Hastingsite $\mathbf{NaCa_2[(Fe^{2+},Mg)_4Fe^{3+}](Si_6Al_2)O_{22}(OH)_2}$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Prismatic crystals, to 4 cm. *Twinning:* Simple or multiple twinning common ∥ {100}.

Physical Properties: *Cleavage:* Perfect on {110}, with intersections at 56° and 124°; partings on {001}, {100}. *Tenacity:* [Brittle.] Hardness = 5–6 D(meas.) = 3.35–3.5 D(calc.) = [3.42]

Optical Properties: Semitransparent. *Color:* Black, dark green, green-brown, yellow; dark green in thin section. *Luster:* [Vitreous.]
Optical Class: Biaxial (–). *Pleochroism:* X = yellow, greenish brown, yellowish green; Y = deep greenish blue, brownish green, very dark olive-green; Z = deep olive-green, smoky blue-green, very dark green. *Orientation:* $Y = b$; $Z \wedge c \simeq 12°$. *Dispersion:* $r < v$, moderate to strong.
$\alpha = 1.685$–1.702 $\beta = 1.71$–1.729 $\gamma = 1.71$–1.728 2V(meas.) = 10°–45°

Cell Data: *Space Group:* $C2/m$. $a = 9.8659(4)$ $b = 18.0139(8)$ $c = 5.3545(2)$ $\beta = 105.082(1)°$ Z = 2

X-ray Powder Pattern: Hastings Co., Ontario, Canada. (ICDD 20-469).
8.43 (100), 3.13 (70), 2.706 (60), 3.39 (50), 3.28 (50), 2.594 (50), 2.559 (50)

Chemistry:	(1)	(2)		(1)	(2)		(1)	(2)
SiO_2	33.50	37.68	MnO	0.26	0.66	F	0.25	
TiO_2	3.26	1.02	MgO	5.00	2.20	H_2O^+	1.37	
Al_2O_3	17.89	14.01	CaO	10.30	9.26	H_2O^-	0.04	
Fe_2O_3	6.65	7.97	Na_2O	3.14	3.31	P_2O_5	0.05	
FeO	16.49	20.63	K_2O	1.48	2.22	$-O = F_2$	0.10	
						Total	[99.58]	98.96

(1) Wolfe Belt, Kargus Ridge, Lyndoch, Ontario, Canada; original total given as 99.53%, corresponds to $(Ca_{1.74}Na_{0.95}K_{0.30})_{\Sigma=2.99}(Fe^{2+}_{2.17}Mg_{1.17}Fe^{3+}_{0.79}Al_{0.58}Ti_{0.39}Mn_{0.04})_{\Sigma=5.14}(Si_{5.27}Al_{2.73})_{\Sigma=8.00}O_{22}(OH)_2$. (2) Hastings Co., Ontario, Canada; by electron microprobe, corresponds to $(Ca_{1.56}Na_{1.01}K_{0.45})_{\Sigma=3.02}(Fe^{2+}_{2.71}Fe^{3+}_{0.94}Al_{0.53}Mg_{0.52}Ti_{0.12}Mn_{0.09})_{\Sigma=4.91}(Si_{5.93}Al_{2.07})_{\Sigma=8.00}O_{22}(OH)_2$.

Polymorphism & Series: Forms a series with magnesio-hastingsite.

Mineral Group: Amphibole (calcic) group: $Mg/(Mg + Fe^{2+}) < 0.30$; $Fe^{3+} > Al^{vi}$; $(Na + K)_A \geq 0.5$; $(Ca + Na)_B \geq 1.34$; $Na_B < 0.67$; $Si < 6.25$; $Ti < 0.5$.

Occurrence: In nepheline syenite and granite; in schists, gneisses, tactites, and amphibolites.

Association: Scapolite, apatite, magnetite, spinel (gneiss); garnet, epidote, hedenbergite, quartz (tactite).

Distribution: Analyzed material from many localities worldwide. In Canada, at Bancroft, and elsewhere in Hastings Co., Ontario; near Crescent Lake, Cassiar Mountains, Yukon Territory. In the USA, at Franklin, Sussex Co., New Jersey; Cornwall, Orange Co., New York; and Iron Hill, Gunnison Co., Colorado. From Koraput, Orissa, and elsewhere in India. In the Sampo mine, Okayama Prefecture, and the Obira mine, Bungo, Oita Prefecture, Japan. From Kakanui, New Zealand. In the Marangudzi ring complex, Zimbabwe. At Almunge, Sweden.

Name: For a locality in Hastings Co., Ontario, Canada.

Type Material: Royal Ontario Museum, Toronto, Canada, M13724.

References: (1) Dana, E.S. (1899) Dana's system of mineralogy, (6th edition), app. I, 3.
(2) Hawthorne, F.C. and H.D. Grundy (1977) The crystal chemistry of the amphiboles. III: Refinement of the crystal structure of a sub-silicic hastingsite. Mineral. Mag., 41, 43–50.
(3) Leake, B.E. (1968) A catalog of analyzed calciferous and subcalciferous amphiboles together with their nomenclature and associated minerals. Geol. Soc. Amer. Special Paper 98, 210 p. [analysis 936].