DRESSERITE, THE NEW BARIUM ANALOGUE OF DUNDASITE

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ABSTRACT

Dresserite occurs with weloganite in cavities in an alkalic sill intruding limestone at St-Michel, Montreal Island, Quebec. Chemical analysis gave BaO 36.6, SrO 0.8, Al_2O_3 25.6, CO_2 22.2, H_2O 15.3, sum 100.5 wt. %, corresponding to $Ba_{1.98}Al_{4.06}C_{4.06}O_{23}H_{13.67}$, ideally $Ba_2Al_4(CO_3)_4(OH)_8 \cdot 3H_2O$. This is the barium analogue of the lead mineral, dundasite. Dresserite occurs as white spherical aggregates averaging about 2 mm in diameter, each made up of tapering fibres elongated parallel to *c*. The lustre is vitreous to silky, hardness is about $2\frac{1}{2}$, and it effervesces in dilute HCl. It is biaxial negative, with $2V \approx 30$ to $40°$, $n_\alpha(\|a) = 1.518$, $n_\gamma(\|c) = 1.601$, and extinction is parallel. The mineral is orthorhombic $a = 9.27$, $b = 16.83$, $c = 5.63$ Å and the space group can be *Pbmm*, *Pb*2_1*m*, or *Pbm*2. The *x*-ray powder pattern superficially resembles that of dundasite. Strongest lines of the pattern are 8.09 (10) (110), 6.23 (6) (120), 3.66 (5) (131), 2.73 (4) (241), 3.17 (3) (150), and a complete listing of observed spectra are given with those of dundasite for comparison. Density and thermal stability data also are given and discussed.

INTRODUCTION

Dresserite is a new barium aluminum carbonate which occurs in an alkalic sill that has intruded Ordovician limestone at St-Michel, Montreal Island, Quebec. The locale and association are the same as that described for weloganite by Sabina *et al.* (1968), who also briefly mentioned that the new mineral, now named dresserite, had been found in association with weloganite. The new name, which has been approved by the Commission on New Minerals and Mineral Names, I.M.A., is in honour of J. A. Dresser (1866–1954) in recognition of his contributions to the geology of the Monteregian Hills. Representative specimens of the mineral are in the National Mineral Collection, Ottawa.

PROPERTIES

Dresserite occurs in cavities in the sill as white spheres and hemispheres ranging from 1 to 3 mm and averaging about 2 mm in diameter. Each sphere consists of numerous transparent, easily separable, radiating blades that taper toward the centre of the sphere. The blades project outward slightly at the spherical surface, producing a roughness visible under the binocular microscope.

Dresserite has a vitreous to silky lustre and a white streak. The hardness is difficult to determine, but is estimated to be $2\frac{1}{2}$ to 3. The mineral is readily soluble with effervescence in dilute hydrochloric acid. In

immersion oil, dresserite is biaxial negative, and length slow, with $2V \approx 30$ to 40°. The mineral has parallel extinction and $n_\alpha(\|a) = 1.518$, $n_\gamma(\|c) = 1.601 \pm 0.004$.

Chemistry

The results of a chemical analysis of a dresserite sample hand-picked under a binocular microscope are given in Table 1. The results yield $Ba_{1.98}Al_{4.06}C_{4.06}O_{23}H_{13.67}$, or $Ba_{2.0}Al_{4.1}(CO_3)_{4.1}(OH)_8 \cdot 2.8H_2O$. The theoretical formula is therefore $Ba_2Al_4(CO_3)_4(OH)_8 \cdot 3H_2O$, which is the barium analogue of dundasite. The formula of the latter mineral is given in Palache, Berman and Frondel (1951) as $Pb_2Al_4(CO_3)_4(OH)_8 \cdot 2H_2O$, but new data by Beaumont and Guillemin (1960) indicate that there are 3 rather than 2 molecules of water in dundasite, thus agreeing with the formula obtained for dresserite.

