ROCK MAGNETISM IN PRESENT SOILS IN THE CENTER OF CÓRDOBA PROVINCE, ARGENTINA

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Resumen.

En el presente trabajo se analizan resultados de parámetros magnéticos obtenidos de perfiles de suelos vírgenes y cultivados de la Serie Manfredi, en la provincia de Córdoba, Argentina. Estos suelos se encuentran en la misma región geomorfológica, bajo el mismo régimen climático, e igual posición topográfica. Sobre la base de los resultados obtenidos se aporta al conocimiento de la influencia de la actividad antrópica en la distribución de los minerales magnéticos en el perfil de suelo.

Palabras Clave: Suelos Actuales. Magnetismo de rocas. Antropización

Abstract

This paper deals with the results of magnetic parameters obtained from cultivated and pristine soil profiles which belong to Serie Manfredi, in Cordoba Province, Argentina. These soils are in the same geomorphological region, under the same climate and on the same topographical position. Based on the obtained results the influence of human activity in the distribution of magnetic minerals in the soil profile is analyzed.

Keywords: Present soil. Rock Magnetism. Anthropization

Introduction

Figure 1. Location Map

To understand the influence of climate in soil is very important because this knowledge is extrapolated in order to elucidate paleoclimate and its relationship with magnetic properties.
In short, there are two models: one of them proposes that the magnetic signal is mainly organic in its origin and the other one suggests a main inorganic origin. (Orgeira et.al.2011)
The sediments contain some percentage of magnetic minerals, which are oxidized or reduced depending on the environment where they lye. The change in magnetic mineralogy ressembles changes in the source area detritus, as well as diagenic and pedogenic changes. (Orgeira et.al. 2008,among others).
This contribution presents the preliminary results of magnetic properties of soils which are in the same climate, in the same geomorphological region and equal topographic positions. One of them is in pristine condition, while the other one has been cultivated, with soybean-corn-soybean rotations over the last 30 years. The depth of the roots of the soybeans is 12 cm and the depth of corn roots is 30 cm.
Analyzed soils are inside the Plataforma Basculada (Tilted Platform) (Capitanelli. 1979), which is characterized by extended flat hills with slopes ranging between 1 º and 3 º and parent material constitued by silty loamy loess.
Manfredi Series represents the lowlands that bisect the hills. (Figure 1 Location Map) The soils are deep and well drained, silty loamy in texture, with an incipient B horizon with slight clay enrichment and irregular prismatic structure, with coatings on the faces of the aggregates. (Hoja Oncativo. INTA 1987)

Methods and Materials

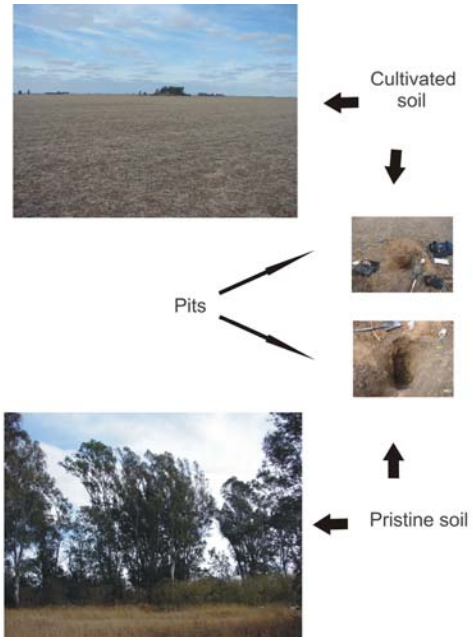

Figure 2. Soils and pits

The samples were taken from pits, with vertical equidistance of 5 cm,. (Figure 2. Soils and pits)
In the laboratory they were dried, disaggregated by the use of mortar, and were stored in plastic containers to be analyzed later.The susceptibility measurement was carried out with a Bartington MS2 at two frequencies (470 Hz-4700 Hz). Hysteresis parameters and low frequency susceptibility were obtained with a vibrating magnetometer (VSM) Molspin. Measurements at high and low temperatures were performed with a AGICO susceptometer Kappabridge.

