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Rare elements accumulation in migmatic gneisses: the case of the Grădiștea de Munte occurrence, Central South Carpathians

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The Grădiștea de Munte rare element prospect has been discovered decades ago by radiometric surveys, the successful investigation continuing with exploration adits. The data available are still scarce, as information about rare metal deposits used to be classified before 1990 in Romania. Papers published during the recent years provide data about the mineralogy [1, 2], structural or genetic models pertaining to the mineralized bodies [3].

The Zr-Nb-Ta-Y+REE-U-Th-(Sn) mineralization is hosted in microcline gneiss containing as additional phases quartz, albite, biotite, albite and magnetite. The rare element minerals appear disseminated, set along the metamorphic foliation, mainly in the biotite-rich layers and consist of thorite, fergusonite, monazite, thalénite, xenotime-(Y), columbite, cassiterite and a probably hydrous Nb-Ta-U-Th – bearing silicate phase, associated with abundant zircon, the mineral species being more often intergrown, but also forming individual grains (Fig. 1). The Nb-bearing silicate phase displays an irregular patchy zonation, being habitually intergrown with zircon (Fig. 3), xenotime, thorite (Fig. 4) and fergusonite (Fig. 5). Though similarities with niobian thorite of [4] exist, the phase appears to have a gel-like constitution and represents a breakdown product of thorite and/or fergusonite, as also indicated by direct relationships (Fig. 4, 5) and related chemical composition (Fig. 9).

The particular features of the mineralization may be summarized as:

- the assemblage records close association of the geochemical pairs Nb-Ta and U-Th
- the lack of segregation among the pairs is similar to magmatic assemblages, contrasting with a hydrothermal origin
- textural evidence supports crystallization during regional metamorphism, indicating mobilization, concentration and deposition of the assemblage related to the prevailing Variscan medium grade event
- occurrence in microcline gneisses of migmatic origin assuming a definite structural position on a regional scale, thereby offering prospects for other similar accumulations in the hosting formation.

[2] Hîrtopanu & Fairhurst (2014) Rom. J. Mineral Deposits 87/1, 53-56

[2] Hîrtopanu & Fairhurst (2014) Rom. J. Mineral Deposits 87/1, 57-60

[3] Popescu et al. (2003) In: Popescu G. C. (2003), De la Mineral la Provincie Metalogenetică, Focus Ed., Petroşani, 618 pp., 411-418

[4] Piilonen et al. (2013) Can. Mineral 51, 597-612

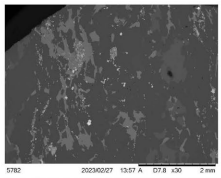

Fig. 1 Strings of rare-element bearing phases (bright) associated with biotite-rich layers (medium grey)

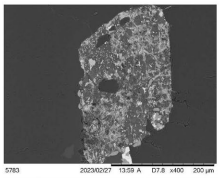

Fig. 2 Biotite-rich possibly pseudomorph aggregate containing HFSE-grains, from brightest to darkest: cassiterite, thorite, fergusonite, Nb-Th-Y-Si phase, zircon

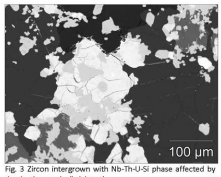

Fig. 3 Zircon intergrown with Nb-Th-U-Si phase affected by dessication cracks (brightest)

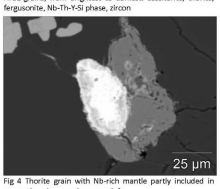

Fig 4 Thorite grain with Nb-rich mantle partly included in magnetite; zircon grains upper left.

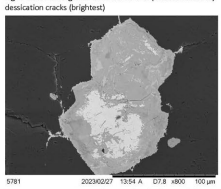

Fig 5. Fergusonite relic replaced by Nb-Th-U-Y inhomogeneous phase

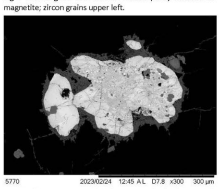

Fig. 6 Inhomogeneous Th-rich monazite-(Ce) cluster with metamict central zone

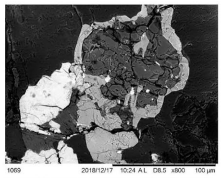

Fig. 7 Apatite mantled by thalénite associated with Nb-Th-U silicate phase (bright)

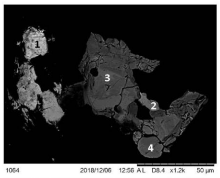

Fig. 8 Grains of Nb-Th-U silicate phase (1), xenotime-(Y) (2), zoned thalénite (3), zircon (4)

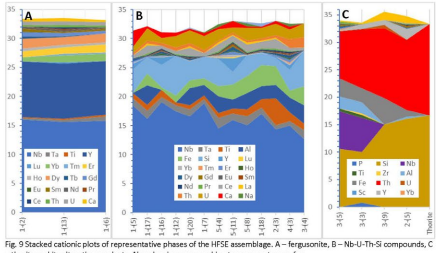

Fig. 9 Stacked cationic plots of representative phases of the HFSE assemblage. A – fergusonite, B – Nb-U-Th-Si compounds, C – thorite and its alteration products. Abundancies expressed in atom percentage p. f. u.