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MINERAL RESOURCES AND MINING PRODUCTION IN MONTENEGRO

Geological survey of Montenegro
Naselje Kruševac bb, 81 000 Podgorica

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General country information

- Montenegro is a sovereign state in South-eastern Europe. Population: 622.099.
- Geographic position: between N 41⁰52 and 43⁰32 and between E 18⁰26 and 20⁰21.
- State area: continental part 13812 km²; at the sea 8.500 km².
- Length of the Adriatic coast is 293 km..
- Border countries: Croatia, Bosnia and Herzegovina Serbia, Kosovo and Albania.
- The capital: Podgorica, population 185.937.
- Classified by the World Bank as an upper middle-income country
- Member of the UN, the World Trade Organization, the Organization for Security and Co-operation in Europe, the Council of Europe, the Central European Free Trade Agreement and a founding member of the Union for the Mediterranean.
- Candidate for joining the European Union and NATO.
- GDP for 2014: 3 billions 425 million Euros





Overview of legislation in Montenegro

Property on mineral resources

- Law on state property (“Official Gazette of Montenegro ”, No 21/09)
The mineral wealth, as wealth of general interest, is owned by the state and can be used under the conditions and in a manner determined by law.

The Mining Law (“Official Gazette of Montenegro ”, No 65/08, 74/10)

By mineral wealth, in terms of the Mining Law, are considered all organic and inorganic mineral resources in solid, liquid and gaseous state, that are located in the primary deposits, as well as technogenic (secondary) mineral raw materials which are formed through the process of exploitation.





Overview of legislation in Montenegro

The right to exploration and exploitation of mineral resources

- Law on concessions (“Official Gazette of Montenegro”, No 8/09)

Concession is the right to use natural resources, commonly used goods and other goods of common interest, which is owned by the state, subject to payment of concession fees by the concessionaire.

The subject of the concession can be exploration or exploitation, or exploration and exploitation of mineral resources

- Annual Work Programme for concessions is made by the Government
- Establishment of the Commission for Concessions
- The process of granting concessions: an initiative of the relevant authority or an interested party initiative
- Concession Act - the main document on which the proceedings for granting concessions is based
- The model of giving concessions: public bidding in an open, two-stage and shortened procedure
- The conclusion of the concession agreement and establishing the concession fees
- Expropriation concession area / getting rights to use the area if the area is state-owned / buying / leasing





Overview of legislation in Montenegro

Detailed geological exploration

- Law on geological explorations (" Official Gazette of Montenegro ", No. 28/93, 27/94, 42/94, 26/07, "Official Gazette of Montenegro ", No 28/11)
 - Project of detailed geological research, revision of the project, revision clause
 - Approval for conducting detailed geological research, performing research, monitoring and control of geological inspection
 - Study on classification, categorization and calculation reserves of mineral resources, revision of studies and verification of the reserves
 - Procedures and deadlines for performing detailed geological research
 - Licence for performing geological exploration





Overview of legislation in Montenegro

Exploitation of mineral resources

- The Mining Law ("Official Gazette of Montenegro ", No 65/08, 74/10)
 - Exploitation can be performed by a company which has the appropriate license, on the basis of the concession agreement
 - Law defines the competences of the: Government and Ministry of Economy (Administration Body competent for mining)
 - State plan for exploitation of mineral resources
 - Licenses for: exploitation of mineral resources and for the creating of mining projects
 - Approvals and consents for the exploitation of mineral resources and others.
 - Mining works are performed in accordance with the technical documentation for the construction of mining works.
 - Monitoring and control of mining inspection
- Law on exploration and production of hydrocarbons ("Official Gazette", No. 41/10 and 62/13)
- Law on Waters ("Official Gazette", No. 27/07)





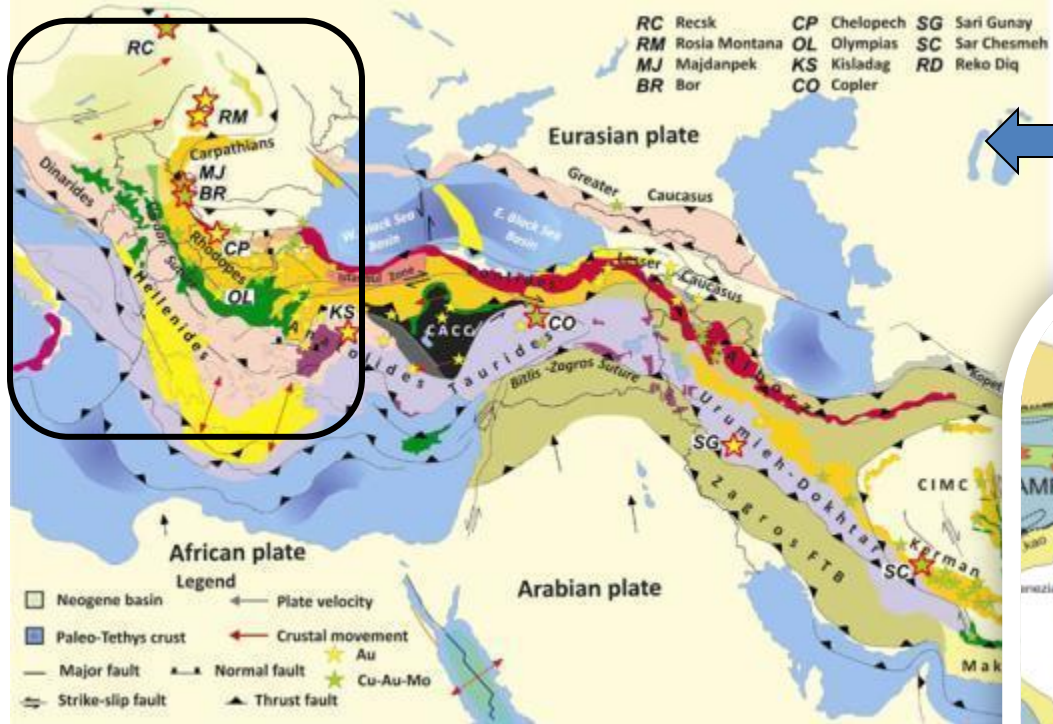
Overview of legislation in Montenegro

Evaluation of Environmental Impact

The law on the assessment of environmental impact (" Official Gazette of Montenegro ", No. 80/05)

- decide on the need for evaluation of environmental impact
- determine the scope and content of an environmental impact study
- decide on the approval of the study



