soil systems

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Editorial

Assessment and Remediation of Soils Contaminated by Potentially Toxic Elements (PTE)

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Potentially toxic elements (PTE) can cause significant damage to the environment and human health in the functions of mobility and bioavailability [1]. Given the urgency to remediate polluted soils all over the world, appropriate innovative and sustainable remediation strategies need to be developed, assessed, and promoted [2–4].

Before that, a detailed knowledge of PTE bioavailability and bioaccessibility as well as of soil processes affecting contaminant dynamics, in terms of lixiviation, colloidal transport, redox conditions, or microbial activity, is essential in order to assess the actual danger/risk posed by contamination [5]. It is widely recognized that the bioavailability of toxic elements in soils depends on their solubility and geochemical forms, rather than on their origin and total concentration. Therefore, the knowledge of their spatial distribution and chemical speciation in soil is of paramount importance to perform an accurate risk assessment. Investigating these aspects requires the use of analytical techniques able to solve the high complexity of the soil matrix with a spatial resolution down to the micrometer—or even nanometer—scale [6].

In addition, a correct evaluation of remediation intervention requires detailed knowledge of the geochemical forms into which PTE have been converted following the soil treatment. This information is crucial to predict any possible transformation PTEs might naturally undergo over time or as consequence of physical–chemical perturbations that might impact the soil system.

In this Special Issue we invited the submission of articles to address the assessment of PTE contamination in soil systems using innovative approaches, the study of soil processes affecting pollutant dynamics, and the application of new sustainable remediation techniques for the long-term reduction in the threat posed by PTE towards the health of the human being and the environment. This volume contains ten original research articles. Four articles deal with the assessment of bioavailability of PTEs in contaminated soils [7–10], three articles report results on the application of phytoremediation to PTEs contaminated soils [11–13], one paper is related to the source–sink relationships of PTEs at basin scale [14], and two manuscripts address the issue of PTEs contamination in urban soils [15,16].

The assessment of the risk posed by the presence of PTEs in soil has been studied by Porfido et al. [7] investigating the Pb availability in a former polluted shooting range. Micro-XRF and SEM-EDX analyses showed that most of the Pb underwent stabilization processes: a weathering crust (mixture of orthophosphates) around Pb-containing bullet slivers dispersed within the soil. Moreover, no toxicity effects and low bioavailability were measured in earthworm tissues. Kaur et al. [8] assessed the risk of the presence of several PTEs in industrial effluents and soils through *Allium cepa* root chromosomal aberration assay and the potential ecological and human health risks and bioaccumulation in plants, respectively. The study of Diquattro et al. [9] assessed the mobility, phytotoxicity, and bioavailability of antimony (Sb) in soils after the addition of municipal solid waste compost (MSWC). The Sb mobility decreased in amended soils as well as phytotoxicity in triticale plants, whereas soil metabolic activity and catabolic diversity increased. Ahmad et al. [10] assessed the phytoextraction of PTEs by different vegetable crops in soil irrigated with city wastewater, evidencing the possibility of using some species for phytoremediation as well as the significant risk to human health and the environment due to PTE content in their tissues.

The adoption of a sustainable remediation strategy was proposed by Gorelova et al. [11] in a study of the bioaccumulation of PTEs in *Echinochloa frumentacea* grown in different contaminated soils. Results obtained by chemical, biochemical, microbiological, and metagenomic (16S rRNA) methods of analysis recommend *E. frumentacea* for phytoremediation of PTEs contaminated soils. Pietrini et al. [12] confirmed the crucial role of plant–microbe interaction in the phytoremediation of PTEs polluted soil by investigating the inoculation of microcosms of *Brassica juncea* and *Helianthus annuus* with a selected microbial consortium. Adopting a phytoextraction strategy, Fedje et al. [13] used sunflowers and rapeseed to extract Zn from the mineral fraction of the incinerator bottom ash in order to meet the increasing worldwide demand of the metal.

The acquisition of soil and sediment geochemical data in a basin located in the eastern Amazon enabled the source distribution of PTEs content and evidenced that local anomalies were mostly influenced by the predominant lithology rather than any anthropogenic impact [14].

Finally, two articles studied the source and distribution of PTEs in soils of two important cities. Rate [15] performed a spatial statistics analysis to define geochemical zones characterized by the presence of PTEs because of historical waste disposal in public recreation areas in Perth, Western Australia. Silva et al. [16] determined the soil PTEs content in six locations (traffic zone, residential area, urban park, and mixed areas) of the city of Lisbon (Portugal), evidencing the low levels of pollution.

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