

**Levinsonite-(Y)****(Y, Nd, Ce, Sm)Al(SO<sub>4</sub>)<sub>2</sub>(C<sub>2</sub>O<sub>4</sub>)•12H<sub>2</sub>O**

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**Crystal Data:** Monoclinic. *Point Group:* 2/m. Prismatic crystals are flattened on {101}, elongated along [101], showing {101}, {010}, and {10 $\bar{1}$ }, to 1 mm; in aggregates of crystals.

**Physical Properties:** *Cleavage:* On {101}, perfect. *Fracture:* Irregular. *Tenacity:* Brittle. Hardness = n.d. D(meas.) = n.d. D(calc.) = 2.181 Soluble in H<sub>2</sub>O.

**Optical Properties:** Transparent. *Color:* Colorless. *Streak:* White. *Optical Class:* Biaxial (+). *Orientation:* Y = b; X  $\simeq$  c; Z  $\wedge$  c = 19°.  $\alpha = 1.48(1)$   $\beta = 1.49(1)$   $\gamma = 1.55(1)$  2V(meas.) = 7(3)°

**Cell Data:** *Space Group:* P2/n. a = 10.289(1) b = 9.234(1) c = 11.015(1)  $\beta = 108.50(1)^\circ$  Z = 2

**X-ray Powder Pattern:** Alum Cave Bluff, Tennessee, USA.  
9.3 (100), 6.28 (90), 4.89 (60), 4.09 (50), 5.20 (40), 3.700 (30), 3.447 (30)

Chemistry:	(1)		(1)	
	SO <sub>3</sub>	24.58	Nd <sub>2</sub> O <sub>3</sub>	5.94
	C <sub>2</sub> O <sub>3</sub>	[11.05]	Sm <sub>2</sub> O <sub>3</sub>	3.21
	Al <sub>2</sub> O <sub>3</sub>	7.83	Eu <sub>2</sub> O <sub>3</sub>	0.54
	Y <sub>2</sub> O <sub>3</sub>	5.72	Gd <sub>2</sub> O <sub>3</sub>	2.23
	La <sub>2</sub> O <sub>3</sub>	0.50	Dy <sub>2</sub> O <sub>3</sub>	1.15
	Ce <sub>2</sub> O <sub>3</sub>	3.02	Er <sub>2</sub> O <sub>3</sub>	0.29
	Pr <sub>2</sub> O <sub>3</sub>	0.76	H <sub>2</sub> O	[33.18]
			Total	[100.00]

(1) Alum Cave Bluff, Tennessee, USA; by electron microprobe, C<sub>2</sub>O<sub>3</sub> and H<sub>2</sub>O calculated from stoichiometry; corresponding to (Y<sub>0.33</sub>Nd<sub>0.23</sub>Ce<sub>0.12</sub>Sm<sub>0.12</sub>Gd<sub>0.08</sub>Dy<sub>0.04</sub>Pr<sub>0.03</sub>La<sub>0.02</sub>Eu<sub>0.02</sub>Er<sub>0.01</sub>) $_{\Sigma=1.00}$ Al<sub>1.00</sub>(SO<sub>4</sub>)<sub>2.00</sub>(C<sub>2.00</sub>O<sub>4</sub>)•12.00H<sub>2</sub>O.

**Occurrence:** Formed by evaporative precipitation during weathering of pyritiferous phyllite, the rare earths probably derived from monazite and xenotime.

**Association:** Zugshunsite-(Ce), epsomite, halotrichite.

**Distribution:** From Alum Cave Bluff, Great Smoky Mountains National Park, Tennessee, USA.

**Name:** To honor Dr. Alfred Abraham Levinson (1927– ), mineralogist, University of Calgary, Calgary, Canada, who originated the nomenclature system in use for rare-earth-bearing minerals.

**Type Material:** University of Michigan, Ann Arbor, Michigan; National Museum of Natural History, Washington, D.C., USA.

**References:** (1) Rouse, R.C., D.R. Peacor, E.J. Essene, T.D. Coskren, and R.J. Lauf (2001) The new minerals levinsonite-(Y) [(Y, Nd, Ce)Al(SO<sub>4</sub>)<sub>2</sub>(C<sub>2</sub>O<sub>4</sub>)•12H<sub>2</sub>O] and zugshunsite-(Ce) [(Ce, Nd, La)Al(SO<sub>4</sub>)<sub>2</sub>(C<sub>2</sub>O<sub>4</sub>)•12H<sub>2</sub>O]: coexisting oxalates with different structures and differentiation of LREE and HREE. *Geochim. Cosmochim. Acta*, 65, 1101–1115. (2) (2001) *Amer. Mineral.*, 86, 1535–1536 (abs. ref. 1).