THE SYSTEM OF

MINERALOGY

of James Dwight Dana and Edward Salisbury Dana
Yale University 1837–1892

SEVENTH EDITION
Entirely Rewritten and Greatly Enlarged

By

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VOLUME II

HALIDES, NITRATES, BORATES, CARBONATES,
SULFATES, PHOSPHATES, ARSENATES, TUNGSTATES,
MOLYBDATES, ETC.

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41.5.4 HERDERITE SERIES

MONOCLINIC; PRISMATIC—2/m

	$a:b:c$	β
Herderite, $CaBe(PO_4)F$		
Hydroxyl-herderite, $CaBe(PO_4)(OH)$	0.6307:1:1.2822	90°06′

A probably complete series extends between herderite and hydroxyl-herderite by mutual substitution of (OH) and F. These species have the same crystal structure [1] as the borosilicate datolite, $CaB(SiO_4)(OH)$. The structures probably are based on a three-dimensional linkage of (BeO_4) and (PO_4) or (BO_4) and (SiO_4) tetrahedra, respectively.

Ref.

1. Strunz, *Zs. Kr.*, **93,** 146 (1936).

41.5.4.1 **HERDERITE** $[CaBe(PO_4)(F,OH)]$. *Haidinger* (*Phil. Mag.*, **4,** 1, 1828). Allogonite *Breithaupt* (23, 1830; 78, 1832). Glucinite *Hidden* (*Am. J. Sc.*, **27,** 135, 1884). Fluor-herderite.

41.5.4.2 **HYDROXYL-HERDERITE** $[CaBe(PO_4)(OH,F)]$. Hydro-herderite, Hydro-fluorherderite *Penfield* (*Am. J. Sc.*, **47,** 329, 1894).

Cryst.[1] Monoclinic; prismatic—$2/m$.

$a:b:c = 0.6307:1:1.2822$; β 90°06′; $p_0:q_0:r_0 = 2.0330:1.2822:1$

$r_2:p_2:q_2 = 1.5598:1.5855:1$; μ 89°54′; p_0' 2.0331, q_0' 1.2822, x_0' 0.0017

Forms: [2]

	ϕ	ρ	ϕ_2	$\rho_2 = B$	C	A
c 001	90°00′	0°06′	89°54′	90°00′	.....	89°54′
b 010	0 00	90 00	.....	0 00	90°00′	90 00
a 100	90 00	90 00	0 00	90 00	89 54	.....
l 120	38 24½	90 00	0 00	38 24½	89 56½	51 35½
m 110	57 45½	90 00	0 00	57 45½	89 55	32 14½
t 012	0 09½	32 40	89 54	57 20	32 40	89 55
v 011	0 04½	52 03	89 54	37 57	52 03	89 56½
s 021	0 02½	68 42	89 54	21 18	68 42	89 58½
e 102	90 00	45 31	44 29	90 00	45 25	44 29
p 113	57 49½	38 45	55 48½	70 32	38 40	58 00½
q 112	57 48½	50 16½	44 29	65 48½	50 11	49 24
n 111	57 47	67 25½	26 10½	60 30½	67 20½	38 37½
q: $\bar{1}$12	−57 43	50 12	135 25½	65 46½	50 17	130 30½
n: $\bar{1}$11	−57 44½	67 24	153 47½	60 28½	67 29	141 19½
r: $\bar{1}$23	−38 20	47 27½	124 03½	54 41½	47 31½	117 11½

Less common and rare:

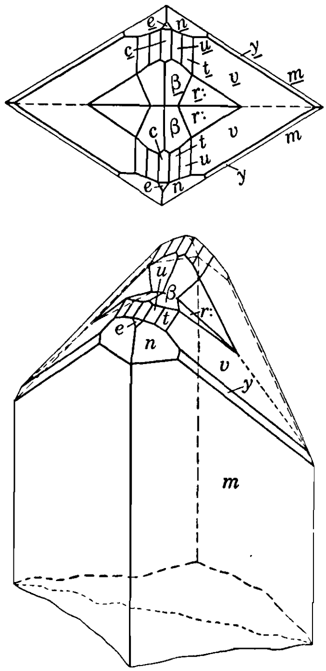
μ 130	α $\bar{1}$04	*d*: $\bar{1}$01	*k* 126	*z*: $\bar{1}$24	*x* $\bar{1}$22
u 013	*S* $\bar{1}$03	*r* 116	*w* 144	*z* $\bar{1}$34	*i* $\bar{2}$43
d 103	*e*: $\bar{1}$02	*p*: $\bar{1}$13	γ 121	*h* $\bar{2}$14	*P* $\bar{1}$31

Structure cell.[3] Space group $P2_1/c$. a_0 4.80 kX, b_0 7.68, c_0 9.80; β 90°06′; a_0:b_0:c_0 = 0.625:1:1.276. Cell contents $Ca_4Be_4(PO_4)_4(OH,F)_4$.

Habit. Stout prismatic [100] or [001]; also thick tabular {001}. In aspect usually pseudo-orthorhombic, rarely monoclinic; sometimes pseudo-hexagonal [001]. Common forms: *c b m t v e q n n*:. Also as botryoidal or spheroidal aggregates with a radial fibrous structure.

Twinning. (1) Twin plane {001}. (2) Twin plane {100}. Most crystals are twinned although some show no outward signs thereof.

