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Geographical View of Mineral Resources: The Case Northeastern Montenegro

Goran Rajović (Corresponding author)
Street Vojvode Stepe 252, Belgrade, Serbia
Jelisavka Bulatović
College of Textile Design, Technology and Management, Street Starine Novaka 20, Belgrade, Serbia

Abstract

Abstract: This paper examines the geographical view of the mineral resources of north-eastern Montenegro. Greatest economic significance is area ore occurrences, then metal ores and non-metals. The diversity and complementarily of mineral resources is a basic characteristic of the considered geographic space, which is of special importance to its future development. Contemporary and future use of mineral resources for commercial purposes requires a new approach that needs to be consistent with the concept of sustainable development.
Key words: Northeastern-Montenegro, mineral resources, ore occurrences, metal ores, non-metal ores, sustainable development.

Introduction

Exploitation of mineral resources in the northeastern part of Montenegro is very old. The oldest dated works are dependable medieval, so some regions have names from the period of the activity. Konjuhe village where there are old slag dumps (Srebrenica), named after the old Slavic name (Srebrnica), which leads us to

believe that in this region was mine (Lutovac, 1973).

According Boričić, Lutovac and Petrić (Boričić et al.,1967), coal are begun Budimlja Austrians exploited even in 1917 year. Between the First and Second World War is the only urban poor used for heating small amounts of coal to water is discovered on the banks of Lima. During World War II Italian Army for their needs carried out in coal Petnjik.

After the Second World War were carried out partial geological survey in the northeastern part of Montenegro (Bešić, 1959), and in the course of geologic mapping are registered and some new phenomena of mineral resources (Bešić, 1980). The mineral resources in limited geographic space can be divided into the following groups:

1. Ore occurrences associated with sediments lake of the upper Oligocene and lower Miocene,
2. Phenomena related to the metal and the Lower Triassic Paleozoic sediments and volcanic rocks-sedimentary formations of the Middle Triassic and
3. Non-metallic mineral resources associated with sediments of the Triassic, Cretaceous, Eugene and Quaternary.

Methodology

This research aims to meet the professional and the general public with the mineral resources of northeastern Montenegro, in the geographical context of their exploitation and use. The core of the methodological procedure used in this study makes geographic (spatial) method and included the north-eastern region of Montenegro. Comparative method allowed us to mineral resources of northeastern Montenegro look at the level of municipalities Berane, Andrijevica and Plav. Permeated through the entire text of the method and integrity, thanks to which we are able to recognize, define and emphasize the importance of mineral resources for the economic development of the north-eastern Montenegro.

The scientific explanation of terms, we applied two methods are used: analytic and synthetic. Analytical methods are considered some of the dimensions of the research topic, a synthetic whole, the interconnections between the case and suggested measures that derive there from.

Results and Discussion

Ore occurrences

The sediments of the upper Oligocene and lower Miocene in Berane and basin Polica there are deposits of lignite-brown coal. Berane basin is represented by gravel, sand, clay and marl. Developed three coal seams are the main coal, the first and second foot wall, foot wall. The main coal seam thickness ranges from 1-10 m, locally to separating, which means that the thickness inlays consisting of marls, ranging up to 1 m. Tertiary main coal seam are carbonaceous and sandy clay. The thickness of the first coal seam varies from 1.2 m to 3.8 m, and was developed in the district Petnjik - Dapsića. Tertiary other foot wall carbon layer is gray and gray-green clay, and the thickness ranges from 2.0 m to 4.5 m. Thus, coal Berane coal basin type is lignite-brown coal (Nikolić and Dimitrijević, 1990). Basin Polica is represented by sandstones, sands, sandy clays, clays and marls, and it was concluded six coal seams. Their number and distribution in different parts of the basin is variable. The carbon layers are often separating, and their thickness ranges from 0.2 m to 7.2 m. Coal Basin shelf also is among the lignite-brown coal. Based on petro graphic and chemical composition and macroscopic properties, coal Berane - basin Polica is largely built of detritus - Textile. The mean content of the petro graphic components of coal provides 86.6% detritus - Textile, detritus 3% - 10.3% gel and textiles - the gel. From the data of technical analysis can be seen that coal contains 16% - 20% moisture, 10 %- 17% ash, and 2% sulfur, 45%-50% of coke, about 30% fish-s, about 35% of volatile and over 52% of combustible substances. In addition, the effect of thermal coal amounts to 16.700 KJ (GTE), and 13.400 KJ (DTE) (Nikolić and Dimitrijević,

1990).

