# DISCRIMINATION BETWEEN DIFFERENT SOURCES OF SOIL POLLUTANTS USING MAGNETO-GEOCHEMICAL DATA SET

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## Introduction

Our primary aim was to distinguish a soil pollution between long-range and local transports of atmospheric pollutants using soil magnetometry supported by geochemical analyses. At present, classic geochemical measurements are frequently supplemented by fast geophysical methods (i.e. soil magnetometry) to determine a potential soil pollution source. Topsoil can be significantly affected by airborne supply of elements from natural and/or anthropogenic sources (e.g. Steinnes et al., 1997). Many elements are emitted to the atmosphere in combustion, high-temperature technological and metal extraction processes (Pacyna et al., 1984) and are accompanied by anthropogenic iron minerals which are formed during these processes (Hulett et al., 1980). Combustion of solid fuels, manufacturing of ferrous and non-ferrous metals are one of the principal European sources of trace element emission (Pacyna et al., 1984).

## Methods

The study area was located in the Izery Mountains and examined soils were developed from the Izera granite. One site of the study area was situated in the forest glade and was exposed to the anthropogenic pressure from a former glasswork that was active here from 1754 until 1891. Whereas, the second site of the study area was located on a neighboring hill (Granicznik), whose western, north-western and south-western parts of the slope were exposed to the long-range transport of atmospheric pollutants from the Czech Republic and Germany. The volume magnetic susceptibility (κ) was measured on the soil surface and in the soil cores using a MS2 Bartington meter, equipped with MS2D and MS2C sensors, respectively. The anthropogenic translocation of topsoil horizons and presence of artifacts (i.e. post-industrial wastes) in soil cores were estimated using the Topsoil Transformation Factor (TTF) according to Łukasik et al. (2015). Additionally, using MS2C measurements and geochemical analyses (selected trace element contents) it was possible to discriminate between natural and anthropogenic origins of a soil magnetic susceptibility signal. The concentration of trace elements was determined with ICP-MS.

## Results

Our results indicate that the forest glade site was characterized by many anthropogenic translocations and confirmed by a relatively high value (0.61) of the TTF. Here, the soil cover is partly developed on magnetic slags (waste from the former glasswork). Moreover, the forest glade was characterized by more "hot spots", higher spatial variability and nugget effect. Additionally, the principal component analyses (PCA) were performed for the properties determined in samples from soil cores of Granicznik and the forest glade. It showed that the mass magnetic susceptibility ($\chi$) value is highly correlated with Cd, Hg, In, Ni and Pb contents, whereas, for the sample set of the forest glade the PCA showed that the $\chi$ value was highly correlated with As, Cd, Cu, Hg, Nb, Ni, Pb, Sb, Sn and Zn. Both, Granicznik and the forest glade sites were inversely correlated with the contents of the lithogenic elements: Nb, Th, U and Zr.

## Conclusion

From our study we can draw the following conclusions: (1) using soil magnetometry it was possible to discriminate between local contaminations (including historical deposition from the local industrial source and waste materials in topsoil) and long-range transport of atmospheric pollutants; (2) in comparison with the forest glade, soil pollution of Granicznik was characterized by a longer range of spatial correlation and significantly lower nugget effect; (3) the histogram of the values of the $\kappa$ originating from Granicznik was less skewed than the histogram for the forest glade; (4) the highest concentration of As, Cd, Hg, In, Mo, Sb and Se on Granicznik are a result of long-range transport of atmospheric pollutants, whereas, the highest contents of Cu, Ni, Pb, Sn and Zn in the forest glade correspond to the local sources of pollutants and anthropogenic pressure (i.e. former glasswork).

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