Geol. vjesnik	Vol. 40	str. 75—80	Zagreb 1987.

UDC 594.1:549.6 *Izvorni znanstveni rad*

Searlesite from the Salt Mine Tušanj, Tuzla, Yugoslavia

Vladimir BERMANEC[1], Vladimir ZEBEC[2] and Zdravko BRAJKOVIĆ[3]

[1]*Department of Mineralogy and Petrology, Faculty of Science, Demetrova 1, YU — 41000 Zagreb*

[2]*Mineralogical and Petrological Museum, Demetrova 1, YU — 41000 Zagreb*

[3]*Salt Mine Tušanj, YU — 75000 Tuzla*

Searlesite, halite, magnesite and a rare mineral northupite were obtained from the salt mine Tušanj in Tuzla. In this paper X-ray determination of the cell dimensions and some optical properties of searlesite are measured. The paper deals with morphology of searlesite, too.

Searlesit, halit, magnezit i rijetki minerali northupit su pronađeni u rudniku soli Tušanj u Tuzli. U radu su prikazani rezultati rendgenografskih određivanja dimenzija jedinične ćelije, neka optička svojstva kao i morfologija searlesita.

INTRODUCTION

Searlesite, $NaBSi_2O_5(OH)_2$, is very rare borosilicate mineral, monoclinic space group $P2_1$. It was found in the few localities in the world (Fahey and Axelrod, 1950; Barić, 1966). First time in Yugoslavia it was found in Lopare near Tuzla (Barić, 1966); together with opal, searlesite is the main mineral in the sedimentary rock. Barić (1966) performed a very complete investigation on chemical content, crystallographic and optical constants of searlesite from Lopare. After that in Yugoslavia it was found in Kremna near Titovo Užice (Živković and Stojanović, 1976).

Vesicular nodules inserted in marl layers, found on the same level with notrhupite in the overlay stratum of IIIB salt series, were extracted from salt mine Tušanj, Tuzla in 1985.

It is impossible to draw the conclusion whether vesicles originate from solution of some organic residue or of some other mineral. Nodules consist of subparalel leaves, made of olive-green northupite (ferronorthupite — first time detected in Tuzla) reminding of leaves of a book. There are many small octahedral northupite crystals on these walls in the same crystallographic orientation. Over the northupite there are searlesite crystals in various orientation, sometimes with {100} growing side by side with northupite leaves.

OPTICAL PROPERTIES

Few tabular crystals of searlesite were preparated into thin sections. Optic axial angle was measured directly by universal stage in the white light; the value of $V_1V_2 = —55^0$ was obtained.

By immersion method, using white light again, two main refraction indexes were measured: $N_y = 1.528$, $N_z = 1.538$. Measurements were done at 22^0 C.

X-RAY DIFFRACTION STUDIES

X-ray powder data of searlesite from Tušanj correspond to literatural data (Fahey and Axelrod, 1950; ICPDS-Powder Diffraction File; Ghose and Wan, 1976).

Theoretical X-ray powder data were calculated by computer program LAZY PULVERIX (Yvon, Jeitscho and Parthe, 1977). Structure data were previously known (Ghose and Wan, 1976).

X-raydiffractogram of impure searlesite was done. A small quantity of rock salt (used for correction of peaks position) from the deposite was in the sample. Philips vertical goniometer was used (34 mA, 40 kV). Diffractogram was made between 4 and 60^0 C 2 Θ, and with CuK_α radiation.

Observed and calculated data are shown in the Table 1.

Table 1.

X-ray powder data for searlesite from Tušanj

I_{ob}	d_{ob}(Å)	$2\Theta_{ob}$(°)	hkl	I_{cal}	d_{cal}(Å)	$2\Theta_{cal}$(°)
100	7.942	11.14	100	62.5	7.9531	11.2
10	5.278	16.82	110	11.5	5.2765	16.8
			001	1.5	4.8884	18.2
25	4.2867	20.72	$10\bar{1}$	61.0	4.2988	20.6
45	4.0401	22.00	101	100.0	4.0422	22.0
			011	2.0	4.0175	22.2
35	3.9724	22.38	200	13.0	3.9765	22.4
10	3.6746	24.22	$11\bar{1}$	15.0	3.6706	24.2
20	3.5256	25.26	020	64.0	3.5260	25.2
20	3.5092	25.38	111	37.0	3.5069	25.4
50	3.4636	25.72	210	59.0	3.4638	25.8
45	3.2295	27.62	120	85.0	3.2234	27.6
40	3.2000	27.88	$20\bar{1}$	53.5	3.1944	28.0
20	2.9863	29.92	201	28.5	2.9857	30.0
35	2.9085	30.74	$21\bar{1}$	50.5	2.9098	30.8
			021	9.0	2.8597	31.2
10	2.7565	32.48	211	25.0	2.7495	32.6
15	2.74666	32.60	$12\bar{1}$	18.0	2.7262	32.8
20	2.6518	33.80	121	49.5	2.6571	33.8
			300	3.0	2.6510	33.8
15	2.6397	33.96	220	30.0	2.6382	34.0
10	2.4800	36.22	310	10.0	2.4815	36.2

