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Exploration for Sediment-Hosted Copper in Europe Using Mineral-system Analysis with Hydrocarbon Data

Howard C. Golden³, William A. Heins², Peter Birch¹, Richard Jameson¹

1. Getech, London, United Kingdom, 2. Getech, Kingston, NY, USA, 3. Getech, Perth, WA, Australia

Many critical mineral systems originate under specific genetic conditions, similar to hydrocarbon systems. We tested this concept by using hydrocarbon-focused geological information from proprietary databases to search for sedimentary copper deposits. The data are global and contain an extensive catalogue of data layers for every geological stage from the Pleistocene to the Asselian, at the beginning of the Permian.

This exercise used hydrocarbon exploration information rarely available to mining explorationists to attempt to predict where sedimentary copper deposits would form in the Kupferschiefer region of Europe. The database was interrogated to extract proxies for genetic criteria for Wuchiapingian (Permian stage that includes the Rotliegend and Zechstein formations) sediment hosted copper formation in Europe. The genetic criteria included depositional environment, copper source, copper-transporting brines, metal trap and fluid circulation.

The proxies for these genetic criteria included oceanic highstand-lowstand range; 170 km lithospheric thickness; oxidised continental sediments and/or volcanics; preserved evaporites or high Permian evaporation; total organic carbon; sedimentation rate; and basement heat production.

In this Kupferschiefer Copperbelt study all the genetic proxy layers were incorporated into a GIS environment and analysed to determine where all or most of the criteria were co-located, resulting in a 'stoplight' system wherein green represents where all or most of the layers coincide, whereas yellow and red colours representing where fewer or none of the layers respectively are coincident.

The final stage of the experiment was to overlay known sedimentary hosted copper deposit locations on the stoplight map. In the Kupferschiefer case, the coincidence is excellent. The success of the test case bodes well for applying the same analytical technique to other geographical locations, other depositional ages, and other deposit types. Improving this analytical strategy and applying it is likely to highlight unexpected new search spaces for highly desirable commodities.