

Boleite**KPb₂₆Ag₉Cu₂₄Cl₆₂(OH)₄₈**

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Crystal Data: Cubic. *Point Group:* $4/m\bar{3}2/m$. Crystals cubic, to 2 cm, rarely modified by {111} and {011}; commonly surficially layered with or overgrown by pseudoboleite with mutually || {001}.

Physical Properties: *Cleavage:* {001}, perfect. Hardness = 3–3.5 D(meas.) = 5.054 D(calc.) = 5.082

Optical Properties: Translucent to opaque. *Color:* Deep Prussian blue to indigo; bluish green in transmitted light. *Streak:* Blue, with greenish tint. *Luster:* Weakly vitreous; pearly on cleavage surfaces.

Optical Class: Isotropic. $n = 2.05$

Cell Data: *Space Group:* $Pm\bar{3}m$. $a = 15.288(2)$ $Z = 1$

X-ray Powder Pattern: Boleo, Mexico; may be totally obscured by the pattern of intergrown pseudoboleite. (ICDD 27-1206).

4.415 (100), 3.821 (80), 2.702 (60), 2.547 (40), 3.505 (35), 2.330 (35), 1.990 (35)

Chemistry:	(1)	(2)	(1)	(2)
AgCl	12.03	11.79	Cl	17.04
Pb	49.16	49.26	H ₂ O	4.35
CuO	17.17	17.46	insol.	0.21
K ₂ O	n.d.	0.68		
			Total	99.96 100.00

(1) Boleo, Mexico; corresponds to Pb_{25.88}Ag_{9.16}Cu_{23.54}Cl_{61.58}O_{49.87}H_{52.65}.

(2) KPb₂₆Ag₉Cu₂₄Cl₆₂(OH)₄₈.

Occurrence: A secondary mineral formed through reaction of chloride with primary sulfides in the oxidized zone of Pb–Cu deposits; in smelter slag immersed in and leached by sea water.

Association: Pseudoboleite, cumengeite, atacamite, anglesite, cerussite, phosgenite, gypsum (Boleo, Mexico); pseudoboleite, anglesite, cerussite, atacamite, paratacamite, leadhillite, paralaurionite, caledonite, phosgenite, matlockite, bideauxite (Mammoth-St. Anthony mine, Arizona, USA).

Distribution: In Mexico, exceptional crystals from the Amelia mine, Boleo, near Santa Rosalía, Baja California; also from an undefined locality in Sonora. In the USA, in the Mammoth-St. Anthony mine, Tiger, and the Vekol mine, Pinal Co.; the Apache mine, Gila Co.; and the Rowley mine, Maricopa Co., Arizona; from Philipsburg, Granite Co., Montana. At Laurium, Greece, in slag. In England, from Cornwall, at Tolcarne Beach, Newquay; at Newport Beach, near Falmouth; and in the Porthilley mine, St. Minver. At Juliushütte, Astfeld, Harz Mountains, Germany, in slag. Found at an undisclosed location in the Kopet-Dag Range, Cheleken Peninsula, Central Asia, Russia. In the Tchah Khuni mine, near Anarak, Iran. From Broken Hill, New South Wales, Australia. In Chile, at Huantajaya, near Iquique, and the Pica district, Cerro de Challocallo, Tarapacá; from Mantos Blancos, and at a number of mines around Caracoles, Sierra Gorda district, southwest of Calama, Antofagasta.

Name: For the occurrence at Boleo, Mexico.

Type Material: National School of Mines, Paris, France.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 78–79. (2) Rouse, R.C. (1973) The crystal structure of boleite – a mineral containing silver atom clusters. *J. Solid State Chemistry*, 6, 86–92. (3) Winchell, R.E. and R.C. Rouse (1974) The mineralogy of the boleite group. *Mineral. Record*, 5, 280–287. (4) Cooper, M.A. and F.C. Hawthorne (2000) Boleite: resolution of the formula, KPb₂₆Ag₉Cu₂₄Cl₆₂(OH)₄₈. *Can. Mineral.*, 38, 801–809.

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