I_{ob}	d_{ob}(Å)	$2\Theta_{ob}$(°)	hkl	I_{cal}	d_{cal}(Å)	$2\Theta_{cal}$(°)
10	2.4448	36.76	002	34.5	2.4442	36.8
10	2.3995	37.48	$30\bar{1}$	6.5	2.4007	37.4
5	2.3884	37.66	$10\bar{2}$	13.0	2.3829	37.8
5	2.3787	37.82	$22\bar{1}$	1.5	2.3673	38.0
1	2.3037	39.10	012	1.0	2.3094	39.0
2	2.2824	39.48	102	2.0	2.2924	39.4
5	2.2648	39.80	221	4.5	2.2786	39.6
			301	4.5	2.2659	39.8
			$11\bar{2}$	1.0	2.2575	40.0
			130	8.5	2.2543	40.0
1	2.1910	41.20	112	2.5	2.1801	41.4
5	2.1560	41.90	311	4.0	2.1573	41.0
			$20\bar{2}$	2.0	2.1494	42.0
5	2.1212	42.62	320	3.5	2.1189	42.6
			031	8.0	2.1185	42.6
			$13\bar{1}$	2.5	2.0625	43.8
2	2.0588	43.98	$21\bar{2}$	11.0	2.0560	44.0
band 44.6—45.0° 20			131	5.0	2.0320	44.6
			230	1.0	2.0236	44.8
			202	4.0	2.0211	44.8
			022	4.5	2.0088	45.2
220 reflection of halite is over			400	3.5	1.9883	45.6
			$12\bar{2}$	26.0	1.9743	46.0
1	1.94342	46.74	212	6.0	1.9429	46.8
2	1.92401	47.24	122	4.5	1.9219	47.2
10	1.91029	47.60	410	3.5	1.9137	47.6
5	1.89754	47.94	321	11.0	1.9062	47.8
5	1.89382	48.04	$23\bar{1}$	23.5	1.8933	48.0
1	1.84763	49.32	231	4.5	1.8469	49.4
			$22\bar{2}$	1.0	1.8353	49.6
15	1.82340	50.02	$41\bar{1}$	16.0	1.8235	50.0
			$31\bar{2}$	1.0	1.8003	50.8
5	1.76485	51.80	040	17.0	1.7630	51.8
5	1.76042	51.94	330	13.0	1.7588	52.0
5	1.75790	52.02	222	1.0	1.7535	52.2
10	1.74214	26.27	411	9.5	1.7432	52.4
			302	2.5	1.7383	52.6
			420	1.5	1.7319	52.8
			140	6.5	1.7212	53.2
			032	1.0	1.6943	54.2
2	1.68936	54.30	312	7.0	1.6878	54.4
2	1.68078	54.6	$33\bar{1}$	7.0	1.6796	54.6
			$13\bar{2}$	3.0	1.6734	54.8
			$42\bar{1}$	1.5	1.6642	55.2
			$32\bar{2}$	7.0	1.6465	55.8
			132	1.5	1.6412	56.0

I_{ob}	d_{ob}(Å)	$2\Theta_{ob}$(°)	hkl	I_{cal}	d_{cal}(Å)	$2\Theta_{cal}$(°)
10	1.62975	56.46	331	1.5	1.6314	56.4
			14$\bar{1}$	2.5	1.6312	56.5
			003	5.5	1.6295	56.4
			10$\bar{3}$	7.5	1.6184	56.8
			141	1.0	1.6160	57.0
2	1.60425	57.44	240	7.0	1.6117	57.2
2	1.59209	57.92	421	5.5	1.6025	57.6
			500	1.5	1.5906	58.0
			11$\bar{3}$	1.0	1.5774	58.6
			322	1.5	1.5591	59.2
			41$\bar{2}$	6.5	1.5577	59.4
15	1.55087	59.62	510	8.0	1.5516	59.6
			20$\bar{3}$	1.0	1.5456	59.8
			50$\bar{1}$	1.0	1.5442	59.8

Some of observed and calculated intensities are rather different because prefered orientation was present (perfect cleavage and tin plates).

