Heavy metal contamination in urban road dusts in the city of Thessaloniki, Greece: mineralogical and morphological characteristics and mobility of potentially toxic metals

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Road dust can be considered as a significant pollution source itself and a primary receptor for urban pollutants in densely populated cities. In the present study 31 samples of urban road dust were collected from various locations in the historic centre of the city of Thessaloniki, the second largest city in Greece and an important urban center in the Balkans. Mineralogical, morphological and chemical characteristics were determined, in order to assess the degree of anthropogenic pollutant contamination, origin of dust samples and possible impact on human health. Samples were collected from accumulated matter of road edges from different locations according to the traffic load they sustain. Mineralogical and morphological characterization of the dust particles were performed by X-Ray powder diffraction (XRPD) and scanning electron microscopy (SEM), respectively. The total concentration of heavy metals was determined (Cd, Cr, Cu, Fe, Mn, Pb, Zn) followed by a statistical analysis (Correlation coefficient analysis, Principal Component Analysis and clustering of the results) in order to estimate the possible origin of heavy metals. Moreover, a comparison between the pollutant content of the selected samples and non-polluted samples (background shale content) was carried out, producing contamination factors useful in the evaluation of the extent of antrophogenic contamination. Road dusts were mainly composed of quartz, calcite, while other mineral phases were present in minor amounts. Dust particles exhibit subhedral to anhedral crystalline grains, near-spherical and irregular agglomerates. Results indicate that anthropogenic participation in the chemical composition of the samples is increased especially for the metals Ni, Cu, Zn, Mn, Pb. Maximum heavy metal contents were: Cd (5.0 μg/g), Cr (155.3 μg/g), Cu (1705.8 μg/g), Mn (641.9 μg/g), Ni (211.5 μg/g), Pb (429.0 μg/g) and Zn (1075.2 μg/g) which were determined in the areas of Aristotelous Square, White Tower and the coastal parts of the city center. Based on the average concentrations, the abundance of heavy metals exhibited the following order: Fe>>Cu>Zn>Mn>Pb>Cr>Ni>>Cd. On the other hand, spatial distribution of heavy metals signifies that hot-spot areas are mainly associated with locations where high traffic density was iden-

tified. Results from correlation coefficient analysis indicate that samples were well mixed mainly due to weather transport processes. Source identification based on the correlations for dust metals imply that Cu and Zn content is probably related to vehicle emissions and deceleration (breaking), while Ni, Mn and Cr relation indicates that possible sources are decay from vehicle parts and fuel additives. High correlations were observed for two metal groups: Fe-Zn-Pb-Cu-Cr and Cu-Cr-Ni indicating the main two sources of road dust pollution. The potential health risks resulting from the elevated heavy metal contents render essential further investigation regarding the problem of urban road dust.

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