A geochemical modeling approach in Lardosa region (Castelo Branco): an environmental management tool

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ABSTRACT

Mining activities and resulting wastes can be considered one of the most important sources of toxic metals and metalloids on the environment. In Portugal, ore extraction and processing has been an important economic activity developed until the early 1970s. Geochemical cartography is a goal in mining prospection and the implementation of a geochemical mapping became a strong possibility, working as a tool in natural resources management. Geochemical modeling in environmental applications is mostly oriented to the recognition and quantification of anthropogenic impacts.

To assess the risk to public health in the surrounding areas of old abandoned W-Sn and Pb-Zn mines and resulting tailings and rejected materials, 333 samples were collected in stream sediments, inside and outside the mining influence area, using a geochemical model. These samples were grouped according the hydrological environment, located in two contiguous watersheds and under the influence of ancient mining. All the samples were prepared and analyzed Fe, Ba, P, Cu, Cr, Ag, B, Zn, Sb, Pb, Ni, V, Mn, Mo, As, W, Co, Cd and U contents. The inexistence of Portuguese legislation concerning parametric values for stream sediments, were applied a quantitative index of progressive contamination on stream sediments, the Geoaccumulation Index (Igeo), as variables to estimated maps.

In a first exploratory multivariate statistical analysis, using the Principal Component Analysis (PCA), applied to Igeo, indicate that the first factor (PC1) explains P and B (positive correlation with the axis) as opposed to Cu, Cr, Ni and V (negative correlation with the axis); the second factor (PC2) explain Fe, Zn and As; Igeo for Cd and for U.

The variographic study analysis of Igeo showed the existence of spatial structure for the new variables synthesis (PC1, PC2, Cd Igeo and U Igeo) and thus interpolate the values using the ordinary kriging. This estimated mapping has an average spatial setting, the spatial distribution of element contents in this study. The stream sediments analyzed showed to be extremely polluted on Cd element and W element and strongly polluted on Cr, B, Ag, Zn and Pb. The accumulation of these elements in stream sediments analyzed is higher on abandoned mining areas and near their influence. The population located near the influence of this abandoned mineralizations have a high risk of contact to these toxic elements, which could be quite harmful to human health.