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Geochemistry of rare earth elements in minesoils from São Domingos mining district (Iberian Pyrite Belt)

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The São Domingos mine is one of the most emblematic mining districts in the lower part of the Guadiana River Basin (SW of Iberian Peninsula). It is located in Portugal (about 5 km from the Spanish border), in the northern sector of the Iberian Pyrite Belt (IPB), one of the largest metallogenetic provinces of massive sulphides in the world. Although mining activity has ceased at present, the large-scale exploitation of this deposit between the second half of the XIX century and the first half of the XX century, has favoured the production of enormous waste dumps, where oxidation of pyrite and associated sulphides is resulting in the production of acid mine drainage (AMD).

Mining wastes, minesoils, and acid mine drainage have been analyzed for their major ions and rare earth elements (REE) with the aim of understanding the REE mobility during sulphide weathering so that lanthanoid series can be used both as a proxy for the extent of water-rock interaction and as a tool for identifying impacts of AMD on natural ecosystems.

Chemical speciation of REE in extracts from minesoils indicates that REE sulphate complexes (mainly LnSO4+) are the primary aqueous form (60-90%), and free ionic species (Ln3+, 10-40%) are the next most abundant form of soil water-soluble fraction and controls the REE speciation model. The REE from this fraction have NASC-normalized patterns with middle-REE (MREE) enriched signature compared to the light-REE (LREE) and heavy-REE (HREE), showing convex MREE-signatures and convexity index values of +1.29 +/- 1.13. These results are consistent with the typical REE fractionation patterns reported for AMD. Poorly crystalline iron oxyhydroxysulphates act as a source of labile MREE by dissolution and/or desorption processes and could explain the MREE-enriched signatures in solution.