Deducing the role of eolian dust sedimentation during soil forming periods on mineral magnetic records and its implications for paleoclimate reconstructions

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Obtaining reliable global and regional records of the past climatic changes during the glacial Pleistocene is of prime importance for building up consistent climate models of the near and far future. Magnetic signature along sequences of alternating loess and (paleo)soil units from the terrestrial environments is considered as semi-continuous record of climate change in the geological past. However, soil formation in aeolian landscapes may occur under different and changing conditions of dust sedimentation. Viewing from this standpoint the depth variations of several rock magnetic characteristics along profiles of Holocene soils from low Danube area allowed us to establish a set of criteria for identification of the past regimes of aeolian sedimentation persisted during the soil forming periods. A conceptual model for the time evolution of the grain size of the pedogenic magnetic fraction with soil depth is proposed, which is built upon the mechanism of soil formation - accretional or stable land surfaces, or a combination of the two. According to the proposed conceptual model, discrimination between accretional soils and soils developed without dust additions during soil forming period can be done. Accretional soils are characterized by parallel changes in grain size sensitive magnetic proxies. Soils, developed at stable landscape conditions show gradation of the depths at which maximum enhancement of various proxies occurs with deepest occurrence of the maximum in frequency dependent magnetic susceptibility, followed by depth of maximum anhysteretic susceptibility and the normalized anhysteretic to isothermal remanence acquired at 100mT field. It is shown that the mean coercivity of the pedogenic component of accretional soils is higher than that of soils developed without eolian input at equal temperature conditions because of the soils’ thermal gradient and different depths, at which pedogenic minerals form in the two settings.