Heyerdahlite $Na_3Mn_7Ti_2(Si_4O_{12})_2O_2(OH)_4F(H_2O)_2$

Crystal Data: Triclinic. *Point Group*: $\bar{1}$. As radiating fans, to 2 mm, of elongated lath-like crystals to ~1 mm. *Twinning*: By 180° rotation around [120].

Physical Properties: *Cleavage*: Perfect on {001}. *Fracture*: Hackly. *Tenacity*: Brittle. Hardness = 3 D(meas.) = n.d. D(calc.) = 3.245

Optical Properties: Transparent. *Color*: Colorless to pale brown. *Streak*: Pale brown. *Luster*: Vitreous.
Optical Class: Biaxial (+). α = 1.694(2) β = 1.710(5) γ = 1.730(5) 2V(meas.) = 80(4)° 2V(calc.) = 84.5° *Pleochroism*: *X* = yellowish brown, *Y* = brownish yellow, *Z* = pale yellow. *Absorption*: $X > Y > Z$. *Dispersion*: Strong, $r > v$. *Orientation*: $X \wedge a = 89.9°$, $X \wedge b = 23.9°$, $X \wedge c = 95.1°$; $Y \wedge a = 86.5°$, $Y \wedge b = 110.1°$, $Y \wedge c = 9.8°$; $Z \wedge a = 3.5°$, $Z \wedge b = 102.0°$, $Z \wedge c = 98.3°$.

Cell Data: Space Group: $P\bar{1}$. a = 5.392(2) b = 11.968(4) c = 11.868(4) α = 112.743(8)° β = 94.816(7)° γ = 103.037(8)° Z = 1

X-ray Powder Pattern: Near Lågendalen, Hedrum, Vestfold County, Norway.
10.745 (100), 2.594 (65), 2.791 (55), 3.582 (43), 2.663 (42), 2.496 (33), 2.686 (29)

Chemistry:

	(1)		(1)
Nb_2O_5	1.67	MgO	0.30
ZrO_2	0.53	Cs_2O	0.12
TiO_2	10.37	Rb_2O	0.82
SiO_2	35.17	K_2O	2.33
PbO	0.22	Na_2O	5.70
ZnO	1.34	F	1.49
FeO	0.14	H_2O	[4.12]
MnO	32.50	$-O = F_2$	0.63
CaO	0.03	Total	96.22

(1) Near Lågendalen, Hedrum, Vestfold County, Norway; average of 8 electron microprobe analyses supplemented by FTIR spectroscopy, H_2O calculated from structure; corresponds to $(Na_{1.18}K_{0.68}Rb_{0.12}Cs_{0.01}Pb_{0.01})_{\Sigma=2.00}Na_{1.00}(Mn_{6.29}Zn_{0.23}Mg_{0.07}Zr_{0.04}Fe^{2+}_{0.02}Ca_{0.01}Na_{0.34})_{\Sigma=7.01}(Ti_{1.78}Nb_{0.17}Mg_{0.03}Zr_{0.02})_{\Sigma=2.00}(Si_{8.03}O_{24})O_2[(OH)_{3.92}F_{0.08}]_{\Sigma=4.00}F_{1.00}[(H_2O)_{1.18}\square_{0.82}]_{\Sigma=2.00}$.

Mineral Group: Astrophyllite supergroup, kupletskite group.

Occurrence: A late-stage hydrothermal mineral in nepheline-syenite pegmatite hosted by foyaite.

Association: Albite, aegirine, hastingsite/magnesio-hastingsite, kupletskite, lorenzenite, pyrophanite.

Distribution: From a road cut ~200 m SE of the Bratthagen farm, Lågendalen, Hedrum, Vestfold County, Norway.

Name: Honors the Norwegian explorer Thor Heyerdahl (1914-2002), who was born and raised in the city of Larvik, which is within the Larvik Plutonic complex - where the first specimens were collected.

Type Material: Royal Ontario Museum, Toronto, Ontario, Canada (M57516).

References: (1) Sokolova, E., M.C. Day, F.C. Hawthorne, and R. Kristiansen (2018) Heyerdahlite, $Na_3Mn_7Ti_2(Si_4O_{12})_2O_2(OH)_4F(H_2O)_2$, a new mineral of the astrophyllite supergroup from the Larvik Plutonic complex, Norway: Description and crystal structure. Mineral. Mag., 82(2), 243-255. (2) (2019) Amer. Mineral., 104(4), 626-627 (abs. ref. 1). (3) Sokolova, E., F. Cámara, F.C. Hawthorne, and M.E. Ciriotti, (2017) The astrophyllite supergroup: nomenclature and classification. Mineral. Mag., 81, 143-153.