Phys. Cleavage {110}, interrupted. Fracture subconchoidal. H. 5–5½. The G. increases with F content; 2.95 (hydroxyl-herderite) to 3.01 (hydroxyl-herderite with OH:F = 1.5:1); 2.94 (calc. for hydroxyl-herderite). Luster vitreous or subvitreous. Colorless to pale yellow or greenish white. Transparent to translucent.



Herderite. Topsham, Me. Twin on {100}.

Opt. In transmitted light, colorless.

ORIENTATION	Hydroxyl-herderite n(Na), Paris,[4] anal. 2.	Herderite (?) n, Topsham [5]	Herderite (?) n(Na), Stoneham [6]
$X \wedge c \sim +87°$		1.591	1.592
Y b	1.632	1.611	1.612
$Z \wedge c \sim -3°$		1.619	1.621
$2V$ [7]	72°	75° ± 5°	67°

Biaxial negative (−). $r > v$, inclined.

Chem. A basic phosphate of calcium and beryllium, $CaBe(PO_4)(OH,F)$. (OH) and F substitute mutually, and a probably complete series extends between the (OH) and F end-members. The names hydroxyl-herderite and herderite are applied to material with (OH) > F and F > (OH), respectively.

Anal.[8]

	1	2	3	4	5	6	7
CaO	34.82	34.04	32.24	33.67	33.65	33.21	34.39
BeO	15.53	16.13	16.50	15.51	15.04	15.76	15.34
P_2O_5	44.06	44.05	39.74	43.74	43.43	44.31	43.53
H_2O	5.59	5.85	7.97	3.70	0.61		
F		tr.	0.87	5.27	8.93	11.32	11.65
Rem.		0.44	3.44		0.46		
	100.00	100.51	100.76	101.89	102.12	104.60	104.91
F = O	–		0.37	2.22	3.76	4.77	4.91
Total	100.00	100.51	100.39	99.67	98.36	99.83	100.00
G.		2.952	2.851	3.01			

1. $CaBe(PO_4)(OH)$. 2. Hydroxyl-herderite. Paris, Maine.[9] Rem. is insol. 3. Hydroxyl-herderite. Newry, Maine.[10] Rem. is MnO 0.16, MgO 0.76, Al_2O_3 0.50, insol. 2.02. Fibrous material. 4. Hydroxyl-herderite. Stoneham, Maine.[11] 5. Herderite. Stoneham, Maine.[12] Rem. is MnO 0.11, Fe_2O_3 0.15, Al_2O_3 0.20. The F determination is said to be probably low, and the H_2O reported may actually be F. 6. Herderite. Stoneham.[14] 7. $CaBe(PO_4)F$.

Tests. B.B. becomes white and opaque and fuses with difficulty. Strongly heated in C.T. affords acid water. Soluble in acids.

Occur. Found typically as a pegmatite mineral formed during the later, hydrothermal, stages of deposition. The original herderite is known only from a few specimens found prior to 1825 at the tin mines of Ehrenfriedersdorf, Saxony. Also found in pegmatite at Epprechtstein and at Reinersreuth in the Fichtelgebirge, Bavaria, Germany. In pegmatite at Mursinsk, Ural Mountains, Russia. In the United States, herderite occurs at Stoneham, Oxford County, Maine, in pegmatite. Hydroxyl-herderite is found at Hebron, Paris, and Newry, in Oxford County, Maine. Herderite or hydroxyl-herderite, as yet unanalyzed, occurs at Auburn and Poland in Androscoggin County, and at Buckfield and Greenwood in Oxford County, in Maine. Also in New Hampshire at the Palermo mine and the Fletcher mine, near North Groton, Grafton County.

Alter. Observed as an alteration product of beryllonite (Newry, Maine).[13]

Name. After S. A. W. von Herder (1776–1838), mining official in Freiberg, Saxony.

Ref.

1. Angles and orientation of Penfield, *Am. J. Sc.*, **47**, 329 (1894), on hydroxyl-herderite (analysis 2) in the unit of Yatsevitch, *Am. Min.*, **20**, 426 (1935), corresponding to the structure cell. The elements apparently vary only slightly with the OH:F ratio—see Ford, *Zs. Kr.*, **50**, 97 (1912). Dana, *Am. J. Sc.*, **27**, 229 (1884), 760 (1892), gave herderite as orthorhombic; the monoclinic symmetry was first established by Penfield. Transformations: Penfield to new, 100/010/003; Goldschmidt (4, 127, 1918) to new, 100/010/002. Herderite is isotypic with datolite.

2. Yatsevitch (1935) and Goldschmidt (1918). Uncertain forms: f 209, E 803, β $\bar{1}15$, g 114, O 443, y 133, G $\bar{3}49$, H 135.

3. Strunz, *Zs. Kr*, **93**, 146 (1936), by rotation method on Topsham material (hydroxyl-herderite ?).

4. Penfield (1894).

5. Yatsevitch (1935).

6. Bertrand in Des Cloizeaux, *Bull. soc. min.*, **9**, 141 (1886).

7. For additional measurements of the optic angle see Penfield (1894) and Des Cloizeaux, *Bull. soc. min.*, **7**, 130 (1884).

8. For additional analyses see Hintze (**1** [4A], 688, 1931).

9. Wells analysis in Penfield (1894).

10. Shannon analysis in Palache and Shannon, *Am. Min*, **13**, 394 (1928).

11. Penfield and Harper, *Am. J. Sc.*, **32**, 107 (1886).

12. Genth, *Am. Phil. Soc.*, **21**, 694 (1884).

13. Palache and Shannon (1928).

14. Mackintosh, *Am. J. Sc.*, **27**, 135 (1884).