Jahnsite-(MnMnFe) $Mn^{2+}Mn^{2+}Fe^{2+}_2Fe^{3+}_2(PO_4)_4(OH)_2\cdot 8H_2O$

Crystal Data: Monoclinic. *Point Group*: 2/*m.* Prismatic crystals to 0.2 mm are elongated along [100], slightly flattened on (010). *Twinning*: By reflection on (001).

Physical Properties: *Cleavage*: Perfect on {001}. *Tenacity*: Brittle. *Fracture*: Irregular. Hardness = ~4 D(calc.) = 2.654

Optical Properties: Translucent. *Color*: Dark orange-brown. *Streak*: Pale greenish brown. *Luster*: Vitreous.
Optical Class: Biaxial (-). $\alpha = 1.673(3)$ $\beta = 1.685$ $\gamma = 1.689$ 2V(calc.) = 60° *Orientation*: $X = b$, $Y \sim c$, $Z = a$. *Dispersion*: Moderate, $r < v$. *Pleochroism*: X = dark brown, Y = brownish orange, Z = yellow.

Cell Data: *Space Group*: $P2/a$. $a = 15.1559(6)$ $b = 7.1478(2)$ $c = 10.0209(4)$ $\beta = 112.059(4)°$ Z=2

X-ray Powder Pattern: Malpensata pegmatite mine, near Olgiasca, Lecco province, Italy.
2.590 (100), 9.221 (89), 2.840 (82), 4.932 (78), 4.651 (78), 3.971 (71), 3.504 (64)

Chemistry:

	(1)	(2)
Na_2O	0.17	
CaO	1.69	
MgO	0.68	
MnO	15.40	15.92
ZnO	0.33	
Fe_2O_3	[18.88]	17.92
FeO	[11.88]	16.12
Al_2O_3	0.04	
P_2O_5	33.68	31.85
H_2O	[18.54]	18.19
Total	101.30	100.00

(1) Malpensata pegmatite mine, near Olgiasca, Lecco province, Italy; average electron microprobe analysis, H_2O by stoichiometry and charge balance, total iron apportioned from structure analysis; corresponds to $(Mn_{0.40}Ca_{0.25}Na_{0.05})_{\Sigma=0.70}Mn(Fe^{2+}_{1.39}Mn_{0.43}Mg_{0.14}Zn_{0.03})_{\Sigma=2.00}(Fe^{3+}_{1.99}Al_{0.01})_{\Sigma=2.00}(PO_4)_4(OH)_{1.35}\cdot 8H_2O$. (2) $Mn^{2+}Mn^{2+}Fe^{2+}_2Fe^{3+}_2(PO_4)_4(OH)_2\cdot 8H_2O$.

Mineral Group: Jahnsite group, jahnsite subgroup; Fe^{3+} > Al in the M(3) structural site.

Occurrence: A low temperature, secondary mineral formed by alteration of primary phosphates in zoned granitic pegmatite.

Association: Rockbridgeite, mitridatite.

Distribution: In the dumps of the Malpensata pegmatite mine, near Olgiasca, Colico municipality, Lecco province, Italy.

Name: Root name, *Jahnsite*, indicates a member of the group with M(3) = Fe^{3+}; the suffix indicates sequentially the dominant atom in the X, M(1), and M(2) structural positions.

Type Material: Mineralogical Collection, Laboratory of Mineralogy, University of Liége, Belgium (21168).

References: (1) Vignola, P., F. Hatert, N. Rotiroti, F. Nestola, A. Risplendente, and F. Vanini (2019) Jahnsite-(MnMnFe), $Mn^{2+}Mn^{2+}Fe^{2+}_2Fe^{3+}_2(PO_4)_4(OH)_2\cdot 8H_2O$, a new phosphate mineral from the Malpensata Pegmatite, Olgiasca, Colico Municipality, Lecco Province, Italy. Can. Mineral., 57(2), 225-233. (2) (2021) Amer. Mineral., 106, 1363 (abs. ref. 1).