ABSTRACT

The magnetic properties of minerals in soils along a west to east transect between Cuchillo Co (La Pampa province) and Necochea (Buenos Aires province) allowed to interpret the relationship between magnetic parameters and edaphological development. The transect of soils represents a climosequence with an aridic soil moisture regime in the west and ustic to udic in the east, in the Pampean Region, Argentina. Rainfall ranges from 450mm/year in the west to 850mm/year in the east in the studied area.

The climatic gradient strongly regulates the soil forming processes, causing morphological differences between soils, mainly at the two ends of the climatic sequence. Towards the west, under semi-arid regimes, the shortage of rainfall inhibits the alteration, neoformation, and translocation of clays, and the sequences of soil horizons are C-Ck or A-AC-Ck. Conversely, the soil profiles show a more evolved sequence of horizons towards the east (A-Bt-BC-C). In intermediate areas transitional soils with Bw horizons are represented.

Three different orders of soils were recognized in the studied area: Aridisols, Entisols and Mollisols. In turn, among these orders it is possible to differentiate the following great groups: Haplocalcids, Petrocalcids, Torripsamments, Haplustolls (aridics and typics), Argiustolls, and Argiudolls. Seventeen (17) soil profiles, with degrees of development ranging from degree 0 in the west to degree 3 in the east, were studied by conventional edaphic as well as magnetic methods.

Iron minerals in soils are sensitive to environmental changes, providing valuable data for studying environmental conditions at regional level, as in the present case of a transect of soils covering a distance of 600 km.

Despite differences in the rainfall regime in the region and the degree of pedogenetic development, a single model of *magnetic behavior* is evident throughout the region. This model is characterized by an increase *of the magnetic signal* (magnetic susceptibility) from the parent material towards the solum of the soil profile.

Magnetic parameters χdf, χ_{MRA}, MRA/MRIS measured in all the samples from the different horizons indicated a greater concentration of fine ferromagnetic minerals in the solum, especially in the more evolved soils. On the other hand, coercivity remanence (Bcr) and interparametric relations such as MRIS/χ and χ_{MRA}/MRIS gave valuable information indicating that they are also sensitive for different degrees of development. Lower values of Bcr as well as MRIS/χ, and higher values of χ_{MRA}/MRIS were associated to the solum, whereas the reverse relationship was registered in the horizons least affected by pedogenesis (BC-C).

Such behavior would be generated by a greater contribution of fine grain size titano-magnetite at the boundary SP/DS in the solum. Genetically, such minerals should be the result of at least two processes: preferential accumulation of ferromagnetic iron minerals and ferromagnetic oxides produced by biomineralization.

Complementary studies were performed by using X-ray difractommetry, scanning electron microscopy (SEM) and X-ray microanalysis (EDX) which enabled us to obtain extra information for the analysis of magnetic data. The magnetic grains are mainly within the medium to coarse silt-fine sand fractions and are of lithogenetic origin. In the fraction coarser than 50 μm dominate the sub-rounded to rounded habits of crystals while in the less than 50 μm fraction it is frequent to find octahedrical crystals of titano-magnetites.

The different techniques used here allowed to assert that the main carrier of magnetic records in the soils studied are mainly titano-magnetites with low content of Titanium and a smooth process of oxidation at low temperature. Applying thermal demagnetization accompanied by susceptibility measurements at high and low temperatures provides relevant information in order to characterize the magnetic mineralogy.

Susceptibility at low temperature allowed to infer about different levels of pedogenetic development from the analysis of the slope of the curve obtained. The Verwey transition is useful in determining the contribution of magnetite but it was determined a clear relation between the slope of the curve and the pedogenetic evolution. More evolved soils showed steeper slope of the curves overcoming the

Verwey transition. This behavior is attributed to the greater relative contribution of finer magnetic minerals.

Once the model of magnetic behavior for the soils in the transect was established, additional studies were conducted on soils located in the central and northern region of the Buenos Aires province, where rainfall is more abundant. The magnetic pattern characterized by an increase of the magnetic signal to the solum extends to the vicinity of the town of Tandil. In contrast, the soils for the La Plata-Punta Indio zone (north of Buenos Aires) show an opposite model of magnetic behavior; i.e. the susceptibility decreases towards the solum. The soils at the north of the Buenos Aires province have degrees of development 4 and 5. Because of that, it is estimated that a degree 3 of pedogenetic development is the limit from which magnetic pattern change.

Between the regions with opposite behavior, a transition zone in which magnetic parameters could not be directly associated to any of the two above-mentioned models was also determined.