

GEM RAW MATERIALS OF THE FRUSHKA GORA MOUNTAIN (SERBIA): GEOLOGICAL CHARACTERISTICS AND ECONOMIC SIGNIFICANCE OF DEPOSITS

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ABSTRACT

The paper, dealing with geological characteristics and economic significance of gem raw materials deposits of the Frushka Gora mountain (Serbia, Yugoslavia), is primarily focused to the best explored deposit of Kozje Brdo.

Key words: gem raw material, deposit, occurrence, geological characteristics, economic significance, Frushka Gora mountain, Serbia, Yugoslavia

INTRODUCTION

One of the most significant regions with the deposits and occurrences of gem raw materials (minerals and rocks) in Serbia is located, as evidenced by the name, at the Frushka Gora mountain and is characterized by both complex geological composition and tectonic structure. A simplified review of geological formations of the Frushka Gora mountain is presented in Fig.1. The main carrier of gem raw materials of the mountain is serpentinite, although they subordinately occur in the Upper Cretaceous breccia-conglomerate (Figs. 1 and 2).

GEM RAW MATERIALS OF THE FRUSHKA GORA MOUNTAIN

Although very modest funds, insufficient even for completion of already commenced exploration, were invested into geological exploration of gem raw materials of the Frushka Gora mountain, they gave favourable results: the existence of one major deposit (the Kozje Brdo deposit) was established as well as a great number of smaller deposits and minor occurrences of gem (and gallantry) raw materials: minerals and rocks [1, 2, 3, 4, 5 and 6].

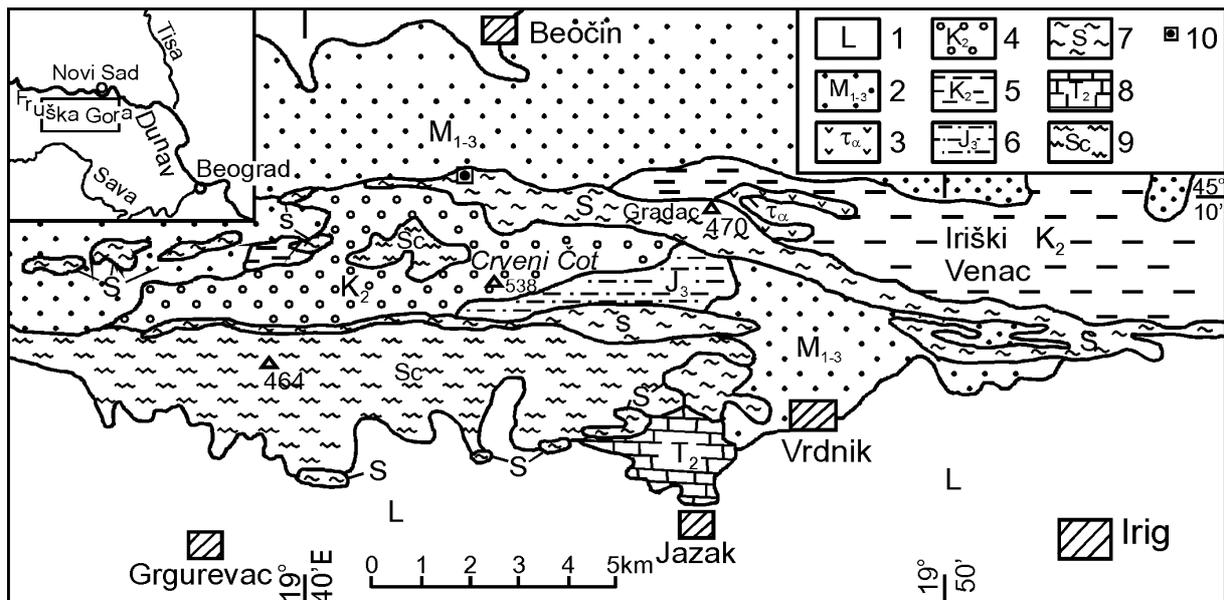


Figure 1. A sketch map of the Frushka Gora mountain (according to the Basic geological map, sheet Novi Sad). Legend: 1 – loess; 2 – Miocene marl, argillite, conglomerate and sandstone; 3 – latite; 4 – Upper Cretaceous red conglomerate and breccia; 5 – the Upper Cretaceous flysch; 6 – Jurassic slate, quartzite and sandstone; 7 – ultrabasite; 8 – Triassic argillite, limestone and dolomite; 9 – Palaeozoic sericite and chlorite schists; 10 – the Kozje Brdo deposit of gem raw materials.

