

Northupite

Na₃Mg(CO₃)₂Cl

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Crystal Data: Cubic. *Point Group:* $2/m\bar{3}$. Octahedra, to 2 cm; globular massive.

Physical Properties: *Fracture:* Conchoidal. *Tenacity:* Brittle. Hardness = 3.5–4
D(meas.) = 2.380–2.407 D(calc.) = 2.40 Slowly decomposes in H₂O, leaving a MgCO₃ residue.

Optical Properties: Transparent to translucent. *Color:* Colorless, pale green if ferroan, or due to inclusions may be pale yellow, gray, brown; colorless in transmitted light. *Luster:* Vitreous.
Optical Class: Isotropic, may be sectorially anomalously birefringent. $n = 1.5144; 1.550$ if ferroan.

Cell Data: *Space Group:* $Fd\bar{3}$. $a = 14.069(2)$ $Z = 16$

X-ray Powder Pattern: John Hay, Jr. Well No. 1, Wyoming, USA.
2.488 (100), 2.706 (71), 8.132 (60), 2.122 (35), 1.758 (30), 4.983 (25), 1.614 (25)

Chemistry:	(1)	(2)	(3)
SO ₃	0.08		
CO ₂	35.12	35.72	35.38
MgO	16.08	15.98	16.20
CaO		0.04	
Na ₂ O	36.99	36.58	37.39
Cl	14.10	14.01	14.25
H ₂ O	0.72	0.04	
insol.	0.22	0.68	
–O = Cl ₂	3.16	3.15	3.22
Total	100.15	99.90	100.00

(1) Searles Lake, California, USA; average of two analyses. (2) John Hay, Jr. Well No. 1, Wyoming, USA. (3) Na₃Mg(CO₃)₂Cl.

Occurrence: An uncommon mineral, formed probably between 20° C and 50° C, as a lacustrine deposit or at depth in mud and clay; may be primary or a replacement of earlier saline minerals.

Association: Tychite, pirssonite (Searles Lake, California, USA); shortite, trona, pirssonite, gaylussite, labuntsovite, searlesite, norsethite, loughlinitite, pyrite, quartz (Green River Formation, Wyoming, USA).

Distribution: In the USA, from Searles Lake, San Bernardino Co., and Borax Lake, Lake Co., California; in the John Hay, Jr. Well No. 1 and the Westvaco trona mine, about 30 km west of Green River, Sweetwater Co., Wyoming. At Lake Katwe and Lake Mahega, Uganda. In the Kanem region, near Lake Chad, Chad. From the Tuzla salt mine, Bosnia-Herzegovina. Around Mt. Erebus, Victoria Land, and on Ross Island, Ross Sea, Antarctica. From the Zabuye Salt Lake, Nagri, Tibet, China.

Name: To honor Charles H. Northup (1861–?), grocer of San Jose, California, USA, who found the first examples.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 278–279. (2) Fahey, J.J. (1962) Saline minerals of the Green River Formation. U.S. Geol. Surv. Prof. Paper 405, 24, 31–34, 47–48. (3) Dal Negro, A., G. Guiseppetti, and C. Tadini (1975) Refinement of the crystal structure of northupite: Na₃Mg(CO₃)₂Cl. *Tschermaks Mineral. Petrog. Mitt.*, 22, 158–163.