American Mineralogist, Volume 109, pages 940–948, 2024

Scandio-winchite, ideally □(NaCa)(Mg_4Sc)(Si_8O_{22})$(OH)_2$: The first Sc-dominant amphibole-supergroup mineral from Jordanów Śląski, Lower Silesia, southwestern Poland

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Abstract

Scandio-winchite, the first natural Sc-dominant amphibole-supergroup mineral, has been discovered in a granitic pegmatite that crops out in close association with rodingite-like calc-silicate rocks and metasomatized granitic bodies in a serpentinite quarry at a Jordanów Śląski village near Sobótka, ~30 km south of Wrocław, Lower Silesia, SW Poland. It occurs as an isolated subhedral crystal, with the size of ~20 × 8 μm in planar section, and as three polycrystalline aggregates, up to 50 μm across, composed of needle-shaped crystals dominated by {110}. It is present within chlorite aggregates that supposedly represent remnants of partly recrystallized xenoliths of the blackwall chlorite schists and is in quartz-feldspar portions of the pegmatite adjoining such xenolithic assemblages. Owing to the scarcity of the material and the exceptionally small size of the crystals, the color, streak, and optical properties could not be measured. By analogy with other amphiboles, scandio-winchite has a vitreous luster, brittle tenacity, and a Mohs hardness of ~5½. The mineral shows an uneven fracture and {110} perfect cleavage, with an angle of ~56° between cleavage planes. The density calculated from the empirical formula and refined unit-cell parameters is 3.026 g/cm^3. The holotype crystal is composed of (in wt%): 55.88 SiO_2, 0.11 TiO_2, 0.53 Al_2O_3, 9.22 Sc_2O_3, 0.44 MnO, 8.89 FeO, 12.77 MgO, 5.71 CaO, 4.12 Na_2O, 0.17 K_2O, and 2.09 $H_2O^{(+)}_{calc.}$; total 99.93. The composition normalized on the basis of 22 O^{2-} + 2 $(OH)^-$ ions corresponds to the empirical formula $^{A}(\square_{0.966}K_{0.031}Na_{0.003})_{\Sigma1}{}^{B}(Na_{1.132}Ca_{0.868})_{\Sigma2}{}^{C}(Mg_{2.704}Fe^{2+}_{1.055}Mn_{0.053}Sc_{1.140}Al_{0.023}Ti_{0.012})_{\Sigma4.987}{}^{T}(Si_{7.935}Al_{0.065})_{\Sigma8.000}O_{22}(OH)_2$, simplified formula (□,K)(Na,Ca)$_2$[(Mg,Fe)$_4$Sc](Si_8O_{22})$(OH)_2$, and the ideal formula □(NaCa)(Mg_4Sc)(Si_8O_{22})$(OH)_2$. The crystal structure was refined in the monoclinic system, space-group symmetry *C*2/*m*, with R_1 index of 6.57%. Its unit-cell parameters are: a = 9.864(2) Å, b = 18.163(3) Å, c = 5.3053(16) Å, β = 104.41(3)°, V = 920.6(4) Å^3; Z = 2, and the *a:b:c* ratio is 0.5431:1:0.2921. The crystal-structure refinement indicates almost exclusively Si-occupied T sites, the M4 sites occupied by nearly equal amounts of Na and Ca, M1 and M3 sites by divalent Mg + Fe cations, and M2 filled in equal proportions by divalent cations and Sc. These results, along with the dominant vacancy at the A site, univocally indicate that the mineral corresponds to a ^{M2}Sc-analog of winchite. Scandio-winchite is most likely a secondary phase of metasomatic origin related to the evolution of the country rocks and partial alteration of the blackwall chlorite schists xenolith induced by the pegmatitic melt and associated fluids.

Keywords: Scandium, new species of amphibole, scandio-winchite, composition, structure refinement, Jordanów Śląski, Poland