Petrological and Geochemical Investigation of the Copper ore Deposit Barhtolomäberg/Silbertal in the Frame of the SFB HiMAT, Vorarlberg, Austria

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The project part 10 (PP10) of the SFB (Sonderforschungsbereich) HiMAT (History of Mining in the Tyrol and adjacent areas) deals with the investigation of several copper ore deposits from the Eastern Alps (Tyrol, Vorarlberg, Salzburg) in order to provide constraints about the ore formation with regard to its P-T-X conditions, as well as to provide geochemical data for future provenance studies of Cu-artefacts. The area of this study is Silbertal, located in the SW of Vorarlberg in the Montafon. The geological frame of the area of this investigation is dominated by two major Austroalpine units, the Northern Calcareous Alps (NCA) in the northern area whereas in the South the Silvretta Crystalline Complex, respectively the Phyllitgneis Zone, occurs. Concerning the ore deposits, there are two major mining sites, which are located above the village Bartholomäberg and at the ridge above the village Kristberg.
The ore bodies occur mostly at the contact between the basis of the NCA, the lower Triassic Alpine Buntsandstein and the Phyllitgneis Zone and the ore bodies occur as lenses and are occasionally dike-shaped. The complex main ore paragenesis consist of copper sulphides such as chalcopyrite, tennantite and tetraedrite showing a linear correlation between As/Sb and Fe/Zn, Ni-Co-As(Sb) sulphides like gersdorffite, corynite [Ni(As,Sb)S], alloclasite [(Co.Fe)AsS] and monosulphides like galena and sphalerite as well as Fe-sulphides like pyrothite, pyrite and arsenopyite. In minor concentrations acanthite (Ag_2S), aikinite ($PbBiCuS_3$), paraschachnerite (Ag_2Hg_3) as well as native elements like bismuth and gold occur. The latter is considered to be a secondary alteration product. Concerning the gangue, it is mainly composed of carbonates such as calcite, siderite¸ankerite, barite and quartz. Azurite, malachite, coveline and limonite are the main representatives of secondary minerals.
In addition, 10 hand specimen were analyzed with the NAA in order to get bulk trace element concentrations for further geochemical provenance studies. This data set shows a clear positive correlation between As, Sb and Ag, Zn, and Sn values, whereas the average of measured Ag reaches up to $155 \mu g/g_{(median)}$. High concentration of Co and Ni show a reverse correlation and correlate with higher Fe values. Au shows very little concentration with an average of $1 \mu g/g$. The median amount of Bi is surprisingly high ($3189 \ \mu g/g_{(median)}$) in contrast to other copper ore deposits investigated within the frame of the SFB HiMAT. Though Ag-Hg minerals are in common, the measured concentrations of Hg with the NAA are rather low and do not exceed more than $2 \ \mu g/g_{(median).}$
Correlating the sequence of mineral assemblages with the low greenschist-facies (ca. 300°C, 0.3 – 0.4 GPa) Eo-Alpine metamorphic overprint, indicates that the main assemblage formed during low $\log fS_2$ values [$\log fS_2$= -9 to -12] and the secondary alteration products grew during increasing $\log fS_2$ values [$\log fS_2$= -6.8 to -8,5] assuming that temperature was constant.

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