

# Mineral Resources Metallogenic Zone Borovica-Vares-Cevljanovici (Bih)

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**ABSTRACT:** Metallogenic zone Borovica-Vareš-Čevljanovici is built of Triassic clastic and carbonate formations that established the presence of significant deposits of iron and complex sulphide-barite deposits. Metalliferous zone Triassic sediments Vareš area is located north of Sarajevo at a distance of about 35 km in a straight line. It stretches a distance of about 25 km and an average width of about 2.5 km. Triassic sediments cover an area approximately 70 km<sup>2</sup>, while the brighter part is about 30 km<sup>2</sup>. Systematic geological studies with shorter intervals were performed in the period from 1967 to 1989, when it was interrupted by the exploitation of the only open reservoirs Veovača. Summing up the results of research of complex sulphide-barite occurrences and deposits in the area are clearly distinguished three groups were identified: north-group deposits and occurrences (the village of Borovica), and the central group of deposits and occurrences-Veovača, Orti, Selište, Prijeljev, Droškovac, Brezik, Smreka south and south-eastern group deposits and occurrences: Barice, Brgule, Smajlova forest. Carried out systematic geological exploration works in the period 1967-1989 was executed evaluation of reserves of lead, zinc and barite deposits in Veovača, Orti, Rupice, Brestica-Juraševac, and other sites are only indicated which leaves room for further research. The environment Veovače, the localities Selište, Orti and Prijeljev obtained are indications interesting mineralization and ore, which would support future prospects in this area. The paper gives an overview of the results of research and quality of reserves of lead, zinc, barite, iron, chromium, manganese metallogenic zone Juniper-Vares-Čevljanovici. Displayed are the geological, mineralogical and chemical characteristics of these data explains the genesis of individual deposits. Previous geological, geochemical, geophysical and exploration drilling and underground mining works were found interesting mineralization and mineralization, indicating the perspective of this area.

**Keywords:** prospecting, lead, zinc, barite, iron, chromium, manganese, Vares, exploration, reserves, quality, genesis.

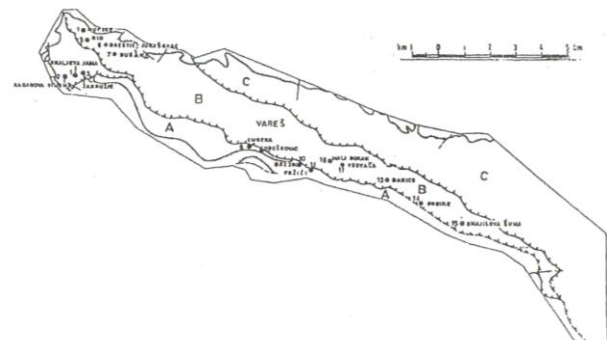
## 1. INTRODUCTION

Area Vareš was built mainly of rocks of Triassic and Jurassic age and is subject of Paleozoic and Quaternary sediments. Since the mineralogical and ore occurrences are in the zone of Triassic sediments geological studies have been devoted to them. Geologic, geochemical, geophysical and laboratory testing and research and exploration drilling and underground mining works were found about 30 ore and mineral occurrences. Of all the so far determined circumstances one has been explored to the level of deposits with calculated mineral reserves and open. Two phenomena are explored in part to the level of deposits with calculated ore reserves but are still in the research phase, and other phenomena at the level of research can be found at the level of ore and mineral occurrences. In the Vares certain mineral resources by 1992 are technical and economic valuation of early global commitment to the exploitation of mineral resources. By 1992 they had developed a variety of industries, among which the most important were mining and metallurgy. Metallic mineral deposits exploited in the mine iron ore and Vares of lead, zinc and barite Veovača. From mineral resources are significant reserves of iron ore deposits Smreka, Droškovac and Brezik. Surface mine deposits of iron ore and Smreka pit Droškovac are flooded and their practical exploitation technically unfeasible. Non-ferrous ore with economically significant contents of lead, zinc and silver and lower concentrations of mercury, copper, arsenic and antimony are found in three specific areas.

