Lemmleinite-K $Na_4K_8Ti_8(Si_4O_{12})_4(OH, O)_8 \cdot 8H_2O$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As pseudo-orthorhombic, spindle-like crystals, elongate along [001] to 1 mm, and to 5 mm in intergrowths. *Twinning*: Polysynthetic on (001).

Physical Properties: *Tenacity*: Brittle. *Fracture*: Conchoidal. Hardness = 5
D(meas.) = 2.80(5) D(calc.) = 2.86 Nonfluorescent.

Optical Properties: Transparent to translucent. *Color*: Colorless. *Streak*: White. *Luster*: Vitreous.
Optical Class: Biaxial (+). $\alpha = 1.667(2)$ $\beta = 1.677(2)$ $\gamma = 1.802(5)$ $2V = 32(1)°$
Orientation: $X = b$, $Y \wedge c = 27°$, $Z = a$. *Dispersion*: Strong, $r > v$.

Cell Data: Space Group: *C*2/*m*. $a = 14.39(3)$ $b = 13.900(6)$ $c = 7.825(9)$ $\beta = 117.6(1)°$ $Z = 4$

X-ray Powder Pattern: Mount Koashva, Khibina massif, Kola Peninsula, Russia.
3.186 (100), 6.94 (61), 6.39 (43, broad), 4.91 (31), 2.600 (28), 2.586 (28), 2.489 (24)

Chemistry:

	(1)		(1)
Na_2O	5.30	Al_2O_3	0.06
K_2O	14.92	SiO_2	39.78
CaO	0.02	TiO_2	18.42
SrO	0.02	Nb_2O_5	13.52
MnO	0.06	Ta_2O_5	0.16
FeO	0.04	H_2O	7.23
		Total	99.53

(1) Mount Koashva, Khibina massif, Kola Peninsula, Russia; average electron microprobe analysis, H_2O by thermal analysis; corresponding to $(Na_{1.033}Ca_{0.002})_{\Sigma=1.035}(K_{1.914}Sr_{0.001})_{\Sigma=1.915}(Ti_{1.392}Nb_{0.614}Mn_{0.005}Ta_{0.004}Fe_{0.004})_{\Sigma=2.019}(Si_{3.999}Al_{0.007})_{\Sigma=4.006}O_{13.65}(OH)_{0.35} \cdot 2.25H_2O$.

Mineral Group: Labuntsovite group, lemmleinite subgroup.

Occurrence: In ultra-agpaitic pegmatites in apatite-nepheline in an alkaline massif.

Association: Sodalite, natrolite, aegirine, K-feldspar, pectolite, alkali amphibole, lamprophyllite, lomonosovite, sphalerite, sitinakite, catapleiite, rhabdophane-(Ce), intergrowths of sazykinaite.

Distribution: At Mount Koashva, Khibina alkaline massif, Kola Peninsula, Russia.

Name: Honors Georgy Glebovich *Lemmlein* (1901-1962), Russian mineralogist and crystallographer, the suffix, K, indicates the dominant cation in B site.

Type Material: A.E. Fersman Mineralogical Museum, Moscow, Russia.

References: (1) Khomyakov, A.P., G.N. Nechelyustov, R.K. Rastsvetaeva, and G.I. Dorokhova (1999) Lemmleinite $NaK_2(Ti,Nb)_2Si_4O_{12}(O,OH)_2 \cdot 2H_2O$ - a new mineral of the labuntsovite-nenadkevichite family. Zapiski Vseross. Mineral. Obshch., 128(5), 54-63 (in Russian, English abs.). (2) (2000) Amer. Mineral., 85, 1844 (abs. ref. 1). (3) Chukanov, N.V., I.V. Pekov, and A.P. Khomyakov (2002) Recommended nomenclature for labuntsovite-group minerals. Eur. J. Mineral., 14, 165-173. (4) (2002) Amer. Mineral., 87, 1732-1733 (abs. ref. 3). (5) Armbruster, T., S.V. Krivovichev, T. Weber, E. Gnos, N.N. Organova, V.N. Yakovenchuk, and Z.V. Shlyukova (2004) Origin of diffuse superstructure reflections in labuntsovite-group minerals. Amer. Mineral., 89, 1655-1666.