Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28261

Artificial soils for the closure of a mine waste dump in the Iberian Pyrite Belt (Tharsis Mine, Huelva)

ALBERTO MOLINERO-GARCÍA[1], RICARDO MILLÁN BECERRO[2], VERÓNICA ASENSIO[3], ANNIKA PARVIAINEN[4], FRANCISCO JOSE MARTIN-PEINADO[2] AND JOSE MIGUEL NIETO[5]

[1]Department of Earth Sciences & Research Center on Natural Resources, Health and the Environment, University of Huelva, Campus 'El Carmen', 21071, Huelva, Spain

[2]Department of Soil Science and Agricultural Chemistry, University of Granada, Avda. Fuentenueva s/n, 18071 Granada, Spain

[3]Edafotec SL

[4]Andalusian Earth Sciences Institute, Spanish Research Council (CSIC), 18100 Armilla, Spain.

[5]Department of Earth Sciences & Research Center on Natural Resources, Health and the Environment. University of Huelva, Campus 'El Carmen', 21071, Huelva, Spain

Abstract

The Iberian Pyrite Belt (IPB), located southwest of the Iberian Peninsula, contains one of the largest deposits of massive sulfides in the world. Its exploitation for over 5000 years has exposed them (mainly pyrite, FeS_2) to surface water and oxygen, leading to the production of acidic leachates with high concentrations of sulfates and metal(loid)s, known as acid mine drainage (AMD). This is a serious environmental problem associated with the mine sector, which causes the released of metals in the soil-plant-water system, degrading ecosystems and also causing a human health problem. The IPB mine waste dumps are an important sources of AMD. The most sustainable strategies to address this problem focus not only on its treatment, but also on its prevention, avoiding the oxidation of the sulfide minerals. This work presents a pilot experience (300m^2 plot) based on the application of an artificial soil (Technosol) on a mine waste dump in the Tharsis mine (IPB, Huelva). The implementation of Technosols aims to avoid AMD generation and enable revegetation. Three Technosols were made with local waste and biochar, to apply three different layers. The first layer, directly on the mine waste, to promote the chemical stabilization of the metal sulfides and stop its oxidation. The middle layer, with "reducing" properties, to limit oxygen infiltration. The third layer, superficial and rich in nutrients to promote the growth of vegetation. The application of these Technosols increased the pH in the leached water and significantly decreased the concentration of metals, establishing itself as an effective technology to stop the generation of AMD. Moreover, the application of Technosols improved the properties of the dump material, increasing its pH, $CaCO_3$ content, Cation Exchange Capacity (CEC), and decreasing the concentration of potentially toxic elements (PTEs). However, leached water and mine waste dump material need to be monitored to verify its long-term effectiveness.

Acknowledgments

This work was supported by the project MINE.THE.GAP (grant agreement Nº 873149) funded by the European Union's H2020 Research and Innovation programme. Alberto Molinero-García also acknowledges Juan de la Cierva Postdoctoral Fellowship (JDC2022–049235-I) supported by MICIU/AEI/10.13039/501100011033 and the European Union Next Generation EU/PRTR