GEOCHEMISTRY, MINERALOGY AND PETROLOGY • SOFIA
ГЕОХИМИЯ, МИНЕРАЛОГИЯ И ПЕТРОЛОГИЯ • СОФИЯ
2008, **46**, 31-34.

Whewellite – a mineral new for Bulgaria

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Abstract. The organic minerals whewellite $CaC_2O_4.H_2O$, together with weddellite $CaC_2O_4.2H_2O$, have been described from the upper soil levels among and on tree roots at Vitosha Mountain, South of Sofia. The mineral whewellite occurs in white crusts composed of tiny transparent to white platy crystals and spherulitic aggregates. This is the first report for whewellite occurrence in Bulgaria.

Key words: organic minerals, whewellite, weddellite, Vitosha

Иван Костов, Йорданка Минчева-Стефанова. Уевелит – нов минерал за България

Резюме. Органичните минерали уевелит $CaC_2O_4.H_2O$, съвместно с уеделит $CaC_2O_4.2H_2O$, са описани от горните части на почвения слой сред и върху корени на дървета от планината Витоша, южно от София. Минералът уевелит се среща като бели корички, представени от микроскопични безцветни до бели плочести кристали и сферолитни агрегати. Това е първо съобщение за находка на уевелит в България.

Introduction

Acad. Prof. Ivan Kostov (1913-2004) was the first to point out the importance and distribution of organic mineralizations in the upper soil layer of the country. The article is a result of the study of samples which he has collected himself. They have been analyzed during the past years and the results have been in a progress for publication by Prof. Jordanka Minčeva-Stefanova (1923-2007). With an analogous title in 1994 both the authors have informed about the first discovery in Bulgaria of the organic mineral weddellite $CaC_2O_4.2H_2O$ and a new genetic type of occurrences of calcium oxalates, correspondingly of organic mineralization in nature (Minčeva-Stefanova & Kostov 1994).

The observed weddellite and its locality were discovered by the first author (I. K.) in Vitosha Mountain near Sofia, about 4 km to the west of the village of Bistritza (along the Stara Reka river at a height of about 1500 m). The specific feature of the deposit is the distribution of this mineral as fine white to yelowish-white crusts, frequently microgranular, overlying different plant debris (rich on mosses, less frequently lichens). They are found in the roots of pine trees at places with forest soil.

The relation of the observed crusts to the roots of trees as a medium rich in organic components has been a base for a scientific prognosis of the first of the authors (I. K.) that the crusts have been formed by organic minerals.

From the analysis of the samples from this first deposit done by the second author (J. M.-S.) it has been proved that the crusts are build up by the mineral weddellite at places with other hydrocarbon minerals. The confirmation of the scientific prognosis was the reason for further on field studies taken by the first author (I. K.). As a result, a second, and later on two more occurrences of organic minerals have been found near the first mentioned location (Minčeva-Stefanova et al. 2008). At the second occurrence in 1994 besides the existence of weddellite a second organic mineral – whewellite $CaC_2O_4.H_2O$, new mineral to Bulgaria has been proved.

Notes on whewellite

Weddellite is supposed to be an organic mineral formed as spherulitic crusts, composed of fine platy crystal individuals. They are transparent to white in colour with a luster. In cases the aggregates are fine fibrous with development of spherulitic forms. A white to pale grass green mineral has been observed, including white needle-like weddellite aggregates. Latest over the weddellite aggregates are fine fibers of unidentified probably organic mineral which turned out to be whewellite. Whewellite grows later on bipyramidal weddellite crystals (Fig. 1, 3) in the complex weddellite-whewellite aggregates (Fig. 2, 4).

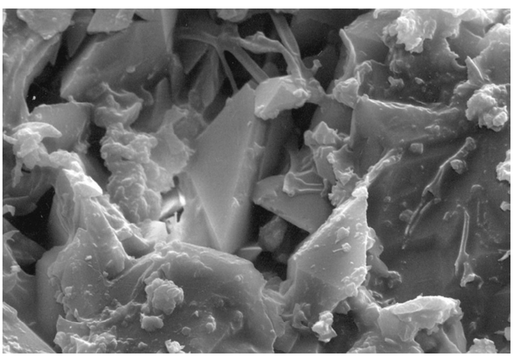

Fig. 1. Tiny whewellite plates on bipyramidal weddellite crystals, Vitosha, SEM x1300