A DTA curve of dundasite from Dundas, Tasmania, gave a profile similar to that obtained by Beaumont and Guillemin (1960) for Sardinian material. The temperatures at which the reactions occur are not identical, but this can probably be attributed to different techniques being used. A micro-method utilizing only a few mg of powder heated at 13°C/min was used in the present study. The resulting DTA curves for dresserite and dundasite are similar in appearance, but the principal endothermic break signalling the combined loss of all CO_2 and H_2O is shifted from 294°C in dundasite to 384°C in dresserite. No additional reactions occur in dresserite, but in dundasite a weak exothermic peak appears at 660°C. After heating to 800°C, the fired charges were examined by *x*-ray diffraction methods. The product from dundasite is $PbAl_2O_4$, and from dresserite, $BaAl_2O_4$.

X-ray data

Single crystal fragments of dresserite are difficult to obtain, partly because of small grain size, and partly because the growth pattern has produced overlapping multiple crystals which are easily distorted. The Weissenberg and precession photographs obtained from dresserite are of poor quality, but are adequate to show that the mineral is orthorhombic, elongated parallel to *c*, and flattened {010}. The cell dimensions are $a = 9.27$, $b = 16.8$, $c = 5.63$ Å. The only systematic absence detected is $0kl$ with $k = 2n$, thus permitting *Pbmm*, $Pb2_1m$, and *Pbm*2 as possible space groups.

The measured *d*-spacings and visually estimated intensities of the *x*-ray powder pattern of dresserite are given in Table 2. Visual examination of the powder patterns of dresserite and dundasite shows a superficial similarity among the lines with low *d*-spacings. Because of the

TABLE 1. CHEMICAL ANALYSIS OF DRESSERITE*

	Wt. %	Relative Molar Fractions	
		Wt. %/M.W.	Alk. Earths as Unity
BaO	36.6	0.2375	1.00
SrO	0.8	0.0077	
Al_2O_3	25.6	0.2498	1.02
CO_2	22.2	0.5019	2.05
H_2O	15.3	0.8444	3.45
	100.5		

*Analyst—J.-L. Bouvier.

physical character of dundasite, no single crystal fragment completely free of satellite reflections could be found. Nevertheless, several upper level precession photographs of the mineral adequately indicate that it has the same space group as dresserite, and hence a complete Ba–Pb solid solution series is possible.

Density

Suspension of minute fibres of dresserite in heavy liquids gave a measured density of 2.96±0.02g/cc. For $2[(Ba,Sr)_2Al_4(CO_3)_4(OH)_8 \cdot 3H_2O]$ and Ba:Sr = 30:1, the cell dimensions given in Table 2 yield a calculated density of 3.06. The agreement is less than satisfactory, and it is assumed that the measured value is too low because of errors related to the physical character of the material. Evidence that this is probably the case was obtained by experimentation with dundasite, which is physically similar and chemically related to dresserite.

The measured density of dundasite is reported in Palache, Berman, and Frondel (1951) to be "about 3.25". Beaumont and Guillemin (1960) obtained 3.41 ± 0.01 from material from Gonnesa, Sardinia. Using the suspension method, we obtained 3.10 ± 0.05 for Gonnesa dundasite, but the material (from the National Mineral Collection, Ottawa) is cotton-like and hence large errors are possible. Under the same conditions, somewhat coarser dundasite from Dundas, Tasmania, gave a density of 3.55 ± 0.05, which is the highest value reported for this mineral. However, the unit cell dimensions from the indexed pattern of dundasite in Table 2 yield a calculated density of 3.81 g/cc for $2[Pb_2Al_4(CO_3)_4(OH)_8 \cdot 3H_2O]$. As there is no other reason for questioning the validity of the chemical formula or unit cell dimensions, and as the measured density is strongly influenced by the physical characteristics of the material, it is assumed that the measured values of both dundasite and dresserite are too low.