Results and Discussion

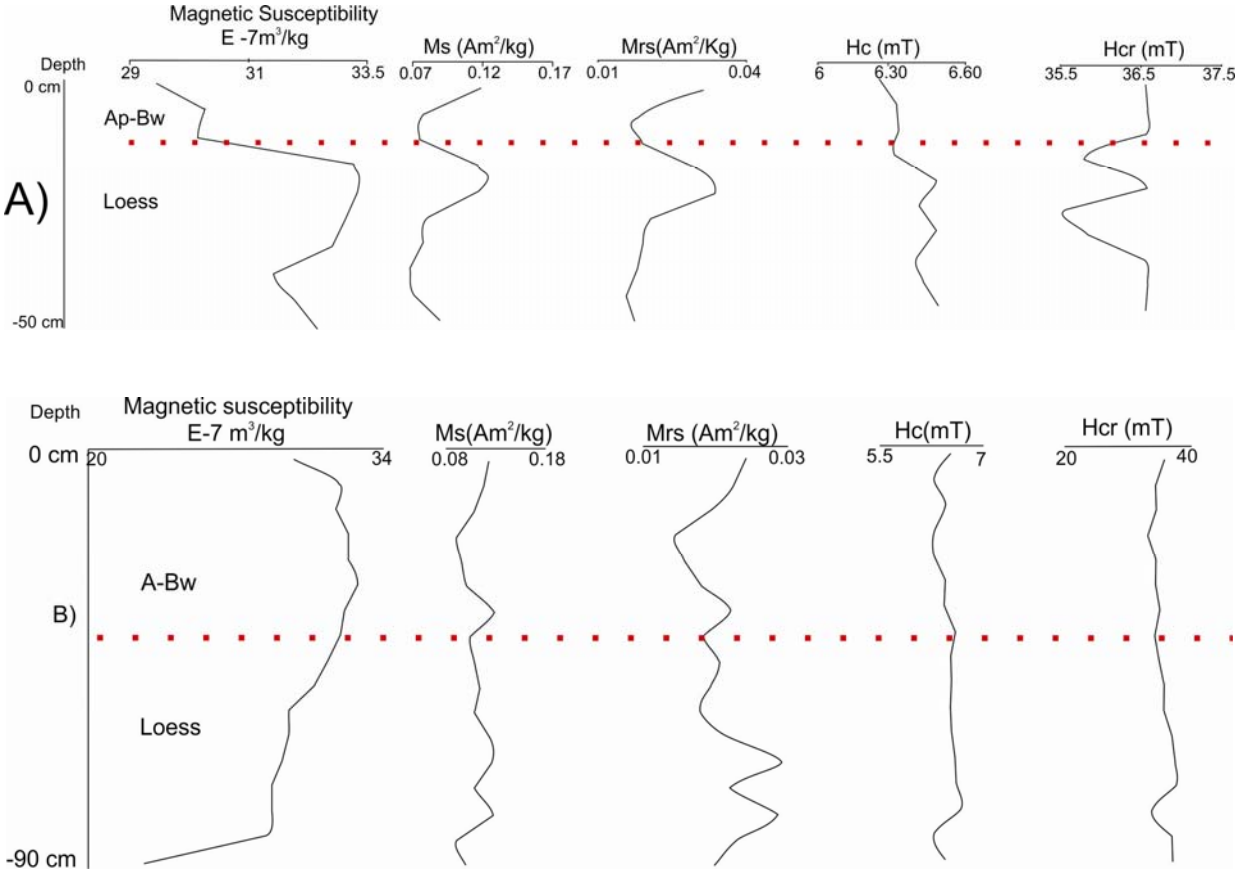

Figure 3. Magnetic properties of cultivated soil (A) and pristine soil (B)

All concentration dependent parameters of magnetic material vary in a similar way, therefore in order to make a simplified analysis, only the variations of the magnetic susceptibility along the soil profile will be taken into consideration

Figure 3 (Magnetic Properties) represents the magnetic susceptibility variations in the pristine soil profile Series Manfredi where an enhancement of around 30% with respect to the parent material is to be seen. The parent material exhibits values of 29 E-7 m3/kg. Bw and A horizons have values between 30-32 E-7 m3/kg. Ms and Mrs show a slight increase and Hc and Hcr, slight decrease.

The values of Hcr / Hc vs. Mrs / Ms indicate a mixture of particles of single domain and superparamagnetic size (Dunlop. 2002) for both soils. (Figure 4 Dunlop plot)