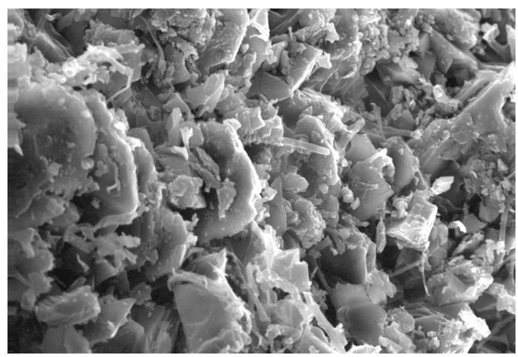

Fig. 2. Complex whewellite-weddellite aggregates, Vitosha, SEM x860

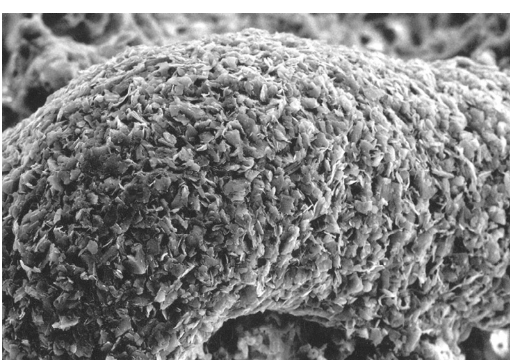

Fig. 3. Complex whewellite aggregate, Vitosha, SEM x400

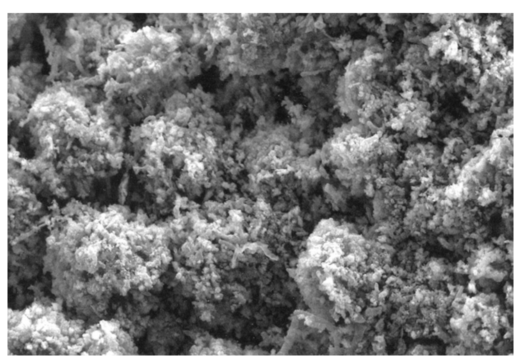

Fig. 4. Complex whewellite-weddellite spherulitic aggregates, Vitosha, SEM x400

Table 1. *X-ray powder data for whewellite: a. from Vitosha Mountain; b. synthetic whewellite (JCPDS, N20-0231); *strong weddellite lines*

a		b		
d (Å)	I	*d* (Å)	I	hkl
6.15*	4	-	-	-
5.99	10	5.93	100	101
5.80	3	5.79	30	110
4.81	<1	4.77	2	200
-	-	4.64	1	011
4.50	<1	4.52	4	101
4.39*	2	-	-	-
3.89	<1	3.78	6	211
3.63	9	3.65	70	020
3.40	<1	3.41	2	120
-	-	3.12	2	021
-	-	3.11	2	121
3.09	1	3.01	10	002
2.96	7	2.966	45	202
2.90	<1	2.915	10	310
-	-	2.897	8	220
2.78*	6	2.840	10	121
2.64	<1	2.523	4	301
2.50	4	2.494	18	112
2.44	2	2.447	4	312
2.41	1	2.417	6	321
-.	-	2.384	4	311
2.36	8	2.355	30	130
-	-	2.347	12	411
-	-	2.320	1	022
-	-	2.301	2	222
2.26	4	2.263	8	202
-	-	2.2254	6	031
2.21	1	2.210	6	402
-	-	2.130	2	231
2.08	4	2.089	2	103
2.03	<1	2.075	14	321
-	-	1.995	2	501
-	-	1.978	10	303
1.962	6b	1.957	2	231
-	-	1.950	10	411
1.930	<1	1.933	8	013
-	-	1.929	2	222
1.903	3	1.890	6	422
-	-	1.859	4	312
1.845	2	1.846	6	510
-	-	1.823	6	040
-	-	1.813	4	123
1.793	2	1.793	6	132
-	-	1.704	2	240
1.695	2	1.691	2	520
-	-	1.683	1	501
-	-	1.648	1	402
1.635	<1	1.639	2	511
-	-	1.621	1	611
1.695	1	1.590	2	600
-	-	1.580	2	233
-	-	1.559	2	042
-	-	1.555	2	431
1.549	1	1.547	2	033
-	-	1.528	2	521
-	-	1.523	1	114
1.510	<1	1.509	1	303
1.503	1	1.502	2	422
1.495	<1	1.498	1	523
1.480	<1	1.483	2	404
-	-	1.476	2	622
1.458	<1	1.457	2	433
1.445	<1	1.443	1	224
-	-	1.419	1	242
1.408	<1	1.406	1	512
1.393	1	1.394	2	323
1.379	1	-	-	-
1.344	1	-	-	-
1.220	2	-	-	-
1.185	4	-	-	-
1.153	3	-	-	-
1.132	2	-	-	-

