Dadsonite (minerals Q and QM), a new lead sulphantimonide

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SUMMARY. Dadsonite was previously described without a name: (mineral Q) from Yellowknife, N.W.T.; (mineral QM) from Madoc, Ontario, and Pershing County, Nevada. Material from a fourth locality (Wolfsberg, Germany) yields good powder patterns, identical with those of QM, and single crystal data identical with those for Q.

Microprobe analysis of the Nevada and Wolfsberg samples gave, respectively, Pb 49·3, 50·8; Sb 31·7, 31·8; S 20·7, 20·3; sum 101·7, 102·9 %, giving $Pb_{11}Sb_{12.0}S_{29.8}$ and $Pb_{11}Sb_{11.7}S_{28.4}$, ideally $Pb_{11}Sb_{12}S_{29}$ or $11PbS·6Sb_2S_3$. Dadsonite is acicular [010], monoclinic, space group $P2$, Pm, or $P2/m$, with a 19·05, b 4·11, c 17·33 Å, β 96° 20', Z = 1, Sp. gr. 5·76. The strongest lines of the X-ray pattern are 3·78 (7), 3·62 (6), 3·38 (10), 2·84 (7), and 2·79 Å (6).

IN his study of the mineralogy of the Yellowknife Bay area, Northwest Territories, Coleman (1953) noted the presence of an acicular sulphosalt, which he referred to as 'mineral Q'. Although Coleman was able to obtain single crystal data for his material, the mineral was not named because of its incompletely known chemistry: 'A very small amount was obtained for a spectrographic analysis, which indicated the presence of the following elements in probable order of decreasing importance: Fe, Cu, Sb, Pb, Ag' (Coleman, 1953, p. 525). Coleman also noted that the cell dimensions obtained for 'mineral Q' were almost identical to those of a synthetic lead sulphantimonide prepared by Robinson (1948).

The occurrence of microscopic amounts of 'mineral Q' in sulphosalt specimens from Madoc, Ontario, and Pershing County, Nevada, was noted by Jambor (1967b), who was, however, unable to obtain confirmatory single crystal data and hence named the mineral from the new localities 'mineral QM'. Because of the poor quality of the X-ray powder patterns, particularly those of 'Q' from Yellowknife, the single crystal data were considered to be an essential prerequisite to establishing the identities of 'Q' and 'QM'. Examination of material from another locality, Wolfsberg, Germany, has established that 'Q' and 'QM' are indeed identical. At the suggestion of Dr. L. C. Coleman, the mineral has been named dadsonite in honour of the late A. S. Dadson, who made significant contributions to the mining development of the Yellowknife gold deposits. The name has been approved by the International Commission on New Minerals and Mineral Names, IMA.

Occurrence and properties. Coleman's (1953) type material came from a surface trench on the Brock Zone of the Giant property, Yellowknife, where the mineral occurred in intimate association with jamesonite as discrete needles in gangue. Dadsonite from Pershing Co., Nevada (Jambor, 1967b) occurred in intimate association with robinsonite, and in the Madoc material as a microscopic veinlet cutting jamesonite. The writer is grateful to W. W. Pinch of Rochester, New York, for the Wolfsberg specimen. Dadsonite on it consists of minute fibrous crystals, which megasopically have the appearance of steel wool, partly coating a white gangue of approximately $5 \times 3 \times 3$ cm. Individual needles of the dadsonite are generally multiple crystals with a length of up to 2 mm, but a thickness of less than 0·1 mm. The needles are striated parallel to the elongation. Dadsonite is lead grey, with a black streak and a hardness of about $2\frac{1}{2}$. Standard etch tests are reported by Coleman (1953) to be the same as those of boulangerite.

The writer is most grateful to E. A. J. Burke of the Instituut voor Aardwetenschappen, der Vrije Universiteit, Amsterdam, for determining the following reflected light optical data. The colour of dadsonite in air and oil is white with a greenish tint. Blood-red internal reflection was observed in oil at the grain edges. Anisotropism is distinct to strong in greenish-grey tints. Although the reflectivity measurements, given below, indicate that dadsonite has quite strong bireflection, this was not perceptible even in oil probably because of the lack of other minerals that would provide a suitable contrast in the polished section.

