THE CONTROL EXERT BY SOIL MINERALOGY IN THE MOBILITY OF POTENTIALLY HARMFUL ELEMENTS TO HUMAN HEALTH IN THE URBAN SOILS OF LISBON, PORTUGAL

AMÉLIA REIS, CARLA PATINHA*, CRISTIANA COSTA, FERNANDO ROCHA, EDUARDO FERREIRA DA SILVA, CLAUDIA DIAS, CRISTINA SEQUEIRA, DENISE TERROSO

University of Aveiro, Aveiro, 3810-193, Portugal
pmarinho@ua.pt

This study aims seeking relations between topsoil mineralogy and geochemistry to assess the importance of minerals in the fixation of potentially harmful element (PHE) in soils of urban spaces frequently used by children. In the urban environment the heterogeneities between sites are high and metal sources, metal distribution among the soil phases, soil physic-chemical properties and, consequently, metal mobility and bioavailability, are site-specific. This study is crucial to understand results on metal fractionation and bioaccessibility estimates for some PHE in the urban soils. Lisbon has an area of 284 km2, 521 774 inhabitants and is divided in 53 districts. The smaller are near the Tagus River and those with a higher population and housing density, a predominance of old buildings, narrow and steep roads, and a high traffic density. The majority of public gardens and playgrounds of the city are located in this area. Topsoil was collected at 51 sites (public parks and gardens, playgrounds and schools). Total concentrations of PHE were determined by ICP-MS in all samples and 26 were selected for mineralogical analyses that were carried out by XRD. The soil clay fraction (<2μm) was also studied by XRD. The microanalysis of soil particles was carried out by SEM. The mineralogy of the 26 soil samples is siliceous (quartz, feldspars and phyllosilicates) but some show significant amounts of carbonates. In the clay fraction, illite, smectite and kaolinite are the most common minerals. In order to seek the relationships between soil mineralogy and geochemistry, linear regression, principal components analysis and cluster analysis were used. The results show that illite is correlated with Pb and calcite with S, indicating that clays and carbonates in the soil may be the main phases in the fixation of these elements. Smectite seems to control the fixation of Ni, Cr and V in soils of the volcanic complex of Lisbon. The results from SEM analysis partly confirm these results. The EDX spectrum of a calcite grain with Si, S, Cl and K in its composition shows a Zn particle at the surface. A possible interpretation is that some calcite particles may be neoformed in the urban soil, incorporating in its structure metallic cations like S, acting as a sink for traffic related S. SEM analysis of the soil clay fraction shows Ni particles at the surface of smectite grains, which supports the hypothesis that smectite is controlling the fixation of Ni in the surface environment.

Keywords: urban soil, soil mineralogy, clays