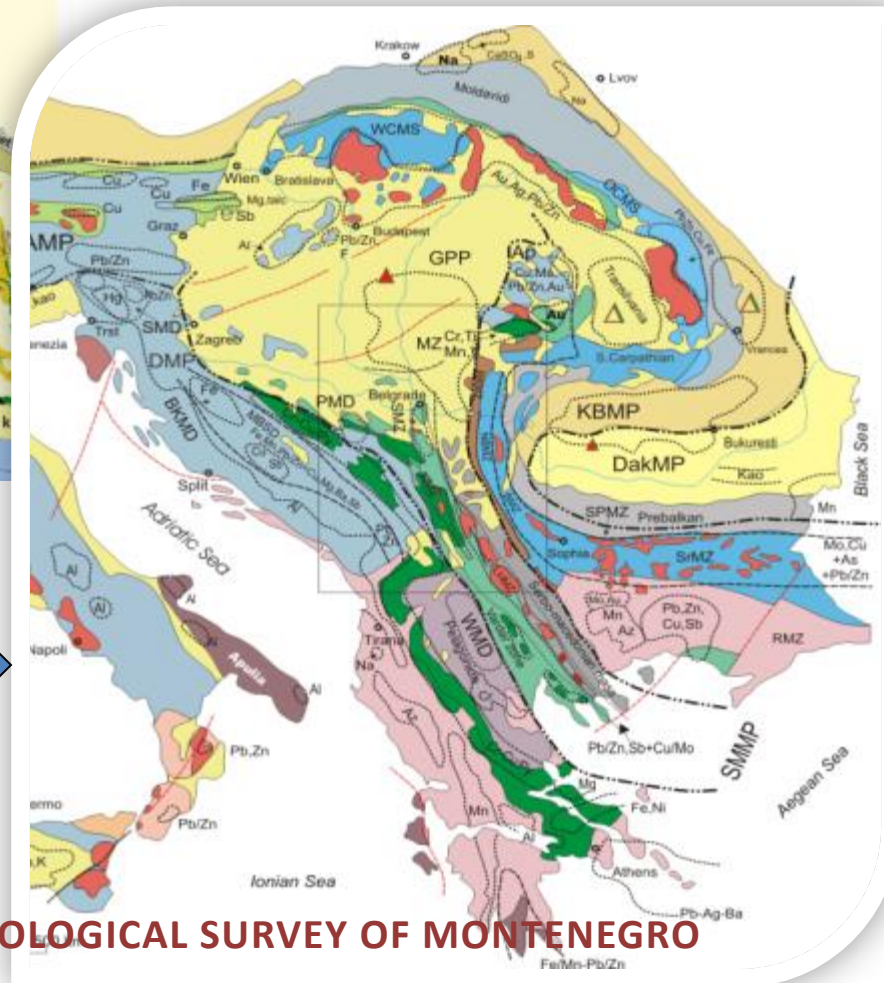


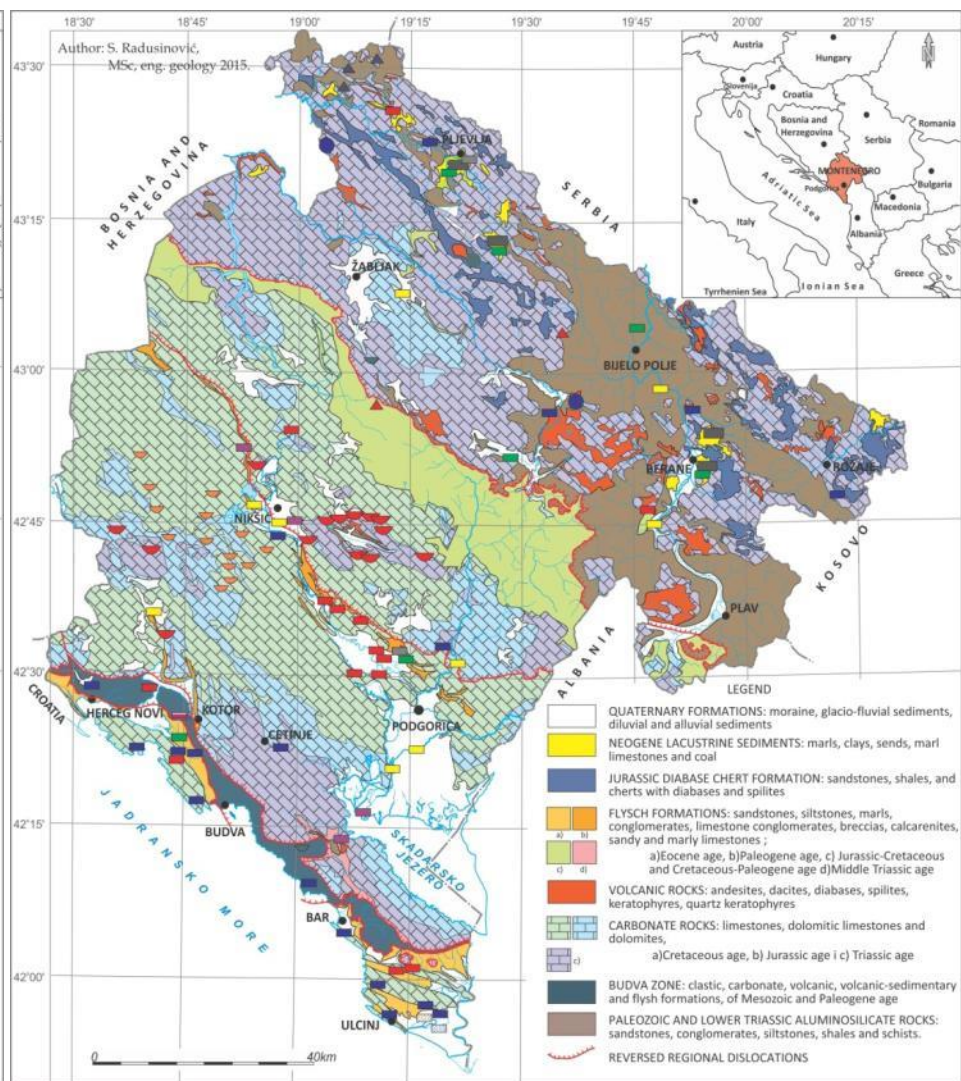
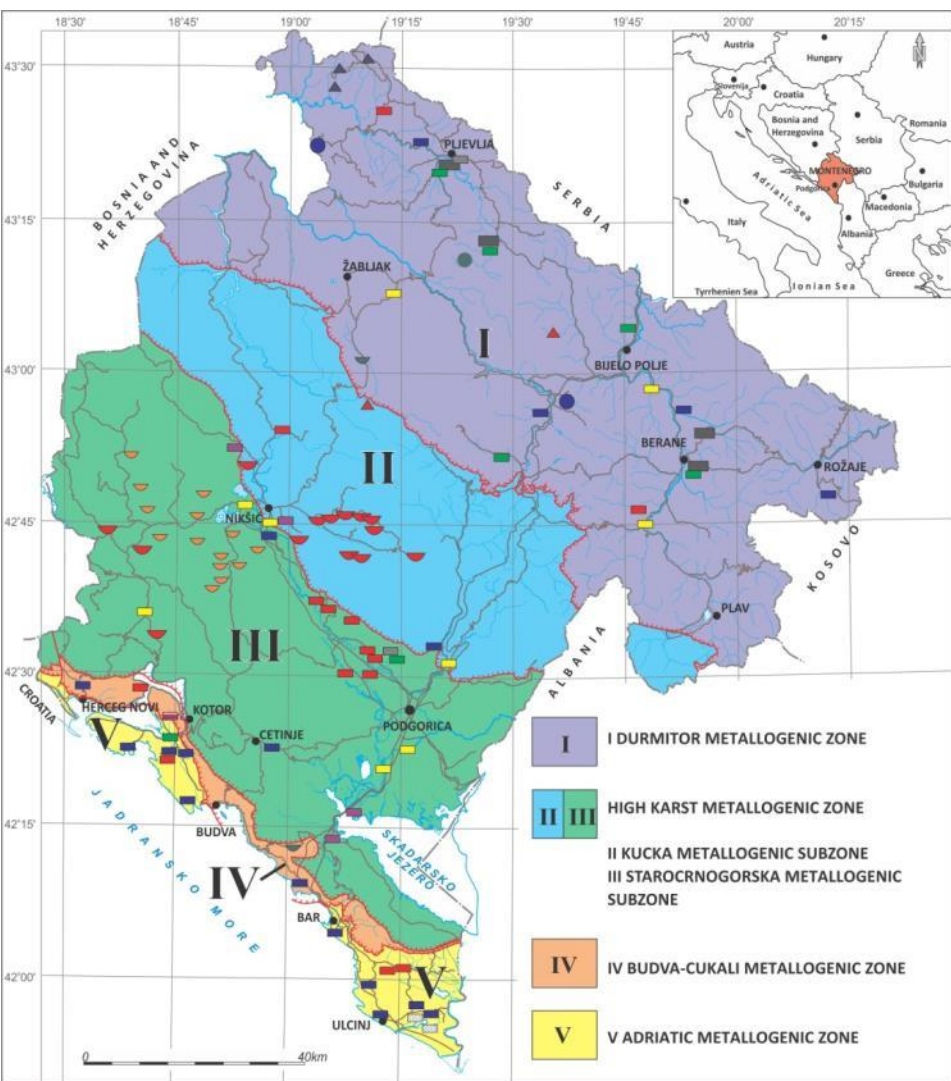
Tethys-Eurasian metallogenic belt
ABCD: Alpine-Balkan-Carpathian-Dinaric metallogenic and geodynamic provinces