The Kozje Brdo deposit, as well as the majority of deposits and occurrences of gem raw materials, are located in the Frushka Gora ultrabasite massif, namely, in its western part, in the ore field of hydrothermal-vein magnesite Cerova Strana (Fig.2). This part of ultrabasite massif underwent intense tectonic deformation (mainly disjunctive), serpentinization, hydrothermal alteration (primarily listwanitization) and mineralization (mainly carbonates and silica). The gem raw materials of the Frushka Gora mountain are represented by chalcedony and carbonate-silica breccia with agate. The following presentation will be focused to the best explored deposit of Kozje Brdo.

The Kozje Brdo deposit

The Kozje Brdo deposit of gem raw materials is located approximately 50 km northwest from Belgrade and about 2,5 km north-northwest from the top of the Frushka Gora mountain – Crveni Čot.

The deposit of Kozje Brdo, located in intensely altered and tectonically shattered serpentinite, has the shape of irregular plate with numerous branches and is surrounded by a swarm of small orebodies of lens-like, nest-like and irregular shapes

(Figs. 2 and 3). This deposit is represented by two basic gem raw materials: chalcedony and carbonate-silica breccia with agate. Small quantities of red-brownish jasper occur as well.

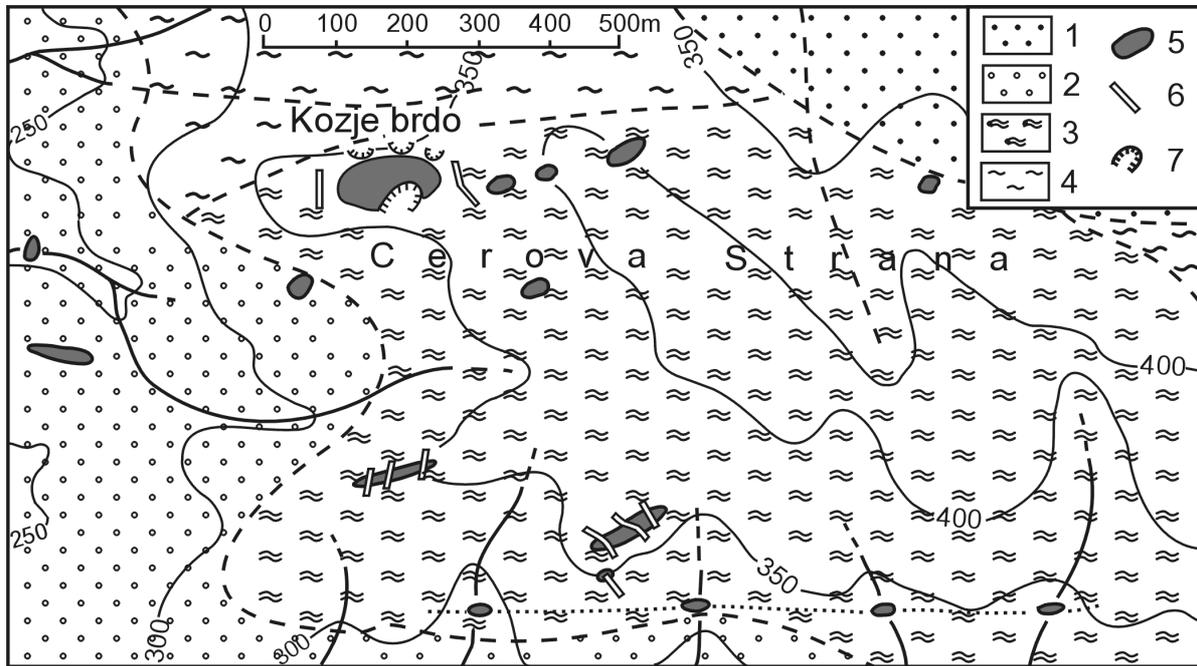


Figure 2. The ore field of Cerova Strana [4]. Legend: 1 – Tertiary gravel and clay; 2 – Upper Cretaceous red conglomerate and breccia; 3 – highly altered serpentinite; 4 – slightly altered serpentinite; 5 – Carbonate-silica breccia with agate, chalcedony; 6 – trench; 7 – quarry.

Chalcedony occurs in zones of highly altered serpentinite and three varieties may be distinguished according to colour: violet, colourless and bluish one.

The violet chalcedony occurs in form of a subhorizontal plate, the thickness of which is 5-15 cm and visible length up to 10 cm, and pieces of the chalcedony were found in other places as well. This type of chalcedony is usually transparent, its colour is light violet with slightly expressed patterns. It is suitable for processing into round forms (mainly caboshons) and may be used for manufacture of cheap (popular) jewellery. The violet chalcedony occurs extremely rare.

The colourless chalcedony occurs more frequently, usually in form of irregular veinlets, the thickness of which is 0,5-1 cm, then in form of stockwork and small nests in altered serpentinite. This variety of chalcedony is more represented in the surrounding occurrences than in the deposit itself. The colourless chalcedony is of greater importance as a gem mineral, particularly its translucent variety, similar to moonstone; it is easy for processing into cabochons and may be used for setting into rings and other jewellery.

