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Arsenian monazite-(Ce) and REE arsenates and carbonates: Composition and substitution in the $REEPO_4$ - $REEAsO_4$ system. Example from Tisovec-Rejkovo rhyolite (Western Carpathians, Slovakia).

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A new occurrence of unique accessory REE-Y-As-P phases: arsenian monazite-(Ce) $Ce(P,As)O_4$ to phosphatian gasparite-(Ce) $Ce(As,P)O_4$and phosphatian chernovite-(Y) $Y(As,P)O_4$ in association with REE carbonates were identified in a small body of Lower Triassic A-type rhyolites of the Silica Superunit near Tisovec-Rejkovo (Central Slovakia), where they occur as very small anhedral to subhedral inclusions (up to 0,1 mm) scattered in the matrix, in interstices in quartz and alkali feldspars or as intergrowths with zircon, thorite and Fe-Ti oxides.

The quantitative WDS analyses gave the following compositions:

Arsenian monazite-(Ce) to gasparite-(Ce): The LREE content ranged from 60.9 to 64.3 oxide wt.% (28.9 to 36.8 wt.% Ce_2O_3). The HREE + Y content ranged from 3.4 to 4.9 wt.% of corresponding oxides. The arsenic content ranged from 22.2 to 32.0 wt.% of As_2O_5. The atomic ratio of As/(As+P) = 0.00 – 0.73, which shows almost complete solid solution in the $LREEPO_4$ - $LREEAsO_4$system.

Chernovite-(Y): The yttrium content ranged from 22.3 to 34.6 wt.% Y_2O_3; the HREE content (Gd_2O_3 to Lu_2O_3) from 13.4 to 22.5 wt.%; and the LREE content (La_2O_3 to Sm_2O_3) from 3.0 to 8.9 wt.%. The arsenic content ranged from 23.1 to 44.2 wt.%

As_2O_5. The atomic ratio of As/(As+P) is 0.62 – 0.94 indicates a wide range of anion group substitution in the (Y,HREE)PO_4 – (Y,HREE)AsO_4 solid solution.

Arsenian monazite-(Ce) to phosphatian gasparite-(Ce) with monoclinic monazite-type structure prefers LREE, mainly Ce, whereas phosphatian chernovite-(Y) with tetragonal zircon/xenotime-type structure preferably accommodates Y and HREE.

The content of Th, U and Si reflected the thorite or huttonite-type substitution $(Th,U)^{4+}$+ Si^{4+} = $(REE,Y)^{3+}$ + $(As,P)^{5+}$in the tetragonal and monoclinic phases, respectivelly. In both cases $(AsO_4)^{3-}$- $(PO_4)^{3-}$ isovalent anion group substitution is dominant and accompanied by minor heterovalent anion group $(SO_4)^{2-}$.

REE carbonates associate with the phosphates - arsenates; they form irregular crystal aggregates in the groundmass, up to 0.3 mm in size. Hydroxylbastnäsite-(Ce) is most common, locally also hydroxylbastnäsite-(La), hydroxylbastnäsite-(Nd), bastnäsite-(Ce), synchysite-(Ce), “synchysite-(La)“, parisite-(Ce), and an unspecified Mn and OH analogue of synchysite-(Ce) occur. Rare cerianite was also identified.

Afore mentioned REE association probably originated during the post-magmatic stage from? Ca, As-rich, S-poor hydrothermal fluids. Primary magmatic monazite-(Ce) was altered to arsenian monazite-(Ce) and gasparite-(Ce), whereas possible xenotime-(Y) was transformed to chernovite-(Y). REE carbonates and cerianite were formed during hydrothermal alteration of the rock as well. Elevated As content in rhyolite (43.5 ppm) compared to other Lower Triassic rhyolite occurrences (3 to 6 ppm As) and the position of the Tisovec-Rejkovo volcanic body in close vicinity of Alpine Muráň fault also support this idea.