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Spurrite, tilleyite and associated minerals in the exoskarn zone from Cornet Hill (Metaliferi Massif, Apuseni Mountains, Romania)

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The high-temperature skarn occurrence from Cornet Hill (Apuseni Mountains, Romania) is known as one of the rare occurrences of spurrite and tilleyite worldwide. Both minerals concentrate in the outer skarn zone, corresponding to the exoskarn, at the contact of a monzodiorite - quartz monzonite body, of Upper Cretaceous age, with Tithonic - Kimmeridgian reef limestones. The skarn from Cornet Hill is clearly zoned. The zoning is, from the outer to the inner part of the metasomatic area: calcite (marble) / tilleyite / spurrite / wollastonite + gehlenite + vesuvianite / wollastonite – grossular / quartz monzonite. The mineral assemblage identified so far includes gehlenite, spurrite, tilleyite, diopside, grossular, titanian andradite, magnetite, monticellite, wollastonite, perovskite, vesuvianite, afwillite, fukalite, ellestadite-(OH), calcite, aragonite, pyrrhotite, scawtite, thaumasite, clinochlore, chrysotile, hibschite, xonotlite, thomsonite, gismondine, plombièrite, tobermorite, riversideite, portlandite, allophane.

Spurrite composes 90-95 of the rock volume of the inner exoskarn zone, where it forms practically monomineralic masses of grayish blue to pale gray color associated with perovskite, grossular, scarce tilleyite and wollastonite, and secondary afwillite, ellestadite-OH, fukalite and thaumasite. Some of the larger patches of spurrite are, however, cross cut by microveins containing scawtite, plombièrite, tobermorite, calcite and secondary aragonite. The mean unit-cell parameters, obtained as average of seven sets of data refined on the basis of X-ray powder patterns, are a 10.496(15), b 6.719(8), c 14.182(18) Å and [U+F062] 101.38(4)°. The average crystal-chemical formula, established on the basis of 23 point analyses is:
(Ca5.012Mg0.002Fe2+0.002Na0.011K0.001)(Si1.990Ti0.002)O8(CO_3)0.995.

Tilleyite represents the main constituent of the outer exoskarn zone. It occurs as monomineralic grey-bluish "orbicules" up to 5 cm2 in size, generally rimmed by scawtite, calcite, plombièrite and tobermorite or riversideite. The mean unit-cell parameters, refined based on a monoclinic P21/a cell (average of 10 least-square refinements on X-ray powder datasets) are: a 15.101(30), b 10.253(12), c 7.577(13) Å and [U+F062] 105.10(22)°. The mean chemical formula, taken as average of 115 point analyses on 14 different samples is:
(Ca4.996Mg0.004 Mn0.002Fe2+0.004Na0.002K0.002)(Si1.997Ti0.002)O7(CO_3)1.997.

Perovskite occurs as pseudocubic twinned crystals up to 0.05 mm in size, enclosed by the masses of spurrite or tilleyite. The unit-cell parameters of a selected sample, refined in the space group Pbnm, are: a 5.382(3), b 5.437(3), c 7.634(4) Å. The average composition of the analyzed grains is: (Ca0.983Mg0.002 Fe2+0.023)(Ti0.982Si0.008Al0.008)O_3.

Ellestadite-(OH) occurs mostly as scattered at random grains throughout the tilleyite or spurrite masses. The average chemical composition recorded as mean of 47 microprobe point analyses on 9 samples leads to the crystal-chemical formula:
(Ca4.916Mg0.001Mn0.002Fe2+0.004Na0.069K0.002)(Si1.492S1.354P0.154)[O12.180(OH)0.651F0.121Cl0.048].

Afwillite is the main alteration product of spurrite, occurring as thin crusts or veins along the cracks of spurrite masses. The unit-cell parameters of a selected sample, refined in the space group Cc, are: a 16.279(6), b 5.631(2), c 13.230(5) Å and [U+F062] 134.80(1)°. The average crystal-chemical formula obtained for the analyzed grains is:
(Ca2.992Mg0.007Mn0.003Fe2+0.001Na0.004K0.002)(Si1.995Ti0.002)O4[(OH)5.988F0.012].

Fukalite occurs as interstitial grains in tilleyite. The individual crystals do not exceed 20 μm in their longest dimension and have a prismatic habit. The average chemical formula is:
(Ca3.994Mg0.0072Mn0.003Fe2+0.001Na0.002K0.001)(Si1.995Al0.003Ti0.002)O6(CO_3)0.999(OH)2.