## 2. OCCURRENCES AND DEPOSITS WITH SIGNIFICANT CONCENTRATIONS

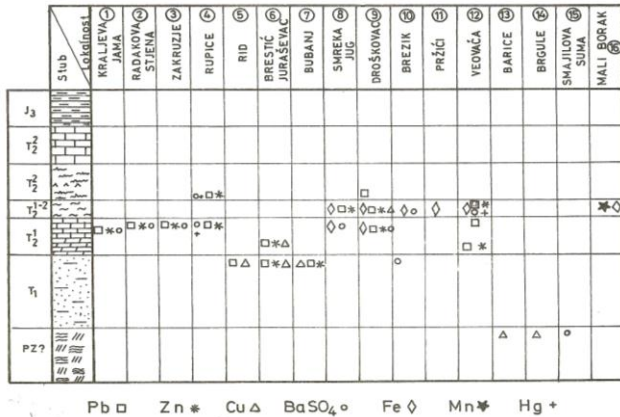
Identified ore occurrences of complex sulphide ores with barite or without divided into three narrower space. The western part of the village around Juniper with occurrences in localities Drum, Juraševac, Brestica, Reed, Rupice, Zavrsje, to wide, entire, Radakova rocks, King's Cave, Sutjeska, cross-Zakrižje and Red Rock. The central group of deposits and occurrences

are deposits of iron ore with concentrations of complex sulphides of lead, zinc and barite. These are spruce, Droškovac, Brezik, then less known Mali Borak and overflow and well researched Veovača, Orti and Selište. At the site Mekuše sulphides are ascertained exploration drilling. Below this site stretches and brecciated ore from the site Orti, this is why this area is considered one of the most promising. Ore concentration in the eastern part of the least explored. Occurrences of sulphide-ferrous metal or barite were found on sites: Barice, Grubanović, Brgule, Gasovac, Ljevački stream, Smajlova forests and some far less significant. The concepts of complex sulphide mineralization in the area of Triassic sediments areas Vareš, one can point out the basic abioc types: 1<sup>st</sup> Complex breccias with barite and sulphides non-ferrous metals, 2<sup>nd</sup> Complex sulphide ore with low content of barite or without him, 3<sup>rd</sup> Complex sulfide ores non-ferrous metals, with iron ore and 4<sup>th</sup> barite ore with low content of non-ferrous metals or without them. Results of surveys carried out have enabled the extraction of more ore sites which are shown in Fig 1. Exploration carried valorized the ore reserves at some phenomena which are translated into reservoirs such as Veovača, Orti, Rupice and Selište. Only in dressing are proven reserves investigations.



**Fig1.** Map of distribution of mineral resources in the zone of Triassic sediments areas Vareš (Veljkovic, 1989).

In all deposits and occurrences are determined syngenetic and epigenetic mineralization types with predominant syngenetic why the methodology drilling consisted in performing vertical exploration wells to determine Anisian and Ladinian in them. The wells in the area Borovice terminated in Ladinian cherts in the area Veovače in lower Triassic clastics or Anisian-Ladinian alevrolytes, sandstones and shale's. Exploration carried out has proven to be syngenetic ore body mineralized breccia after the fall of extending up to 2000 meters in length (Veovača, Rupice) and the continuity of epigenetic ore bodies rather uncertain due to the low level of exploration. On the whole the level of exploration and developments in metallogeny zone is quite low except Veovače and Rupice [5].



