



Environmental geochemistry of a highly polluted area: the Mazarambroz Pb-Zn mine (Castilla-La Mancha region, Spain)

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Human activities, as mining, can alter the concentrations of metals in the environmental compartments and facilitate their dispersion (Moreno Grau, 2003).

Total concentrations are usually evaluated, but they do not provide information about the bioavailability and toxicity of metals, since changes in the environmental conditions cause selective release of the total metal content (Sahuquillo et al., 2003). Thus, the bioavailability or toxic effects of the metals can only be studied by determining their chemical partitioning (Quevauviller, 1998). Leaching by selective chemical extracts is the conventional method for evaluating the availability of elements.

The Mazarambroz Pb-Zn mine, located in the Castilla-La Mancha region (central Spain), is an important case of abandoned Pb-Zn sulphide mine, with high concentrations of other highly toxic heavy metals such as Cu, As and Cd.

The objectives of this work were to determine the extent of the heavy metal contamination and to study the heavy metal bioavailability, by the application of selective chemical extractions, in the Mazarambroz mine area.

Soil and sediment samples were taken from the studied area according to a systematic sampling type (regular grid). Soil main parameters (reactivity and conductivity) were determined.

Chemical extractions were made using two different selective reagents: i) CaCl₂ (0.01M) (Novozamsky et al., 1993) and; ii) EDTA (0.05 M) (Quevauviller, 1996). The contents of heavy metals in the extracts were measured by inductively coupled plasma-mass spectroscopy (ICP-MS). The compounds extracted with the CaCl₂ solution represent the water soluble and exchangeable fractions, so they can be considered as the metal concentration that can be absorbed by plants. EDTA solution extracts metals on exchange sites of both inorganic and organic complexes. Additionally, it can dissolve calcareous materials through complexation of calcium and magnesium (Chao, 1984; Sahuquillo et al., 2003).

Total geochemical analyses of the samples were carried out using a Field Portable X-Ray Fluorescence Spectroscopy analyser (EDXRF). Results were statistically processed with Minitab 15.0 and mapped with Surfer 9.

The mean concentrations of the studied heavy metals are significantly higher than the world average, the Castilla-La Mancha region mean and the local reference value for soils, so the studied area can be considered a polluted area as consequence of the mining process carried out in the Mazarambroz Pb-Zn mine.

The total affected area by high concentrations of heavy metals differs depending on the studied element, reaching the maximum extension and importance for lead and zinc.

In the studied area, soil and sediments are also affected by very low pH and high conductivity, which indicates the presence of soluble salts, likely sulfates, products of the sulfide oxidation. These results would imply an increase in the heavy metal mobility and transference to the plants and, as a consequence, an increase in the environmental damage since the area close to the mine is used for the cultivation of cereals and rabbit hutting.

The results of the extractions show that the highest extracted concentrations are obtained from the sediment samples due to the influence of the stream in the weathering of this type of materials.

References

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