

# **Litharge from El Centenillo and Fuente Espi: A geochemical and mineralogical investigation of Spanish silver processing in the Sierra Morena**

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Galena is treated as the most important silver ore in antiquity and especially in Roman mining history, but many other silver mineralisation and phases occur in the Earth's crust that also contain valuable amounts of silver for exploitation. This study addresses the silver-containing sulfosalts and how to decide between the alternative ores when only metallurgical remains are preserved and the mining context is not evident. Numerous samples of ore minerals, slags, lead metal and stones were collected by one of us (C. Domergue) over several years in the Spanish Sierra Morena, including two Roman foundry sites: Cerro del Plomo and Fuente Espi, both in the mining district of Linares-La Carolina. Cerro del Plomo is closely associated with lead-bearing ore veins near the foundry, while the mines that supplied Fuente Espi with lead ore have not yet been archaeologically explored. The metallurgical remains from the two foundries were analysed for their microstructure, mineralogy and phase composition using microscopy, electron microprobe analysis, and X-ray diffraction. It was hoped that the litharge in particular would provide information about the ores used. Metal inclusions of copper and lead were identified, both still containing some silver. The cooling history and stratigraphy of the litharge cakes were developed and parallels drawn with earlier cupellation models. The litharge cakes from Cerro del Plomo and Fuente Espi are comparable in terms of microstructure and phase composition. Chemical and isotope analysis will follow and be the subject of a separate publication.