**Fig.2.** Ore deposits and mineralizations in zone of the Triassic sediments.

**2.1 VEOVAČA DEPOSIT**

The deposit is located in the middle Triassic sediments Vareš area and is located about 3.5 km east of Vareš in a straight line. Occurrences zone reservoirs located sea level height between 1020-1090 m. This tray pit works investigated on two levels. Exploration wells per network 30 x30. These explorations western part of the reservoir with a length of about 350 m is fully defined. When opening the bearing ores has already been removed to the level of 1035 m. Barite mineralization and sulphide lead and zinc in the area Veovača were observed and from senior researchers and usually treated as a concentration in dolomite Jeremic [1]. Heterogeneous breccia which is disposed barite with sulphides of lead, zinc, copper, antimony and mercury were first observed and isolated during regional geological research in the period 1967-1972, and are shown in the works of D. Veljkovic [8,9,10,11,12]. These breccias are preserved in one hectometer overturned syncline, which is in the upper part tight around 50m. Breccias are of sedimentary origin, in places, turbiditskih characteristics and heterogeneous. Are constructed of pieces, uneven sized, sandstone, dolomite, limestone, dark and black quartz sericite shale, metamorphosed sandstone, and seldom lydite and tuff. Age some of the materials, which became part of breccia, the most convenient materials Lower Triassic and partly Middle Triassic. In some pieces were found and the remains of the lower Triassic fauna. Black quartz-sericite shales and sandstones metamorphosed clearly differ from formations of Triassic age and probably belong to the older formations. In the zone of Triassic formations, east of Veovače move Mekuše-Grubanović-Brgule separated the narrow belt of metamorphic, conditionally as Paleozoic. The fragment of breccia its compo-

sition and metamorphism most similar to them. The presence lydite in metamorphites and their lack in Triassic sediments would go in favor of this setting. From the above it can be concluded that the breccias certainly younger than Verf and lower Anisian. In the eastern part of the breccia deposits lie above hematite shales in which the analyzed layers of barite. Since breccias lie above the yellowish limestone in which it was discovered fauna Anisian age, leads to the conclusion that the breccia belonging to the highest part of Anisian or lowest part of the Ladinian. This status of these specific sediments in column Triassic formations suggests that their formation was not possible to bind to the volcanic activity and the Middle Triassic tectonic processes that are caused by volcanism. Binder in heterogeneous breccias is clay with carbonate or sulphides admixture and barite with sulphides of lead, zinc, copper, mercury, antimony and iron. Barite builds layered and lenticular concentration of crystalline to micro-crystalline composition. Sulphides behave similarly and generally follow the barite concentration. Coarse aggregates suggest that in some parts of the breccia and hydrothermal conditions existed somewhat higher temperature cycle. Most likely in those parts of the breccia which were closer to the source of mineralized solutions. Based on knowledge of the mineralogical composition of the reservoir and the representation of individual species or groups of minerals are as many types of ore, of which the representation according to the importance of the two most significant reservoirs:

- breccia with barite, sphalerite, pyrite and markasitom and
- dark barite with sphalerite and galena rarely marcastie. In the first phase of the study it was found that prospecting is the most abundant mineral barite. He appears as a dark gray or white crystalline and microcrystalline the Geode, wires or lenses.



**Fig 3.** Galena, sphalerite and barite deposits from Veovača, Vareš (BiH).

**2.1.1 THE GENESIS OF DEPOSITS**

Based on current research and knowledge prospecting Veovača, it was found that it is a mineral association of low temperature cycle of creation. Removal of sandy barite, barite or sandstone cemented with black siltstones, as noted in several places in the reservoir, indicating a sedimentary origin. The formation of deposits is probably related to the submarine volcanic activity Middle Triassic, when the conditions exist for the formation and other deposits in the Triassic complex (as de-

posits of iron and manganese). One should bear in mind that sulphation formed under reducing geochemical conditions, which are probably ruled in the deeper parts of the sedimentary basin. During the investigation it was determined that the tray is formed in several stages.

- The first stage is the formation of deposits and breccias in sedimentary conditions. For this phase are related to the first two types of ore, which have the greatest significance for the tray.
- In the second phase, there was a recrystallization ore substance in some parts of the reservoir and to the formation of aggregates coarse grain. At Cementation process was performed and partial depigmentation of barite, which is partially tainted.
- The third and final phase of forming the hydrothermal reservoir, telethermal level, in which they are, incurred some wire types of mineral associations, such as quartz, anti-monite and bulangerite and associations calcite realgar. The influence of hydrothermal solution is somewhat more pronounced in the zone of dolomite, east of the reservoir, where they established wire calcite with barite, hydrothermal quartz, and in some places and fluorite.

