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New insights into the genesis of Bavaria´s largest Cu-Zn deposit in Kupferberg, NE Bavaria, Germany

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The Cu-Zn deposit of Kupferberg is located in the Saxothuringian Zone of the Palaeozoic Variscan basement in northeastern Bavaria (Germany). The deposit is located in the Vogtland Syncline and positioned between the allochthonous Münchberg metamorphic complex in the east and the "Franconian Lineament", a major northwest-southeast tending regional fault zone, in the west. The deposit is hosted by an Early Palaeozoic volcano-sedimentary succession, the Randschiefer Formation (RF), and consists of a northwest-southeast directed string of several stratiform, sulfide-rich ore lenses. The mineralogy of these lenses is dominated by quartz, carbonate, pyrite and chalcopyrite with minor amounts of sphalerite and chlorite.

The genesis of Kupferberg, Bavaria´s largest known Cu-Zn deposit, remains speculative. The general lamination and the stratiform position of the ore speak in favour of a syngenetic mineralization. This is contradicted, however, by the occurrence of ore lenses in different tectonic units. Consequently, the so far generally preferred genetic model [1] sees supergene enrichment between the Cretaceous and the Tertiary as most critical in the ore formation. Recent trace element analysis on pyrite showed three generations. The pyrite generation that is coeval with the principal Cu-mineralization in the form of chalcopyrite has Co/Ni ratios (on average 35) typical of hydrothermal, possibly metamorphic, formation [2].

Cu isotope analyses of chalcopyrite from different ore lenses all yielded a very narrow δ^{65}Cu range between -0.26 and 0.36 ‰. Both the absolute values and the narrow range compare well to the δ^{65}Cu range known for hydrothermal chalcopyrite in crustal rocks [3]. Metamorphism has been shown to further restrict the range in δ^{65}Cu [4]. Because of the anchimetamorphic character of the host rocks this effect might be applicable to Kupferberg deposit. In contrast, δ^{65}Cu ranges from supergene enrichment zones are much wider, between -6.0 and 8.0 ‰ [5]. The lack of such a wide range at Kupferberg speaks against supergene mineralization to have played a major role. Data on local native copper and malachite conform to a wider range expected for supergene enrichment.

Furthermore, a number of geological features previously interpreted as Silurian chert intercalations in the RF show remarkable enrichments in base metals like Zn in combination with microscopic evidence for the silicification of previous shale. Both the string of ore lenses and the now recognized spatial distribution of silicified shale show a remarkably good fit with the northwest-southeast oriented thrust fault system in the proximity of Kupferberg. A distinct change in colour within the shales of the RF is interpreted as reflecting various degrees of fluid-rock interaction. The spatial distribution of these variably altered zones follows the direction of the thrust fault system and thus supports extensive syn- to late kinematic fluid flux with regard to the tectonic emplacement of the Münchberg metamorphic complex.

Our new data not only provide evidence for a principally hypogene origin of the Kupferberg Cu-Zn deposit but furthermore suggests that the main phase of Cu mineralization took place during

synorogenic fluid movement from the very low-grade metamorphic footwall when it was overthrust by the medium- to high-grade metamorphic Münchberg metamorphic complex. Thus Kupferberg might represent the rare case of a truly metamorphic base metal deposit.

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