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High resolution multi-proxy study of the Süttő loess-palaeosol sequence, Hungary

Erzsebet Horvath (1), Manfred Frechen (2), Agnes Novothny (3), Paul Königer (4), Christine Thiel (5), Lara Wacha (6), Christian Rolf (7), Ulrich Hambach (8), Gabriella Barta (9), and Bernadett Bajnoczi (10)

(1) Eötvös Loránd University, Institute of Geography and Geology, Department of Physical Geography, Budapest, Hungary (herzsebet@gmail.com), (2) Leibniz Institute for Applied Geophysics (LIAG), Hannover, Germany, (3) Eötvös Loránd University, Institute of Geography and Geology, Department of Physical Geography, Budapest, Hungary, (4) Leibniz Institute for Applied Geophysics (LIAG), Hannover, Germany, (5) Leibniz Institute for Applied Geophysics (LIAG), Hannover, Germany, (6) Leibniz Institute for Applied Geophysics (LIAG), Hannover, Germany, (7) Leibniz Institute for Applied Geophysics (LIAG), Hannover, Germany, (8) University of Bayreuth, Geosciences, Bayreuth, Germany, (9) Eötvös Loránd University, Institute of Geography and Geology, Department of Physical Geography, Budapest, Hungary, (10) Institute for Geochemical Research, Hungarian Academy of Sciences, Budapest, Hungary

Abstract

The loess-palaeosol record at Süttő (47°44.26' N, 18°26.87' E, 256 m a.s.l.), Hungary provides an excellent high-resolution archive for palaeoenvironmental changes of the Northern part of the Carpathian Basin. Loess deposits up to 20 m thick cover the Süttő travertine complex, located next to the right bank of the Danube River. The loess is intercalated by two greyish stratified horizons, three brownish steppe-like soils and a pedocomplex, which is preserved in a small palaeovalley, including a reddish-brown palaeosol covered by a chernozem-like palaeosol.

Detailed infrared stimulated luminescence (IRSL) dating was carried out, revealing more or less continuous sedimentation from MIS 6 to MIS 2. Independent age control is provided by radiocarbon dating for the upper part of the profile, by infrared radiofluorescence (IRRF) dating for the bottom of the sequence and by amino acid racemisation (AAR) from the main loess units. Uranium-series (230Th/234U) dating correlates the travertine underlying the loess with MIS 7 (8).

The multi-dating approach provided an excellent chronological framework for the sediment succession at Süttő. In order to reconstruct the palaeoclimatic and environmental changes high resolution grain size, palaeomagnetic, geochemical (bulk carbonate stable isotope composition and n-alkanes) and malacological analyses were performed, which provides a high-resolution multi-proxy record of the Süttő loess-palaeosol sequence. The MS curve of Süttő shows a clear difference between loess and palaeosol horizons, indicating the alterations of arid and more humid conditions. Clay-, sand-, coarse sand content and U ratio were calculated from the results of high-resolution grain size measurements. The clay content showed excellent agreement with the MS curve, both are providing a good proxy for the local temperature and precipitation regime.

Relative palaeointensities (RPIs) of the samples were calculated, using the intensity of magnetization after magnetic cleaning in alternating fields normalized by the bulk low field susceptibility or by the anhysteretic remanent magnetization (ARM). When the Süttő RPI record is compared to the high resolution RPI stack GLOPIS an impressive conformity supporting the chronological framework for the sediment succession at Süttő. The Mono Lake and the Laschamp excursion are recorded at the Süttő loess-palaeosol sequence between the depth of 6 and 7.5 m in RPI data but not in direction.

Secondary carbonates, biomineralization and bicarbonate solutions play a great role in the palaeoenvironmental reconstruction. The various types of secondary carbonates (e.g. calcified root cells, hypocoatings) provide different information on the palaeoenvironment, such as the velocity of the dust accumulation and the precipitation of the vegetation period (moister or drier conditions). The results of secondary carbonate analyses correlate well with the results of the malacological analysis and broadened our knowledge about the Süttő sequence.

In addition to those data sets we analysed the carbon and oxygen isotopic composition (δ13C and δ18O) of bulk carbonate and carbonate nodules in order to get further insight into palaeoprecipitation and palaeoclimatic conditions. To strengthen the interpretation based on isotopic data, we examined biomarkers derived from land plants (long-chain n-alkanes) for both loess and palaeosols to add information on the vegetation changes.

* Corresponding author: herzsebet@gmail.com