## 2.2 QUALITY AND RESERVES

Alongside research activities were carried out trials of investigative work to determine the quality of metalliferous zones. Trench was performed using grooves, continuously throughout the length of all research works. Identified balance reserves in the deposit Veovača amounts 2. 970 000 t contents Pb 0,88 %, Zn 1,91 % and BaSO<sub>4</sub> 18,70 % The established reserves at the deposit Veovača next Pb, Zn i BaSO<sub>4</sub> ore contains other elements: Ag-65 g/t; Au-0,30 g/t; Cu-0,07%; Sb-0,09% i Hg-0,02% (table. 1).

Mineral deposit	CATEGORY RESERVES	QUANTITY (t)	Pb (%)	Zn (%)	BaSO <sub>4</sub> (%)	Hg (%)	Ag (g/t)
VEOVAČA	A+B+C <sub>1</sub>	2.970.000	0,88	1,91	18,70	0,02	65
ORTI	A+B+C <sub>1</sub>	500.000	1,20	1,87	25,53	0,02	67
SELIŠTE	A+B+C <sub>1</sub>	1.500.000	3,20	0,60	-	-	10
Total	A+B+C <sub>1</sub>	4.970.000	1,61	1,51	19,68	0,02	49

The environment Veovače, the localities Selište, Orti and overflow obtained indications interesting mineralization and ore, which would support future prospects of the region, where more intensive research has only just begun. Mineralization which was established in the locality of Orti is completely similar to the mineralization in the deposit Veovača. In the locality of Prijeljev and Selište, also close Veovače, mineralization is related to dolomite and dolomite limestone. The appearance of the wire type. Numerous data obtained during geological research indicates that the tray Veovača can fully defined, but other phenomena should be intense and fully explore.

## 2. ORTI DEPOSIT

It is located about 300 km north of Veovača. In geological terms the rest of the bottom one hectometer syncline which is somewhat preserved to the east. In many elements of ore

concentrations are similar to concentrations in the reservoir Veovača. The difference is in the dominance of fine-grained breccia and aleurolitic psammite creations that differentiate fine-grained breccia with barite and sulphides Pb and Zn. Less represented minerals Cu, Sb and Hg. Identified balance reserves at the site Orti amounts 470. 000 t, Pb-1,20, Zn-1,87 i BaSO<sub>4</sub> 25,53 %, Hg 0,02% i Ag 67 g/t. At the site Selištu balance reserves are 1.500 000 t, Pb-3,20 % i Zn-0,60 i Ag 10g/t (table 1).

## 3. RUPICE DEPOSIT

Tray complex ore barite with sulphides of zinc lead located northeast of the village of Juniper located about 1 km. From Vareš is located west at a distance of about 18 km. The remains of old mining operations and various archival data indicate that the bearing holes explored and exploited during the Roman and medieval Sasa. Exploration works were conducted in the period from 1878 to 1941 by the Austro-Hungarian, as evidenced by written documentation preserved. Systematically and in a continuously investigated in the periods from 1967 to 1969 and 1979 to 1982 is realized Geoinžinering Sarajevo, Geoinstitut Ilidza The works were found the following reserves: B+C<sub>1</sub> +C<sub>2</sub> -957.767 t ore with content Pb-2,36 %, Zn-3,18 %, BaSO<sub>4</sub>-37, 76 %, te Hg 0,03 % i Ag 76 g/t.

(Table 2).

Mineral Deposit	CATEGORY RESERVES	QUANTITY (t)	Pb (%)	Zn (%)	BaSO <sub>4</sub> (%)	Hg (%)	Ag g/t
BOROVICA	B+C <sub>1</sub> +C <sub>2</sub>	957.767	2,36	3,18	37,76	0,03	76
DROŠKOVAC	Oligonite-siderite A+C <sub>1</sub>	753.600	3,01	1,01	4,02		
	Pyrite	134.300	2,38	1,15	3,54		

Investigated the terrain is built from lower Triassic, middle tertiary and Jurassic sediments. The oldest sediments in the vicinity of the village of Lower Triassic sandstones Borovice are gray-green to brown, then sandy marl, limestone and slate. Middle Triassic sediments are represented dolomite and dolomitic limestone gray to white gray. Middle Triassic cherts also belong with shales and sandstones and limestones tuff with cherts. Jurassic sediments are made of greenish limestone, sandstone and dark gray silification gray marl.

