Låvenite $(Na,Ca)_2(Mn^{2+},Fe^{2+})(Zr,Ti,Nb)Si_2O_7(O,OH,F)_2$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Crystals prismatic ‖ [100] or tabular with {100}, {110}, {111}, {101} dominant, to 2 cm. As acicular radial to stellate or matted fibrous aggregates, granular, massive. *Twinning:* Polysynthetic on {100}.

Physical Properties: *Cleavage:* Good on {100}. *Fracture:* Uneven. *Tenacity:* Brittle. Hardness = 5–6 VHN = 764–824 D(meas.) = 3.4–3.55 D(calc.) = 3.498

Optical Properties: Transparent to translucent. *Color:* Colorless, light to dark yellow, beige, yellow-orange, red-brown to brown-black; in thin section, colorless to shades of orange. *Streak:* Yellow. *Luster:* Vitreous to greasy.
Optical Class: Biaxial (–). *Pleochroism:* X = colorless, pale yellow; Y = colorless, pale greenish yellow; Z = very pale yellow, orange to brownish yellow. *Orientation:* $Y = b$; $Z \wedge c = -20°$. *Dispersion:* $r < v$, perceptible. *Absorption:* $Z > Y > X$. α = 1.690–1.720 β = 1.707–1.746 γ = 1.720–1.760 2V(meas.) = 73°–85°

Cell Data: *Space Group:* $P2_1/a$. $a = 10.83(1)$ $b = 9.98(1)$ $c = 7.174(5)$ $\beta = 108.1(1)°$ Z = 4

X-ray Powder Pattern: Langesundsfjord, Norway.
2.89 (100), 2.82 (90), 3.21 (70), 3.97 (50), 2.00 (50), 1.792 (50), 1.649 (40)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
SiO_2	29.63	29.72	30.92	MgO		0.12	
TiO_2	2.35	3.22	11.30	CaO	9.70	8.32	10.92
ZrO_2	28.79	27.40	16.72	Na_2O	10.77	12.44	10.70
Fe_2O_3	4.73		0.12	K_2O			trace
Y_2O_3		0.23		F		4.68	1.55
$(Nb,Ta)_2O_5$	5.20	4.73	3.01	LOI	2.24		
FeO		3.86	4.89	$-O = F_2$		1.97	0.65
MnO	5.59	5.54	10.34	Total	99.00	98.29	99.82

(1) Lille Arø Island, Norway. (2) Låven Island, Norway; by electron microprobe, corresponds to $(Na_{1.62}Ca_{0.37}Y_{0.01})_{\Sigma=2.00}(Mn_{0.31}Ca_{0.23}Fe^{2+}_{0.22}Zr_{0.21}Mg_{0.01})_{\Sigma=0.98}(Zr_{0.70}Ti_{0.16}Nb_{0.14})_{\Sigma=1.00}(Si_2O_7)(F_{0.99}O_{0.95})_{\Sigma=1.94}$. (3) Lovozero massif, Russia.

Polymorphism & Series: Dimorphous with burpalite.

Occurrence: In alkalic rocks and related pegmatites.

Association: Feldspars, nepheline, titanite, ilmenite, apatite, zircon, amphibole, biotite, eudialyte, catapleiite, astrophyllite, rinkite, lorenzenite, aegirine.

Distribution: In Norway, on Låven and the Arø Islands, in the Langesundsfjord. In Italy, from the Isle of Ischia, near Naples, Campania. In Russia, in the Lovozero, Khibiny, and Kovdor massifs, Kola Peninsula; the Burpala massif, about 120 km north of Lake Baikal, and from Zaangar'ya, Yenisei Ridge, Siberia. At Kruft, Mendig, and other places in the Laacher Kessel, Eifel district, Germany. From the Kangerdlugssuaq Fjord, Greenland. On Tamara Isle, Los Islands, Guinea. On Boa Vista Island, Cape Verde Islands. From Tenerife, Canary Islands. At Mont Saint-Hilaire and in the Saint-Amable sill, near Varennes, Quebec, Canada. From Granite Mountain, near Little Rock, Pulaski Co., Arkansas, USA.

Name: For its occurrence on Låven Island, Langesundsfjord, Norway.

Type Material: Wroclaw University, Wroclaw, Poland, II–14583.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 375–376. (2) Deer, W.A., R.A. Howie, and J. Zussman (1986) Rock-forming minerals, (2nd edition), v. 1B, disilicates and ring silicates, 335–342. (3) Vlasov, K.A., Ed. (1966) Mineralogy of rare elements, v. II, 381–384. (4) Mellini, M. (1981) Refinement of the crystal structure of låvenite. Tschermaks Mineral. Petrog. Mitt., 28, 99–112. (5) Horváth, L., E. Pfenninger-Horváth, R.A. Gault, and P. Tarassoff (1998) Mineralogy of the Saint-Amable Sill, Varennes and Saint-Amable, Québec. Mineral. Record, 29, 83–118, esp. 102.