Fluoroleakite $NaNa_2(Mg_2Fe^{3+}{}_2Li)Si_8O_{22}F_2$

Crystal Data: Monoclinic. *Point Group*: 2/*m.* Poorly-terminated prisms along [001], to 3 mm, display {100} and {110}; also in small aggregates and as inclusions in cámarite.

Physical Properties: *Cleavage*: Perfect on {110}, intersecting at ~56º. *Fracture*: Splintery. *Tenacity*: Brittle. *Hardness* = ~ 6 D(meas.) = n.d. D(calc.) = 3.245

Optical Properties: Transparent. *Color*: Black. *Streak*: Light gray to colorless. *Luster*: Vitreous. *Optical Class*: Biaxial (-). α = 1.663(2) β = 1.673(2) γ = 1.680(2) 2V(meas.) = 80.9(6)° 2V(calc.) = 79.4° *Orientation*: $X \wedge a$ = 14.1° (in β obtuse), $Y \parallel b$, $Z \wedge c$ = 75.9° (in β acute). *Pleochroism: X* = pale gray-green, *Y* = medium gray, *Z* = gray-brown.

Cell Data: *Space Group*: *C*2/*m.* a = 9.8297(3) b = 17.9257(6) c = 5.2969 β = 103.990(1)° Z = 2

X-ray Powder Pattern: Verknee Espe deposit, Akjailyautas Mountains, Kazakhstan.
2.718 (100), 8.434 (40), 4.464 (30), 3.405 (30), 3.137 (20), 2.541 (20), 2.166 (20)

Chemistry:

	(1)	(2)
SiO_2	53.34	55.52
TiO_2	1.27	
Al_2O_3	0.62	
V_2O_3	0.05	
Fe_2O_3	[15.10]	18.44
FeO	[6.00]	
MnO	2.04	
ZnO	0.18	
MgO	6.40	9.31
CaO	0.13	
Na_2O	9.08	10.74
K_2O	1.98	
Li_2O	[1.10]	3.45
H_2O	[0.16]	
F	3.33	4.39
-O=F	1.40	.
Total	99.39	100.00

(1) Verknee Espe deposit, Kazakhstan; average of 10 electron microprobe analyses, Li and Fe^{2+}/Fe^{3+} from structure analysis; corresponds to $(Na_{0.64}K_{0.38})(Na_{1.98}Ca_{0.02})(Li_{0.66}Mg_{1.42}Fe^{2+}{}_{0.75}Mn^{2+}{}_{0.26}Zn_{0.02}Fe^{3+}{}_{1.69}V^{3+}{}_{0.01}Ti^{4+}{}_{0.14}Al_{0.03})(Si_{7.93}Al_{0.07})O_{22}(F_{1.57}OH_{0.16}O_{0.27})$. (2) $NaNa_2(Mg_2Fe^{3+}{}_2Li)Si_8O_{22}F_2$.

Mineral Group: Amphibole supergroup, sodium amphibole group.

Occurrence: By the reaction of alkaline granite with post-magmatic fluids rich in Li and F.

Association: Cámarite, Li-bearing riebeckite, aegirine, astrophyllite.

Distribution: From the Verknee Espe rare-element deposit, Akjailyautas mountains, Eastern Kazakhstan District, Kazakhstan.

Name: As the *fluor*ine-dominant analogue of *leakeite.*

Type Material: A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (#3828/1).

References: (1) Cámara, F., F.C. Hawthorne, N.A. Ball, G. Bekenova, A.V. Stepanov, and P.E. Kotel'nikov (2010) Fluoroleakeite, $NaNa_2(Mg_2Fe^{3+}{}_2Li)Si_8O_{22}F_2$, a new mineral of the amphibole group from the Verkhnee Espe deposit, Akjailyautas Mountains, Eastern Kazakhstan District, Kazakhstan: description and crystal structure. Mineral. Mag., 74(3), 521-528.
(2) (2011) Amer. Mineral., 96, 1910 (abs. ref. 1).