## 4.1 DESCRIPTION RESERVES

Mineralogical and microscopic tests on the tray holes can be extracted following types of ore bodies: Barites with sulphides. It is the most common type, and also the most economically important. Within this type of ore body can be divided into three subtypes, which differ both macroscopically, and substance Ba, Pb, Zn, Cu, which was confirmed by chemical analysis. The first subtype of the so-called. "Spotty barites" with the content of barite over 90%. Second subtype barites bodies belong thick dark gray barites with a slightly lower content of useful components, and that 20-70% of barite. Third subtype belong gray barites, dense with content up to 50%

barite. Barite occurs in the form of microcrystalline rarely in large tabular crystals.

**4.2 THE GENESIS OF DEPOSITS**

By their genetic and paragenetic characteristics of the deposit's closest Veovači with the difference that the breccia are not represented extensively, but is dominated by barite layered lens-concentration with sulphides of lead, zinc, mercury, antimony and copper. Previous field and laboratory studies were collected elements that indicate that the socket holes belong to the complex hydrothermal-sedimentary type isolated marine sedimentary area. Age deposits are probably the upper or lower Anisian Ladin age. Smaller content of barite in dolomite limestone and clastic sediments Anisian lower trijasa.ove phenomena were noted in the stratigraphic basement of iron ore in the deposit Spruce and Droškovac and slightly east to localities Mali Borak, Prijeljev and Selište. These occurrences were found at the site and Barice, Big up, Radakova rocks, full, end pit, Sutjeska, Cross and Zakrižje west of Borovice. Northeast of juniper are the most significant Juraševac, Brestica, Reed and drum.

**4. THE DEPOSIT OF IRON ORES VAREŠ-SMREKA**

In the Vares iron ore mining was carried out until 1992 at three sites: Smreka and Brezik (surface mining) and Droškovac (underground excavation). In Droškovcu exploitation initially conducted surface mining and later moved to underground mining. The footwall ore bodies in the open pit Smreka build breccia limestones of Jurassic age over which lies siderite series (siderite and sideritic limestone) that separates the series of hematite series kremencelkalka small thickness exist while overlaying make Werfenian sediments. In the pit Droškovac siderite is located in the core antklinale and on the wings of hematite. For open pit mining Brezik series of Triassic age lies unconformably on the Jurassic sediments. Overlaying ore body build limestone, marl limestone, marl and sandy shale liskunoviti Scythian age.

**Iron ore-siderite**

Table 3.

Mineral DEPOSIT	CATEGORY OF RESERVES	RESERVES(t)	QUANTITY			
			Fe	Mn	SiO <sub>2</sub>	G.Z.
Smreka	A+B+C <sub>1</sub>	95.411.000	32,97	3,22	6,45	29,55
Brezik	A+B+C <sub>1</sub>	15.799.000	33,37	2,30	6,72	26,32
Droškovac	A+B+C <sub>1</sub>	36.231.000	31,91	3,37	6,62	29,75
<b>Total</b>	<b>A+B+C<sub>1</sub></b>	<b>147.441.000</b>	<b>32,75</b>	<b>3,16</b>	<b>6,52</b>	<b>29,25</b>

**Iron ore-hematite**

Mineral DEPOSIT	CATEGORY RESERVES	RESERVES (t)	QUANTITY			
			Fe	Mn	SiO <sub>2</sub>	G.Z.
Smreka	A+B+C <sub>1</sub>	18.087.000	29,18	5,07	20,08	12,07
Brezik	A+B+C <sub>1</sub>	1.765.000	48,50	1,95	12,00	7,20
Droškovac	A+B+C <sub>1</sub>	4.357.000	35,37	4,73	17,36	9,53
<b>Total</b>	<b>A+B+C<sub>1</sub></b>	<b>24.209.000</b>	<b>31,70</b>	<b>4,78</b>	<b>19,00</b>	<b>11,26</b>