X-ray powder data for whewellite from Vitosha Mountain have been obtained in a 57.3mm Debye-Scherrer camera, Cu radiation, Ni filter applied, relative intensities estimated visually (Table 1). The data are compared with those for a synthetic sample. They are in correspondence to the JCPDS card N20-0231, Cu radiation, Gunier camera (1997).

Whewellite $CaC_2O_4.H_2O$ is monoclinic-prismatic, $P2_1/n$, *a* 6.29, *b* 14.58, *c* 10.12 Å, β 109^{o}46', *Z*=8, with good $\{\bar{1}01\}$ and imperfect {010}, {001} and {110} cleavages, with structure presented by a framework of Ca polyhedra and C_2O_4 groups (Tazzoli & Domeneghetti 1980). It is found almost exclusively as equant to short prismatic [001] crystals enriched in forms, common also as heart-shaped twins on $\{\bar{1}01\}$. As F forms are accepted {100}, {010}, {021}, {011}, $\{12\bar{1}\}$ and {121}, as S forms – {101}, {012}, {110},{120}, {140} and $\{14\bar{1}\}$, the forms {001} and $\{10\bar{1}\}$ considered to be either F or S forms (Franchini-Angela & Aquilano 1984). On laboratory grown crystals {011} and {121} forms are missing, but in the natural crystals

Table 2. *X-ray powder data for weddellite: a. from Vitosha Mountain; b. synthetic weddellite (JCPDS, 17-0541)*

a		b	
d (Å)	I	*d* (Å)	I
7.50	3	8.73	4
6.81	<1	6.32	6
6.10	10	6.18	100
4.82	2	-	-
4.37	8	4.42	30
3.93	4	3.91	8
3.66	3	3.68	12
3.35	1	3.39	4
3.10	2	3.09	10
2.95	<1	2.81	14
2.77	9	2.775	65
2.42	4	2.408	16
2.36	1	2.367	2
2.25	6b	2.243	25
2.22	1	2.210	6
2.13	3	2.118	8
2.03	1	2.024	6
1.953	3	1.957	10
1.899	2	1.899	3
1.831	2	1.846	10
1.797	1	1.797	2
1.734	1	1.741	6
1.580	1b	1.578	2
1.501	2	1.500	2
1.389	2	1.387	4
1.324	<1b	1.329	2
1.284	<1	1.279	<1
1.197	1	1.192	2
1.154	<1	1.150	2

most frequent are {021}, $\{12\bar{1}\}$, {001}, {010}, {100}, $\{14\bar{1}\}$, $\{12\bar{3}\}$ and $\{13\bar{1}\}$ forms. A sub-cell with halved *b* and *c* edges suites a pseudoisometric $(I)^a$ ratio $2a/(b'+c')=1.02$. Whewellite as large up to 7 cm crystals, usually as heart-like twins or tabular and columnar habits, are described from Saxony and Thüringen, Germany, in parageneses of calcite, dolomite or barite, and sulphide minerals (Hofmann 1991). Assumed for the mineral is a trend of crystal habits $(I)^a{}_i \rightarrow (I)^a{}_{(110)}$ (Kostov & Kostov 1999).

X-ray powder data for weddellite from the new occurrence on Vitosha Mountain is in good agreement with the data from its first occurrence and with the data for synthetic weddellite.

Conclusion

Whewellite has been reported from a number of countries world-wide (for different genetic type kind of deposits and coexistence with other organic minerals see Minčeva-Stefanova et al. 2008 and the cited literature therein), but this is its first record in Bulgaria. The occurrence of both weddellite and whewellite among and on the roots of trees in the upper soil layer is suggested as a new wide spread genetic type of organic mineralization.

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Accepted May 23, 2008
Приета на 23. 05. 2008 г.