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Arsenic-rich fergusonite-beta-(Y) from Mount Cervandone (Western Alps, Italy): Crystal structure and genetic implications

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Abstract

An As-rich variety of fergusonite-beta-(Y) occurs as greenish yellow pseudo-bipyramidal crystals up to 1 mm in length in centimeter-sized secondary cavities within sub-horizontal pegmatite dikes at Mount Cervandone (Western Alps, Italy). The mineral is associated with quartz, biotite, potassium feldspar, and orange-yellow barrel-shaped hexagonal crystals of synchysite-(Ce) up to 2 mm in length. Fergusonite-beta-(Y) crystallized during the Alpine metamorphism under amphibolite-facies conditions, as a result of interaction between As-enriched hydrothermal fluids, circulating through the pegmatite dikes, and precursor accessory minerals in the pegmatites enriched in high-field-strength elements. These pegmatites are of NYF (niobium-yttrium-fluorine) geochemical type and served as the principal source of Be, Y, Nb, Ta, and rare-earth elements (REE) that were liberated and redeposited as rare Be-As-Y-REE minerals, including the As-rich fergusonite-beta-(Y). The latter mineral crystallizes with monoclinic symmetry [a = 5.1794(14), b = 11.089(3), c = 5.1176(14) Å, β = 91.282(8)°, V = 293.87(14) Å^3, space group $I2/a$] and has the empirical formula $(Y_{0.70}Dy_{0.07}Er_{0.05}Ca_{0.05}Gd_{0.02}U_{0.02}Yb_{0.01}Tb_{0.01}Th_{0.01}Nd_{0.01})_{\Sigma 0.95}(Nb_{0.68}As^{5+}_{0.27}W_{0.06}Ta_{0.01}Si_{0.01})_{\Sigma 1.03}O_4$. The crystal structure of fergusonite-beta-(Y) has been refined using a thermally untreated single crystal to R_1 = 6.6% for 441 observed reflections with $F_o/\sigma F_o > 4$. The incorporation of As in the structure of monoclinic fergusonite-type phases is discussed in the context of the data available for synthetic analogs.

Keywords: Fergusonite, single crystal, X-ray diffraction, EMPA