Total reserves of coal in Berane-basin are Polica 176.231.197tons. It is widespread in all parts of Berane lowland (Budimlja, Petnjik, Zagorje, Polica, Beran Selo, and Dolac). Excavation of coal in this basin started in the sixties in the district "Budimlja" and was completed in the late seventies, when I started building a new mine investment district "Petnjik" that began production in 1981 in the eponymous pit, where and today is exploitation of coal. Production of coal ranged from 10.000 in 1960 to 107.000 tones in 1989. In the same period, coal production has increased from 276.000 to 2.159 million tons, or at a rate 8.25% (**www.mans.co.me**).

Brown Coal Mine "Ivangrad" not escaped the fate of the collapse of the economic giants in our country. At the beginning of the nineties was sinking more and more in an uncertain economic future. In 2004 found to be insolvent. On the ninth bid for 1.51 million Euros, the Greek company "Balkan energy" purchased the mine in 2008, and received its exploitation concession for 20 years, with the obligation to build a thermo-block of 110 megawatts over the next four years, invest another 120 million (**www.mans.co.me**). However, the extraction and processing of coal are still waiting, and mining for now is only considered a potential resource periodically.

Program Development in Berane coal basin (lignite and brown coal ≈ 180 million), would cause the intense regrouping and integration of industrial enterprises in this part of north-eastern Montenegro, which could cause the need for capacity expansion (Beran Selo, Dolac). Communication between them is relatively inexpensive and applicable to the road network, which mainly goes trough the river Lim. The roads are second and third rows and are oriented in three directions and the direction north to Bijelo Polje, east to the south to in Rožaje and Andrijevica. Through these routes was connectivity with other parts of Montenegro, and Serbia. The nearest railway station on the Belgrade-Bar, located in Bijelo Polje, at a distance about 35 km from the mine (Petrović et al., 2011).

If we add to all this in Berane basins, there are immense reserves of marl. Marl especially is on the right side of Lima, mostly on the shelf, Jasikovac, but in the hamlet Đurake. These marls same qualities match the requirements of the cement industry. According Lutovac (1957) only on Jasikovac reserves could be provided for the production of two hundred years should be annually produced 80.000 tons of cement (Rajović, 2005).

Occurrence of metal

In the considered geographic space are detected and the appearance and bearing the following metals: lead, zinc, copper, iron and pyrite. They occur in sedimentary and volcanic rocks: Paleozoic, Lower and Middle Triassic. Occurrence of lead and zinc were discovered east of Konjuhe on the right side of the river Perućica stand on the site (see map 1). Demonstrate an area of about 2 km. They occur in the Permian sediments, Lower and Middle Triassic. Mineralization occurs in the form of wires and impregnation, and their thickness ranges from 0.2 m to 1.0 m. The content of zinc in the wires is very variable, in some trials reaches 5%, while the middle is 0.3%, while the content of lead is far smaller and does not exceed 0.1%. Besides lead and zinc in Konjusi occurs and copper, whose average content is about 0.15%. Association Konjusi minerals are: pyrite, sphalerite, chalcopyrite, galena and others. The mineralization is genetically related to diorite and quartz diorite, and was created at higher temperatures and lower levels (Group of author, 1982).

On the right side of the river Lima in the area between the axes Kostreš and Omarska and head were discovered also the appearance of lead and zinc. They occur in quartz-keratophyre, tuffs, volcanic breccias and limestones. Mineralization is manifested in the form of wires. The content of lead and zinc ore FACING pieces ranging up to 6% of lead and zinc. In this area of land in some trials of zinc content ranges up to 1.1%, and lead to 0.8%. Mineral association of the hatchet is: pyrite, sphalerite, galena and chalcopyrite. On the eastern slopes

of the wider area of Bjelasica in Zabrđe and Šestaverca and wire thickness not exceeding 1 m and the provision is rarely followed for longer than 20 m. The content of zinc in the ore wired King's Brook is 2.5% or 3%, in Border Creek to 0.5% in Vaćevinama to 0.2%. Occurrence of copper was found in the creek beside Konjuh stand. They occur with lead-zinc mineralization. Copper content of this locality ranges from 0.1% to 0.2% (Group of author, 1982).

