

Prediction of the environmental impact of modern slags: A petrological and chemical comparative study with Roman age slags

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ABSTRACT

This work presents a comparative study of Roman and modern slags, which represent the same type of mining waste but which were produced at vastly different times. The natural laboratory in which both materials are found is São Domingos, one of the most emblematic of Portuguese mining districts in the Iberian Pyrite Belt (IPB). The methodology included: (1) detailed studies of the mineralogy and geochemistry of both materials with a reflected-light optical microscope, scanning electron microscope (SEM), electron microprobe analyses (EMPA), and bulk-rock analyses; (2) MELTS thermodynamic software to quantitatively test fractional crystallization of both glassy matrix types; (3) TWQ-v. 2.32 software for performing internally consistent thermometric calculations; and (4) a modified Community Bureau of Reference (BCR)-sequential extraction procedure applied to the chemical speciation of potentially toxic elements.

The combination of petrologic studies and sequential extraction leaching may be used to evaluate and predict pollution impact on the environment. We conclude that a 2000 year time gap has not produced an important modification to the base-metal extraction system as reflected by the petrologic similarity of both slags and that, considering the total mass of modern slags, the transfer rate of metals to the environment over the next 2000 years will be ~6.7 t/year of Fe, 1 t/year of S, 81.1 kg/year of Zn, 55.5 kg/year of Pb, 6.5 kg/year of Cu, 0.7 kg/year of As, 31.2 g/year of Sb, and 18.3 g/year of Cr. The results demonstrate the pollutant potential of the slags within this IPB mining district as revealed by the spoiled state of the fluvial courses in the region.

Keywords: Environmental impact, petrogenesis, prediction, slag, sequential extraction