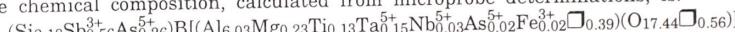


Adam PIECZKA¹, Mariola MARSZAŁEK¹

HOLTITE — THE FIRST OCCURRENCE IN POLAND

Abstract. Holtite — a very rare silicate mineral with a complex chemical composition has been found in the granitoid pegmatite, occurring in the marginal zone of the Szklary serpentinite massif. The mineral has been reported so far only from Australia and Russia. Besides typical of pegmatites components, such as K-feldspars, albite, quartz, muscovite, clinochlore, hydrobiotite, it is also accompanied by tourmaline, spessartine, zircon, chrysoberyl, and unidentified manganese oxides. The holtite occurs as strongly elongated needles. It crystallizes in the orthorhombic system, space group Pnma. Cell parameters: $a = 4.7048(5)$ Å, $b = 11.897(2)$ and $c = 20.398(3)$ Å, are slightly higher than those reported in literature due to the presence of magnesium in its structure. The chemical composition, calculated from microprobe determinations, is:



The origin of holtite from Szklary is associated with an intrusion of the granitic magma into basic and ultrabasic rocks.

Key-words: holtite, Szklary, Poland, chemical composition, X-ray data, IR-spectrum.

Holtite ($\text{Si}_{2.25}\text{Sb}_{0.75})\text{B}[\text{Al}_{6.00}(\text{Al}_{0.43}\text{Ta}_{0.27}\square_{0.30})\text{O}_{15}(\text{O},\text{OH})_{2.25}]$) is a very rare mineral related to dumortierite $\text{Si}_3\text{B}[\text{Al}_{6.75}\square_{0.25}\text{O}_{15}(\text{O}_{2.25}\text{OH}_{0.75})]$, described so far only from Australia (Pryce 1971) and the Kola Peninsula, Russia (Voloshin et al. 1976). It crystallizes in the orthorhombic system and its space group is Pnma. The two occurrences of holtite are associated with intrusions of acid volcanics into older metamorphosed complexes, composed of amphibolites or schists and gneisses. In the Australian occurrence holtite is associated with quartz, microcline, tourmaline, tantalite and stibiotantalite, while in the Russian one with quartz, plagioclase, microcline, muscovite, tourmaline, spodumene, amblygonite, pollucite, lepidolite, microlite, simpsonite, stibiotantalite and zircon.

In Poland, holtite in trace amounts has been identified as an accessory component in a pegmatite, occurring in the contact between granites of the so-called Niemcza zone and serpentized peridotitic rocks, exposed in one of the pits of the abandoned mine of nickel silicates in Szklary near Ząbkowice Śląskie (Lower Silesia). The pegmatite is composed mainly of orthoclase, albite, quartz, muscovite, while the subordinate minerals include clinochlore, hydrobiotite,

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tourmaline (Pieczka 1987), spessartine (Pieczka et al. 1996), not fully determined hydroxy-oxide and phosphate phases with manganese as the main cation, while accessory phases contain zircon, chrysoberyl and holtite.

Holtite was found in one of the fragments of the pegmatite, where it occurs as a thin vein, 1 mm in diameter, in radial aggregates of strongly elongated crystals (fibres) straw-yellow in colour and with the silky lustre. Its individuals are 0.1 mm long and 2–5 µm thick (Fig. 1). The elongation is negative, and the indices of refraction are: $n_\alpha = 1.740$ – 1.747 , n_β and $n_\gamma \approx 1.76$. The typical paragenesis includes quartz, feldspar, tourmaline, zircon, and the mentioned mixture of mainly hydroxy-oxides.

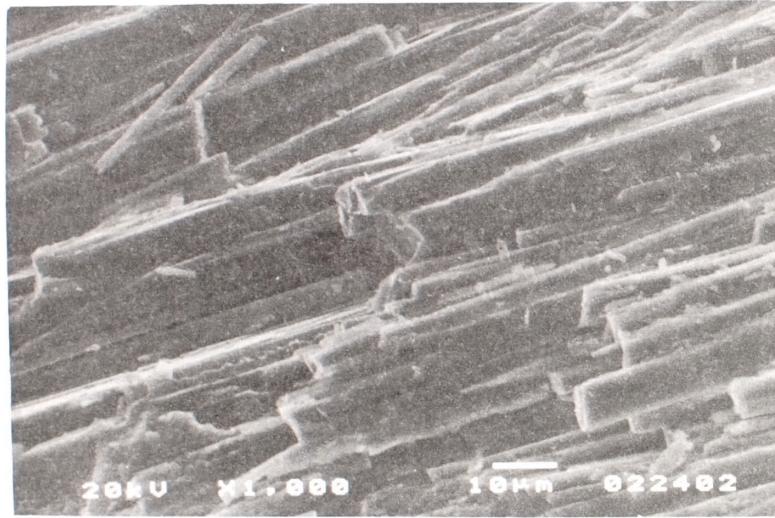


Fig. 1. SEM photomicrograph of holtite from Szklary

The habit of the mineral, as well as the character of its occurrence suggested initially that the mineral is dumortierite, like it was in the case of the Australian occurrence. Only point chemical analyses, carried out with a JEOL 5200 scanning electron microscope combined with an EDS Link Exl attachment have shown the presence of significant amounts of such elements as Sb, Ta, As and Nb which are of no quantitative importance in the structure of dumortierite (Moore, Araki 1978; Alexander et al. 1986; Chopin et al. 1995).

