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Geochemistry of the Zn-Pb-Cu-(Ag)-(Au) epithermal deposits from San José (SE Spain)

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The San José Zn-Pb-Cu-(Ag-Au) vein systems, previously described as low-sulfidation [1], are located in the Cabo de Gata Volcanic Field (SE Spain). These deposits comprise mainly base metal bearing sulfide/sulfosalts quartz veins, while disseminated pyrite with small quantities of gold appear in areas of vuggy silica alteration.

Wallrock alteration includes silicification, advanced argillic, argillic and propylitic zones. Very abundant, penetrative, stockwork-like Fe-Al sulfate veins are found in the argillic and advanced argillic alteration, but ore veins do not show a clear relationship with the alteration zone. Mass balance using the isocone method reveals a gradual lixiviation of most of the elements (except silica) in the highly altered volcanic rocks involving a generalized loss of mass and an increase in the content of some metallic elements (Zn, Pb, Cu) in the less altered zones.

Vein sulfides show a similar or slighty heavier sulfur signature ($\delta^{34}S$: 6-12‰) compared to the dominant volcanic signature of the zone ($\delta^{34}S$: 1-7‰[1]), suggesting a magmatic source but with possible incorporation of sea water sulfate via inorganic reduction. Such magamtic input could also be related to the gold mineralization. The barite signature ($\delta^{34}S$: 19-21‰) also supports sea water involvement. Pyrite in silicification shows depleted sulfur ($\delta^{34}S$: 2-6‰) perhaps as product of the disproportionation of magmatic SO_2 which produced the acid alteration. Abundant alunite-jarosite has light sulphur ($\delta^{34}S$: 4-10‰), but its abundance and ocurrence rule out a simple supergene origin. Meanwhile, oxygen isotopes in quartz ($\delta^{18}O$: 8-18‰) indicate the likely involvement of magmatic and non-magmatic fluids in ore mineralization.

The field, mineralogical and geochemical data suggest a complex mineralization history in the San José area, with evidence of both low and high sulfidation hydrothermal systems and the involvement of magmatic and seawater fluids

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