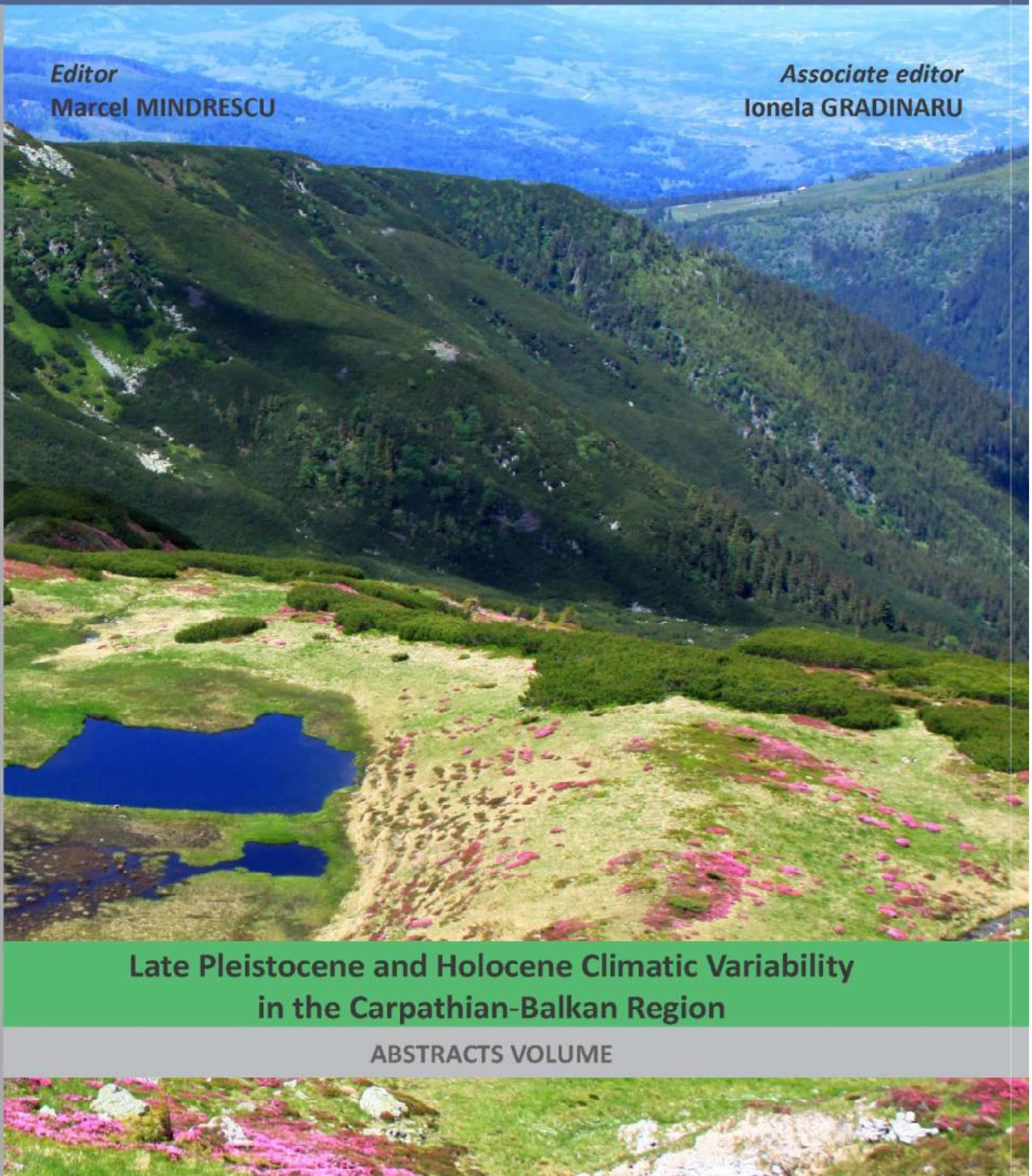
PAGES PAST GLOBAL CHANGES

cirques & lakes
PN-II-RU-TE-2012-3-0386

Editor
Marcel MINDRESCU

Associate editor
Ionela GRADINARU



Late Pleistocene and Holocene Climatic Variability in the Carpathian-Balkan Region

ABSTRACTS VOLUME

Ştefan cel Mare University Press

Nov. 2014
Late Pleistocene and Holocene climatic variability in the Carpathian-Balkan region. Abstracts volume
Ştefan cel Mare University Press

Environmental change indicated by a site-specific grain size ratio – the example of the Semlac loess-paleosol sequence (Romania)

Philipp Schulte[1], Frank Lehmkuhl[1], Holger Kels[1] and Nicole Klasen[2]

