

## REE ACCESSORY MINERALS IN THE FELSIC SILICIC ROCKS OF THE WEST-CARPATHIANS: THEIR DISTRIBUTION, COMPOSITION AND STABILITY

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The paragenesis of the accessory minerals in the granitic rocks depends on the water or volatile content, and very strongly on aluminosity and alkalinity of the primary melt. From among the different accessory minerals, the typomorphic REE-bearing accessory minerals currently help to discriminate (by their presence or absence or physico-chemical character) following granite genetic suites in the Western Carpathians: Palaeozoic orogenic I- and S- type and anorogenic A- and S-type. Generally, the REE-rich accessory mineral assemblages typical for the I-type granites is formed by allanite, apatite, and sphene on the other hand the paragenesis characteristic for the S-type granites contains mainly monazite, apatite, xenotime and garnet.

The allanite / monazite antagonism, which is important for the recognition of the S / I-type granite suites is very distinctly developed in the West-Carpathian granites. The relationships between monazite and allanite are explained by different solubilities of these minerals when the solubility of allanite in peraluminous granites is higher than monazite. Generally, allanite precipitated rather in metaluminous (or slightly peraluminous) than peraluminous granitic rocks, so allanite is typical for the I-type granitic rocks, on the other hand, monazite for the S-types. The highest content of allanite is observed in the Lower Carboniferous Sihla I-type granitoids, which is known in the Slovak Ore Mts, Tribeč Mts. and Čierna Hora Mts. In comparison with the I-type granitic rocks, total Al in allanite increases with whole rock peraluminosity, usually being above 2.0 Al pfu in allanites from S-type granites. Monazite is characteristic for the S-type granites, only more evolved I-type or late differentiated I-type granitic rocks contain beside allanite also monazite. The monazite composition, as solid solution of the monazite s.s. component, brabantite and huttonite, show some dependency on the primary melt composition and physicochemical conditions. The proportion of brabantite increases with peraluminosity and peralkalinity as can be demonstrated on the example of the Spiš-Gemer granites, while huttonite content in the monazite increases with temperature. Apatites from the S-type granites show pronounced Eu-negative anomaly, in contrary to I-type granites, where higher redox conditions in the melt caused the presence of Eu mainly in the trivalent form. The S-type granites contain more Eu in divalent form due to the reduction regime, state this valence being easier incorporated into plagioclase. Except REEs, apatite is typomorphic mineral also due to the presence of other elements which discriminate the granite rocks between the S or I-types. More peraluminous granites, like orogenic West-Carpathian S-type granites produce apatites with higher content of Mn and Fe compared to the I-type of granites.

Stability of the principal REE-bearing accessory minerals, as monazite or allanite, is in the fluid regime restricted. The alteration of monazite is possible already by subsolidus magmatic fluids in the low temperature conditions. In such conditions monazite breaks down and newly-formed LREE-enriched apatite occurs on the monazite grains. It is known from the S-type granitic rocks presented e.g. in Suchý. The new apatite usually forms only very tiny rims on monazite, but sometimes the alteration is much less complete. Other alteration also on the rim of monazite grains is the result at formation of huttonite. This is accompanied by the increased mobility of the actinides as U and Th, and this was described in the Western Carpathians e.g. in the Tribeč Mts. within the S-type granite suites. Formation of rhabdophane on monazite surface is also possible. Monazite from the felsic silicic rocks overprinted in the amphibolite facies breaks down to allanite often with formation of an intermediate zone of apatite (FINGER *et al.*, 1998, BROSKA & SIMAN, 1998). This assemblage is associated with the reaction between biotite, anorthite and monazite-(Ce) with high activity of Ca. The apatite in such transition zone in monazite-allanite-epidote coronas or grains contains usually low amount of the REEs. Similar to monazite, xenotime is also unstable during overprinting under the amphibolite metamorphic conditions. Xenotime alteration is resulted in formation of REE-rich epidote in the form of coronas around the xenotime grains. Such alteration of xenotime is known from the orthogneisses in the Western Tatra Mts., during retrogression events (JANÁK *et al.*, 1999). Allanite breakdown is also common and usually REE-rich epidote is the product of such disintegration. Titanite shows interesting alteration, because allanite and REE epidote represents the breakdown products. Usually these minerals form small patches within the titanite grains and this effect reflects the mobility of the REEs or REE-leaching processes.

The stability of the REE-bearing accessory minerals is in most aspects still unknown phenomenon, although their distribution is crucial for the understanding of the REE mobility in the granitic rocks.

### References

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