This finding has spurred the authors to carry out an approximate estimation of the chemical composition on the basis of several quantitative analyses in selected places of the studied mineral. The microprobe analyses were carried out in the Institute of Metallurgy in Gliwice. The average result of these analyses, completed with stoichiometric amounts of B_2O_3 and normalized to 100 wt.%, is shown in Table 1.

TABLE 1
Chemical composition (wt.%) of holtite
from Szklary

Component	wt.%
SiO_2	20.23
Sb_2O_3	12.94
Al_2O_3	47.38
MgO	1.43
TiO_2	1.56
Ta_2O_5	5.14
Nb_2O_5	0.69
As_2O_5	5.04
Fe_2O_3	0.20
$B_2O_3^*$	5.39
	100.0

* B_2O_3 content calculated from the stoichiometric composition (the analysis normalized to 100%)

parameters of typical dumortierites and their Ti-Fe varieties (Table 2). The differences may be attributed to the chemical composition. As it has recently been found, higher amounts of magnesium ions in dumortierites result in a considerable increase of the cell parameters of these minerals (Chopin et al. 1995), and the same phenomenon is the most probable also in the holtite in question.

TABLE 2

Cell parameters of holtite and dumortierite (examples)

Mineral name	References	Cell parameters		
		<i>a</i>	<i>b</i>	<i>c</i>
Holtite	this study	4.7048(5)	11.897(2)	20.398(3)
	Hoskins et al. 1989	4.6914(5)	11.896(2)	20.383(4)
Dumortierite Fe, Ti-dumortierite	Moore, Araki 1978	11.828(1)	20.243(3)	4.7001(5)
	Alexander et al. 1986	11.781(2)	20.177(3)	4.692(1)
		11.802(2)	20.222(4)	4.695(2)
Mg-dumortierite	Chopin et al. 1995	11.91(3)	20.40(3)	4.730(2)

Taking into consideration the remarks on the crystal structure and forms of substitution in holtite (Hoskins et al. 1989), and also the substitution of ions, which appear when the Mg^{2+} and Ti^{4+} are introduced into the dumortierite structure (Alexander et al. 1986; Chopin et al. 1995), the following approximate chemical formula of holtite from Szklary has been arrived at:
 $(Si_{2.18}Sb_{0.56}As_{0.26})B[(Al_{6.03}Mg_{0.23}Ti_{0.13}Ta_{0.15}Nb_{0.03}As_{0.02}Fe^{3+}_{0.02}O_{0.39})(O_{17.44}O_{0.56})]$

An infrared spectrum, recorded for the mineral in question with a FTIR BIO-RAD 165 spectrometer, is shown in Figure 2. It is similar to the IR-spectrum of holtite from the Kola Peninsula (Voloshin et al. 1976).

Then, a powder sample representing the mixture of the studied mineral and accompanied quartz was X-rayed and the obtained pattern measured using the quartz as an internal standard. The list of interplanar spacings d_{hkl} was compared with the JCPDS record (Table 3). Then, using the step recording with the distance $\Delta 2\Theta = 0.005^\circ$, the positions of 10 reflections with Miller indices determined without any doubt were precisely measured as the basis for calculation of cell parameters *a*, *b* and *c*. They are as following: $a = 4.7048(5)$ Å, $b = 11.897(2)$ and $c = 20.398(3)$ Å. The obtained values only slightly exceed figures reported for holtite (Pryce 1971; Voloshin et al. 1976; Hoskins et al. 1989), and at the same time are considerably different from the lattice

