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Environmental assessment of Ni and Cd in topsoil and ground-level dust from urban playgrounds, public gardens and parks from Lisbon, Portugal

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This study presents results from a project untitled "Geochemical survey of Lisbon urban soils: a baseline for future human health studies". Fifty one topsoil and 50 ground-level dust samples were collected in playgrounds, schoolyards, urban parks and public gardens. At each site, 1 uncontaminated moss transplant was fixed to a horizontal tree limb, which remained in situ for a period of 6 months. Soil were sieved to the <2 mm (usually used in environmental studies) and <250 µm (usually used in bioaccessibility testing) soil fractions. Dust samples were sieved to the <250 µm fraction. Total concentrations of potentially harmful elements (PHE) were determined by ICP-MS. Concentrations of PHE in the soil, one of the important pathways of exposure, where compared with those in dust and in moss. Oral bioaccessibility testing for Ni and Cd was carried out using the Unified Bioaccessibility Method (Wragg et al, 2009), validated by the Barge group. The results show that Ni in topsoil is uncorrelated with the physical-chemical soil parameters but is correlated with trace elements (TE) like Sr, Y, Sc, Mg, Cr, Ti or V. Higher Ni concentrations occur in soils of the Volcanic Complex of Lisbon (VS). Previous studies indicate that these are residual and in situ soils, a conclusion that is confirmed by the geochemical association found. So, the source of Ni is mostly geogenic. In dusts Ni is correlated with Mg, Cr, Ti and other TE typical of the VC, but it is also correlated with Ni, Cr, V concentrations in the topsoil, which implies that some dusts are re-suspended from soil. Bioaccessibility estimates of Ni are slightly higher in the stomach phase (G) and the samples with a higher fraction of bioaccessible Ni belong to the VC, meaning that although geogenic this PHE is bioaccessible in values that reach the 15 mg/kg. In topsoil, Cd is only correlated with Cu, Zn and Mo, indicating that Cd in soil is not related with the parent material but with anthropogenic sources. In dust Cd is correlated with other PHE like Sb, Pb, Cu and As. Levels of Cd in biomonitors indicate that there are anthropogenic sources emitting this PHE for the atmosphere, which may be dispersed by the wind or reach the soil through the deposition of Cd-laden particles. Bioaccessibility estimates are low and similar in the G phase and the stomach/intestinal phase (GI) but, unlike Ni, higher bioaccessibility estimates do not occur in the same samples in both phases. The different trends in Ni and Cd bioaccessibility between simulated G and GI phases are likely to be related to pH of each phase, by possible reactions with site-specific soil matrix components and potential ligands in the extracted solutions.