Florencite-(Ce) $(Ce, La)Al_3(PO_4)_2(OH)_6$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}\ 2/m$. As pseudocubic rhombohedra, $\{01\overline{1}1\}$, may be modified by $\{10\overline{1}0\}$, $\{02\overline{2}1\}$, $\{0001\}$, to 2 cm.

Physical Properties: *Cleavage:* Good on $\{0001\}$; interrupted on $\{11\overline{2}0\}$. *Fracture:* Splintery to subconchoidal. *Tenacity:* Brittle. Hardness = 5–6 D(meas.) = 3.45–3.54
D(calc.) = 3.47–3.69

Optical Properties: Transparent to translucent. *Color:* Pale yellow to butterscotch-yellow, red-orange, pink, pale brown, colorless to gray; colorless to pale yellow in thin section, may be zoned. *Luster:* Greasy to resinous.
Optical Class: Uniaxial (+). $\omega = 1.680$–1.702 $\epsilon = 1.705$–1.715

Cell Data: *Space Group:* $R\overline{3}m$. $a = 6.972(2)$ $c = 16.261(6)$ $Z = 3$

X-ray Powder Pattern: Matta dos Creoulos, Brazil; near florencite-(La) and -(Nd). (ICDD 8-143).
2.93 (100b), 5.63 (90), 2.16 (80), 1.885 (80), 3.48 (70), 2.21 (70), 1.741 (70)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
SO_3		1.7		Sm_2O_3	1.48	0.2	
P_2O_5	27.40	26.0	27.67	CaO	0.47	1.6	
Al_2O_3	29.60	29.8	29.81	SrO		9.0	
La_2O_3	8.68	5.3		BaO		0.1	
Ce_2O_3	17.79	8.8	31.99	F		1.6	
Nd_2O_3	3.78	2.6		H_2O	n.d.	12.9	10.53
Pr_6O_{11}		0.7		$-O = F_2$		0.7	
				Total		99.6	100.00

(1) Mackenzie Mountains, Canada; by electron microprobe, average of ten partial analyses; corresponding to $(Ce_{0.56}La_{0.28}Nd_{0.12}Sm_{0.04}Ca_{0.04})_{\Sigma=1.04}Al_{3.00}(PO_4)_{1.99}(OH)_6$. (2) Kangankunde Hill, Malawi. (3) $CeAl_3(PO_4)_2(OH)_6$.

Mineral Group: Crandallite group.

Occurrence: As a weathering product, typically of apatite, in highly argillized igneous rocks, bauxite, saprolite, carbonatites; authigenic in shales and sandstones; formed by the interaction of guano-reacted waters with gabbroic rock.

Association: Kaolinite, muscovite, alunite, siderite, quartz (sedimentary rocks); monazite, bastnäsite, apatite, ankerite, strontianite, barite, sphalerite, quartz (carbonatites).

Distribution: Many localities, but chemical analysis is required to determine which florencite species is present. Characterized material from Brazil, at Tripuhy, near Ouro Preto; from Matta dos Creoulos, and Lavra da Tejucana, near Diamantina, Minas Gerais; large crystals at Brumado, Bahia, Brazil. From the Backbone Ranges, Mackenzie Mountains, Northwest Territories, Canada. At Salmchâteau, Belgium. From the Corris area, Gwynedd, Wales. At the La Vanguardia kaolin deposit, near Combarbalá, Illapel region, Chile. On Middleton's Ridge, Ascension Island. At Klein Spitzkopje, Namibia. On Kangankunde Hill, Malawi. From Mt. Weld, 35 km south of Laverton, Western Australia. Most likely widespread in minor amounts in marine sediments.

Name: Honors Dr. William Florence (1864–1942), Brazilian mineralogist who made an early analysis, and for the dominant rare earth element, *cerium*.

Type Material: National Museum of Natural History, Washington, D.C., USA, R5209.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 838–839. (2) McKie, D. (1962) Goyazite and florencite from two African carbonatites. Mineral. Mag., 33, 281–297. (3) Pouliot, G. and H.J. Hofmann (1981) Florencite: a first occurrence in Canada. Can. Mineral., 19, 535–540. (4) Kato, T. (1990) The crystal structure of florencite. Neues Jahrb. Mineral., Monatsh., 227–231.