NE Mediteran Sector

Metallogenic units of Montenegro are part of the regional metallogenic units exceeding its territorial boundaries

After: Jelenković R. i dr., 2016: Strategic mineral resources of Serbia and legislation, MINATURA2020, Beograd, 2016



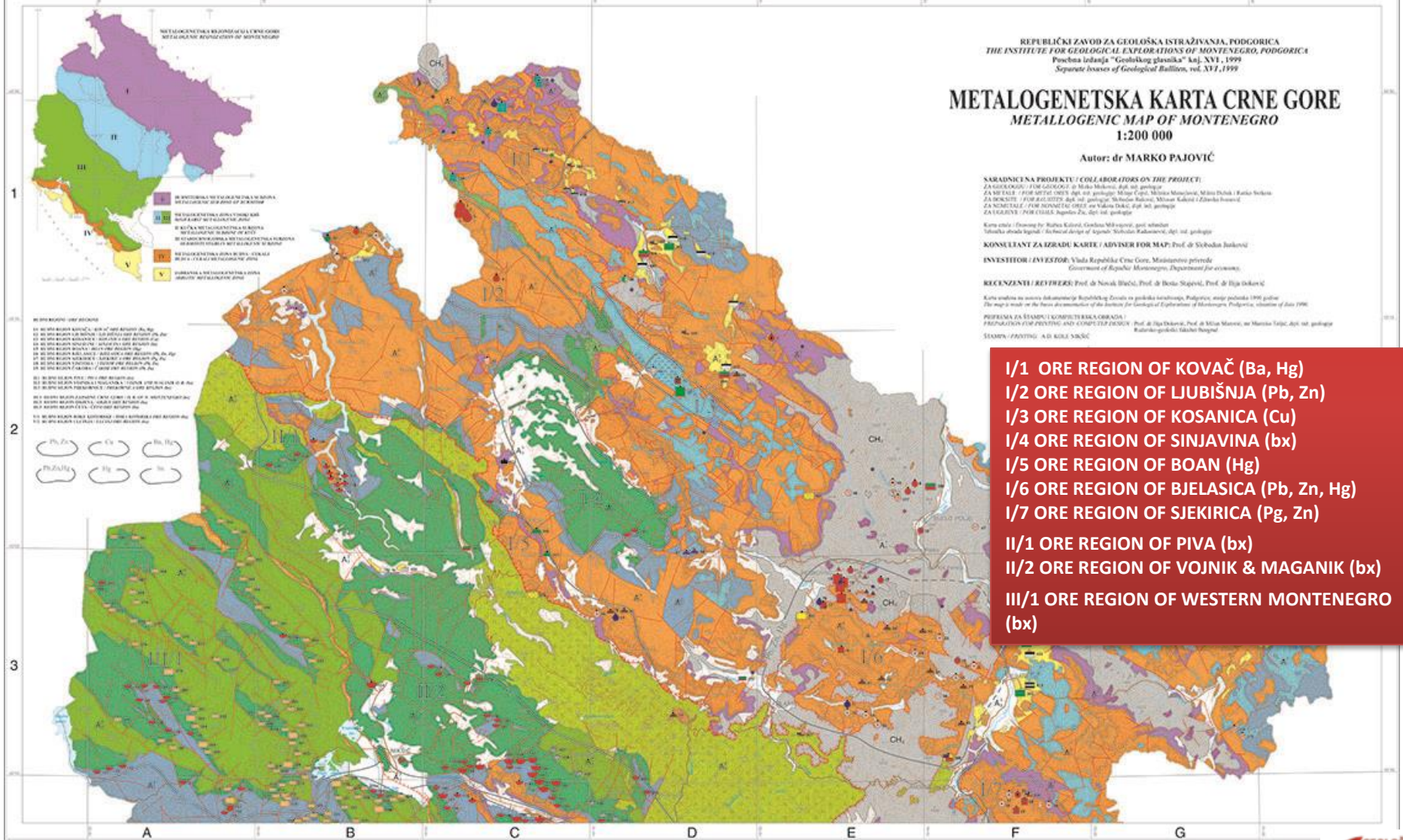


Metallogenic reorganization map of Montenegro

Lithological map of Montenegro

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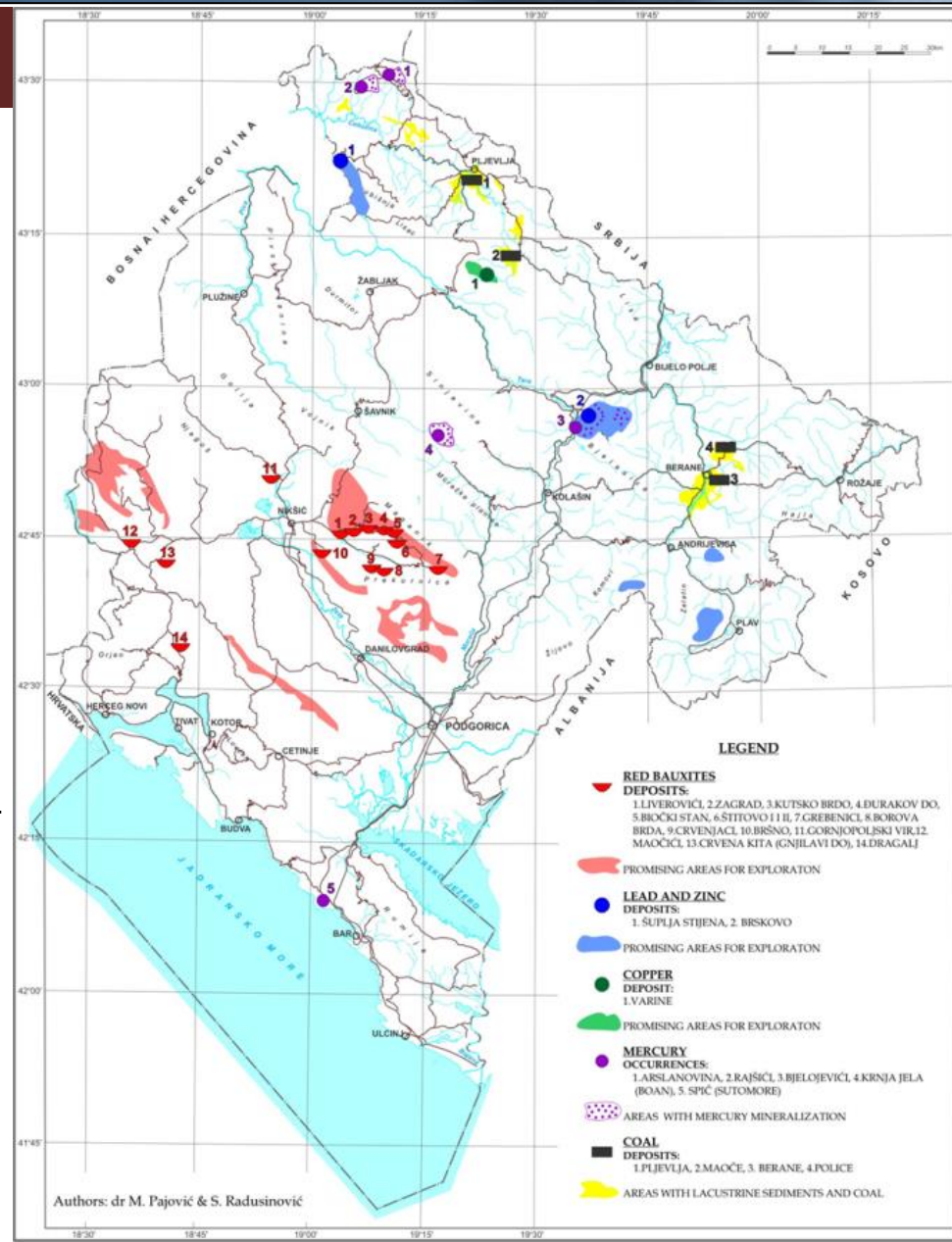
- I/1 ORE REGION OF KOVAČ (Ba, Hg)
- I/2 ORE REGION OF LJUBIŠNJA (Pb, Zn)
- I/3 ORE REGION OF KOSANICA (Cu)
- I/4 ORE REGION OF SINJAVINA (bx)
- I/5 ORE REGION OF BOAN (Hg)
- I/6 ORE REGION OF BJELASICA (Pb, Zn, Hg)
- I/7 ORE REGION OF SJEKIRICA (Pb, Zn)