TABLE 2. *X*-RAY POWDER DIFFRACTION DATA FOR DRESSERITE AND DUNDASITE: CuKα RADIATION, 114.6 mm CAMERA

	Dresserite[1]			Dundasite[2] (Dundas, Tasmania)		
hkl	$I_{est.}$	$d_{meas.}$ (Å)	$d_{calc.}$ (Å)	$I_{est.}$	$d_{meas.}$ (Å)	$d_{calc.}$ (Å)
100				½	8.85	9.05
110	10	8.09	8.12	10	7.91	7.92
120	6	6.23	6.23	3	6.07	6.07
021	3	4.68	4.68	5	4.63	4.63
111	2	4.63	4.64	2	4.57	4.58
200			4.63	2	4.52	4.53
210	2B	4.47	4.47	2	4.36	4.36
121				½	4.11	4.12
040				1	4.09	4.09
220				2	3.96	3.96
140				<½	3.72	3.73
131	5	3.66	3.65	8	3.60	3.59
230	1	3.58	3.57	½	3.49	3.48
211	<½	3.5	3.50			
041	2	3.37	3.37	2	3.30	3.30
221	2	3.29	3.29	5	3.23	3.23
141				6	3.09	3.10
150	3	3.17	3.16		3.08	3.08
240	2	3.11	3.12	3	3.03	3.03
310	2	3.02	3.04	4	2.968	2.967
002	2	2.81	2.82	2	2.800	2.805
060				2	2.729	2.725
151	<½	2.76	2.76	½	2.697	2.697
241	4	2.73	2.73	5	2.666	2.668
301	½	2.71	2.71			
022	3	2.667	2.670			
112			2.660	4	2.643	2.644
311			2.674	<½	2.617	2.623
321	½B	2.578	2.579	<½	2.524	2.527
340	<½	2.489	2.491			
331	<½	2.452	2.452			
061				<½	2.457	2.451
202	1	2.406	2.406	4	2.385	2.384
212	1	2.384	2.382	<½	2.358	2.359
260				1	2.337	2.334
042				<½	2.314	2.313
222				<½	2.289	2.289
400	½B	2.324	2.318	3	2.264	2.263
142	<½	2.269	2.269			
350			2.276	2	2.218	2.217
232				½	2.182	2.184
140						2.181
261				<½	2.158	2.155
171				1	2.098	2.098
270	<½	2.134	2.134	3	2.075	2.076
	2	2.108		1	2.059	
	1	2.097		2	2.035	
	<½	2.073		½	1.994	
	½	2.056		<½	1.978	
	<½	2.022		1	1.956	
	½	1.991		1	1.920	
	<½	1.962		<½	1.906	
	<½	1.949		1	1.867	

TABLE 2. (*concluded*)

	Dresserite[1]			Dundasite[2] (Dundas, Tasmania)		
hkl	$I_{est.}$	$d_{meas.}$ (Å)	$d_{calc.}$ (Å)	$I_{est.}$	$d_{meas.}$ (Å)	$d_{calc.}$ (Å)
	<½	1.912		1	1.847	
	½	1.893		1	1.820	
	1	1.833		1	1.796	
	½	1.796		2	1.770	
	½	1.768		3	1.760	
	½	1.748		4	1.741	
				<½	1.716	
				2	1.700	
				½	1.689	
				<½	1.676	
				<½	1.656	
				1	1.641	
				<½	1.617	
				1	1.588	
				<½	1.572	
				<½	1.555	
				<½	1.541	
				½	1.526	
				½	1.516	
				1	1.502	
				½	1.484	
				1	1.468	
				<½	1.450	
				½	1.436	
				½	1.420	
				½	1.403	
				<½	1.390	
				1	1.382	
				<½	1.363	
				½	1.352	
				½	1.337	

[1]Indexed with $a = 9{,}27$, $b = 16.83$, $c = 5.63$ Å.
[2]Indexed with $a = 9.05$, $b = 16.35$, $c = 5.61$ Å.

Associated minerals

Among the numerous minerals mentioned by Sabina *et al.* (1968) as occurring in the St-Michel sill, the most closely associated with dresserite are weloganite, plagioclase, quartz, dawsonite and a powdery hydrous aluminum oxide which gives an *x*-ray diffraction pattern similar to that of gibbsite. Another hydrous barium aluminum carbonate, which is not megascopically distinguishable from dresserite, was found in only one small portion of the sill. This mineral may be the barium analogue of aluminohydrocalcite, $CaAl_2(CO_3)_2(OH)_4 \cdot 2H_2O$(?), but the writers have so far been unable to obtain a specimen of the latter for comparative purposes.

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