Occurrence of iron was discovered in the mountains Bjelasica in a number of localities: Kurikuće, Lubnice, Zekova Glava, Crna Glava, Strmi Pad, Konjusi (site of Klina). Occurrence of iron in Bjelasica occurs in the form of hematite, which is to say that the hematite occurs along the plate with red charts, which lie over keratophyre and below the slope of layered limestone. Iron content in these localities ranges from 17% - 33%. In the Clinical Konjuh iron ore presented hematite, and manifests as a contact lens on the volcanic rocks and limestone. Occurrence of pyrite was found in a number of localities on the mountain Bjelasica: Zekova Glava, Kurikuće, Lubnica, Crni Vrh. Pyrite occurs in the form of wires in the form of impregnation, as well as volcanic-sedimentary rock formation. Wire pyrite in the Paleozoic sediments ranges from 0.1 to 1 m (Group of author, 1982).

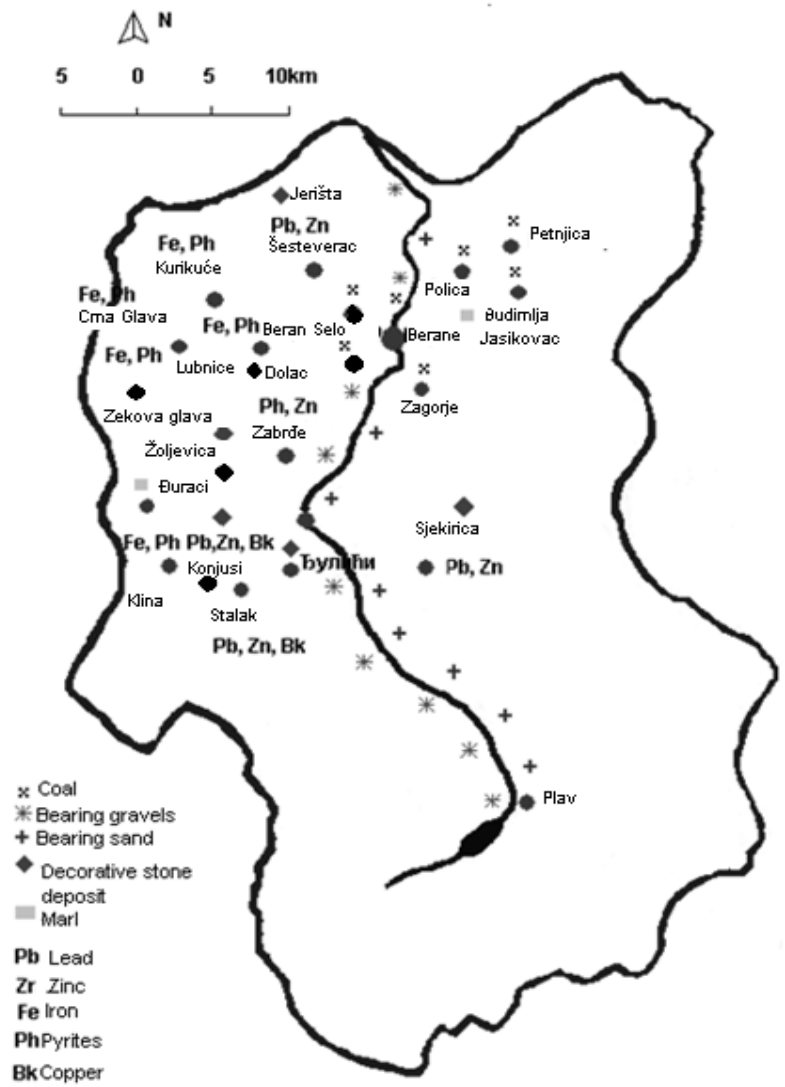
Occurrence of none

From nonmetallic mineral resources on the observed geographic, there are deposits of building materials: gravel, sand and decorative stones. Numerous deposits of gravel and sand are found in the bed of the river Lima (Plav, Andrijevica, and Berane). Only in Bandović Most, the amount of gravel and sand, available for an annual extraction is estimated at approximately 100-120.000 m^3. In the northeastern part of Montenegro there are limestone quarries in the Triassic. There is a certain amount of building stone, which can be exploited locally, but the conditions are unfavorable for continuing exploitation. When it comes to the exploitation and processing of marble and ornamental stone, it

should be noted that there are multiple sites of different architectural building stone and marble, the most significant: the site Trebačka river, Seoce, Piševska River, Babov Potok, Pčelinjak, Žoljevica.

