Parabutlerite $Fe^{3+}(SO_4)(OH)\cdot 2H_2O$

Crystal Data: Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$. As crystals, elongated and striated along [001], to 3 mm, which may have complex form development, showing {110}, {011}, {012}, {111}, and a dozen other forms; massive. *Twinning:* On {142}, rare.

Physical Properties: *Cleavage:* Poor on {110}. *Fracture:* Conchoidal. *Tenacity:* Brittle. Hardness = 2.5 D(meas.) = 2.55 D(calc.) = 2.538

Optical Properties: Transparent. *Color:* Pale orange, pale orange-brown; pale yellow in transmitted light. *Luster:* Vitreous.
Optical Class: Biaxial (+). *Pleochroism:* X = colorless to pale yellow; Y = pale yellow to greenish yellow; Z = pale yellow to brownish yellow. *Orientation:* $X = b$; $Y = c$; $Z = a$. *Dispersion:* $r > v$, moderate. α = 1.589–1.598 β = 1.660–1.663 γ = 1.737–1.750
2V(meas.) = 43.5°–87°

Cell Data: *Space Group: Pmnb.* $a = 7.38$ $b = 20.13$ $c = 7.22$ Z = 8

X-ray Powder Pattern: Alcaparrosa, Chile.
4.99 (FFF), 3.11 (FFF), 5.83 (F), 3.60 (mF), 2.499 (mF), 1.839 (mf), 4.07 (m)

Chemistry:

	(1)	(2)
SO_3	39.15	38.96
Fe_2O_3	39.21	39.06
H_2O	22.00	21.98
insol.	0.23	
Total	100.59	100.00

(1) Alcaparrosa, Chile. (2) $Fe(SO_4)(OH)\cdot 2H_2O$.

Polymorphism & Series: Dimorphous with butlerite.

Occurrence: An uncommon mineral in the oxidized zone of pyritic veins, may be formed by alteration of other sulfates.

Association: Copiapite, cuprocopiapite, butlerite, jarosite, melanterite, fibroferrite.

Distribution: From Chuquicamata, at Quetena, west of Calama, and Alcaparrosa, near Cerritos Bayos, southwest of Calama, Antofagasta, Chile. In the Santa Elena mine, Quebrada de La Alcaparrosa, San Juan Province, Argentina. In the USA, at the Dexter No. 7 mine, Calf Mesa, San Rafael district, Emery Co., Utah. At Saghand, near Yazd, Iran. From the Auguste mine, Fuchsberg, near Halle, Saxony-Anhalt, Germany. At Agrokipia, Cyprus. From Iskazentgyörgy and Nyirád, Hungary.

Name: From the Greek *para*, for *near*, and its relation to *butlerite*.

Type Material: American Museum of Natural History, New York City, New York, 4629-30; Harvard University, Cambridge, Massachusetts, 94834; National Museum of Natural History, Washington, D.C., USA, 115159.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 610–611. (2) Borène, J. (1970) Structure cristalline de la parabutlérite. Bull. Soc. fr. Minéral., 93, 185–189 (in French with English abs.). (3) Cesbron, F. (1964) Contribution à la minéralogie des sulfates de fer hydratés. Bull. Soc. fr. Minéral., 87, 125–143 (in French).