Allanite-(Ce) alterations in the Mukinbudin Feldspar Quarries pegmatite, Mukinbudin, Western Australia

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The Mukinbudin area, Western Australia, comprises a pegmatite field with pegmatite bodies classified as NYF-type [1]. Allanite-(Ce) has been found in Mukinbudin Feldspar Quarries in form of metamict masses. The allanite masses are round-shaped being up to tens of centimeters in diameter and show no distinct crystal faces. The mineral is black, brittle and glassy in appearance. It has distinctive ochre to brown coating with red tint which is up to few millimeters thick. Along with allanite, the mineral assemblage comprises albite, beryl, biotite, chalcopyrite, fergusonite-(Y), magnetite, microcline, monazite, pyrolusite, quartz, and zircon.

XRD pattern of the allanite sample showed that the mineral is heavily metamictized with just a dozen diffraction poor-resolved maxima yielding a unit cell a=8.99 (2), b = 5.76 (2), c = 10.28(3) Å, β = 115.1(2)°, V=482(2) $Å^3$. The volume of the unit cell exceeds the one of recrystallized allanite (V ~ 478 $Å^3$) due to metamictization. The coating around allanite masses is composed mainly of bastnäsite based on XRD pattern.

SEM analysis showed veinlets throughout the investigated allanite grain, whereby some of them could be observed macroscopically. Preliminary chemical analyses (EDS) showed a typical allanite-(Ce) content. The veinlets inside allanite are mostly composed of titanite. Throughout the grain there are lot of $ThSiO_4$ inclusions which are frequently aligned in almost straight-line clusters. In some cases, $ThSiO_4$ inclusions are surrounded by tiny grains of titanite and an Y-Ti-Fe oxide. The rim zone of the allanite masses is distinct from the rest of the grain showing a more complex composition. Generally, the rim is composed of altered allanite-(Ce) that is intersected by veins of bastnäsite-(Ce) and mica (Figure 1). ED spectra yielded fluorine in the composition of bastnäsite, but IR spectra showed also the presence of OH group, which in part could also originate from the altered allanite-(Ce) and mica.

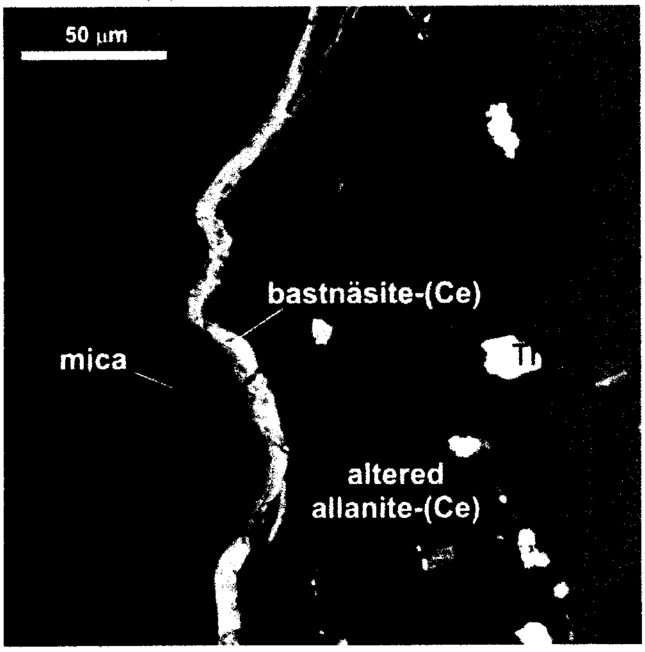

Figure 1: BSE image of the rim zone of allanite-(Ce) from Mukinbudin

[1] Jacobson M. I., Calderwood, M.A. and Grguric B.A. (2007). *Guidebook to the Pegmatites of Western Australia*, Hesperian Press, Carlisle, p. 356.

A possible new mineral species, "ferrogatehouseite" $(Fe,Mn)_5(PO_4)_2(OH)_4$ from Conţu Pegmatite, Romania

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Gatehouseite, $Mn_5(PO_4)_2(OH)_4$, is a rare Mn-bearing phosphate, since this mineral is only reported in a sedimentary iron ore deposit in Australia [1]. Like in many Mn-bearing phosphates structures, Fe may replace Mn and a complete solid solution often exists between the Mn- and Fe-bearing end-members. One more time, our work leads us to consider the existence of a hypothetic new species, "ferrogatehouseite", which would be the iron dominant equivalent species of gatehouseite.

During the research on the Li-bearing pegmatites from Conţu (Cibin Mountains, South Carpathians, Romania) a rich phosphate association, including heterosite - purpurite, lithiophilite - triphylite, sicklerite - ferrisicklerite, fluorapatite, vivianite, monazite, wolfeite was identified. Other associated minerals include spodumene, quartz, muscovite, K-feldspar, plagioclase, beryl, cassiterite, columbite group minerals, lepidolite, rutile, scarce schorl, uraninite, topaz, spessartine, sillimanite, titanite. Pegmatites from Conţu are hosted by micaschists and gneisses related to the Sebeş - Lotru Series.

Phosphates belonging to the triphylite - lithiophilite series generally occur as nests in the spodumene and feldspar masses. They form granular masses of greenish gray color that turns locally into dark brown or black, due to the weathering. Both optical and scanning electron microscope studies show that triphylite abundantly contains inclusions of wolfeite and of a gatehouseite-like phase, the later occurring in the (001) perfect cleavage plane of triphylite.

X-ray powder data were obtained on a representative sample and indexed according to ICDD file 01-070-0516, belonging to gatehouseite. These data allow the refinement of the unit-cell parameters, in the space group $P2_12_12_1(19)$: a = 9.103(3) Å, b = 18.019(6) Å and c = 5.685(9) Å. The a and b parameters are slightly larger while c is slightly smaller compared to those of gatehouseite, given by Pring and Birch (1993), i.e., a = 9.097(2) Å, b = 18.002(3) Å and c = 5.693(2) Å.

Electron-microprobe analyses of this mineral, identified as iron-rich gatehouseite (sample 14/c4), yielded (in wt.% oxides): P_2O_5 = 26.76, FeO = 38.97, MnO = 27.15, MgO = 0.41, CaO = 0.05, H_2O (calculated for charge balance) = 6.79, total =100.13. But the empiric formula of this sample is $(Fe_{2.877}Mn_{2.030}Mg_{0.053}Ca_{0.004})(PO_4)_2(OH)_4$, which is related to the one of gatehouseite but with Fe >Mn. Chemical analyses on two other samples yielded similar empiric formulae, i.e., $(Fe_{3.083}Mn_{1.855}Mg_{0.021}Ca_{0.009})(PO_4)_2(OH)_4$ and $(Fe_{2.735}Mn_{1.717}Mg_{0.042}Ca_{0.003})(PO_4)_2(OH)_4$ (samples 13/c4 and 17/c4, respectively).

Further investigations by FTIR and micro-Raman are needed to acquire more details about the H_2O content of this potential ferrous homologue of gatehouseite. The petrographic texture indicates that "ferrogatehouseite" as well as wolfeite, partially replaced triphylite along its cleavage plane during the hydroxylation hydrothermal stage.

[1] Pring A., and Birch W.D. (1993). Gatehouseite, a new manganese hydroxy phosphate from Iron Monarch South Australia. *Mineralogical Magazine*, 57, 309-313.