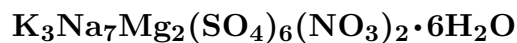


## Humberstonite



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**Crystal Data:** Hexagonal. *Point Group:*  $\bar{3}$ . As hexagonal crystals, platy on {0001}, with {10 $\bar{1}$ 1}, to 0.3 mm; typically in massive aggregates.

**Physical Properties:** *Cleavage:* Perfect on {0001}. *Fracture:* Irregular. *Tenacity:* Brittle. Hardness =  $\sim$ 2.5 D(meas.) = 2.252 D(calc.) = 2.252 Soluble in H<sub>2</sub>O.

**Optical Properties:** Transparent. *Color:* Colorless. *Luster:* Vitreous. *Optical Class:* Uniaxial (-).  $\omega = 1.474(2)$   $\epsilon = 1.436(2)$

**Cell Data:** *Space Group:*  $R\bar{3}$ .  $a = 10.9055(3)$   $c = 24.3949(9)$   $Z = 3$

**X-ray Powder Pattern:** Oficina Alemania, Chile.

3.39 (100), 2.724 (70), 8.14 (60), 8.80 (35), 4.53 (35), 2.583 (35), 1.866 (35)

### Chemistry:

	(1)	(2)
SO <sub>3</sub>	42.99	42.31
N <sub>2</sub> O <sub>5</sub>	9.14	9.51
MgO	7.47	7.10
Na <sub>2</sub> O	18.43	19.11
K <sub>2</sub> O	12.17	12.45
H <sub>2</sub> O <sup>+</sup>	9.78	
H <sub>2</sub> O <sup>-</sup>	0.40	
H <sub>2</sub> O		9.52
Total	100.38	100.00

(1) Oficina Alemania, Chile; after removal of NaNO<sub>3</sub> impurity with acetone, (SO<sub>4</sub>)<sup>2-</sup> and (NO<sub>3</sub>)<sup>1-</sup> confirmed by IR. (2) K<sub>3</sub>Na<sub>7</sub>Mg<sub>2</sub>(SO<sub>4</sub>)<sub>6</sub>(NO<sub>3</sub>)<sub>2</sub>•6H<sub>2</sub>O.

**Occurrence:** Formed by repeated natural leaching of nitrate ore with reprecipitation in irregular pods above the local regolith.

**Association:** Blödite, nitratine, kieserite.

**Distribution:** In Chile, from near Oficina Alemania and ten km west of Oficina María Elena; an ore in the Taltal nitrate district, Antofagasta; locally abundant in near-surface nitrate layers throughout the Atacama Desert.

**Name:** Honors James Thomas Humberstone (1850–1939), industrial chemist whose contributions permit economical extraction of nitrate from the Chilean deposits.

**Type Material:** National Museum of Natural History, Washington, D.C., USA, 120898.

**References:** (1) Mrose, M.E., J.J. Fahey, and G.E. Ericksen (1970) Mineralogical studies of the nitrate deposits of Chile. III. Humberstonite, K<sub>3</sub>Na<sub>7</sub>Mg<sub>2</sub>(SO<sub>4</sub>)<sub>6</sub>(NO<sub>3</sub>)<sub>2</sub>•6H<sub>2</sub>O, a new saline mineral. *Amer. Mineral.*, 55, 1518–1533. (2) Burns, P.C. and F.C. Hawthorne (1994) The crystal structure of humberstonite, a mixed sulfate-nitrate mineral. *Can. Mineral.*, 32, 381–385.