

Mannardite

BaTi₆(V³⁺, Cr³⁺)₂O₁₆•H₂O

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Crystal Data: Tetragonal. *Point Group:* 4/m. Crystals prismatic, bounded by {110} and {001}, may be doubly-terminated; elongated along [001], flattened on {100}, bent or twisted about [001], deeply striated || elongation, to 5 mm; in fanlike aggregates.

Physical Properties: *Cleavage:* {100}, good. *Fracture:* Uneven to subconchoidal. *Tenacity:* Brittle. Hardness = 5.5–7 VHN = 609 D(meas.) = 4.12–4.43 D(calc.) = 4.28

Optical Properties: Opaque. *Color:* Jet-black; pale reddish brown in reflected light. *Streak:* White to grayish white. *Luster:* Adamantine. *Optical Class:* Uniaxial (+). *Anisotropism:* Strong; light pinkish gray to dark brownish gray. *Birefractance:* Distinct; light to dark brown.

R₁–R₂: (400) 16.5–18.0, (420) 16.3–17.6, (440) 16.0–17.2, (460) 15.7–17.0, (480) 15.5–16.9, (500) 15.4–17.0, (520) 15.2–17.2, (540) 15.1–17.4, (560) 15.0–17.7, (580) 15.0–17.9, (600) 15.0–18.1, (620) 15.0–18.3, (640) 15.0–18.4, (660) 15.0–18.5, (680) 15.1–18.6, (700) 15.1–18.6

Cell Data: *Space Group:* I₄/a. a = 14.357(2) c = 5.908(1) Z = 4

X-ray Powder Pattern: Rough claims, Canada; close to redledgeite. 3.201 (100), 1.586 (80), 2.473 (70), 1.887 (70), 2.224 (50), 1.690 (50), 1.394 (40)

Chemistry:	(1)	(2)	(1)	(2)
TiO ₂	60.1	60.2	Cr ₂ O ₃	1.9
Fe ₂ O ₃		3.7	BaO	19.4
V ₂ O ₃	16.3	12.2	H ₂ O	[2.2]
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			Total	[99.9] [100.0]

(1) Rough claims, Canada; by electron microprobe, H₂O calculated + Ba = 2; corresponds to Ba_{1.02}(Ti_{6.03}V_{1.75}Cr_{0.20})_{Σ=7.98}O₁₆•0.98H₂O. (2) Bathurst, Canada; by electron microprobe, H₂O calculated + Ba = 2; corresponds to Ba_{1.04}(Ti_{6.07}V_{1.32}Fe_{0.38}Cr_{0.20})_{Σ=7.97}O₁₆•0.96H₂O.

Mineral Group: Cryptomelane group.

Occurrence: In late-stage quartz-carbonate veins cutting shale and siltstone (Rough claims, Canada); in an orebody in faulted metasediments and iron formation (Bathurst, Canada); in a silver-bearing polymetallic deposit (Kantsi, China); in kimberlite (Star mine, South Africa).

Association: Barytocalcite, norsethite, sulvanite, barite, quartz (Rough claims, Canada); edingtonite, harmotome, barytocalcite, siderite, sphalerite, quartz (Bathurst, Canada).

Distribution: On the Rough claims, north of Sifton Pass, British Columbia, and in the Brunswick No. 12 orebody, Bathurst, New Brunswick, Canada. In China, from Kantsi, Sichuan Province. In the Star mine, Free State, South Africa.

Name: Honors Dr. George William Mannard (1932–1982), formerly President of Kidd Creek Mines, Ltd., Toronto, Canada, for his interest in the mineral deposits of British Columbia.

Type Material: Geological Survey of Canada, Ottawa, 64197; Royal Ontario Museum, Toronto, Canada, M40292, M40293; The Natural History Museum, London, England, 1983,68 and 1983,69; National Museum of Natural History, Washington, D.C., USA, 150275, 150337, 162567.

References: (1) Scott, J.D. and G.R. Peatfield (1986) Mannardite [Ba•H₂O](Ti₆V³⁺)₂O₁₆, a new mineral species, and new data on redledgeite. *Can. Mineral.*, 24, 55–66. (2) (1988) *Amer. Mineral.*, 73, 193 (abs. ref. 1). (3) Szymański, J.T. (1986) The crystal structure of mannardite, a new hydrated cryptomelane-group (hollandite) mineral with a doubled short axis. *Can. Mineral.*, 24, 67–78.

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