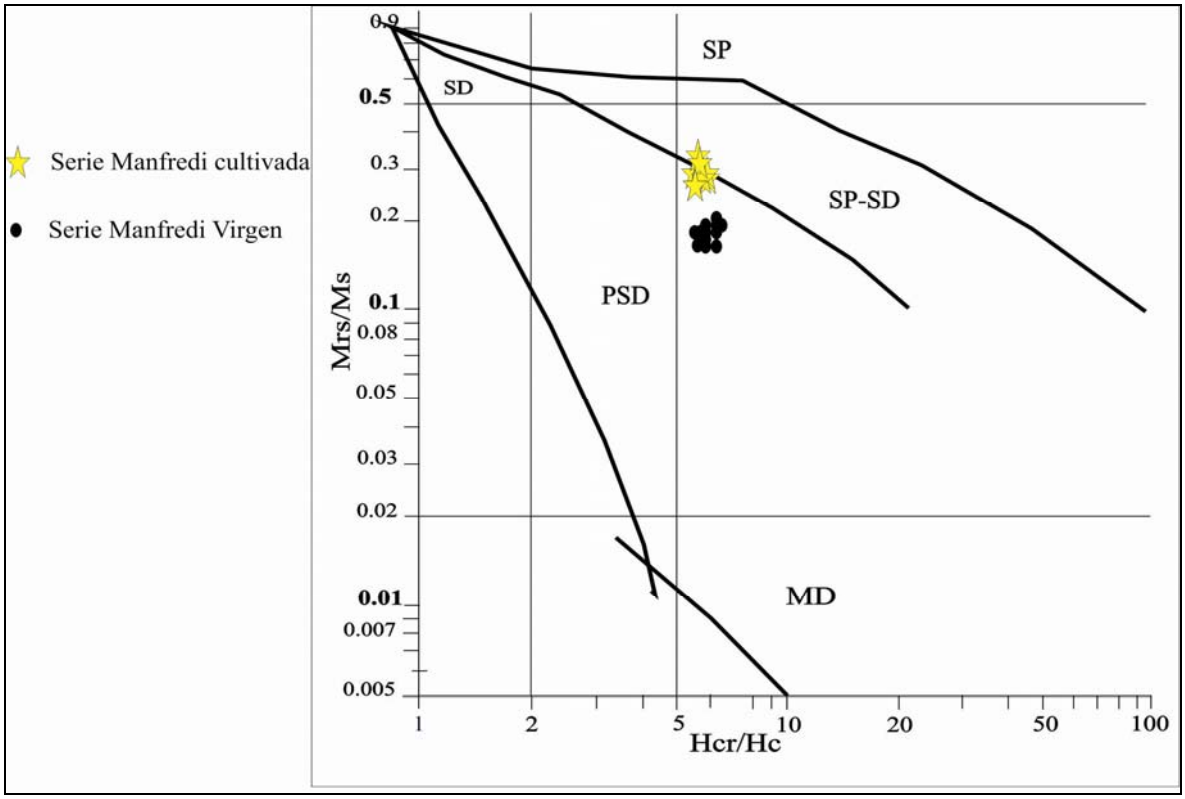

Figure 4. Dunlop plot

Variations in susceptibility at high and low temperature (Fig. 5) indicate magnetite or titanomagnetites and the cooling curve could be a wide Verwey transition.
Variations in magnetic susceptibility throughout the soil profile of cultivated Manfredi Series experience a depletion of around 10% compared to the parent material, from values of 32 E-7 m3/kg in Ck, up to values of 28 E-7 -29 m3/kg in Bw and A horizons . This is accompanied by a decrease in the Ms and Mrs and a slight increase in Hc and Hcr.

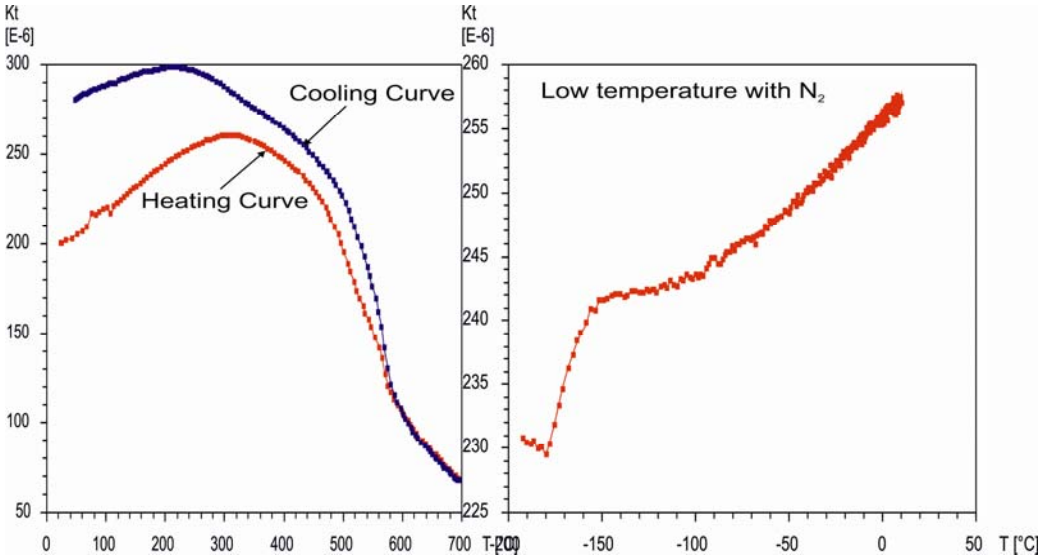

Figure 5. High and low temperature of the C horizon from the pristine soil. Magnetic susceptibility (Kt E-6) vs. Temperature (ºC)

Conclusions

The variation of magnetic susceptibility of the cultivated Manfredi series indicates a depletion of magnetic material which may be the result of the excessive contribution of organic matter due to fertilizers and manure which are added to increase crop yields. This input of organic matter would change the normal pH and Eh of soil, favouring the depletion of magnetic minerals. The pristine soil has higher susceptibility in the overlying horizons with respect to parent material; this behaviour is naturally related to climate, drainage and elapsed time.

Acknowledgment

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