- II/1 ORE REGION OF PIVA (bx)
- II/2 ORE REGION OF VOJNIK & MAGANIK (bx)
- III/1 ORE REGION OF WESTERN MONTENEGRO (bx)

Pajović. M., 1999: Metallogenetic map of Montenegro – northern part



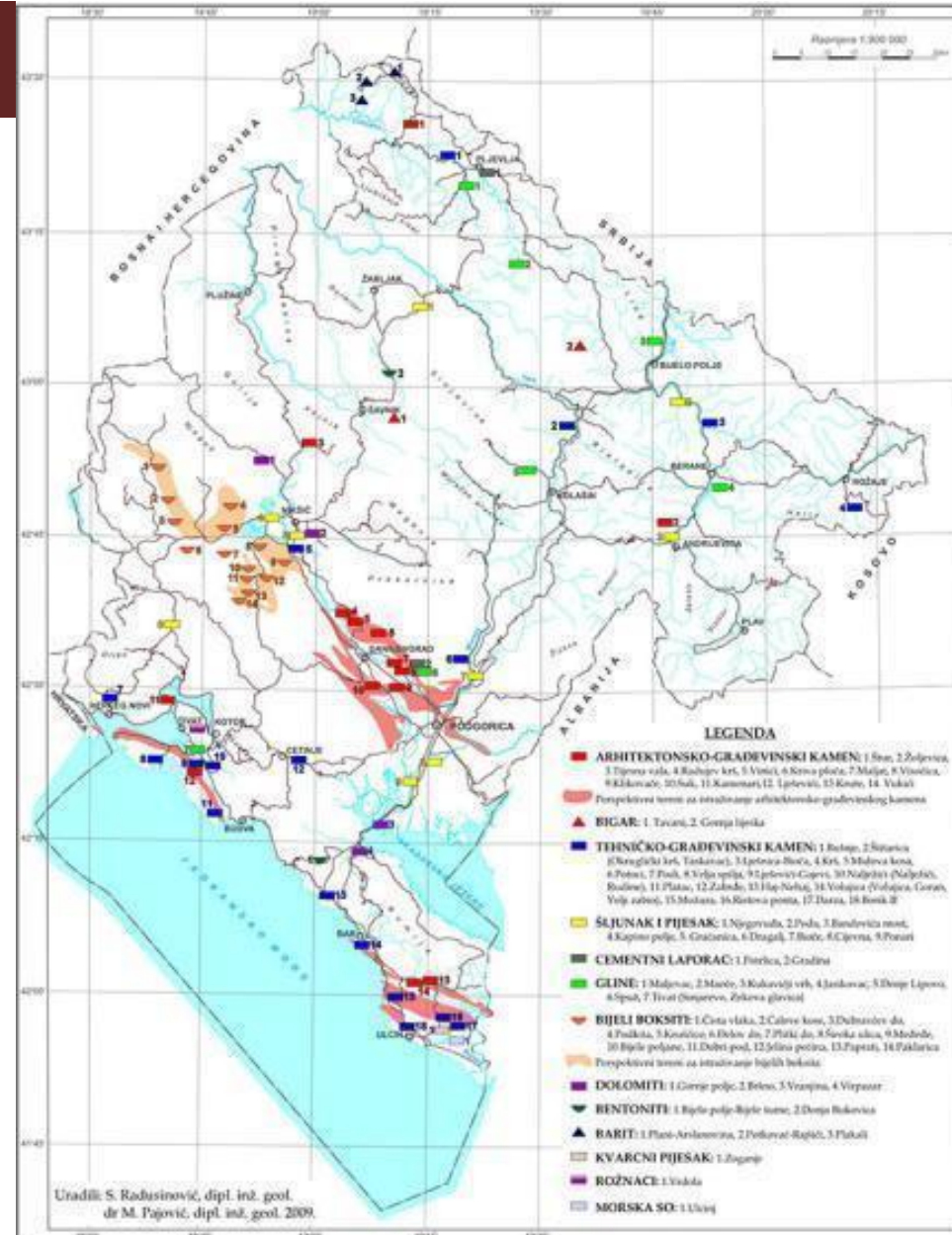
Deposits and occurrences of mineral resources of Montenegro

- 28 kinds of mineral resources were discovered in Montenegro
- 15 have been exploited (3 MMR, 11 NMR, 1 EMR)
- 23 kinds of mineral resources have the economic importance
- Metallic mineral resources (MMR):
 - RED BAUXITE
 - LEAD AND ZINC
 - COPPER
 - MERCURY
 - Occurrences of MANGANESE, IRON, TITANIUM, CHROMIUM AND RARE EARTH ELEMENTS IN BAUXITES
- Energy mineral resources (EMS):
 - COAL
 - OIL AND GAS.



