PEDOGENIC IRON OXIDES IN SOILS: MAGNETIC CHARACTERIZATION AND LINK TO THE CLIMATE

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Soils are generally found to be magnetically enhanced with respect to the material from which they form, due to the formation of pedogenic iron oxides. These oxides include weakly magnetic minerals such as ferrihydrite, goethite, and hematite, and strongly magnetic, ultrafine maghemite. The latter is considered the major responsible for the magnetic susceptibility enhancement. The mechanism by which these iron minerals form, and the time required for pedogenesis to eventually reach a steady state, is not completely understood. Nevertheless, a significant correlation is found between magnetic enhancement of modern soils and rainfall, which allows to establish a so-called climofunction that can be used to reconstruct the past continental climate from susceptibility measurements of paleosols.
However, there are at present three main limitations to this approach: 1) although the correlation with rainfall is significant, there is a large scattering of available data, which prevents a precise use of a climofunction based on a limited number of samples, 2) different climofunctions are needed to explain the magnetic enhancement of soils from different regions, even when formed on a similar parent material: for example, loessic soils from Northwestern US are systematically less enhanced than soils from the Chinese Loess Plateau, while many soils formed on Pampean loess (Argentina) are not magnetically enhanced, 3) some contradictions have been found among soils from the Chinese Loess Plateau.
Our knowledge about the magnetic enhancement of soils can be improved by addressing the following questions: 1) does the parent material influence pedogenesis? 2) is the usual estimate of susceptibility enhancement, obtained by subtracting a “background susceptibility”, correct? 3) is rainfall the only climatic parameter driving the formation of new iron minerals? 4) is a steady state eventually reached?
By addressing these questions I will show how it is possible to eliminate some of the problems encountered in establishing a universal climofunction. Results obtained so far are very encouraging, since they reconcile differences previously observed between soils from different regions, and increase the quality of the correlation with climate.

Soils, pedogenic magnetite, climate

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