

## **MULTI-STAGE AND LONG-TERM ORIGIN OF THE KUPFERSCHIEFER COPPER DEPOSITS IN POLAND**

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The Polish Kupferschiefer copper deposit ore horizon comprises Weissliegende sandstones, Zechstein shales and Werra dolomites. Timing of its mineralization has been a subject of many controversies, ranging from syn- to epigenetic. We present two main types of mineralization which evidence a complex and very long-term mineralization process. In the organic-rich shale finely dispersed Cu and Cu-Fe sulfides dominate over later diagenetic forms, and are mainly present as framboids and spherules. Taking into account that copper sulfides often replaced iron monosulfide framboids, and by comparison with modern precipitation of pyrite framboids, we assume a syn-early diagenetic origin of this mineralization. Position of massive ores in the Weissliegende sandstone is well defined in the sequence of diagenetic events, postdating most of them. Sulfides have replaced both detrital grains and diagenetic cements (including authigenic illite). As the K-Ar ages of illite growth from the deposit range from 160 to 186 Ma we suggest that crystallization of massive sulfides took place in the Middle or Late Jurassic. Isotopic composition of different forms of sulfides suggests that bacterial sulfate reduction in an open to closed system was the main source of sulfur throughout the whole period of the deposit formation, both directly or partly via organo-sulfur compounds. Release of sulfur from the latter could make it available for mineralization also during late diagenesis. Summarizing, the mineralizing process in the Kupferschiefer probably began during the deposition of the shale at the early Zechstein and lasted at least till the late Jurassic.