. This condition of things was reflected in folklore by metaphors "poor country rich..." or "our mountains golden hold and we beg from door to door...".

During the communist period, the Romanian state has intensively exploited the resources, developing powerful mining sector but in the post-revolutionary period activity has entered total collapse, even in the context of raw materials prices increase and the development of mining activity in numerous European and world countries.

Extraction of solid mineral resources has an old history in Romanian territory (over 2000 years) being characterized by a variety of useful mineral capitalized. Until the end of XX century, mining industry in Romania has known a continuous and relevant development extracting different fossil fuels, ferrous and nonferrous ores, precious and radioactive ores, useful rocks for construction, ornamental rocks, mineral salts, etc.

Deposits of useful substances are spread across the whole country territory, ores being in mountain areas and those of coal and nonmetallic in hill and depressions areas.

In 1990, overall, mining industry has had a maximum production of approx. 160 million tons (coal, ores and salt), there were 278 mines and quarries in operation and 70 processing plants, of which 30 in the sector of metallic iron minerals, 34 in the sector of non-metalliferous and 6 in the coal sector. These industrial objectives have been spread in 41 mining basins located in the territory of the 23 counties [2].

Therefore, mining sector was at that time a socio-economic pole and a way of living for approximately 10 % of Romanian population and has both a well-developed infrastructure and the necessary logistics in the field, impressed by research and design units operating in cities located close to mining perimeters (Baia Mare, Petroșani, Cluj, Deva, Craiova, București). At the same time, the training for the necessary staff in mining units (mining workers, technical staff) was ensured by
mining college, technical mining schools, the two Institutes of mines in Baia Mare and Petroșani and Geological Institutes in country university centers.

In the main seven mining companies in Romania (metals, salt and coal) the employed staff January 1997 was of 175 879 persons. This statistic doesn’t cover employees of the mining units specialized in useful rocks, ballast and small careers. In the same period, there were over 1 500 ballast and quarries with an annual production of more than 150 million tons of minerals aggregates and useful rocks [2].

After 1990, mining sector has entered a permanent regress process, dropping production up to approx. 70 million tons in 2005 and after 2007 when ores and a part of coal mines have close, production decrease was much more obvious.

![Figure 1](image-url)

**Figure 1.** Evolution of total annual extraction (mining mass) 1950-2010 [2]

We had a history and a tradition in mining activity and mineral resources capitalization and we still have potential and for its valorization we need specialists trained in structured and solid mining school, supported and promoted responsible.

Mining activity during the communist period has been developed, sometimes oversized with organization deficiencies which did it - sometimes - inefficient but after 1990, in an economic and political conflict situation it has been strongly compromised: irresponsible organization, concentrates supply and sale through intermediaries, social conflicts and trade unions, etc. All these have led to the total collapse of this activity.

As an example, in comparison with Romanian mining activity evolution, in other European and world countries have elaborated development strategies for mining sector and subsequently for professional education and research, which were applied. The results obtained in these countries are spectaculars and prove the coherence and the pragmatism of their previsions.

In the context of its strategy, Sweden allow a prominent place to education and research development in mining domain. There is also a very clear structure of the economic significance of Mineral industry: operating costs, salaries and pensions, profit, taxes and contributions to the state, dividends to state, dividends to private owners, allowances for the urban transformations, allowances for environment remedies as well as the production for the main minerals and its share in the European economy.
Figure 2. Evolution and prognosis of mining production 1900 – 2020 of Sweden strategy 2013 [3]

Our research team initiated a comparative analysis of Romanian mining industry strategy with development strategies of European and world countries. The conclusions of this research demarche were presented and published.

3. Actual Romanian mineral resources potential

Romania is an important and rich country from the point of view of useful mineral substances because of the 3000 minerals known in the world, 500 can be found in its underground and 35 minerals have been found and described for the first time, here. Today Romania still has over 15 billion tons of total geological reserves of various useful mineral substances which represents a potential mining wealth over 250 billion euro given by the value of the usable mining products after extraction and processing with the current technologies [2].

The total reserves which we have consist of the following: 3 billion tons lignite, 1 billion tons coal, over 750 million tons gold-silver ores, 100 million tons polymetallic ores, 1 billion tons copper ores, 4 billion tons of salt, a few tens of billions of tons of useful and ornamental rocks, etc. [2]. Mining activity continued after 2007 to a different scale and in a different form.

From the public data of NAMR page for 2013 it was recorded 1.382 proposals for new perimeters in the phase of request: 11 permits on exploration; 882 permits on exploitation; 37 licenses for exploration; 33 operating licenses. To illustrate here are a few of active permits and licenses (2014): in Maramures 53; in Cluj 29; in Bistrita 28; in Alba 44 permits + 14 licenses; Arad 38; Timis 35; Constanta 37; Gorj 37 permits + 26 licenses (19 on lignite); Bihor 4 licenses for lignite exploration; reserves of ores Titan, Zirconium, Molybdenum Tellurium, etc. are in the phase of research [4], [5].

