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Syn- late orogenic vein hosted Co-Ni mineralization in the Siegerland-District of the Rhenish massif, NW Germany

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The Siegerland district, which hosts diverse syn-late orogenic mineralization styles, is located in the fold-and-thrust-belt of the Rhenish Massif. Peak-metamorphism and deformation occurred at 312-316±10 Ma (Ahrendt et al., 1978) at temperature-pressure conditions of 280-320 °C and 0.7-1.4 kbar (Hein, 1993). At least four syn-late orogenic mineralization stages are identified, which are Co-Cu-Au, Pb-Zn-Cu, Sb-Au, and hematite-digenite-bornite mineralization. Co-sulfarsenides of the alloclasite-cobaltite-gersdorffite series are typical of the Co-Cu-Au mineralization-type, whereas the Co-Ni thiospinel siegenite is typical of the Pb-Zn-Cu mineralization (Fenchel et al, 1985).

Co-Cu-Au mineralization is closely related to the formation of NE-ENE trending reverse faults (i.e. the first-order Siegen Main reverse fault system) and associated imbrication zones, crosscutting and reactivating older siderite-quartz veins. Co-(Ni)-sulpharsenides are associated with late stage chalcopyrite and are replaced by galena and sphalerite of the Pb-Zn-Cu mineralization. A spatial variation in the composition of Co-(Ni)-sulpharsenides is observed. Ni-poor sulpharsenides of the alloclasite-cobaltite series are mainly found within vein systems of the Betzdorf-Weidenau imbrication zone, located in the hanging wall of the Siegen main- and parallel reverse faults. The reverse fault systems are hosted by siliciclastica of the Lower Siegen beds.

Sulpharsenides of the cobaltite-gersdorffite series occur in addition to members of the alloclasite-cobaltite series in vein systems related to reverse faults in the SE-section of the Siegen imbricate fold. The fault systems are hosted by Middle Siegen beds. Within the Upper Siegen beds, only a few occurrences of Co-(Ni)-sulpharsenides are known. The mineralization is absent in the Ems beds.

The Co/Ni ratio of the sulpharsenides shows no lithogeochemical relationship to the Co/Ni ratio of the host rocks with the different stratigraphical systems. Instead, the compositional differences of the sulpharsenides may be explained by the spatial position of the reverse fault systems, which separate the different, NE-trending structural zones in SE-direction. In addition, a difference of the formation depth and temporal variations may be considered to explain the observed compositional variations.

Siegenite is associated with Pb-Zn-Cu mineralization and is spatially separated from the Co-Cu-Au mineralization. Siegenite mineralization occurs mainly to the SE of the Siegen anticlinorium in the Burbach-imbrication zone in the hanging wall of the Burbach reverse fault system and to the N in the Müsen district. Siegenite is the first sulphide mineral present and is postdated by chalcopyrite, tetrahedrite, sphalerite and galena. Sulpharsenides of the alloclasite-cobaltite-gersdorffite series are absent. This suggests that siegenite may present a spatial variation of the Co-Ni-sulpharsenides.

We conclude, that Co-Ni mineralization in the Siegerland-Wied district is related to syn-late orogenic ore forming processes and that variations of the Co/Ni ratio as well as the As/S ratio of the different Co-bearing phases may be interpreted by the spatial and temporal evolution of the fluid and reverse fault system.

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