[1] Department of Geography, RWTH Aachen University, Templergraben 55, D-52056 Aachen, philipp.schulte@geo.rwth-aachen.de

[2] Institute of Geography, University of Cologne, Albertus-Magnus-Platz, D-50923 Cologne

Loess sequences provide important and at least a partial continuous record of Quaternary palaeoenvironmental change. In addition, loess-palaeosol sequences provide valuable information concerning environmental change and climate evolution. It is customary to reconstruct such changes by means of grain sizes ratios. In this study, we calculated an site-specific grain size (GS) ratio (Schulte et al. in review) and compare this ratio with the common U-ratio (Vandenberghe et al, 1985) and, in addition, with selected geochemical parameters. As an example we present the Middle to Late Pleistocene loess-paleosol section of Semlac in western Romania (MIS 10 – 1) (Fig. 1).

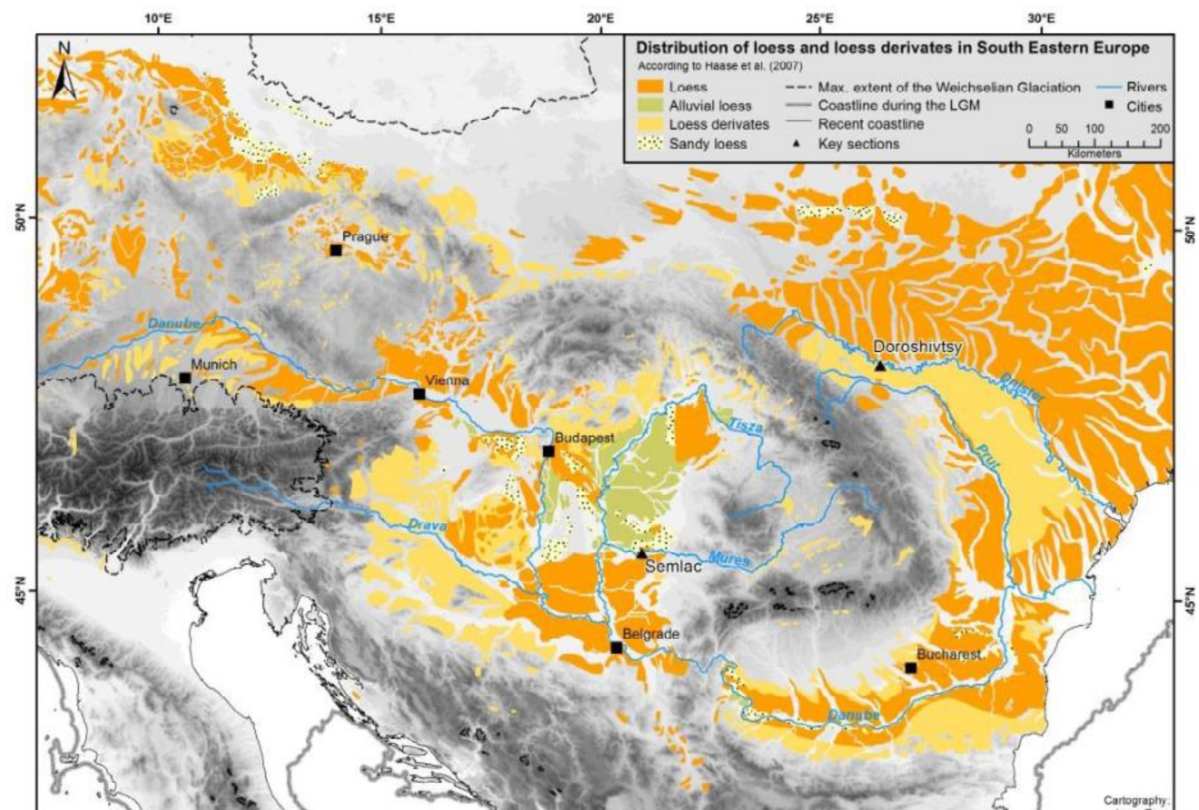


Fig. 1 Loess distribution in Europe (modified according to Haase et al. 2007), maximum extent of the Weichselian ice sheet, coastline during LGM and location of the Semlac section in south-western Romania.

Regional setting

The loess section Semlac (46°7'12.97"N / 20°56'54.70"E / ~100 m a.s.l.) is situated in the Arad Plain (Câmpia Aradului) in western Romania at an undercut slope position on the right bank of the Mureş River (Fig. 1). The more than 10 m thick section contains four main palaeosol complexes developed in very homogenous loess with high silt content without any major discordance. A first chronological model which is based on luminescence dating and rock magnetics suggests an age from the MIS 10 to MIS 1 (Kels, 2012, Kels and Hambach, pers. comm.).

