MINERALOGICAL AND MORPHOLOGICAL CHARACTERIZATION OF TECHNOGENIC MAGNETIC PARTICLES (TMPs) IN HEAVILY CONTAMINATED INDUSTRIAL SOILS

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Abstract

Anthropogenic magnetic particles with a "technogenic" origin are an important source of heavy metal contamination in soils and are used for identification of polluting sources and degree of contamination. The objective of this study was the characterization of TMPs separated from contaminated industrial soils which was performed by means of magnetic susceptibility measurements, ICP-MS, XRD and SEM-EDS. Volume magnetic susceptibility () was measured directly in the field around a chemical industry in Sindos industrial area, Northern Greece and representative soil samples were collected from sites where elevated values were recorded. Mass specific magnetic susceptibility (χlf) depended on the content of TMPs and ranged from 52.6x10-8 to 821.2x10-8 m3/kg with the maximum values detected in the immediate neighborhood of the industrial unit where the most contaminated soils were also identified. Soil samples presented elevated As, Cd, Cu, Pb, Sb, Sn and Zn contents with the highest concentrations reaching 103μg g-1, 8.8 μg g-1, 341 μg g-1, 1480 μg g-1, 4.7 μg g-1 , 28.8 μg g-1 and 2730 μg g-1, respectively and as mentioned in all cases were recorded in the vicinity of the industrial unit. Extremely high correlation coefficients between χlf and Zn, Sb, Sn, Ni, Fe, Cr and Pb contents confirmed their strong correlation with the TMPs. Pollution Load Index (PLI) ranged between 1.03 and 59.04 indicating a strongly polluted region. Mineralogically the TMPs exhibited a dominant iron spinel phase, mainly

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magnetite probably mixed with various proportions of magnesioferrite and maghemite, along with hematite, wustite and iron. In spite of magnetic separation the quartz and calcite contents were still high, while minor amounts of plagioclase were detected. Morphologically, irregular-shaped particles were the most commonly observed particles in TMPs with various Fe contents often associated with elevated heavy metal contents.

Keywords: magnetic properties, heavy metals, soils, XRD, SEM