Laverovite $K_2NaMn_7Zr_2(Si_4O_{12})_2O_2(OH)_4F$

Crystal Data: Triclinic. *Point Group*: $\bar{1}$. As an elongated zone, ~ 500 μm long, on the rim of a lath-like intergrowth of four minerals: laverovite, zircophyllite, astrophyllite, and kupletskite.

Physical Properties: *Cleavage*: Perfect on {001}. *Tenacity*: Brittle. *Fracture*: Hackly. Hardness = 3 D(meas.) = n.d. D(calc.) = 3.367

Optical Properties: Transparent. *Color*: Pale brown to dark brown. *Streak*: Light brown. *Luster*: Vitreous.
Optical Class: Biaxial (–). $\alpha = 1.670(2)$ $\beta = 1.710(5)$ $\gamma = 1.740(5)$ 2V(meas.) = 82(2)° 2V(calc.) = 80°. *Pleochroism*: *X* = yellowish brown , *Y* = brownish yellow, *Z* = pale yellow. *Absorption*: $X > Y > Z$. *Dispersion*: Strong, $r > v$.

Cell Data: *Space Group*: $P\bar{1}$. $a = 5.4329(1)$ $b = 11.9232(3)$ $c = 11.7491(3)$ $\alpha = 112.905(2)°$ $\beta = 94.696(1)°$ $\gamma = 103.178(1)°$ Z = 1

X-ray Powder Pattern: Desourdy quarry, Mont Saint-Hilaire, Montérégie, Québec, Canada. 2.589 (100), 2.788 (97), 3.452 (92), 2.680 (68), 1.590 (50), 2.504 (44), 1.776 (39)

Chemistry:

	(1)		(1)
Nb_2O_5	0.56	CaO	0.48
ZrO_2	9.78	MgO	0.76
TiO_2	4.69	Cs_2O	0.05
SiO_2	33.52	K_2O	6.00
Al_2O_3	0.94	Na_2O	2.28
SrO	0.13	F	1.80
ZnO	0.07	H_2O	[2.57]
FeO	13.94	$– O = F_2$	0.76
MnO	20.51	Total	97.32

(1) Desourdy quarry, Mont Saint-Hilaire, Québec, Canada; average electron microprobe analysis supplemented by FTIR spectroscopy, H_2O calculated from structure; corresponds to $(K_{1.78}Sr_{0.02}Cs_{0.01}\square_{0.19})_{\Sigma=2}(\square_{1.85}Na_{0.15})_{\Sigma=2}(Na_{0.88}Ca_{0.12})_{\Sigma=1}(Mn_{4.03}Fe^{2+}_{2.71}Mg_{0.25}Zn_{0.01})_{\Sigma=7}$ $(Zr_{1.11}Ti_{0.82}Nb_{0.06}Mg_{0.01})_{\Sigma=2}[(Si_{7.78}Al_{0.26})_{\Sigma=8.04}O_{24}]O_2[(OH)_{3.68}F_{0.32}]_{\Sigma=4}[\square_{1.85}(H_2O)_{0.15}]_{\Sigma=2}$.

Mineral Group: Astrophyllite supergroup, kupletskite group.

Occurrence: A late-stage hydrothermal mineral in a nepheline-syenite pegmatite.

Association: Zircophyllite, kupletskite, astrophyllite, aegirine, analcime, orthoclase, albite.

Distribution: From the Desourdy quarry (which became part of the Demix and later the Poudrette quarry), Mont Saint-Hilaire, La Vallée-du-Richelieu RCM, Montérégie, Québec, Canada.

Name: Honors Professor Nikolay Pavlovich *Laverov* (1930-2016) Academician of the Russian Academy of Sciences, a prominent Russian ore geologist.

Type Material: RRUFF Database (R060216), University of Arizona, Tucson, USA. Acquired from the Royal Ontario Museum, Toronto, Ontario, Canada (M57542).

References: (1) Sokolova, E., M.C. Day, F.C. Hawthorne, A.V. Kasatkin, R.T. Downs, L. Horváth, and E. Pfenninger-Horváth (2019) Laverovite, $K_2NaMn_7Zr_2(Si_4O_{12})_2O_2(OH)_4F$, a new astrophyllite-supergroup mineral from Mont Saint-Hilaire, Québec, Canada. Can. Mineral., 57(2), 201-213.
(2) (2021) Amer. Mineral., 106, 1186-1187 (abs. ref. 1).