

SPECIAL COLLECTION: APATITE: A COMMON MINERAL, UNCOMMONLY VERSATILE

Pieczkaite, ideally $\text{Mn}_5(\text{PO}_4)_3\text{Cl}$, a new apatite-supergroup mineral from Cross Lake, Manitoba, Canada: Description and crystal structure‡

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ABSTRACT

Pieczkaite, ideally $\text{Mn}_5(\text{PO}_4)_3\text{Cl}$, is a new apatite-supergroup mineral from Cross Lake, Manitoba, Canada. It occurs as small patches and narrow veins in large crystals of apatite and (Mn,Cl)-bearing apatite in phosphate pods in the quartz core of a granitic pegmatite. Veins of Mn-bearing apatite narrow to ~25 μm where the Mn content becomes high enough to constitute pieczkaite. It is gray with a grayish-white streak, does not fluoresce under ultraviolet light, and has no observable cleavage or parting. Mohs hardness is 4–5, and pieczkaite is brittle with an irregular fracture. The calculated density is 3.783 g/cm^3 . Optical properties were measured using a Bloss spindle stage at a wavelength of 590 nm (using a gel filter). Pieczkaite is uniaxial (–) with indices of refraction $\omega = 1.696$, $\varepsilon = 1.692$, both ± 0.002 . Pieczkaite is hexagonal, space group $P6_3/m$, $a = 9.504(4)$, $c = 6.347(3)$ Å, $V = 496.5(1)$ Å³, $Z = 2$, $c/a = 1:0.6678$. The six strongest lines in the X-ray powder diffraction pattern are as follows: d (Å), I , (hkl) : 2.794, 100, ($\bar{2}31$, $\bar{1}31$); 2.744, 88, (030); 2.639, 34, ($\bar{1}22$); 2.514, 25, (031, 022); 1.853, 25, ($\bar{3}42$, $\bar{1}42$); 3.174, 24, (002). Chemical analysis by electron microprobe gave P_2O_5 37.52, MnO 41.77, FeO 2.45, CaO 13.78, Cl 3.86, H_2O 0.60, $\text{O}\equiv\text{Cl}$ –0.87, sum 99.11 wt% where the H_2O content was calculated as 1 – Cl apfu. The resulting empirical formula on the basis of 12 O anions is $(\text{Mn}_{3.36}\text{Fe}_{0.20}\text{Ca}_{1.40})_{\Sigma 4.96}(\text{P}_{1.01}\text{O}_4)_3(\text{Cl}_{1.62}\text{OH}_{0.38})_{1.00}$, and the end-member formula is $\text{Mn}_5(\text{PO}_4)_3\text{Cl}$. The crystal structure of pieczkaite was refined to an R_1 index of 4.07% based on 308 observed reflections collected on a three-circle rotating-anode diffractometer with $\text{MoK}\alpha$ X-radiation. Pieczkaite is isostructural with apatite, Mn is the dominant cation at both the [9]- and [7]-coordinated-cation sites in the structure, and Cl is the dominant monovalent anion.

Keywords: Pieczkaite, new mineral species, phosphate, apatite supergroup, granitic pegmatite, Cross Lake, Manitoba, Canada, crystal structure, electron-microprobe analysis, Raman spectrum