Methods

The particle size was measured with a Laser Diffraction Particle Size Analyzer (Beckman Coulter LS 13 320 PIDS) by calculating the mean diameters of the particles within a size range of 0.04 - 2000 µm with an error of 2 %. To remove the organic matter, the samples were treated with 0.70 ml 30 % H2O2 at 70 °C for several hours. To keep particles dispersed, the samples were treated with 1.25 ml Na4P2O7 x 10 H2O for 12 hours. The Mie theory was applied to determine the grain-size distribution (Fluid RI: 1.33; Sample RI: 1.55; Imaginary RI: 0.1). To determine the element concentrations of the fine-grained fractions, the <63-µm fraction was sieved and dried at 105 °C for 12 hours. An 8 g-quantity of the sieved material was mixed with 2 g Fluxana Cereox, homogenized and pressed to single pellets with a pressure of 20 t for 120 s. To determine the element concentrations by x-ray fluorescence, a Spectro Xepos was used. Every sample was measured twice. Mean values were calculated from the two measurements. To characterize the sediment layers of the two sections we calculated a section specific GS-ratio respectively (0.04 to 5.88 µm / 11.29 to 26.15 µm for Semlac and 3.5 to 8.1 µm / 69.6 to 161.1 µm for Doroshivtsy). In order to ensure that each parameter of the ratio represents just one sedimentary or post sedimentary process, we narrow down the respective GS-range to the GS-classes which show constant variations with depth. For reasons of comparability we calculated the U-ratio of 44 to 16 µm versus 5.5 to 16 µm (Vandenberghe et al., 1985).

Results

For the 10.70 m thick sequence, 10 different main units can be distinguished (Fig. 2). The documented loess body contains four loess-palaeosol-complexes with individual features. Generally, the loess is comparably homogenous with a distinctive dominance of silt for the whole section, higher amounts of clay in-between the palaeosols and two major events with an increase of sand. The lower part of the sequence from 7.10 m on was decalcified. The section is labelled in the loess units from L1 to L4 and in the fossil soil complexes from S0 to S3 following the Serbian loess classification (Marković et al., 2008, 2009). The individual GS-ratio shows clear variations between the weakly weathered loess units and the palaeosol complexes (Fig. 3). The numerator of the ratio appears to be related to pedogenic processes and particularly to the relocation and new formation of clay minerals. The denominator is obviously related to the strength of the loess accumulation. In general, the Semlac-specific GS-ratio is lower in the loess sequences (especially in L1L1, L2, L3 and L4) and higher in the palaeosols (S0, S1, S2, S3). The L1S1 palaeosol, which was formed during MIS 3, is an exception; there is no distinct difference to the surrounding loess units. The results of XRF analysis showed comparable results to the GS-ratio. In particular, the Al/Na ratio which is shown in Fig. 2 showed a similar curve progression as a function of the loess units and the palaeosol complexes.

