SPATIAL ESTIMATION OF SOIL SAMPLES ACCORDING TO HARMFUL EFFECTS ON HUMAN HEALTH: THE CASE OF PANASQUEIRA MINE (CENTRAL PORTUGAL)

ANA RITA SALGUEIRO[1]*, PAULA HELENA ÁVILA[2], EDUARDO FERREIRA DA SILVA[1], HENRIQUE GARCIA PEREIRA[3]

[1]*GeoBioTec - GeoBiociências, Geotecnologias e Geoengenharia da UA , Aveiro, 3810-193, Portugal*
[2]*LNEG – Laboratório de S. Mamede de Infesta, S. Mamede de Infesta, 4466-901, Portugal*
[3]*CERENA – Centro de Recursos Naturais e Ambiente do IST, Lisboa, 1049-001, Portugal*
rita.salgueiro@ist.utl.pt

Mining activity is one of the main industrial activities that produce more residues, left in piles or tailings dam, subject to weathering, leading to the production of acid mine drainage (ADM) that consequently affects the surrounding environment (namely soils and the local population). The beneficiation process at Panasqueira Mine have given rise, during a long production period, to a large amount of sulphide-rich waste, contained in several tailing ponds, two of them located nearby S. Francisco de Assis Village. AMD evidences associated with sulphides leaching, with low pH and high metal contents, were noticed and also measured in streams closer to the mine. The local community subsists on agriculture and cattle breading. When soil quality became compromised it affects all the food chain, from the soil itself, prone to be absorbed and/or ingested; to plants, that apart from nutrients also capture heavy metals; to cattle fed locally until the population that consumes vegetables and meat from local production. The assessment of soil contamination in this area is then of most importance. A new two-step methodology for soil sample categorization according to harmful effects on human health is proposed, based on Geostatistics (Multivariate Data Analysis). The first step comprises the combined use of Principal Component Analysis (PCA) and Correspondence Analysis (CA). PCA was applied to a data set of 75 soil samples and respective chemical analysis which allowed distinguishing between geological and anthropogenic origins of the elements, giving rise to the identification of the contaminant group of chemical elements that act in this area. Once identified the contaminant group, a complete disjunctive matrix of the data is built classifying each sample, for each element, as Clean (above the average local background level - analysis of 20 soil samples located upstream of the mining area), in need of Reclamation (above the guide level for agriculture soils) or in need of Intervention (if sample value is between mean local background and guide level). The referred matrix is then submitted to a CA, which has the advantage of projecting variables and samples in the same factorial space enabling to extract a hierarchy of samples according to their contamination level. The second step concerns the spatial estimation of soil samples based on the categorisation previously established. For that a Multiphase approach based on Kriging was used.

Keywords: soil pollution, multivariate analysis, spatial estimation