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Fahlore reaction textures and compositionional variations from the Schwaz-Brixlegg mining district (Tyrol, Austria)

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The fahlore minig area of Schwaz-Brixlegg in the lower Inn valley (Austria) is located in the northern Austroalpine Greywacke Zone. In the area of Schwaz and Brixlegg the Northern Greywacke Zone consists of dolomites (Schwaz Dolomite), schists (Wildschönau Schists) and gneisses (Schwaz Augengneis). The Schwaz-Brixlegg ore deposits are situated in the Devonian Schwaz Dolomite. The ore mineralization is a result of hydrothermal metal transport in the lower Devonian sedimentation environment.

In the fahlore deposit in Brixlegg, fahlores texturally occur in three generations. The main fahlores are zoned tetrahedrite-tennantite solid solutions (fahlore I + II), which show reaction textures involving the transformation of fahlores into the assemblage chalcostibite + stibnite + sphalerite + pyrit $\pm$ enargite-famatinite $\pm$ fahlore III along the model reactions: (e.g. $Cu_{10}Zn_2Sb_4S_{13}$ + $Cu_{10}Zn_2As_4S_{13}$ + 3 $S_2 -> 4$ Cu_3AsS_4 + 2 Cu_3SbS_4 + 2 $CuSbS_2$ + 4 ZnS). In addition, we can distinguish three types of reaction domains. Type one consists of chalcostibite + stibnite + pyrite + sphalerite + enargite-famatinite + fahlore III. In type two fahlore III is absent and in type three enargit- famatinit is absent but fahlore III is present again. Barite commonly occurs with this mineralization.

In BSE images, the fahlore grains show a strong patchy zoning. Sb rich fahlore I changes to As rich fahlore II patches along grain boundaries and fractures

most likely associated with hydrothermal alteration. Fahlore I shows the composition $(Cu_{5.88-5.96}Ag_{0.04-0.12})Cu_{3.53-4.63}(Zn_{0.85-1.75}Fe_{0.05-0.73}Hg_{0.03-0.17})(As_{1.32-2.32}Sb_{1.72-2.72})(S_{12.98-13.00}Se_{0.00-0.02})$ on the other hand fahlore II shows a slight As-richer composition, namely $(Cu_{5.91-5.98}Ag_{0.02-0.09})Cu_{3.65-4.61}(Zn_{0.78-1.80}Fe_{0.08-0.90}Hg_{0.04-0.09})(As_{1.58-2.39}Sb_{1.65-2.42})(S_{12.98-13.00}Se_{0.00-0.02})$. The fahlores deviate from ideal stoichiometry with a maximal semi-metal deviation of 0.278 a.p.f.u. and a metal deviation of 0.815 a.p.f.u.

Associated with the fahlore grains are 50-200 μm large reaction areas, which show three different mineral assemblages (with fahlore III and Enargit-Famatinit, without Enargit Famatinit but with Fahlore III, without fahlore III but with Enargit Famatinit). Within these reaction zones, the grain sizes range from 1μm to 15μm. The enargit-famatinite grains also show strong chemical As-Sb zoning. Their chemical composition can be described with $Cu_{2.61-3.08}(As_{0.16-0.97}Sb_{0.03-0.88})S_{4.00}$. Compared to fahlore I and II, fahlore III composition is Sb-richer and As-poorer. Some reaction domains are enargit-famatinite-free and contain high amounts of fahlore III. The third texture assemblage contains fahlore III and enargit-famatinit. Thermodynamic calculations shows that the formation of the three different reaction domains mainly depends on fS_2 of the coexisting fluid and/or temperature.

The ore assemblage in Schwaz shows a similar ore mineral assemblage as Brixlegg. Fahlores with strong As-Sb zoning mainly occur. Texturally and chemically, two generations of fahlore I and fahlore II can be distinguished. Fahlore I shows the composition $Cu_{5.88-5.93}Ag_{0.07-0.12})Cu_{3.89-4.68}(Zn_{0.34-0.86}Fe_{0.68-1.18}Hg_{0.05-0.46})(As_{1.19-2.03}Sb_{2.09-2.77})(S_{12.98-13.00}Se_{0.00-0.02})$. Fahlore II occurs along grain boundaries and fractures and is slightly As-richer with a composition of $(Cu_{5.90-5.96}Ag_{0.04-0.10})Cu_{3.78-4.70}(Zn_{0.37-0.85}Fe_{0.77-1.15}Hg_{0.05-0.33})(As_{1.43-2.47}Sb_{1.61-2.68})(S_{12.98-13.00}Se_{0.00-0.02})$. Contrary to Brixlegg, in the fahlores from Schwaz no reaction texture or barite mineralization was found.