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Yangite, $PbMnSi_3O_8 \cdot H_2O$, a new mineral species with double wollastonite silicate chains, from the Kombat mine, Namibia

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Abstract

A new chain-silicate mineral species, yangite, ideally $PbMnSi_3O_8 \cdot H_2O$, has been found on a specimen from the Kombat mine, Otavi Valley, Namibia. Associated minerals are melanotekite and rhodochrosite. Yangite is colorless to pale brown in transmitted light, transparent with white streak and vitreous luster. Broken pieces of yangite crystals are bladed or platy, and elongated along [010]. It is sectile with a Mohs hardness of ~5; cleavage is perfect on {101} and no twinning or parting was observed. The measured and calculated densities are 4.14(3) and 4.16 g/cm^3, respectively. Optically, yangite is biaxial (–), with $n_\alpha = 1.690(1)$, $n_\beta = 1.699(1)$, $n_\gamma = 1.705(1)$, Y = b, $Z \wedge c = 11°$, and $2V_{meas} = 77(2)°$. It is insoluble in water, acetone, and hydrochloric acid. An electron microprobe analysis demonstrated that the sample was relatively pure, yielding the empirical formula (with calculated H_2O) $Pb_{1.00}Mn^{2+}_{1.00}Si_{3.00}O_8 \cdot H_2O$. Yangite is triclinic and exhibits space group symmetry $P\bar{1}$ with unit-cell parameters $a = 9.6015(9)$, $b = 7.2712(7)$, $c = 7.9833(8)$ Å, $\alpha = 105.910(4)$, $\beta = 118.229(4)$, $\gamma = 109.935(5)°$, and $V = 392.69(7)$ Å^3. Its crystal structure is based on a skeleton of double wollastonite SiO_4 tetrahedral chains oriented parallel to [010] and interlinked with ribbons of Mn- and Pb-polyhedra. Yangite represents the first chain silicate with two-connected double chains and possesses all of the structural features of a hypothetical triclinic $Ca_2Si_3O_8 \cdot 2H_2O$ phase proposed by Merlino and Bonaccorsi (2008) as a derivative of the okenite structure. The difference in the H_2O component between the hypothetical phase and yangite likely is a consequence of the larger Pb^{2+} with its lone-pair electrons in yangite replacing the smaller Ca^{2+} in the hypothetical phase.

Keywords: Yangite, chain silicate, wollastonite chains, crystal structure, X-ray diffraction, Raman spectra