Formation of the uranium and REE bearing phosphatite occurrence of Pécsely (Balaton Highland, Hungary)

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Abstract

The studied phosphatite occurrence is located in the Balaton Highland, in the SW part of the Transdanubian Ridge (W-Hungary). Earlier investigations have revealed radioactive anomaly, which have drawn the attention to the uranium bearing sedimentary phosphatite layer. The studied phosphatite layer together with some fluorite veins is located in Triassic limestone and dolomite. The last research was done in the area nearly half a century ago, although the formation of the phosphatite layer and the origin of the U content have not been answered, so this work aims to contribute with our knowledge on the characteristics and origin of this mineralization.

The studied uranium-bearing layer is located in a Triassic limestone (Vászoly Limestone Formation) which is unconformly overlapping an Anisian dolomite bearing (Tagyon Limestone Formation). The latter contains epigenetic fluorite veins and was formed as basinal carbonate with volcanic tuff intrabeds. The phosphatite is thought to have formed syngenetically with the shallow marine limestoneduring sedimentary processes. The horizontal extension of the layer is large, but the thickness is small (below 30 cm). The main component of the layer is carbonate-fluorapatite, associated by some calcite, rare hematite, pyrite and zircon.

Based on our studies, the main mineral phase, the carbonate-fluorapatite is located around the primary rock-forming calcite whereas the remaining space is filled by a later generation of calcite. The fluorite grains found in veins and cavities below the phosphatite layers are euhedral and have dark purple colour and rarely, calcite occurs together with them, too. The cathode-luminescence pictures of the fluorite shows a fine zonation which may be caused by the radioactivity of the phosphatite layers.

Based on the quantitative analyses (EPMA) of the carbonate-fluorapatite grains, the uranium content of the studied layer is most likely related to this phosphate mineral, as it contains 0.023-0.3 mass% U, while no other U-bearing phases were observed. However, the carbonate-fluorapatite grains contain also rare earth elements: 0.031-0.889 mass% total REE content (La, Ce, Nb, Dy, Sm, Nd, Tb, Pr, Ta, Y, Gd, Eu) was proven. Based on the elemental mapping, both the U and REE occur homogenously distributed in the crystals. The data analysis revealed that the uranium and sulphur content and the uranium and calcium content are positively correlated, while the uranium and phosphorus content correlates negatively. Quantitative analyses of fluorite showed that it contains ~0.01 mass% U and <0.174 mass% total REE content. The elemental mapping prepared on the fluorite revealed that its REE content is most likely related to submicron sized REE mineral inclusions. Future geochemical analyses may help in understanding the origin of the P, U and REE content as well may explain the possible relationships among the phosphatite layers, the fluorite veins and cavities and tuff levels which are settled into the host rock (limestone) and the nearby Permian red sandstone.

Based on the now available data, it can be concluded that the source of the U was most likely an older rock, e.g. the nearby Permian alluvial sandstone or the volcanic tuff layers, whereas the high relative phosphorous content may derive from the high amount of fishbone and organic materials of the host rock. However the found euhedral carbonate-fluorapatite crystals along the cavities of the studied layer, the concentrating role of a hydrothermal fluid has to be taken into consideration, too. Since brecciated phosphatite occurs among the fluorite veins, it is suggested that the fluorite formed most probably later than the phosphatite layer with the leaching of the fluorine content of the carbonate-fluorapatite.

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