The impact of heavy metals concentration on soil biological properties in Kintyre Pb mining area, Jamaica

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Soil contamination with heavy metals occurs as a result of both anthropogenic and natural activities. Heavy metals could have long-term hazardous impacts on the health of soil ecosystems and adverse influences on soil biological processes. Soil microorganisms are recognized as sensors towards any natural and anthropogenic disturbance occurring in the soil ecosystem. Similarly, soil nematodes are also considered as one of the important soil biota and frequently influenced by HM contamination. The total number of nematode individuals has recently been used to investigate changes in soil biota composition in response to environmental stresses. This study was conducted within the Kintyre Pb mining area. Soil sampling plots are located in the Hope River valley, in the foothills of the Port Royal Mountains near to the Kingston. Mining was discontinued in the late 19th century, leaving a legacy of superficial tailings and crushed ore. These materials have been dispersed into the surrounding areas. HM concentrations, soil pH, soil moisture content (SM), total number of nematode individuals (TotalNem) and nematode community structure were studied. 18 soil samples (0-10 and 10-20 cm) from 3 sampling plots with different pollution levels (low (<100 mg/kg), moderate (300-700 mg/kg) and very high (>1000 mg/kg) concentration) were sampled in triplicate. Airdrieyed soils samples were sieved trough 2mm mesh and HM, TotalNem, SM, pH were determined in subsamples. TotalNem was significantly lower ($p<0.05$) in soil samples with high concentration of HM from the soil sampling plot C than in soils with low and moderate HM content from the soil sampling plots A and B. No significant differences were observed SM and pH between soil layers and sampling plots. TotalNem patterns confirmed that the concentration of heavy metals had a significant impact on nematodes. The soil nematodes were sensitive to Pb, Cd and Zn as an indicator of soil pollution with HM and can be used within the Environmental assessment projects.

A Chinese antimony smelting site and possibility for its phytoremediation

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Anthropogenic sources such as mining operations and smelting plants are great contributors to antimony (Sb) accumulation in the environment. Sb is considered a non-essential element and is toxic to most living organisms at elevated concentrations. Chinese Sb vein-type ore deposits account for 55% of the world's resources of Sb [1], and the country has been the global dominant in its production for over 10 decades. As a consequence, water and soil as well as fauna and flora within Sb mining and smelting areas are significantly contaminated by this metalloid and co-occurring elements [2-5]. Its anthropogenic release is mainly to the land; therefore, it is crucial to investigate the fate of Sb within the soil system in the smelting areas where its release is often very high and land needs to be cleaned up.

Discussion of results

Soils were sampled at uncultivated, cultivated and fallow farmland in the vicinity of a Sb smelter in Guangxi Zhuang, China. Topsoils at all the sites were heavily polluted by metals including Sb, Pb and As; and their concentrations were measured at 410-3330 $mg \cdot kg^{-1}$, 410-3690 $mg \cdot kg^{-1}$ and 200-460 $mg \cdot kg^{-1}$, respectively. However, the elevated concentrations of Hg (0.11-0.30 $mg \cdot kg^{-1}$) may be occurred both naturally and anthropogenically at the sites studied. This study showed that aerosol particles from Sb smelter can result in severe pollution of the local environment by toxic metals and pose a high risk via agricultural plants. Dissoluble proportion of Sb was insignificant (0.70-1.63%) compared to its deposition in the surface soils; however, water extractable amounts produced a slightly reduced germination rate on wheat seed with a lighter weight. Sb(III) adsorption on the smelting site soil was studied in order to examine its mobilization in pH changes; furthermore, to determine an optimal pH for higher Sb mobility that could facilitate plant uptake. The adsorption maximum (56 $ml \cdot g^{-1}$) appeared at pH of 3, while it was 10-17 $ml \cdot g^{-1}$ at pH of 6-7 which showed anion sorption may be dominant in Sb sorption onto bulk soil. It is therefore suggested that to maintain soil pH near neutral will increase Sb concentration in the soil water solution and it will enhance the feasibility of the phytoremediation.

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