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Wind-blown origin of the Neogene red clay in the Pannonian Basin

J. Kovács

University of Pécs, Department of Geology, Pécs, Hungary H-7624 Pécs, Ifjúság u. 6, (jones@gamma.ttk.pte.hu)

The red clay is a significant deposit underlying the Quaternary loess–paleosols sequence in the Pannonian Basin. The development of the red clays correlates with pediment formation at the end of the Miocene (Messinian) and at the beginning of the Pliocene (Zanclean–Piacenzian, 4.6–3.2 Ma B.P.). The oldest red clay horizons can be found on foothills of Hungarian mountains. The sedimentary processes involved and the origin of the materials remain controversial. In particular their grain-size distribution is compared with that of typical Quaternary loess–paleosols, as well as lacustrine and fluvial sediments. It appears from the sedimentological data that the main part of the red clay is of a wind-blown origin. The red clay was transported by weak westerly winds and has been modified by post-depositional alteration.

The comparison of the grain-size distributions of the red clay and the lacustrine sediments indicates quite different sedimentary environments. Visible differences between the grain-size distributions of the red clay and the fluvial sediments make obvious that the red clay is unlikely to have had a fluvial origin. The particle-size characteristics of the Neogene red clay sediments are very similar to those of the paleosols (reddish clay) within the Pleistocene loess deposits, suggesting an eolian origin for the red clay. A small amount of slight differences between the grain-size distributions of these sediment groups however indicate some differences in transport modes and depositional environment. It appears from the sedimentological data that the main part of the red clay is of a wind-blown origin. The red clay cannot be considered as a weathering product of the bedrock because the chemical element composition of both formations is quite different. The red clay was transported by weak westerly winds and has been modified by post-depositional alteration. The Late Miocene sediments within the Pannonian Basin are loosely consolidated sediments, which underlie the Great Hungarian

Plain. The Late Miocene sediments consist of marine and shallow lacustrine deposits of conglomerates, marls, sandstones, clays, and sands. Under suitably arid–semiarid conditions and/or limited vegetation cover, these sediments would provide a source of loose granular material, which could be entrained by eolian processes. Recently it has been held that the desertification of Pannonian Basin corresponds to the Messinian Salinity Crisis. The Late Miocene or Messinian was a semiarid or semidesert climatic period. The climate of the Early Pliocene was a transition between semidesert and savannah. The desert climate conditions are reconstructed from the fossils (*Meriones*, etc.) and the carbonate evaporites, pebbles covered by desert varnish, which can be found W Hungary and Pest Plain. Laboratory experiments have demonstrated the possibility that eolian reworking of the Messinian sands and other similar deposits could theoretically contribute material to the red clay, loess and loess-like deposits of the Pannonian Basin.

We conclude that the red clay in the Pannonian Basin is of a wind-blown origin and that it was consequently affected by weathering processes in the Pliocene.