

**Crystal Data:** Monoclinic. *Point Group:* 2/m. As short prismatic crystals, to 5 cm. In columnar or acicular aggregates; granular, lamellar, massive. *Twinning:* Simple and polysynthetic twinning on {100} and {010}.

**Physical Properties:** *Cleavage:* Good on {110}, (110) ∧ (1 $\bar{1}$ 0) ~87°; partings on {100} and {010}. *Fracture:* Uneven to conchoidal. *Tenacity:* Brittle. Hardness = 5.5–6.5 D(meas.) = 3.56 D(calc.) = [3.65]

**Optical Properties:** Transparent to opaque. *Color:* Black, dark green, green-brown; brownish green in thin section. *Luster:* Vitreous or dull.

*Optical Class:* Biaxial (+). *Pleochroism:* Weak; X = pale green, bluish green; Y = green, bluish green; Z = green, yellow-green. *Orientation:* Y = b; Z ∧ c = 48°; Z ∧ a = 34°. *Dispersion:* r > v, strong. α = 1.732 β = 1.739 γ = 1.757 2V(meas.) = 63°

**Cell Data:** *Space Group:* C2/c. a = 9.852(4) b = 9.031(3) c = 5.242(3) β = 104.84(4)° Z = 4

**X-ray Powder Pattern:** Cordillera Blanca, Peru; magnesian. (ICDD 25-160). 2.995 (100), 2.528 (80), 2.970 (50), 1.638 (40), 1.629 (40), 3.26 (30), 2.890 (30)

<b>Chemistry:</b>	(1)	(2)	(3)		(1)	(2)	(3)
SiO <sub>2</sub>	48.00	48.50	48.44	MgO	2.12	0.83	
TiO <sub>2</sub>		0.04		CaO	20.35	22.64	22.60
Al <sub>2</sub> O <sub>3</sub>	0.63	0.53		Na <sub>2</sub> O	0.34		
Fe <sub>2</sub> O <sub>3</sub>	3.32	1.03		K <sub>2</sub> O	0.18		
FeO	22.25	22.74	28.96	H <sub>2</sub> O <sup>-</sup>	1.72		
MnO	0.81	3.84		Total	99.72	100.15	100.00

(1) Tignitoio iron deposit, Elba, Italy; corresponds to (Ca<sub>0.90</sub>Mg<sub>0.13</sub>)<sub>Σ=1.03</sub>(Fe<sub>0.77</sub><sup>2+</sup>Fe<sub>0.10</sub><sup>3+</sup>Mn<sub>0.03</sub>Na<sub>0.03</sub>Al<sub>0.01</sub>K<sub>0.01</sub>)<sub>Σ=0.95</sub>(Si<sub>1.98</sub>Al<sub>0.02</sub>)<sub>Σ=2.00</sub>O<sub>6</sub>. (2) Dal'negorsk, Russia; corresponds to Ca<sub>1.00</sub>(Fe<sub>0.81</sub><sup>2+</sup>Mn<sub>0.13</sub>Mg<sub>0.05</sub>Al<sub>0.01</sub>)<sub>Σ=1.00</sub>(Si<sub>1.99</sub>Al<sub>0.01</sub>)<sub>Σ=2.00</sub>O<sub>6</sub>. (3) CaFeSi<sub>2</sub>O<sub>6</sub>.

**Polymorphism & Series:** Forms two series, with diopside, and with johannsenite.

**Mineral Group:** Pyroxene group.

**Occurrence:** A common constituent of metamorphosed iron formations or other ferruginous siliceous sediments; common in Fe-Mn skarns. In alkalic granites, syenites, and in xenoliths in kimberlite.

**Association:** Grunerite (iron formations); arfvedsonite, quartz, fayalite (granites, syenites).

**Distribution:** A few localities for studied material include: in Sweden, at Nordmark, Värmland, and Yxsjö, Örebro. From Prägraten, Tirol, Austria. At Fürstenberg, Saxony, Germany. From Rio Marina, Elba, Italy. On Seriphos, Greece. In the USA, at Iron Hill, Gunnison Co., Colorado; fine crystals from the Laxey mine, South Mountain, Owyhee Co., Idaho; in the Pima district, Pima Co., and the Westinghouse mine, Santa Cruz Co., Arizona; at Hanover, Grant Co., New Mexico. In the Vesturhorn intrusion, southeast Iceland. Large crystals from Broken Hill, New South Wales, Australia. In the Obira mine, Bungo, Oita Prefecture, Japan. At Tirodi, Madhya Pradesh, and Kacharwali, Nagpur district, Maharashtra, India. Fine crystals from the Skardu area, Pakistan. At Dal'negorsk, Primorskiy Kray, Russia.

**Name:** To honor the Swedish chemist, M.A. Ludwig Hedenberg, who first described the species.

**References:** (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 352–364, esp. 356. (2) Deer, W.A., R.A. Howie, and J. Zussman (1978) Rock-forming minerals, (2nd edition), v. 2A, single-chain silicates, 198–293. (3) Maslenikov, A.V. and V.N. Zaitsev (1978) Refinement of the structure of natural hedenbergite. Zap. Vses. Mineral. Obsch., 107, 113–115 (in Russian). (4) Phillips, W.R. and D.T. Griffen (1981) Optical mineralogy, 191–193.

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