The parameters of the unit cell of searlesite from these observed values were calculated by computer program POWDER (Lindqvist and Wengelin, 1967). These parameters are shown on the Table 2.

Table 2.

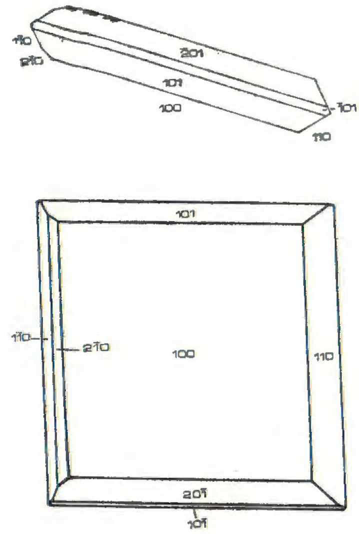
Unit cell dimensions of searlesite

	Green River Formation (Fahey & Awerlor, 1950)	Tušanj	Cave Springs, Nevada (Ghose & Wan, 1976)
a	7.972(10)	7.967(7)	7.9814(12)
b	7.052(10)	7.079(14)	7.0657(8)
c	4.900(10)	4.910(12)	4.9054(4)
β	93.95(17)	93.95(7)	93.95(1)

MORPHOLOGY

Crystals of searlesite are colourless, transparent, with bright flat faces, not soluble in water, up to few milimeters in size, most frequently under 1 mm. Crystals are usually tabular with dominant {100} faces. They have perfect {100} and good {10$\bar{2}$} cleavage. Besides these tabular crystals with sqare habits (fig. 1) and with faces on all sides, there are (more rare) elongated crystals with dominant {100} faces, too (fig. 2). These elongated crystals are growing with one side adhered to the ground. It seems that these elongated crystals are younger than tabular.

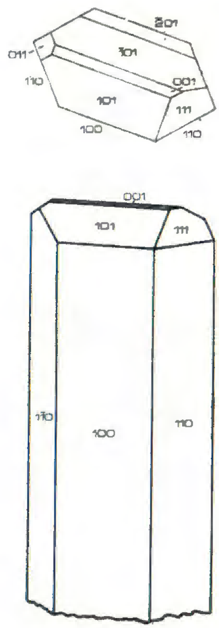
The following faces are found when 5 of the crystals were measured: {001}, {100}, {110}, {1$\bar{1}$0}, {2$\bar{1}$0}, {101}, {$\bar{1}$01}, {$\bar{2}$01}, {0$\bar{1}$1} and {111}.



1

Fig. 1. Searlesite from the salt mine Tušanj.

Sl. 1. Searlesit iz rudnika soli Tušanj.



2

Fig. 2. Searlesite from the salt mine Tušanj.

Sl. 2. Searlesit iz rudnika soli Tušanj.

Although searlesite belongs to monoclinic space group $P2_1$, the fact was sometimes neglected and the forms indexed as in holohedry (B a r i ć, 1966; T r u b e l j a & B a r i ć, 1979); in $P2_1$ space group all the holohedral forms with $k \neq 0$ split into the left and right faces, and it is eassy to assert the non-equivalence of the left and right side of the searl esite crystals.

The authors thank prof. dr Stjepan Šćavničar for discussions and critical review of the manuscript.

Measured crystxals of searlesite are housed in Mineralogical and Petrological Museum in Zagreb (inventory number 3367).

Received: November 28, 1986.

LITERATURA

B a r i ć, Lj. (1966): Searlesit von Lopare in Nordostbosnien. *Ber. deutsch. Ges. Geol. Wiss. B. Miner. Lagerstätten. 11, 4,* 407—421, Berlin.

B a r i ć, Lj. & J o v a n o v i ć, Č. (1966): Kratak litostratigrafski prikaz šibošničko-loparskog bazena i ispitivanja izvršenih na sirlesitu. *Geol. glasnik, 11,* 2—8, Sarajevo.

