

Base and precious metals waste material of the S. Domingos & Aljustrel Mines, Portugal: potential economic benefit and improvement environmental quality

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Ore minerals are not just valuable as sources of raw material but may also be viewed as environmental pollutants responsible for the generation of acid mine waste runoff, and for the release of various toxic metals into the environment. The study conducted in the S. Domingos and Aljustrel mines is part of the research project PROMINE (Nano-particle products from new mineral resources in Europe), an EU 7th Framework's Programme. Geochemical campaigns were conducted aiming the characterization of the mine's wastes/products. S. Domingos and Aljustrel mines showed high potential for wastes as new products some of which are critical raw materials.

The S. Domingos massive sulphide orebody, dominated by pyrite, is located at the top of a Volcanic Sedimentary Complex (VSC) sequence. Economically relevant grades of Sb (above 1%), Bi (above 0.2%) and Re (until 3.4 mg kg⁻¹) minor metals and base metals were found in the Achada do Gamo waste pile of these Cu-rich pyrite ores near the sulphur factories where ashes, milled pyrite and debris of ore minerals were deposited. Palaeoweathering of the S. Domingos orebody has resulted in an important gossan horizon which was intensely mined during Roman occupation of Iberian Peninsula and subsequently mined out in

the 19th century. In this gossan dump interesting Au concentrations (1 to 4 mg kg⁻¹) can still be found.

Just as in S. Domingos, Aljustrel was also mined since pre-Roman times and a very important Roman exploitation centre (Vipasca) is recognized on site. Modern mining began in the 19th Century. The 19th Century separation technology was carried out in "telleiras" a pyrite ore roasting process developed at Pedras Brancas, located 6 km east of Aljustrel. These ore processed materials presented 0.9 mg kg⁻¹ of Au but are already deposited in a remediated area of Algarés sector. Milled pyrite deposited in Algarés sector has Au (280 µg kg⁻¹), Ag (29 mg kg⁻¹), Pb (above 5000 mg kg⁻¹), Sb (465 mg kg⁻¹), Sn (115 mg kg⁻¹) and Zn (887 mg kg⁻¹). Although high, these concentrations are lower than for the same type of waste in S. Domingos. This situation was probably induced by different processes in the ore treatment where in Aljustrel the recovery of the metals was more efficient (Aljustrel mine was modern compared to S. Domingos), or just different types of primary ores (different mineral constitution of the São Domingos lens and the Aljustrel Moinho, Algarés Aljustrel lenses). Recovery of the metals from the wastes is both of economic and environmental value.

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