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Traceability of potentially harmful elements in wetlands influenced by mining activities

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The traceability of potentially toxic chemical elements (PTEs) both for human health and ecosystems is a relevant research subject in risk analysis. The term "traceability" is used here in the meaning of fate and transport of PTEs in the soil, rizosphere and plants grown in wetlands developed in areas influenced by mining activities. The study deals with typical PTEs as well as with other elements (silicon, iron and phosphorus) that play an essential role in these processes.
The aim of this study was to study the feasibility of using three plant species frequently used in artificial wetlands for remediation purposes. The selected species grew on soils affected by mining activities amended with limestone filler, and data on their vegetative growth, nutrient uptake and PTEs transfer were determined to select the most suitable species in terms of remediation.
The experiments were conducted using two topsoils collected from the most recent exploitation stage in Portman Bay (Murcia, Spain): a black sandy sample (BS) and a yellow fine texture sample (YS) and they were carried out in two ponds (7x3 meters). Black sand obtained from the Bay was deposited in one of the ponds, the other containing a mixture of yellow sand rich in jarosite from the same zone mixed with a calcareous filler. Water was incorporated to the ponds to simulate wetlands. On the other hand, pots were prepared by mixing, in different proportions, black or yellow sands obtained from the Bay with the calcareous filler and turba. A total of 15 sets of pots were used. The pots were placed inside the artificial wetlands and used for growing three plants (namely Iris pseudacorus, Juncus effuses and Phragmites australis). Each experiment was made in triplicate and so the results here presented correspond to the total 135 experiments set.
The total PTEs content (As, Cd, Cu, Fe, Pb and Zn) was determined and the bioconcentration factor (BCF) and transfer factor (TF) calculated. In addition, the levels of Si and P were also measured and a scanning electron microscopy (SEM) study was carried out.
Under the reducing conditions existing in the wetland, the PTEs could be absorbed by the roots, particularly iron. Within the root, the conditions become more oxidising and insoluble compounds, such as iron oxyhydroxides, are formed, avoiding that PTEs are transferred to leaves. This situation takes place in the three selected species, but more strength is observed in the experiments with yellow samples.
The results indicate that it is feasible to use the selected species for phytostabilisation of soils contaminated with PTEs. J. effusus, P. australis and I. pseudacorus could be considered as tolerant, and natural or artificial wetlands containing these species could be used for remediation purposes. Taking into account that these species showed high BCF and low TF, they can be used for phytostabilisation of contaminated soils. Since the transfer to the aerial parts of the plants is scant, the risk of incorporation to the trophic chain is very low.