In the area of deposits of iron ore in Smreka inter stratified limestone dark gray come Pb minerals. Zn, Cu with veins and lenses of barite. The thickness of the mineralized zone ranges from 1-3 m. The distance between the end points detected by providing over 500 m. Mineralization occurs in the hanging wall of limestone. Partially zinc prevails, while it is in some cases Pb. Where prevailing barite lenses or veins, less noticed minerals zinc and lead, and more are represented copper minerals. From several levels at PK "Juniper" was sampled, for insight into the quality of the ore zones with non-ferrous metals. 12 samples were taken and we got average content of barite 40, 42-86, 15 % u 11 while the samples in a single sample, the content of 11, 17 % BaSO<sub>4</sub>. Proved reserves A+C<sub>1</sub> categories in the mine Droškovac amounts 753.600 t sa 3, 01 % Pb, i 1, 01 % Zn.

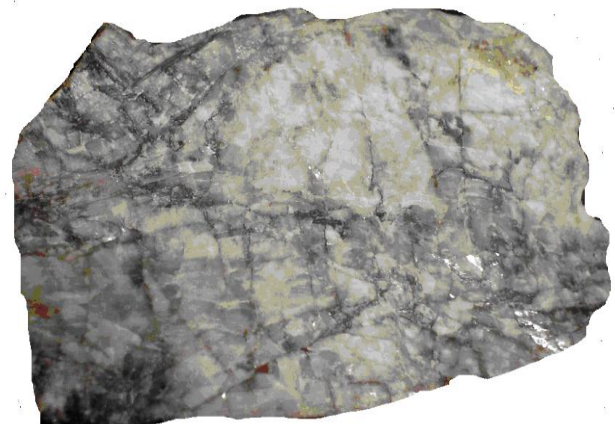


Fig 4. Barite from open pit Smreka near Vareš (BiH).

**5. THE DEPOSIT CHROMIUM IN ČEVLJANOVIĆI**

In Bosnia and Herzegovina Hronova ore is mined in the past in Duboštica near Vares where chromite layers alternating with layers of stratified lherzolites and pyroxene. Since they refer all concordant layers are differences arising from the same primary magma. Exploitation of chromium was carried out in the pits Rakovac, Soft down, Meda, Šabanluke and Borak, during the period from 1880 to 1966 when it suspended. The last mining operations with the aim of starting operation carried out in 1971year. The works were reduced to the treatment rise and hallway to a lesser extent on the development of new parts of the mine pit in Rakovac. In the Duboštica in much lesser extent Vijaka revealed 79 occurrences of chrome ore and chromite in which the organized exploitation of chromite.

## 6. THE DEPOSIT OF MANGANESE IN ČEVLJANOVIĆI

The mine in Čevljanovići is put into operation during the Austro-Hungarian occupation in 1881 and exploitation lasted until 1965. Minerals of manganese in the wider area Čevljanovići genetically related to Middle Triassic volcano-sedimentary series, as well as in other areas of Bosnia and Herzegovina (Konjic, Jablanica, Prozor, northwestern Bosnia). Manganese occurrences are caused by sediment, under the influence of the basic volcanism. Minerals manganese related to chert, whose genesis is directly related to the submarine effusion of lava. Manganese zone extends from Čevljanovići towards Olovo, Vares and Borovice. The barite-lead-zinc deposit Veovača near Vares psilomelane occurs as a secondary mineral in the company with goethite and limonite. In addition to metallic and non-metallic mineral resources areas Vares perspective because they can be used as: metallurgical raw materials (fluxes, refractory's, foundry raw materials and raw materials for petrologija), chemical and agronomic raw materials (chemical raw materials, fillers, and agricultural raw materials) and raw materials for construction, or technical construction stone, architectural building stone, cement raw materials and raw materials for binding materials [6].