TABLE 3

X-ray powder data for holtite from Szklary

Holtite Szklary		Holtite JCPDS 25-1209		hkl	Holtite Szklary		Holtite JCPDS 25-1209		hkl
d _{hkl}	I	d _{hkl}	I		d _{hkl}	I	d _{hkl}	I	
1	2	3	4	5	1	2	3	4	5
10.297	75	10.309	100	011	1.942	2	1.946	4	062, 233
5.922	100	5.917	30	020	1.930	3	1.934	4	048, 206
		5.882	30	013			1.931	4	129
5.116	45	5.128	20	022	1.906	2	1.908	2	216, 063
		5.076	30	004	1.878	2	1.873	4	234
4.243	5	4.255	3	111, 102	1.847	2	1.845	2	064, 240
3.864	15	3.861	12	024, 103	1.837	2	1.835	1	241
		3.846	12	015	1.826	2	1.828	3	160
3.621	2	3.623	2	121			1.821	2	161
3.466	17	3.460	12	122, 104			1.799	1	
3.425	7	3.436	6	033			1.789	2	
		3.390	3	006	1.778	2	1.770	2	
3.338	3	3.311	3	114	1.748	2	1.751	2	
3.238	14	3.226	20	123	1.740	2	1.742	2	
3.082	11	3.067	6	105			1.736	2	
2.974	20	2.967	20	040	1.731	2	1.730	2	
2.952	46	2.941	40	026			1.692	2	
2.907	7	2.899	8	132	1.678	2	1.681	6	
2.856	8			042			1.678	2	
2.844	12	2.841	10	035	1.670	2	1.667	2	
2.767	2	2.762	3	133	1.658	3	1.658	3	
2.732	3	2.732	2	125, 043			1.656	2	
2.684	7	2.681	7	116	1.645	2	1.650	2	
2.569	7	2.571	8	044			1.645	1	
2.552	7	2.545	8	008			1.639	2	
2.495	3	2.494	2	141	1.632	2	1.629	2	
		2.475	2	107			1.626	2	
2.434	5	2.427	6	135	1.617	2	1.621	2	
2.367	12	2.364	20	051			1.616	2	
2.358	9	2.353	15	143, 200	1.567	4	1.570	6	
2.345	12	2.342	20	037, 028			1.565	6	
		2.336	25	201	1.555	4	1.553	8	
2.235	7	2.237	4	108, 046			1.550	4	
2.195	2	2.203	2	118, 220	1.541	2	1.543	2	
2.179	2			213			1.502	1	
		2.174	2	221	1.486	2	1.488	4	
2.126	2	2.137	2	204, 150			1.484	3	
2.106	5	2.114	6	151, 214			1.481	4	
2.094	7	2.092	10	137, 128	1.476	2	1.475	4	
		2.075	2	152	1.471	2	1.471	4	
2.020	2	2.016	4	230, 146	1.451	3	1.451	3	
2.007	2	2.008	2	224, 215	1.434	2	1.435	2	
1.978	5	1.980	6	060, 061			1.431	2	
		1.965	4	039, 154	1.414	2	1.412	2	

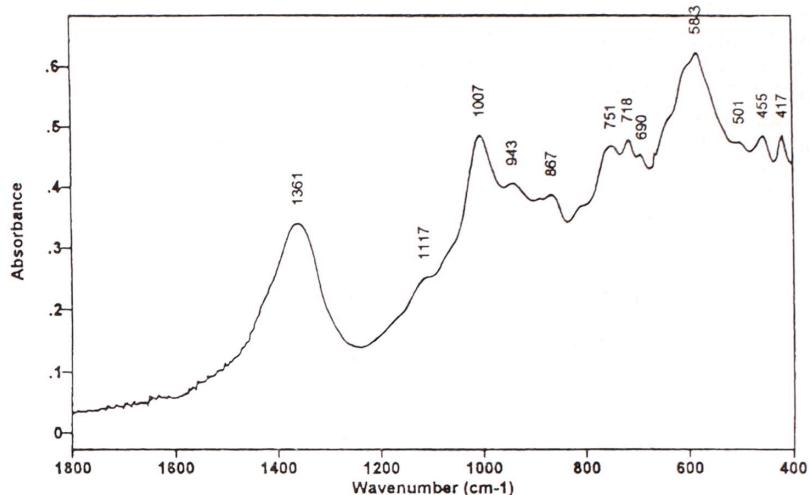


Fig. 2. IR-spectrum of holtite from Szklary

All the results presented above point to holtite as a mineral identified without any doubts. Therefore, Szklary near Ząbkowice Śląskie in Lower Silesia, Poland, are the next, the third so far locality where holtite occurs.

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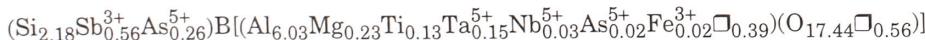
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HOLTYT — PIERWSZE WYSTĄPIENIE W POLSCE

Streszczenie

W pegmatycie granitoidowym znajdującym się w brzeżnej strefie serpentynitowego masywu Szklar rozpoznano obecność bardzo rzadkiego minerału o złotonym składzie chemicznym — holtytu. Dotychczas opisany był on jedynie z Australii oraz Rosji. Holtytowi ze Szklar — prócz typowych dla pegmatytów składników, jak: K-skalenie, kwarc, albit, muskowit — towarzyszą również klinochlor, hydrobiotyt, turmalin, spessartyn, cyrkon, chryzoberyl, goethyt oraz niezidentyfikowane tlenkowe fazy manganowe. Występuje jako skupienia silnie wydłużonych, igiełkowych osobników. Charakteryzuje się one typowymi dla holtytu wartościami stałych sieciowych: $a = 4,7048(5)$ Å, $b = 11,897(2)$ Å, $c = 20,298(3)$ (grupa przestrzenna Pnma) nieco tylko podwyższonymi obecnością magnezu. Skład chemiczny określony mikrosondą elektronową odpowiada formule:



Podobnie jak w przypadku wcześniej stwierdzonych wystąpień obecność holtytu związana jest z intruzją kwaśnej magmy granitoidowej w zasadowe i ultrazasadowe skały osłony.