

Augite

(Ca, Na)(Mg, Fe, Al, Ti)(Si, Al)₂O₆

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Crystal Data: Monoclinic. *Point Group:* $2/m$. Stubby prismatic crystals, square or octagonal in section, to 10 cm; elongated || [001], acicular, skeletal, dendritic. Exsolution lamellae and overgrowths common. *Twinning:* Simple or multiple on {100}, common; also on {001}.

Physical Properties: *Cleavage:* Good on {110}, (110) \wedge (1 $\bar{1}$ 0) \sim 87°; partings on {100} and {010}. *Fracture:* Uneven to conchoidal. *Tenacity:* Brittle. Hardness = 5.5–6 D(meas.) = 3.19–3.56 D(calc.) = 3.31

Optical Properties: Transparent to opaque. *Color:* Black, brown, greenish, violet-brown; in thin section, colorless to gray; clear cores zoned to dark rims common, also oscillatory and sector zoning. *Streak:* Gray-green. *Luster:* Vitreous, resinous to dull.

Optical Class: Biaxial (+). *Pleochroism:* X = pale green, pale brown, green, greenish yellow; Y = pale brown, pale yellow-green, violet; Z = pale green, grayish green, violet. *Orientation:* Y = b; Z \wedge c = -35° to -50°; X \wedge a = -20° to -35°. *Dispersion:* r > v, weak to moderate. *Absorption:* Weak; Y > Z > X. $\alpha = 1.671\text{--}1.735$ $\beta = 1.672\text{--}1.741$ $\gamma = 1.703\text{--}1.774$ 2V(meas.) = 25°–61°

Cell Data: *Space Group:* C2/c. a = 9.699 b = 8.844 c = 5.272 $\beta = 106.97^\circ$ Z = 4

X-ray Powder Pattern: Locality unknown. (ICDD 24-203). 2.994 (100), 3.324 (75), 2.949 (65), 2.516 (65), 2.566 (55), 2.134 (35), 2.895 (34)

Chemistry:	(1)	(2)	(1)	(2)	
SiO ₂	51.83	45.30	MgO	16.00	11.20
TiO ₂	0.49	4.33	CaO	19.21	22.24
Al ₂ O ₃	3.07	6.72	Na ₂ O	0.27	0.78
Fe ₂ O ₃	1.38	3.98	K ₂ O	0.02	0.18
FeO	7.21	5.15	H ₂ O ⁺	0.47	0.15
MnO	0.17	0.19	H ₂ O ⁻	0.11	0.05
			<u>Total</u>	100.23	100.27

(1) Stillwater complex, Montana, USA; corresponds to (Ca_{0.76}Fe_{0.22}²⁺Na_{0.02}) $\Sigma=1.00$ (Mg_{0.88}Al_{0.05}Fe_{0.04}³⁺Ti_{0.01}Mn_{0.01}) $\Sigma=0.99$ (Si_{1.92}Al_{0.08}) $\Sigma=2.00$ O₆. (2) Stöffel, Germany; corresponds to (Ca_{0.91}Na_{0.07}Fe_{0.04}²⁺) $\Sigma=1.02$ (Mg_{0.66}Fe_{0.13}³⁺Fe_{0.09}²⁺Ti_{0.08}Al_{0.04}) $\Sigma=1.00$ (Si_{1.69}Al_{0.31}) $\Sigma=2.00$ O₆.

Mineral Group: Pyroxene group.

Occurrence: Essential in mafic igneous rocks, basalt, gabbro; common in ultramafic rocks; in some high-grade metamorphic rocks and metamorphosed iron formations.

Association: Orthoclase, sanidine, labradorite, olivine, leucite, amphiboles, pyroxenes.

Distribution: Widespread; only a few classic localities, much studied or providing fine examples, are listed. From Arendal, Norway. In Italy, from Vesuvius, Campania; around Frascati, Alban Hills, Lazio; on Mt. Monzoni, Val di Fassa, Trentino-Alto Adige; at Traversella, Piedmont; and on Mt. Etna, Sicily. Around the Laacher See, Eifel district, Germany. At Ústí nad Lábem (Aussig), Bílina, and Vlčí Hora, near Černošín, Czech Republic. On the Azores and Cape Verde Islands. In Canada, from Renfrew and Haliburton Cos., Ontario; at Otter Lake, Pontiac Co., Quebec; and many other localities. In the USA, from Franklin and Sterling Hill, Ogdensburg, Sussex Co., New Jersey; and at Diana, Lewis Co., and Fine, St. Lawrence Co., New York. From Tomik, Gilgit district, Pakistan. At Kangan, Andhra Pradesh, India.

Name: From the Greek for *luster*, apparently based on the appearance of its cleavage surface.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 352–364, esp. 360–362. (2) Deer, W.A., R.A. Howie, and J. Zussman (1978) Rock-forming minerals, (2nd edition), v. 2A, single-chain silicates, 294–398. (3) Clark, J.R., D.E. Appleman, and J.J. Papike (1969) Crystal-chemical characterization of clinopyroxenes based on eight new structure refinements. MSA Spec. Paper 2, 31–50. (4) Phillips, W.R. and D.T. Griffen (1981) Optical mineralogy, 196–198.

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