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GEOLOGY AND GEOCHEMISTRY OF THE RAŠTELICA BARITE DEPOSITS SOUTHWEST OF SARAJEVO, BOSNIA AND HERZEGOVINA

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Key words: Bosnia, Raštelica, Permian strata-bound barite deposit, $SrSO_4$%, $\delta^{34}S$ of barite, fluid inclusions data.

Abstract

The Raštelica barite deposit occurs in the lowest part of Permian carbonate rocks along their contact with underlying Middle Permian variegated sanstones. Mineralization is in form of a few ten meters long and 0.3 to 3 m thick conformable bedded lensoid bodies. Crude or contains 90% $BaSO_4$. Bornite is the main copper mineral associated with chalcopyrite. Content of $SrSO_4$ in barite is 4.4%. $\delta^{34}S$ of sulphate sulphur is +9.5‰ indicating source of sulphur from the Permian sea water. Fluid inclusions were performed on quartz and barite crystals. Warming of frozen inclusions gave rise of four or five solid phases. Homogenization temperature for all inclusions were measured from +220 to +350°C. Salinity was obtained between 32.6 and 32.9 wt % NaCl equ. Most of features suggest submarine hydrothermal origin.

Ključne riječi: Bosna, Raštelica, stratabound permsko ležište barita, %$SrSO_4$, $\delta^{34}S$ barita, studij fluidnih inkluzija.

Sažetak

Baritno ležište Raštelica formirano je u najdonjim nivoima permskih karbonatnih stijena duž kontakta sa srednjopermskim šarenim pješčenjacima. Orudnjenje ima oblik desetak metara dugih i 0.3 - 3 m debelih konkordantno uloženih slojevitih leća. Rovna ruda sadrži 90% $BaSO_4$. Glavni bakarni mineral je oskudan bornit asociran sa halkopiritom. Sadržaj $SrSO_4$ u baritu iznosi 4.40 %. $\delta^{34}S$ sulfatnog sumpora u baritu je +9.5‰ indicirajući na porijeklo sumpora iz permskog mora. Fluidne inkluzije su proučene na kristalima kvarca i barita. Zagrijavanjem inkluzija, prethodno zamrznutih na -75°C nastalo je četiri ili pet čvrstih faza. Temperatura homogenizacije iznosila je od +220 do +350°C. Salinitet je određen sa 32.6 do 32.9 wt% NaCl equ. Većina karakteristika ležišta upućuje na submarinski ekshalativno-hidrotermalan postanak.

Introduction

The Raštelica village is situated about 35 km southwest of the town Sarajevo (Fig. 1a). Small barite deposits were found in 1950, on the northeastern part of the Ivan Mountain, one km southwest of Raštelica, along southeastern slopes of the Medanovac hill. They cover surface of 250 m x 150m and have been explored by some ten trenches, 15 shallow boreholes and a few short adits (Fig. 1).

Previous investigations

The first report on the Raštelica barite deposits was made by the enterprise "**Barite mines and mills Kreševo**" in 1955. Jurković (1956) gave a detailed microscopic description of ore and gangue minerals. In 1958 Institute for geological investigations of construction material and soil from Sarajevo performed geological and mining investigations and elaborated a report.

In 1959/1960 the Barite mines and mills Kreševo organized detailed mining explorations: trenches, short adits, 15 boreholes, and made four small open pits. Jeremić (1963) states that the Raštelica barite deposit belongs to the monomineral group of barite occurrences. Tončić-Gregl (1964) carried out first detailed geological map (M 1.1000), made sketches of the open pits and calculated reserves of barite crude ores.

Ramović, M. (1976) focused his attention on grey and dark-grey coloured barites from the Raštelica deposit, as well as on the dark-grey limestones, some ten meters thick on the both sites of the Crna rijeka (Black River) northwards of Raštelica. He uttered opinion that the barite occurrences hosted by these limestones could be syngenetic. Jovanović et al. (1978) write that the area of Bradina, Medanovac, Raštelica and Tarčin is built up of Middle Permian conglomerate, sandstone, shale transgressively overlying older Palaeozoic rocks. They quoted also small barite deposits at Raštelica. Barić & Trubelja (1984) cited shortly data given by Jurković (1956).

Šiftar (1990) published 25 analyses of $SrSO_4$ contents and 18 $\delta^{34}S$ values of the Raštelica barite. Ramović, E. (1991) registered the Raštelica barite deposit. Strmić (1999) performed fluid inclusion study of some quartz and barite crystals from the same deposit.

Geology

The oldest rocks are phyllites, one series of alternating thin bedded shales and platy to thin banded quartz-sericite silt-sandstones, which were drilled by a few boreholes.

