Bastnäsite-(Ce) $(Ce, La)(CO_3)F$

Crystal Data: Hexagonal. *Point Group:* $\bar{6}2c$. Commonly in tabular to equant crystals, with {0001} and {$10\bar{1}0$}, may be modified by {$11\bar{2}0$}, {$10\bar{1}1$}, {$10\bar{1}2$}, {$10\bar{1}3$}, {$11\bar{2}2$}, horizontally striated, may be elongated, commonly in syntaxic intergrowth with röntgenite-(Ce), synchysite-(Ce), parisite-(Ce), or cordylite-(Ce), to 20 cm; granular, massive.

Physical Properties: *Cleavage:* On {$10\bar{1}0$}, indistinct; {0001}, a parting, distinct to perfect. *Fracture:* Uneven. *Tenacity:* Brittle. Hardness = 4–4.5 D(meas.) = 4.9–5.2 D(calc.) = 5.12 (for $Ce(CO_3)F$). Strongly piezoelectric; dark red cathodoluminescence.

Optical Properties: Transparent to translucent. *Color:* Wax-yellow, honey-yellow, reddish brown; in transmitted light, pale yellow to colorless. *Luster:* Vitreous to greasy, pearly on basal partings.
Optical Class: Uniaxial (+). *Pleochroism:* Faint. *Absorption:* $O < E$. $\omega = 1.717$–1.722 $\epsilon = 1.818$–1.823

Cell Data: *Space Group:* $P\bar{6}2c$. a = 7.118(1) c = 9.762(1) Z = 6

X-ray Powder Pattern: Stove Mountain, Colorado, USA.
2.88 (100), 3.56 (71), 2.06 (50), 1.892 (50), 4.90 (35), 2.01 (35), 1.675 (24)

Chemistry:

	(1)	(3)		(1)	(3)
P_2O_5	0.60		F	6.23	8.69
CO_2	20.20	20.14	$-O = F_2$	2.61	3.66
La_2O_3	36.30	37.28	Total	101.22	100.00
Ce_2O_3	40.50	37.55			

(1) Madagascar. (2) Gallinas Mountains, New Mexico, USA; analysis not given, corresponds to $(Ce_{0.48}La_{0.37}Nd_{0.10}Pr_{0.04}Sm_{0.01})_{\Sigma=1.00}(CO_3)F$. (3) $(Ce, La)(CO_3)F$ with Ce:La = 1:1.

Polymorphism & Series: 4H, 6R, 3R polytypes; forms a series with hydroxylbastnäsite-(Ce).

Occurrence: The most abundant RE-bearing mineral, typically hydrothermal, although primary igneous occurrences are known. In granite and alkali syenites and pegmatites; in carbonatites; in contact-metamorphic deposits; rarely as a detrital mineral in placers.

Association: Allanite-(Ce), cerianite-(Ce), synchysite-(Ce), parisite-(Ce), cerite-(Ce), fluocerite-(Ce), fluorite.

Distribution: In Sweden, from the Bastnäs mine, near Riddarhyttan, Västmanland. At the Trimouns talc deposit, six km northeast of Luzenac, Ariège, France. In a large deposit at Karkin, near Eskiçehir, Eskiçehir Province, Turkey. Fine crystals from Shinwaro, Kunar Province, Afghanistan. On Zegi Mountain, Fata, Pakistan. Large crystals from Andakatany, Ambatofangehana, and elsewhere in Madagascar. At Karonge, Burundi. On Wigu Hill, Tanzania. From Nkombwa Hill, Zambia. In the USA, from near Stove Mountain, in the St. Peters Dome area, and at Crystal Park, near Pikes Peak, El Paso Co., Colorado; at the Red Cloud fluorite mine, Gallinas Mountains, Lincoln Co., New Mexico; in a large deposit at Mountain Pass, San Bernardino Co., California; from Granite Mountain, near Little Rock, Pulaski Co., Arkansas; in the Trout Brook Valley, near Ticonderoga, Essex Co., New York. At Mont Saint-Hilaire, Quebec, Canada. A major ore mineral in the Bayan Obo Fe–Nb–RE deposit, 130 km north of Baotou, Inner Mongolia, China. There are numerous minor localities.

Name: For its first-noted occurrence in the Bastnäs mine, Sweden, and content of *cerium*.

Type Material: Swedish Museum of Natural History, Stockholm, Sweden, 23:0476.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 289–291. (2) Ni, Y., J.M. Hughes, and A.N. Mariano (1993) The atomic arrangement of bastnäsite-(Ce), $Ce(CO_3)F$, and structural elements of synchysite-(Ce), röntgenite-(Ce), and parisite-(Ce). Amer. Mineral., 78, 415–418. (3) Jansen, G.J., G.B. Magnin, Jr., and B. Levin (1959) Synthesis of bastnaesite. Amer. Mineral., 44, 180–181.