

# Diffusion and Reaction-Controlled Cu-Pb-Zn Ore Mineral Precipitation in a Reducing System: A Model Applied to the Pattern of Ore Mineral Precipitation in the Kupferschiefer and Other Black Shales

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## Abstract

The major ore minerals in black shale-hosted copper deposits typically have a zoned distribution. In this paper a numerical model that couples the processes of chemical reaction and interdiffusion of metals and sulfur is applied to reproduce the pattern of mineral precipitation in a reducing black shale environment. The results indicate that under reducing conditions, discrete regions of sulfide precipitation develop, and with time these regions evolve toward the source of the metals. The model shows that the observed spatial distribution of the different sulfides may be a consequence of reaction and diffusive supply of metals and sulfur rather than changes in Eh. Although this result does not prove that variations in Eh and pH were not responsible for the zoned mineral distribution in black shales, it does illustrate the need to consider reactive transport modeling when one attempts to model ore deposition in black shales. Comparison of these results with published data on the Kupferschiefer black shale-hosted copper deposits reveals a number of similarities including a similar pattern of sulfide distribution and the same sense of asymmetry in plots of sulfide concentration vs. distance.