

Middendorffite**K₃Na₂Mn₅Si₁₂(O, OH)₃₆·2H₂O**

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 (-). $\alpha = 1.534(3)$ $\beta = 1.562(2)$ $\gamma = 1.563(2)$ $2V(\text{meas.}) = 10(5)^\circ$
 $2V(\text{calc.}) = 21^\circ$ *Orientation:* $X \sim c$. *Pleochroism:* Strong, $X =$ yellowish to colorless; $Y =$ brown; $Z =$ deep brown.

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

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 ₂ O	4.55	4.44	Al ₂ O 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 ₂ O	10.16	10.12	H ₂ O	7.73 8.39
FeO	0.68		<u>-O = F₂</u>	<u>0.10</u>
ZnO	0.15		Total	99.81 100.00

(1) Hilairite pegmatite, Khibiny pluton, Kola Peninsula, Russia; average of 19 electron microprobe analyses, H₂O by Penfield method, OH and H₂O 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) Middendorffite, $K_3Na_2Mn_5Si_{12}(O,OH)_{36} \cdot 2H_2O$, a new mineral from the Khibiny massif, Kola Peninsula. *Zap. Ross. Mineral. Obsch.*, 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).