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The adaptation of *Miscanthus x giganteus* plant to soils developed from mining wastes

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Most of anthropogenic activities are responsible for many kinds of pollutions in air, water and/or soils. Through core extraction, mining activities generally lead to huge amount of contaminated wastes by inorganic pollutants originated from the extracted bedrock.

As contaminated sites are more and more common, their remediation is of key importance particularly using biological tools. Thus, management has to be suitable to the site configuration and in order to reduce pollution transfer to its entire ecosystem.

The studied site was a former gold mine located in the region Limousin (Massif Central, France). All the 34 000 t of wastes have been stored in a settling basin on an area of 1.2 ha since 1964. After pioneer vegetation colonization, soils have developed from the mining waste. Gold was linked to mineralogical phases (primary minerals) such as pyrite (FeS_2), arsenopyrite (FeAsS), galena (PbS) and minor Cu and Sb sulfides. The acidic and oxidation conditions in the settling basin lead to formation of secondary phases, namely a new mineralogical re-organization of the main PTEs (Potentially Toxic Elements) which has been characterized.

The natural vegetation development currently displays a zonation into 3 main zones with different contamination levels in Pb, As and Sb, the three main PTEs. A detailed characterization of 2 soil profiles including chemical bioavailability assessment was performed in relation to PTEs transfer into the natural vegetation. These profiles have been identified as Anthroposol Artificiel (Référentiel Pédologique, French nomenclature) or Technosol (WRB, Food and Agriculture Organization). Depending on the vegetation type and the physico-chemical features of the mining wastes, the soil profiles were shallow ($<$ 11 cm depth) with an organic horizon within 2 to 5 cm and a beginning of organo-mineral incorporation. pH values were between 3.5 and 5, with a high CEC (Cationic Exchange Capacity) reaching 64 cmol+.kg^{-1} in organic horizons.

The 2 aims of this study was (i) to understand the geochemical behavior and bioavailability of PTEs taking into account their belonging to mineralogical bearing phases and (ii) to assess the adaptation of *Miscanthus x giganteus* on such soils.

PTEs bioavailability was assessed by 4 different reagents: $CaCl_2$ 0.01M, acetic acid 0.11M, the A-Rhizo method (organic acids such as acetic, lactic, citric, malic, formic acids) miming the roots exudation and DTPA (Diethylene Triamine Pentaacetic Acid) have been performed on samples from both studied profiles. Overall, the bioavailability corresponds to no more than 1% of the respective total concentrations of studied PTEs whatever the method. But, in term of concentration, Pb and As availability reached 350 and 550 mg.L^{-1}.

The world population feed is one of the most important questions of the 21st century. To set arable fields free to grow up food crops, we studied the C4 plant producing biomass *Miscanthus x giganteus*. The adaptation of the plant was assessed by studying the physiological response. Leaves gas exchanges implied into photosynthesis were measured. Without any inputs to the 3 contaminated soils, a three months culture under controlled conditions showed a clear reduced biomass production compared to plants growing on compost. We found that the PTEs accumulation was low given the total concentrations but exceeding the thresholds required by the French law to burn such a biomass. However, photosynthesis activity appears to be not so strongly impacted by the contamination levels.