In 2016, it were approved 1489 permits and licenses for exploitation and exploration to which are added 510 in approval procedure (940 exploitation permits, 475 operating licenses and 74 exploration licenses). These statistical data show that in Romania today there are approximately 2000 active mining perimeters [5].

Romania is an important country both in surface and population, with a remarkable geo mining potential, exploited and capitalized in historical periods. In the time of mining closure, the idea that our resources would be exhausted or too poor was driven. This statement was contradicted by the results obtained by many private companies in the research and exploration of mining sector. In the moment when somebody have expressed his intention to exploit a detrimental flow claimed that the holding of mineral reserves should be made by Romanian state. However, Romanian state has ceased...
operating activity at the time in which the price of metals on the Stock Exchange has reached historical level even if there were production capacities, open and/or prepared reserves, experience and qualified staff.

As an example, it may be put into question numerous projects of mineral resources exploitation in Apuseni Mountains and Baia Mare area which are tergiversated for a long time, with adverse consequences on economic, social and environmental protection situation. The exploitation of Rosia Montana is an atypical case in which the Romanian state exploit national mineral resource and sell it as raw material abroad. In 2014, it has been extracted a production of 2.37 million tons ore, after processing the obtained concentrate represents 7264 t Cu and in 2015 production was 2,66 million tons ore, and 7612 t Cu concentrate. The added value lost through the sale of copper in concentrate in comparison with finished product is triple [6], [7]. The benefits obtained by processing some resources until finished product could be used in part to solve environmental problems created by exploitation activity.

4. The need of mining education continuity in Romania

For the pursuit of activity in the field of mineral resources exploitation and capitalization, the formation of specialists at various levels is necessary: professional education, technical and engineering. In the framework of engineering there are three distinct competent authorities: the production engineer, design engineer and research engineer. To get out on the labor market with production engineers, mining engineering high school learn its graduates’ knowledge that other engineering specializations do not address: development of the perforation and shooting-blasting techniques monographs, working with explosives, etc.

Technical documents to obtain exploitation permits – laborious materials including much mining specific information – are renewing on annual basis. This work can be carried out only by the specialist mining engineer attested by NAMR.

Each mining perimeter in operation requires at least a mining specialist in view of the problems complexity in this area: technical specific documents, works of deposits opening and preparation, mechanical derockment and mining blasting (only mining school learn its graduates the entire technique of mining blast), transport and climatization, specific rules of labor protection, environment and deposits protection. In addition to higher education units it must function technical schools for staff training: technical mining school, mining blasting school, geology and topography mining school.

At the moment, the lack of interest for the formation of competent staff in the field of mining is reflected in the production activity and the drafting of technical documents: design and execution mining perimeters closures (mining waste deposits, tailing ponds, underground and surface areas); salt mines operation and safety; the manner of drawing up the monographs of perforation and shooting-blasting; the quality of the exploited rocks for infrastructure works (units not complying with technical quality standards concerning characteristics of resistance and geometry).

The road and railway infrastructure development implies the use of huge quantities of hard rocks which are operated by perforation and shooting with explosives. Only mining engineering school learn these techniques.

If the Romanian school no longer forms engineers, companies coming to invest in mineral resources capitalization will be forced to bring specialists from other countries. So, Romania - which was, once, the supplier of well prepared and appreciated specialist in Europe and worldwide - will become importer of mining engineers.

5. Brief history of mining school in Romania

Baia Mare mining education has started in 1864 with 3 years mining school for mine management and organization staff. The school activity has continued up to 1873.

Between 1873 and 1918 the mining school moved on and has functioned in Baia Sprie. In 1919, it comes back to Baia Mare and has two specializations: mining and metallurgy, with Romanian
teaching language. In 1937, Baia Mare mining school achieve the qualification of school for technical mining and chemical - metallurgical conductors. In troubled years between 1940 and 1945 Baia Mare mining school find refuge in Brad.

In 1945 in Baia Mare appears technical mining school which keep the same status up to 1948, in 1949 it moves in Brad achieving the degree „Institut de Inginieri” (Engineering high school). In 1948 by Romanian education reform, it was transformed in 5 years mining engineering institute.

In 1969 was set up Technical Institute of Engineers Baia Mare, under the patronage of Polytechnic Institute of Cluj Napoca.

The 1st of October 1974, it was set up the Higher Education Institute, with two faculties: Faculty of Pedagogical Education and Faculty of Technical Education. The technical domain is structured in various specializations: Mining, Technological Electromechanical Mining, Nonferrous Metallurgy and Civil constructions, training technical engineers, day and evening classes.

The 1st of October 1984, Higher Education Institute from Baia Mare go back under the patronage of Polytechnic Institute of Cluj Napoca with the name Technical Engineering Institute.

