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

550 years in sedimentological record from a varved type lake (Bolătău, Bukovina, NE Romania) - changing storm frequency and climate fluctuation

Németh A.[1], Mindrescu M.[2], Grădinaru I.[2], Bihari Á.[3], Fekete J.[1] and Kern Z.[1]

[1] Hungarian Academy of Sciences (MTA); Research Centre for Astronomy and Earth Sciences, Institute for Geological and Geochemical Research (CSFK-FGI), nemethalexandra89@gmail.com

[2] University of Suceava, Geography Department, Romania

[3] Institute of Nuclear Research of the Hungarian Academy of Sciences Hertelendi Laboratory of Environmental Studies, Debrecen, Hungary

In the present paper we introduce lake Bolătău, located in Obcina Feredeului, Eastern Carpathians (Romania), with seasonally controlled sedimentation and significant potential for generating precipitation sensitive proxy record. Two sediment cores were compared against each other in order to achieve a better understanding of the lateral discontinuity of observed microfacies and an accurate interpretation of the sedimentological data.

Keywords: precipitation, microsedimentology, annually laminated sediments

Geochemical and sedimentological analyses of lacustrine sediments are valuable tools for understanding the dynamics of local and regional climate. Our study is focused on the landslide-dammed Lake Bolătău (N 47° 37’ 21’’, E 25° 25’ 54’’) located at 1137 m a.s.l. in Obcina Feredeului, one of the Flysch nappes pertaining to the Romanian Eastern Carpathians (Mindrescu et al., 2013). The onset of lacustrine sedimentation was estimated at ~4.6 ka cal BP (Mindrescu et al., submitted). From this currently eutrophic lake two sediment cores were extracted (April and November 2013). The basement morphology of Lake Bolătău is quite complex despite its small surface area (Figure 1), therefore we assumed that at the same depth of the sediment in distinct coring points different and not coeval sedimentological information can be found. Our aim was to verify whether a correlation between the two cores was possible and if the same trends could be observed in the changing sedimentological features.

The first core was drilled far from the inflow, whereby the bottom morphology was flat, whereas the second was drilled on the inflow’s slope.

Petrographic thin sections were prepared from the cores and were examined under polarization microscope and BSE microscope. BSE microscopy proved that framboidal pyrite was abundant: its presence means that oxic-anoxic interface was often close to the top of the sediment surface (Wilkin et al, 1996) preventing bioturbation.

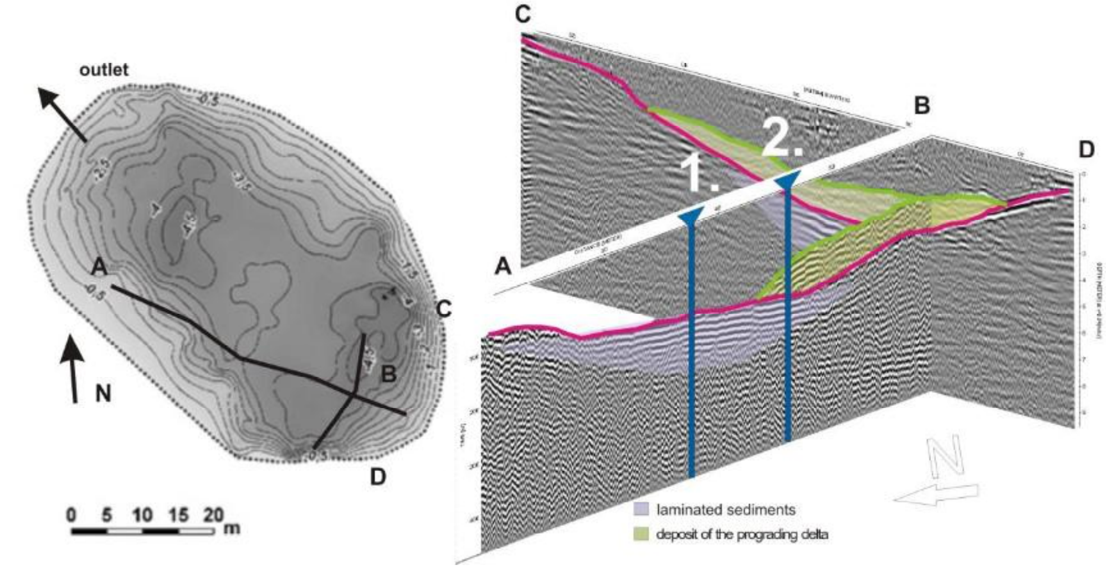

Fig. 1 Bathymetric map and ground penetrating radar (GPR) profiles of Lake Bolătău. Track lines of the crossed GPR profiles are indicated in the lake map. Position of the sediment cores are indicated on the radargrams by blue vertical lines.

