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Mössbauer spectroscopy: an excellent additional tool for the study of magnetic soils and sediments

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Since the discovery a half century ago of the resonant gamma absorption, known as the Mössbauer effect, the derived spectroscopic method (MS) has proven to be a very suitable tool for the characterization of soil and rock minerals. From the conventional absorption spectra of iron containing compounds, so-called hyperfine parameters are derived which are more or less typical for each kind of mineral. So, MS has a certain analytical power for the characterization of iron-bearing minerals. This is especially true for magnetic minerals for which the spectrum contains an additional hyperfine parameter. Moreover, MS also allows retrieving information about the magnetic structure and behavior. Because the relative area of the spectra is to some extent proportional to the amount of iron atoms in their environment, MS yields not only quantitative information about the various minerals present but also about the iron in the different crystallographic sites.

The power of MS as an excellent additional tool for the study of magnetic soils and sediments could be well demonstrated in the joint research with Jozef Hus (CPG-IRM, Dourbes). In our common work, the emphasis went mainly to the study of Chinese loess and soils. Using MS on magnetically separated samples the various magnetic species in a loess and its associated soil were for the first time discerned in a direct way. Further, magnetically enriched samples of four different loess/paleosol couplets from a loess sequence in Huangling have been systematically investigated by MS. From the obtained qualitative and quantitative information the neoformation of magnetite/maghemite in the soils, responsible for the increased observed remanence and susceptibility, could be evidenced.