

Chlorapatite

Ca₅(PO₄)₃Cl

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Crystal Data: Hexagonal or monoclinic. *Point Group:* 6/*m* or 2/*m*. As prismatic hexagonal crystals, to 5 cm; granular, massive, may be in zoned intergrowths with fluorapatite.

Physical Properties: *Cleavage:* Poor on {0001} and {10 $\bar{1}$ 0}. *Tenacity:* Brittle. Hardness = ~5 D(meas.) = 3.17–3.18 D(calc.) = 3.172 (monoclinic).

Optical Properties: Transparent to translucent. *Color:* Greenish yellow, pinkish white, light greenish gray. *Luster:* Vitreous. *Optical Class:* Uniaxial (-), may be biaxial (-). *Pleochroism:* Weak to moderate; in pale colors. *Absorption:* E > O. $\omega = 1.650\text{--}1.667$ $\epsilon = 1.647\text{--}1.665$ $\alpha = 1.665$ $\beta = 1.667$ $\gamma = \sim 1.667$ 2V(meas.) = ~10°

Cell Data: *Space Group:* P6₃/*m*. a = 9.5979 c = 6.7762 Z = 2, or *Space Group:* P2₁/*b*. a = 9.605 b = 19.210 c = 6.785 $\beta = 120^\circ$ Z = 6

X-ray Powder Pattern: Bob's Lake, Canada. 2.853 (100), 2.770 (100), 1.960 (50), 1.838 (50), 3.39 (40), 2.306 (40), 1.910 (25)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
P ₂ O ₅	41.2	40.62	40.89	Cl	6.2	3.22	6.81
CaO	53.4	54.87	53.84	H ₂ O	0.09	0.50	
F	0.13	0.84		-O = (F, Cl) ₂	1.45	1.08	1.54
				Total	99.57	98.97	100.00

(1) Bob's Lake, Canada; Ca_{4.95}(PO₄)_{3.02}[Cl_{0.91}(OH)_{0.05}F_{0.04}]_{Σ=1.00}. (2) Fairfax, Virginia, USA; H₂O calculated for stoichiometry, corresponding to Ca_{5.13}(PO₄)_{3.00}[Cl_{0.48}(OH)_{0.29}F_{0.23}]_{Σ=1.00}. (3) Ca₅(PO₄)₃Cl.

Polymorphism & Series: End-member chlorapatite is monoclinic.

Mineral Group: Apatite group; Cl > F or OH.

Occurrence: Relatively much rarer than fluorapatite or hydroxylapatite, formed in F-deficient environments. In calcisilicate marble; an accessory mineral in layered mafic intrusions; in veins through diabase; replacing triphylite in granite pegmatite. In meteorites.

Association: Actinolite, diopside, calcite, quartz, talc (Bob's Lake, Canada); amphibole, chlorite, plagioclase, titanite, datolite (Bull Run quarry, Virginia, USA); olivine, orthopyroxene, phlogopite, ferroalluaudite, chromite (Angarf-Sud pegmatite, Morocco).

Distribution: Analyzed material noted from: in the USA, the Fairfax quarry, Centreville, Fairfax Co., and Bull Run quarry, Loudoun Co., Virginia; at the Stillwater complex, Montana; in the White Picacho district, Maricopa and Yavapai Cos., Arizona. From Bob's Lake, Frontenac Co., Quebec, Canada. In the Bushveld complex, Transvaal, South Africa. At the Angarf-Sud pegmatite, Tazenakht Plain, Morocco. From Rajagarh, near Ajmer, Rajasthan, India. At Kurokura, Kangway Prefecture, Japan. From Kragerø and Ødegården, Bamble, and as large crystals from Snarum, Norway.

Name: For dominant chlorine and membership in the apatite group; see fluorapatite.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 879–889. (2) Chang, L.L.Y., R.A. Howie, and J. Zussman (1996) Rock-forming minerals, (2nd edition), v. 5B, non-silicates, 297–334. (3) Phillips, W.R. and D.T. Griffen (1981) Optical mineralogy, 81–84. (4) Hounslow, A.W. and G.Y. Chao (1970) Monoclinic chlorapatite from Ontario. Can. Mineral., 10, 252–259. (5) Mitchell, R.S. and T.V. Dagenhart, Jr. (1981) Chlorapatite from northern Virginia: the first occurrence in the United States. Southeastern Geology, 22, 45–52. (6) Hughes, J.M., M. Cameron, and K.D. Crowley (1989) Structural variation in natural F, OH, and Cl apatites. Amer. Mineral., 74, 870–876. (7) Hughes, J.M., M. Cameron, and K.D. Crowley (1990) Crystal structures of natural ternary apatites: solid solution in the Ca₅(PO₄)₃X (X = F, OH, Cl) system. Amer. Mineral., 75, 295–304.

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