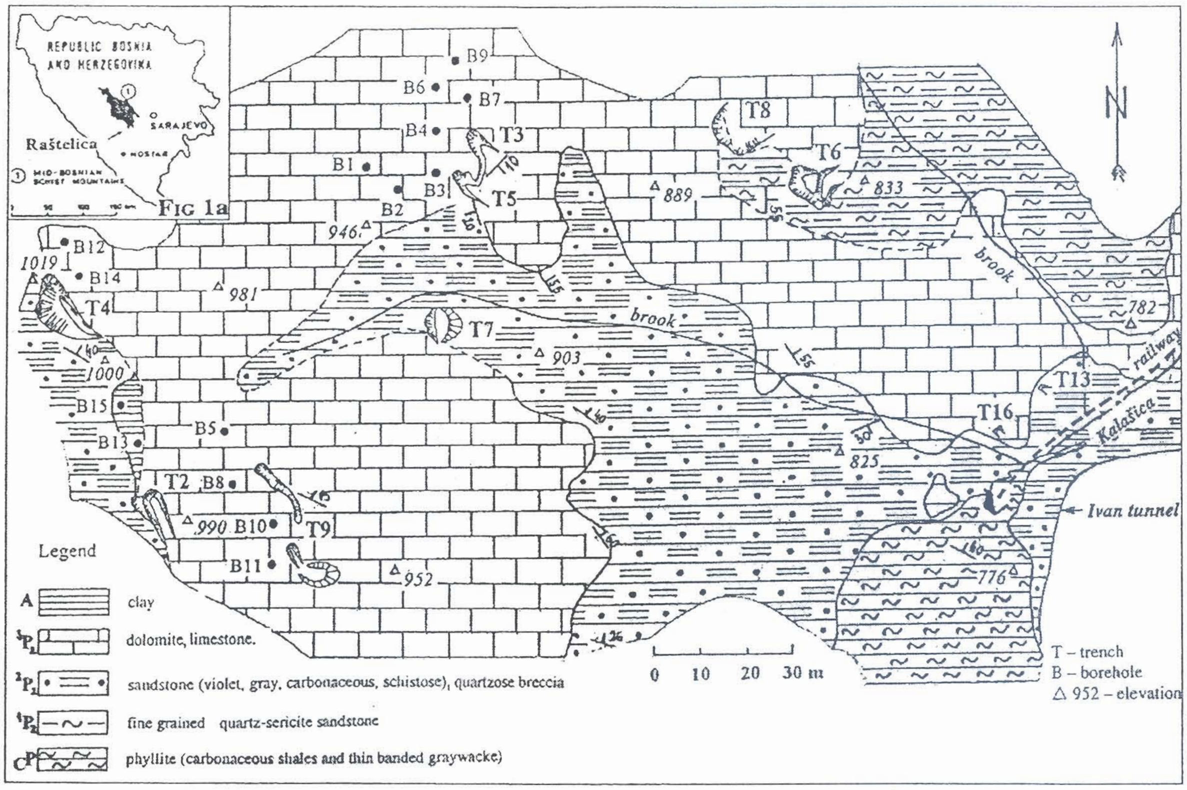


Fig. 1. Geological map of the Raštelica barite deposit. Made by R. Tončić Gregl (1964), simplified and rectified by I. Jurković.

They occupy southeastern part of the mapped terrain in the neighbourhood of the Ivan tunnel on the railway Sarajevo-Mostar.

The younger Permian series disconformably overlying phyllites is built up of variegated schistose sandstone, calcareous quartz-sericite schists and rare breccias. They are situated in the central, northeastern and outermost western part of the geological map. Jovanović et al. (1978) divided these rocks in three groups: $^3P_2$ with quartz sericite schists, quartzites and lydites, $^2P_2$ with phyllitoid rocks and $^1P_2$ with chlorite-muscovite schists. These rocks have been drilled in all boreholes excepting B-12 and B-15. The youngest series is represented by different carbonate rocks, with dolomite or dolomitized limestone, in lower part and porous, vuggy limestone at the top wich grade in Permo-Triassic (Jovanović et al., 1978).

Barite occurs mainly along contact between carbonate rocks in the roof and Middle Permian variegated sandstones. (Plate I, phot. 1, 2, 3 and 4) as elongated lenses, 0.3 to 3 m thick and a few meters to twenty meters long. In borehole B-10 were drilled two barite horizons, first barite body along contact with variegated sandstone, the second one 10 meters remote in the dolomitized limestones. In boreholes B-5, B-4 and B-7 barite bodies were some meters remote from contact. In the open pit IV (trenches T-6 and T-8) dolomitized limestone, mineralized with barite lenses, nests and veinlets grade into vuggy limestone.

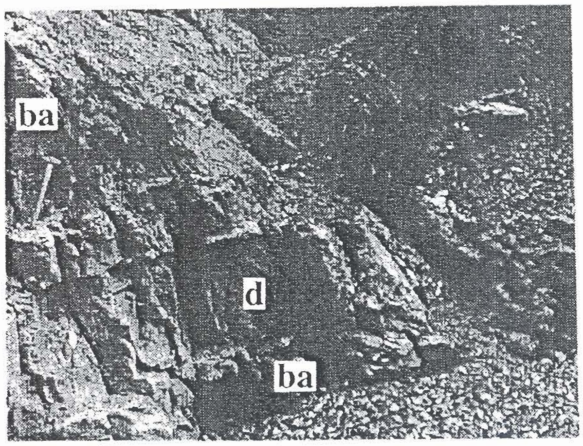
As postgenetic occurs dilluvial clay with angular barite fragments found in trench T-2 (open pit II), 6- to 8 meters thick covering surface of 30x10 m. Similar clay was drilled in boreholes B-13 and B-15 (Fig. 2).

General strike of all strata is NW-SE and the dip N 10-60°E. Younger tectonic movements caused numerous fissures, faults and crushed zones.

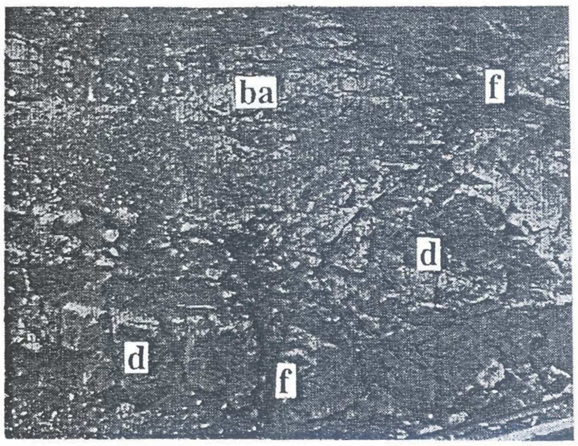
Mining exploration

Barite outcrops on the Medanovac hill were investigated by some trenches and short adits in 1950. During the period 1959-1960 15 boreholes, from 10 to 44 m deep, in total 361.7 m were performed (Fig. 2). Positive were eight boreholes, the average thickness of barite lenses was 1.64 m. Boreholes B-1, B-9 and B-15 were sterile. Boreholes B-6, B-11, B-12 and B-14 drilled small veinlets and dispersed nests. Boreholes B-2, B-4 and B-7 drilled richer barite mineralization.

