Urban agriculture in Portugal: reactivity of potentially toxic elements

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Soils are an essential component of the urban environment, contributing directly or indirectly to the general quality of life (Ajmone-Marsan and Biasioli, 2010). Soil contamination has been an area of intense study particularly in the last decade, since the accumulation of contaminants in soil can result in toxicity to organisms, disruption of ecosystems and adverse effects on human and animal health (Franz et al., 2008). Risks associated with potentially toxic elements (PTEs) in soils depend on soil properties (such as pH and organic carbon content) which affect chemical speciation, solubility and the free metal ion activity in the soil solution and thereby control PTEs' availability (Römkens et al., 2004). Total element concentration in soils generally includes a non-reactive or inert fraction and a reactive fraction which is in equilibrium with the directly available pool (Römkens et al., 2009; Rodrigues et al., 2010). The reactive fraction includes soluble precipitates of contaminants, metals sorbed to soil organic carbon, clay and amorphous metal oxides surfaces and is assumed to be in equilibrium with the soil solution (Rieuwerts et al., 2006; Römkens et al., 2009).

The main objective of the present study was to evaluate the reactive pool of As, Ba, Cd, Co, Cr, Cu, Ni, Pb and Zn in soils from urban settings (Oporto city and suburbs) and to compare such values with the reactivity of soils from industrial areas (Estarreja Chemical Complex) and mining sites (Aljustrel, Caveira and Lousal). Soil samples were collected at three distinct areas:

- The urban agglomeration: Oporto, a coastal city in the North-West of Portugal (the "Grande Porto" area has a population of approximately 1,400,000 inhabitants and includes an airport, an oil refinery and areas of intensive road traffic) (n=45).

- The industrial area: Estarreja Chemical Complex – with several chemical industries including a chlor-alkali plant that is located 1 km North from the centre of the Estarreja town (7,800 inhabitants) (n=73).

- Caveira, Lousal and Aljustrel (South-West of Portugal): soil samples were collected from pasture and agricultural fields surrounding these three

mining areas, located at the Iberian Pyrite Belt; the mineralogy of which is characterized by the dominance of pyrite, associated with other ore minerals (sulphides) (n=67).

An assessment of the reactive contents of PTEs in soil was obtained by extraction with 0.43 M HNO3 (Rodrigues et al., 2010). Extracts of HNO3 were analyzed by ICP-MS according to ISO 17294-1:2005 and ISO 17294-2:2003 procedures.

This work aims to contribute to the development of risk assessment tools in view of food safety and the protection of human and animal health in urban areas in Portugal. In particular, this information will be important for developing soil quality criteria for agricultural practices in urban areas.

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