Bulgakite $Li_2(Ca,Na)Fe^{2+}_7Ti_2(Si_4O_{12})_2O_2(OH)_4(O,F)(H_2O)_2$

Crystal Data: Triclinic. *Point Group*: $\bar{1}$. As platy crystals and irregular grains to 1 cm.

Physical Properties: *Cleavage*: Perfect on {001}, moderate on {010}. *Tenacity*: Brittle. *Fracture*: Hackly. Hardness = ~ 3 VHN = 165-221 (50 g load). D(meas.) = 3.30(2) D(calc.) = 3.236

Optical Properties: Transparent. *Color*: Brownish orange. *Streak*: Pale brown. *Luster*: Vitreous. *Optical Class*: Biaxial (+). α =1.695(3) β = 1.711(2) γ = 1.750(3) 2V(meas.) = 70(5)° 2V(calc.) = 67° *Dispersion*: Strong, $r < v$. *Pleochroism*: X = intense reddish brown, Y = light brown, Z = greenish light brown. *Absorption*: $X < Z < Y$.

Cell Data: Space Group: $P\bar{1}$. a = 5.347(1) b = 11.965(2) c = 11.65(3) α = 113.457(8)° β = 94.533(8)° γ = 103.08(1)° Z = 1

X-ray Powder Pattern: Darai-Pioz alkaline massif, Tajikistan.
10.54 (100), 3.50 (100), 2.578 (100), 2.783 (90), 1.576 (68), 2.647 (55), 1.760 (52)

Chemistry:	(1)		(1)
SiO_2	35.63	TiO_2	11.07
Al_2O_3	0.95	Nb_2O_5	0.49
Na_2O	1.04	ZrO_2	0.37
K_2O	3.27	SnO_2	1.18
Cs_2O	0.31	F	1.01
CaO	2.56	Li_2O	1.36
MgO	0.16	Rb_2O	0.85
ZnO	0.15	$-O = F_2$	0.43
FeO	29.24	H_2O	[4.04]
MnO	7.14	Total	100.38

(1) Darai-Pioz alkaline massif, Tajikistan; average of 5 electron microprobe analyses supplemented by FTIR and atomic absorption spectroscopy, H_2O from structure; corresponds to $(Li_{0.94}K_{0.91}Rb_{0.12}Cs_{0.03})_{\Sigma=2.00}(Ca_{0.60}Na_{0.40})_{\Sigma=1.00}(Fe^{2+}_{5.34}Mn_{1.32}Li_{0.25}Mg_{0.05}Na_{0.04}Zn_{0.02})_{\Sigma=7.02}(Ti_{1.82}Sn_{0.10}Nb_{0.05}Zr_{0.04})_{\Sigma=2.01}[(Si_{7.78}Al_{0.24})_{\Sigma=8.02}O_{24}]O_2(OH)_4(F_{0.70}O_{0.30})[(H_2O)_{0.94}\square_{1.06}]_{\Sigma=2.00}$.

Mineral Group: Astrophyllite supergroup, astrophyllite group.

Occurrence: In fenitized amphibole-quartz-feldspar rock from a complex alkaline massif.

Association: Alkali amphibole, quartz, microcline, bafertisite, aegirine, calcybeborosilite-(Y), thorite, fluorite.

Distribution: From the moraine of the Darai-Pioz glacier, upper reaches of the Darai-Pioz River, in the region of the Turkestan, Zeravshan, and Alay Ranges, Tajikistan.

Name: Honors Lev Vasil'evich Bulgak (b. 1938), Russian mineralogist, gemologist, translator of geological literature, and discoverer of several new minerals who worked from 1975 to 2003 at the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia.

Type Material: A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (4572/1).

References: (1) Agakhanov, A.A., L.A. Pautov, E. Sokolova, Y.A. Abdu, and V.Y. Karpenko (2016) Two astrophyllite-supergroup minerals: bulgakite, a new mineral from the Darai-Pioz alkaline massif, Tajikistan and revision of the crystal structure and chemical formula of nalivkinite. Can. Mineral., 54(1), 33-48. (2) (2017) Amer. Mineral., 102, 1143 (abs. ref.1).