

The role of secondary minerals in the control of erosion processes under a Mediterranean mining landscape

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ABSTRACT

The result of mining activity is the presence of several silt ponds and mining tailings spread all over the Sierra Minera (Cartagena-La Union Mountains, SE Spain). These ponds, joint to other wastes deposits constitute the main source of heavy metals to the environment. Besides, these metal sources areas act as dispersion focus towards the surrounding and subsidiary areas due to the erosion processes. Interaction between metal and salts present in these environments, provoke an secondary effect on the landscape modeling. The major o minor strength of the erosion processes is controlled by the presence of salts in soil and mining wastes (silt ponds and mining tailings). The aim of this work concerns the relation between the salt-metal compounds and the erosion and landscape modeling processes.

Keywords: secondary minerals; erosion processes; Mediterranean mining area

INTRODUCTION

Heavy metal pollution of soils causes a wide range of health and environmental problems in most of the countries. Cartagena-La Union Mountains, SE Spain, is a Mediterranean area with more than 2500 years of mining tradition (Fundación Sierra Minera, 2001). Piles from ancient times, when less developed technologies were used, and especially more recent ones from large scale exploitations, are rich in content of various metals such as lead (Pb), iron (Fe) and zinc (Zn). This heavy metal pollution level is affecting to environmental quality and human health of these areas, but also to the surrounding lands (Buck et al., 2004; Carmona et al., 2005).

The study area is basically an anthropogenic landscape where the mining activity has provoked important land degradation in the course of the centuries because of the mining activity, in this particular case by the extraction of several mineral veins such as esfalerite, galena and pyrite and their post-treatment by the transformation industry (Manteca and Ovejero, 1992). The result of this activity is the presence of several silt ponds and mining tailings spread all over the Sierra Minera mountains. These ponds, joint to other wastes deposits constitute the main source of heavy metals to the environment. Besides, these metal sources areas act as dispersion focus towards the surrounding and subsidiary areas due to the erosion processes. Interaction between metal and salts present in these environments, provoke a secondary effect on the landscape modeling. The major o minor strength of the erosion processes is controlled by the presence of salts in soil and mining wastes (mining ponds and mining tailings).

DESCRIPTION OF THE ROLE OF SECONDARY MINERALS IN THE EROSION PROCESSES IN MINING AREAS

In these areas, there are endogenous factors that favor the supergenic alteration of the sulfides present in the mining wastes. As a consequence of this alteration, there is a great anions liberation, mostly sulfates, to the soil solution. Between these endogenous factors, they stand out by order of importance, the porosity that of a side determines the water presence in the body of the residue, together with cracks and microbreaks, and straight related to her the ventilation with the consequent contribution of necessary oxygen so that the cycles of alteration geochemistry break loose. Other factor could be the grain of the particles that integrate them since to minor size of particles, major it will be his reactive surface, what make an increase of the effectiveness of the processes of supergene alteration. Accordingly, there is an increase of sulfates concentration in the soil solution and joint to it a dip of the strata that shape the mining ponds.

As for the exogenous factors that determine the process the following ones stand out:

- the climate marked by the dryness and the scarce number of rainy days
- the orientation or exhibition, being observed that a direct relation exists in those sectors of the mining ponds with orientation sun porch opposite to the orientations of shady, favouring the development of the process,
- other important factor is the mineralogy of the neoprecipitates or present secondary minerals in the same ones (this fact is explained by existing direct relation between the temperature and the geochemical reactions of the wastes).

The interaction between these factors determines the processes of supergene alteration and formation of secondary minerals. During the process of formation of these supergenic minerals happen an important physical action provoked by the pressures exercised during the crystalline growth of the salt as regards the volume of the solution in his initial stadiums (Winkler and Singer 1972), (associated to the days after the rains), or the increasing of volume caused in the step from anhydride forms to hydrated and vice versa determined by the alternation of humid and dry periods. As a result of it, there is a disintegration of the materials of the mining ponds that contributes to an intensive and extensive action of the erosive processes (Figure 1).



Figure 1: action of the erosive processes on mining wastes.



Figure 2: saltcrusts from the studied area

The most immediate consequence to this phenomenon is the saltcrust appearance (Fig. 2) in the surfaces in the flanks of the mining ponds (Fig. 3) and other mining wastes deposits which concern high erodibility values that contribute to a high erosion rate in short period time.



Figure 3: landslide in the flanks of the mining ponds of the studied mining area.

CONCLUSIONS

The high content in sulfate salts as a result of the superg enic sulfide alteration, that is content in the mine waste pond and tailing, give rise to the formation of taffoni according whit their geomorphologic position in the waste pond and the wind erosion action. The evolution of this geomorphological process provokes the instability of the mining ponds sides, increasing the erosion rate and the amount of available metal for environment.

The result of these processes is the formation in the first step it is the formation of saltcrusts, with a double origin. On one hand those that result from the in situ alteration of the primary or secondary sulphides on ponds sides. On the other hand, those salts that comes from the salt precipitation after circulation of soil solution through soil or waste profile that make a change in the facies or it precipitation on surface as a result of the phenomena of capillary ascension through the network of pores of the mining structures.

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