Reflectivity was measured by Dr. Burke with a Leitz MPV Microscope Photometer mounted on a Leitz Ortholux microscope. The prism reflector was used during the measurements. With a 16X, 0·40 air objective, the area of the stage object illuminated was 25×25 μm, and the area measured, 5×5 μm (square diaphragms). Only two grains of dadsonite proved to be sufficiently large to obtain reliable results. Using carborundum standard NPL N. 2538·30, the reflectivity of dadsonite at the four standard wavelengths is as follows: 34·8–39·7 (450 nm),[1] 34·9–40·0 (546 nm), 34·2–39·6 (589 nm), and 32·7–37·4 (650 nm).

The physical and optical properties of dadsonite are not diagnostic; X-ray diffraction methods are necessary for a reliable identification.

Chemistry. On the basis of a microprobe analysis of 'mineral QM' from Pershing Co., Nevada, and calculations utilizing the cell dimensions obtained by Coleman for 'Q', it was speculated (Jambor, 1967b) that an appropriate formula for the mineral was $11PbS·6Sb_2S_3$. A microprobe analysis of the Wolfsberg material confirms the validity of the previously reported analysis (see table I).

After recalculation of the analytical totals to 100 %, the formula of the Wolfsberg dadsonite is $Pb_{11}Sb_{11·7}S_{28·4}$, and for Nevada dadsonite, $Pb_{11}Sb_{12·0}S_{29·8}$. For the theoretical formula $Pb_{11}Sb_{12}S_{29}(11PbS·6Sb_2S_3)$, the calculated density is 5·76 g/cm³ for $Z = 1$ and $V = 1349$ Å³ (table II). Although a measured density could not be obtained, the density determinative curve for lead sulphantimonides (Jambor, 1967a)

[1] 1 nm (nanometre) $= 1m\mu = 10^{-9}$ metres.

is applicable and yields for dadsonite a predicted density of 5·82, corresponding satisfactorily with the calculated value.

X-ray data. Dadsonite is monoclinic, with morphological elongation [010]. From rotation and Weissenberg films about this axis, Coleman (1953) obtained a 19·06, b 4·11, c 17·26 Å, β 95° 50′, possible space groups $P2$, Pm, $P2/m$. With the same conditions this writer obtained from the Wolfsberg material a 19·05, b 4·11, c 17·33 Å, β 96° 20′. An additional zero-level precession photograph showed that the 010 diffraction spot is present, thus confirming that the above space group possibilities are correct.

TABLE I. *Microprobe analyses of dadsonite. Analyst: G. R. Lachance*

	Pershing Co., Nevada (QM-Jambor 1967b)				Wolfsberg, Germany			
		Recalc. to 100 %	Atomic ratios			Recalc. to 100 %	Atomic ratios	
Pb	49·3	48·48	0·2340	11·0	50·8	49·37	0·2383	11·0
Sb	31·7	31·17	0·2560	12·0	31·8	30·90	0·2538	11·7
S	20·7	20·35	0·6346	29·8	20·3	19·73	0·6153	28·4
	101·7	100·00			102·9*	100·00		

* Optical spectrographic analysis by F. Hill shows trace Si, faint trace Al.

The indexed X-ray powder diffraction pattern of dadsonite from Wolfsberg is given in table II. The Wolfsberg material yields good powder patterns, identical with those of QM, and single crystal data identical with those of Q. The identity of these compounds is thus confirmed.

Synthetic phase II. Coleman (1953) recognized the similarity of his Yellowknife sulphosalt and an artificial lead sulphantimonide described by Robinson (1948) as phase II. Like dadsonite, the artificial phase was acicular along [010]. From rotation and Weissenberg photographs, Robinson obtained a 19·16, b 4·12, c 17·39 kX, β 96° 24′, provisional space group $P2/m$. The X-ray powder diffraction pattern of phase II and dadsonite are similar, but not identical, although most of the differences are probably attributable to what appears to be pronounced preferred orientation effects in the pattern of phase II. A significant difference arises when the compositions of dadsonite and phase II are compared. The Pb:Sb ratio of the latter is 3·4:5·4 (Robinson, 1948), and hence Jambor (1967a) concluded that the formula of phase II is $9PbS \cdot 7Sb_2S_3$. Dadsonite has the formula ratio $11PbS:6Sb_2S_3$ whereas the equivalent ratio for phase II would be $11PbS:8·7Sb_2S_3$. The run in which phase II was obtained also contained galena and semseyite, but contamination by either of these would have increased the proportion of lead rather than lowering it as is required in the established formula of dadsonite. The reason for the divergence in the lead–antimony ratios of phase II and dadsonite is therefore not known.