## CONCLUSION

The results of research in the area of Vares suggest enormous possibilities of finding new ore reserves of lead, zinc, barite, silver, copper and others. Results of surveys carried out deposits of lead, zinc and barite in the Vares area allowed the extraction of more ore sites. Exploration carried out valuation ore deposits of lead, zinc and barite on some phenomena that are translated into reservoirs such as Veovača, Orti, Rupice and Seliste. Only in PRELJEV are proven reserves investigations Previous investigations carried out in the zone of Triassic sediments point to tremendous opportunities for finding new ore reserves especially in the Lower Triassic and Middle formations. Besides the above mentioned deposits have been registered occurrences of barite (in the Brgula Smajlovi and forest), and the occurrence of copper in Borovice and live on the site Veovača. In the wider surrounding of Vares in addition to mineral resources there are numerous non-metallic mineral resources of magmatic, sedimentary and metamorphic origin. Among the non-ore mineral raw materials are the most detailed explored spilite, amphibolites and limestone suitable as a raw material for the production of technical and building materials, architectural and decorative stone and rock wool. Of non-metallic minerals mined limestone from the quarry "rocks" for the blast furnace and construction, and quartz sand to make sure Han for the foundry. Numerous smaller or larger limestone quarries and mines mini quartz sands and sandy clay were opened for the ferrous metallurgy.

## REFERENCES

- [1] Jeremić, M. sedimentna baritna ležišta Bosne, Zavod za geološka istraživanja I ispitivanja građevinskog materijala i tla NR BiH, Geološki glasnik – 5, Sarajevo, 1961.
- [2] Kulenović, E. Contribution to the zones with non-ferrous metals in the roof of the iron mines of Vareš, Geological Bulletin no. 12, p. 285-289, Sarajevo 1968.

- [3] Kulenović, E., Operta, M., Brđanović, M. (Triassic limestones Vareš as mineral resources in various fields of industry, V-International scientific conference "non-metallic inorganic materials", Proceedings, str.113-123, Zenica 2004.
- [4] Kurtanović, R. Breakdown of exploration monomineral barite in Bosnia and Herzegovina, II International Scientific Conference "Non-metallic inorganic materials" Proceedings, pp. 75-81, Zenica 1998.
- [5] Operta, M. Olovo, cink i barit u metalogenetskoj zoni Borovica-Vareš, VI Naučno-stručni simpozij sa međunarodnim učešćem, „Metalni i nemetalni anorganski materijali“, Zbornik radova, str. 287-293, Zenica 2006.
- [6] Operta, M. Hyseni, S., Kurteshi, K., Muzaferovic, S Geological structure, potentiality And qualitative characteristics of the limestone reservoir rocks "near Vares (BH).Union of Scientist in Bulgaria. City of Plovdiv. Series C. Technics and Technologies, Vol VIII, 2010.
- [7] Ramović, M. Review of mineral deposits of zinc and lead in Bosnia and Herzegovina, Geological Bulletin no. 3, p. 5-125, Sarajevo. 1957.
- [8] Veljkovic, D. Projektni elaborate regionalnog geološkog istraživanja trijasa Borovica-Vareš-Čevljanovići-Ozren u 1971 godini, FSD Instituta za geologiju, Sarajevo 1971.
- [9] Veljkovic, D. Prilog poznavanju ležišta olovo-cinkanih ruda u zoni trijaskih sedimenata Vareš, geološki glasnik 17, 269-291, Sarajevo 1973.
- [10] Veljkovic, D. Neka zapažanja o geološkom sklopu zone trijaskih sedimenata Borovica-Vareš-Ozren, Zbornik radova, IX kongres geologa Jugoslavija, Sarajevo 1978.
- [11] Veljkovic, D. Tektonski sklop područja Vareš-Lipnica-Kamenica, Vareš, geološki glasnik 28, Sarajevo 1983.
- [12] Veljkovic, D. ontribution to the knowledge of genetic and non-genetic characteristics of complex sulphide ores of lead, zinc and barite zone in Triassic sediments areas Vareš, Proceedings "minerals, rocks and extinct lives flex BiH", p. 73-84, Sarajevo 1989.