



## **Influence of the contaminated wastes/soils on the geochemical characteristics of the Bodelhão stream waters and sediments from Panasqueira mine area, Portugal**

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Panasqueira is a famous Portuguese tin-tungsten mine operating more or less continuously since the end of the nineteenth century. This mine is located in the Central Iberian Zone, northwest of Castelo Branco, about 35 km from Fundão, being the greatest producer of tungsten in Europe. Panasqueira mine also produces copper and tin. The ore exploitation has caused huge local visual and chemical impact from the large waste tailings, together with water drainage from mine galleries, seepage and effluents from water plant treatment.

The objective of this work was to evaluate the influence of the contaminated wastes and soils on the water and sediments characteristics of the Bodelhão stream. This stream crosses the mine area at the bottom of the main tailings, receiving sediments, seepage and drainage waters from wastes and/or soils developed on the waste materials which cover the host rocks (schists), and also from the water treatment plant.

Waste materials contain different levels of hazardous chemical elements depending on their age and degree of weathering (mg/kg – As: 466–632; Cd: 2.6–4.2; Cu: 264–457; Zn: 340–456; W: 40–1310). Soils developed on old wastes (60–80 years old) are mainly silty loam, acidic (except one soil (pH 8.2) developed on waste materials covered by leakage mud from a pipe conducting effluent to a pond), with relatively high concentration of organic carbon (median 48.6 g/kg). The majority of soils are heavily contaminated in As (158–7790 mg/kg), Cd (0.6–138 mg/kg), Cu (51–4081 mg/kg), W (19–1450 mg/kg), and Zn (142–12300 mg/kg). The fraction of these elements extracted with DTPA solution, relatively to total concentration, varies from low to As (< 4%) to high, as for Cd (4–76%) or Zn (1.5–60%).

Surface waters collected after the water treatment plant are less acidic (pH: 5.6–6.5) than those collected upper stream (pH 4.9) and showed high electric conductivity (up to 1.5 mS/cm), high concentrations of sulfate (618–1030 mg/L), and hazardous elements: up to 12.4 µg As/L; 83.7 µg Cd/L; 210 µg Cu/L; 5.8 mg Zn/L.

The highest concentrations of chemical elements in the river bank sediments (g/kg, As: 5.56–44.0; Cu: 1.99–>10; Zn: 1.29–14.1; S: 7.2–66.9; W: 1.04–6.32, and Cd: 11.4–138 mg/kg) when compared with the same elements in soils, indicate high dispersion of the chemical elements through waters both in solution and particulate material. Bed and river banks are contaminated by sedimentation and elements adsorption/precipitation on previous sediments. Distinct layers in a vertical profile in sediments showed different elemental composition suggesting differences on chemical elements dispersion over time. Water treatment plant reveals low efficiency on the mine effluents treatment. Considering the low quality of the Bodelhão stream water it should be discouraged its use for irrigation.