

Zavalíaite, $(\text{Mn}^{2+}, \text{Fe}^{2+}, \text{Mg})_3(\text{PO}_4)_2$, a new primary phosphate from the La Empleada pegmatite, San Luis Province, Argentina

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Zavalíaite, ideally $(\text{Mn}^{2+}, \text{Fe}^{2+}, \text{Mg})_3(\text{PO}_4)_2$, is a new phosphate mineral species from the La Empleada granitic pegmatite, San Luis province, Argentina (Hatert *et al.*, 2011), which forms exsolution lamellae occurring within lithiophilite. The empirical formula, based on 8 oxygen atoms, is $(\text{Mn}_{1.31}^{2+}\text{Fe}_{1.19}^{2+}\text{Mg}_{0.52})(\text{PO}_4)_2$, and the single-crystal unit-cell parameters are $a = 6.088(1)$, $b = 4.814(1)$, $c = 10.484(2)$ Å, $\beta = 89.42(3)^\circ$, $V = 307.2(1)$ Å³, space group $P2_1/c$. Zavalíaite is the Mn^{2+} -rich equivalent of sarcopside $[(\text{Fe}, \text{Mn})_3(\text{PO}_4)_2]$; Moore, 1972] and of chopinite $[(\text{Mg}, \text{Fe})_3(\text{PO}_4)_2]$; Grew *et al.*, 2007], and belongs to the sarcopside group of minerals (Strunz 8.AB.15, Dana 38.3.1.1.). The mineral is named in honour of María Florencia de Fátima Márquez Zavalía (or Márquez-Zavalía (1955-)), researcher and Head of the Department of Mineralogy Petrography and Geochemistry, IANIGLA, CCT Mendoza, CONICET, Argentina, for her contribution to the knowledge of Argentinean mineralogy. The mineral species and name were approved by the Commission on New Minerals, Nomenclature and Classification of the International Mineralogical Association (CNMNC-IMA) under the number 2011-012.

The crystal structure of zavalíaite is identical to those of sarcopside and of chopinite, and can be compared to an olivine structure in which Si^{4+} is replaced by P^{5+} . Consequences of this substitution are the presence of vacancies on 1/3 of the M1 positions, as well as strong octahedral distortions induced by bond valence requirements. These octahedral distortions provoke a marked ordering of Fe at the M1 site, and of Mn at the M2 site. A detailed cationic distribution has also established, which takes into account the results of the electron-microprobe analysis of zavalíaite: $0.5 \text{Fe}^{2+} + 0.35\text{Mn}^{2+} + 0.15 \text{Mg}$ on M1, and $0.475 \text{Mn}^{2+} + 0.35 \text{Fe}^{2+} + 0.175 \text{Mg}$ on M2. Bond-valence calculations indicate bond-valence sums of 2.01 for M1, 1.95 for M2, 4.88 for P, and 1.93 to 1.99 for the oxygen atoms.

The genesis of zavalíaite lamellae is discussed and compared to the genetical processes responsible for the formation of sarcopside lamellae observed in triphylite (Roda-Robles *et al.*, 2010 and 2011). Exsolution of zavalíaite appeared during the cooling of primary, Li-poor lithiophilite; consequently, this mineral can be considered as a primary phosphate, which crystallized under pegmatitic conditions similar to those of lithiophilite formation.

References

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