Gunningite $(Zn, Mn^{2+})SO_4 \cdot H_2O$

Crystal Data: Monoclinic. *Point Group:* $2/m$. As delicate, nearly cryptocrystalline, efflorescences.

Physical Properties: Hardness = ~2.5 D(meas.) = 3.195 (synthetic). D(calc.) = 3.369 Readily soluble in H_2O.

Optical Properties: Translucent. *Color:* White to colorless. *Streak:* White. *Luster:* Vitreous.
Optical Class: Biaxial (+) (by analogy to other members of the kieserite group). $\alpha = 1.577$ (α') β = n.d. $\gamma = 1.630$ (γ') 2V(meas.) = n.d.

Cell Data: *Space Group:* $C2/c$ (synthetic). $a = 6.925(2)$ $b = 7.591(2)$ $c = 7.635(3)$ $\beta = 118.19(1)^\circ$ Z = 4

X-ray Powder Pattern: Synthetic.
3.404 (100), 3.056 (47), 2.5185 (46), 4.81 (39), 4.759 (39), 3.307 (28), 3.348 (23)

Chemistry:

	(1)	(2)
SO_3		44.61
FeO	0.6	
MnO	3.1	
ZnO	40.8	45.35
CdO	1.0	
H_2O		10.04
Total		100.00

(1) Calumet mine, Galena Hill, Canada; partial XRF analysis of reprecipitated H_2O−soluble material. Identity in general can be established by spectrographic determination of dominant zinc and agreement of X-ray diffraction pattern with the synthetic compound. (2) $ZnSO_4 \cdot H_2O$.

Mineral Group: Kieserite group.

Occurrence: Of rare occurrence in dry areas of the oxidized portions of sphalerite-bearing deposits; occurs also as a post-mining efflorescence on museum specimens.

Association: Sphalerite, scorodite, gypsum, pharmacosiderite, jarosite, arsenopyrite, "limonite" (Keno Hill–Galena Hill district, Canada); woodruffite, smithsonite (Willett mine, Canada); szomolnokite, starkeyite, anhydrite, gypsum (Goldstrike mine, Nevada, USA); boyleite, coquimbite, zincocopiapite, jarosite, melanterite, römerite, siderotil, voltaite, chalcanthite, hexahydrite, gypsum (Les Vallettes, Switzerland).

Distribution: In Canada, from the Comstock-Keno mine and several other deposits in the Keno Hill–Galena Hill district, about 56 km northeast of Mayo, Yukon Territory; at the Willett mine, near Lardeau, British Columbia; in the Brunswick No. 2 mine, Bathurst, New Brunswick. In the USA, from Goldstrike mine, Lynn district, Eureka Co., Nevada, and at Bisbee, Cochise Co., Arizona. From Les Vallettes, Valais, Switzerland. At the Kamariza mine, Laurium, Greece. From Kropbach, Münstertal, Black Forest, Germany.

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Type Material: Geological Survey of Canada, Ottawa, 12139; Royal Ontario Museum, Toronto, Canada.

References: (1) Jambor, J.L. and R.W. Boyle (1962) Gunningite, a new zinc sulphate from the Keno Hill-Galena Hill area, Yukon. Can. Mineral., 7, 209–218. (2) (1962) Amer. Mineral., 47, 1218–1219 (abs. ref. 1). (3) Pistorius, C.W.F.T. (1961) Crystallographic properties of $CuSO_4 \cdot H_2O$ and $ZnSO_4 \cdot H_2O$. Acta Cryst., 14, 534. (4) Wildner, M. and G. Giester (1991) The crystal structures of kieserite-type compounds. I. Crystal structures of $Me(II)SO_4 \cdot H_2O$ (Me = Mn,Fe,Co,Ni,Zn). Neues Jahrb. Mineral., Monatsh., 296–306. (5) (1982) NBS Mono. 25, 19, 86.