GEMAS: Unmixing magnetic properties of European agricultural soil

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High resolution magnetic measurements provide new methods for world-wide characterization and monitoring of agricultural soil which is essential for quantifying geologic and human impact on the critical zone environment and consequences of climatic change, for planning economic and ecological land use, and for forensic applications. Hysteresis measurements of all Ap samples from the GEMAS survey yield a comprehensive overview of mineral magnetic properties in European agricultural soil on a continental scale. Low (460 Hz), and high frequency (4600 Hz) magnetic susceptibility k were measured using a Bartington MS2B sensor. Hysteresis properties were determined by a J-coercivity spectrometer, built at 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. The resulting data are used to create the first continental-scale maps of magnetic soil parameters. Because the GEMAS geochemical atlas contains a comprehensive set of geochemical data for the same soil samples, the new data can be used to map magnetic parameters in relation to chemical and geological parameters. The data set also provides a unique opportunity to analyze the magnetic mineral fraction of the soil samples by unmixing their IRM acquisition curves. The endmember coefficients are interpreted by linear inversion for other magnetic, physical and chemical properties which results in an unprecedented and detailed view of the mineral magnetic composition of European agricultural soils.