Cebaite-(Ce) $Ba_3Ce_2(CO_3)_5F_2$

Crystal Data: Monoclinic. *Point Group:* $2/m$. As tabular grains, to 0.2 mm, and granular aggregates.

Physical Properties: *Cleavage:* On $\{30\overline{1}\}$ (?), imperfect. *Fracture:* Uneven.
Hardness = 4.5–5 D(meas.) = 4.31–4.66 D(calc.) = 4.81

Optical Properties: Semitransparent. *Color:* Yellow-orange to wax-yellow. *Streak:* Yellow-orange to pale gray. *Luster:* Vitreous to waxy.
Optical Class: Biaxial (–). $\alpha = 1.598$–1.604 $\beta = 1.735$ $\gamma = 1.740$–1.748 2V(meas.) = 5°–10°

Cell Data: *Space Group:* $C2/m$. $a = 21.42(5)$ $b = 5.078(5)$ $c = 13.30(5)$ $\beta = 94.8(2)°$
$Z = 4$

X-ray Powder Pattern: Bayan Obo deposit, China.
3.25 (10), 1.99 (9), 3.98 (8), 2.11 (8), 2.20 (4), 2.52 (3), 2.35 (3)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
P_2O_5	0.07			CaO	0.29	0.61	
CO_2	23.43	[21.42]	21.36	SrO	0.62	1.43	
RE_2O_3	29.03	28.34	31.86	BaO	43.28	42.77	44.64
Al_2O_3	0.03			Na_2O	0.28	0.10	
Fe_2O_3	0.42			K_2O	0.37		
ThO_2	0.71	0.92		F	3.81	3.76	3.69
FeO		0.16		$-O = F_2$	1.60	1.58	1.55
MnO		0.16		Total	100.74	[98.09]	100.00

(1) Bayan Obo deposit, China; RE = La 31.69%, Ce 46.94%, Pr 5.15%, Nd 12.63%, Sm 1.36%, Eu 0.24%, Gd 0.43%, Tb 0.28%, Dy 0.18%, Er 0.11%, Tm 0.09%, Yb 0.02%, Y 0.88%; stated to correspond to $(Ba_{2.73}Na_{0.09}K_{0.07}Sr_{0.06}Ca_{0.05})_{\Sigma=3.00}(RE_{1.71}Fe^{3+}_{0.05}Th_{0.03}P_{0.01})_{\Sigma=1.80}$ $C_{5.15}O_{15.95}F_{1.94}$. (2) Khibiny massif, Kola Peninsula, Russia; by electron microprobe, CO_2 calculated for stoichiometry; $RE_2O_3 = La_2O_3$ 5.67%, Ce_2O_3 14.45%, Pr_2O_3 1.63%, Nd_2O_3 5.54%, Sm_2O_3 0.48%, Eu_2O_3 0.07%, Gd_2O_3 0.5%; corresponds to $(Ba_{2.90}Sr_{0.14}Ca_{0.11}Na_{0.03}Mn_{0.02})_{\Sigma=3.20}$ $RE_{1.82}(CO_3)_5F_{2.06}$. (3) $Ba_3Ce_2(CO_3)_5F_2$.

Occurrence: In carbonatite-derived dolomitic marble (Bayan Obo deposit, China); in a differentiated alkalic massif (Khibiny massif, Kola Peninsula, Russia).

Association: Zhonghuacerite-(Ce), aegirine, fluorite, barite, apatite (Bayan Obo deposit, China); mckelveyite-(Ce), ewaldite, cordylite-(Ce), donnayite-(Ce) (Khibiny massif, Kola Peninsula, Russia).

Distribution: From the Bayan Obo Fe–Nb–RE deposit, 130 km north of Baotou, Inner Mongolia, China. At the Khibiny massif, Kola Peninsula, Russia. From the Upohlava conglomerates, Slovakia.

Name: For two of the essential elements, CErium and BArium.

Type Material: n.d.

References: (1) Zhang Peishan and Tao Kejie (1983) New data for cebaite. Scientia Geologica Sinica, 4, 409–413 (in Chinese with English abs.). (2) (1985) Amer. Mineral., 70, 214 (abs. ref. 1). (3) Zhuming Yang (1995) Structure redetermination of natural cebaite-(Ce), $Ba_3Ce_2(CO_3)_5F_2$. Neues Jahrb. Mineral., Monatsh., 56–64. (4) Mercier, N. and M. Leblanc (1993) Crystal growth and structures of rare earth fluorocarbonates: I. Structures of $BaSm(CO_3)_2F$ and $Ba_3La_2(CO_3)_5F_2$: revision of the corresponding huanghoite and cebaite type structures. Eur. J. Solid State Inorg. Chem., 30, 195–205. (5) Zaitsev, A.N., F. Wall, and M.J. Le Bas (1998) REE-Sr-Ba minerals from the Khibina carbonatites, Kola Peninsula, Russia: their mineralogy, pargenesis, and evolution. Mineral. Mag., 62, 225–250.