

**Montebrasite****LiAl(PO<sub>4</sub>)(OH, F)**

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**Crystal Data:** Triclinic. *Point Group:*  $\bar{1}$ . Crystals typically equant, may be short to long prismatic, to 10 cm; as coarse cleavable or blocky to rounded nodular masses. *Twinning:* Common on  $\{\bar{1}11\}$ , producing tabular composite crystals; microscopic polysynthetic twinning on  $\{111\}$ .

**Physical Properties:** *Cleavage:* Perfect on  $\{100\}$ ; good on  $\{110\}$ ; distinct on  $\{0\bar{1}1\}$  [morphological orientation of ref. (1)]. *Fracture:* Uneven to subconchoidal. *Tenacity:* Brittle. Hardness = 5.5–6 D(meas.) = 2.98–3.04 D(calc.) = [3.03]

**Optical Properties:** Translucent to transparent. *Color:* Pale brown, pink, pale yellow, gray, white, colorless; colorless in transmitted light. *Luster:* Vitreous, pearly on cleavages. *Optical Class:* Biaxial (+), may be biaxial (-). *Dispersion:*  $r < v$ .  $\alpha = 1.594\text{--}1.615$   
 $\beta = 1.608\text{--}1.624$   $\gamma = 1.616\text{--}1.646$   $2V(\text{meas.}) = 66^\circ\text{--}101^\circ$

**Cell Data:** *Space Group:*  $C\bar{1}$ .  $a = 6.713(1)$   $b = 7.708(1)$   $c = 7.0194(7)$   $\alpha = 91.31(1)^\circ$   
 $\beta = 117.93(1)^\circ$   $\gamma = 91.77(1)^\circ$   $Z = 4$

**X-ray Powder Pattern:** Varuträsk, Sweden. (ICDD 12-448).  
2.968 (100), 3.164 (90), 4.672 (70), 3.200 (60), 3.327 (45), 3.271 (45), 3.229 (45)

<b>Chemistry:</b>		(1)	(2)	(1)	(2)	(1)	(2)
P <sub>2</sub> O <sub>5</sub>	49.11	48.31	Na <sub>2</sub> O	0.14		H <sub>2</sub> O <sup>-</sup>	0.07
Al <sub>2</sub> O <sub>3</sub>	35.10	34.70	K <sub>2</sub> O	0.01		-O = F <sub>2</sub>	0.59
CaO	0.08		F	1.40	6.47		
Li <sub>2</sub> O	9.52	10.17	H <sub>2</sub> O <sup>+</sup>	5.25	3.07	Total	100.09
							100.00

(1) Tanco pegmatite, Canada; corresponds to Li<sub>0.93</sub>Na<sub>0.01</sub>Al<sub>1.01</sub>(PO<sub>4</sub>)<sub>1.01</sub>(OH)<sub>0.85</sub>F<sub>0.11</sub>.

(2) LiAl(PO<sub>4</sub>)(OH, F) with OH:F = 1:1.

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

**Mineral Group:** Amblygonite group.

**Occurrence:** A late primary and secondary mineral in zoned granite pegmatites; may be an ore of lithium.

**Association:** Hydroxylapatite, spodumene, lepidolite, petalite, pollucite, tourmaline, triplite, lithiophilite, lacroixite, crandallite, muscovite, albite.

**Distribution:** A few localities for well-studied material include: from Montebras, Creuse, France. In the Varuträsk pegmatite, 15 km northwest of Skellefteå, Västerbotten, Sweden. From the Tanco pegmatite, Bernic Lake, Manitoba, Canada. In the USA, at the Nevel quarry and Bell Pit, Newry, Oxford Co., and elsewhere in Maine; in the Midnight Owl pegmatite, White Picacho district, Maricopa Co., Arizona; in South Dakota, from the Peerless and Hugo mines, near Keystone, Pennington Co.; around Custer, Custer Co., at the Tip Top and Tin Mountain mines, with large masses from the Beecher lode, eight km southeast of Custer; at the Nesbit mine, Gunnison Co., Colorado; in the Stewart mine, Pala, San Diego Co., California. In Brazil, gemmy crystals from Linópolis, Galiléia; at Araçuaí, Itinga, Governador Valadares, and other places in Minas Gerais. In the Buranga pegmatite, near Gatumba, Rwanda.

**Name:** For the locality, Montebras, France, from which it was first described.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 823–827. (2) Černá, I., P. Černý, and R.B. Ferguson (1973) The fluorine content and some physical properties of the amblygonite-montebrasite minerals. *Amer. Mineral.*, 58, 291–301. (3) Greiner, D.J. and F.D. Bloss (1987) Amblygonite-montebrasite optics: response to (OH)<sup>-</sup> orientation and rapid estimation of F from 2V. *Amer. Mineral.*, 72, 617–624. (4) Groat, L.A., M. Raudsepp, F.C. Hawthorne, T.S. Ercit, B.L. Sherriff, and J.S. Hartman (1990) The amblygonite-montebrasite series: characterization by single-crystal structure refinement, infrared spectroscopy, and multinuclear MAS-NMR spectroscopy. *Amer. Mineral.*, 75, 992–1008.

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