Manaevite-(Ce)

$Ca_{11}(Ce, H_2O, Ca)_8Mg(Al, Fe)_4(Mg, Ti, Fe^{3+})_8 [Si_2O_7]_4[(SiO_4)_8(H_4O_4)_2](OH)_9$

Crystal Data: Tetragonal. *Point Group*: 4/*m* 2/*m* 2/*m*. As rims to 0.8 mm on vesuvianite crystals.

Physical Properties: *Cleavage*: None. *Tenacity*: Brittle. *Fracture*: Conchoidal to uneven. Hardness = 4.5 D(meas.) = 3.80(3) D(calc.) = 3.72 Nonfluorescent.

Optical Properties: Translucent. *Color*: Dark orange. *Streak*: Brownish orange.
Luster: Vitreous to greasy.
Optical Class: Uniaxial (-). ω = 1.760(5) ε = 1.750(5) Some samples slightly biaxial with 2V(meas.) = 0°-5°. *Pleochroism*: Weak: *O* = light yellowish brown, *E* = brown.
Dispersion: Strong. *Absorption*: *O* < *E*.

Cell Data: *Space Group: P*4/*nnc*. *a* = 15.925(1) *c* = 11.966(1) Z = 2

X-Ray Diffraction Pattern: Kovdor massif, Kola Peninsula, Russia.
2.991 (100), 2.787 (95), 2.636 (81), 2.503 (47), 3.289 (31), 4.61 (30), 5.98 (27)

Chemistry:

	(1)		(1)
H_2O	5.96	Fe_2O_3	[6.18]
F	0.33	SrO	0.42
Na_2O	0.30	La_2O_3	3.16
MgO	4.69	Ce_2O_3	10.50
Al_2O_3	4.00	Pr_2O_3	1.20
SiO_2	28.04	Nd_2O_3	3.70
SO_3	0.22	Sm_2O_3	0.26
Cl	0.06	Gd_2O_3	0.13
CaO	19.53	PbO	0.42
TiO_2	5.70	ThO_2	3.06
MnO	0.05	–O = (F, Cl)	0.15
FeO	[0.80]	Total	98.56

(1) Kovdor massif, Kola Peninsula, Russia; average electron microprobe, MAS NMR, and IR and Mössbauer (for Fe^{2+}/Fe^{3+})spectroscopic analyses, H_2O by TGA and CHN analysis with chromatographic completion; corresponds to $[Ca_{11.92}(H_2O)_{2.22}Ce_{2.19}Nd_{0.75}La_{0.66}Th_{0.40}Na_{0.33}Pr_{0.25}Sr_{0.14}Pb_{0.06}Sm_{0.05}Gd_{0.03}]_{\Sigma=19.00}(Mg_{3.98}Al_{2.69}Fe^{3+}_{2.65}Ti_{2.44}Fe^{2+}_{0.38}Mn_{0.02})_{\Sigma=12.16}S^{6+}_{0.10}[Si_{15.97}(H_4O_4)_{2.03}]_{\Sigma=18.00}[O_{67.10}(OH)_{1.90}]_{\Sigma=69.00}[(OH)_{8.31}F_{0.61}Cl_{0.06}]_{\Sigma=9.00}$.

Mineral Group: Vesuvianite group.

Occurrence: In skarn-like metasomite in a phlogopite deposit in an alkaline-ultramafic massif.

Association: Wollastonite, monticellite, thomsonite-Ca, tobermorite, strontianite, sphalerite, fluorapatite/hydroxylapatite, pectolite.

Distribution: From the Kovdor massif, Kola Peninsula, Russia.

Name: Honors Nikolay Mikhailovich *Manaev* (1936-2012), former Chief Geologist, Kovdorslyuda Mining and Dressing Company, for his contribution to the geology, mineralogy, and exploitation of the Kovdor phlogopite deposit, Kola Peninsula, Russia. A suffix for the dominant rare earth element.

Type Material: A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (5075/1) and the Mineralogical Museum, Department of Mineralogy, St. Petersburg State University, St. Petersburg, Russia (1/19666).

References: (1) Moiseev, M.M., T.L. Panikorovskii, S.M. Aksenov, A.S. Mazur, J.A. Mikhailova, V.N. Yakovenchuk, A.V. Bazai, G.Y. Ivanyuk, A.A. Agakhanov, V.V. Shilovskikh, I.V. Pekov, A.V. Kasatkin, V.S. Rusakov, V.O. Yapaskurt, V.Y. Karpenko, and S.V. Krivovichev (2020) Insights into crystal chemistry of the vesuvianite-group: manaevite-(Ce), a new mineral with complex mechanisms of its hydration. Physics and Chemistry of Minerals, 47(3), 18, 1-14.