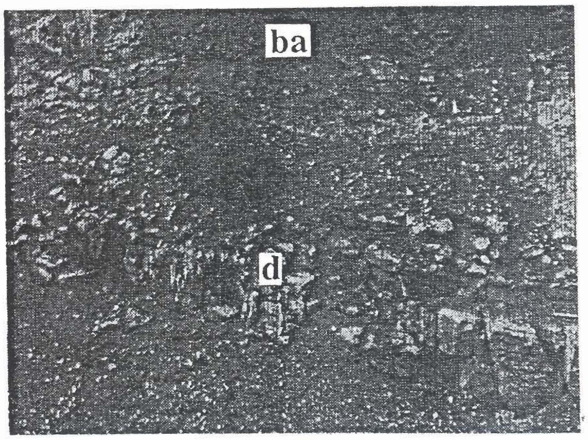
In the open pit II, 200 m distant in the southeastern direction, limited by trenches T-1, T-2, T-6a, T-9 and with boreholes B-2, B-5, B-8, B-10, B-11, B-13 and B-15, two barite beds were exploited. The bigger one with 32117 t of crude ore containing 92.64% $BaSO_4$ and smaller one with 1516 t of ore and 83.27 % of $BaSO_4$. In the open pit III, limited by trenches T-3 and T-5 and boreholes B-1, B-2, B-3, B-4, B-6, B-7 and B-9 were exploited also two barite beds. The bigger one had 13.747 t of ore (90.83% of $BaSO_4$), and the smaller one had 300 t of ore containing 91.82 % $BaSO_4$. In the open pit IV, 150 m further on east, trenches T-6, T-8, T-8a and T-11 exploited insignificant ore reserves.



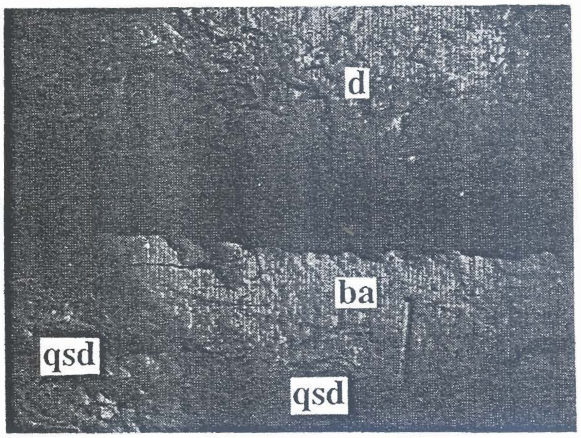
Phot. 1. Raštelica,T-3 - T-5. Barite lenses (ba), separated by dolomite beds (d).



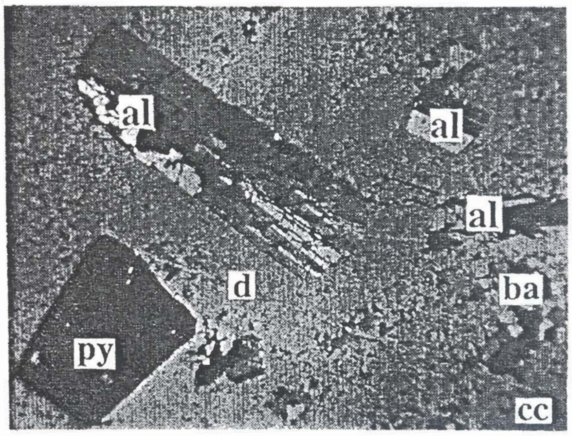
Phot. 2. Raštelica,T-3 - T-5. Crushed barite bedded lense (ba) along fault (f); d-dolomite.



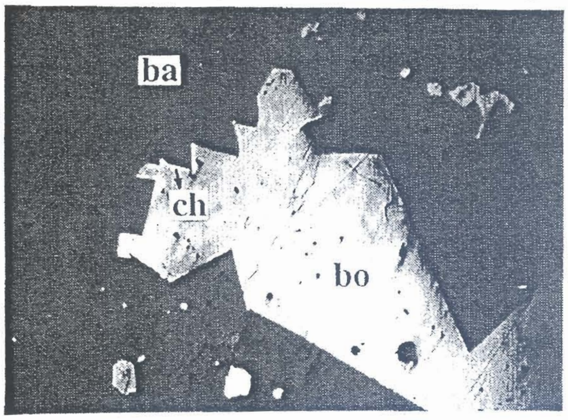
Phot. 3. Raštelica,T-3 - T-5. Barite lense (ba), more than 2m thick; d-dolomite.



Phot. 4. Raštelica,T-4. Barite lensoid body (ba), along the contact between quartzose sandstone (qsd) in footwall and dolomite (d) in the roof.



Phot. 5. Raštelica,T-8. Microgranular dolomitized and baritized limestone (d) with pyrite (py), albite (al), calcite (cc) and barite crystals (ba). Thin section, N+, magnif. 14x.



Phot. 6. Raštelica. Xenomorphic bornite crystals (bo) fill interstices of barite crystals (ba). Chalcocite (ch) replaces bornite. Polished section. Magnif. 56x.

Plate I. Raštelica. Photograph of barite ore deposite.

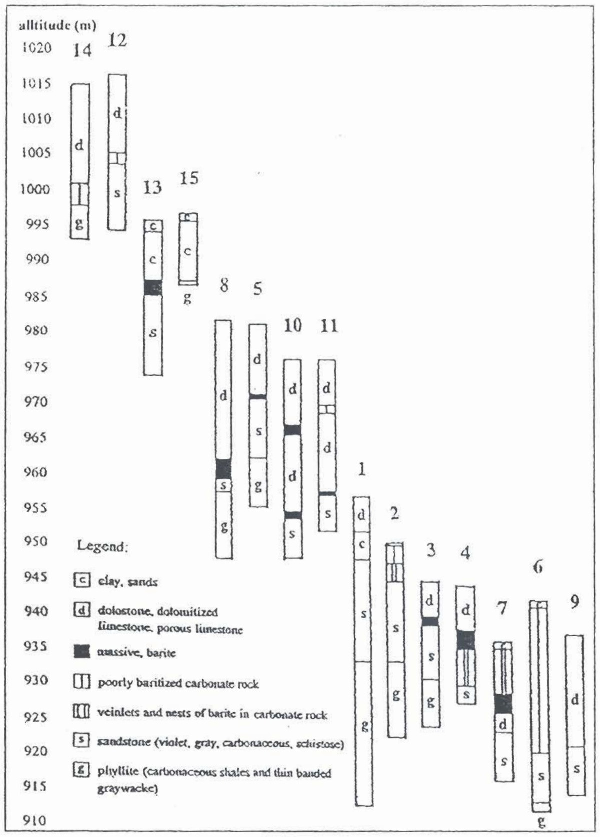


Fig. 2. Profiles of 15 boreholes at the Raštelica barite deposit. Made by S. Aba (1959-1960, Rudniki i mlinovi barita Kreševo), simplified and rectified by I. Jurković.

