New minerals for Bulgaria from the Iglika skarn deposit, SE Bulgaria

Нови минерали за България от скарново находище Иглика, ЮИ България

Svetlana Encheva[1], Petko Petrov[1], Dorota Środek[2], Irina Galuskina[2]
Светлана Енчева[1], Петко Петров[1], Дорота Сродек[2], Ирина Галускина[2]

[1] Earth and Man National Museum, Sofia, Bulgaria; E-mails: sencheva@abv.bg; petkopet@abv.bg
[2] University of Silesia, Faculty of Earth Sciences, Sosnowiec, Poland; E-mails: dsrodek@gmail.com; irina.galuskina@us.edu.pl

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The Iglika skarn deposit is located in the Srednogorie structural-metallogenic zone in SE Bulgaria. A description of its formation, mineral associations, and facies analysis is given by Ivanova-Panayotova and Kanazirski (1995). It is the only deposit of magnesian skarns in Bulgaria with an extremely monticellite composition, and also the only location where the mineral merwinite occurs (Ivanova-Panajotova, 1962). Furthermore, the minerals thaumasite and xonotlite were found there for the first time in Bulgaria (Kostov et al., 1964). Pertsev et al. (1975) found a mixture of dellaite and montichelite in white porcelain-like veins in a monomineral merwinite skarn, which was proved by optical data and a diffractogram of the mixture. In the present work, we provide data on the chemical composition of dellaite and Cl-bearing dellaite.

In the last two years some new minerals and varieties for this locality have been proved. Among them Cl-bearing dellaite, rankinite, rustumite, hydroxylellestadite, and foshagite are found there.

Dellaite, $Ca_6(Si_2O_7)(SiO_4)(OH)_2$, is observed in white veinlets as irregular crystals with good cleavage in a close association with monticellite and Ca-hydrosilicates (Fig. 1a). Furthermore, it forms characteristic symplectite aggregates with monticellite (up to 70 μm in size) in primary merwinite grains (Fig. 1b). **Rankinite**, $Ca_3Si_2O_7$, is represented by irregular grains intensively substituted by later calcium hydrosilicates

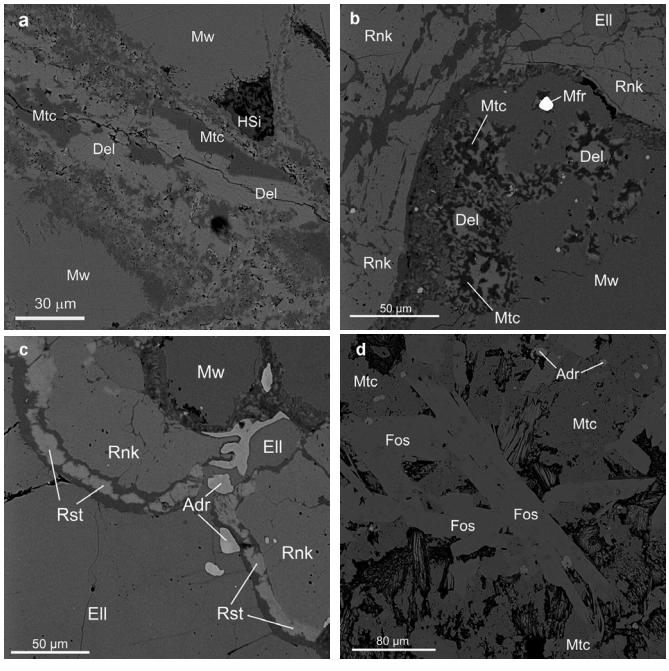

Fig. 1. SEM photographs of minerals from Iglika skarn deposit

Abbreviations: Mw – merwinite, Mtc – monticellite, Del – dellaite, Rnk – rankinite, Rst – rustumite, Ell – hydroxylellestadite, Fos – foshagite, Adr – andradite, Mfr – magnesioferrite, HSi – Ca-hydrosilicate

