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Quantitative–spatial assessment of soil contamination in S. Francisco de Assis due to mining activity of the Panasqueira mine (Portugal)

Eduardo Ferreira da Silva · Paula Freire Ávila · Ana Rita Salgueiro · Carla Candeias · Henrique Garcia Pereira

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Abstract Through the years, mining and beneficiation processes produces large amounts of As-rich mine wastes laid up in huge tailings and open-air impoundments (Barroca Grande and Rio tailings) that are the main source of pollution in the surrounding area once they are exposed to the weathering conditions leading to the formation of AMD and consequently to the contamination of the surrounding environments, in particularly soils. In order to investigate the environmental contamination impact on S. Francisco de Assis (village located between the two major impoundments and tailings) agricultural soils, a geochemical survey was undertaken to assess toxic metals associations, related levels and their spatial distribution, and to identify the possible contamination sources. According to the calculated contamination factor, As and Zn have a very high contamination factor giving rise to 65.4 % of samples with a moderate to high pollution degree; 34.6 % have been classified as nil to very low pollution degree. The contamination factor spatial distribution put in evidence the fact that As, Cd, Cu, Pb, and Zn soils contents, downstream Barroca Grande tailing, are increased when compared with the local Bk soils. The mechanical dispersion, due to erosion, is the main contamination source. The chemical extraction demonstrates that the trace metals distribution and accumulation in S. Francisco de Assis soils is related to sulfides, but also to amorphous or poorly crystalline iron oxide phases. The partitioning study allowed understanding the local chemical elements mobility and precipitation processes, giving rise to the contamination dispersion model of the study area. The wind and hydrological factors are responsible for the chemical elements transport mechanisms, the water being the main transporter medium and soils as one of the possible retention media.

Keywords Soil contamination · Principal component analysis (PCA) · Correspondence analysis (CA) · Availability · Panasqueira mining area

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E. Ferreira da Silva (✉) · A. R. Salgueiro · C. Candeias
Geosciences Department, Geobiosciences, Geotechnologies and Geoengineering (GeoBioTec) Research Center, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal
e-mail: eafsilva@ua.pt

P. Freire Ávila
LNEG–National Laboratory of Energy and Geology. S. Mamede Infesta INETI, 4466-956 S. Mamede de Infesta, Portugal

H. Garcia Pereira
Technical Institute, CERENA–Technical University of Lisbon, Avenida Rovisco Pais, 1, 1049-001 Lisboa, Portugal

Introduction

Metal mining processing and smelting have been recognized as a major contributor to environmental pollution, providing sources of heavy metals that may lead to the contamination of the surrounding environment (Adriano 1986; Benvenuti et al. 1995; Gray 1997; Liu et al. 2003; Zhou et al. 2007). High concentrations of heavy metals can be found in and around abandoned and active mines due to the discharge and dispersion of mine waste materials into nearby soils, food crops, and stream sediments (Lee et al. 2001; Jung 2001; McKenzie and Pulford 2002; Witte et al. 2004). This will eventually lead to a loss of biodiversity, amenity, and economic well being, and a potential health risk to residents in the vicinity of the mining area may occur (Verner and Ramsey 1996; Lee et al. 2001; Wong et al. 2002; Galán et al. 2003).

At present, management of contaminated soils is a major issue, which may have serious consequences. Numerous

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