TRACE METALS IN TOPSOILS AND STREET DUST SAMPLED IN THE SAO PAULO UNIVERSITY CAMPUS, BRAZIL

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Introduction

Geochemistry of contaminants in urban atmosphere, dust, soil, water and vegetation need a greater understanding. Urban soils are submitted to intense anthropic activities related to civil construction, industrial activities and vehicular traffic that are responsible for their degradation and chemical contamination. The metropolitan region of São Paulo, is the fourth world's largest city with an agglomeration of 21 million inhabitants in an area of 8051 km^2 of which 18,7% are in the municipality of São Paulo. The greater part (66%) of the municipality of São Paulo area is urban area and accounts with a population of 11 million of inhabitants and a fleet of 4.4 million of vehicles (cars accounting for 73% of the fleet). Since the occurrence and distribution of metals in Brazilian tropical urban soils and street dust is little known, the aim of this study is to discuss the concentration values, distribution and sources of trace metals in street dust and adjacent topsoils in a site (The University Campus) of the São Paulo city.

Methods

The sampling site is located in the western region of the São Paulo city, a green-park (7.4 km^2) surrounded by important avenues with intense vehicle traffic and inside a commercial and residential area of the city surrounded by some industrial or manufacturing activities. Sampling was performed during the dry winter season from 2012 to 2014 and 25 topsoils samples were collected until 10 cm depth. Street dust samples (n=11) were collected using a commercial clean vacuum, brush and plastic pan, in one square meter area that included gutter area and part of asphaltic pavement of the road. Topsoil and street dust samples were air-dried at room temperature and passed through a 2mm mesh nylon sieve to remove stones, grass, leaves or any other greater materials (cigarette butt, plastic, etc.). All samples were homogenized and quartered. Samples were submitted to particle size analyses and X-Ray Diffraction analyses, and trace metals (As, Ba, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sb, V, Zn, Pt, Pd) composition of bulk and fine fractions was quantified by ICP-MS for after acid digestion (*aqua regia*). A statistical treatment of data has also been performed.

Results

The average clay and sand content of topsoils samples was 22.1±6.18%, and 51.1 ±9.55%, respectively. Primary minerals (quartz, feldspar, mica) are dominant with gibbsite and kaolinite as secondary minerals. Concentrations of metals are generally lower than the reference value established by CETESB (São Paulo

State Environmental Agency) except for Cd (0.59±0.6 $mg.kg^{-1}$), Ni (11.2±15.3 $mg.kg^{-1}$), Pb (40.8±14.1 $mg.kg^{-1}$), Cr (42.2±23.8 $mg.kg^{-1}$) and Zn (95.6±50.8 $mg.kg^{-1}$). The order of heavy metal contents measured in topsoils was: Zn>V>Ba>Cr>Pb>Cu>Ni>As>Co>Mo>Cd>Sb. Average heavy metal contents also showed a great variation between sampling point but considering the concentration variation between sampling sites most of the concentration values did not exceed the quality reference values, except for As, Cd, Pb, Zn, and Cr, and Co, Cd, Ni and Sb only for some sampling points. In street dust bulk samples, the sand fraction was predominant (>50%) and primary minerals such as quartz and feldspar were also dominant with iron oxides and clay minerals as secondary minerals. Zn showed the highest average concentration (230±153 $mg.kg^{-1}$ and 540 ±218 $mg.kg^{-1}$ in bulk and fine fraction, respectively) and then Cu>Ba>Pb>Cr>V>Ni>Co>Mo>As>Cd. Considering soil and street dust ratios, Sb, Pd, Cu, Pt, Mo, Zn, Ba, Ni and Cd were enriched (from 12.2 for Sb to 1.3 for Cd) in street dusts. Some trace metals may be associated with tire wears (Al, Si, Ca, Zn) and brake abrasion dusts (Fe, Cu, Sb, Ti, Ba, Cr, Ni), street painting (Cr, Pb), surface automotive catalysts deterioration for Pt and Pd (Camatini et al., 2001; Adachi e Tainosho, 2004; Thorpe e Harrison, 2008; McKenzie et al., 2009; Bucko et al., 2010; Gunawarda et al., 2012; Morcelli et al., 2005).

Conclusion

Considering the results obtained in this study, there is a clear contribution of vehicular sources and transfer of trace metals between topsoils and street dust, that may also affect transfers of trace metals to atmosphere and hydrosphere. Further studies are needed and in order to better understand this complex urban environment, studies have to be extended to other areas of the São Paulo city and heavy metal isotopes might be used.

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