Actinolite $Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$

Crystal Data: Monoclinic. *Point Group:* $2/m$. As bladed crystals, to 15 cm; columnar, may be kinked or bent; radiating fibrous to asbestiform; granular to massive. *Twinning:* Simple or lamellar, common ∥ {100}; lamellar, less common ∥ {001}.

Physical Properties: *Cleavage:* Good on {110}, with intersections of 56° and 124°; parting on {100}. *Tenacity:* Brittle, tough in fibrous aggregates ("nephrite jade"). Hardness = 5–6 D(meas.) = 3.03–3.24 D(calc.) = [3.07]

Optical Properties: Transparent to translucent. *Color:* Bright green to grayish green; in thin section, colorless, pale green to deep green. *Streak:* White. *Luster:* Vitreous, silky. *Optical Class:* Biaxial (–). *Pleochroism:* Weak; X = pale yellow, yellowish green; Y = pale yellow-green, green; Z = pale green, deep greenish blue. *Orientation:* $Y = b$; $Z \wedge c$ = 14°–18.5°. *Dispersion:* $r < v$, weak. α = 1.613–1.646 β = 1.624–1.656 γ = 1.636–1.666 2V(meas.) = 79°–86°

Cell Data: *Space Group:* $C2/m$. a = 9.891(1) b = 18.200(1) c = 5.305(1) β = 104.64(1)° Z = 2

X-ray Powder Pattern: Sobotin, Czech Republic. (ICDD 25-157).
2.719 (100), 2.543 (100), 3.401 (80), 8.47 (70), 4.91 (70), 3.143 (70), 2.959 (70)

Chemistry:

	(1)		(1)
SiO_2	55.17	MnO	0.18
TiO_2	0.17	MgO	16.21
Al_2O_3	2.69	CaO	12.08
FeO	11.07	Na_2O	0.82
		Total	98.39

(1) Southeast Anglesey, Wales; by electron microprobe, corresponding to $(Ca_{1.83}Na_{0.22})_{\Sigma=2.05}(Mg_{3.41}Fe^{2+}_{1.26}Al_{0.23}Fe^{3+}_{0.05}Mn_{0.02}Ti_{0.02})_{\Sigma=4.99}(Si_{7.79}Al_{0.21})_{\Sigma=8.00}O_{22}(OH)_2$.

Polymorphism & Series: Forms a series with tremolite and ferro-actinolite.

Mineral Group: Amphibole (calcic) group: $0.5 \quad Mg/(Mg + Fe^{2+}) \quad 0.89$; $(Na + K)_A < 0.5$; $Na_B < 0.67$; $(Ca + Na)_B \geq 1.34$; Si ≥ 7.5.

Occurrence: Produced by low-grade regional or contact metamorphism of magnesium carbonate, mafic, or ultramafic rocks; also in glaucophane-bearing blueschists.

Association: Talc, epidote, chlorite, glaucophane, pumpellyite, lawsonite, albite.

Distribution: Many localities. In Austria, on Mt. Greiner, Zillertal, and at Untersulzbachtal. From Zermatt, Valais, Switzerland. At Snarum and Arendal, Norway. From the Ural Mountains, Russia. In the USA, from Gouverneur, St. Lawrence Co., New York; Franklin and Newton, Sussex Co., New Jersey; Chester, Windsor Co., Vermont; in the Fairfax quarry, Centreville, Fairfax Co., Virginia; Crestmore, Riverside Co., California; at Salida, Chaffee Co., Colorado. "Nephrite jade" occurs, in the USA, south and east of Lander, Fremont Co., Wyoming; north from Cape San Martin, Monterey Co., California; and around Jade Mountain, near the Kobuk River, Alaska. Along the Fraser River, British Columbia, Canada. Around Mt. Cook, South Island, New Zealand. Fine material from the Kunlun Mountains, Sinkiang Uighur Autonomous Region, China.

Name: From the Greek for *ray*, in allusion to the mineral's common radiating fibrous habit.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 389–391. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 2, chain silicates, 249–262. (3) Mitchell, J.T., F.D. Bloss, and G.V. Gibbs (1971) Examination of the actinolite structure and four other C2/m amphiboles in terms of double bonding. Zeits. Krist., 133, 273–300. (4) Gibbons, W. and M. Gyopari (1986) A greenschist protolith for blueschist in Anglesey, U.K. In: B.W. Evans and E.H. Brown, Eds., Blueschists and eclogites, Geol. Soc. Amer. Memoir 164, 217–228. (5) Phillips, W.R. and D.T. Griffen (1981) Optical mineralogy, 229–231.