Spatial distribution of Pb, Cd and Cr concentrations in moss transplants from urban recreational areas in Lisbon, Portugal

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Owing to their ability to accumulate heavy metals, mosses are especially suitable to monitor heavy metal airborne pollution. Heavy metals are taken up very fast due to the lack of an epidermis and a cuticle, and they have a large surface-to-weight ratio.

This study presents results from a project untitled "Geochemical survey of Lisbon urban soils: a baseline for future human health studies", and the main aims are (1) to report on spatial patterns for Pb, Cd and Cr concentrations in moss transplants from public recreational areas in Lisbon; (2) to compare such patterns with those of soil and ground-level dust. Fifty one topsoil and ground-level dust samples were collected in playgrounds, schoolyards, urban parks, public gardens, road-side and airport of Lisbon. At each site, 1 uncontaminated moss transplant was fixed to a horizontal tree limb, which remained in situ for a period of 6 months. Only 44 moss samples were recovered from site. The selected moss species was *the Hypnum cupressiforme Hedw and the green* part was used for analysis of Pb, Cd and Cr by ICP-MS.

For Pb, the results show that concentrations are high, range from 7.2-75.1 mg kg^{-1} and the higher values occur in the older part of the city. Lead emissions are mainly related to traffic and the physiographic characterisitcs of the old city explain the higher Pb concentrations in the moss. The element has a similar spatial distribution in soils and dusts, suggesting that airborne Pb-particles settle in the topsoil. For Cd, the results show that concentrations are low, range from 0.077-0.435 mg kg^{-1} and the spatial distribution is irregular, indicating point sources. However, the airport moss samples have the highest Cd concentrations. Also soil and dust samples form the airport have the highest Cd concentrations, which suggest that air-traffic is a source of Cd in the city. For Cr, the results show that concentrations range from 1.6-8.9 mg kg^{-1} and the higher values occur in the old city. Soils and dust show different distribution patterns, perhaps due to the fact that in the city Cr has an important geogenic source.

In conclusion and despite the fact that by its location on the Atlantic coast and winds regime, high levels of pollutants are uncommon in Lisbon, the biomonitoring survey indicates that Pb emissions are probably traffic related, are still significant and have an higher environmental impact in the old city where the housing density is higher, the streets are narrow and have strong slopes, and the traffic is quite intense. Concentrations of Cd and Cr are quite lower and metal-laden airborne particles do not seem to be a significant source to the urban soils.

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