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Assessement of metalloids phytoavailability in mining soils

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Trace metals in soil might have origin from anthropogenic sources as metal mining and processing. Soil acts as a metalloid reservoir considered dangerous due to their potential toxicity and persistence in the environment. Metalloids accumulation in soil can degrade its quality. Phytotechnologies use metal tolerant plants and microorganisms to extract, degrade, contain or immobilize metalloids in soil, promoting their restoration. Borralha mine (Portugal) explored tungsten; soil is contaminated with high metalloid concentrations and can benefit from phytotechnologies in its remediation and requalification. Energy crops such as sunflower (*Helianthus annuus*) and *Populus sp*., with high potential success to adapt to contaminated soil, assisted by microorganisms (mycorrhizal fungi and plant growth promoting bacteria) that stimulate crop growth, can benefit soil quality and functionality reducing the stress promoted by the contamination. Assessing the environmentally available concentrations and metalloids distribution in soil fractions was the first step in this study. Soil physico-chemical parameters: 52% sand, 42.4% silt, 2.1% clay; pH 5.0; 10.5% OM; 4.2% CO32-, 0.11% N and 113 µS/cm EC. According to the proposed guidelines for Portuguese soil (in mg kg-1 Cu=35; Cd=0.6; As=22; Pb=34 and Zn=85) Cu exceed 24 times de guideline value and Cd 15 times. Sequential chemical extraction: most pollutant fraction consists of metals bounded to sulfides and released under oxidizing conditions in AMD production, nevertheless, Cu and Cd were extracted with acetic acid suggesting linkage to the easily mobilized phases. Selective single extraction to assess bioavailability of metalloids according to the maximum permitted levels for water soluble forms of Cd=0.03 and Cu=0.7 mg kg−1 extracted soluble concentrations of Cd and Cu (H20Cd 3.7X, NH4NO3Cd 8.3X, EDTACd 40X and H20Cu 1.3X, NH4NO3Cu 15.7X, EDTACu 407X) are above toxic levels revealing metal mobility; extraction capacity of metals followed the order of EDTA> NH4NO3>H2O; the mobility and bioavailability of the metalloids declines as Cd>>Zn>Cu>Pb>As.

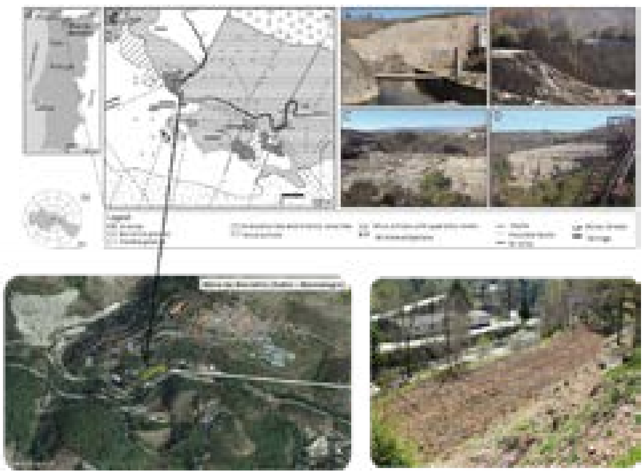

Figure 1: (a) Location of the study area (b) main geological units and (c) wind rose of the prevailing winds. Main sources of contamination: tailings (A, C, D) with huge volumes and pond (B) with rejected muds and slush discharged from the ore process. 1) experimental area for phytotechnologies studies and 2) delimited Sunflower and *Populus* plots where soil was collected.

Recent Publications

1. Avila P F, Ferreira da Silva E and Candeias C (2017) Health risk assessment through consumption of vegetables rich in heavy metals: the case study of the surrounding villages from Panasqueira mine, Central Portugal. Environ. Geochem. Health. 39(3):565-589.
2. Moreira H et al. (2016) Selection of metal resistant plant growth promoting rhizobacteria for the growth and metal accumulation of energy maize in a mine soil-effect of the inoculum size. Geoderma. 278:1-11.
3. Avila P F et al. (2015) Assessing heavy metal/metalloids pollution in soils after eight decades of intense mining exploration: the case study of Borralha mine, Portugal. Geological Communications. 102(1):89-98.
4. Candeias C et al. (2014) Heavy metal pollution in mine-soil-plant system in S. Francisco de Assis - Panasqueira mine (Portugal). Appl. Geochem. 44:12-26.
5. Avila P F et al. (2008) Geochemistry and mineralogy of mill tailings impoundments from the Panasqueira Mine (Portugal): implications for the surrounding environment. Mine Water and the Environment. 27(4):210-224.

Biography

Paula F Avila pursued her PhD in Environmental Geochemistry; Master's Degree in Geochemistry and a Degree in Geological Engineering. She is a Researcher at the Mineral Science and Technology Unit of the National Laboratory of Energy and Geology (Portugal) since 1993. Her areas of research interest include environmental geochemistry and environmental mineralogy; risk analysis associated with diffuse and/or catastrophic mining contamination, medical geology and human health implications, degraded soil remediation methods including phytoremediation; geochemistry applied to mining; ore mineralogy; minerals and their intergrowth; methods of geochemical analysis; statistical methods applied to geochemical data; development of diffuse and catastrophic contamination modeling methodologies, based on the chemical forms of the trace elements and metalloids, their bioavailability, mobility and reactivity in the different sub-areas of the geosystem.

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