Graftonite-(Mn) $MnFe^{2+}_2(PO_4)_2$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. Granular and as lamellae (to 0.5 mm wide) intergrown with triphylite or products of its topotactic oxidation.

Physical Properties: *Cleavage*: Good on {010}. *Fracture*: Irregular.
Tenacity: Brittle. Hardness = ~5 D(meas.) = n.d. D(calc.) = 3.793

Optical Properties: Transparent. *Color*: Pinkish brown, colorless in transmitted light.
Streak: Colorless. *Luster*: Vitreous.
Optical Class: Biaxial (+). α = 1.710(2) β = 1.713(2) γ = 1.725(5) 2V(meas.) = 54.2(2)°
2V(calc.) = 53.4° *Orientation*: $X \parallel b$, $Y \wedge a$ = 44.2° in β obtuse, $Z \wedge a$ = 35.0° in β acute.
Dispersion: $r < v$, weak. *Pleochroism*: None.

Cell Data: Space Group: $P2_1/c$. a = 8.811(2) b = 11.494(2) c = 6.138(1) β = 99.23(3)° Z = 4

X-ray Powder Pattern: Calculated pattern.
2.874 (100), 2.858 (79), 3.506 (73), 2.717 (56), 2.953 (55), 2.916 (53), 2.899 (44)

Chemistry:

	(1)	(2)
P_2O_5	40.02	39.81
FeO	27.31	40.03
MnO	26.06	19.89
MgO	0.66	
CaO	4.74	
ZnO	0.29	.
Total	99.09	100.00

(1) Near Lutomia village, Lower Silesia, southwest Poland; average of 20 electron microprobe analyses supplemented by Raman and Mössbauer spectroscopy; corresponds to $(Fe_{1.34}Mn_{1.30}Ca_{0.30}Mg_{0.05}Zn_{0.01})_{\Sigma=3.00}(PO_4)_{1.99}$. (2) $MnFe_2(PO_4)_2$.

Polymorphism & Series: Forms series with beusite and graftonite members of the group.

Mineral Group: Graftonite group.

Occurrence: A common primary phosphate in beryl-columbite-phosphate subtype of zoned rare-element pegmatites related to anatectic melts, generated by partial melting of metasedimentary-metavolcanics rocks during amphibolite-facies metamorphism and migmatization.

Association: Sarcopside, graftonite-(Ca), triphylite oxidized topotactically to ferrisicklerite and heterosite, alluaudite-group minerals, wolfeite, stanĕkite, whitlockite.

Distribution: From two quarries near Lutomia village, ~5 km southeast of Świdnica and ~60 km southwest of Wrocław, Lower Silesia, southwest Poland.

Name: The suffix indicates the ^{M1}Mn-analogue of *graftonite*, $^{M(1)}Fe^{M(2),M(3)}Fe_2(PO_4)_2$.

Type Material: Mineralogical Museum, University of Wrocław, Faculty of Earth Science and Environmental Management, Institute of Geological Sciences, Wrocław, Poland (MMWr IV7927 and IV7928).

References: (1) Pieczka, A., F.C. Hawthorne, N. Ball, Y. Abdu, B. Gołębiowska, A. Włodek, and J. Żukrowski (2018) Graftonite-(Mn), ideally $^{M1}Mn^{M2,M3}Fe_2(PO_4)_2$, and graftonite-(Ca), ideally $^{M1}Ca^{M2,M3}Fe_2(PO_4)_2$, two new minerals of the graftonite group from Poland. Mineral. Mag., 82(6), 1307-1322. (2) (2020) Amer. Mineral., 105(7), 972-973 (abs. ref. 1). (3) Hawthorne, F.C. and A. Pieczka (2018) Classification of the minerals of the graftonite group. Mineral. Mag., 82(6), 1301-1306.