The bluish transparent chalcedony is the most beautiful, but the rarest one and was found only in placers.

Carbonate-silica breccia with agate (the Frushka Gora stone) occurs in the deposit of Kozje Brdo in form of larger nests or irregular veins, associated with magnesite or highly altered serpentinite.

Magnesite is the oldest formation of hydrothermal activity, highly tectonically shattered, pervaded and cemented by dolomite, ankerite and calcite with admixed silica. Thus, both veins and nests, various in shape and colour, were formed. The most widespread textural forms, apart from breccia, are cockade and similar forms, as well as symmetric veins, sporadically containing elongated agate lenses. The main specificity of the Frushka Gora stone is a mixture of carbonate and silica, mostly chalcedony (agate), rarely quartz (in geodes' cores). Chalcedony, in form of impregnations, also pervades carbonates, making them harder

Carbonate bands are mostly green, ochre-yellow, white and brown, while rare black bands and spots also occur. All the mentioned colours occur in various shades and combinations but are clearly contoured. Silica bands are whitish-bluish and clearly different from crystalline carbonates. Dense magnesite is mostly yellow-brownish.

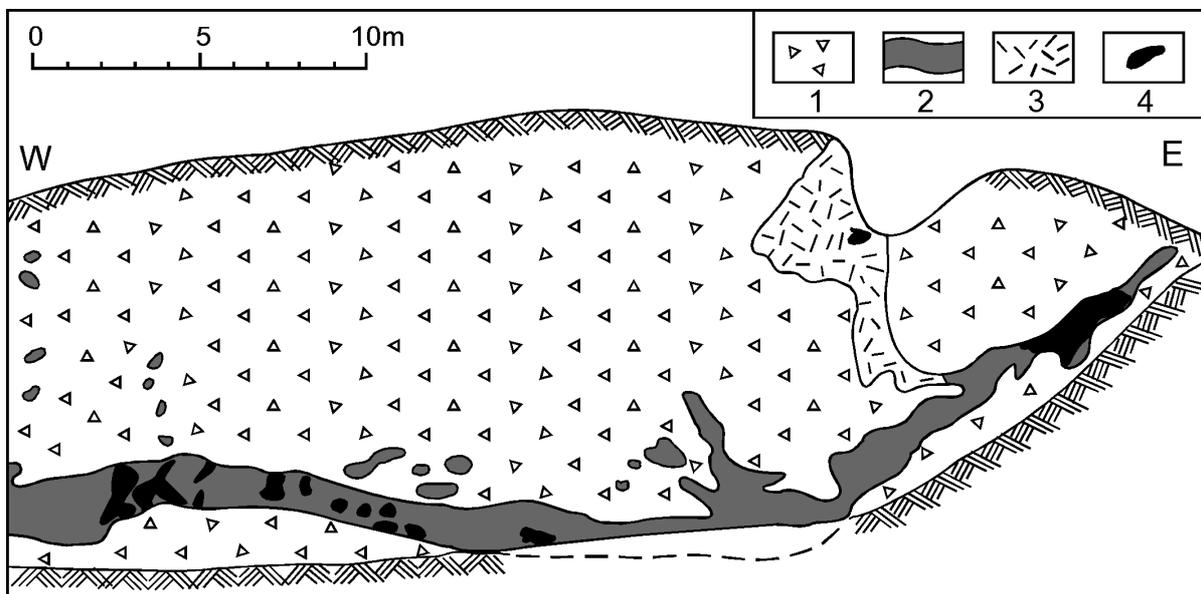


Figure 3. The open cross-section of the Kozje Brdo quarry [4]. Legend: 1 – highly altered and brecciated serpentinite; 2 – carbonate-silica breccia with agate; 3 – red-brown jasper; 4 – agate nests.

The Frushka gora stone may be processed in round shapes and used for the manufacture of cheap (popular) jewellery. It can also be used, as a famous Brazilian agate, for the manufacture of decorative platelets and decorative-utility objects

(“stone gallantry”): ashtrays, vases, clock dials, etc. As a heterogeneous material this stone requires skilled processing adequate to its properties.