We observed three different microfacies in the laminated sediment. The first one consists of thin (<mm) clay, silt or fine sand laminas alternating rhythmically with organic material and clay. We interpreted this as seasonal rhythmic, varvite-type stratification, although its features varied along the core between more clastic and more organic types (Zolitschka, 2007) probably depending on the sediment supply and seasonal runoff. The second observed microfacies is several millimeters thick, normally graded fine sand and organic detritus covered by clay. This is very likely the result of episodic storm events (Sturm and Matter, 1978). Turbidite flows deposited very fine, graded sand in the distal part of the inflow while clay spread on the thermocline and settled out later throughout the lake. The frequency of these events also changes along the cores. The third type is structureless silt and fine sand with organic detritus. The upper ~30 cm-long section of the second core is entirely made up of this microfacies, whereas the first sediment core consists of varved lake sediment with intercalating microturbidites; on this core the third type of microfacies can only be observed in a 2 cm-thick section a few centimeters below the top of the core. Comparing the location of the second core against the GPR image it became apparent that the "deltas" of the inflowing ravines must be built up by sediments of the third microfacies type. As it is clearly visible on the GPR section (Figure 1) the sampled "delta" is not intercalated into the annual layers in the basement but separated by a downlap surface. The transition between the structure-free silt and the annually laminated sediments is indeed rapid in the second core; however, the analysis of thin sections showed that it is affecting the thickness of annual layers on the top 3 cm of the laminated sediments.

An age-depth model for the Bolătău sediment record was established based on 8 AMS radiocarbon dates from terrestrial macrofossils and ^{210}Pb activity of the uppermost 21 cm of sediment. The clearly distinguishable double peaks of the ^{137}Cs flux (i.e. mid-1960s: global fallout maximum; 1986: Chernobyl accident) also indicate the lack of redeposition and bioturbation. We verified this model for the upper 80 cm of the profile by counting the annually formed laminae on the first core.

While the sedimentological features of the two cores were different, correlation between them was possible based on the lateral thinning of inflow sediments, flood layers and the observed trends in the lamina thickness. The first core showed that in the 15th century annual lamination was relatively thicker than in the following century and microturbidites were also more abundant. The first great increase in lamina thickness happened in the end of 17th century accompanied by a growing number of microturbidites in the beginning of the 18th century. The thinnest lamination was observed in both cores from ~1800 to 1850 then in the second half of the 19th century it became anomalously thick. This is in agreement with the existing instrumental data: precipitation in the second half of the century was documented to be very high. One of the widest storm laminae was dated to be from 1913 based on lamina counting, therefore it probably coincides with one of the largest ever recorded precipitation extreme of the region from 1912.

Based on the observed sedimentological changes we attempted to compare Lake Bolătău against proximal lakes with similar data.

Acknowledgements

Thanks to “Lendület” program of the Hungarian Academy of Sciences (LP2012-27/2012). This is contribution No.20. of 2ka Palæoclimatology Research Group. MM and IG acknowledge the project PN-II-RU-TE-2012-3-0386 (UEFISCDI Romania).

References

Mîndrescu, M, Cristea, A.I., Hutchinson, S.M., Florescu, G., Feurdean, A. (2013) Interdisciplinary investigations of the first reported laminated lacustrine sediments in Romania, Quaternary International 239: 219-230. doi: 10.1016/j.quaint.2012.08.2105.

Mindrescu et al. (submitted)

Sturm, M. and Matter, A. (1978). Turbidites and varves in Lake Brienz (Switzerland): deposition of clastic detritus by turbidity currents. In: A. Matter and M. E. Tucker (Editors), Modern and Ancient Lake Sediments. International Association of Sedimentologists, Spec. Publ., 2: 145-167.

Wilkin, R. T., Barnes, H. L., and Brantley, S. L. (1996) The size distribution of framboidal pyrite in modern sediments: An indicator of redox conditions: Geochimica et Cosmochimica Acta, 60: 3897–3912.

Zolitschka, B. (2007) "Varved lake sediments". Encyclopedia of quaternary science. Elsevier, Amsterdam: 3105–3114.