Geophysical Research Abstracts
Vol. 16, EGU2014-3238, 2014
EGU General Assembly 2014

Geochemical mapping of polluted soils and environmental risk assessment associated to mining activities: a comparison case study in El Campillo (Huelva, Spain) and the Zambales (Luzon Island,The Philippines)

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The soil is one of the environmental systems which could be most affected by the dispersion of pollutant, also because of the close relationship with the atmosphere and meteoric waters. The distribution and type of contamination depends closely on the climate, precipitations, drainage, vegetation, lithology and human activities. As a matter of fact, soil contamination due to heavy metals and metalloids, such as As, Cd, Cr, Cu, Ni, Pb and Zn, represents the source of a severe potential hazard for the ecosystem equilibrium and the health of living beings.

This study is carried out in two abandoned mining zones near to populated areas, which underwent similar mining history, but in very different climatic and environmental conditions. The aim of the research is to analyze the influence of precipitation amounts, soil thickness, drainage density and vegetation cover on pollutant distribution. The first zone is in El Campillo, a town at the Rio Tinto mining district and belongs to the Iberic Pyritic Belt of the southwest Iberian peninsula. This mining site is characterized by a Mediterranean climate with low precipitation (700 mm/year), low vegetation cover and poor soil development. The second case study is the Zambales Mountain Range, a mining district in the Luzon Island of the Philippines dominated by a tropical weather, forests, intense rainfalls (2350 mm/year) and good soil development.

The wide spectrum of climatic variables in the case studies requires to develop a single flexible methodology for the mapping and monitoring of the environmental degradation in both semi-arid and tropical environments, allowing comparative studies. The methodological approach comprises remote sensing, Geographic Information System (GIS), spatial statistical analysis, field sampling, ICP analysis and isotopic geochemical analysis.

The presentation illustrates the first stage of the project. The processing of multispectral (Aster) and hyperspectral (Hyperion) images, in comparison with available geological and geochemical data, is used to search for spectral indicators of specific pollutant or anomalies in the vegetation cover related to soil contamination. Then, digital elevation models (DEMs) are used to delineate the drainage and superficial flow and to find potential correlations with the remobilization and dispersion of the pollutant in the soils, sediments and water bodies.

These results allow a first comparison between the case studies, and delineate the different behavior of pollutants dispersion in the two climatic end-members. Also the remote sensing and GIS analysis form the basis to plan the future soil and sediment sampling campaign, according to the specific characteristics of the areas. The field, remote sensing and ICP data will be integrated in a GIS database for spatial geostatistical analysis. Those analysis will be complemented with the lead isotopic analysis of soil samples and human hair samples collected from the people who lives close to the mining zones, in order to determine the origin of the lead from the isotopic composition.