## Grunerite $Fe_2^{2+}(Fe^{2+},Mg)_5Si_8O_{22}(OH)_2$



**Crystal Data:** Monoclinic. *Point Group:* $2/m$. Commonly as acicular or fibrous radiating crystals; may be asbestiform. *Twinning:* Simple or multiple twinning common ∥ {100}, producing narrow twin lamellae.

**Physical Properties:** *Cleavage:* Perfect on {110}, with intersections of ∼56° and ∼124°. *Tenacity:* Brittle. Hardness = 5–6 D(meas.) = 3.40–3.60 D(calc.) = 3.531

**Optical Properties:** Translucent. *Color:* Dark green to brown, gray to greenish gray; colorless to pale green or brown in thin section. *Luster:* Vitreous, silky when fibrous.
*Optical Class:* Biaxial (–). *Pleochroism:* With increasing Fe content, $X$ = pale yellow; $Y$ = pale yellow-brown; $Z$ = pale brown. *Orientation:* $Y = b$; $Z \wedge c = -16°$ to $-12°$; $X \wedge a = -3°$ to 2°. *Dispersion:* $r > v$, weak. $\alpha = 1.663–1.688$ $\beta = 1.677–1.709$ $\gamma = 1.697–1.729$
2V(meas.) = 80°–90°

**Cell Data:** *Space Group:* $C2/m$. $a = 9.5642(7)$ $b = 18.393(2)$ $c = 5.3388(3)$ $\beta = 101.892(3)°$ Z = 2

**X-ray Powder Pattern:** Wabush Iron Formation, White Lake, Newfoundland, Canada.
8.33 (100), 3.06 (70), 2.756 (70), 2.189 (50), 4.13 (40), 3.26 (40), 2.628 (40)

**Chemistry:**

| | (1) | (2) | | (1) | (2) |
|---|---|---|---|---|---|
| $SiO_2$ | 49.33 | 47.54 | MgO | 6.65 | 0.04 |
| $TiO_2$ | 0.02 | | CaO | 0.18 | 0.00 |
| $Al_2O_3$ | 0.39 | 0.20 | $Na_2O$ | 0.12 | 0.29 |
| $Fe_2O_3$ | | 0.71 | $K_2O$ | 0.20 | 0.11 |
| FeO | 40.94 | 47.25 | F | | 0.01 |
| MnO | 0.54 | 2.14 | $H_2O^+$ | 1.54 | 1.55 |
| | | | Total | 99.91 | 99.84 |

(1) Wabush Iron Formation, Newfoundland, Canada; corresponds to $(Fe^{2+}_{5.50}Mg_{1.59}Mn_{0.08}Na_{0.04}K_{0.04}Ca_{0.03})_{\Sigma=7.28}(Si_{7.92}Al_{0.08})_{\Sigma=8.00}O_{22}(OH)_{1.64}$. (2) Rockport, Essex Co., Massachusetts, USA; corresponds to $(Fe^{2+}_{6.63}Mn_{0.30}Fe^{3+}_{0.09}Na_{0.09}K_{0.02}Mg_{0.01}Al_{0.01})_{\Sigma=7.15}(Si_{7.97}Al_{0.03})_{\Sigma=8.00}O_{22}(OH)_{1.74}$.

**Polymorphism & Series:** Dimorphous with ferro-anthophyllite; forms a series with cummingtonite.

**Mineral Group:** Amphibole (Fe–Mn–Mg) group: $Mg/(Mg + Fe^{2+}) < 0.3$; $(Ca + Na)_B < 1.34$; $Li < 1.0$; $Mn < 0.5$.

**Occurrence:** Common in medium- to high-grade metamorphosed iron formations. A product of contact metamorphism, and in some blueschist facies metaquartzites.

**Association:** Magnetite, hematite, hedenbergite, riebeckite, fayalite, garnet, quartz.

**Distribution:** Many localities. From Collobrières, Var, France. At Loch Duich, Ross-shire, and Glen Beag, Glenelg, Inverness-shire, Scotland. From the Botallack mine, St. Just, Cornwall, England. In Portugal, at Vila Real. At Strömshult, near Tunaberg, Sweden. Commercial production from the Penge area, Transvaal, South Africa. From around Michigamme, Marquette Co., Michigan, USA. In Canada, in the Labrador City area, Labrador, Newfoundland. At Gualilan, Argentina.

**Name:** To honor the French chemist, Louis Emmanuel Gruner (1809–1883), who provided the first analysis.

**References:** (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 386, 391. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 2, chain silicates, 235–248. (3) Klein, C. (1964) Cummingtonite-grunerite series: a chemical, optical and X-ray study. Amer. Mineral., 49, 963–982. (4) Finger, L.W. (1969) The crystal structure and cation distribution of a grunerite. MSA Special Paper 2, 95–100. (5) Chakraborty, K.L. (1963) Relationship of anthophyllite, cummingtonite and mangano-cummingtonite in the metamorphosed Wabush Iron-formation, Labrador. Can. Mineral., 7, 738–750. (6) Phillips, W.R. and D.T. Griffen (1981) Optical mineralogy, 225–228.