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Priscillagrewite-(Y), $(Ca_2Y)Zr_2Al_3O_{12}$: A new garnet of the bitikleite group from the Daba-Siwaqa area, the Hatrurim Complex, Jordan

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Abstract

Priscillagrewite-(Y), ideally $(Ca_2Y)Zr_2Al_3O_{12}$ ($Ia\bar{3}d$, a = 12.50 Å, V = 1953.13 Å^3, Z = 8), a new member of the garnet supergroup and bitikleite group, was discovered in a fluorapatite layer (metaphosphorite) hosted by varicolored spurrite marble in the Daba-Siwaqa area of the Transjordan plateau south of Amman, central Jordan. The Daba-Siwaqa area is the largest field of the Hatrurim Complex pyrometamorphic rocks distributed along the rift of the Dead Sea. Priscillagrewite-(Y) and other accessory minerals (such as members of the brownmillerite-srebrodolskite series, fluormayenite, lakargiite, baghdadite, hematite, sphalerite, zincite, garnet of the andradite-grossular series, tululite, vapnikite, minerals of the lime-monteponite series and members of the magnesiochromite-zincochromite series, cuprite, and Y-bearing and Y-free perovskite) are distributed irregularly in varicolored spurrite marble. The empirical formula of priscillagrewite-(Y), based on 12 O atoms, is $(Ca_{2.19}Y_{0.65}Ce^{3+}_{0.03}Nd^{3+}_{0.03}Gd^{3+}_{0.02}Dy^{3+}_{0.02}Er^{3+}_{0.02}Yb^{3+}_{0.02}La^{3+}_{0.01}Sm^{3+}_{0.01})_{\Sigma 3.00}(Zr_{1.79}Ti^{4+}_{0.13}Sb^{5+}_{0.07}U^{6+}_{0.01})_{\Sigma 2.00}(Al_{1.70}Fe^{3+}_{1.21}Si_{0.04}P^{5+}_{0.04})_{\Sigma 2.99}O_{12}$. A good match was obtained for electron backscatter diffraction (EBSD) patterns with a garnet model having a = 12.50 Å. The new garnet forms idiomorphic, isometric crystals up to 15 μm in size. It is transparent and has pale yellowish tinge, and its luster is vitreous. Priscillagrewite-(Y) is isotropic: n = 1.96 based on the Gladstone-Dale calculation using a = 12.50 Å and the empirical formula. The Mohs hardness is about 7–7.5. Density calculated from the empirical formula is 4.48 g/cm^3. Raman spectrum of priscillagrewite-(Y) is similar to those of other minerals of the bitikleite group and contains the following bands (cm^{-1}): 150, 163, 240, 269, 289, 328, 496, 508, 726, and 785. The strongest lines of the calculated powder diffraction data are as follows [(*hkl*) d_{hkl} (*I*)]: (422) 2.552 (100), (642) 1.670 (96), (420) 2.795 (84), (400) 3.125 (72), (200) 4.419 (35), (640) 1.733 (32), and (1042) 1.141 (25). Priscillagrewite-(Y) is interpreted to be a relic of the high-temperature association formed in the progressive stage at the peak pyrometamorphism conditions when temperature could have reached close to 1000 °C.

Keywords: Priscillagrewite-(Y), $(Ca_2Y)Zr_2Al_3O_{12}$, new mineral, garnet supergroup, bitikleite group, electron backscatter diffraction, Raman spectroscopy, Daba-Siwaqa, central Jordan