Table 1. Chemical composition of the new minerals from Iglika skarn deposit

	Dellaite	Cl-bearing dellaite	Rustumite	Rankinite	Hydroxylellestadite	Foshagite
Wt.%	mean 8	mean 5	mean 12	mean 8	mean 7	mean 3
CaO	62.79	60.70	61.47	59.13	56.00	54.14
SiO_2	33.81	33.15	33.11	41.98	18.10	42.78
SO_3	0	0	0	0	23.95	0
Cl	0.16	3.08	4.78	0	0.67	0
H_2O	3.32	2.52	1.98			4.32
-O=Cl	0.04	0.70	1.08		0.15	
Total	100.06	99.75	100.26	101.11	100.22	101.24
*Ca	5.99	5.99	9.98	3.01	5.00	4.03
Si	3.01	3.01	5.02	1.99	1.51	2.97
SO_4	0	0	0	0	1.50	0
Cl	0.12	0.47	1.28	0	0.09	0
OH	1.88	1.53	2.00		0.91	2.00

*Formula calculated on the basis of cations respectively: 9 for dellaite, 15 for rustumite, 5 for rankinite, 8 for hydroxylellestadite, and 7 for foshagite. Water is added on the basis of charge balance.

(Fig. 1b, c). **Rustumite**, $Ca_{10}(Si_2O_7)(SiO_4)(OH)_2Cl_2$, is an alteration product after rankinite and forms fine zones (up to 50 μm in thickness) on its grains (Fig. 1c). **Hydroxylellestadite**, $Ca_5(SiO_4)_{1.5}(SO_4)_{1.5}OH$, is represented by anhedral grains, up to 1.5 mm (Fig. 1c). **Foshagite**, $Ca_4(SiO_3)_3(OH)_2$, forms elongated prismatic crystals or fibrous aggregates (Fig. 1d). It is the latest mineral in this association.

Chemical analyses were carried out using an electron microprobe CAMECA SX100 (Institute of Geochemistry, Mineralogy and Petrology, University of Warsaw). The results for Iglika minerals are given in Table 1. **Dellaite** from symplectite aggregates inside merwinite grains is characterized by higher Cl contents, whereas dellaite forming bigger aggregates is practically Cl-free. The highest chlorine content in dellaite is 3.81. That corresponds to 0.59 *apfu* in empirical crystal chemical formula – $Ca_{5.99}(Si_2O_7)(SiO_4)(Cl_{0.59}OH_{1.41})_{\Sigma 2}$. Some negligible impurities of Mg, Fe and Mn are noted in the composition of dellaite from Iglika. Cl-bearing dellaite was described in the skarns of the Birkhin massif in Eastern Siberia, Russia (Armbruster et al., 2011). The composition of F-free, low Cl-bearing **rustumite** from Iglika is similar to the one from skarns near Ikizedere, Turkey (Gfeller et al., 2013). **Hydroxylellestadite** with insignificant Cl content has a crystal chemical formula $Ca_5(SiO_4)_{1.51}(SO_4)_{1.50}(OH)_{0.91}Cl_{0.09}$. **Rankinite** and **foshagite** from Iglika are characterized by constant compositions, which are close to the ideal stoichiometric formulas.

Chemical composition of merwinite and monticellite in this association is characterized by FeO impurity, their crystal chemical formulas are as follows: $Ca_3(Mg_{0.89}Fe^{2+}_{0.02})_{\Sigma 0.91}(SiO_4)_2$ and $Ca(Mg_{0.88}Fe^{2+}_{0.12})_{\Sigma 1.0}SiO_4$, respectively.

The Raman spectra were recorded on a WITec confocal Raman microscope CRM alpha 300 (Institute of Physics, University of Silesia, Poland). For the studied Cl-bearing dellaite they correspond to the spectrum reported by Armbruster et al. (2011). The strongest bands are at 600–1000 cm^{-1} range and they are connected to Si-O vibration in the tetrahedrons and $[Si_2O_7]^{6-}$ groups. Two intense bands occurring at 3400–3700 cm^{-1} range are linked to stretching vibration of OH^- groups. The intensity of these bands is uneven and depends on the orientation of the crystals. The Raman spectrum of rustumite is analogous to the ones described by Gfeller et al. (2013). The main intense bands in Raman spectrum are related to vibrations of Si-O in the 600–1000 cm^{-1} range.

All the minerals described above are formed during the regressive stage of alteration of high-temperature merwinite skarns.

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