

Re-Os study of the Polish Kupferschiefer: implications for source and timing of metal enrichment

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The age and genesis of world-class copper deposits of the Kupferschiefer-type have been a subject of much debate with proposed synsedimentary to postdepositional models. The ¹⁸⁷Re-¹⁸⁷Os isotope system has been successfully applied to generate whole rock isochrons in differently aged organic carbon-rich sediments.

Six samples of typically Cu-mineralized Upper Permian calcareous black shale and limestone of the Kupferschiefer type from the Lubin mining district (Poland) were studied for Re-Os isotopes, platinum group elements (PGE), and selected major and trace elements.

Mineralized black shales ($Cu_{avg.} = 4.9$ wt.%, $Ag_{avg.} = 242$ ppm, $Pb_{avg.} = 138$ ppm and $Zn_{avg.} = 87$ ppm) display low PGE values (Pt = <2 – 3.2 ppb, Pd = <2 – 2.8 ppb, Ru = <10 ppb, Rh = 0.4 – 5.2 ppb and Ir = <0.1 ppb) and $c(Re) = 249.4 - 22174$ ppb, $c(Os) = 0.4831 - 1.0009$ ppb and $^{187}Os/^{188}Os = 10.26 - 426.7$. Lower base metal but comparable PGE, Re and Os values are typical for basal limestone. Calculated correlation coefficients indicate preferential Re affinity to Cu-sulfides and Os affinity to organic matter.

In a ¹⁸⁷Os/¹⁸⁸Os vs ¹⁸⁷Re/¹⁸⁸Os plot the entire data set defines an isochron corresponding to an age of 240 ± 3.8 Ma, which most likely reflect late diagenetic/epigenetic metal enrichment.

The initial ¹⁸⁷Os/¹⁸⁸Os ratio of 0.99 ± 0.22 is slightly less radiogenic but within the variation range of present-day seawater and excludes any significant contribution from hydrothermal/mantle or meteoritic PGE sources.

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