Total reserves of 43.722 t of crude ores with 92.20 % of $BaSO_4$ in 1964. were evaluated.

Chemical composition of barite

In Table 1 are presented mean values of chemical analyses performed on the average samples of cores from all mineralized boreholes in the Raštelica deposit. The average composition of barite from 11 boreholes is as follows: 90.09 % $BaSO_4$, 1.75 % SiO_2, 2.16 % R_2O_3, 2.36 % CaO, 0.66 % $MgCO_3$, 2.39 % lost of ignition; density is 4.12 g/ccm. The average composition of 13 barite samples taken from trenches is as follows: 90.00 % $BaSO_4$, 2.23 % SiO_2, 2.07 % R_2O_3, 1.20 % $CaSO_4$, 0.16 % $MgCO_3$; density is 4.12 g/ccm.

Paragenesis of the Raštelica barite deposit

The following paragenesis of barites was determined by microscope: **pyrite, quartz, sphalerite, bornite, chalcopyrite I, exsolution of chalyopyrite II, chalcopyrite III, digenite (blue isotropic chalcocite), myrmekitic intergrowths of chalcocite with bornite, lamellar chalcocite, idaite, barite, calcite, sericite** as primary (hypogene) minerals and **goethite, lepidocrocite, malachite** and **chalcocite** as hypergene minerals.

Pyrite is the oldest mineral of the paragenesis. It occurs irregularly disseminated along barite salbands as small, often irregular, rarely automorphic grains or in veinlets and nests. Genetically, fine rows of pyrite in barite are interesting. Grains are very often cataclazed. The $\delta^{34}S$ value of this pyrite is -0.7‰.

Subordinate quartz is in form of corroded, polygonal grains, often with undulate extinction. Eleven analyses of barite cores gave average content of 1.73% SiO_2 (varying from 0.60 to 2.96 % SiO_2). Five analyses from barite crude ore taken in open pits gave 2.23 % SiO_2 (varying from 0.19 to 4.73 % SiO_2).

Sphalerite shows dark internal reflexions indicating marmatite. The sphalerite grains were observed in interstices of barite grains or inside small masses of bornite (Plate II, phot. 10).

Bornite is the main sulphide mineral. It is in form of small masses, some mm in diameter, often associated with **chalcopyrite I** (Plate II, phot. 10 and 11). Bornite contains exolutions of **chalcopyrite II** in form of discs and platelets along (100) and lamellae along (111) of bornite. Very rarely **myrmekitic intergrowths of chalcocite with bornite** were observed.

Exsolutions of chalcopyrite in bornite indicate hydrothermal solution with temperature over +175°C, even higher than +225°C (Ramdohr, 1983).

Lamellar chalcocite (paramorph of rhombic chalcocite after cubic digenite) distinguishes a pseudo-octahedral lamellar structure of chalcocite platelets with (001) !! (111) of **digenite.**

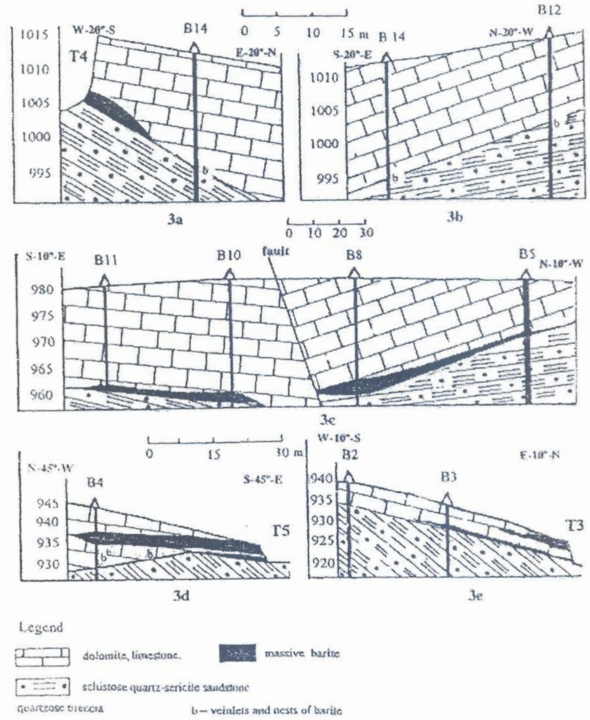
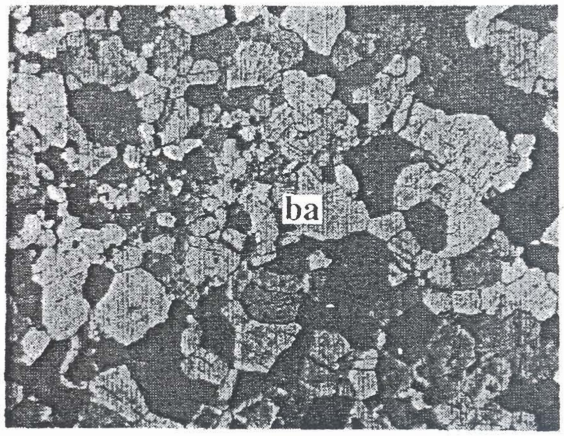
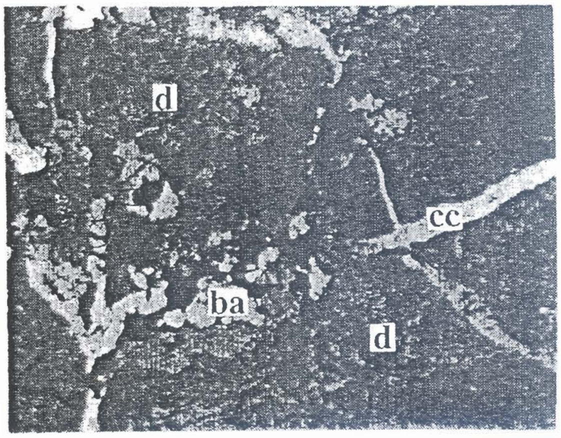


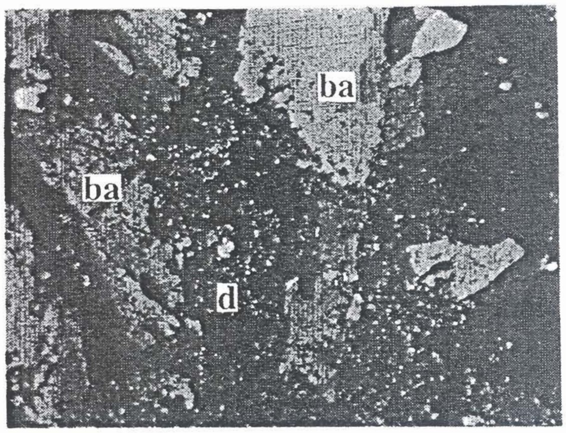
Fig. 3. Cross-sections of ore bodies of the Raštelica barite deposit. Made by R. Tončić Gregl (1964), simplified and rectified by I. Jurković.



