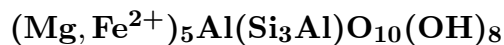


# Clinochlore



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**Crystal Data:** Monoclinic. *Point Group:*  $2/m$ . In thin to thick pseudohexagonal crystals, with tapering pyramidal faces, to 10 cm. Commonly foliated, fibrous, granular, earthy, massive. *Twinning:* Twin plane {001}; twin axis [310], composition plane {001}.

**Physical Properties:** *Cleavage:* {001}, perfect. *Tenacity:* Laminae flexible, inelastic. Hardness = 2–2.5  $D(\text{meas.}) = 2.60\text{--}3.02$   $D(\text{calc.}) = 2.628$

**Optical Properties:** Transparent to translucent. *Color:* Grass-green, olive-green, yellowish, white; pink, rose-red; colorless to pale green or yellow in thin section. *Streak:* Greenish white to white. *Luster:* Pearly, greasy, dull.

*Optical Class:* Biaxial (+) or (-). *Pleochroism:* Distinct;  $X =$  light yellow-green to light blue-green;  $Y = Z =$  light greenish yellow to light blue-green. *Orientation:*  $Y = b$ ;  $Z \wedge c = 2^\circ\text{--}9^\circ$ . *Dispersion:*  $r < v$ . *Absorption:*  $Y \simeq Z > X$  or  $Z \simeq Y > X$ .  $\alpha = 1.571\text{--}1.588$   $\beta = 1.571\text{--}1.588$   $\gamma = 1.576\text{--}1.597$   $2V(\text{meas.}) = 0^\circ\text{--}50^\circ$

**Cell Data:** *Space Group:*  $C2/m$ .  $a = 5.350(3)$   $b = 9.267(5)$   $c = 14.27(1)$   $\beta = 96.35(5)^\circ$   
 $Z = 2$

**X-ray Powder Pattern:** Synthetic (IIB structure); berthierine plus clinochlore easily mistaken for chamosite.

3.57 (100), 2.540 (100), 2.008 (100), 1.539 (100), 14.1 (80), 7.14 (80), 4.76 (80)

| Chemistry:                     | (1)   | (2)   | (1)                           | (2)    |        |
|--------------------------------|-------|-------|-------------------------------|--------|--------|
| SiO <sub>2</sub>               | 33.83 | 32.12 | MgO                           | 34.94  | 35.36  |
| Al <sub>2</sub> O <sub>3</sub> | 12.95 | 9.50  | CaO                           |        | 1.24   |
| Fe <sub>2</sub> O <sub>3</sub> | 2.25  |       | H <sub>2</sub> O <sup>+</sup> | 13.11  | 10.25  |
| Cr <sub>2</sub> O <sub>3</sub> |       | 7.88  | H <sub>2</sub> O <sup>-</sup> |        | 2.04   |
| FeO                            | 3.02  | 1.98  | Total                         | 100.10 | 100.37 |

(1) Zillertal, Austria; corresponds to  $(\text{Mg}_{4.94}\text{Fe}_{0.24}^{2+})_{\Sigma=5.18}(\text{Al}_{0.65}\text{Fe}_{0.16}^{3+})_{\Sigma=0.81}(\text{Si}_{3.21}\text{Al}_{0.79})_{\Sigma=4.00}\text{O}_{10}(\text{OH})_8$ . (2) Deer Park, Wyoming, USA; corresponds to  $(\text{Mg}_{5.05}\text{Fe}_{0.16}^{2+}\text{Ca}_{0.13})_{\Sigma=5.34}(\text{Cr}_{0.60}\text{Al}_{0.15}\text{Fe}_{0.15}^{3+})_{\Sigma=0.90}(\text{Si}_{3.08}\text{Al}_{0.92})_{\Sigma=4.00}\text{O}_{10}(\text{OH})_8$ .

**Polymorphism & Series:** Forms a series with chamosite; stacking disorder is common.

**Mineral Group:** Chlorite group.

**Occurrence:** A hydrothermal alteration product of amphiboles, pyroxenes, biotite. In chlorite schists, serpentinites, marbles, calc-silicate rocks, amphibolites, less commonly in ultramafic rocks. In ore veins; a detrital component of sediments.

**Association:** Serpentine, calcite, dolomite, actinolite, biotite, olivine, plagioclase, talc, chromite, uvarovite.

**Distribution:** Some localities for well-crystallized material are: in the USA, in the Emery mine, Chester, Hampden Co., Massachusetts; at Texas, Lancaster Co., and West Chester, Chester Co., Pennsylvania; in the Tilly Foster mine, Brewster, Putnam Co., New York. In the Zillertal, Tirol, Austria. From the Pfitschtal, Trentino-Alto Adige; Val Malenco, Lombardy; and at Ala, Piedmont, Italy. At Rimpfischwänge, near Zermatt, Valais, Switzerland. From Ojén, Málaga Province, Spain. On Unst, Shetland Islands, Scotland. In the Kop Krom [chrome mine], Kop Mountains, near Aşkale, Turkey. In Russia, in the Ural Mountains, at Akhmatovsk, Berbliouchka, and Hardadinsk; and at Miass, Ilmen Mountains, Southern Ural Mountains.

**Name:** For its inclined optic axes and the Greek *chloros*, for green, its common color.

**References:** (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 644–650, 650–653 [penninite, kämmererite]. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 3, sheet silicates, 131–163. (3) Bayliss, P. (1975) Nomenclature of the trioctahedral chlorites. *Can. Mineral.*, 13, 178–180. (4) Rule, A.C. and S.W. Bailey (1987) Refinement of the crystal structure of a monoclinic ferroan clinochlore. *Clays and Clay Minerals*, 35, 129–138.

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