Middendorfite $K_3Na_2Mn_5Si_{12}(O, OH)_{36}\cdot 2H_2O$

Crystal Data: Monoclinic. *Point Group*: 2/*m* or 2. As imperfect rhombic or octagonal plates, to 0.4 mm; as intergrown wormlike segregations, to 1 mm, or fan-shaped intergrowths.

Physical Properties: *Cleavage*: Perfect {001}. *Tenacity*: flexible but not elastic. *Fracture*: scaly. Hardness = 3-3.5 D(meas.) = 2.60(2) D(calc.) = 2.65

Optical Properties: Transparent. *Color*: Dark to bright orange. *Streak*: Yellowish. *Luster*: Vitreous.
Optical Class: Biaxial (–). α = 1.534(3) β = 1.562(2) γ = 1.563(2) 2V(meas.) = 10(5)° 2V(calc.) = 21° *Orientation: X* ~ *c*. *Pleochroism*: Strong, *X* = yellowish to colorless; *Y* = brown; *Z* = deep brown.

Cell Data: *Space Group*: $P2_1/m$ or $P2_1$. *a* = 12.55(1) *b* = 5.721(2) *c* = 26.86(2) β = 114.04(7)° *Z* = 2

X-ray Powder Pattern: Hilairite pegmatite, Khibiny pluton, Kola Peninsula, Russia.
12.28 (100), 2.840 (90), 2.634 (88), 4.31 (81), 2.366 (76), 1.669 (64), 3.555 (62)

Chemistry:

	(1)	(2)		(1)	(2)
Na_2O	4.55	4.44	Al_2O_3	0.20	
MgO	0.18		SiO_2	50.87	51.64
CaO	0.11		TiO_2	0.17	
MnO	24.88	25.41	F	0.23	
K_2O	10.16	10.12	H_2O	7.73	8.39
FeO	0.68		$-O = F_2$	0.10	
ZnO	0.15		Total	99.81	100.00

(1) Hilairite pegmatite, Khibiny pluton, Kola Peninsula, Russia; average of 19 electron microprobe analyses, H_2O by Penfield method, OH and H_2O confirmed by IR, corresponding to $K_{3.04}(Na_{2.07}Ca_{0.03})_{\Sigma=2.10}(Mn_{4.95}Fe_{0.13}Mg_{0.06}Ti_{0.03}Zn_{0.03})_{\Sigma=5.20}(Si_{11.94}Al_{0.06})_{\Sigma=12}[O_{27.57}(OH)_{8.26}F_{0.17}]\cdot 1.92H_2O$. (2) $K_3Na_2Mn_5Si_{12}(O,OH)_{36}\cdot 2H_2O$.

Occurrence: A late hydrothermal mineral in a hyperperalkaline pegmatite.

Association: Microcline, sodalite, cancrisilite, aegirine, calcite, natrolite, fluorite, narsarsukite, labuntsovite-Mn, mangan-neptunite, donnayite.

Distribution: Hilairite pegmatite, level +252 m, Kirovsky Mine, Mount Kukisvumchorr, Khibiny alkaline pluton, Kola Peninsula, Russia.

Name: Honors Aleksandr Fedorovich von Middendorf (1815–1894), Academician of the Imperial Russian Academy of Sciences, who carried out the first mineralogical study of the Khibiny Mountains.

Type Material: A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, 3312/1.

References: (1) Pekov, I.V., N.V. Chukanov, V.T. Dubinchuk, and A.E. Zadov (2006) Middendorfite, $K_3Na_2Mn_5Si_{12}(O,OH)_{36}\cdot 2H_2O$, a new mineral from the Khibiny massif, Kola Peninsula. Zap. Ross. Mineral. Obshch., 135(3), 42–52 (in Russian, English abstract); (2007) Geology of Ore Deposits, 49, 522–529 (in English). (2) (2009) Amer. Mineral., 94, 1079 (abs. ref. 1).