Silver-bearing ores of the Clara Mine, SW-Germany

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The Clara Mine, located in the Schwarzwald, SW Germany is the last operating hydrothermal vein-type deposit in this area actively exploiting fluorite, barite, and silver. The deposit is famous for its large mineral diversity (currently, more than 400 species are known). It comprises three different veins (1. barite, 2. fluorite and 3. quarz-galena) hosted by Variscan gneiss units and formed by fluid mixing processes during the Jurassic-Cretaceous and Paleogene. Our study focuses on the Ag-rich sulfide mineralization hosted by the barite-dominated vein. Using optical microscopy, electron-microprobe, and fluid inclusion analysis of samples covering the mineralization in a vertical profile of 600 m, we provide new insight in the ore mineralogy and element redistribution processes with a special focus on silver.

Mineralogically, the samples can be subdivided into two groups. Group (I) represents samples from the 4th level down to the 10th level having a simple ore mineralogy with tennantite-tetrahedrite (fahlore), chalcopyrite, and arsenopyrite. Fahlore shows silver contents between 0.1-4.5 wt.% with an average of 1.3 wt.%. The second group (II) occurs from the 11th level down to the present mining level (19th level) containing variable amounts of fahlore, chalcopyrite, arsenopyrite, and polybasite-pearceite (± galena, pyrargyrite-proustite, billingsleyite, matildite, famatinite-luzonite, enargite, pyrite-marcasite). In contrast to group (I), this paragenesis shows discrete silver minerals and high silver contents in fahlore between 1.3-23.1 wt.% (average 13.8 wt.%). This observations lead to the conclusion, that the vein system shows a large-scale vertical stratification regarding silver, with low-Ag ores in the upper part and high-Ag ores in the lower parts. Additionally to the depth zonation, parts of the vein show a later fluid overprint resulting in a lead- and silver-rich association of polybasite-pearceite, pyrargyrite-proustite, and galena ± billingsleyite. Fluid inclusion temperatures in quartz and fluorite implies that temperatures of these redistribution fluids are higher (~220°C) than the ore formation fluid (between 70 and 150°C). This paragenesis is interpreted to have formed from a hot, lead-enriched fluid mobilizing silver by the dissolution of group (II) ores. The fluid may be related to the quartz-galena mineralized vein.