

Dufrenite

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Crystal Data: Monoclinic. *Point Group:* $2/m$. Crystals rare, rounded, tabular, to 1 mm; in sheaflike or subparallel aggregates. Usually radial fibrous, botryoidal masses or crusts.**Physical Properties:** *Cleavage:* One, perfect; another, less perfect, both || fiber elongation; a third \perp first two, in traces. *Tenacity:* Brittle. *Hardness* = 3.5–4.5 *D*(meas.) = 3.1–3.34 *D*(calc.) = [3.41]**Optical Properties:** Translucent to almost opaque. *Color:* Greenish black, dark green, olive-green when fresh, olive-brown to reddish brown when oxidized, typically concentrically banded; in transmitted light, bluish green, reddish brown, yellow. *Luster:* Vitreous to silky. *Optical Class:* Biaxial (+). *Pleochroism:* X = deep blue, bluish green, pale yellow-brown, pale brown; Y = buff, pale yellow-brown to brown, deep blue; Z = deep red-brown, olive-brown, dark brown, greenish blue. *Dispersion:* $r < v$, commonly, or $r > v$; both extreme. *Absorption:* $Z > Y > X$; may be $Z > X > Y$. $\alpha = 1.810$ – 1.842 $\beta = 1.813$ – 1.850 $\gamma = 1.855$ – 1.925 $2V$ (meas.) = Small to very small.**Cell Data:** *Space Group:* $C2/c$. $a = 25.84(2)$ $b = 5.126(3)$ $c = 13.78(1)$ $\beta = 111.20(6)^\circ$ $Z = 2$ **X-ray Powder Pattern:** Cornwall, England; close to natrodufrenite. 3.151 (10), 12.00 (9), 5.002 (9), 3.393 (7), 2.860 (6), 4.410 (5), 2.101 (5)**Chemistry:**

	(1)	(2)	(3)
SiO ₂	0.43	0.53	
P ₂ O ₅	31.10	30.26	32.51
Al ₂ O ₃	0.87		
Fe ₂ O ₃	47.03	55.63	45.73
FeO	6.80		8.23
CuO		0.95	
CaO	1.68	1.50	3.21
MgO	0.17	trace	
H ₂ O	11.47	10.62	10.32
Total	99.55	99.49	100.00

(1–2) Wheal Phoenix, Cornwall, England. (3) $\text{Ca}_{0.5}\text{Fe}^{2+}\text{Fe}_5^{3+}(\text{PO}_4)_4(\text{OH})_6 \cdot 2\text{H}_2\text{O}$.**Occurrence:** A secondary mineral formed principally in iron ore deposits.**Association:** Goethite, beraunite, quartz.**Distribution:** In Germany, from Hirschberg, Ullersreuth, and Lobenstein, Thuringia; at Hauptmannsgrün, near Reichenbach, Saxony; in the Rotläufchen mine, Waldgirmes, near Giessen, Hesse; at Hagendorf, Bavaria. From the West Phoenix United mines, Linkinhorne, and in the Gunheath china clay pit, St. Austell, Cornwall, England. From the Mangualde pegmatite, near Mesquitela, Portugal. In the USA, at Rock Run, Cherokee Co., Alabama; in the Palermo #1 mine, near North Groton, Grafton Co., New Hampshire; from the Tip Top mine, 8.5 km southwest of Custer, Custer Co., South Dakota; at the Sequoia Pit, Iron Point district, Humboldt Co., and in the Gold Quarry mine, near Carlin, Maggie Creek district, Eureka Co., Nevada; in the Santa Rita mine, Grant Co., New Mexico. From Dandarragan, Western Australia. In the El Criollo pegmatite, Cerro Blanco, Tanti district, 45 kilometers west of Córdoba, Córdoba Province, Argentina. There are probably additional localities, but requiring confirmation.**Name:** To honor Professor Ours Pierre Armand Petit-Dufrenoy (1792–1857), French mineralogist, National School of Mines, Paris, France.**Type Material:** University of Chicago, Chicago, Illinois, 1247; Harvard University, Cambridge, Massachusetts, USA, 97427.**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 873–875. (2) Moore, P.B. (1970) Crystal chemistry of the basic iron phosphates. *Amer. Mineral.*, 55, 135–169.

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