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Underground weathering of native arsenic accumulation in Jáchymov mines, Czech Republic: Extreme arsenical AMD environment with exotic mineralogy

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At the 10^{th} level of the Svornost mine in Jáchymov (St. Joachimsthal), Czech Republic, a lens of native arsenic (with traces of arsenopyrite and pyrite) has been weathering in the moist environment of an old mining adit for more than 40 years. The moisture condenses as droplets on the arsenic and flows over the surrounding host rocks. These droplets consist of an extremely acidic waters (pH = 0) with colossal As concentrations ($\sim$13.5 wt.%) and precipitate blooms of secondary alteration products, mostly arsenolite, As_2O_3, and its dimorph claudetite, kaatialaite, $Fe[AsO_2(OH)_2]_3{\cdot}5H_2O$, locally also scorodite, $FeAsO_4{\cdot}2H_2O$, parasymplesite, $Fe_3(AsO_4){\cdot}8H_2O$, picropharmacolite, $Ca_4Mg(AsO_4)_2[AsO_3(OH)]_2{\cdot}12H_2O$, melanterite, $FeSO_4{\cdot}7H_2O$ and sulphur.

Among the secondary mineral phases, two were found to be containing U^{4+} in their crystal structures. They were recently described and approved as the new minerals by the CNMNC of the IMA. Běhounekite, $U^{4+}(SO_4)_2(H_2O)_4$ (Plášil et al. 2011) is the first U^{4+} sulphate found in nature. It occurs rarely as green prismatic crystals directly growing on the surface of altered arsenic. Recently approved mineral štěpite, $U(AsO_3OH)_2(H_2O)_4$ (IMA 2012-006) (Plášil et al. 2012), is then the first confirmed U^{4+} arsenate. Crystal structures of both minerals were determined by single-crystal X-ray diffraction. Both minerals contain U atom [8]–fold coordinated by O atoms or H_2O groups (with average U–O distance $\sim$ 2.37 Å), forming more or less distorted tetragonal square antiprisms. The valence state of U was confirmed from the bond-valence analysis of their crystal structures and the X-ray absorption near-edge structure (XANES) spectroscopy as well. Samples with both minerals were found by collectors in the very beginning of the exploration of the site lying at the footwall below the ore body. They are probably products of precipitation from the solutions containing mobile $(UO_2)^{2+}$ in the contact with AsO_4/SO_4 rich solutions at the surface of reducing native arsenic. Such system represents the near end-member of an AMD with prevalence of As and only partial role of Fe and S.

Plášil, J., Fejfarová, K., Novák, M., Dušek, M., Škoda, R., Hloušek, J., Čejka, J., Majzlan, J., Sejkora, J., Machovič, V., Talla, D. (2011) Běhounekite, $U(SO_4)_2(H_2O)_4$, from Jáchymov (St Joachimsthal), Czech Republic: the first natural U^{4+} sulphate. *Mineralogical Magazine*, **75**, 2739-2753.

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