

Diverse Origins of 14 Hyperenriched Black Shales in the Mississippi Valley, U.S.A.

Raymond M. Coveney, Jr.*

University of Missouri, Kansas City MO 64110

*E-mail, coveneyr@umkc.edu

Europe has its Kupferschiefer, but the Pennsylvanian section of the Midwestern USA has at least 14 hyperenriched black shales (HBS), each containing >2000 g/t Zn, V, and/or Mo, close to ore-grade values, and 50 to 500 g/t U and/or Pb. Provisionally defined as metalliferous shales containing amounts of metals that exceed those of average black shale by more than one order of magnitude, HBS include such widespread beds as the Eudora, Excello, Heebner, Hushpuckney, Mecca Quarry, and Stark shales that underlie more than 40,000 km² of the central USA. Considerable controversy has existed about the sources of metals in HBS for decades. Sedimentary, hydrothermal, and supergene processes have all been proposed for metals contained by the HBS, but Holland's preference for seawater has dominated the recent literature. For example, Scott et al. dismiss the contention, voiced by several groups of investigators including this author, that HBS gained their metals hydrothermally, in part because hydrothermal vents in oceanic settings are not enriched in Mo or V. However, this objection may not apply to the continental setting where the American Pennsylvanian shales occur. Thus, the feasibility of forming HBS from circulating hydrothermal brines should not be ruled out at this time. The fact that the deposits occur in the greater Mississippi Valley, famed for world-class Pb-Zn deposits that formed from widespread migrating oil-field brines, must be considered.

Late Paleozoic ages for shale deposition are well-constrained by stratigraphy, but only a handful of radiometric dates currently exist for MVT ores. Widespread MVT-type fluid inclusions occur in flat-lying and otherwise dull country rocks throughout the Midwest, suggesting that hyperenriched metal values for the HBS may have been derived during the Kiaman (~Pennsylvanian-Permian) paleomagnetic interval when the MVT ores formed. On the other hand, the strong influence of modern supergene enrichment can be discerned in the case of at least one rich deposit in the Minnelusa Fm. of South Dakota that contains 3800 g/t U and 6000 g/t Mo. Thus, it is not appropriate to attribute metal enrichments in the midcontinent Pennsylvanian HBS deposits exclusively to deposition from seawater, although that possibility cannot be ruled out for the shales based on what we know.

If the Midwestern HBS turn out to owe most of their metals to hydrothermal activity, it follows that other sources of metals besides ordinary sedimentary processes may also have been important in other HBS settings around the globe. Efforts to discern sedimentary paleoenvironments from trace metal or isotopic data in HBS may be difficult if not impossible if hydrothermal influences are essential. Pending the arrival of precise radiometric dates we may never be able to ascertain the true origins of the American HBS. However, there is a distinct possibility that HBS may be regarded as pathfinders that indicate proximity to world-class sediment-hosted Pb-Zn ore deposits like those of the Mississippi Valley in other geographic settings.