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Soil erosion at agricultural land in Moravia loess region estimated by using magnetic properties

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A detailed field study on a small test site of agricultural land situated in loess region in Southern Moravia (Czech Republic) and subsequent laboratory analyses have been carried out in order to test the applicability of magnetic methods for the estimation of soil erosion. Chernozem, the original dominant soil unit in the wider area, is nowadays progressively transformed into different soil units along with intensive soil erosion. As a result, an extremely diversified soil cover structure has resulted from the erosion. The site was characterized by a flat upper part while the middle part, formed by a substantive side valley, is steeper (up to 15°). We carried out field measurements of magnetic susceptibility on a regular grid, resulting in 101 data points. The bulk soil material for laboratory investigation was gathered from all the grid points.
We found a strong correlation between the volume magnetic susceptibility (field measurement) and mass specific magnetic susceptibility measured in the laboratory (R2 = 0.80). Values of the magnetic susceptibility are spatially distributed depending on the terrain. Higher values were measured in the flat upper part (where the original top horizon remained). The lowest values of magnetic susceptibility were obtained on the steep valley sides. Here the original topsoil was eroded and mixed by tillage with the soil substrate (loess).
The soil profile that was unaffected by erosion was investigated in detail. The vertical distribution of magnetic susceptibility along this ”virgin” profile was measured in laboratory on the samples from layers along the whole profile with 2-cm spacing. The undisturbed profile shows several soil horizons. Horizons Ac and A show a slight increase in magnetic susceptibility up to a depth of about 70 cm. Horizon A/Ck is characterized by a decrease in susceptibility, and the underlying C horizon (h > 103 cm) has a very low value of magnetic susceptibility. The differences between the values of susceptibility in the undisturbed soil profile and the magnetic signal after uniform mixing the soil material as a result of tillage and erosion are fundamental for the estimation of soil loss in the studied test field. Using the uneroded profile from the studied locality as a basis for examining the changes in cultivated soils, tillage homogenization model can be applied to predict changes in the surface soil magnetism with progressive soil erosion. The model is very well applicable at the studied site.

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