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The Zn-Pb-(Ag) epithermal mineralization of Mazarrón (Spain) A preliminary isotope study

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The Volcanic Field of SE Spain hosts several precious/base-metal epithermal volcanic-hosted deposits[1]. Among them, Mazarron comprises several volcanic centers of high-K calc-alkaline/shoshonitic composition which show pervasive hydrothermal alteration and related Zn-Pb-Ag mineralization. Deposits occur as stockworks and vein systems of sphalerite, silver-rich galena, pyrite and marcasite with quartz and carbonates. Common Fe-Al sulfates are found in a thick net of decimetre to submillimetre sizeveins. Barite veins are also present.

Preliminary sulfur isotope study for the base-metal sulfides show a $\delta^{34}S$ range between 5 and 13‰. In contrast, pyrite-marcasite values show a wider $\delta^{34}S$ range: between -3 to 29‰, with depleted sulfur in earlier crystals. Barite exhibits a bimodal $\delta^{34}S$ distribution: from +14 to +18‰ and around +54‰. $\delta^{18}O_{barite}$ is more homogeneous: between +12 to +17‰); Fe-Al sulfates, show significant variations in isotopic signature of S (2-14‰), O (3 to 13‰ in SO_4 and 1 to 11‰ in OH group) and D (-54 to -115‰). O isotope equilibrium between SO_4 and OH in these minerals is only established in one case, yielding a temperature of 150ºC and pointing to a typical low-temperature hydrothermal environment.

The range in sulfide sulfur isotopic is suggestive of thermochemical sulfate reduction of sea water. The extremely enriched sulfur signatures (pyrite-marcasite and barite) indicating closed system conditions. Isotopic (e.g. depleted deuterium values) and geological evidence also support a magmatic fluid input. The Fe-Al sulfate mineralizing event may represent the waning stage of the hydrothermal system, rather than a supergene event as is invoked in other epithermal deposits with similar sulfur signatures[1]. These data therefore suggest a marine-magmatic origin for the Mazarrón ore-fluids.

Mazarron in an unusual and tantalising deposit, the origin of which involved complex mineralizing processes, not typical of epithermal volcanic-hosted deposits.

[1] Arribas *et al.* (1995) *Econ. Geol.* **90**, 795-822.