Deposits and occurrences of mineral resources of Montenegro

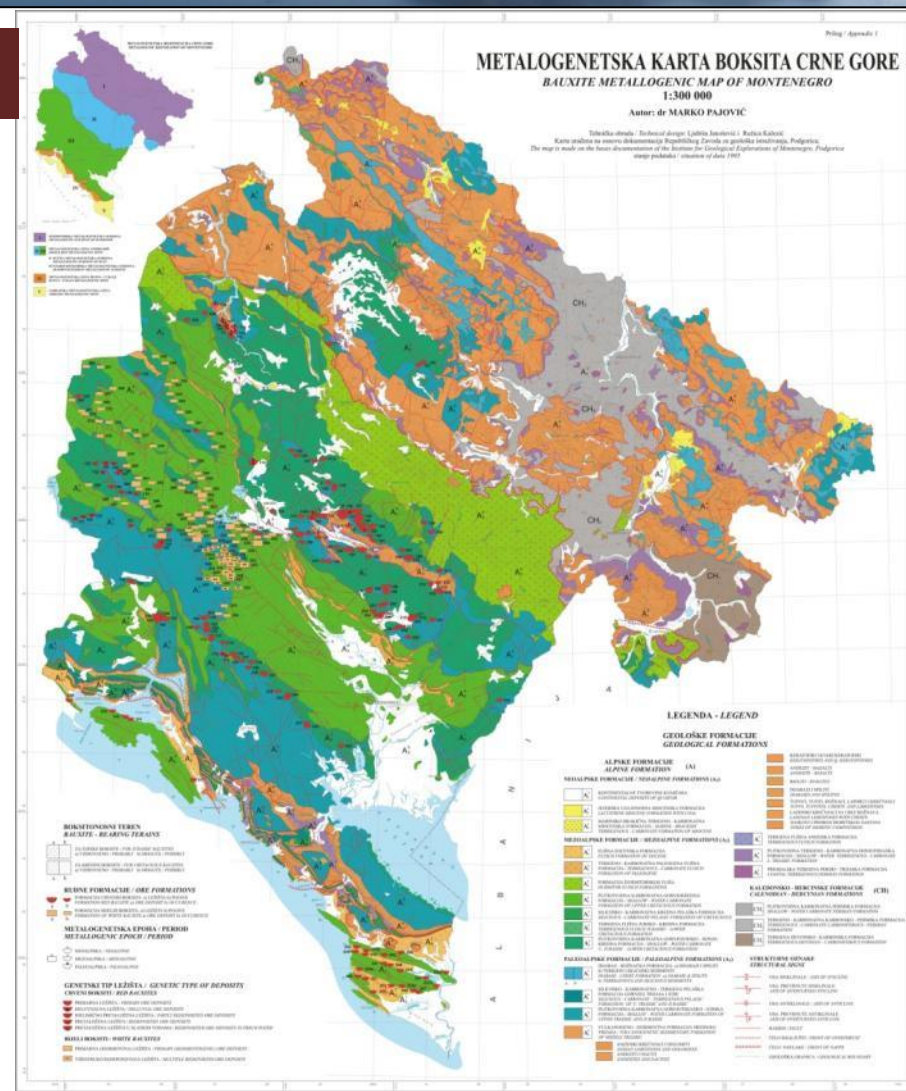
- Non-metallic mineral resources (NMS):
 - ARCHITECTURAL-BUILDING STONE
 - TRAVERTINE
 - TECHNICAL-BUILDING STONE
 - SAND AND GRAVEL
 - BRICK CLAY
 - CEMENT LIME
 - WHITE BAUXITE
 - DOLOMITE
 - BARITE
 - BENTONITE
 - QUARTS SAND
 - CHERT
 - SEA SALT



Metallic mineral resources (MMR)

Red bauxite :

- deposits and occurrences are widespread in the central and less spread in southern parts of Montenegro and represent the major metallic mineral deposits.
- 30 deposits and 150 occurrences of the red bauxite were discovered, in three geological periods: during the Triassic, Jurassic and Early Paleogene.
- The most important red bauxite reserves are located in the wider area of the Nikšić, where largest karst red bauxite deposits were discovered: Liverovići I and II, Zagrad, Kutsko brdo, Djurakov do, Biocki stan and Stitovo I and II.





Metallic mineral resources (MMR)

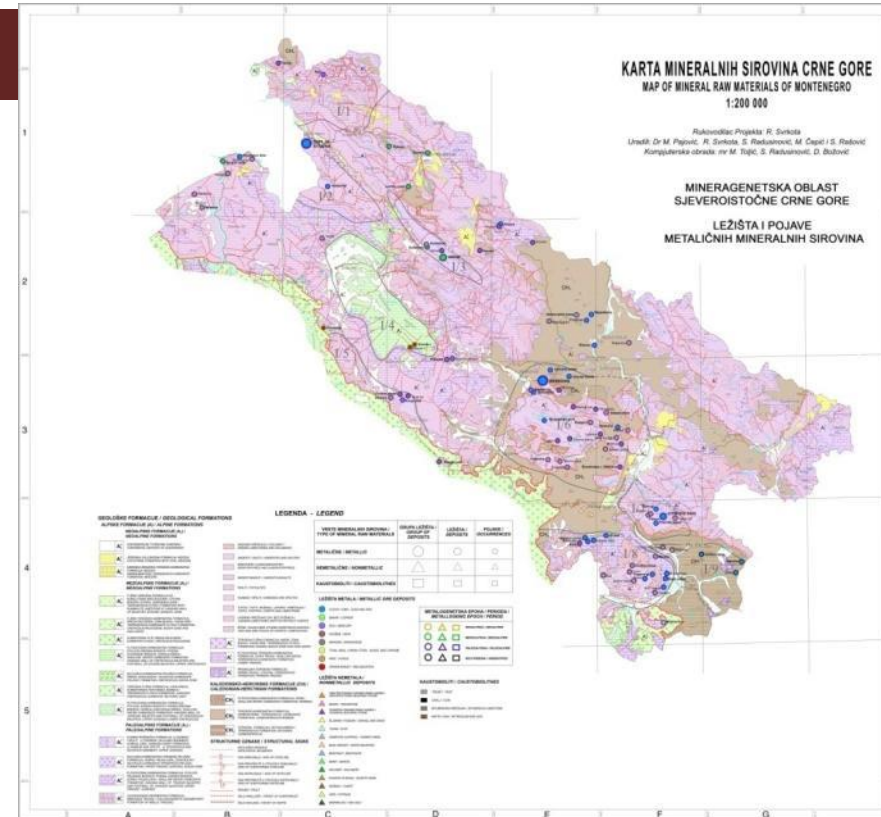
- State of Proved reserves (by detailed exploration) of red bauxite in Montenegro at the end of 2005. was in total of 38.665.000 t
- Balance and Conditional-balance reserves (Economic reserves which may be used to obtain aluminium – which average SiO₂ content is less than 6%) were 20.864.000 tons, which is about 54% of total.
- Perspective red bauxite reserves (Indicated resources) in the amount of 30 to 50 million tons (depending on evaluation criteria and the author) were evaluated in Montenegro.
- Red bauxite exploitation, in recent years, is carried out by surface mining (open pits) in following mines: Zagrad, Djurakov do and Stitovo II, whilst in Biocki stan mine (due to the huge depth of bauxite) underground mining methods are performed
- 23,2 million tones of red bauxite were produced in Montenegro in the period from 1948 to 2005.



