

# Pyrochlore

# (Ca, Na)<sub>2</sub>Nb<sub>2</sub>O<sub>6</sub>(OH, F)

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**Crystal Data:** Cubic; typically metamict. *Point Group:*  $4/m\bar{3}2/m$ . Typically octahedra, modified by {001}, {011}, {112}, {113}, to 7 cm; granular, massive. *Twinning:* On {111}, rare.

**Physical Properties:** *Cleavage:* {111}, may be a parting. *Fracture:* Subconchoidal to uneven, splintery. *Tenacity:* Brittle. Hardness = 5–5.5 VHN = 542–665 (100 g load). D(meas.) = 4.45 to 4.90 if uranoan. D(calc.) = 4.33 (for CaNaNb<sub>2</sub>O<sub>6</sub>F). May be radioactive.

**Optical Properties:** Translucent to opaque. *Color:* Black to brown, chocolate-brown, reddish brown, amber-orange, red-orange. *Streak:* Brown. *Luster:* Vitreous to resinous.

*Optical Class:* Isotropic, weak anomalous anisotropism.  $n = 1.9\text{--}2.2$

R: (400) 11.3, (420) 11.2, (440) 11.1, (460) 11.0, (480) 11.0, (500) 10.9, (520) 10.8, (540) 10.7, (560) 10.6, (580) 10.5, (600) 10.5, (620) 10.4, (640) 10.4, (660) 10.4, (680) 10.4, (700) 10.4

**Cell Data:** *Space Group:*  $Fd\bar{3}m$ .  $a = 10.35\text{--}10.47$   $Z = 8$

**X-ray Powder Pattern:** Blue River, British Columbia, Canada.

3.00 (100), 1.838 (60), 1.568 (50), 5.98 (25), 3.13 (20), 2.60 (20), 1.194 (20)

Chemistry:(1)	(2)	(1)	(2)	(1)	(2)			
UO <sub>3</sub>	10.68	ThO <sub>2</sub>	0.20	Na <sub>2</sub> O	6.20			
U <sub>3</sub> O <sub>8</sub>	0.03	UO <sub>2</sub>	8.42	F	4.61	0.49		
Nb <sub>2</sub> O <sub>5</sub>	65.8	34.27	RE <sub>2</sub> O <sub>3</sub>	2.56	H <sub>2</sub> O	[1.74]	11.42	
Ta <sub>2</sub> O <sub>5</sub>	0.04	4.27	Fe <sub>2</sub> O <sub>3</sub>	0.56	3.80	P <sub>2</sub> O <sub>5</sub>	0.07	
SiO <sub>2</sub>	0.17	2.68	MnO	0.00	0.22	S	0.04	
TiO <sub>2</sub>	2.59	9.79	PbO	0.41	–O = F <sub>2</sub>	1.94	0.21	
ZrO <sub>2</sub>	0.60		CaO	15.8	13.62	Total	[100.00]	100.11
SnO <sub>2</sub>	0.00	0.25	SrO	0.93				

(1) Oka, Canada; diopside+apatite+pyrite 0.3%, H<sub>2</sub>O by difference; corresponds to (Ca<sub>1.06</sub>Na<sub>0.74</sub>Sr<sub>0.03</sub>RE<sub>0.06</sub>)<sub>Σ=1.89</sub>(Nb<sub>1.86</sub>Ti<sub>0.12</sub>Fe<sub>0.03</sub><sup>3+</sup>Zr<sub>0.02</sub>)<sub>Σ=2.03</sub>O<sub>5.94</sub>F<sub>0.91</sub>(OH)<sub>0.25</sub>. (2) Hybla, Canada.

**Polymorphism & Series:** Forms a series with microlite.

**Mineral Group:** Pyrochlore group and subgroup; (Na + Ca)<sub>A</sub> > 20%; (Nb + Ta)<sub>B</sub> > 2Ti<sub>B</sub>; Nb<sub>B</sub> > Ta<sub>B</sub>.

**Occurrence:** In pegmatites in nepheline syenites and other alkalic rocks; in granite pegmatites and greisens; characteristic in carbonatites; detrital.

**Association:** Zircon, aegirine, apatite, perovskite, columbite.

**Distribution:** Numerous localities. From Fredriksvärn, Larvik, and the Langesundsfjord, Norway. On Alnö Island, Sweden. From near Schelingen, Kaiserstuhl, Baden-Württemberg, and in the Eifel district, Germany. In Russia, at Miass and Vishnevogorsk, Ilmen Mountains, Southern Ural Mountains; large crystals from the Tatarskoye deposit, Yenisei Ridge, Siberia; and in the Lovozero massif, Kola Peninsula. On San Miguel Island, Azores. From Oka, Quebec; Hybla, Ontario; and elsewhere in Canada. At Narssärssuk, Greenland. From the Mbeya carbonatite, Panda Hill, near Mbeya, Tanzania. On Rouma Isle, Los Islands, Guinea. In the Mt. Weld carbonatite, 35 km south of Laverton, Western Australia.

**Name:** From the Greek for *fire* and *green*, to which color the mineral usually turns on ignition.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 747–757. (2) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. U.S. Geol. Sur. Bull. 1064, 326–333. (3) Hogarth, D.D. (1961) A study of pyrochlore and betafite. Can. Mineral., 6, 610–633. (4) Perrault, G. (1968) La composition chimique et la structure cristalline du pyrochlore d'Oka, P.Q. Can. Mineral., 9, 383–402 (in French with English abs.). (5) Hogarth, D.D. (1977) Classification and nomenclature of the pyrochlore group. Amer. Mineral., 62, 403–410. (6) Gaertner, H.R. (1930) Die Kristallstrukturen von Loparit und Pyrochlor. Neues Jahrb. Mineral., Monatsh., 61, 1–30 (in German).

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