Starting with 1990, Technical Engineering Institute came back to the old denomination of Higher Education Institute of Baia Mare, which by Government Decision it is transformed in Baia mare University. This one become, in 1996, North University of Baia Mare and in its frame functions Mining Faculty (1990-1996), then the denomination changes back to Mining and Metallurgy Faculty (1996-2001), and later Mineral Resources and Environment Faculty (2002-2014).

In 2012, after the fusion with Cluj Napoca Technical University, North University become North University Centre of Baia Mare and in 2014, Mining Engineering specialization, by reorganization, belong to Engineering Faculty, Department of Mineral Resources Engineering, Materials and Environment.

Other mining schools in Romania. In 1835, it was set up in Săcărâmb, the first School (Middle Mining School) with mining specialization in Transilvania and South-East Europe with German teaching Language, up to 1881, subsequent, in Hungarian teaching language up to 1906. In 1862 this one is transformed in Technical Engineers Institute with foreign teachers.

In 1864, by the decision of Alexandru Ioan Cuza, it was set up Superior School of Bridges, Roads, Mine and Architecture and then, in 1920, by a Decision of Ferdinand the king of Romania, it was set up Polytechnic Schools in București and Timișoara, each with one Faculty of Mining and Metallurgy.
After the 1948 reform, in București was set up Mining Institute and in Petroșani, Coal Institute. Both concentrate after 1957 in Petroșani Mining Institute.

In conclusion (in 2017), along 153 years, we speak about Mining Education in Baia Mare (with interruptions between 1940 – 1945 and 1949 - 1969), 70 years in Săcărâmb, 93 years in București (1864 – 1957) and 69 years in Petroșani (starting in 1948).

6. Conclusions
Exploitation mining activities shall be carried out at different scales: small production capacities in which are involved small groups of people or even individuals, activities called generically "artisanal mining" up to enormous production capacities, millions and tens of millions of tons per year, carried out by large companies which allocate considerable resources, making investments of the order of billions of dollars in a single mining perimeter.

Mineral resources belong to the state and, consequently, regardless of the scale of the works, it is required a technical documentation and a legal framework for the activity pursuit. For artisanal mining Romania has no rules to encourage the small entrepreneurs to legalize their activity which generates numerous illegal activities from which, both the state and the developer are losing.

The establishment of a legal and responsible framework for the mining at any level implies the existence on the labor market of specialists trained in technical or higher schools. Those formed in technical schools will activate at the level of execution regardless the production capacity and the graduates of higher schools will involve at the level of execution in medium and large activities, up to design and research. The technical documentation to obtain the exploitation processing and recovery permit, regardless the scale of the works, presupposes the involvement of a specialist mining engineer.

In recent years, medium and vocational mining school has completely disappeared and the superior school, represented in Petroșani and Baia Mare, crossed periods particularly heavy, experiencing the lack of candidates and difficulties about work places for graduates, depriving a country with a remarkable mining potential, of the most valuable resource, the human. The number of graduates of the two schools was small and the request for mining engineers has occurred in regions distant from the university centers.

The need for mining engineers appears mainly in open pits operating by perforation and blasting. Non-availability of them has made that work performed by other specialties engineers or companies from abroad. The results of this condition of things are reflected in the technical state of mining activities and resulted mining products: bad geometry of mining perimeters, incorrect blasting with important percentages of large blocks, loads of explosive not blasted after shooting (extremely dangerous items), units not complying with quality characteristics on mechanic resistances, geometry

Figure 4. Middle Mining School (in German language teaching) 1835 – Săcărâmb [4]
and particle size distribution imposed by Quality Technical Normative for roads, bridges, railways, civil and industrial construction works, rehabilitations and construction of wastes deposits, etc.

Our documentary and research intention has the purpose to argue the need for continuation and development of mining school in Romania, to sensitizing and warn concerning the risk of losing the tradition and skills required by the training of mining industry specialists. If, for superior school there is a chance for continuity and development, vocational and technical school has lost - for the moment - perspective. All this is happening while in the neighboring countries and all over the world mining school develops at all levels.

References
[1] Fodor D 2005 Mining history pages, Publishing House INFOMIN, Deva
[2] Fodor D 2015 Mining and Environment, Publishing House Corvin, Deva
[3] Bud I, Duma S, Pașca I, Gusat D and Bud A 2016 The collapse of mining industry in Romania in the period of development opportunities through coherent strategies, Scientific Bulletin Series D: Mining, Mineral Processing XXX(1) 7-8
[4] Bud I, Duma S, Pașca I, Gusat D and Bud A 2015 150 years retrospective of mining education in Baia Mare, Scientific Bulletin Series D: Mining, Mineral Processing, Non-Ferrous Metallurgy, Geology & Environmental Engineering XXIX(1) 7-12
[5] ***www.namr.ro
[6] Bud I, Pașca I, Duma S and Gusat D 2016 Paradigms of Copper exploitation and capitalization in Romania, Mining Revue/Revista Minelor XXII(1) 13-15
[7] ***www.cuprum.ro