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Magnetic Susceptibility of Saxony Soils and their Quantification

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Measurements of magnetic susceptibility are the basis of soil magnetometry, which is an approximate, semi-quantitative method of fast delineation of soil contamination level. Ferrimagnetics present in atmospherically deposited particulate matter, contribute to topsoil magnetic signature and can be easily detected using concentration-dependent magnetic parameters, such as low-field magnetic susceptibility. The magnetic susceptibility is higher, the larger is the amount of ferrimagnetics in the soil.

There are many parameters taken into account during soil quantification and qualification, such as soil physical properties, pH, humus content, chemical composition etc. In this context soil magnetic susceptibility is worth to be taken into consideration as a new parameter that describes human impact on soil processes and properties.

Studies on magnetic susceptibility of Saxony soils were made on the basis of archival soil samples taken in 4 × 4 grid in 1992/1993 from organic and topsoil horizons of forest soils (Oh and Ah), topsoil horizons (Ap) of arable lands, pastures, meadows and reclaimed lignite mine sites (Leipzig area) as well as subsoil horizon (B) of whole area of Saxony. Number of soil samples amounted to 1165 from Ap, Ah horizons, 261 from Oh horizon and 1188 from B horizon. Mass magnetic susceptibility measurements (χ) were made using MS2B Bartington apparatus.

Results of magnetic susceptibility (χ) are very diverse and vary from an unity to 1580 × 10^{-8} m^3kg^{-1}. The mean value of χ decreases from the organic layer (222 × 10^{-8} m^3kg^{-1}) through topsoil (47 × 10^{-8} m^3kg^{-1}) to subsoil (27 × 10^{-8} m^3kg^{-1}).

Magnetic susceptibility distribution exhibits areas with various level of soil contamination. Particularly high χ occurs in industrial and urban areas: region of Leipzig, Dresden, Hoyerswerda and in the south: Bad Schandau, Freiberg, Chemnitz and Zwickau. Increased χ are observed in area called “The Black Triangle” that is under the influence of power plant dust emissions from three countries (Germany: Hirschwelde, Hagenwerden and Boxberg; Poland: Turów; Czech Republic: Pocerady and Melnik power plants). Except the location of the magnetically enhanced areas close to the industrial and urban sources of pollution, the second observation suggesting their technogenic origin is high content of heavy metals in organic and topsoil horizons of forest soils. High values of χ characterize soils in areas where none of industrial emitters occur: area of Plauen, Zittau, Annaberg and Bad Schandau. In these cases the magnetic anomalies have geogenic character and are caused by basaltic parent rock.

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