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Application of soil magnetometry on urban and industrial areas affected by different sources of pollution

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Soil magnetometry as a proxy screening method has proven to be a suitable method for outlining soil pollution, connected with industrial and urban dust deposition as well as qualitative and semi-quantitative evaluation of potentially contaminated areas with considerably high concentration of technogenic iron particles and related heavy metals. In combination with geochemical method it could be also used for better targeting the geochemical sampling and reducing the number of chemical analysis. During this study the method was applied on areas dominated by 3 different sources of pollution: urban (mostly related to coal combustion), metallurgical and coke production. The three analyzed forest complexes were artificially planted and grow on anthroposols with different stage of transformation. During the study analysis of vertical distribution of magnetic susceptibility (κ) in 40 topsoil profiles taken in 3 above mentioned forest areas were performed. Additionally, soil samples taken from horizons with increased magnetic susceptibility (mostly organic horizon) and from mineral horizons (considered as a background) were selected to chemical analysis of 9 heavy metal content (Fe, Mn, Co, Ni, Cu, Zn, As, Cd and Pb). X-ray fluorescence method was applied for geochemical study. The highest κ values up to 1200 $\times$ 10-5 SI units were measured in the vicinity of metallurgical plant but the correlation between κ values and heavy metal content was there very low and statistically not significant. The considerably high correlation between magnetic susceptibility and some heavy metals (Pb, Zn, Cd, Cu, As) were observed on 2 other areas of study. On the base of these study in combination with former mineralogical study of industrial dusts and topsoils, the following conclusions have been drown:
[U+F0A7] Steelworks – emit strongly magnetic technogenic magnetic particles (TMPs) including metallic iron (α-Fe) that is strong ferromagnetic (giving high κ values) but do not contain heavy metals in considerable amount. The metals connected with iron metallurgy are mostly Ni and Cr.
[U+F0A7] Power plants and urban sources connected with fly ash emission – emit TMPs in forms of ferrimagnetic iron oxides. The magnetic fraction of fly ashes is connected with such metals as Pb, Zn, Cd and sometimes As and Cu.
[U+F0A7] Coking plants – emit considerably lower amount of TMPs not only in form of magnetic oxides but also sulphides as pyrrhotite or pyrite. With such TMPs mostly Pb, As, Cu, Cd and Zn are connected.