

Howlite



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Crystal Data: Monoclinic. *Point Group:* $2/m$. Crystals tabular, flattened on {100}, with {100} dominant and terminated by {011} and {001}, to 1 cm. Most commonly nodular. When massive, chalky to porcelaneous.

Physical Properties: *Fracture:* For porcelaneous types, nearly even and smooth. Hardness = 3.5 D(meas.) = 2.53–2.59 D(calc.) = 2.61

Optical Properties: Translucent in thin fragments. *Color:* White; in thin section, colorless. *Luster:* Subvitreous, glimmering.

Optical Class: Biaxial (–). *Orientation:* $X = b$; $Z \wedge c \simeq 51^\circ$. $\alpha = 1.583\text{--}1.586$
 $\beta = 1.596\text{--}1.598$ $\gamma = 1.605$ $2V(\text{meas.}) = 73^\circ$

Cell Data: *Space Group:* $P2_1/c$. $a = 12.820(3)$ $b = 9.351(1)$ $c = 8.608(2)$
 $\beta = 104.84(2)^\circ$ $Z = 4$

X-ray Powder Pattern: Sterling Borax mine, California, USA.
6.2 (100), 3.10 (90), 3.90 (80), 2.04 (70), 2.07 (50), 1.794 (50), 12.4 (40)

Chemistry:	(1)	(2)	(3)
SiO ₂	15.33	15.50	15.35
B ₂ O ₃	44.52	44.38	44.48
CaO	27.94	28.45	28.66
Na ₂ O	0.53		
K ₂ O	0.13		
H ₂ O	11.55	11.58	11.51
rem.		0.09	
Total	[100.00]	100.00	100.00

(1) Windsor, Canada; recalculated to 100.00% after deduction of 4.32% gypsum. (2) Daggett, California, USA; remainder is Na₂O and MgO. (3) Ca₂B₅SiO₉(OH)₅.

Occurrence: In borate deposits.

Association: Colemanite, ulexite, bakerite.

Distribution: In Canada, near Windsor; at Wentworth; large crystals on the shore of Bras D'Or Lake, 2.5 km south of Iona, Cape Breton Island, Nova Scotia. In the USA, in California, in the Sterling Borax mine, Tick Canyon, near Lang, Los Angeles Co.; near Calico, San Bernardino Co.; in Gower Gulch and at the Billie mine, near Ryan, Inyo Co.; at the Russell and other borate mines north of Lockwood Valley, Ventura Co.; and in the Kramer deposit, Kern Co. From Magdalena, Sonora, Mexico. At Susurluk, Turkey. From Baljevac na Ibru, near Kraljevo, and near Bela Stena, Yugoslavia.

Name: For Henry How (1828–1879), Canadian chemist, geologist, and mineralogist, University of King's College, Windsor, Nova Scotia, Canada, who first described the species.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 362–363. (2) Murdoch, J. (1957) Crystallography and X-ray measurements of howlite from California. *Amer. Mineral.*, 42, 521–524. (3) Griffen, D.T. (1988) Howlite, Ca₂SiB₅O₉(OH)₅: structure refinement and hydrogen bonding. *Amer. Mineral.*, 73, 1138–1144.