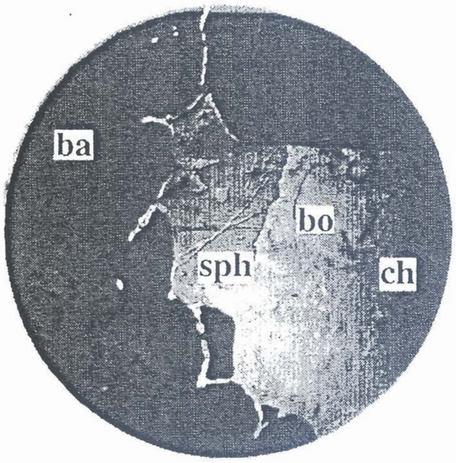
Phot. 7. Raštelica, T-15. Allotriomorphic granular structure of barite (ba).
Thin section, N+, magnif. 104x.



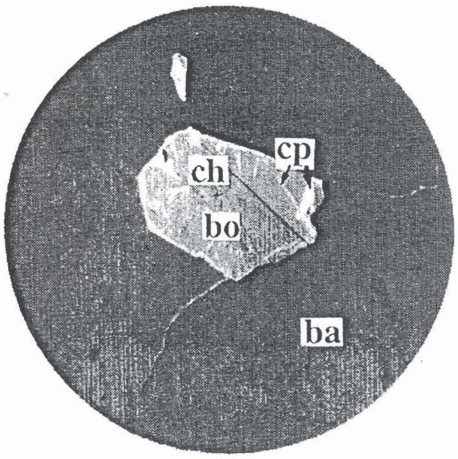
Phot. 8. Raštelica, T-6. Veinlets of calcite (cc) and barite (ba) replace microgranular dolomite (d).
Thin section, N+, magnif. 104x.



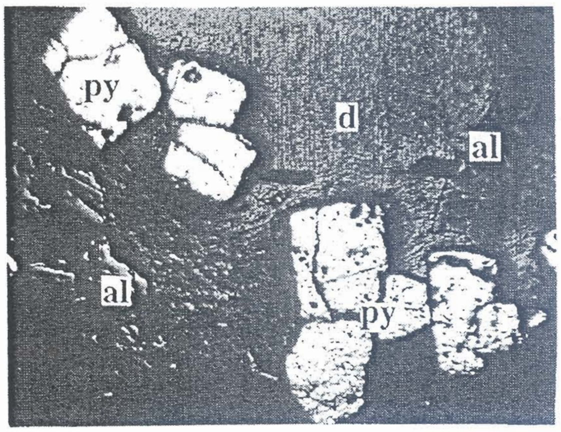
Phot. 9. Raštelica, T-3. Coarsegrained barite (ba) replace dolomite (d) – sieved structure.
Thin section, N+, magnif. 38x.



Phot. 10. Raštelica. Bornite (bo) and chalcocite (ch) replace sphalerite (sph) filling a drusy space in barite (ba).
Polished section, magnif. 104x.



Phot. 11. Raštelica. Bornite (bo) with exsolution of discs and laminae of chalcopyrite (cp). In bornite is small mass of chalcocite (ch). Gangue (darkgray) is barite (ba).
Polished section, magnif. 200x.



Phot. 12. Raštelica, T-8. Idiomorphic crystals of pyrite (py) and albite (al) crystals in dolomite (d).
Polished section, magnif. 56x.

Plate II.Raštelica . Microphotograph of thin and polished section.

Table 1. Chemical analyses of the Raštelica barite sample. Samples No 1-11, and No 17-25 were analyzed in the laboratory of the enterprise "Rudnik i mlinovi barita Kreševo" in Tarčin (1959/1960), samples No 12-15 in the laboratory in Mostar (1954-1958). Legend: T – trench, B

No.	B T	g/cm³	$BaSO_4$	SiO_2	R_2O_3	CaO	$MgCO_3$	Lost of ign.
1	B2	4.20	93.62	0.60	2.02	1.75		1.72
2	B3	4.16	91.84	2.08	1.63	1.07		1.78
3	B5	3.96	81.98	2.44	2.71	3.28		4.62
4	B7	4.19	92.24	2.02	2.21	1.03		0.94
5	B8	4.26	94.39	0.69	0.76	1.07		2.01
6	B10	3.81	83.24	1.71	1.44	5.51		6.81
7	B11	4.09	86.03	0.91	7.54	2.64		1.93
8	B12	3.87	87.55	0.86	2.55	4.21		4.03
9	B13	4.22	93.73	2.96	0.51	0.72		0.84
10	B4	4.16	92.11	2.22	1.34		1.10	1.51
11	B6	4.21	94.27	2.78	1.70		0.22	0.20
12	B6	4.12	90.09	1.75	2.16	2.36	0.66	2.39
13	T	3.66	85.54	2.54	0.73		tr	
14	4	4.08	91.26	1.16	2.60	1.60	0.24	
15	4a	4.34	95.54	2.53	1.84	1.40	0.08	
16	4	3.50	76.35	4.73	4.70	0.23		
17	T4	4.24	92.21	0.19	0.50	1.57		
18	T2	4.34	96.77					
19	T3	4.17	90.95					
20	T4	4.31	94.47					
21	T5	4.40	91.43					
22	T6	4.39	96.51					
23	T8	4.06	87.16					
24	T9	3.83	78.91					
25	TU	4.26	92.89					

Indigo-blue rhombic chalcocite, found in some bornite crystals, characterized by its strong reflection pleochroism and anisotropic effects represents probably paramorphose of covellite after rhombic chalcocite as cited in Ramdohr (1983).

