HYDROTHERMAL MINERAL ASSEMBLAGE OF THE RARE ELEMENTS ENRICHED ROCK BODIES, BÜKK MOUNTAINS, HUNGARY

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The Institute of Mineralogy and Geology at the University of Miskolc conducted a chemical analysis of metavolcanics samples from the southeast Bükk Mountains in 2014 in the frames of the CriticEl project. One of the analysed samples contained unexpected rare earth element (REE) and other rare element (Zr, Nb, Ta, Th, Y) enrichment. These elements belong to the high field strength (HFSE) elements, which are usually stable during the processes of metamorphism and weathering. The enrichment of these elements is rare, mainly connected to carbonatite or alkaline magmatism, although in the Bükk Mts. there is no known magmatic source.

During the new explorations based on the results further occurrences were found in the SE and NE part of the Bükk Mts. (NÉMETH et al., 2016). The enriched rock bodies are Triassic metavolcanics layers (in case of the SE occurrence) and siliciclastic sedimentary layers (in case of both the SE and NE occurrences). All these layers are interbedded to carbonate layers, which do not contain any enrichment. Based on our results the enrichment has a metasomatic origin. We did further investigations to describe the mineral assemblage of the enriched rock bodies. Here we present our new results.

Chemical analyses of the studied samples were carried out by ICP and XRF measurements, while the mineralogical composition was studied with XRD, microprobe analysis and optical microscopy. The XRD method is not appropriate to detect the most interesting, rare element bearing minerals due to their small amount and the overlapping peaks. To identify the micrometre-sized minerals, only the EPMA measurements produced acceptable results. They are usually present as alteration products of earlier grains in mixed aggregates. The most general ones are zircon, REE-phosphates [most probably monazite-(Ce)] and Nb-bearing Ti-oxides. Ca-REE-Ti-Nb-oxide (aeschynite or euxenite) and REE-carbonates (parisite or synchysite) are characteristic for certain sedimentary rock layers only, the first one is from Vesszős Valley (NE Bükk), the second one from Közép-szék-lápa (SE Bükk).

Based on the results of ICP analyses the enrichment of the REEs (except Eu) can reach 5–10 times compared to the upper crust. The presence of the LREEs is more significant, but there is a small increase in the rate of HREE with the increasing total REE content. The REE pattern always shows a strong negative Eu anomaly. The enrichment rate of the Zr usually 2–7 (the maximum is 19), the Nb 12–16, the Th 3–8 (the maximum is 30) times compared to the crust. Usually, the metavolcanics samples have higher rate of enrichment, but a siliciclastic layer from Vesszős Valley (NE Bükk) contains the highest amount of enrichment. In spite the phosphate and Ti-oxide alteration minerals, both P and Ti are depleted during the alteration process.

Regarding the metavolcanics, the most enriched bodies belong to the – often peperitic – basalt of the Central unit of the Bükk Mountains (Szinva Metabasalt Formation). The rock forming minerals are quartz, trioctahedral micas, feldspars and chlorite. With higher rate of the enrichment the samples contain less albite (the rate of the potassic feldspars is higher) and less chlorite. Chlorites are likely to be altered to micas due to the enrichment.

In the enriched siliciclastic sedimentary rocks from the SE part of the mountain (Közép-szék-lápa) quartz and micas are the main components. There are only a few feldspar grains, which are usually albite. In the NE part of the mountains (Vesszős Valley) these rocks almost entirely consist of micas, but there is a smaller enrichment also in marly layers, where calcite and quartz are also present. The analysed carbonate wall rock consists of calcite, dolomite and chlorite (iron-free clinochlore).

The typical accessory minerals of both rock types are iron oxide-hydroxides, titanium oxides, apatite (with REE content) and biotite. Titanite occurs in non-altered rocks only.

According to the small grain size (<10 μm), textural position, sometimes chemical composition of the rare element bearing minerals, the enrichment was caused by a metasomatic process. The fluids reacted with the silicate minerals. The alteration caused the generation of new, rare element bearing minerals and sometimes the incorporation of rare elements into already existing phases. Other minerals, as the alkali feldspars and biotite also could be the product of the alteration. The carbonate layers were not affected by the alteration.

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Reference

NÉMETH, N., BARACZA, M. K., KRISTÁLY, F., MÓRICZ, F., PETHŐ, G. & ZAJZON, N. (2016): Földtani Közlöny, 146: 11–26.