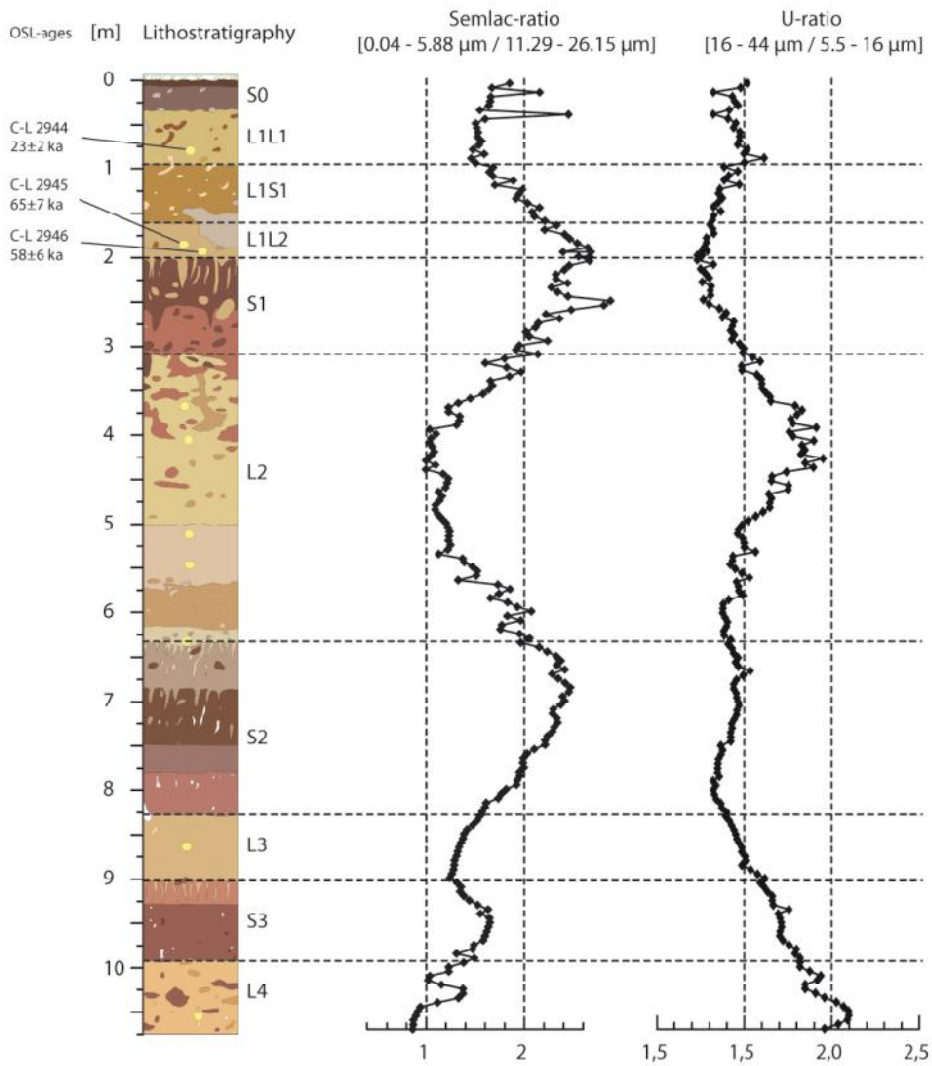


Fig. 2 Lithostratigraphy, specific GS-ratio, and U-ratio of the Semlac section. OSL dating was carried out on silty quartz samples (grain size 40-63 µm) and a standard SAR protocol. The central age model was used for De calculation.

Conclusion

In Semlac the natural outcrop is exposed at a plateau (Arad Plain) with likewise horizontal layers. The results from grain size measurements show that there was a very continuous accumulation of dust that took place under highly consistent circumstances of accumulation (source area and wind direction) since the MIS 10. During interglacial and interstadial periods well developed palaeosol complexes were formed. The GS-variation is mainly influenced by post-depositional processes (clay mineral relocation and -formation).

For the calculation of a specific GS-ratio the ranges of the entire GS spectrum should be selected which react as sensitively as possible on individual processes. The advantage of the site-specific GS-ratios compared to the U-ratio is their independency of firm boundaries and their higher sensitivity to individual sedimentary or post-sedimentary processes.

Acknowledgements

The authors would like to thank the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) for funding of the project in the context of the CRC 806 "Our way to Europe", subproject B1 "The „Eastern Trajectory“: Last Glacial Palaeogeography and Archaeology of the Eastern Mediterranean and of the Balkan Peninsula". We would like to thank several colleagues for support during the field work, especially Valéry Sitlivy (former Institute of Prehistoric Archaeology, University of Cologne, Germany), Cristian Ţuţu (Târgovişte, Romania); and several helpers from Romania and Germany.

References

Kels H. (2012). Stepping through the palaeolandscape: A transect from the Carpathian foothills to the lowland of the Romanian Banat, Quaternary International 279-280, 240-241.

Marković S. B., Bokhorst M. P., Vandenberghe J., Mccoy W. D., Oches E. A., Hambach U., Gaudenyi T., Jovanovi M., Zöller L., Stevens T., Machalett B. (2008). Late Pleistocene loess-palaeosol sequences in the Vojvodina region, north Serbia, Journal of Quaternary Science 23 (1), 73-84.

Marković S. B., Hambach U., Catto N., Jovanović M., Buggle B., Machalett B., Zöller L., Glaser B., Frechen M. (2009). Middle and Late Pleistocene loess sequences at Batajnica, Vojvodina, Serbia, Quaternary International 198 (1-2), 255-266.

Schulte P., Lehmkuhl F., Kels H., Loibl C., Klasen N., Hauck T. (2014) (in review): Environmental change indicated by grain-size variations and trace elements: examples from two different sections – the sandy-loess sediments from Doroshivtsy site (Ukraine) and the loess section Semlac (Romania). DUST2014 - 1st International Conference on Atmospheric Dust.

Vandenberghe J., Mücher H.J., Roebroeks W., Gemke D. (1985). Lithostratigraphy and palaeoenvironment of the Pleistocene deposits at Maastricht-Belvédère, Southern Limburg, the Netherlands, Mededelingen Rijks Geologische Dienst 39 (1), 7-18.