Schulenbergite $(Cu, Zn)_7(SO_4)_2(OH)_{10} \cdot 3H_2O$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}$ or 3. Crystals are hexagonal or rhombic, very thin tabular, to 4 mm, in spherules, sheaves, and rosettes.

Physical Properties: *Cleavage:* Perfect on {0001}; poor on $\{11\overline{2}0\}$. Hardness = ∼2
D(meas.) = 3.28–3.42 D(calc.) = 3.38–3.45

Optical Properties: Transparent. *Color:* Pale blue-green, emerald-green. *Streak:* Blue-green, pale green. *Luster:* Vitreous, pearly on {0001}.
Optical Class: Uniaxial (–). *Pleochroism:* Faint to strong; O = colorless, emerald-green to green; E = colorless to pale green. $\omega = 1.640–1.707$ $\epsilon = 1.623–1.666$

Cell Data: *Space Group:* $P\overline{3}$ or $P3$. $a = 8.211–8.249$ $c = 7.106–7.183$ Z = 1

X-ray Powder Pattern: [Glücksrad mine,] Germany.
7.186 (100), 2.700 (80), 2.527 (80), 3.581 (40), 3.209 (30), 2.157 (30), 1.559 (30)

Chemistry:

	(1)	(2)		(1)	(2)
SO_3	17.4	15.13	CuO	36.7	53.18
CO_2	0.8		ZnO	28.1	11.39
CoO		0.84	H_2O	17.4	[18.68]
NiO		0.78	Total	100.4	[100.00]

(1) [Glücksrad mine,] Germany; CO_2 by gas chromatograph, H_2O by TGA; corresponds to $(Cu_{4.00}Zn_{3.00})_{\Sigma=7.00}[(SO_4)_{1.89}(CO_3)_{0.16})]_{\Sigma=2.05}(OH)_{9.90} \cdot 3.43H_2O$. (2) Cap Garonne mine, France; by electron microprobe, average of nine analyses, H_2O by difference; corresponds to $(Cu_{5.77}Zn_{1.21}Ni_{0.10}Co_{0.09})_{\Sigma=7.17}(SO_4)_{1.63}(OH)_{11.08} \cdot 3.40H_2O$.

Occurrence: A rare secondary mineral formed in the oxidized zone of Cu–Zn-bearing hydrothermal mineral deposits, commonly post-mine; in Cu–Zn slags.

Association: Namuwite, brochantite, posnjakite, ktenasite, serpierite, linarite, malachite, cerussite, hemimorphite, smithsonite, gypsum, chalcopyrite, sphalerite, quartz.

Distribution: In Germany, in the Harz Mountains, from dumps at the Glücksrad mine, near Oberschulenberg, and in slag at the Ochsenhütte, Granetal, and at Juliushütte, Astfeld, near Goslar; from the Marie mine, southeast of Wilnsdorf, near Siegen, and in the Wilder Mann mine, near Müsen, Siegerland; from the Bastenberg mine, near Ramsbeck, North Rhine-Westphalia; in the Richelsdorfer Mountains, Hesse; on dumps of the Friedrichssegen mine, near Bad Ems, at the Virneberg mine, near Rheinbreitbach, Rhineland-Palatinate, and elsewhere. From the Cap Garonne mine, near le Pradet, Var, France. In England, from the Smallcleugh mine, Nenthead, Cumbria; large crystals in the Waterbank mine, Ecton Hill, Staffordshire, at the Prince of Wales mine, Calstock, and in the Penberthy Croft mine, St. Hilary, Cornwall. In Wales, from the Dyfngwm mine, Penegoes, Powis; in Dyfed, at the Penrhiw mine, Ystumtuen, from the Ystrad Einion mine, at the Nantycagl (Eaglebrook) mine, Ceulanymaesmawr, and in the Frongoch mine. From the Kamariza mine, and in slag, at Laurium, Greece. At Broken Hill, New South Wales, Australia.

Name: For its occurrence at the Glücksrad mine, near Oberschulenberg, Germany.

Type Material: Institute of Crystallography and Petrography, University of Hannover, Hannover, Germany; National School of Mines, Paris, France.

References: (1) Hodenberg, R.v., W. Krause, and H. Täuber (1984) Schulenbergit, $(Cu, Zn)_7(SO_4, CO_3)_2(OH)_{10} \cdot 3H_2O$, ein neues Mineral. Neues Jahrb. Mineral., Monatsh., 17–24 (in German with English abs.). (2) (1985) Amer. Mineral., 70, 438 (abs. ref. 1). (3) Mumme, W.G., H. Sarp, and P.J. Chiappero (1994) A note on the crystal structure of schulenbergite. Archs Sci. Genève, 47(2), 117–124.