Gainesite $Na_2(Be,Li)(Zr,Zn)_2(PO_4)_4 \cdot 1-2H_2O$

Crystal Data: Tetragonal. *Point Group:* $4/m\ 2/m\ 2/m$. Crystals are steep tetragonal bipyramids, to 2 mm, with prominent {111} and tiny {001}.

Physical Properties: *Fracture:* Conchoidal. Hardness = 4 D(meas.) = 2.94(2) D(calc.) = 2.89

Optical Properties: Transparent. *Color:* Pale bluish lavender; nearly colorless in transmitted light. *Luster:* Vitreous.
Optical Class: Uniaxial (+). $\omega = 1.618(2)$ $\epsilon = 1.630(2)$

Cell Data: *Space Group:* $I4_1/amd$. a = 6.567(3) c = 17.119(5) Z = 2

X-ray Powder Pattern: Nevel quarry, Maine, USA; close to mccrillisite.
6.068 (100), 3.265 (90), 3.023 (50), 2.881 (40), 4.240 (30), 2.165 (30), 2.012 (30)

Chemistry:

	(1)	(2)		(1)	(2)
P_2O_5	45.0	45.0	CaO	0.86	0.7
SiO_2	0.59	0.1	SrO	0.15	0.0
ZrO_2	33.0	33.0	Li_2O	1.7	0.8
HfO_2	n.d.	0.7	Na_2O	6.82	7.8
Al_2O_3	1.21	0.5	K_2O	1.45	2.4
FeO	0.54	1.0	Rb_2O	0.11	0.1
MnO	0.83	0.7	Cs_2O	1.93	2.2
ZnO	4.11	< 0.1	F		< 0.1
BeO	2.8	2.3	H_2O	n.d.	4.3
MgO	0.30	0.35	Total	101.4	101.95

(1) Nevel quarry, Maine, USA; by electron microprobe, total Fe as FeO, total Mn as MnO; corresponds to $(Na_{0.38}Li_{0.06}Mn^{2+}_{0.04}Fe^{2+}_{0.02})_{\Sigma=0.50}(Na_{0.30}K_{0.10}Cs_{0.05}Ca_{0.05})_{\Sigma=0.50}Li_{0.22}(Be_{0.35}Li_{0.08}Al_{0.07})_{\Sigma=1.00}(Zr_{0.83}Zn_{0.15}Mg_{0.02})_{\Sigma=1.00}[(P_{0.99}Si_{0.01})_{\Sigma=1.00}O_4]_4$. (2) Do.; by electron microprobe, Zn, Be, Li by LA-ICP-MS and ion microprobe, H_2O by ion microprobe, total Fe as FeO, total Mn as MnO; corresponds to $Na_{1.00}(Na_{0.59}K_{0.32}Cs_{0.10}Rb_{0.01})_{\Sigma=1.02}(Be_{0.58}Li_{0.34}Mg_{0.06}Al_{0.06})_{\Sigma=1.04}(Zr_{1.69}Fe_{0.09}Ca_{0.08}Mn_{0.06}Hf_{0.02})_{\Sigma=1.94}[(P_{1.00}Si_{0.01})_{\Sigma=1.01}O_4]_4 \cdot 1.5H_2O$.

Occurrence: A very rare accessory mineral in a granite pegmatite.

Association: Roscherite, eosphorite, albite.

Distribution: From the Nevel quarry, Newry, Oxford Co., Maine, USA.

Name: To honor Dr. Richard Venable Gaines (1917–1999), American mineralogist, economic geologist, and mineral collector, of Earlysville, Virginia, USA, for his interest in beryllium minerals.

Type Material: Harvard University, Cambridge, Massachusetts, 119133; National Museum of Natural History, Washington, D.C., USA, 114848, 137843.

References: (1) Moore, P.B., T. Araki, I.M. Steele, G.H. Swihart, and A.R. Kampf (1983) Gainesite, sodium zirconium beryllophosphate: a new mineral and its crystal structure. Amer. Mineral., 68, 1022–1028. (2) Foord, E.E., M.E. Brownfield, F.E. Lichte, A.M. Davis, and S.J. Sutley (1994) Mccrillisite, $NaCs(Be,Li)Zr_2(PO_4)_4 \cdot 1-2H_2O$, a new mineral species from Mount Mica, Oxford County, Maine, and new data for gainesite. Can. Mineral., 32, 839–842.