

Technogenic magnetic particles in soils as an evidence of historical human activity

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Abstract: Technogenic magnetic particles (TMPs) are different mineral forms of iron that exhibit ferro- or ferrimagnetic properties. They are formed during wide variety of technologic processes occurring in high temperature. Independently of iron forms, Fe contained in raw materials, fuels or additives is transformed into oxide forms, exhibit enhanced values of magnetic susceptibility. The subject of study were TMPs occurring in soils and peat-bogs on areas of historical human activities connected with exploitation and smelting of iron, silver and lead ores since early Middle Ages. During this study's surface magnetic susceptibility (κ) with MS2D Bartington sensor were measured to find the local soil magnetic anomalies. In these places, the vertical cores up to 30 cm depth were collected using HUMAX core sampler. Vertical distribution of magnetic susceptibility along the cores was measured in the laboratory using MS2C Bartington core sensor. The larger TMPs fraction was separated from the section with increased κ values in cores by using a hand magnet. The separation of fine fraction of TPSs was carried out in ultrasonic bath from fine soil material suspended in isopropanol to avoid their coagulation.

TMPs were mostly separated from the depth of 15 – 30 cm of soil profiles. Four kinds of TMPs were described among separated magnetic fraction:

- charcoal brittle particles (0.5 – 5 mm) with rust color on the surface and black on fracture
- irregular ceramic particles up to 10 mm
- ash and ore particles (up to 10 mm)
- strong magnetic particles of metallic iron ca. 10 mm with almost regular shape and rounded edges.

Ongoing detailed mineralogical studies and radiocarbon dating of collected TMPs will give some more information.

Additional peat profiles from adjacent peat-bog were also studied. The highest value of magnetic susceptibility in peat-bog profile was measured at the depth of 12 cm in peat layer where the high content of fine charcoal particles was also observed. In the same peat layer the high content of Ag, Cu, Pb and Sn were detected by chemical analysis. Slightly enhanced κ values (in relation to diamagnetic negative values measured as a background for peat bog) were detected up to 40 cm depth that corresponds with presence of charcoal particles.

Keywords: magnetic susceptibility, technogenic magnetic particles, iron minerals, peat bog