Fahey, J. J. & Axelrod, J. M. (1950): Searlesite from Green River Formation of Wyoming. *Am. mineral. 35*, 1014—1020, Washington.

Fleischer, J. J., Pabst, A. & Cabri, L. J. (1976): New mineral names. *Am. mineral. 61*, 1053—1056, Washington.

Ghose, S. & Wan, C. (1976): Structural chemistry of borosilicates, part II: searlesite, $NaBSi_2O_5(OH)_2$: Absolute configuration, hydrogen locations and refinement of the structure. *Am. mineral. 61*, 122—129, Washington.

Lindquist, O. & Wengelin, F. (1967): POWDER a program for the refinement of all dimensions and for the indexing of powder photographs. Gothenburg.

Mangold, M. (1962): DUDEN, Aussprachenwörterbuch. Bibliographisches Institut. Manheim.

Powder Diffraction File. ICPDS. 6—37. Philadelphia. 1974.

Trubelja, F. & Barić, Lj. (1979): Minerali Bosne i Hercegovine. Knjiga I. Silikati. 307—313. Zemaljski muzej BiH, Sarajevo.

Yvon, K., Jeitscho, W. & Parthe, E. (1977): LAZY PULWERIX, a programme to calculate theoretical X-ray and neutron diffrection powder patterns. Univs. de Geneve.

Živković, M. & Stojanović, D. (1976): Serouzait u sedimentnom magnezitu Kremne kod Titovog Užica. (Searlesite in sediment magnesite at Kremna near Titovo Užice — summary in english). *Zapisnici Srpskog geološkog društva za 1975—6*, 301—311, Beograd.

Searlesit iz rudnika soli Tušanj, Tuzla

V. Bermanec, V. Zebec i Z. Brajković

U jesen 1985, u rudniku soli Tušanj, u krovini IIIB serije soli na nivou na kojem se nalazi i northupit unutar laporovitih proslojaka nađene su nodule s kristalićima searlesita, northupita i halitom. Na searlesitu su izvršena rentgenografska, optička i goniometrijska određivanja. Rezultati rentgenografskih određivanja su prikazani u tablici 1. Na temelju tih vrijednosti izračunati su parametri jedinične ćelije (rezultat je uspoređen sa literaturnim podacima u tablici 2).

Djelomično su provedena i optička određivanja. U bijeloj svjetlosti je određen kut optičkih osi $2V = -55°$, a metodom imerzije određeni su glavni indeksi loma $N_y = 1.528$ i $N_z = 1.538$ pri temperaturi 22° C.

Na 5 kristalića izvršena su goniometrijska određivanja. Utvrđeno je prisustvo ploha slijedećih formi: {001}, {100}, {110}, {1$\bar{1}$0}, {2$\bar{1}$0}, {$\bar{1}$01}, {101}, {$\bar{2}$01}, {0$\bar{1}$1} i {111}.

Izgled kristala prikazan je na slici 1 i 2.

U našim dosadašnjim radovima ovaj se mineral različito nazivao. Pojavljuju se imena sirlesit (Barić i Jovanović, 1966), sjerlzit (Trubelja i Barić, 1979) i serouzait (Živković i Stojanović, 1976). Mineral je dobio ime po Johnu W. Searlesu, jednom od prvih istraživača Kalifornije, po kojem je dobilo ime i jezero Searles u San Bernardino County, gdje je mineral prvi puta pronađen. Opisali su ga Larsen i Hicks (preuzeto od Fahey i Axelrod, 1950). Očito je da u ovom slučaju fonetska transkripcija dovodi samo u zabludu pa ne vidimo razlog da ime tog minerala ne pišemo searlesit, tim više što se jedino u tom nazivu može prepoznati ime čovjeka po kojem se mineral zove. To možemo potkrijepiti svježim primjerom gdje u engleskom govornom području minerale barićit i marićit pišu isto tako izvorno našim slovom »ć« (Fleischer, Pabst i Cabri, 1976).

Ime ovog minerala može se prilagoditi našem jeziku tako što se na kraju riječi ne stavlja »e« (kao u engleskom) nego završava odgovarajućim nastavkom pojedinih padeža.

Ovo ime, searlesit, bi se pravilno izgovaralo kao u engleskoj riječi »earl«, to jest grof, ali za taj izgovor u našem jeziku ne postoje odgovarajući znakovi (Mangold, 1962).