Høgtuvaite $\mathbf{(Ca,Na)_2(Fe^{2+},Fe^{3+},Ti)_6(Si,Be,Al)_6O_{20}}$

Crystal Data: Triclinic, pseudomonoclinic. *Point Group:* $\bar{1}$. As prismatic crystals, to 4 cm, with well-developed striations ∥ elongation; rarely in radiating groups. *Twinning:* Polysynthetic, ubiquitous, twin axis ⊥ pseudomonoclinic (010).

Physical Properties: *Cleavage:* Two good, intersecting at ∼55°; a parting ⊥ elongation. *Fracture:* Uneven. *Tenacity:* Brittle. Hardness = 5.5 D(meas.) = 3.85–3.88 D(calc.) = 3.92–3.98

Optical Properties: Opaque; transparent to translucent only in ultrathin sections. *Color:* Black. *Streak:* Dark green. *Luster:* Subadamantine to nonmetallic. *Optical Class:* Biaxial (–) (?). *Pleochroism:* Very strong; X = bronze; Z = green. $\alpha = 1.78$ (α') β = n.d. $\gamma = 1.82$ (γ') 2V(meas.) = Large.

Cell Data: *Space Group:* $P\bar{1}$. $a = 10.317(1)$ $b = 10.724(1)$ $c = 8.855(1)$ $\alpha = 105.77(1)°$ $\beta = 96.21(1)°$ $\gamma = 124.77(1)°$ Z = 2

X-ray Powder Pattern: Near Mo i Rana, Norway.
2.529 (100), 8.48 (90), 2.098 (63), 2.925 (59), 2.676 (48), 2.075 (47), 3.125 (46)

Chemistry:

	(1)	(2)		(1)	(2)
SiO_2	31.60	30.09	MgO	0.42	2.74
TiO_2	2.77	6.02	CaO	10.44	13.38
SnO_2	0.53		Na_2O	1.52	1.35
Al_2O_3	2.64	3.55	K_2O	0.00	0.30
Fe_2O_3	[19.03]	11.12	H_2O^+		0.35
FeO	[28.06]	26.91	H_2O^-		0.07
MnO	0.27	1.26	F	0.00	
BeO	2.65	2.32	LOI		0.22
			Total	[99.93]	[99.68]

(1) Near Mo i Rana, Norway; by electron microprobe and ICP, average of four samples, Fe^{2+}:Fe^{3+} by wet chemical analysis and Mössbauer spectroscopy; corresponding to $(Ca_{1.63}Na_{0.43})_{\Sigma=2.06}(Fe^{2+}_{3.42}Fe^{3+}_{2.08}Ti_{0.30}Mg_{0.09}Mn_{0.03}Sn_{0.03})_{\Sigma=5.95}(Si_{4.60}Be_{0.92}Al_{0.45})_{\Sigma=5.97}O_{20}$. (2) Ilmen Mountains, Russia; original total given as 100.28%; corresponding to $(Ca_{2.09}Na_{0.38}K_{0.03})_{\Sigma=2.50}(Fe^{2+}_{3.29}Fe^{3+}_{1.22}Ti_{0.66}Mg_{0.30}Mn_{0.08})_{\Sigma=5.55}(Si_{4.39}Be_{0.81}Al_{0.61})_{\Sigma=5.81}O_{20}$.

Mineral Group: Aenigmatite group.

Occurrence: As a late-stage metamorphic mineral in peraluminous granitic gneisses and mafic pegmatites associated with a beryllium deposit (near Mo i Rana, Norway).

Association: Quartz, albite, microcline, biotite, phenakite, zircon, fluorite, calcite, many minor beryllium and sulfide minerals (near Mo i Rana, Norway).

Distribution: Found about 16 km northwest of Mo i Rana, Norway. In the Ilmen Mountains, Southern Ural Mountains, Russia.

Name: For Høgtuva Mountain, near the type locality in Norway.

Type Material: University of Oslo, Oslo, Norway; National Museum of Natural History, Washington, D.C., USA.

References: (1) Grauch, R.I., I. Lindahl, H.T. Evans, Jr., D.M. Burt, J.J. Fitzpatrick, E.E. Foord, P.-R. Graff, and J. Hysingjord (1994) Høgtuvaite, a new beryllian member of the aenigmatite group from Norway, with new X-ray data on aenigmatite. Can. Mineral., 32, 439–448. (2) Yakubovich, O.V., Y.A. Malinovskii, and O.V. Polyakov (1990) Crystal structure of makarochkinite [høgtuvaite]. Kristallografiya (Sov. Phys. Crystal.), 35, 1388–1394 (in Russian). (3) (1992) Amer. Mineral., 77, 448 (abs. ref. 2).