

## Magnetic properties of soil profiles – combination of geogenic, pedogenic, and anthropogenic signal

M. Szuszkiewicz<sup>1</sup>, T. Magiera<sup>1,2</sup>, A. Łukasik<sup>1</sup>, M. Wawer<sup>1</sup>, M. Mendakiewicz<sup>1</sup>

<sup>1</sup>Institute of Environmental Engineering, Polish Academy of Sciences, Zabrze, Poland

<sup>2</sup>Department of Land Protection, Opole University, Opole, Poland

Corresponding author: [marcin.szuszkiewicz@ipis.zabrze.pl](mailto:marcin.szuszkiewicz@ipis.zabrze.pl)

**Abstract:** Magnetic properties of soil are a result of content in soil profile magnetic minerals (mostly iron oxides and hydroxides) of both, natural (geo- and pedogenic) and anthropogenic (technogenic) origin. The proper interpretation of vertical distribution of magnetic susceptibility in soil profile, needs the information about magnetic properties of minerals present in geological bedrock, subsoil and topsoil horizons. The study was aimed on characterization of magnetic properties, mineralogical composition as well as physicochemical properties of organic and mineral soil horizons. The essence of these research is to show the character and diversification of selected rocks types and its influence on magnetic properties (magnetic susceptibility anomalies) in soil profiles, in the local scale. The collected material included soil samples and some sedimentary, igneous rocks (i.e. volcanic and plutonic) as well as metamorphic rocks, occurring in Poland. Magnetic properties of bedrock and soil samples were determined according to the measurements of mass magnetic susceptibility ( $\chi$ ) and frequency dependent susceptibility ( $\chi_{fd}$  %) as well as thermomagnetic curves of volume magnetic susceptibility ( $\kappa$ ). Technogenic character and nature of research sites of magnetic susceptibility anomalies, was distinctly observed only in the uppermost part of soil profiles, in organic soil horizons (topsoil). This anthropogenic peak of  $\chi$  may indicate the presence of technogenic magnetic particles (TMPs) and the analyses of thermomagnetic curves suggest that the predominant magnetic component is magnetite and/or maghemite. In some studied profiles noticeable  $\chi$  value increment is observed in subsoil horizons, revealing pedogenic character of magnetic susceptibility (influence of soil forming process – presence of superparamagnetic grains). Analyses of thermomagnetic curves and calculations of  $\chi_{fd}$  support the presence of pedogenic iron minerals (magnetite) in upper part of subsoil horizons. The strong geogenic character of anomaly with increasing  $\chi$  values downward the soil profile (lower part of subsoil horizons/bedrock) was also observed in this research. The results will allow for verification and correct interpretation of mentioned anomalies (in the local scale), which are an effect of a

number of coexisting factors: geo-, pedo-, and anthropogenic (including technogenic particles deposition).

**Keywords:** magnetic susceptibility, iron minerals, bedrock, soil horizons

**Acknowledgement:** The study was financially supported by the National Science Center (Poland) – project No. DEC-2011/01/N/ST10/07548.