Zincobotryogen $(Zn, Mg, Mn^{2+})Fe^{3+}(SO_4)_2(OH)\cdot 7H_2O$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Prismatic crystals, to a few mm, showing {010}, {$\bar{1}$01}, {120}, {110}, minor {$\bar{1}$11}, {101}, singly and in conical radiating aggregates.

Physical Properties: Hardness = ∼2.5 D(meas.) = 2.19–2.20 D(calc.) = [2.24]

Optical Properties: Transparent to translucent. *Color:* Bright red-orange to chestnut-brown. *Luster:* Vitreous to greasy.
Optical Class: Biaxial (+). *Pleochroism:* Strong. *Orientation:* Negative elongation, parallel extinction. *Dispersion:* $r > v$. $\alpha = 1.542$ $\beta = 1.551$ $\gamma = 1.587$ 2V(meas.) = n.d. 2V(calc.) = 54°

Cell Data: *Space Group:* $P2_1/n$. $a = 10.488$–10.51 $b = 17.819$–17.85 $c = 7.14$–7.185 $\beta = 100°00'$–$100°50'$ Z = 4

X-ray Powder Pattern: Synthetic.
8.963 (100), 5.163 (75), 3.027 (61), 6.354 (58), 4.095 (53), 2.762 (52), 3.219 (51)

Chemistry:

	(1)	(2)
SO_3	36.03	36.1
Al_2O_3	0.01	
Fe_2O_3	18.34	18.4
FeO	0.85	1.2
MnO	1.75	3.6
ZnO	11.77	7.7
MgO	2.50	1.6
Na_2O	0.05	
K_2O	0.00	
H_2O^+	29.13	30.9
H_2O^-	0.22	
Total	100.65	99.5

(1) Xitieshan mine, China; corresponds to $(Zn_{0.64}Mg_{0.27}Mn^{2+}_{0.11}Fe^{2+}_{0.05})_{\Sigma=1.07}Fe^{3+}_{1.00}(SO_4)_{1.96}(OH)_{1.00}\cdot 6.61H_2O$. (2) Rammelsberg mine, Germany; corresponds to $(Zn_{0.47}Mn^{2+}_{0.25}Mg_{0.20}Fe^{2+}_{0.08})_{\Sigma=1.00}Fe^{3+}(SO_4)_2(OH)\cdot 7H_2O$.

Occurrence: A rare secondary mineral formed in the oxidation zone, typically in an arid climate.

Association: Pickeringite, chaidamuite, coquimbite, copiapite, butlerite, pyrite (Xitieshan mine, China); zincian melanterite (Rammelsberg mine, Germany).

Distribution: From an undisclosed Pb–Zn deposit [Xitieshan mine, south of Mt. Qilianshan, Chaidamu], Qinghai Province, China. At the Rammelsberg mine, near Goslar, Harz Mountains, Germany. In the USA, from Bisbee, Cochise Co., Arizona; in Colorado, from the Prompt Pay and Running Lode mines, Central City district, Gilpin Co., in the Summitville mine, Rio Grande Co., and at the Bonanza mine, Bonanza district, Saguache Co.

Name: For its dominant content of *zinc* and relation to *botryogen*.

Type Material: n.d.

References: (1) Tu Kwang-chih, Li Hsi-lin, Hsieh Hsien-deh, and Yin Shu-sen (1964) Zincobotryogen and zincocopiapite, two new varieties of sulphate minerals. Acta Geologica Sinica, 44(1), 99–101. (in Chinese with English abs.). (2) (1964) Amer. Mineral., 49, 1776 (abs. ref. 1). (3) Zemann, J. (1961) Über den Botryogen vom Rammelsberg. Fortschr. Mineral., 39, 84 (in German). (4) (1983) NBS Mono. 25, 20, 67.