

Crystal Data: Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$. Crystals prismatic, to 40 cm; commonly lamellar, fibrous, or massive. *Twinning:* Simple and lamellar twinning on {100}.

Physical Properties: *Cleavage:* Good, {210}, (210) \wedge (2 $\bar{1}$ 0) \sim 88°; partings on {100} and {010}. *Fracture:* Uneven. *Tenacity:* Brittle. *Hardness* = 5–6 *D*(meas.) = 3.2–3.9 *D*(calc.) = 3.189

Optical Properties: Translucent to opaque. *Color:* White, grayish, yellowish, greenish, olive-green, brown; colorless in thin section. *Streak:* White to grayish. *Luster:* Vitreous to pearly on cleavages.

Optical Class: Biaxial (+). *Orientation:* $X = b$; $Y = a$; $Z = c$. *Dispersion:* $r < v$, weak to moderate. $\alpha = 1.649$ – 1.667 $\beta = 1.653$ – 1.671 $\gamma = 1.657$ – 1.680 $2V$ (meas.) = 55°–90°

Cell Data: *Space Group:* $Pbca$. $a = 18.23$ $b = 8.84$ $c = 5.19$ $Z = 8$

X-ray Powder Pattern: Bamble, Norway.

3.175 (100), 2.878 (55), 2.540 (25), 1.488 (25), 2.497 (18), 2.477 (18), 1.473 (18)

Chemistry:

	(1)		(1)
SiO ₂	58.48	MnO	0.02
TiO ₂	trace	MgO	34.71
Al ₂ O ₃	0.88	CaO	0.50
Fe ₂ O ₃	0.72	Na ₂ O	0.23
Cr ₂ O ₃	0.25	K ₂ O	0.08
FeO	3.93	H ₂ O ⁻	0.21
		Total	100.01

(1) Maliba Matso, Lesotho; corresponds to (Mg_{1.77}Fe_{0.11}²⁺Al_{0.04}Ca_{0.02}Na_{0.02}Fe_{0.02}³⁺) $_{\Sigma=1.98}$ Si_{2.00}O₆.

Polymorphism & Series: Dimorphous with clinoenstatite; forms a series with ferrosilite.

Mineral Group: Pyroxene group.

Occurrence: In pyroxenites, peridotites, and dunites; in ultramafic inclusions in alkalic olivine basalts and kimberlite; in mafic volcanics, rarely in felsic volcanics. Characteristic of charnockites and the granulite metamorphic facies, in regionally metamorphosed rocks and metagabbros. Common in chondrite, achondrite, and stony-iron meteorites.

Association: Olivine, phlogopite, clinopyroxene, diopside, spinel, pyrope.

Distribution: Prominent localities for well-studied material include: from Žďár (Zdjarberg), Czech Republic. At Ødegården and Kjörrestad, Bamble, Norway. From The Lizard, Cornwall, England. At Dawros, Co. Connaught, Ireland. From Kupferberg, Bavaria, and the Bellerberg volcano, two km north of Mayen, Eifel district, Germany. At Kraubath, Styria, Austria. Fine crystals from Mbeya, Tanzania. At Liahobong, Lesotho. In the USA, at Webster, Jackson Co., and on Corundum Hill, Macon Co., North Carolina; at Wood's chrome mine and Texas, Lancaster Co., and elsewhere in Pennsylvania. Gem material from Embilipituya, Sri Lanka.

Name: From the Greek for *opponent*, in allusion to its refractory nature under the blowpipe.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 346–348. (2) Deer, W.A., R.A. Howie, and J. Zussman (1978) Rock-forming minerals, (2nd edition), v. 2A, single-chain silicates, 20–162. (3) Pollack, S.S. and W.D. Ruble (1964) X-ray identification of ordered and disordered orthoenstatite. *Amer. Mineral.*, 49, 983–992.

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