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Environmental geochemical and microbiological studies on urban soil from former industrial city Salgótarján, Hungary

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Excessive input of potentially toxic elements (PTE) into urban environments has one of the most important environmental concerns around the world. Accumulated heavy elements in the environment constitute potential health hazards to humans, harm to living resources and ecological systems [1]. The aim of this study is 1) identifying distribution of PTEs in the urban soil samples and assessing contamination level as well as possible contamination sources and 2) determining the number of lead, cadmium and mercury tolerant microorganisms in contaminated soils of Salgótarján, a former industrial city.
Salgótarján city is located in the northeastern part of Hungary, surrounded by forested hills. Although, the coal mines, coal-fired power plant, iron and steel works closed several decades ago, their waste dumps, slag and fly ash spoils, still spread around in the whole city, and being a serious potential pollution source.
To perform our research study, 36 urban soil samples were collected from residential areas (houses, parks, playgrounds and kindergartens) of Salgótarján and a brown soil sample from forest area, about 6 km away from city center, as local geochemical background. PTEs concentration was measured by ICP-MS and the results varied widely, ranging from 8.5 to 1692 mgkg-1 for Pb, from 0.10 to 1.59 mgkg-1 for Cd and from 0.028 to 0.451 mgkg-1 for Hg. The four most PTE contaminated sampling sites (park, playgrounds and road site), as well as a geochemical background site (brown forest soil), were chosen also for microbiological investigations. The number of tolerant bacteria and fungi were checked using selective media containing 200 ppm Cd, Hg and Pb, respectively. SEM-EDS analysis showed that the selected urban soil samples have high percentage of slag, coal, Fe-alloy, and spherical metal grains. Among these, particularly slag and coal particles contain elevated concentrations of Cu, Zn, Ag, Cr, Sn and Sb.
Microbiological analysis revealed that number of bacteria in the samples varies between 2.3*10^4 - 23.9*10^4, while number of fungi between 0.68*10^4 - 2.7*10^4, respectively. These results show that increasing concentration of PTEs in the soil samples increased the number of metal tolerant microorganisms in these soils: number of tolerant fungi was higher in case of cadmium, whereas number of bacteria was higher in case of lead contaminated soil samples. Though, only concentration of the Pb (80 mgkg-1, mgkg-1, 433 mgkg-1, 1692 mgkg-1 and 17 mgkg-1) shows high correlation (R2=0.8) with CFU results, the effect of Cd and Hg on the number of tolerant microorganisms is undeniable.

Reference:
[1] D. C. Adriano, Trace Elements in Terrestrial Environments: Biogeochemistry, Bioavailability and Risks of Metals, Springer,New York, USA, 2003.