Multi-proxy-approach in palaeoenvironmental reconstructions using terrestrial sequences from southeastern Transylvania, Romania

S. Pötter[1], J. Bösken[1], U. Hambach[2], D. Veres[3,4], D. Kárátson[5], S. Wulf[6], I. Obreht[7], S.B. Marković[8], F. Lehmkuhl[1]

Introduction

Tephrochronology in terrestrial sediments gained increased attention throughout the last years, since it can be used to enhance chronostratigraphy and to correlate various archives. In southeastern Europe, this approach is frequently used because the region lies in the dispersal zone of several regional and supra-regional tephras. By distinct characterisation of these layers, paleoenvironmental data can be put in a temporal frame. In this study, the polygenetic sediment sequence Bodoc in Transylvania, which contains several tephra layers as well as periglacial features, was sampled in 2015 and is currently analysed in a multi-proxy-approach to reconstruct climate and landscape evolution in the region during the late Pleistocene. Geochemical, granulometric, photospectrometric and magnetic investigations are conducted and will be supported by luminescence and radiocarbon dating, as well as by tephrochronological methods.

Study site & sampling

The sediment sequence Bodoc is located in southeastern Transylvania, Romania (Fig. 1). The geomorphological setting of the section is influenced by fluvial, presumably aeolian and alluvial input since it is located on an alluvial fan at the left bank of the Olt river (560 m a.s.l.).

The section is situated ca. 20 km south of the Ciomadul volcanic complex, which provided regional (Karátson et al., 2013) and supra-regional tephra layers (Wulf et al., 2016).

The section was described and sampled in fall 2015. Sampling was conducted in two subprofiles (BOD 1 & BOD2) in a resolution of 5 cm. The sequence shows aeolian and fluvial influences and several tephra layers (Fig. 2). The lower part (BOD2) additionally shows periglacial features in form of cryoturbation and ice wedge casts (Fig. 4).

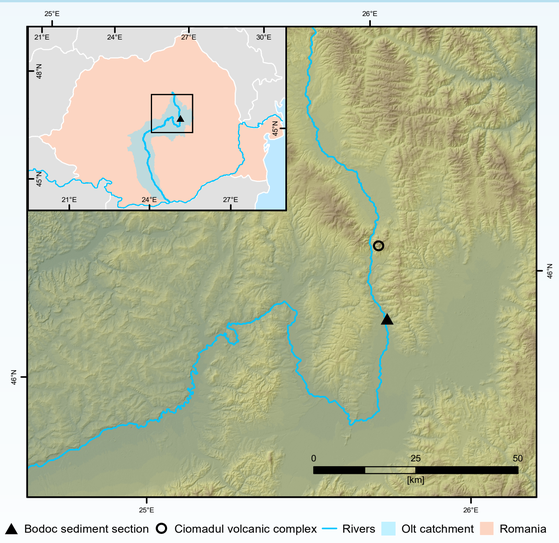

Fig. 1: Location of the study site and the Ciomadul volcanic complex in Romania.