Outcrops of volcanic rocks in the upper reaches of the river Trebačka appear on the left and right, from an altitude of about 850 m, while only the riverbed is covered with blocks of the same rocks. For natural cane, the rock is pale green, and the fresh green and gray-green layout. On the surface are also observed cracks some of which are open and wide and ten centimeters fall allow larger blocks rocks. In the cutting path that leads from the hamlet Gunjaje, Steppe to summer pasture at an altitude of 1.170 m to 1.185 were discovered brecciate limestone's. According to the geologic map of Montenegro 1:10.000, these rocks are represented and northwest of the hamlet Gunjaje. At about twenty meters in a south east direction, there is a slit in which the traces of mine holes, which means that the stone used probably as a quarry for the construction of residential buildings (www.andrijevica.me).

Outlet Piševskoj rocks in the river are an integral part of the volcanogenic massive axes, which covers an area about 25 km². From rock to been discharged and are represented by andesitic keratophyre, volcanic breccias and tuffs, with mutual crossings. The presence of andesitic is most pronounced on the western slopes Piševa and in the middle and lower reaches of the river Piševske. These rocks are particularly revealed in the notches of the forest road that goes along with Piševsku River with herright hand. The rocks are gray-green to blue-green color. Scorn resulting changes of carbonate rocks, mainly Lower Triassic bio-turbine formation, build terrain in high stream flows Bradevec, and Babov and Malinovac. The rocks are best discovered in the bed of the stream Babovog, which occur at an altitude of 1.170 m to 1.600 m. Scorn, are very compact and sail rock, usually striped texture. Their color is mostly gray and grayish-green, are being observed and one yellow-green and jonquil, which of course depends on the mineral composition. Brecciate limestone and dolomite limestone were discovered on the ridge



Map 1 Mineral resource in Northeastern Montenegro

of the bee, at an altitude of 1,150 m to 1,450 m, followed by delivery to the west, southwest and nameless streams, gullies actually. At the ridge, the terrain is covered and covered, so that the boundary between the reddish limestone and gray crystalline limestone, which are below them, masked and unclear

(www.andrijevica.me).

Žoljevica on the hill is the cradle of architectural - building stone. This deposit build medium - gray and white Triassic massive limestone mesmerist. Mesmerist white limestone on the surface, covering an area of about 3.000 m², and its thickness is about 30 m, while mesmerist gray limestone, covers an area of 30.000 m² and has a thickness of about 50 m. Resource estimates of gray marble B + C1 category, amount to 2.223 million m³. Reserves gray-white marble and white marble belong to the C1 category and amount to about 60,000 m³. Decorative stones of this deposit is very decorative, perfectly polished, and attains a high sheen. Due to their physical - mechanical properties of rock 'Žoljevice "can be used to produce plates for covering horizontal and vertical surfaces, objects in the construction industry (www.andrijevica.me).

Geological studies performed during the 1955 and 1963, defined the following characteristics of stone: the size and shape of the bearing, physical and mechanical properties of white and gray varieties, so that the cutting test, the white variety have broken down completely, while the gray variety, obtained plates of excellent quality and a beautiful shine . Based on the above data it can be said that the bay "Žoljevica" fully defined in terms of quantity and quality. However, it is not marble survey received sufficient attention, despite the fact that the site be considered after the Arandjelovac and Prilep, can be considered as one of the most significant in the former Yugoslavia (Lutovac, 1973). Wonderful marble with "Žoljevice" we should "valorize" the art-tourism event, "Marble and Sounds." Far lead us to emphasize, what are the riches and what possibilities the marbles and marble breccias, provided the northeastern part of Montenegro, for its economic development.

There are various estimates of mineral reserves in the northeastern part of Montenegro. However, research that is smaller or greater intensity exercise, lead to the discovery of new ore deposits, and are not prone to such estimates. However, we believe that mining in limited geographic space, given the presence of mineral resources, i.e. their diversity and reserves, only part used the opportunities that it

provides the raw material base.

