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Supergénne minerály z U-Cu rudného výskytu Východná-Nižný Chmelienec v Nízkych Tatrách (hronikum, Slovensko)

Supergene minerals from the U-Cu ore occurrence Východná-Nižný Chmelienec, the Nízke Tatry Mts. (Hronic Unit, Slovakia)

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Abstract

An association of supergene U-Cu and Y/REE minerals was found in a relic of old ore dump at the abandoned U deposit occurrence Východná-Nižný Chmelienec, the northern slopes of the Nízke Tatry Mts., Slovakia. They have partially recent origin, since exploration of the locality took place between 1965 and 1966. The studied mineral assemblage is represented by goethite, malachite, uranophane and (meta)zeunerite, in a lesser extent baryte and rare zálesíite. Uranophane appears separately (globular aggregates, thin coatings) and it also forms the main part of the yellow to yellow-green crystalline crusts on the rock cracks. The chemical composition of the uranophane was determined by electron microprobe analyses and it is close to its ideal chemical formula $Ca(UO_2)_2(SiO_3OH)_2 \cdot 5H_2O$. The average chemical composition of the studied uranophane can be expressed by an empirical formula $(Ca_{1.0}Mg_{0.02}K_{0.01}Fe_{0.01}Ba_{0.01})_{\Sigma 1.05}(UO_2)_{2.08}(SiO_3OH)_{1.84} \cdot 5H_2O$. The infrared vibrational spectra of the studied uranophane show ν_3 $(UO_2)^{2+}$ at 850-760 cm^{-1}; the ν_3 $(SiO_4)^{4-}$ antisymmetric stretching vibration at 1000-900 cm^{-1}; the ν_1 $(SiO_4)^{4-}$ symmetric stretching vibration at 1150-1199 cm^{-1}; the δ H_2O bending vibration at 1800-1600 cm^{-1} and OH stretching vibrations at 3407; 3408 and 3409 cm^{-1}. The weak bands 2648; 2646 and 2651 cm^{-1} may be assigned to organic impurities. The calculated U-O bond length 1.83 Å corresponds to short U-O bonds in uranophane. The accessory admixtures of uranophane coatings are (meta)zeunerite and zálesíite. (Meta)zeunerite occasionally forms thin coatings of light green to emerald green tabular crystals (up tu 0.5 mm) on the surface of the rocks. Chemical analyses of (meta)zeunerite correspond to the empirical formula $(Cu_{0.66}K_{0.03}Fe_{0.01}Ca_{0.01})_{\Sigma 0.71}(UO_2)_{2.11}[(AsO_4)_{1.96}(PO_4)_{0.01}]_{\Sigma 1.97} \cdot 12H_2O$. Zálesíite occurs as crystalline aggregates, nests, formed by tiny acicular crystals, up to 100 μm in length. This is the second finding (occurrence) of this mineral in Slovakia. An average zálesíite chemical composition is $(Ca_{0.83}REE_{0.18}U_{0.05}Al_{0.03}Ti_{0.01})_{\Sigma 1.10}(Cu_{5.81}Fe_{0.06}Zn_{0.02})_{\Sigma 5.90}[(AsO_4)_{2.75}(SiO_4)_{0.21}(PO_4)_{0.02}(SO_4)_{0.03}]_{\Sigma 3.01}(OH)_{5.10} \cdot 3H_2O$. Malachite, which has been also found in the association, is only a minor mineral in the studied locality. The formation of uranyl silicates (uranophane) and minerals of the mixite group (zálesíite), present at the studied locality, points to neutralization of acidic supergene fluids in the mine dumps. Possibly, this environment later (precipitation of baryte) passed to neutral or slightly basic conditions (precipitation of carbonates - malachite). The identified uranyl phosphates/arsenates (zeunerite/metazeunerite), typical of an acidic environment, are therefore rare.

***Key words**: uranium, supergene zone, (meta)zeunerite, uranophane, malachite, zálesíite, Nižný Chmelienec, Nízke Tatry Mts., Western Carpathians*

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