Levinsonite-(Y) $(Y, Nd, Ce, Sm)Al(SO_4)_2(C_2O_4) \cdot 12H_2O$

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_2O.

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:* $P2/n$. $a = 10.289(1)$ $b = 9.234(1)$ $c = 11.015(1)$ $\beta = 108.50(1)°$ 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_3	24.58	Nd_2O_3	5.94
C_2O_3	[11.05]	Sm_2O_3	3.21
Al_2O_3	7.83	Eu_2O_3	0.54
Y_2O_3	5.72	Gd_2O_3	2.23
La_2O_3	0.50	Dy_2O_3	1.15
Ce_2O_3	3.02	Er_2O_3	0.29
Pr_2O_3	0.76	H_2O	[33.18]
		Total	[100.00]

(1) Alum Cave Bluff, Tennessee, USA; by electron microprobe, C_2O_3 and H_2O calculated from stoichiometry; corresponding to $(Y_{0.33}Nd_{0.23}Ce_{0.12}Sm_{0.12}Gd_{0.08}Dy_{0.04}Pr_{0.03}La_{0.02}Eu_{0.02}Er_{0.01})_{\Sigma=1.00}Al_{1.00}(SO_4)_{2.00}(C_{2.00}O_4) \cdot 12.00H_2O$.

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

Association: Zugshunstite-(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) $[(Y, Nd, Ce)Al(SO_4)_2(C_2O_4) \cdot 12H_2O]$ and zugshunstite-(Ce) $[(Ce, Nd, La)Al(SO_4)_2(C_2O_4) \cdot 12H_2O]$: 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).