
# FOUR ABANDONED MINES, ONE ACID MINE DRAINAGE AFFECTED RIVER AND AN UNSOLVED ISSUE FOR A WATER SUPPLY RESERVOIR

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## 1. Purpose

Acid mine drainage (AMD) is a global problem that affects watercourses draining coal and metals mining regions. The Iberian Pyrite Belt (IBP) represents an extreme scenario in what concerns AMD, extensively described in the scientific literature, as a result of more than 4,000 years of sulphide mining.

This study aims to modelling a typical AMD-watercourse, which drains to a water reservoir used for human supply. The mineral-water interactions that promote the AMD processes are associated with four abandoned mines with distinctive mineral paragenesis. The present work addresses the spatial evolution of the contamination degree from AMD sources until the water reservoir, by using a graphical-statistical approach. The implemented methodology may be extrapolated to other systems affected by similar problems. In addition, the results will contribute to the state of the art by dealing with a representative watershed in the Iberian Pyrite Belt, whose pollutants are incorporated into a water supply dam.

## 2. Methodology

The study area is located in the basin of Chanza river, in the Iberian Pyrite Belt. Particularly, it was developed in the Trimpancho watercourse, which flows into the Chanza dam, built for human water supply. The Trimpancho receives leachates of four sulphide mines: Volta Falsa, Trimpancho, La Condesa and Nuestra Señora del Carmen.

Sampling points were selected immediately upstream and downstream of each mine waste dump, in order to evaluate the effects of respective leachates in the physical-chemical parameters of the system. Sampling and *in situ* measurements were performed in April 2013, following the usual protocol in AMD streams. Sulphate was analyzed by photometry and metals by mass spectrometry with inductively coupled plasma (ICP/MS) and optical emission spectrometry (ICP/OES). Data processing was made with software package STATGRAPHICS Centurion XVI.

## 3. Results

Figure 1 shows the spatial evolution of physical-chemical indicators along the system. Points 1 and 2 correspond to Trimpancho channel before receiving AMD influence. Sampling points 18 and 19 are located in the Chanza River after the confluence of the polluted Trimpancho. Points 3 to 17 indicate are mixing zones, reflecting the spatial evolution of the course under the influence of the inputs from the four mines.

The metal load follows the pattern set by the pH values, with higher concentrations observed for lower pH conditions. Fe concentration (Figure 1) rises till point 7 where it reaches maximum and from there begins to decrease due to sulphate and hydroxisulphates precipitation (mainly jarosite).

As expected, taking in consideration the mineral paragenesis, Fe and Cu are the dominant metals, reaching the highest concentrations.

Ca and Mg from the shale and quartzite host rock are also incorporated in the water system, due to dissolution promoted by low pH values. At Point 10, Zn concentration raises considerably, which is in accordance with the abundance of sphalerite in the La Condesa mine.

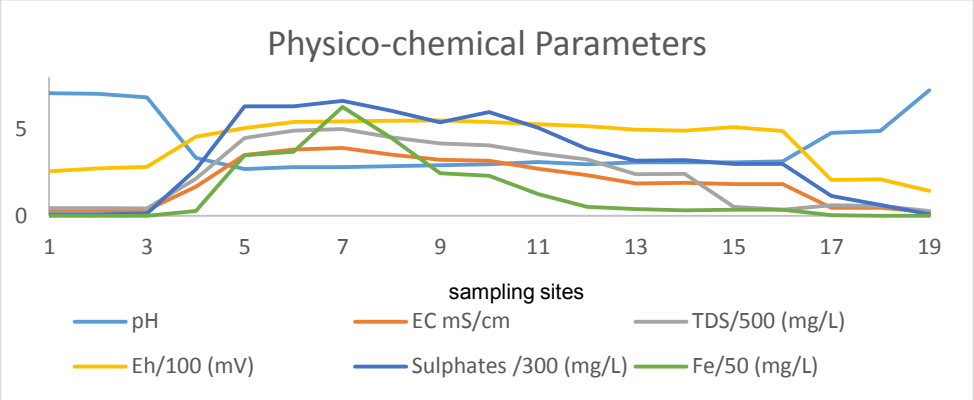


**Figure 1.** Spatial evolution of physico-chemical parameters.

The cluster analysis (Figure 2) allows the establishment of proximity relationships between variables and, then, to propose the hydrogeochemical operation model, based on the grouping of variables in different subcluster, which were related with the paragenesis and with the physical-chemical of the water.

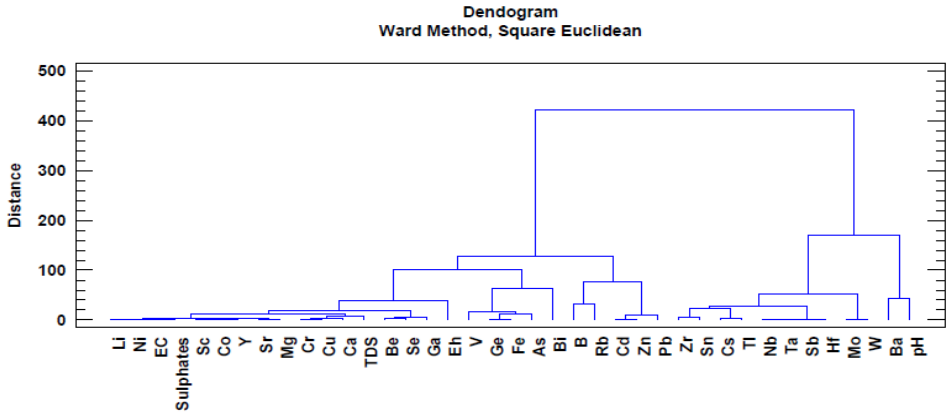


**Figure 2**. Cluster analysis of variables (Variables Dendogram)

## 4. Conclusions

The size of the channel under study, together with the presence of several AMD sources with specific paragenesis, allow its use as a “key site” for modeling processes in a AMD mining channel, with environmental impact in a water dam supply. Also, the rising price of copper in answer to the high demand from Asian countries increases the relevance of such type of modelling approaches. The results indicate typical AMD contamination, contributing to an advance in the state of the art, as the methodology may be extrapolated to other areas with similar problems. It may be useful to the Organizations responsible for land and water management. Identically, it may serve mining companies that in the current market must reach conditions of "zero discharge" to the river system and at the same time must assume the environmental passive arising from the presence of old mines.