Instead of a Conclusion

The phrase sustainable development in professional terminology introduced by the Brundtland report "Our Common Future" in 1987. Sustainable development is defined as a coordinated system of technological, economic and social measures in the overall development in which the principles of cost-effectiveness and reasonableness of the use of natural and created value in order to preserve and enhance the quality of the environment (Tucović and Staletović, 2008).

The overall sustainable development of the northeastern part of Montenegro is the basis can be seen through the three basic parameters which are necessarily and appropriately be combined:

Which is a set of social activities that bring to life the social fabric of the considered periodically? This, especially, the social importance, finally, affects the economic effects that are achieved in the use of mineral resources,

Ecology, which necessarily includes the activities of mineral resources while causing minimal damage to the environment (flora, fauna, water, soil, pollution) and benefits the environment in the best possible way, through the protection and preservation of natural resources and natural heritage,

Economics, which includes activities that contribute to the continued economic well-being of local communities, employees, citizens.... (**www.centar-jls.com)**.

Mineral resources are here, above all, be seen as a huge driving force behind economic growth, especially undeveloped area, which was passed and considered, it leads, which is of special importance to the creation of new jobs and to increase income.

The question is: How does the use of mineral resources potential of the considered geographic space, to be environmentally friendly, long-term sustainable, and that all in some way to intensify the social and ecological-economic life? Of course, no

matter how the mineral resources of the northeastern part of Montenegro were great, they are not unlimited and inexhaustible. Therefore, their use must be planned and rational.

It can be said that almost all projects related to the use of mineral resources, regularly causing increased negative anthropogenic impact on the environment and the environment. It is therefore necessary to determine the mineral potential of the considered resources space, which is a prerequisite for the rational use of natural environment and its protection (Rakićević, 1986). Thus confirm clearly formulated position Vasović and Biočanina (2007) "The present generation needs to plan and create a self adequate quality of the environment, but this right shall retain the next generation. In accordance with the concept of sustainable development it is expected that work culture is based on humane principles of ecological and ecumenical social efficiency. Environmental Movements in our society is justified by a compelling necessity, but also an obligation".

Numerous development and environmental issues need to be imposed as soon as possible approaches to concrete actions for the sustainable management of mineral resources. In the field of environmental protection is necessary to implement the Strategy for the sustainable development of mineral resources with special emphasis on its environmental component.

Sustainable Development Strategy, whose acronym reads a SARM (aggregates Sustainable resource management - Sustainable management of mineral resources), deals with themes of safe, sustainable and uninterrupted supply of mineral resources. Ensuring reliable and uninterrupted access to mineral resources is becoming increasingly important factor in European competition, and the release of European Commission (The raw materials Initiative - Meeting our critical needs for growth and jobs ("Management of raw materials - meeting our needs for growth and creating jobs"), defined three policies in this area: unrestricted access to mineral resources, the sustainable supply of mineral resources and increase efficiency and promote recycling (www.kfbih.com).

SARM project at the local level based on the following activities: to optimize the

efficiency of production of primary raw materials, prevent or minimize the environmental impact of operation, minimize the number of illegal quarries, promote recycling (waste from construction and demolition) and increase the capacity stakeholders. At the regional level, SARM is based on: the assessment of quantity of mineral raw materials and transport links, developing strategies for sustainable management of mineral resources, as well as protected areas, also taking into account the balance of minerals in the definition of land use planning and land management, course guidelines developed and procedures for planning the sustainable supply of mineral resources (www.kfbih.com).

Threats to the environment and its reproductive capacity are only one, but not the only example that points to the dangerous pitfalls meanderings and short of previous techno-economic development. Therefore a new approach to development must be based on the perception of science and technology dominant in the new environmental Instead of the techno-economic paradigm.

To the northeastern part of the economy of Montenegro in the future faster to develop and potentially opportunities for its development were used, including adequate and uninterrupted supply of mineral resources, it is necessary to carry out a number of changes, ranging from social treatment, to specific measures of overall economic policy. Among the many changes in this direction should be made, the environment seems to us as a priority and a necessary condition for all subsequent efforts have given full effect.

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