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Production of high resolution topsoil magnetic variability maps for England and Wales and an initial assessment of the importance of soil forming factors upon magnetic enhancement.

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Magnetic enhancement of topsoil was first observed over half a decade ago (Le Boyne 1955). Since then several theories have sought to explain the chemistry, physics and formation of the minerals that commonly produce the enhanced magnetic effect in soils of the temperate/Mediteranean climate zones. Dearing et al. (1996) tested several theories by creating and analyzing maps of low field magnetic susceptibility (χ_{LF} $\times$ 10^{-6} m^3 kg^{-1}) and frequency-dependent susceptibility (χ_{FD} $\times$ 10^{-9} m^3 kg^{-1} and χ_{FD}%) of soils across England based on measurements of the National Soil Resource Institute's (NSRI) National Soil Inventory (NSI) sub-sampled at 10 km grid intersections. From this analysis, a conceptual model of secondary ferromagnetic mineral (SFM) formation was constructed that describes the role of different environmental factors and biogeochemical processes responsible for the magnetic patterns observable at different spatial and temporal scales.

The present study has elevated the spatial - resolution of the previous study by Dearing et al. (1996) to a 5 km grid by analyzing an additional 3701 topsoil samples for low field susceptibility and frequency dependent magnetic parameters (χ_{LF} $\times$ 10^{-6} m^3 kg^{-1}, $\chi_{FD}\times$ 10^{-9} m^3 kg^{-1} and χ_{FD}%). Maps of each parameter containing 5656

and 5279 (for frequency dependent data) samples for England and Wales will be presented together with a further map denoting samples that are dominated by pollution, most likely due to fly-ash particles.

By employing spatially corresponding a) soil attribute data from the NSI, b) climate data from the Met Office and c) geological data from the British Geological Survey, the univariate influence of 'soil forming factors' (or representative variables for the soil forming factors) upon the soil magnetic signature has been examined. Zero order correlations suggest that the interlinked factors of *Parent material* and *Drainage* are extremely important. *Parent material* is the predominant source of Fe and the degree of *Drainage* a significant influence upon the soils redox potential and the dissolution of SFMs. By using multiple regression and constraining the dataset so that certain factors are held constant other factors such as *Mean Annual Rainfall* (MAR) emerge as potentially important. Over a third of the variance in Log $_{b(10)}\chi_{LF}$ $\times 10^{-6}$ m^3 kg^{-1} and χ_{FD}% can be accounted for when using variables that represent soil forming factors in a standard multiple regression.