Metallic mineral resources (MMR)

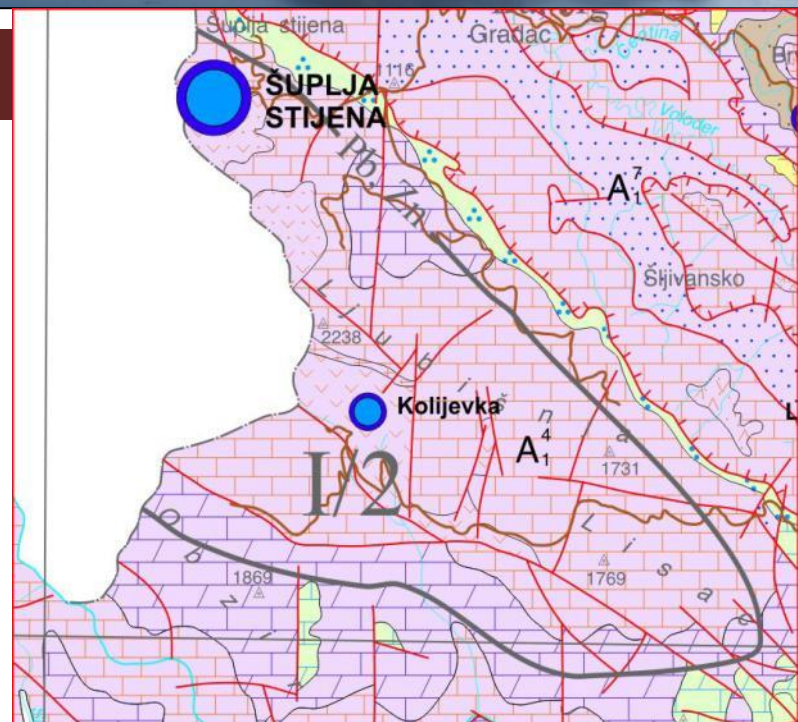
LEAD AND ZINC:

- deposits and occurrences are related to area of northeastern Montenegro
- economic concentrations of the ore of these metals were proved in mountain regions Ljubisnja (mine Suplja stijena) and Bjelasica (mine Brskovo).
- several economically interesting mineral occurrences were proved in areas of mountains Visitor and Sjekirica
- In all stated regions ore is placed in volcanic and volcano-sedimentary rocks of the Middle Triassic



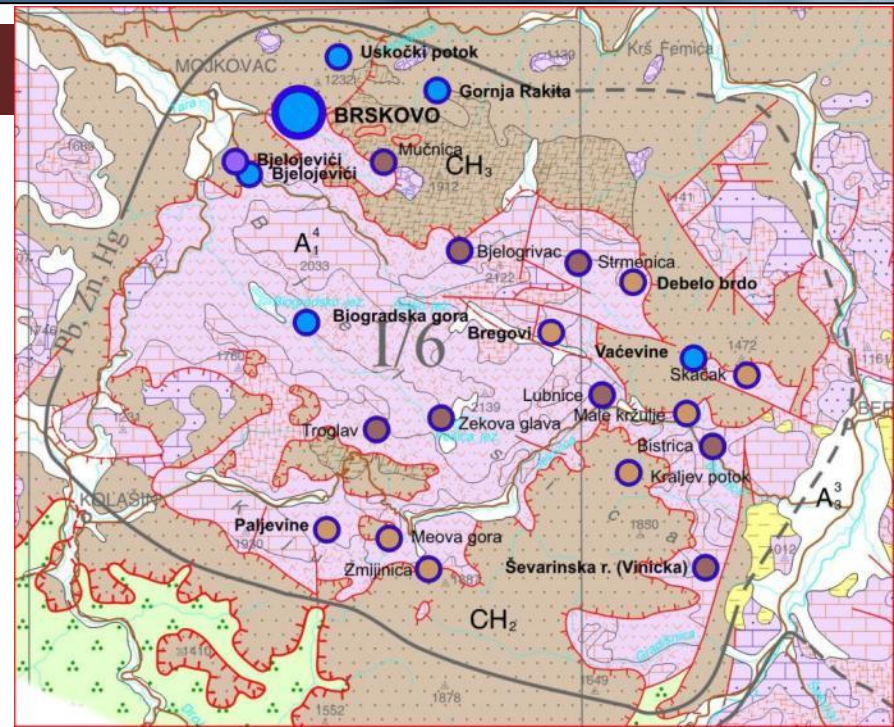
Metallic mineral resources (MMR)

- In the area of ores of Ljubisnja especially important area is the mine **Šuplja stijena**, which consists of four deposits:
 1. Šuplja stijena,
 2. Djurdjeve vode,
 3. Paljevine and
 4. Ribnik.
- Certified Balance reserves (Economic reserves) of lead and zinc ore in Suplja stijena are 18,416,000 tons, whilst Perspective ones (Indicated resources) are estimated to 10 to 40 million tons.
- Between 1954. and 2000., by means of surface (open pit) and underground mining method 4,233,238 t of ore was excavated and produced 78,662 t of concentrate Pb and 304,242 t of Zn concentrate.



Metallic mineral resources (MMR)

- Mining region of mountain Bjelasica is the second important area of lead and zinc ore, which is well known by **Brskovo mine**, from which lead and silver were exploited in the second half of the XIII century. In recent history, mine Brskovo was opened in 1976 and worked for only twenty years.
- In the area of this mine deposit of lead and zinc ore were proven in the localities: Zuta prla, Razvrsje, Visnjica, Igrista, Brskovo and Gradina.
- Proved reserves (Economic reserves) of lead and zinc ore in the mine Brskovo are 15,796,000 t.



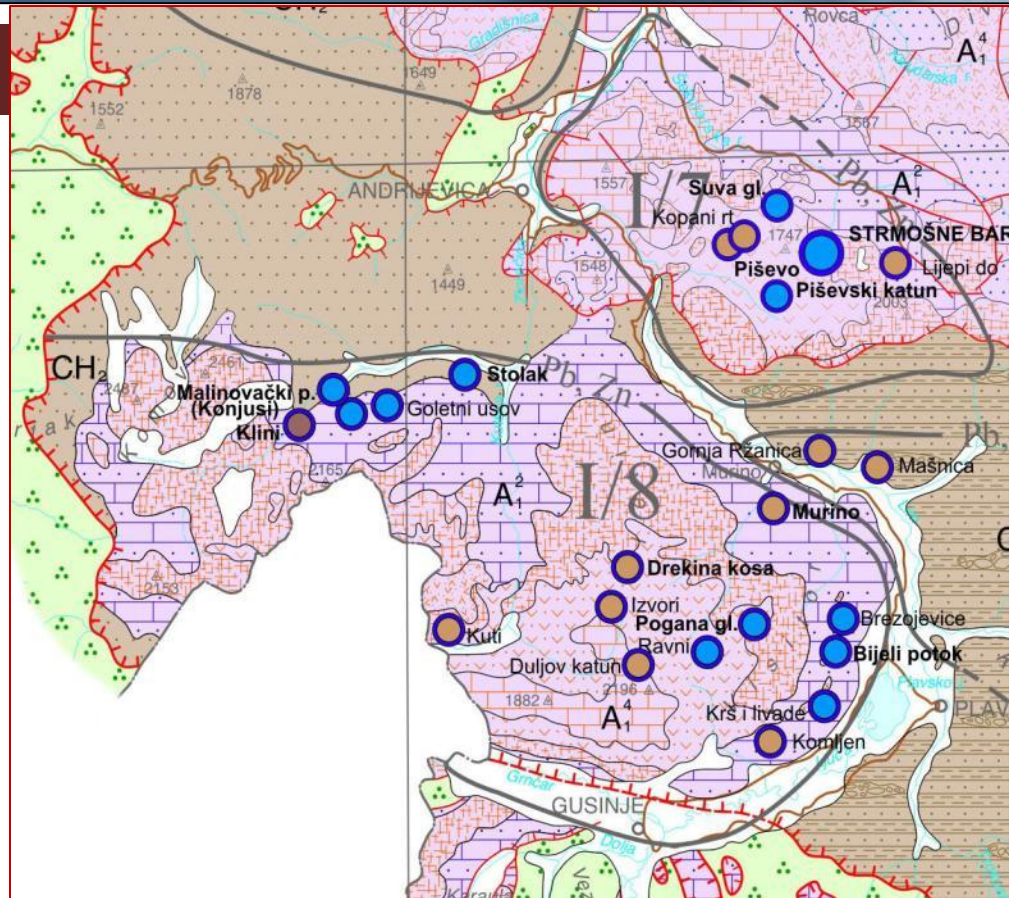
- From Brskovo mine, in the period from 1976 to 1991, underground and surface methods of exploitation excavated 2.851 million t of ore and produced: 32,588 t of Pb concentrate, 89,263 t of Zn concentrate and 133,910 t of pyrite (FeS₂) concentrate.