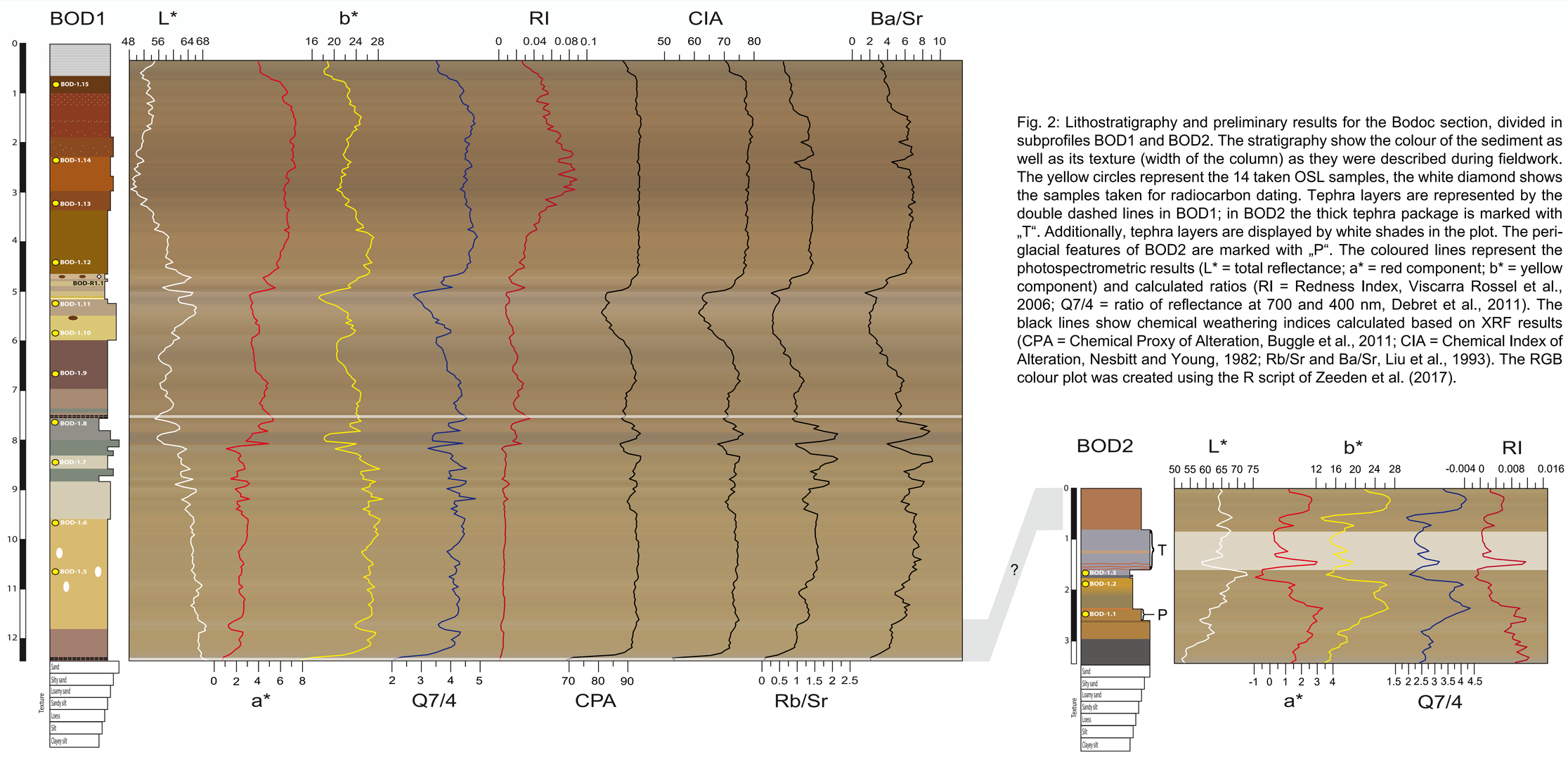

Fig. 2: Lithostratigraphy and preliminary results for the Bodoc section, divided in subprofiles BOD1 and BOD2. The stratigraphy show the colour of the sediment as well as its texture (width of the column) as they were described during fieldwork. The yellow circles represent the 14 taken OSL samples, the white diamond shows the samples taken for radiocarbon dating. Tephra layers are represented by the double dashed lines in BOD1; in BOD2 the thick tephra package is marked with „T“. Additionally, tephra layers are displayed by white shades in the plot. The periglacial features of BOD2 are marked with „P“. The coloured lines represent the photospectrometric results (L* = total reflectance; a* = red component; b* = yellow component) and calculated ratios (RI = Redness Index, Viscarra Rossel et al., 2006; Q7/4 = ratio of reflectance at 700 and 400 nm, Debret et al., 2011). The black lines show chemical weathering indices calculated based on XRF results (CPA = Chemical Proxy of Alteration, Buggle et al., 2011; CIA = Chemical Index of Alteration, Nesbitt and Young, 1982; Rb/Sr and Ba/Sr, Liu et al., 1993). The RGB colour plot was created using the R script of Zeeden et al. (2017).

Preliminary results

The results from the colour measurement and the geochemical analysis show a 4.5 m thick package of weathered sediment and buried soils at the top of the section (Fig. 2). The complex weathering indices (CIA and CPA) indicate homogeneous weathering intensities of the material. Below, a loess package is clearly visible in all data. In the lower part of BOD1, some fluvial influenced reduction horizon can be seen due to their dark grey-greenish colour and high weathering intensities. The lowest part of the subprofile again shows homogeneous structures, until the last samples reach a tephra layer, which shows low values for all weathering indices. The A-CN-K ternary plot shows a distribution almost parallel to the CN-joint, which indicates feldspar weathering (Fig. 3). The light shift to the right side shows a tendency to illitisation. The tephra at the bottom can be seen in the two points in the bottom-left corner of the plot.

The photospectrometic data for BOD2 shows similarities to the lithostratigraphy. Especially the iron bands at the bottom of the tephra package are indicated in the a*-value as well as in the redness index.

