# Roman slag characteristics and distribution in the Portuguese segment of the Iberian Pyrite Belt.

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KEY-WORDS: Roman mining, Iberian Pyrite Belt, S. Domingos, Aljustrel, Caveira

ABSTRACT: During the Roman period, several massive sulphide deposits in the Portuguese segment of the Iberian Pyrite Belt (IPB) were intensely exploited. Detailed mining wastes mapping of the Caveira, Aljustrel and S. Domingos mines allowed a better understanding of Roman slag characteristics and distribution. The surveys indicate that Roman slag covers at present a total area of 200736 $m^2$ (78852 $m^2$ at Caveira, 79809 $m^2$ at Aljustrel, 28173 $m^2$ at S. Domingos, and 13902 $m^2$ at Fortes); the XIX century maps show areas of 442424 $m^2$ at Aljustrel and 92410 $m^2$ at S. Domingos. Considering an average slag density of 3.1 $g.cm^{-3}$ and a standard thickness of 3 m (2 m at Fortes), as suggested by field data, a (minimum) total volume of 1.87 $Mm^3$ (5.79 Mt) of Roman slag can be estimated for the Portuguese IPB. Taking into account the efficiency values quoted in literature as typical for Roman metallurgical processes and the slag mass estimated, a minimum of 370000 t of Cu, 139 t of Ag and 9 t of Au were produced in the Roman Lusitania Province. At Aljustrel and Caveira Roman slag show significant Pb, Cu, Zn, Fe, (As), (Sb) contents, besides low Au and Ag grades; local topography, accessible water sources and outcropping ores favoured the Roman mining. At S. Domingos, non-weathered slag comprises a glass-silicate matrix (zoned fayalite, melilite and pyroxene) including abundant oxides (mostly magnetite), and minor sulphides (pyrite, pyrrhotite, chalcopyrite, galena) and sulpho-antimonides. At Caveira, slag presents a similar composition, although more enriched in Cu-bearing phases. In situ Roman mining wastes, sometimes including pottery fragments, are key-areas of mining heritage promoted by the ATLANTERRA project; these archaeological/cultural sites must be preserved. The knowledge concerning the IPB Roman mining is still incomplete; new research should be developed seeking the ore source, processing methods and time dating.

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