

Anthophyllite

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Crystal Data: Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$. Crystals rare, to 25 cm; as bladed aggregates of untruncated prismatic crystals. Commonly lamellar or fibrous, asbestiform.

Physical Properties: *Cleavage:* Perfect on {210}, intersecting at 54.5° and 125.5° ; distinct on {010} and {100}. *Tenacity:* Brittle; fibers are elastic. *Hardness* = 5.5–6 *D(meas.)* = ~ 2.9 –3.5 *D(calc.)* = 3.09

Optical Properties: Transparent to translucent. *Color:* Gray, brownish gray, yellowish brown, clove-brown, brownish green, emerald-green; in thin section, colorless to pale green or yellow. *Streak:* White or grayish. *Luster:* Vitreous, pearly on cleavage.

Optical Class: Biaxial (+) or (-). *Pleochroism:* When Fe-rich, moderate; *X* = clove-brown, yellowish brown, grayish brown; *Y* = clove-brown, brown-gray, brownish; *Z* = clove-brown to dark brown, grayish blue to green, lilac. *Orientation:* *X* = *a*; *Y* = *b*; *Z* = *c*. *Dispersion:* $r > v$ or $r < v$, weak to moderate. *Absorption:* $Z > Y = X$ or $Z = Y > X$. $\alpha = 1.603$ – 1.679 $\beta = 1.617$ – 1.685 $\gamma = 1.627$ – 1.690 $2V(\text{meas.}) = \sim 80^\circ$

Cell Data: *Space Group:* *Pnma*. *a* = 18.544(2) *b* = 18.026(2) *c* = 5.282(1) *Z* = 4

X-ray Powder Pattern: Georgia, USA.

3.05 (100), 3.24 (60), 8.26 (55), 2.84 (40), 2.54 (40), 3.65 (35), 8.9 (30)

Chemistry:	(1)	(1)	(1)
	SiO ₂ 58.08	FeO 10.18	Na ₂ O 0.05
	TiO ₂ 0.04	MnO 0.20	K ₂ O 0.01
	Al ₂ O ₃ 0.30	MgO 27.99	H ₂ O [2.20]
	Fe ₂ O ₃ 0.65	CaO 0.17	Total [99.87]

(1) Ochsenkogel, Gleinalpe, Austria; by electron microprobe, $\text{Fe}^{2+}:\text{Fe}^{3+}$ by wet chemical analysis, H₂O calculated from stoichiometry; corresponding to $(\text{Mg}_{5.71}\text{Fe}_{1.17}^{2+}\text{Fe}_{0.07}^{3+}\text{Ca}_{0.02}\text{Mn}_{0.02}\text{Na}_{0.01})_{\Sigma=7.00}(\text{Si}_{7.95}\text{Al}_{0.05})_{\Sigma=8.00}\text{O}_{22}(\text{OH})_{2.00}$.

Polymorphism & Series: Forms a series with magnesio-anthophyllite and ferro-anthophyllite.

Mineral Group: Amphibole (Fe–Mn–Mg) group: 0.1 $\text{Mg}/(\text{Mg} + \text{Fe}^{2+})$ 0.89; $(\text{Ca} + \text{Na})_{\text{B}} < 1.34$; $\text{Li} < 1.0$; $\text{Si} \geq 7.0$.

Occurrence: From medium- or high-grade metamorphism, in amphibolites, gneisses, metaquartzites, iron formations, granulites, and schists derived from argillaceous sediments, ultramafic, or mafic igneous rocks; a retrograde reaction product.

Association: Cordierite, talc, chlorite, sillimanite, mica, olivine, “hornblende,” gedrite, magnesio-cumingtonite, garnet, staurolite, plagioclase.

Distribution: From Kongsberg and Snarum, Norway. At Schneeberg, Saxony, Germany. From Norberg, Sweden. At Hermanov, Czech Republic. In Greenland, from Fiskensæset. In the USA, from Chesterfield, Hampshire Co., Massachusetts; the Carleton talc mine, near Chester, Windsor Co., Vermont; near Media, Delaware Co., Pennsylvania; the Day Book deposit, near Spruce Pine, Mitchell Co., North Carolina; in California, at the Winchester quarry, Riverside Co., and near Coffee Creek, Carrville, Trinity Co.; in the Copper Queen mine, Prairie Divide, Park Co., Colorado. From Munglinup, Western Australia.

Name: From the Latin *anthophyllum*, meaning *clove*, in allusion to the mineral’s color.

References: (1) Dana, E.S. (1892) Dana’s system of mineralogy, (6th edition), 384–385.

(2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 2, chain silicates, 211–229. (3) Rabbitt, J.C. (1948) A new study of the anthophyllite series. *Amer. Mineral.*, 33, 263–323. (4) Beatty, S. (1950) X-ray diffraction patterns of asbestos. *Amer. Mineral.*, 35, 579–589. (5) Walitzi, E.M., F. Walter, and K. Ettinger (1989) Verfeinerung der Kristallstruktur von Anthophyllit vom Ochsenkogel/Gleinalpe, Österreich. *Zeits. Krist.*, 188, 237–244 (in German).

(6) Phillips, W.R. and D.T. Griffen (1981) Optical mineralogy, 223–225.

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