Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17941

How does Chemical Speciation of Rare Earth Elements and Other Trace Metals in Legacy Mine sites Influence Phyto-availability?

KAISA HELEN FORSYTH[1], ALINE DIA[1], ROSA MARQUES[2,3], MARIA ISABEL PRUDÊNCIO[2,3], CATARINA DIAMANTINO[4], EDGAR CARVALHO[4], DULCE RUSSO[2,3], MARTINE BOUHNIK-LE-COZ[1], MELANIE DAVRANCHE[5] AND MATHIEU PÉDROT[1]

[1]Université de Rennes 1, CNRS, Géosciences Rennes, UMR 6118

[2]Centro de Ciências e Tecnologias Nucleares (C2TN), Instituto Superior Técnico, Universidade de Lisboa

[3]Departamento de Engenharia e Ciências Nucleares (DECN), Instituto Superior Técnico, Universidade de Lisboa

[4]EDM - Empresa de Desenvolvimento Mineiro

[5]Université de Rennes, Géosciences Rennes, UMR-CNRS 6118

Presenting Author: kaisa.patterson@univ-rennes1.fr

This investigation focused on the chemical speciation of the <2 mm fraction of soils and sediments collected from three legacy mine sites in Portugal: São Domingos and Lousal, two polymetallic sulfide mines, and Quinta do Bispo, a uranium mine. These legacy mining sites vary in geochemical context and stage of the environmental remediation works.

A three-step BCR extraction scheme, standardized by the Standard Measurements and Testing Programme of the European Community, was used to determine chemical speciation. The BCR extraction partitions the soil into three fractions defined as the: “easily labile and exchangeable”, “reducible”, and “oxidizable” mineral phases. The remaining soil composition was defined as the “residual” soil mineral pool. Speciation was compared with total trace element concentrations for water, soil, and plant samples collected from the same sites. Analytes of interest included Rare Earth Elements (REE), uranium (U), and lead (Pb). All of the targeted analytes are environmentally significant concerns in mining areas.

Low concentrations of REE were associated with the easily labile and exchangeable soil phases, concomitant with a majority of the REE was associated with the residual. Indicating that generally, soil REE are not available for plant uptake. The origin of REE, U, and Pb found in plants may originate from plant manipulations of the rhizosphere weathering soil minerals. Sediments collected from an Acid Mine Drainage (AMD) passive treatment system in Lousal showed a higher concentration and percentage of REE associated with the easily labile and exchangeable and reducible mineral phases when compared with sediments collected from other sites. The association of REE with these two fractions implies that the behavior, mobility, and fate of REE depends on changes in pH and redox conditions. A middle REE (Sm to Tb) concavity across all three sites for all sequential extraction steps suggests that the light and heavy REE (La to Pm and Dy to Lu) are stabilized in the residual mineral fraction. There was a distinct negative europium anomaly (Eu*) for the residual soil minerals of Quinta do Bispo. Accordingly, any positive Eu* can be attributed to less recalcitrant soil mineral pools.