GC2024-PERM044

Rock-magnetic indicators of climate in subaerial deposits, how do they work?

Alexey Y. Kazansky[1,2]

[1] Lomonosov Moscow State University
[2] Geological Institute of the Russian Academy of Sciences

Ponencia invitada

kazansky_alex@mail.ru

Loess and loess like subaerial deposits are one of the most complete and least ambiguous palaeoclimatic archives on the continental Earth's surface. It is the most extensive type of Quaternary sediments deposits, covering nearly 10% of the land surface, including large territories of semi-arid and forest steppe environments from Europe Asia and America. Measurements of magnetic properties play a sufficient role in palaeoenvironment reconstructions of loess-palaeosol successions all over the world. In early studies the magnetic proxies, such as low field (Klf) and frequency-dependent (Kfd) magnetic susceptibility, were the most popular magnetic parameters me and which were interpreted in commonly accepted models: the pedogenic magnetic enhancement. This "pediogenic "or "Chinese" mechanism explains synchronous increase of Klf and Kfd in soil horizons by the neoformation and enhancement of ultrafine superparamagnetic grains in palaeosols in the course of pedogenesis. This mechanism was firstly developed for loess-palaeosol successions of the Chinese Loess Plateau and later successfully applied to European and Central Asian loess provinces [1]. Relation between Klf and Kfd in this model follows so called 'true loess line" [2]. Nevertheless, loess-palaeosol magnetic properties in some regions not al do not fit this line and located far from the predicted model. Thus for loess-palaeosol successions in Alaska, which demonstrate an opposite trend – increase of Klf in loess and decrease in paleosol with near zero Kfd values the "wind-vigour" or "Alaskan" model was proposed. The opposite character of rock magnetic characteristics was explained here by strong winds bringing more magnetic materials during glacials and low wind intensity and weak pedogenesis during interglacials [1]. These two models are finite members of the whole variety of climatic changes in different climatic and geomorphological environment and, consequently, the response of magnetic parameters to climatic changes in there will be different. This, in turn, prevents a wide application of the magnetic parameters of loess-paleosol successions.

This brief review highlights the current magnetic enhancement models with special emphasis on the identification of unusual trends in magnetic enhancement and understanding their drivers. Using specific examples from the world practice and our research, the main mechanisms of changes in magnetic properties under the influence of climate will be discussed. Among them are: superposition of the "Alaskan" and "Chinese" mechanisms, which we called the "Siberian" one [3]; dissolution of fine magnetic grains due to leaching in waterlogging conditions in periglacial zone; variations in the source of magnetic minerals of aeolian origin; surface oxidation of magnetic grains; chemical alteration of magnetic grains; physical fragmentation of magnetic grains resulted from weathering and some other. It will be demonstrate that all mechanisms can coexist in one section and mechanism change can occur in same section and/or within one region. Because the behavior of different magnetic parameters is not uniform in the models described above this differences should considered in interpretations of magnetic data in climatic sense.

[1] Evans M.E., Heller F. Environmental Magnetism. - New York : Academic Press, 2003.

[2] Zeeden, C., Hambach, U., Veres, D., Fitzsimmons, K., Obreht, I., B¨osken, J., Lehmkuhl, F., 2018. Millennial scale climate oscillations recorded in the lower Danube loess over the last glacial period. Palaeogeogr. Palaeoclimatol. Palaeoecol. 509 (2018) , 164–181.

[3] Matasova, G.G., Kazansky, A.Y., Zykina, V.S., Superposition of Alaskan and Chinese models of paleoclimate records in magnetic properties of Upper and Middle Neopleistocene deposits in southern West Siberia. Russ. Geol. Geophys. 44, (2003) 638–651