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Using magnetic susceptibility to qualitatively assess soil erosion on cultivated slopes of the Eastern Rif, Morocco

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The soil resources in the Rif are at serious risk because of the increasing anthropogenic pressure that gradually is transforming larger surfaces of natural soils into agriculture land. The application of the magnetic properties to assess soil degradation is based on the specific behaviour of the iron components that almost fully control the magnetic order in the soil. The distribution of magnetic minerals within the soil profile allows to asses the status of the soil evolution and its degradation features. Thus, in the case of stable soils there is a constant increase of the magnetic susceptibility from the deep layers to the soil surface. On the contrary a degraded soil shows an irregular distribution of the magnetic susceptibility and lower values.

This study was conducted on an area of the Eastern Rif in Morocco that is characterized by severe soil erosion due to the combination of highly erodible substrate, intense rainstorm events as well as important degradation of the vegetation cover. A soil sampling was carried out taking into account the main factors controlling the soil evolution such as lithology, slope degree and land cultivation. A total of 36 soil cores distributed along representative slopes were sampled. Soil samples were collected also on young alluvial areas for its comparison with those materials derived from the alteration of the slopes in the study area.

The measurements of the magnetic susceptibility were made with a susceptibilimeter Bartington type with an MS2B probe on 216 soil samples. The soil cores were sectioned each 5 cm for the analyses of magnetic susceptibility. From these measurements a clear distinction between soil groups was made based on the ranges of magnetic sus-

ceptibility, below and above 40 10^{-8} m^3/kg. For the two groups of soils, the magnetic susceptibility varied both in the soil depth profile and along the soil toposequence. These differences were related to the influence of the main erosion factors. The lithology appears to be the main factor for the variation of the magnetic susceptibility of soil particles. The topographic factor and the land use play different roles. The slope determines the evolution of the magnetic susceptibility due to the continuous lost of the top soil. The elimination of the natural vegetation cover and the shifting to cultivated land for cereals has a negative impact on the soil evolution, and for the same values of slope and substrate the magnetic susceptibility decreases significantly. On the contrary, soils on steep slopes but with natural vegetation cover retain better the magnetic minerals than those with gentler slopes that are under cultivation. The range of values of magnetic susceptibility in the soils developed on recent alluvial materials are similar to those on the slopes of the study area, indicating that the latter are the main source of sediments transported by the river system in the area. These results show that the human action by grazing, clearing and especially tilling has weakened the soil and made it much more vulnerable to erosion. The analysis of the main erosion factors can help to promote the rational use of the land and to establish conservation strategies in these fragile agroecosystems.