



GEMAS: Mineral magnetic properties of European agricultural soils

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The GEMAS survey of European agricultural soil provides a unique opportunity to create the first comprehensive overview of mineral magnetic properties in agricultural soil on a continental scale. Samples from the upper 20 cm were taken in large agricultural fields (Ap-sample) at a density of 1 site/2500 km². After air drying and sieving to < 2 mm, low (460 Hz), and high frequency (4600 Hz) magnetic susceptibility k was measured on 2500 samples using a Bartington MS2B sensor to obtain frequency dependence of magnetic susceptibility k_{fd} . Hysteresis properties are determined using a J coercivity spectrometer, built in the paleomagnetic laboratory of Kazan University, providing for each sample a modified hysteresis loop, backfield curve, acquisition curve of isothermal remanent magnetization, and a viscous IRM decay spectrum. Each measurement set is obtained in a single run from zero field up to 1.5 T and back to -1.5 T, taking approximately 15 minutes. This allows to measure a wide range of magnetic parameters for large sample collections. Because the GEMAS geochemical atlas provides a comprehensive set of geochemical measurements characterizing the individual soil samples, the new data allow to study magnetic parameters in relation to chemical and geological parameters. The results show a clear large scale spatial distribution with e.g. broad distinct lows of k over sandy sediments of the last glaciation in central northern Europe and other sedimentary basins. More localized positive k anomalies occur near young volcanism, or old basalts exposed on the surface. On the other hand, frequency dependence of k displays a much more scattered behavior, indicating either high noise level, or large local variability. Clearly distinguishable, small-scale patterns in the randomized data set indicate that the latter is more likely. This indicates that local influences on soil magnetic properties, including anthropogenic effects, may be easier detected by frequency dependence than by k itself, which is largely controlled by geological and climatic background variability. Mapping the isothermal mineral magnetic properties shows again a clear relation to large scale European geology. Thereby, the GEMAS data set of magnetic parameters provides a continent wide reference of the natural background in Ap soil. For the first time the geological background variability of magnetic minerals for national and local soil studies is defined at the European scale.