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Chemical and ecotoxicological effects of the use of drinking-water treatment residuals for the remediation of soils degraded by mining activities

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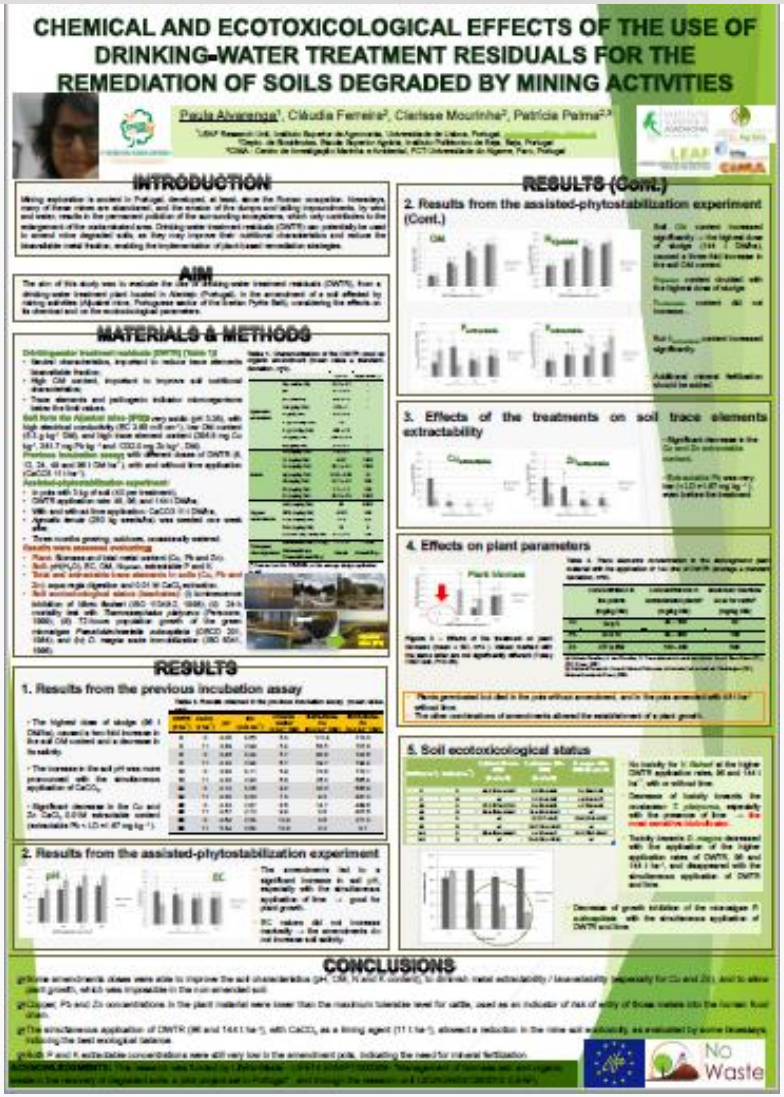

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LEAF LINKING LANDSCAPE, ENVIRONMENT, AGRICULTURE AND FOOD

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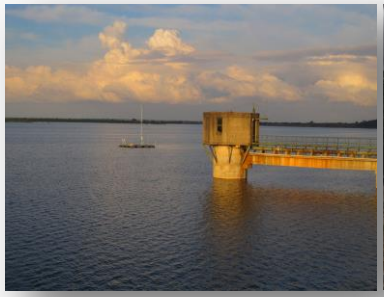
Background & Objectives

Soils from abandoned mines are highly acidic, poor in OM and nutrients, and contaminated with metal(loid)s.

Amending these soils with organic wastes can ameliorate their properties, diminish ecotoxicity and allow their phytostabilization.

The study aim was to evaluate the use of drinking-water treatment residuals (DWTR) in the amendment of a soil affected by mining activities (Aljustrel mine, Iberian Pyrite Belt), evaluating the effects on soils' chemical and ecotoxicological properties, and on the establishment of a plant cover.





Materials & Methods

An assisted-phytostabilization experiment was outlined, using *Agrostis tenuis* and DWTR, 48, 96, and 144 t DM ha^{-1}, with and without lime, 11 t ha^{-1} $CaCO_3$.

The effects of the DWTR on the soil were assessed by measuring the effects on:

- **Plants:** Biomass and total metal content (Cu, Pb and Zn).
- **Soil:** pH(H_2O), EC, OM, $N_{Kjeldahl}$, extractable P and K.
- **Total and extractable trace elements in soils (Cu, Pb and Zn)**: aqua-regia digestion and 0.01 M $CaCl_2$ extraction.
- **Soil ecotoxicological status (leachates):** (i) luminescence inhibition of *Vibrio fischeri* (ISO 11348-2, 1998); (ii) 24-h mortality test with *Thamnocephalus platyurus* (Persoone, 1999); (iii) 72-hours population growth of the green microalgae *Pseudokirchneriella subcapitata* (OECD 201, 1984); and (iv) *D. magna* acute immobilization (ISO 6341, 1996).

Results & Discussion

- Some amendments doses were able:
  - to improve the soil characteristics (pH, OM, N and K content),
  - to diminish metal extractability / bioavailability (especially for Cu and Zn), and
  - to allow plant growth, which was impossible in the non-amended soil.
- **Copper, Pb and Zn concentrations in the plant material** were lower than the maximum tolerable level for cattle, used as an indicator of risk of entry of those metals into the human food chain.
- Both **P and K extractable concentrations** were still very low in the amendment pots, indicating the need for mineral fertilization.
- The simultaneous application of DWTR (96 and 144 t ha^{-1}), with $CaCO_3$ as a liming agent (11 t ha^{-1}), allowed a **reduction in the mine soil ecotoxicity**, as evaluated by some bioassays, inducing the best ecological balance.