

Gayite, a new dufrénite-group mineral from the Gigante granitic pegmatite, Córdoba province, Argentina

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ABSTRACT

Gayite, ideally $\text{NaMn}^{2+}\text{Fe}^{3+}(\text{PO}_4)_4(\text{OH})_6 \cdot 2\text{H}_2\text{O}$, is a new member of the dufrénite group found at the Gigante granitic pegmatite, Punilla department, Córdoba province, Argentina. It is named for Hebe D. Gay (b. 1927), Professor Emeritus of Mineralogy of the National University of Córdoba (Argentina). The new mineral is monoclinic, space group $C2/c$, $a = 25.975(3)$ Å, $b = 5.1766(3)$ Å, $c = 13.929(1)$ Å, $\beta = 111.293(2)^\circ$, $Z = 4$. The strongest lines in the X-ray powder diffraction pattern are [d in Å, (I): 12.054 (33), 5.045 (60), 4.147 (37), 3.424 (71), 3.179 (100), 3.004 (33), 2.881 (42), 2.426 (36), 2.109 (39), 1.585 (50)]. It occurs associated with morinite, natrodufrénite, and quartz in cavities in massive apatite-(CaF), as clusters of tabular crystals up to 130 μm on edge dominated by $\{100\}$, with subordinate $\{20\bar{1}\}$ and possibly also $\{110\}$, $\{111\}$, and $\{11\bar{1}\}$. Crystals display striations parallel to $[010]$. The mineral is greenish black with an olive green streak and vitreous luster. Thin tablets are transparent. Gayite is brittle, with perfect $\{100\}$ cleavage and irregular fracture. Its Mohs hardness is 4 to 5. The measured density is 3.15(5) g/cm^3 , and the calculated density is 3.241 g/cm^3 . The mineral dissolves slowly in dilute HCl. Gayite is biaxial (+), $\alpha = 1.787(3)$, $\beta = 1.792(3)$, $\gamma = 1.806(3)$, $2V_{\text{meas}} = 60(5)^\circ$, $2V_{\text{calc}} = 62.1^\circ$; moderate dispersion, $r < v$; strong pleochroism, X (bluish-green) $\gg Z$ (orange) $> Y$ (yellow); orientation $Y = \mathbf{b}$, $X \wedge \mathbf{a} = 48^\circ$ in obtuse β . Analysis by electron microprobe (average of 28 analyses given in wt%) provided TiO_2 0.12, Al_2O_3 3.10, Fe_2O_3 41.95, MnO 5.97, MgO 0.08, CaO 0.23, ZnO 0.15, Na_2O 3.03, P_2O_5 32.73, and H_2O (calculated by stoichiometry) 10.31, total 97.67 wt%. The empirical formula, based on 24 O, is $(\text{Na}_{0.85}\text{Ca}_{0.02})_{\Sigma 0.87}(\text{Mn}_{0.74}^{2+}\text{Fe}_{0.12}^{2+}\text{Mg}_{0.02}\text{Zn}_{0.02}\text{Ti}_{0.01}^{4+})_{\Sigma 0.90}(\text{Fe}_{4.47}^{3+}\text{Al}_{0.53})_{\Sigma 5.00}(\text{P}_{4.03}\text{O}_{16})(\text{OH})_6 \cdot 2\text{H}_2\text{O}$. The crystal structure ($R_1 = 6.10\%$) shows gayite to be a member of the dufrénite group, along with dufrénite, natrodufrénite, matioliite, and burangaite. The structure is a framework consisting of Fe^{3+}O_6 octahedra, Mn^{2+}O_6 octahedra, and PO_4 tetrahedra with channels along the \mathbf{b} axis containing Na atoms. The most unusual feature of the structure is an octahedral face-sharing $\text{Fe}^{3+}\text{-Mn}^{2+}\text{-Fe}^{3+}$ trimer.

Keywords: Gayite, new mineral, dufrénite group, pegmatite phosphate, Córdoba, Argentina