

Bermanite**Mn²⁺Mn₂³⁺(PO₄)₂(OH)₂•4H₂O**

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Crystal Data: Monoclinic, pseudo-orthorhombic. *Point Group:* 2/m. Crystals are tabular on {010}, with additional forms, to 5 mm; as sheaflike aggregates and rosettes; generally as thin films or druses on fractures. *Twinning:* Polysynthetic about [101] with composition plane {101} or about $\bar{1}01$ with composition plane {101}, common; as reflection twins, on {001} about [100], or with two more individuals twinned on $\{301\}$ about [100] producing composite fourlings.

Physical Properties: *Cleavage:* Perfect on {001}; imperfect on {110}. *Tenacity:* Brittle. Hardness = 3.5 D(meas.) = 2.84–2.85 D(calc.) = 2.87

Optical Properties: Translucent. *Color:* Reddish brown, darkening on exposure; yellowish brown to brownish red, with red internal reflections, in transmitted light. *Luster:* Vitreous to slightly resinous, dull.

Optical Class: Biaxial (-). *Pleochroism:* X = light red; Y = pale yellow; Z = deep red. *Orientation:* X = b; Y \wedge a = 32.5°; Y \wedge c = -36.5°. *Dispersion:* r < v, strong. *Absorption:* Z > X > Y. α = 1.685–1.690 β = 1.725–1.729 γ = 1.748–1.751 2V(meas.) = 72°–75°

Cell Data: *Space Group:* P2₁. a = 5.425–5.446 b = 19.206–19.25 c = 5.425–5.428 β = 110.29°–110.40° Z = 2

X-ray Powder Pattern: 7U7 Ranch, Arizona, USA.

9.63 (100), 2.905 (36), 4.82 (28), 3.263 (23), 3.673 (19), 5.10 (16), 3.062 (11)

Chemistry:	(1)	(2)	(1)	(2)	(1)	(2)	
P ₂ O ₅	31.4	30.80	Mn ₂ O ₃	30.6	34.26	CaO	0.75
Al ₂ O ₃	0.19		MnO	12.8	15.39	H ₂ O	20.2
Fe ₂ O ₃	3.20		MgO	1.05		Total	100.19
							100.00

(1) 7U7 Ranch, Arizona, USA; corresponding to (Mn_{0.82}²⁺Mg_{0.12}Ca_{0.06})_{Σ=1.00}(Mn_{1.75}³⁺Fe_{0.18}³⁺Al_{0.02})_{Σ=1.95}(PO₄)₂(OH)₂•3.99H₂O. (2) Mn²⁺Mn₂³⁺(PO₄)₂(OH)₂•4H₂O.

Occurrence: A late-stage hydrothermal mineral replacing primary phosphate phases, usually triplite or lithiophilite, in complex granite pegmatites.

Association: Triplite, strengite, leucophosphite, huréaulite, lithiophilite, stewartite, sicklerite, rockbridgeite, phosphosiderite, strunzite, switzerite, paulkerrite.

Distribution: In the USA, from the 7U7 Ranch, 40 km west of Hillside, Bagdad district, Yavapai Co., Arizona; in the Williams pegmatite, Coosa Co., Alabama; at the Stewart Lithia mine, Pala, San Diego Co., California; from the White Elephant, Bull Moose, Linwood, and Tip Top mines, near Custer, Custer Co., South Dakota; in the Palermo #1 and Fletcher mines, near North Groton, Grafton Co., New Hampshire. At the El Criollo pegmatite, Cerro Blanco, Tanti district, 45 km west of Córdoba, Córdoba Province, Argentina. From the McMahon quarry, near Olary, and in the Wiperaminga Hill West quarry, Boolcoomata, South Australia. From the Sapucaia pegmatite mine, about 50 km east-southeast of Governador Valadares, Minas Gerais, Brazil. At the Buranga pegmatite, near Gatumba, Rwanda. In the Kobokobo pegmatite, Lusungu River district, Kivu Province, Congo (Zaire). From the Tsaobismund pegmatite, 60 km south of Karibib, Namibia. At Hagendorf, Bavaria, Germany. Other minor localities have been noted.

Name: In honor of Dr. Harry Berman (1902–1944), Professor of Mineralogy, Harvard University, Cambridge, Massachusetts, USA.

Type Material: Harvard University, Cambridge, Massachusetts, 97863–97865, 119698; National Museum of Natural History, Washington, D.C., USA, 120405.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 967–968. (2) Hurlbut, C.S., Jr. and L.F. Aristarain (1968) Bermanite, and its occurrence in Córdoba, Argentina. *Amer. Mineral.*, 53, 416–431. (3) Kampf, A.R. and P.B. Moore (1976) The crystal structure of bermanite, a hydrated manganese phosphate. *Amer. Mineral.*, 61, 1241–1248.

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