ANALYSIS OF HEALTH AND ENVIRONMENTAL RISK ASSESSMENT OF AN ABANDONED Zn-Pb MINE THROUGH THE WEATHERING PROCESSES OF THE LOCAL MINERALS. N. Goienaga[1,*], J.A.-Carrero[1], I. Arrizabalaga[1], J. Bustamante[1], L.A. Fernández[1] and J.M. Madariaga[1].

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Introduction: Hardrock mining activities are long-term industrial activities that take place in the natural environment potentially disturbing large amounts of material and land areas. Closure of a mining operation often implies a continuous leaking of risky trace metals into the surrounding environment [1].

The present research aim is to determine the concentration of pollutants in different media as a way to assess the impact of potential sources of contamination. The chemical analysis of their concentrations in different environmental compartments (i.e., soil, air, vegetation) may be an interesting indirect methodology for human health and environmental risk assessment. Thus, the migration of such pollutants should be monitorized in order to avoid a long-term cronic impact of soil, surface and ground water qualities.

Experimental: Ten effluorescence samples were collected along the main gallery of the abandoned mine. Once their physico-chemical characterization was carried out, more exhaustive analytical techniques were used: ICP-MS to know the soil composition and Raman for determining its molecular characteristics.

Movility tests were also performed in order to have a notion of the movable and, consequently, bioavailabe fraction. These solutions were measured by ICP-MS and Ion-Chromatography.

Results and discusion:

The movility test applied showed how easily some ions were able to dissolved in hugh amounts. Not only the most common anions present in soils were obtained (i.e. phosphates, sulphates) but also environmentallly risky heavy metals (Zn, Pb, Cu, As, Hg, etc.).

The present study tried to understand the behaviour that the mine-soil polluting components may have under natural weathering conditions. To achieve this, the molecular structures present in the effluorescences were identified by Raman spectroscopy. Besides, the minerals found were classified into primary (geologically natural minerals) and secondary (non-stable phases derived form the weathering of the primary ones)[2].

The primary mineral list observed included galena (PbS), sphalerite (ZnS), calcite ($CaCO_3$), etc. while the secondary mineral list incorporated calomel (HgCl), olivenite ($Cu_2AsO_4(OH)$), getchellite ($SbAsS_3$), tinticite ($Fe_5(PO_4)_4(OH)_4 \cdot 7H_2O$), otavite ($CdCO_3$), wolfeite ($Fe_2(PO_4)(OH)$), claudetite ($As_2O_3$) etc.
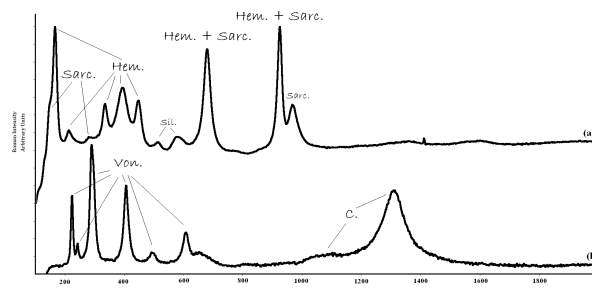

Fig.1. (a) Mixed spectrum of sarcopside (Sarc.) and hemimorphite (Hem.).
(b) Mixed spectrum of black charcoal (C.) and vonseite (Von.).

Conclusions:

The concern resulting from the potential exposure to contaminants was the starting point to develop new methodologies in order to evaluate the consequences that those might have over both the environment and human health. Among these methods, risk assessment has been one of the most widely used [1,3]. As it has been shown, environmental monitoring is basic in order to carry out a correct evaluation of the exposure.

The knowledge of the ions' solubilities mixed with the several mineral phases found per metal (i.e. oxide, sulphide, phosphate, etc.), provide a better understanding of the leaching processes for each metal that may have taken or will take place. Furthermore, considering that the studied area is mainly karstic, such processes become crucial in the groundwater protection. Therefore, such research can be included as a first step within the set of tools for risk assessment that governmental policy makers should consider.

References:

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