Chalcopyrite III and **chalcocite** are locally the transformation products (desintegration). One part of such chalcocite is lamellar originating by disintegration of digenite, the other part is as discs and spindles along crystallographic planes of bornite.

Idaite is found inside bornite crystals characterized by its strong anisotropic effects, strong reflection pleochroism and typical reflectivity colours in air and in cedar oil.

Two nonidentified minerals ocluded in bornite were observed: first is pinkish. white in colour, with reflectivity higher than that of bornite, with weak anisotropic effects; second is grey in colour and with anisotropic effect.

Barite is the predominant mineral in paragenesis. Its participation in cores of boreholes vary from 81.98 % to 94.39 %. Mean value of 11 analyses is 90.09 % $BaSO_4$. Content of $BaSO_4$ in samples taken from 13 trenches varies from 76.35 % to 96.77 % $BaSO_4$ (mean value is 90.00 % $BaSO_4$). Structure of barite is allotriomorphic or inhomogeneous. Size of grains varies from 20 to 2500 micrometers. The grains are isometric, irregular, polygonal, oval, platy, or fan-shaped. Local is visible beggin of recrystallization. Aggregates of coarse grained barite are characterized by fissures, diturbed cleavage, bent twinned lamellae, locally with undulate extiction, even irregular optical fields. Crystals from one bigger druse were subjected to the examination by goniometer (made by Lj. Barić, presented in Jurković, 1956). Crystals have platy habit in the direction of (001) and elongation along the axis a (100). The most often combination of forms are (001), (102) and (001) or (001), (102), (101) and (011), very rarely ss (110). Plane (001) is better developed, then (102) and (011). Very often plane (101) is narrow. Planes (110) are small, they are in form of deltoid.

Calcite is younger than barite, but older than sulphide phase. It occurs in narrow veinlets, nests and as individual grains different in size in barite, along salbands in carbonate host rocks (dolomite, dolomitized limestone, limeston). In 9 samples content was 2.59 % CaO (varying from 0.72 to 5.51 % CaO).

Sericite, is found along salbands, in fissures or in interstatices of barite crystals.

Goethite, lepidocrocite, malachite and hypergene chalcocite are secondary minerals.

Distribution of $SrSO_4$ in Barite

Šiftar (1990) analyzed, by spectrochemical method, 25 varieties of barite samples taken from all four open pits, or 11 trenches. Following types of barite structure were analyzed: fine-grained, coarse-grained, recrystallized, grey-coloured, samples with fine bedded pyrite, from compact barite bodies or lenses. Analyzed were also samples taken from barite veinlets and nests in carbonate rocks.

The mean obtained value was 4.40 % $SrSO_4$, varying from 2.1 % to 9.9 % (Fig. 4a). Eight samples of fine-grained and coarse-grained barite from veinlets and nests gave 4.31 % $SrSO_4$. Five samples of expressively fine bedded barite marked by rows of fine-grained pyrite gave 4.00 % $SrSO_4$. Dense, compact, fine-grained eleven barite samples gave the mean 4.63 % $SrSO_4$.

In the trench T-8 Šiftar (1.c.) found a part of barite body in the direct contact with fine-grained recrystallized barite with coarse-grained barite alternating with fine rows of pyrite grains. Fine-grained sample gave 2.9 % $SrSO_4$, whereas the coarse-grained ore yielded 8.3 % $SrSO_4$, indicating an increase of $SrSO_4$ content during the recrystallization.

Sulphate sulphur isotopic composition of barite

Seventeen barite samples elected among those analyzed on $SrSO_4$ content gave mean value of $\delta^{34}S$ of +6.17 ‰, varying from +0.7 ‰ to + 11.7 ‰ (Šiftar, 1990), shown in Fig. 4b.

Two groups of samples can be distinguished. The first group comprises seven samples of compact, dense, fine-grained, often grey-coloured barite with rows of fine-grained pyrite. These samples were taken from barite bodies at the contact of carbonate rock and variegate sandstone. This group which gave mean $\delta^{34}S$ value of +9.52 ‰, varying from +8.00 ‰ to +11.7 ‰ probably belongs to the first barite generation (Fig. 4b)

Samples of the second group were taken from barite veinlets, nests and coarse-grained aggregates. Ten samples of this group which gave mean $\delta^{34}S$ value of 4.00 ‰, varying from 0.7‰ to + 6.00 ‰ (Fig. 4b) represent a younger generation or recrystallized barite.

Fluid inclusion study

Mikrothermometry has been performed on the Chaixmeca microthermometry apparatus type MTM.

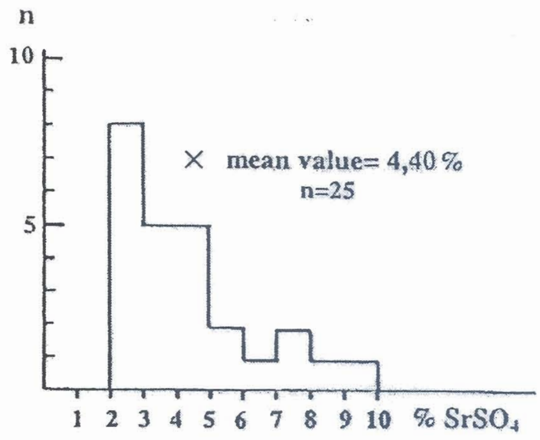


Fig. 4a. Distribution of $SrSO_4$ in barits. Made by D. Šiftar (1990).

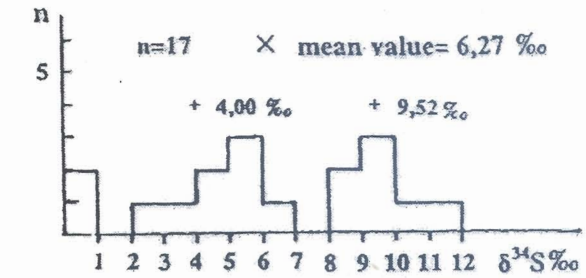


Fig. 4b. Distribution of sulphate and sulphur isotope values. Made by D. Šiftar (1990).

