

**Berzeliite****NaCa<sub>2</sub>(Mg, Mn<sup>2+</sup>)<sub>2</sub>(AsO<sub>4</sub>)<sub>3</sub>**

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**Crystal Data:** Cubic. *Point Group:*  $4/m\bar{3}2/m$ . Very rare trapezohedra {211}, with small modifying faces {001}, {011}, {012}, to 4 mm; commonly as rounded grains or massive.

**Physical Properties:** *Fracture:* Subconchoidal to uneven. *Tenacity:* Brittle.  
Hardness = 4.5–5 D(meas.) = 4.08 D(calc.) = 4.068

**Optical Properties:** Transparent to translucent. *Color:* Colorless, yellow, honey-yellow to yellow-orange, yellowish red, brownish orange; in transmitted light, colorless to orange. *Streak:* Nearly white to yellow-orange. *Luster:* Resinous.

*Optical Class:* Isotropic; may show weak anomalous birefringence.  $n = 1.707\text{--}1.748$

**Cell Data:** *Space Group:*  $Ia\bar{3}d$ .  $a = 12.355(2)$   $Z = 8$

**X-ray Powder Pattern:** Långban, Sweden. (ICDD 19-165).

2.754 (100), 1.712 (70), 1.648 (70), 5.03 (60), 3.09 (60), 2.632 (60), 2.517 (60)

<b>Chemistry:</b>	(1)	(2)	(3)		(1)	(2)	(3)
P <sub>2</sub> O <sub>5</sub>	1.23	1.48		CaO	19.27	18.76	18.72
As <sub>2</sub> O <sub>5</sub>	56.72	54.92	57.54	Na <sub>2</sub> O	4.56	4.70	5.17
V <sub>2</sub> O <sub>5</sub>	0.23	0.09		K <sub>2</sub> O	0.08		
SiO <sub>2</sub>	0.66	0.57		Cl		0.03	
FeO	trace	0.03		H <sub>2</sub> O <sup>+</sup>	0.37	0.24	
MnO	2.83	9.59	11.84	H <sub>2</sub> O <sup>−</sup>	0.34	0.12	
PbO	0.35	0.19		−O = Cl <sub>2</sub>		0.01	
MgO	13.60	9.30	6.73	Total	100.24	100.01	100.00

(1) Långban, Sweden; corresponds to (Na<sub>0.84</sub>K<sub>0.01</sub>)<sub>Σ=0.85</sub>(Ca<sub>1.97</sub>Pb<sub>0.01</sub>)<sub>Σ=1.98</sub>(Mg<sub>1.94</sub>Mn<sub>0.23</sub>)<sub>Σ=2.17</sub>[(As<sub>0.94</sub>P<sub>0.03</sub>Si<sub>0.02</sub>V<sub>0.01</sub>)<sub>Σ=1.00</sub>O<sub>4</sub>]<sub>3</sub>. (2) Do.; corresponds to Na<sub>0.89</sub>Ca<sub>1.96</sub>(Mg<sub>1.35</sub>Mn<sub>0.79</sub>)<sub>Σ=2.14</sub>[(As<sub>0.93</sub>P<sub>0.04</sub>Si<sub>0.02</sub>)<sub>Σ=0.99</sub>O<sub>4</sub>]<sub>3</sub>. (3) NaCa<sub>2</sub>(Mg, Mn)<sub>2</sub>(AsO<sub>4</sub>)<sub>3</sub> with Mg:Mn = 1:1.

**Polymorphism & Series:** Forms a series with manganberzeliite.

**Occurrence:** In metamorphosed Fe–Mn orebodies.

**Association:** Hausmannite, rhodonite, tephroite, hedyphane, caryinite, manganoan biotite, längbanite, braunite, hematite, dolomite, barite, calcite.

**Distribution:** In Sweden, found at Långban and Nordmark, Värmland, and in the Sjö mine, near Grythyttan, Örebro.

**Name:** In honor of the noted Swedish chemist and mineralogist, Jöns Jacob Berzelius (1779–1848).

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 681–683. (2) Blix, R. and F.E. Wickman (1958) A contribution to the knowledge of the mineral berzeliite. Arkiv Mineral. Geol., 2(33), 417–424. (3) Hawthorne, F.C. (1976) Refinement of the crystal structure of berzeliite. Acta Cryst., 32, 1581–1583.