Gormanite $Fe_3^{2+}Al_4(PO_4)_4(OH)_6 \cdot 2H_2O$

Crystal Data: Triclinic, pseudomonoclinic. *Point Group:* $\overline{1}$ or 1. Crystals are elongated along [010], with large {001}, giving a bladelike aspect, with smaller {100}, {102}, {$\overline{1}$02}, {010}, to 1 cm; commonly in radial aggregates. *Twinning:* Polysynthetic around [010], composition plane {001}, universal.

Physical Properties: *Cleavage:* On {001}, poor. Hardness = 4–5 D(meas.) = 3.10–3.13 D(calc.) = 3.10–3.12

Optical Properties: Semitransparent. *Color:* Blue-green. *Streak:* Pale green. *Luster:* Vitreous.
Optical Class: Biaxial (–). *Pleochroism:* $X = Z$ = colorless; Y = blue. *Orientation:* X (163°,7°); Y (-77.5°,86.5°); Z (12.5°,84°) [using (ϕ,ρ)]. *Dispersion:* $r > v$, very strong. *Absorption:* $Y > X = Z$. $\alpha = 1.619(3)$ $\beta = 1.653(3)$ $\gamma = 1.660(3)$ 2V(meas.) = 53(2)° 2V(calc.) = 56°

Cell Data: *Space Group:* $P\overline{1}$ or $P1$. $a = 11.79(1)$ $b = 5.11(1)$ $c = 13.61(1)$ $\alpha = 90°50(5)'$ $\beta = 99°00(5)'$ $\gamma = 90°05(5)'$ Z = 2

X-ray Powder Pattern: Yukon Territory, Canada.
3.395 (100), 2.554 (90d), 2.925 (80), 4.761 (60), 3.154 (60d), 3.062 (40), 6.72 (30)

Chemistry:

	(1)	(2)		(1)	(2)
P_2O_5	37.23	38.05	MgO	6.65	8.10
Al_2O_3	25.51	27.33	CaO	0.26	
Fe_2O_3	3.82		H_2O	11.45	12.07
FeO	14.68	14.45	Total	99.91	100.00
MnO	0.31				

(1) Yukon Territory, Canada; Mg, Ca, Al by AA, P by XRF, H_2O by TGA; after removal of quartz 7.0%, corresponds to $(Fe^{2+}_{1.56}Mg_{1.26}Ca_{0.04}Mn_{0.03})_{\Sigma=2.89}(Al_{3.82}Fe^{3+}_{0.36})_{\Sigma=4.18}(PO_4)_4(OH)_{6.32} \cdot 1.69H_2O$. Commonly strongly chemically zoned, although optical property variations are not a guide. (2) $(Fe^{2+},Mg)_3Al_4(PO_4)_4(OH)_6 \cdot 2H_2O$ with Fe^{2+}:Mg = 1:1.

Polymorphism & Series: Forms a series with souzalite.

Occurrence: As low-temperature fracture fillings in phosphate-ironstones (Yukon Territory, Canada); in fractures in tonalite (Bisbee, Arizona, USA).

Association: Souzalite, siderite, ludlamite, oxidized vivianite, arrojadite, kryzhanovskite, quartz (Yukon Territory, Canada); chlorite, calcite, quartz (Bisbee, Arizona, USA).

Distribution: From Rapid Creek, Yukon Territory, Canada. In the USA, in large crystals at Bisbee, Cochise Co., Arizona; in New Hampshire, from the G.E. Smith mine, Newport, Sullivan Co. and the Charles Davis pegmatite, Groton, Grafton Co. At the Tsaobismund pegmatite, 60 km south of Karibib, Namibia.

Name: Honoring Donald Herbert Gorman (1922–), Professor of Mineralogy, Department of Geology, University of Toronto, Toronto, Canada.

Type Material: Royal Ontario Museum, Toronto, Canada, M35123, M35124, M37368; National Museum of Natural History, Washington, D.C., USA, 137494, 137495, 145741.

References: (1) Sturman, B.D., J.A. Mandarino, M.E. Mrose, and P.J. Dunn (1981) Gormanite, $Fe_3^{2+}Al_4(PO_4)_4(OH)_6 \cdot 2H_2O$, the ferrous analogue of souzalite, and new data for souzalite. Can. Mineral., 19, 381–387. (2) (1982) Amer. Mineral., 67, 622–623 (abs. ref. 1).