Techniques: temperature range from 180°C (with liquid nitrogen) to +600°C; digital read out with ±0.1°resolution; small vertical gradient (e.g. 0.8°C) for one mm in the center of the field, at +400°C. Reproducibility of measurements 0.1°C between -60°C and +400°C. Apparatus is built in silica condenser for better illumination of sample, with infrared filter to decrease heating of the sample by the light of the microscope (Poty et al., 1976).

a) Inclusion morphology

For the preparation of slides, irregular, partially transparent quartz grains and white non-transparent small barite plates were used.

Inclusions in quartz crystals are: (1) primary two-phase (L + V), rich in liquid phase, homogeneously filled, automorphic, showing negative crystallographic forms of quartz (Fig. 6.1.); (2) primary multi-phase (L + V + S) inclusions, isometric (Fig. 6.2.) or needle-shaped (Fig. 6.3.); (3) secondary two-phase (L + V) inclusions along healed up fissures (Fig. 6.3.); (4) solid inclusions (S) with square habit; (5) gas inclusions, partially or completely dark (Fig. 6.4.).

Inclusions in barite crystals are: (1) primary two-phase (L + V), very irregular (Fig. 6.4.); (2) irregular primary multi-phase (L + V + S) (Fig. 6.5.); (3) secondary, two-phase (L + V) inclusions enriched on liquid phase situated along healed fissures.

b) Cryometry

Microthermometry was perfomed only on primary quartz and barite inclusions. Inclusions were first freezed at -75°C adopting brown colour and collapse of gas buble. Successive warming of this frozen mass gave rise to four or five solid phases presented on the Table 2.

The first melting occurred from -51 to -55°C (Fig. 5a), the second phase from -28 to -26°C (only one inclusion at -24.9°C) (Fig. 5b) whereas the third phase is characterized by corroded crystals with very low relief. Its melting occurred between -17 and -21°C (Fig. 5c).

phase between -10°C to -13°C. Barite inclusions behaved on the contrary.

c) Homogenization temperature

All quartz inclusions homogenized into liquid state. Barite inclusions cracked at +85 - +90°C, deformed and fluid inlcusion leaked.

Homogenization temperatures of the three multiphase quartz inclusions were registered at +219.7, +220.5 and +221.8°C. The total homogenization temperature for all inclusions were measured in the interval from +220 to +350°C (Fig. 5f).

Table 2. Solid phases in quarz and barite inclusions. Salinities (wt% NaCl equ.) were determined on the basis of dissolution temperature of hydrohalite (S_1) or halite (S_2).

	Quartz		Barite	
	Four types of hydrates	Five types of hydrates	Four types of hydrates	Five types of hydrates
T_1 (k)	-51.0 to -55.0°C	-51.0 to -52.5°C	-52.0 to -55.0°C	-52.0 to -53.5°C
T_2	-25.5 to -27.0°C	-24.5 to -28.0°C	-26.5 to -27.5°C	-25.5 to -28.5°C
T_3	-17.5 to -21.0°C	-18.5 to -21.0°C	-17.5 to -20.0°C	-19.0 to -20.5°C
T_4	-11.0 to -12.5°C	-10.0 to -12.5°C	-10.5 to -13.0°C	-10.0 to -11.5°C
T_5		- 8.0 to + 3.0°C		- 3.0 to - 5.0°C
T_6	+230 to +270°C	+219.7 to +221.8°C		
T_H		+220 to +350°C	not determined due to cracking of barite crystals at +85 to +90°C	
S_1		>25.0 wt% to 32.9 wt% equ. NaCl		
S_2		32.6 to 32.9 wt% equ. NaCl		

These three first phases were registered in all quartz and barite inclusions. The fourth melting phase on the prismatic crystals occurred between -10 and -13°C (Fig. 5d). This phase is not registered on the inclusions characterized by the last melting between -7 and +3°C. The fifth phase occurred in the interval between -7 and +3°C. The fifth phase occurred in the interval between -7 and +3°C (Fig. 5e). Cubic crystals assumed a prismatic appearance in the course of melting.

It has been noted that the fluid inclusions in quartz characterized by last melting interval between -7 and +3°C dominate over those with last

d) Salinity

On the basis of the last melting point of hydrohalite (according to Roedder, 1962) the inferior limit of 25 weight % of NaCl equ. was determined.

Salinities from the melting points for halite from +219.7°C to +221.8°C using Shepherd's (1985) diagram were obtained. They gave salinities between 32.6 and 32.9 wt % NaCl equ. (Table 2) (Collins, 1979).

