PŮVODNÍ PRÁCE/ORIGINAL PAPER

Se a Cu mineralizace z Bílé Vody u Javorníka (Česká republika)

Se and Cu mineralization from Bílá Voda near Javorník (Czech Republic)

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Abstract

An interesting Se and Cu mineralization has been found in the dumps of the abandoned uranium occurrence Bílá Voda near Javorník, Rychlebské hory Mountains, Czech Republic. Uraninite forms abundant aggregates up to 1 - 2 mm in size formed by spherical to hemi-spherical aggregates up to 50 - 100 μm across. Its chemical composition corresponds to the empirical formula $[(U_{0.57}Si_{0.08})_{\Sigma 0.65}(REE+Y)_{0.09}(Ca_{0.15}Cu_{0.05}Pb_{0.03}Fe_{0.02})_{\Sigma 0.25}]O_{1.68}$. Mineral phase close to coffinite was observed in association with uraninite and Cu minerals as collomorphic aggregates up to 1 mm in size. Beside dominant U (27 - 37 at. %) it contains a very unusual contents of Cu (18 - 25 at. %) and ΣREE+Y (11 - 13 at. %); Si varies in the range 12 - 29 at. %. Chalcopyrite forms crystalline grains up to 1 mm across, aggregates composed by prismatic crystals up to 100 μm in length and altered relics up to 100 μm in association with covelline, bornite, unnamed $Cu_9Fe_7S_{16}$, uraninite and Cu-rich coffinite. Its chemical composition can be expressed by the empirical formula $Cu_{1.00}Fe_{0.98}(S_{2.00}Se_{0.02})_{\Sigma 2.02}$. Rammelsbergite was found as crystalline aggregates up to 100 μm. For its chemical composition is characteristic $NiCo_{-1}$ substitution with Co contents in the range 0.18 - 0.44 *apfu*. Löllingite and safflorite were observed more rarely as grains up to 50 μm in association with rammelsbergite and nickeline. For löllingite, the $FeNi_{-1}$ substitution with contents of Ni in the range 0.06 až 0.40 *apfu* is dominant. The chemical composition of safflorite varies especially in Co/Ni/Fe ratios. Nickeline occurs only rarely as aggregates up to 50 μm across in association with löllingite group minerals and uraninite. Its chemical composition corresponds to the empirical formula $(Ni_{0.94}Co_{0.03}Fe_{0.01}Cu_{0.01})_{\Sigma 0.99}(As_{0.98}S_{0.04})_{\Sigma 1.02}$. Silver forms irregular grains up to 30 μm in size in carbonate gangue in association with Ni-Co-Fe arsenides, its empirical formula is $(Ag_{0.99}Hg_{0.01})_{\Sigma 1.00}$. Clausthalite occurs as abundant inclusions up to 15 - 20 μm across in bornite, anomalous bornite, digenite, djurleite and covelline. Its chemical composition can be expressed by the empirical formula $(Pb_{0.98}Fe_{0.01}Cu_{0.01})_{\Sigma 1.00}(Se_{0.96}S_{0.04})_{\Sigma 1.00}$. Naumannite was found only rarely as irregular grains and aggregates up to 20 μm in size in association with clausthalite and coffinite. Its empirical formula is $(Ag_{1.97}Cu_{0.03}Fe_{0.01})_{\Sigma 2.01}(Se_{0.98}S_{0.02})_{\Sigma 1.00}$. Bornite forms aggregates up to 500 μm across with abundant tiny clausthalite inclusion; its aggregates are replaced by later digenite and djurleite. Bornite was also observed as pseudomorphoses after chalcopyrite up to 100 μm in length. Its chemical composition corresponds to the empirical formula $Cu_{4.83}Fe_{0.99}(S_{3.95}Se_{0.05})_{\Sigma 4.00}$. Chemically anomalous bornite was found as aggregates up to 200 μm in size partly replaced by later covellite and unnamed $Cu_9Fe_7S_{16}$. Its empirical formula $Cu_{3.92}Fe_{0.97}(S_{3.98}Se_{0.02})_{\Sigma 4.00}$ is close to ideal composition Cu_4FeS_4. Digenite occurs as lath-like aggregates up to 100 μm in length strongly altered by later djurleite. Aggregates of digenite and djurleite partly replaced earlier bornite. The chemical composition of digenite can be expressed by the empirical formula $(Cu_{8.98}Fe_{0.02}Pb_{0.01})_{\Sigma 9.01}(S_{4.90}Se_{0.09})_{\Sigma 4.99}$. Djurleite forms aggregates up to 200 μm across with abundant relics of earlier digenite. Its chemical composition corresponds to the empirical formula $(Cu_{30.68}Fe_{0.08}Pb_{0.01})_{\Sigma 30.77}(S_{15.96}S_{0.27})_{\Sigma 16.23}$. Covellite was found in association with uraninite and coffinite as abundant aggregates up to 300 μm in size replacing earlier chalcopyrite and chemically anomalous bornite. Its empirical formula is $(Cu_{1.04}Fe_{0.01})_{\Sigma 1.05}(S_{0.94}Se_{0.01})_{\Sigma 0.95}$. Unnamed Cu sulfide with chemical composition close to $Cu_9Fe_7S_{16}$ was observed as elongated or lens-shape crystals up to 20 μm in length in aggregates of earlier covellite and anomalous bornite in association with uraninite and covellite. It also forms elongated crystals and aggregates up to 40 μm in size replacing earlier chemically anomalous bornite. Its chemical composition can be to express by an ideal formula $Cu_{9-x}Fe_{7+x}S_{16}$ (x ±0.5) and by empirical formula $Cu_{9.03}(Fe_{6.99}Pb_{0.02})_{\Sigma 7.01}(S_{15.89}Se_{0.07})_{\Sigma 15.96}$.

***Key words**: selenides, Cu-sulfides, chemical composition, uraninite, coffinite, chalcopyrite, Ni-Fe-Co arsenides, silver, clausthalite, naumannite, bornite, digenite, djurleite, covellite, unnamed $Cu_9Fe_7S_{16}$, Bílá Voda, Rychlebské hory Mountains, Czech Republic*

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