Zugshunstite-(Ce) $(Ce,Nd)Al(SO_4)_2(C_2O_4)\cdot 12H_2O$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Stubby crystals, somewhat elongated along [100], showing {010} and {012}, with minor {111}, to 1 mm; in subparallel aggregates.

Physical Properties: *Cleavage:* On {010}, poor. *Fracture:* Irregular. *Tenacity:* Brittle. Hardness = n.d. D(meas.) = n.d. D(calc.) = 2.121 Soluble in H_2O.

Optical Properties: Semitransparent. *Color:* Very pale pink under incandescent light, pale blue under fluorescent room light. *Streak:* White.
Optical Class: Biaxial (+). *Dispersion:* $r > v$, medium. $\alpha = 1.455(5)$ $\beta = 1.485(2)$ $\gamma = 1.528(3)$ 2V(meas.) = 85(5)°

Cell Data: *Space Group:* $C2/c$. $a = 8.718(1)$ $b = 18.313(2)$ $c = 13.128(2)$ $\beta = 93.90(1)°$ Z = 4

X-ray Powder Pattern: Alum Cave Bluff, Tennessee, USA.
7.9 (100), 3.93 (70), 5.36 (50), 5.01 (40), 3.74 (20), 3.29 (20), 3.07 (20)

Chemistry:

	(1)		(1)
SO_3	24.01	Sm_2O_3	0.80
C_2O_3	[10.80]	Eu_2O_3	0.27
Al_2O_3	6.92	Gd_2O_3	0.14
La_2O_3	2.16	Fe_2O_3	1.11
Ce_2O_3	13.17	CaO	0.04
Pr_2O_3	1.68	H_2O	[32.41]
Nd_2O_3	6.50	Total	[100.01]

(1) Alum Cave Bluff, Tennessee, USA; by electron microprobe, C_2O_3 and H_2O calculated from stoichiometry; corresponding to $(Ce_{0.54}Nd_{0.26}La_{0.09}Pr_{0.07}Sm_{0.03}Eu_{0.01}Gd_{0.01})_{\Sigma=1.01}Al_{1.00}(SO_4)_{2.00}(C_{2.00}O_4)\cdot 12.00H_2O$.

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

Association: Levinsonite-(Y), epsomite, halotrichite.

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

Name: Derived from the Cherokee Indian term for the Great Smoky Mountains, source of the mineral.

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).