The writer is grateful to L. G. Berry and J. D. Scott of Queen's University for the loan of the original single crystal films of Q and phase II. The larger cell dimensions reported by Robinson for phase II are authentic; whether this phenomenon arises from mechanical effects such as film shrinkage, or whether it truly reflects a variation in cell

TABLE II. *Dadsonite X-ray powder data indexed with a* 19·05, *b* 4·11, *c* 17·33 Å, β 96° 20'. *Cu-Kα radiation,* 114·6-*mm camera*

I	d_{meas}	d_{calc}	hkl	I	d_{meas}	I	d_{meas}
1	8·64 Å	8·61 Å	002	1	2·634	½	1·563
3	8·18	8·19	$\bar{1}02$	<½	2·559	½	1·544
1	7·53	7·53	102	1	2·510	<½	1·532
½	6·75	6·75	$\bar{2}02$	<½	2·478	½	1·516
½	6·04	6·05	202	½	2·454	1	1·508
1	5·69	5·67	$\bar{1}03$	1	2·385	<½	1·487
<½	5·36	5·38	103	1	2·360	<½	1·476
<½	4·70	4·70	$\bar{4}01$	½	2·323	<½	1·466
2	4·31	4·30	$\bar{1}04$	<½	2·290	1	1·456
4	4·10	4·11	010	2	2·256	½	1·439
3	4·03	4·03	303	4	2·218	½	1·420
2	3·96	3·97	402	<½	2·180	1	1·397
½	3·87	3·87	$\bar{4}03$	½	2·159	<½	1·385
7	3·78	{ 3·79	$\bar{5}01$	½	2·134	<½	{ 1·370
		{ 3·79	500	½	2·115	½B	{ 1·350
<½	{ 3·73	3·72	$\bar{2}11$	<½	2·093	<½	1·346
½	{ 3·70	3·71	012	4	2·065	1	1·335
6	3·62	3·62	$\bar{5}02$	2	1·934	½	1·328
½	3·46	3·47	403	½	1·921		
10B	3·38	{ 3·39	304	½	1·895		
		{ 3·38	$\bar{4}04$	4	1·886		
<½	3·34	3·33	502	<½	{ 1·872		
<½	{ 3·25	3·26	113	<½	{ 1·864		
<½	{ 3·23	3·22	$\bar{2}13$	½	1·846		
2	3·158	3·156	600	<½	1·830		
2	3·122	3·133	312	2	1·812		
½	3·071	3·075	$\bar{6}02$	1B	1·791		
2	3·022	3·024	404	<½	1·774		
1	2·994	2·989	$\bar{4}12$	<½	1·752		
2	2·888	2·893	305	1	1·731		
7	2·840	{ 2·855	412	2	1·724		
		{ 2·835	$\bar{2}06$	2	1·695		
6	2·794	2·785	$\bar{5}11$	1	1·683		
3	2·726	{ 2·729	$\bar{3}06$	1	1·664		
		{ 2·715	$\bar{5}12$	½	1·640		
		{ 2·715	511	½	1·614		
3	2·648	2·650	405	1	1·588		

dimensions is not known. Variations in the cell size of pure boulangerite have also been noted by the writer (1967b), and it may be that these are an indication of non-stoichiometry equivalent to that known in lead sulpharsenides. The differences in cell dimensions between natural dadsonite and phase II could thus be meaningful, but the divergence is considered to be of a varietal rather than a fundamental nature.

From a comparison of the single crystal films of Q, phase II, and Wolfsberg dadsonite, it is concluded that all the single crystal X-ray fragments represent one compound.

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