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Arsenic in the environment
Arsenic from nature to humans

•Arsenic leaching from the tailings of Vale das Gatas abandoned mine (Northern Portugal) – a case study

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INTRODUCTION

•In the Vale das Gatas mine a tin–tungsten mineralization occurs associated to numerous quartz veins. The mineral paragenesis comprises cassiterite, wolframite, scheelite, sulphides, particularly arsenopyrite, among others. Mining activities were developed from 1883 until 1986. After the mine closure the tailings remained deposited nearby the mine plant in spite of its high As contents (Ávila, 2005). The tailings have been disposed of for approximately 100 years. These leftovers are classified as coarse mine waste, coarse from the heavy media separation, sand, shale and clays. Climate, which is aggressive in this region, with hot and dry summers and cold and rainy winters, affected the exposed materials during the deposition phases in the active mine life. The site localization is present in figure 1.

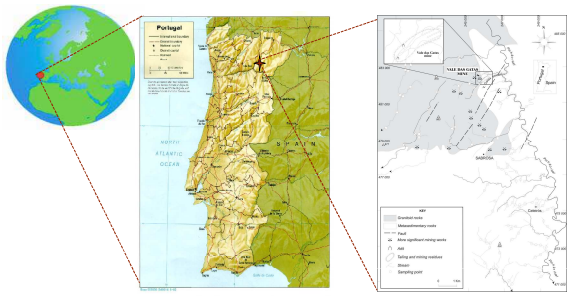

Figure 1- Vale das Gatas site location

EXPERIMENTAL

In order to reproduce the natural acid generation and according to the steps of sulphides oxidation defined by Kleinman et al. (1981) an acid sequential extraction was made.

In the first step, simulating rain action, 50 mL of water at pH 6 was added to 1g of tailing material, and put in an orbital shaker at the constant temperature of 20ºC. When equilibrium was reached a sample was collected for determination of Arsenic. Then the pH was adjusted to 2.5 by adding small amounts of sulphuric acid, and the extraction procedure was repeated. Finally, the pH was adjusted to 0.7 and the last sample was collected to quantify the arsenic content.

The procedure was repeated in the presence of 10% humic acid in order to simulate the influence of organic matter presence. The extracted liquids were filtered trough a 0.45 µm acetate membrane and after dilution in 12% HCl, were analysed for As by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES).

RESULTS and DISCUSSION

The samples were collected in depth, along three grooves with approximately 4m each, in the tailing slopes, one of them draining directly to a small creek. Surface runoff and water percolation leach the tailings and form acid mine drainage. Details of sampling points are represented in figure2. First a test was made to estimate the time required to achieve an equibrium between the solid and the liquid phases. The results (fig 3) showed that a period of 24 h was sufficient to obtain a steady As Concentration in the extract.

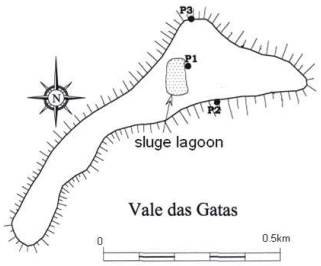

Figure 2 -Vale das gatas dumping site and sample points localization.

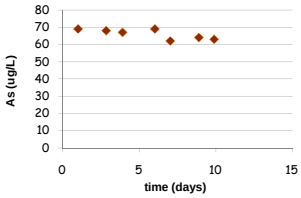

Figure 3 – As concentration *vs* contact time.

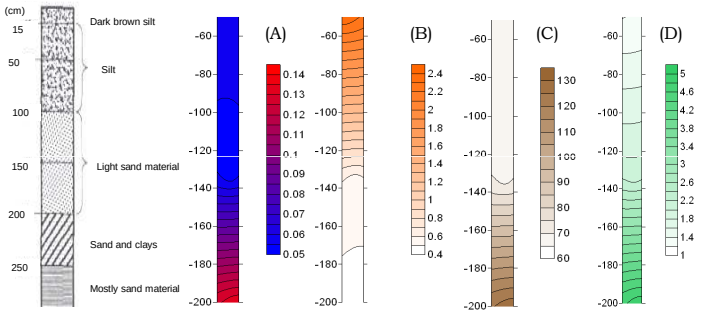

Figure 4- P1 Geological characteristics and As concentration (mg/L) at pH 4 (A), 2.5 (B) 0.7 (C) and with 10% humic acid (D)

Arsenic concentrations determined in the extract (mg/L) are represented in figures 4, 5 and 6 (Surfer 8.0 software, kriging method). Even thought the first extraction was made with water at pH 6, immediately after the contact the pH changes to approximately 4, indicating that the tailing material was oxidised and that, even with a moderated pH condition, a serious arsenic leaching was occurring. At lower pHs, the amount of arsenic released increases up to 5 magnitude orders, due to the arsenic dissolution adsorbed on clays and shale materials.

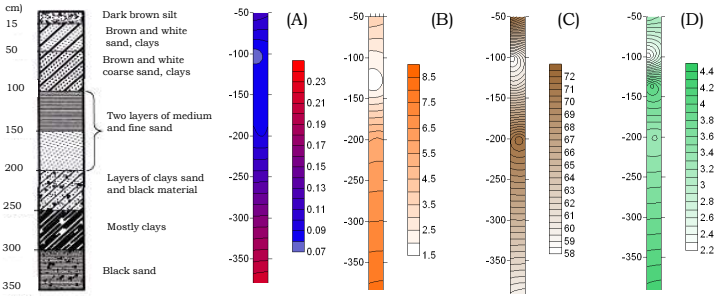

Figure 5- P2 Geological characteristics and As concentration (mg/L) at pH 4 (A), 2.5 (B) 0.7 (C) and with 10% humic acid (D)

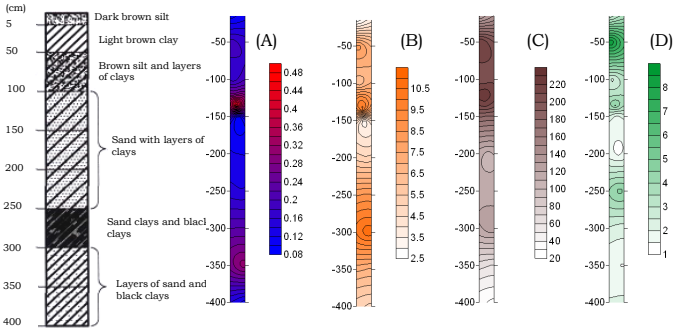

Figure 6- P3 Geological characteristics and As concentration (mg/L) at pH 4 (A), 2.5 (B) 0.7 (C) and with 10% humic acid (D)

CONCLUSIONS

This study lead to the conclusion that the tailing material is strongly altered and As has a high local environmental mobility. It also revels that the acid generation level is enough to partially dissolve the organic matter and increase the arsenic mobilization.

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