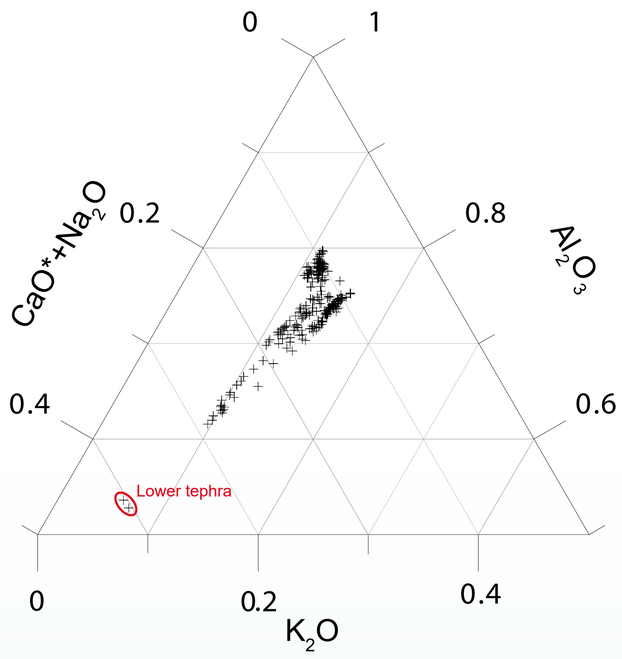

Fig. 3: A-CN-K ternary plot (Nestbitt and Young, 1989) for BOD1.

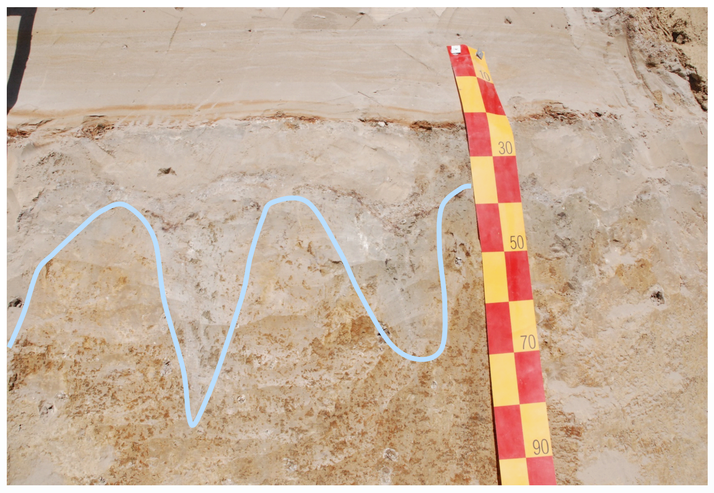

Fig. 4: Ice wedge casts next to the subprofile BOD2.

Conclusions & future work

The sediment sequence Bodoc shows great potential for palaeoenvironmental reconstruction in the study area. The various influences (aeolian, fluvial, alluvial and volcanic, as well as periglacial) lead to a certain complexity of this archive, which will be investigated in further analyses. The used set of methods can be used to disinguish between sedimentary units. Ongoing analyses regarding the geochemistry for BOD2 as well as magnetic parameters and the grain size will allow us a better understanding of the sedimentary dynamics of the sequence. Further geochemical investigations of the tephra layers as well as luminescence and radiocarbon dating will help us to help establishing a high-resolution geochronology.

Acknowledgements

This project is affiliated to the CRC 806 “Our way to Europe”, subproject B1 "The ‘Eastern Trajectory’: Last Glacial Paleogeography and Archeology of the Eastern Mediterranean and of the Balkan Peninsula", supported by the DFG (Deutsche Forschungsgemeinschaft, Grant number INST 216/596-2).

References

Buggle et al. (2011). Quaternary International (240), pages 12-21.
Debret et al. (2011). Earth Science Reviews (109), pages 1-19.
Karátson et al. (2013). Journal of Volcanology and Geothermal Research (255), pages 43-56.
Liu et al. (1993). Chemical Geology (106), pages 359-374.
Nesbitt and Young (1982). Nature (299), pages 715-717.
Nesbitt and Young (1989). The Journal of Geology (97), pages 129-147.
Viscarra Rossel et al. (2006). Geoderma (133), pages 320-337.
Wulf et al. (2016). Journal of Quaternary Science (31), pages 565-576.
Zeeden et al. (2017). Quaternary International (429), pages 100-107.

Stephan Pötter
[1]Physical Geography and Geoecology
Department of Geography, RWTH Aachen University
+49 241 80 96477, stephan.poetter@geo.rwth-aachen.de
[2]BayCEER & Chair of Geomorphology, University of Bayreuth
[3]Institute of Speleology, Romanian Academy
[4]Interdisciplinary Research Institute on Bio-Nano-Science of Babes-Bolyai University
[5]Department of Physical Geography, Eötvös University
[6]Department of Geography, University of Portsmouth
[7]Organic Geochemistry Group, MARUM-Center for Marine Environmental Sciences and Department of Geosciences, University of Bremen
[8]Chair of Physical Geography, Faculty of Sciences, University of Novi Sad

DFG Deutsche Forschungsgemeinschaft

Physical Geography and Geoecology

RWTH AACHEN UNIVERSITY