Metallic mineral resources (MMR)

- In addition to significant Proved reserves of lead and zinc ore in the area of Suplja stijena and Brskovo, Perspective reserves (Indicated resources) were estimated in the same areas:

- Suplja stijena: 10 Mt,
- wider area of Brskovo: 12 Mt,
- area of Sjekirirca: 6 Mt
- area of Visitor: 2 Mt

or a total of about 30 Mt of reserves.





Non-metallic mineral resources (NMS):

ARCHITECTURAL-BUILDING STONE:

- Open pits: Maljat , Krute, Visocica, Radujev krš , Živsko razdolje, Brankov krš, Tospude, Dolovi.
- 2 important regions:
 1. Bjelopavlici region with about 4 million m³ of proven (Economic) reserves
 2. Costal region with proven reserves of 2 million m³ of rock mass.
- Potential reserves (Indicated resources) are estimated at 50 million m³ of rock mass.
- 2 types of decorative stone (with specific physical and decorative quality) :
 1. Bokit
 2. Travertine





Non-metallic mineral resources (NMS):

TECHNICAL-BUILDING STONE:

- 26 deposits were investigated, with proven reserves of about 60 million m³, with only one deposit of volcanic origin with about 2.5 million m³.
- There is significant lack of technical-building stone of volcanic rocks in the market, although there is potential of this raw material in Montenegro.

CEMENT LIME:

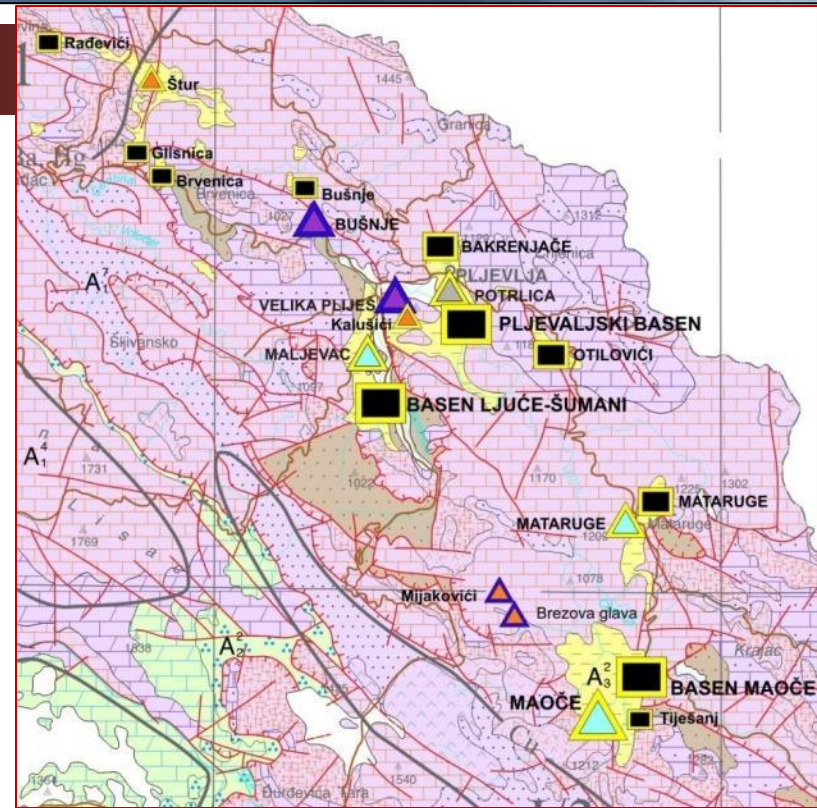
- Deposits are placed in the area of Potrlica near Pljevlja where coal is exploited, too.
- 90 million tones of reserves of this mineral resource were proven
- Production only took place in Pljevlja between 1976 and 1988 when the cement plant produced 1.66 million tons of cement.

DOLOMITE:

- 80 million tons of high-quality dolomite were proved (Measured and Indicated reserves), but, unfortunately, still have not been used for various reasons.

Energy mineral resources (EMS):

- Regarding energy resource in Montenegro, **the coal** is mined, and the potential of **oil and gas** is still in the domain of research and perspectives evaluation.
- The only economically significant deposits of coal in Montenegro are in the Neogene lacustrine basins, known as Pljevlja and Berane coal basins.
- In the first basin coal belongs to the soft brown coals in transition to the so-called brownish-black lignite, and in the other it belongs to hard matte brown coal - or brown coal.



Energy mineral resources (EMS):

- **PLJEVLJA BASIN**

- Pljevlja basin, in the strict sense, includes revirs (deposits): Potrlica, Kalusici, Komini, Radosavac, Grevo and Rabitlje, and Cementara (part of Potrlica). Proved reserves (Economic reserves) of coal in Potrlica in the end of 2010 were 32.600.000 t, with average DTE 10.69 MJ / kg.



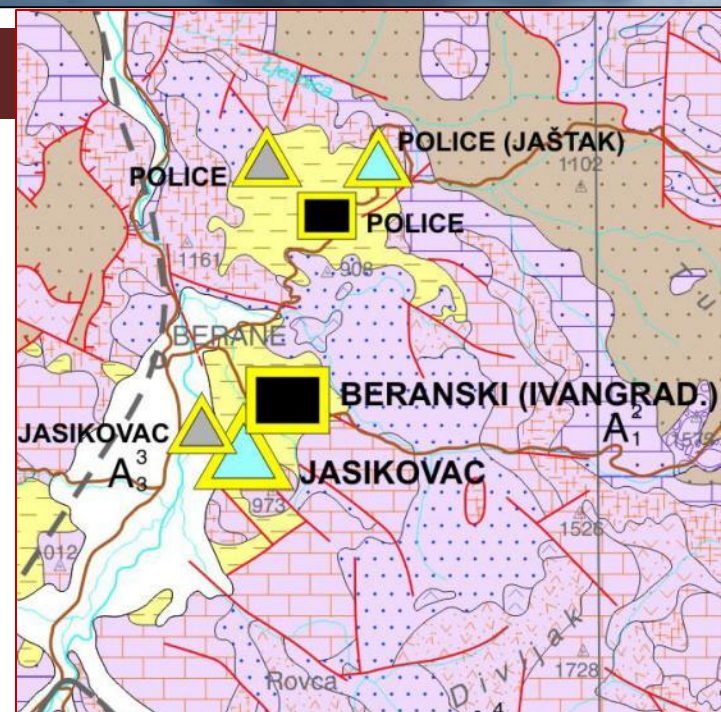
- Total proven coal reserves (Proved and Measured reserves) in the area of Pljevlja were, at the end of 2007, about 215,5 million tons, of which coal reserves in Maoce are about 55%.

