

**Pumpellyite-(Mg)****Ca<sub>2</sub>MgAl<sub>2</sub>(SiO<sub>4</sub>)(Si<sub>2</sub>O<sub>7</sub>)(OH)<sub>2</sub>·H<sub>2</sub>O**

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**Crystal Data:** Monoclinic. *Point Group:* 2/m. Crystals bladed, typically elongated along [010]; in stellate clusters, fibrous, or dense mats. *Twinning:* Common on {001} and {100}.

**Physical Properties:** *Cleavage:* Distinct on {001} and {100}. Hardness = 5.5  
D(meas.) = 3.18(3) D(calc.) = 3.20

**Optical Properties:** Translucent to nearly opaque. *Color:* Green, bluish green, greenish black, brown; colorless, green, yellow, brown in thin section. *Luster:* Vitreous.

*Optical Class:* Biaxial (+). *Pleochroism:* Strong; X = nearly colorless to pale greenish yellow; Y = blue-green; Z = almost colorless to brownish yellow. *Orientation:* Z ∧ c = 20°–25°.

*Dispersion:* r < v, strong; less commonly r > v. *Absorption:* Y > Z ≥ X. α = 1.695–1.702  
β = 1.703–1.709 γ = 1.717–1.722 2V(meas.) = 80°

**Cell Data:** *Space Group:* A2/m. a = 8.83(1) b = 5.90(1) c = 19.17(2) β = 97°7(5)'  
Z = 4

**X-ray Powder Pattern:** Calumet, Michigan, USA.

2.90 (100), 3.79 (50), 2.74 (50), 2.452 (40), 2.64 (30), 2.210 (30), 1.597 (30)

**Chemistry:**

	(1)		(1)
SiO <sub>2</sub>	37.18	CaO	23.08
Al <sub>2</sub> O <sub>3</sub>	23.50	Na <sub>2</sub> O	0.19
Fe <sub>2</sub> O <sub>3</sub>	5.29	K <sub>2</sub> O	trace
FeO	2.09	H <sub>2</sub> O <sup>+</sup>	6.28
MnO	0.13	H <sub>2</sub> O <sup>-</sup>	0.06
MgO	3.18	Total	[100.98]

(1) Calumet and Hecla mine, Michigan, USA; original total given as 100.97%, corresponds to (Ca<sub>1.99</sub>Na<sub>0.03</sub>)<sub>Σ=2.02</sub>(Mg<sub>0.38</sub>Fe<sub>0.32</sub><sup>3+</sup>Al<sub>0.22</sub>Fe<sub>0.14</sub><sup>2+</sup>Mn<sub>0.01</sub>)<sub>Σ=1.07</sub>Al<sub>2.00</sub>Si<sub>2.99</sub>O<sub>11</sub>(OH)<sub>2.43</sub>.

**Polymorphism & Series:** Forms two series, with pumpellyite-(Fe<sup>2+</sup>), and with julgoldite-(Fe<sup>2+</sup>).

**Mineral Group:** Pumpellyite group.

**Occurrence:** A widespread product of low-grade metamorphism of amygdaloidal basalts and diabases; in glaucophane schists and in graywackes.

**Association:** Chlorite, epidote, actinolite, lawsonite, glaucophane, prehnite, zeolites, quartz.

**Distribution:** In the USA, in Michigan, at Calumet, Houghton Co., and elsewhere on the Keweenaw Peninsula and Isle Royale; at Skaggs Springs, 24 km northwest of Healdsburg, and at Novato and Porter Creek, Sonoma Co., and elsewhere in California. From Lendalfoot, Ayrshire, Scotland. At Great Penhaver Point, Roseland, and in the Penlee quarry, Newlyn, Cornwall, England. From Knipane, Iveland, Norway. In Germany, at Herbornseelbach, Hesse. At Wienern, Styria, Austria. From Obří Důl (Riesengrund), Czech Republic. Around Tiso, Trentino-Alto Adige, Italy. In Japan, from Oonara, Sanbagawa, Gumma Prefecture, and many other localities. From New Zealand, in the Tasingatura district, South Island.

**Name:** For Raphael Pumpelly (1837–1923), pioneer student of the paragenesis of copper deposit minerals of the Keweenaw Peninsula, Michigan, USA, and dominant *magnesium* content.

**Type Material:** Harvard University, Cambridge, Massachusetts, 90919; National Museum of Natural History, Washington, D.C., USA, 95279–95281; The Natural History Museum, London, England, 1926,225–226.

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- References:** (1) Palache, C. and H.E. Vasser (1925) Some minerals of the Keweenawan copper deposits: pumpellyite, a new mineral; sericite; saponite. *Amer. Mineral.*, 10, 412–418.
- (2) Coombs, D.S. (1953) The pumpellyite mineral series. *Mineral. Mag.*, 30, 113–135.
- (3) Deer, W.A., R.A. Howie, and J. Zussman (1986) *Rock-forming minerals*, (2nd edition), v. 1B, disilicates and ring silicates, 201–247. (4) Yoshiasa, A. and T. Matsumoto (1985) Crystal structure refinement and crystal chemistry of pumpellyite. *Amer. Mineral.*, 70, 1011–1019.