Hydrothermal Mineral Systems Related to the Breakup of the Supercontinent Pangea

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Mesozoic hydrothermal systems host the majority of Europe's fluorspar and barite resources as well as significant resources of metals such as Ag, Co, Zn, Pb, Ni and Cu. Their genetic link to extensional tectonics in conjunction with the opening of the North Atlantic has long been suspected, but their spatial and temporal relation to the tectonic evolution of Europe has remained enigmatic.

We compiled 114 published ages from 20 regions related to Mesozoic mineralization across western and central Europe as well as from deposits located in North Africa. Thorough evaluation of available geochronological data for fluorite-barite-Pb-Zn , native-metal-arsenide-carbonate and MVT-type mineralization in Continental Europe and North Africa reveals a distinct, as yet unrecognized, time-space relationship between the distribution of hydrothermal mineral systems and the tectonic evolution of the Tethys-Atlantic-Caribbean rift system. The onset of fluorite-barite-Pb-Zn, native-metal-arsenide and MVT-Pb-Zn mineralization related to the Tethys-Atlantic-Caribbean rift in Continental Europe and North Africa becomes younger with increasing distance to the initial rift axis: from ~230 Ma in proximal, ~195 Ma in intermediate to 140 Ma in distal positions.

We propose that the onset of ore formation in continental rift zones is controlled by mid-crustal fluid release in response to heating and depressurization related to crustal thinning and mantle exhumation. As crustal thinning and mantle exhumation progresses successively from the main rift zones into the continental hinterland, hydrothermal mineralization in distal areas is significantly younger (140-90 Ma) as in proximal areas (230-200 Ma). Based on this assessment we propose the first continental-scale model for the genesis of Mesozoic hydrothermal ore deposits associated to the breakup of the supercontinent Pangea.