Coal basin	Measured reserves (Mt)	Average DTE (MJ/kg)
Maoce	118,8	12,1
Mataruge	7,749	8,15
Otilovici	3,5	10,2
Bakrenjaca	1,332	10,2
Glisnica	1,7	9,38

Energy mineral resources (EMS):

- **BERANE BASIN**

- Includes several deposits of coal: Budimlja, Petnjik, Zagorje, Berane and Police.
- The coal in the Berane basen is significantly of higher quality than Pljevlja coal, with values of DTE from 14 to 17 MJ/kg



- Proved reserves in Petnjik deposit are 13.166.000 t and in deposit Police 22.546.000 tv, of which 11.798.000 t are calssified as balance class (Measured reserves). Indicated reserves of coal in Zagorje are 3.338.000 t.
- Coal exploitation in Berane basin started at deposit of Budimlja in 1959 and was ended in 1980. Total of about 1.626.000 t of coal was taken by underground mining method.
- About 920.000 t of coal was also taken by underground mining method from Petnjik deposit in the period from 1981 to 1997.



Energy mineral resources (EMS):

OIL AND GAS

- Exploration on land started in 1949 in Montenegro, and the offshore in 1970.
- Until now, 17 exploratory boreholes whose length varies from 900 m to 5309 m were performed on land, and four deep exploration wells whose length varies from 3700 m up to 4750 m were done underwater. These researches revealed occurrence of bitumen, oil and gas
- On the sea of Montenegro, in addition to exploration drilling, about 11000 km of 2D seismic and 300 km of 3D seismic profiles were done. The results of researches on land and offshore show that there were objective conditions for formation of hydrocarbon deposits.
- Recent discoveries of oil in the southern part of the Italian Adriatic basin and results of oil in neighboring Albania, might support this assessment.



Mineral resources and mining production in Montenegro

Mineral raw material	Geological reserves and total production of mineral resources in Montenegro		
	Proved reserves	Resources	Total production
Red bauxite	35 Mt	50 Mt	25 Mt
Lead and Zinc	34.2 Mt	30 Mt	9.5 Mt Concentrates: 127 Kt Pb; 447 kt Zn; 134Kt FeS ₂
Copper	5.3 Mt	2 Mt	-
Architectural-building stone	6 Mm ³	60 Mm ³	Evaluation – primary blocks: 0.25 Mm ³
Technical-building stone	60 Mm ³	Large	Evaluation – aggregates of all fractions: 20 Mm ³
Brick clay	6.4 Mt	500 Mt	No reliable data
Cement lime	90 Mt	Not evaluated	Cement: 1.66 Mt
White bauxite	5.6 Mt	10 Mt	Evaluation: 300 Kt
Dolomite	80 Mt	Large	-
Barite	0.4 Mt	Not evaluated	65.4 Kt
Bentonite	2.4 Mt	1.4 Mt	164.7 Kt
Quartz sand	-	7 Mt	-
Chert	1.2 Mt	1.5 Mt	-
Coal	251.2 Mt	100Mt	68.1 Mt



Protected areas and areas perspective for exploration of mineral resources

NATIONAL LEVEL OF PROTECTION (National parks, monuments of nature, strict nature protection, etc.) : **124.964,24 ha**

INTERNATIONALLY PROTECTED AREAS: 247.889 ha

• **Approved exploitation fields** *Source: Ministry of Economy*

– 31

• **Concessionaires** *Source: Ministry of Economy*

– MMR.....2

– NMR....22

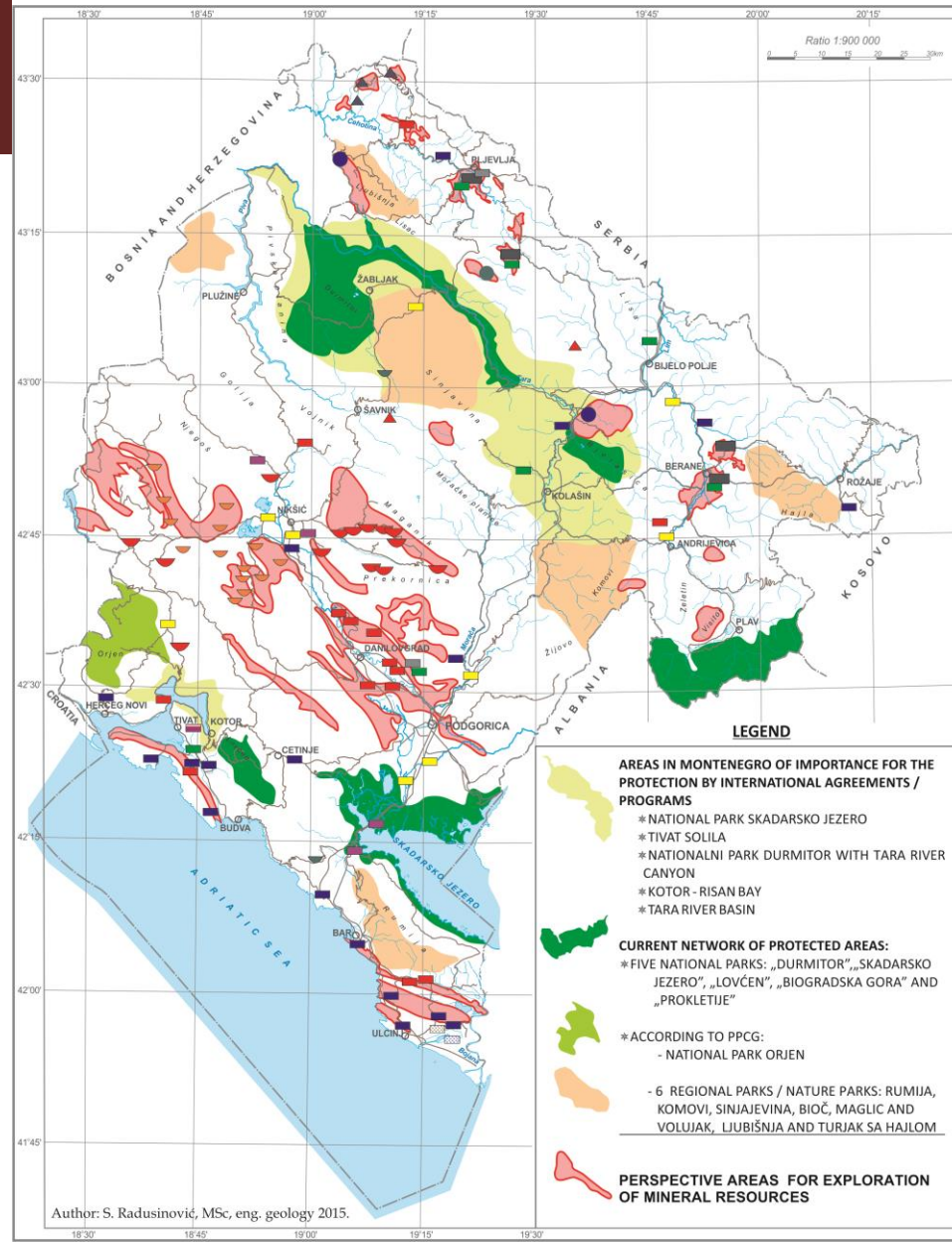
– EMR..... 2

• **The area under concession for exploitation**

6.324 ha, or 0,46 % the territory of Montenegro

• **Areas perspective for exploration of mineral resources**

– 1.110 km² , or 8 % the territory of Montenegro





Literature and data sources

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12. Coal Mine Pljevlja
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15. Bauxite Mines Niksic
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**THANK YOU FOR
ATTENTION !!!**

