Hydrothermal contributions are essential for making ores in a Neptunist World

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Victor Goldschmidt has been credited with discovering that black shales contain abundant metals (P. Wignall, Black Shales, Oxford, 1994). However, some unusually enriched shales contain exceptionally large amounts of metals ─ even >2000+ ppm for Zn for instance. Such shales are termed hyper-metalliferous here. Examples of hyper-metalliferous shales include the Kupferschiefer of N. Europe, which has been mined in selected areas for Cu since ~1200 A.D. No cupriferous horizons have been found in the Pennsylvanian shales perhaps because of the 1-2 km depth where they occur. At least 12 different distal hyper-metalliferous shales closely resembling Europe's regionally Zn-rich Kupferschiefer occur in Pennsylvanian strata of the Midwestern U.S. but none of these has been mined yet. After four decades of study I am convinced that the Pennsylvanian shales derived their extreme metal tenors mainly from hydrothermal sources for the following reasons. Beds adjoining the black shales contain MVT ores, which seem to be universally regarded as products of basinal brines migrating through selected feeder zones during the Late Paleozoic. In addition exceptionally large enrichments of Zn and other metals occur in the vicinity of major structural disturbances, such as basement faults. Moreover available radiometric and paleomagnetic data conform with a hydrothermal origin for the ores.

Recognition of the essential role for hydrothermal activity in forming the American shales may be the key to the discovery of ore deposits similar to the discrete minable portions of the Kupferschiefer. Such deposits may well include deposits of Cu, Au and Pt group elements analogous to the renowned Kupferschiefer ores of Germany and Poland.