The transition from invisible to visible Au-Ag-Bi mineralization in a retrograde anchimetamorphic orogenic setting of the Rhenish Massif

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The Siegerland-Wied District, located in the fold-and-thrust-belt of the Rhenish Massif, is known for its synorogenic, peak-metamorphic siderite-quartz (±pyrite, pyrrhotite, ullmannite) veins formed at 280-320 °C[1]. Two consecutive stages of syn-late orogenic, retrograde polymetallic ore mineralizations, mainly controlled by the Siegen-Main-Reverse Fault System, were formed between 150-260°C [2,3].

The first stage Co-(Ni)-Cu-Au mineralization is characterized by the predominance of cobaltite-alloclasite-glaucodote and subordinate Co-bearing gersdorffite or siegenite with contemporaneous-late stage chalcopyrite-1. Separate chalcopyrite veins also occur. Chalcopyrite-1 is succeeded by sulfides of the Zn-Pb-Cu (-Sb) mineralization, characterized by a succession of sphalerite, tetrahedrite, chalcopyrite-2 and galena.

The sulfarsenides of the first stage reveal variable concentrations of invisible structurally bound Au, Ag, Bi, Pb and Te, determined by La-ICP-MS. Early stage chalcopyrite-1 is enriched by invisible Co, Ni, As, Bi and Mn, whereas late stage chalcopyrite-1 is enriched in structurally bound Ag, As, Cd, Hg, In, Sn, Sb, and Pb. Obviously, chalcopyrite-1 marks the transition between both mineralization-stages.

Visible, Ag-rich gold is closely related to the formation of chalcopyrite-1 and is often found in association with sphalerite, fahlore and galena on brittle fractures within pyrite and ullmannite of the siderite-quartz lodes. Native Bi and Bi-sulfosalts may occur in paragenesis with the gold.

We conclude, that during precipitation of the sulfarsenides, Au, Ag, Bi, Sb and Te scavenged contemperaneously with As and S from the hydrothermal fluid forming the invisible, structurally bound Au-mineralization in Fe-Co-Ni sulfarsenides. At the beginning of the Zn-Pb-Cu(-Sb) mineralization stage, visible Ag-rich gold is precipitated from a sulfur-bearing fluid already depleted in arsenic.

[1] Hein, U.F.(1993). *Min. Mag. 57, 451-476.*
[2] Hellmann et.al.(2013). *DMG Jahrestagung 2013, 213.*
[3] Erlinghagen, K-P.(1989). *N.Jb. Min. Mh. 1989, 557-567.*