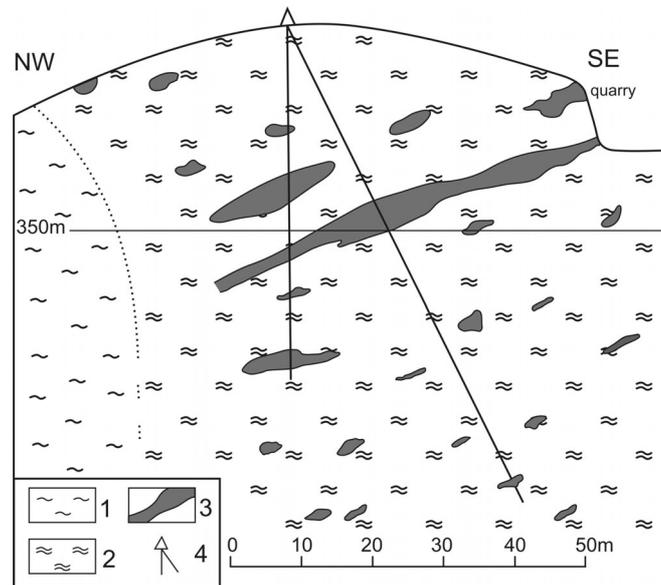


Figure 4. Geological cross-section of the Kozje Brdo deposit [4]. Legend: 1 – slightly altered serpentinite: 2 – highly altered and brecciated serpentinite: 3 – carbonate-silica breccia with agate; 4 – boreholes

CONCLUSION

Although very modest funds, insufficient even for completion of already commenced exploration, were invested into geologic exploration of gem raw materials of the Frushka Gora mountain, they gave favourable results: the existence of one major deposit (the Kozje Brdo deposit) was established as well as a great number of smaller deposits and minor occurrences of gem (and gallantry) raw materials: minerals and rocks.

The Kozje Brdo deposit, formed in highly altered and tectonically shattered serpentinite, is characterized by two main gem raw materials: chalcedony and carbonate-silica breccia with agate. The ore body has the shape of irregular plate with numerous branches and is surrounded by a swarm of small orebodies of lens-like, nest-like and irregular shapes.

Chalcedony usually occurs in zones of highly altered serpentinite and three varieties may be distinguished according to colour: violet, colourless and bluish one. It is very suitable for processing and making round shapes (mainly cabochons) and may be used in the manufacture of rings and other jewelry.

The agate-bearing carbonate-silica breccia (the Frushka Gora stone) frequently occurs in the deposit exhibiting specific textural forms such as cockade and similar forms, as well as symmetric veins sporadically containing elongated agate lenses. The main specificity of the Frushka Gora stone is a mixture of carbonate and silica, mostly chalcedony (agate), rarely quartz (in geodes' cores). The Frushka Gora stone may be processed into round forms and used for the manufacture of cheap (popular) jewelry, and can also be used, as a famous Brazilian agate, for the manufacture of decorative platelets and decorative-utility objects.

The deposit of Kozje Brdo, representing the example of a small deposit but advantageous for exploitation, might be very interesting for private capital investment in the period to come, as regards small required investments and a short period of production activation.

References

- [1] Antonovi} A., *Pojave ahata na Frushkoj gori*, Zapisnici SGD za 1980, p 21-24, Beograd, 1980.
- [2] Antonovi} A., *Elaborat o rezervama ahatonosnog karbonatnog ganga na lokalnosti Kozje Brdo, Frushka Gora*, Fond struchne dokumentacije – Geoinstitut, 33 p., Beograd, 1982.
- [3] Antonovi} A., Naumovich D., Peshich D., Zegarac S., *Agatebearing carbonate onyx in the Frushka gora mountain – a new jewel-ornamental stone*, World congress od non-metallic minerals, Sumamry 2, p 151-156, Belgrade, 1985.
- [4] Antonovi} A., *Ukrasno-juvelirski kamen na Frushkoj gori*, Radovi Geoinstituta, knj. 33, p 227-238, Beograd, 1996.
- [5] Ili} M., *Juvelirske mineralne sirovine i njihova nalazishta u Srbiji.*- Izd. Rudarsko-geoloski fakutet Univerziteta u Beogradu, 139 p., Beograd, 1998.
- [6] Ili} M., Maleshevich N., Pejchich M., Miladinovich Z., *Kratak prikaz juvelirskih mineralnih sirovina Srbije*, Vesnik Geozavoda, Serija A, B, knj. 48, p. 169-201, Beograd, 1998.
- [7] Ili} M., *Specifichnosti juvelirskih mineralnih sirovina i njihove implikacije na istrazivanje i eksploataciju lezishta ovih sirovina u Srbiji*, Zbornik radova IV medjunarodne nauchne konferencije o povrsh. ekspl., Bor, 22-24 sept. 1999, Jug. komitet za povr. ekspl., RTB Bor, RGF Univerz. u Beogradu, p. 31-34, Bor, 1999.
- [8] To{ovi} R., *Kratak osvrt na strukturu genetskih tipova lezishta i pojava juvelirskih mineralnih sirovina Srbije*, Zbornik radova savetovanja KAMEN 2000, Arandjelovac, 11-13. oktobar 2000, p. 235-238, Arandjelovac, 2000.