

**Crystal Data:** Orthorhombic. *Point Group:* 2/m 2/m 2/m. As euhedral crystals or columnar aggregates having nearly square cross sections, commonly elongated || [001], to 20 cm. Also fibrous, compact, massive. *Twining:* On {101}, rare.

**Physical Properties:** *Cleavage:* Good on {110}, poor on {100}. *Fracture:* Uneven to subconchoidal. *Tenacity:* Brittle. Hardness = 6.5–7.5 D(meas.) = 3.13–3.16 D(calc.) = 3.149

**Optical Properties:** Transparent to nearly opaque with inclusions. *Color:* Pink, violet, yellow, green, white, gray; in thin section, colorless to pink or green. *Streak:* White. *Luster:* Vitreous to subvitreous.

*Optical Class:* Biaxial (–) or (+). *Pleochroism:* Weak; X = reddish pink; Y = Z = greenish yellow. *Orientation:* X = c; Y = b; Z = a. *Dispersion:* r < v, strong. α = 1.632 β = 1.636 γ = 1.643 2V(meas.) = 71°–86°

**Cell Data:** *Space Group:* Pnnm. a = 7.7980(7) b = 7.9031(10) c = 5.5566(5) Z = 4

**X-ray Powder Pattern:** Minas Gerais, Brazil.

5.542 (100), 4.527 (90), 2.773 (90), 2.170 (90), 3.924 (60), 3.524 (60), 2.466 (50)

**Chemistry:**

	(1)	(2)
SiO <sub>2</sub>	36.74	37.08
TiO <sub>2</sub>	0.01	
Al <sub>2</sub> O <sub>3</sub>	62.70	62.92
Fe <sub>2</sub> O <sub>3</sub>	0.36	
FeO	0.05	
CuO	0.02	
MgO	0.03	
K <sub>2</sub> O	0.07	
H <sub>2</sub> O <sup>+</sup>	0.15	
H <sub>2</sub> O <sup>–</sup>	0.01	
Total	100.14	100.00

(1) Goat Mountain, Shoshone Co., Idaho, USA. (2) Al<sub>2</sub>SiO<sub>5</sub>.

**Polymorphism & Series:** Trimorphous with kyanite and sillimanite; forms a series with kanonaite.

**Occurrence:** A result of contact metamorphism of argillaceous sediments, also in regionally metamorphosed schists. Rare in granites and pegmatites, which however afford the largest crystals. Detrital in some sandstones.

**Association:** Kyanite, sillimanite, cordierite, corundum, garnet, tourmaline, mica.

**Distribution:** Widespread; some localities for good crystals follow. From Hornachuelos, near Córdoba, Córdoba Province, Spain. On the Lisens Alp, Selraintal, Tirol, Austria. At Gefrees, Bodenmais, and elsewhere in Bavaria, Germany. From the Claggau quarry, Co. Galway, Ireland. In the USA, from Lancaster, Worcester Co., Massachusetts; Leiperville, Delaware Co., Pennsylvania; around Custer, Custer Co., South Dakota; in California, from Fresno, Fresno Co., near Ogilby, Cargo Muchacho Mountains, Imperial Co., and near Daltons Ranch, Madera Co. From Mt. Howden, Bimbowrie, South Australia. At Nawalapitiya, Sri Lanka. Gem crystals from the Santa Teresa district, Espírito Santo, Brazil.

**Name:** For an occurrence in the Andalusia region, Spain.

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**References:** (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 496–498. (2) Deer, W.A., R.A. Howie, and J. Zussman (1982) Rock-forming minerals, (2nd edition), v. 1A, orthosilicates, 759–779. (3) Skinner, B.J., S.P. Clark, Jr., and D.E. Appleman (1961) Molar volumes and thermal expansions of andalusite, kyanite, and sillimanite. *Amer. J. Sci.*, 259, 651–668. (4) Winter, J.K. and S. Ghose (1979) Thermal expansion and high-temperature crystal chemistry of the  $\text{Al}_2\text{SiO}_5$  polymorphs. *Amer. Mineral.*, 64, 573–586. (5) Gunter, M. and F.D. Bloss (1982) Andalusite-kanonaite series: lattice and optical parameters. *Amer. Mineral.*, 67, 1218–1228.