Multi-proxy characterisation of metalliferous shales of the Kupferschiefer Deposit

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The potential of using organic parameters for refining models of ore genetic processes has recently gained increasing interest. The Kupferschiefer deposit covers about 600,000 km^2 of Europe and is a remarkable example of a metalliferous deposit (Pb, Zn, Cu, Ag, Au, PGE) associated with organic matter–rich sediment.

Two different ore genesis models have been proposed for different regions of the Kupferschiefer. The first one involves the presence of anoxic and sulfidic bottom waters, promoting accumulation of redox-sensitive trace elements. The second one involves the presence of metal-bearing oxidising brines leading to accumulation of metals including Au, Ag and PGE.The analysed samples derive from a section located in the Thuringian Basin, Germany, and contain metalliferous black shales from the basal T1-I sub-unit that is found throughout the Kupferschiefer deposit. In order to gain further insight into the source of the metals, detailed characterisation of organic matter and associated metals was conducted using a multi-proxy approach including x-ray fluorescence (XRF) mapping, detailed scanning electron microscopy (SEM), bulk stable isotopes analysis, rock-eval pyrolysis, whole rock geochemistry and hydrocarbon characterisation.

The results reveal a complex scenario that involves a mixed source of metals derived from i) a first episode of redox-sensitive metal enrichment in a stratified water column under euxinic conditions and ii) a subsequent nrichment episode *via* interaction with a mildly oxidative hydrothermal brine. The present study not only provides greater understanding of the mechanisms involved in the Kupferschiefer mineralisation but also highlights the benefits of using such organic-inorganic multi-proxy characterisation to gain further insight into the genesis of strata-bound deposits.