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Cu isotope variability in Bavaria′s largest Cu-Zn deposit in Kupferberg (NE Bavaria, Germany)

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Kupferberg, a small town c. 15 km northeast of Kulmbach, owns its existence to Bavaria′s largest Cu-Zn deposit, which was mined intermittently from the 13th to the 19th century. The deposit is located in the Saxothuringian Zone of the Variscan basement in northeastern Bavaria. It is positioned between the allochthonous Münchberg metamorphic complex in the east and a major northwest-southeast tending regional fault zone, the "Franconian Lineament", in the west. The deposit is hosted by an Early Palaeozoic volcano-sedimentary succession of the Randschiefer Formation (RF) and consists of a northwest-southeast directed string of several stratiform, sulfide-rich ore lenses. These lenses show a remarkably simple mineralogy dominated by quartz, carbonate, pyrite and chalcopyrite with minor amounts of sphalerite and chlorite.
The genesis of the Cu-Zn mineralization has remained speculative. A purely syngenetic model, supported by the generally laminated appearance of the ore, has to be questioned because of the ore lenses occurring in different tectonic units. Urban & Vaché (1972) proposed supergene enrichment between the Cretaceous and the Tertiary as most critical. To test such a supergene versus hypogene Cu-mineralization, we investigated the Cu isotopic composition of primary and secondary Cu phases as well as the trace element distribution in three pyrite 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. Chalcopyrite, present at highly variable modal proportions, yielded a narrow range in δ^{65}Cu from -0.26 to 0.36 ‰Ḃoth the absolute values and the narrow range are similar to the δ^{65}Cu range known for hydrothermal chalcopyrite in crustal rocks (Markl et al. 2006). Metamorphism has been shown to further restrict the range in δ^{65}Cu (Ikehata et al. 2011) – an effect that might be applicable to Kupferberg. In contrast, undoubtedly supergene native copper and malachite yielded δ^{65}Cu of as much as 1.75 ‰ which is in line with observations on supergene Cu mineralization elsewhere (Mathur and Fantle 2015). Our new results suggest a principle phase of hypogene Cu-mineralization, possibly related to Variscan metamorphic fluid circulation, with subsequent supergene Cu-mineralization due to interaction with groundwater having been subordinate.

Literature

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