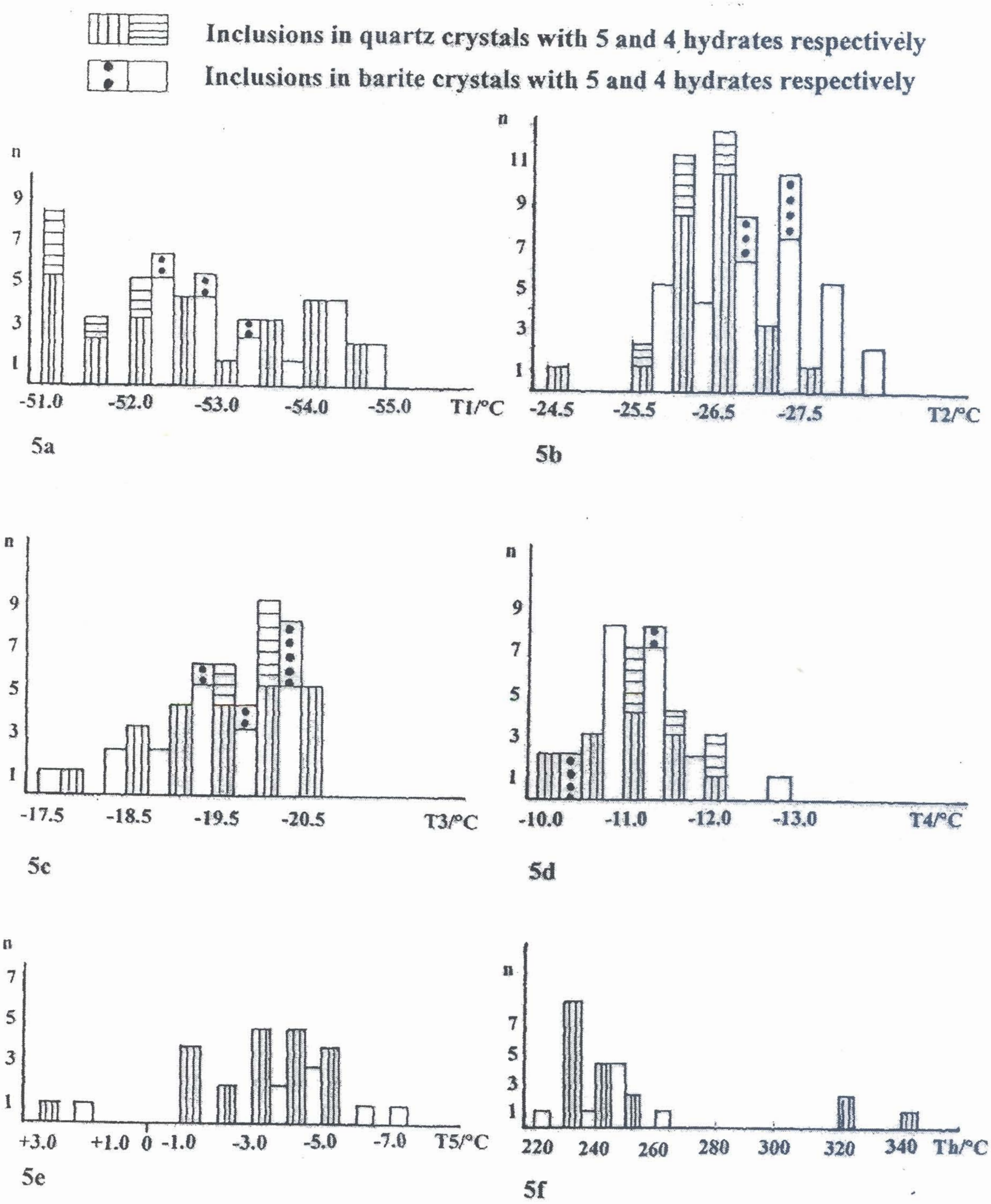


Fig. 5. Cryometry and homogenisation temperature of quartz and barite crystals from the Raštelica deposit (made by. S. Strmić): 5a – frequency distribution/eutectic temperature; 5b – frequency distribution/temperature of the last melting of the second phase; 5c – frequency distribution/temperature of the last melting of the third phase; 5d – frequency distribution/temperature of the last melting of the fourth phase; 5e – frequency distribution/temperature of the last melting of the fifth phase; 5f – frequency distribution/homogenisation temperature.

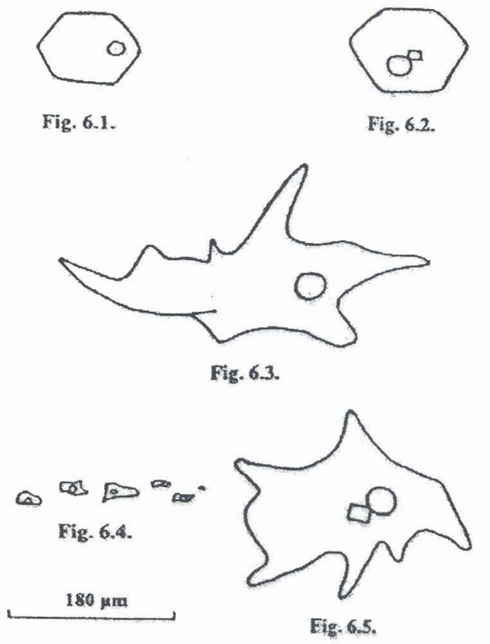


Fig. 6. Morphology of fluid inclusions (made by S. Strmić, 1999).

Conclusion

The Raštelica barite deposits on the Medanovac hill are hosted by carbonate rocks along their contact with variegated sandstones. A series of mineralized carbonate rocks begins with weakly or strongly dolomitized limestones and terminates with vuggy (poreus) limestones of transitional Middle Permian and Permo-Triassic age.

Most barites occurs in form of short lensoid bodies, 0.3 to 3.0 m thick mainly along the contact with underlying sandstones. Only some barite lenses lie 5-10 meters remote of the contact, inside carbonate rocks. Interspace between the barite bodies is locally slightly to strongly mineralized with barite nests, veinlets or with dispersed barite grains and minute agglomerations.

Barite deposits are of hydrothermal origin. Exolutions of chalcopyrite in bornite indicate temperature over +175°C, even over 225°C (Ramdohr, 1983). Homogenezation temperatures of inclusions in quartz crystals gave range from 220°C to +350°C. Sphalerite from the Raštelica deposits is marmatite, formed at higher mesothermal temperature.

Barite deposits occur exclusively in the lower parts of the Middle Permian carbonate series, consequently they are stratabound deposits. Values of $\delta^{34}S$ in barites, ranging between +9.00 ‰ and +11.7 ‰, obtained from barite samples taken in compact barite bodies, indicate sulphate sulphur from the Permian sea water (Claypool, G. E. et al., 1980; Cortecci, G. et al., 1981).

The Raštelica barite deposit, characterized by bornite and chalcopyrite as the main ore minerals, strongly differ from all other barite deposits in the Mid-Bosnian Schist Mountains which are characterized by gold and silver-bearing mercurian tetrahedrite as the main sulphide (sulphosalt) mineral.

Some specific field observations put forward the dilemma concerning the genesis of these barite deposits: (1) epigenetic, metasomatic hydrothermal origin or (2) stratiform hydrothermal sedimentary origin.

The most conspicuous characteristics of the Raštelica barite deposits are: (a) bedded lensoid bodies; (b) lack of disconformable veins; (c) very narrow zone of carbonate rocks (5-to 10 m) mineralized with barite; (d) barite lenses and lensoid bodies are conformable with bedding of carbonate rocks; (e) fine alternations of barite, pyrite and dolomitized limestone; (f) often grey and dark-grey coloured barite which by blow of hammer produces exhalation (fume) of H_2S gas.

We are more inclined to accept the second hypothesis of stratiform genesis of the Raštelica barite deposit.

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