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Magnetic signature of anthropogenic pollution of soil and correlation with heavy metals in the broader Kozani-Ptolemaida region, Northern Greece.

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Since 1951, the character of Greece has changed from a mainly agricultural into a more industrial country. In the course of the economic revival, this change implied a rapid development of urban and industrial areas, resulting in serious consequences for the Hellenic environment. The present study focuses on fly ash and heavy metal pollution, one of the major environmental problems of the broader Kozani – Ptolemaida region (northern Greece) where five power plants are operating. The target of the project was twofold: (a) to challenge the correlation between ferrimagnetic mineral content and geochemical properties of samples from polluted areas, (b) to estimate the spatial distribution of several pollutants within the study area.

Towards this scope, the magnetic susceptibility was mapped using a Bartington susceptibility meter (MS2D-loop) with a resolution of 1×1 km, and soil samples were collected from each measurement point. After drying and sieving, the specimens were subjected to several laboratory experiments: measurement of magnetic low-field susceptibility at low and high frequency, isothermal remanence acquisition, thermomagnetic analyses, alternating field demagnetization of both natural and isothermal remanent magnetization, anhysteretic remanence experiments and hysteresis loops. The concentrations of Fe, Mn, Cr, Cu, Pb and Zn in the studied soils were determined by X-ray fluorescence and ICP-AES analyses were carried out on HNO_3 digests from the same samples.

The *in-situ* susceptibility values exhibit significant variation, ranging from very low background values (7×10^{-5} SI) to high values (730×10^{-5} SI), with a mean of 141×10^{-5} SI. The same variation arises from laboratory susceptibility measurements at low and high frequency, with a mean frequency dependence (F-factor) of 5 %. Preliminary geochemical measurements indicate concentrations of 40-360 mg(Cr^{3+})/kg, 10-30 mg(Cu)/kg, 3523-21543 mg(Fe)/kg, 195-1150 mg(Mn)/kg, 46-471 mg(Ni)/kg, 3-25 mg(Pb)/kg and 19-70 mg(Zn)/kg. An excellent linear correlation was found between magnetic susceptibility and the concentrations of soil Fe, Mn, Cu and Pb, whereas the correlation between magnetic susceptibility and concentration of Zn and Cr^{3+} in soil was poor, suggesting that the pollutants are physically not related to the magnetic minerals.