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

ABSTRACTS VOLUME

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1000 years of high resolution environmental change in the Eastern Carpathians, NE Romania: a multi-proxy approach

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Background

Climate changes and anthropogenic activities are projected to have a significant impact on mountain environments. This is because of their ecosystems' sensitivity and increased response to the extreme weather events and natural catastrophes (Beniston, 2000). The modification of climatic conditions can therefore impact heavily on mountain ecosystems. Furthermore, human impact has been shown to modify environmental response to climatic stressors (Beniston, 2003; Jones & Mann, 2004). This holds particularly true because mountain regions are usually at the border of conflicting interests between economic development and environmental conservation (IPCC, 1996). Deciphering the relation between local mountain environment, climate variability and human components therefore becomes of great importance for both regional climate study and local socio-economies.

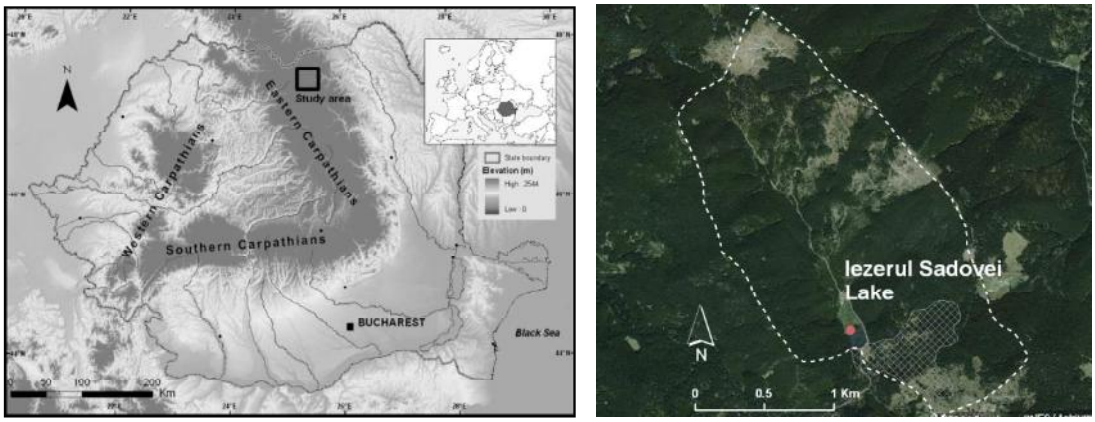

Fig. 1 Location of the study site (Iezerul Sadovei Lake) (left); aerial photo of lake and catchment in 2013 (right): the watershed is marked with white, dashed line; the landslide that led to the formation of the lake is represented by the gridded, grey area.

From this perspective, a sedimentary lacustrine sequence located in the Eastern Carpathians, Northern Romania, has been subjected to multi-proxy analyses with the purpose of reconstructing local environmental changes in response to climatic variability and human impact. The sequence (4.1 m long) covering the last millennium is layered throughout and offers an excellent opportunity for high-resolution past environmental reconstruction. The study site, formed by landsliding, is located at 930 m asl (N 47° 36' 13''; E 25° 26' 58''); it has an area of 0.75 ha, with 4.4 m maximum water depth (in 2010) (Mindrescu et al., 2013). The lake catchment and surrounding area (Fig. 1) are highly susceptible to slope movement due to their geology (i.e., flysch), terrain gradients and climate parameters (heavy and prolonged rainfall, especially during early spring and summer; high soil moisture levels ensured by the generally cool climate).

Methods and results

The methods employed in this study are sediment geochemical characteristics (elemental composition, organic matter and carbonate content), physical properties (water content of sediment, mineral magnetic properties, grain size), as well as biological indicators (tree macrofossils and pollen). The chronology of the entire sequence was established on four AMS radiocarbon measurements performed at Hertelendi Laboratory of Environmental Studies in Debrecen, Hungary (Fig. 2).

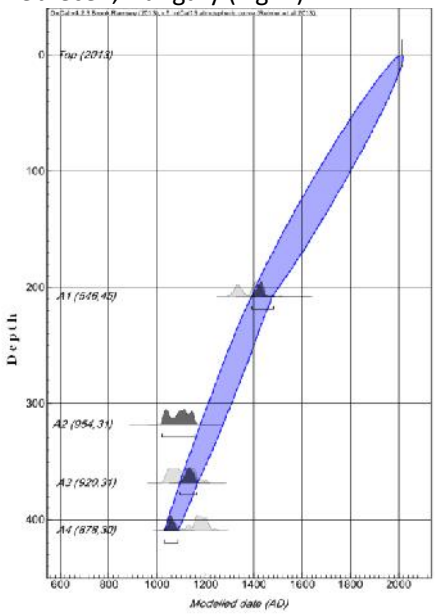

Fig. 2 Age-depth model for Iezerul Sadovei Lake; A1, A3, A4 - radiocarbon dates used for the construction of the model; A2 - radiocarbon date excluded from the model.

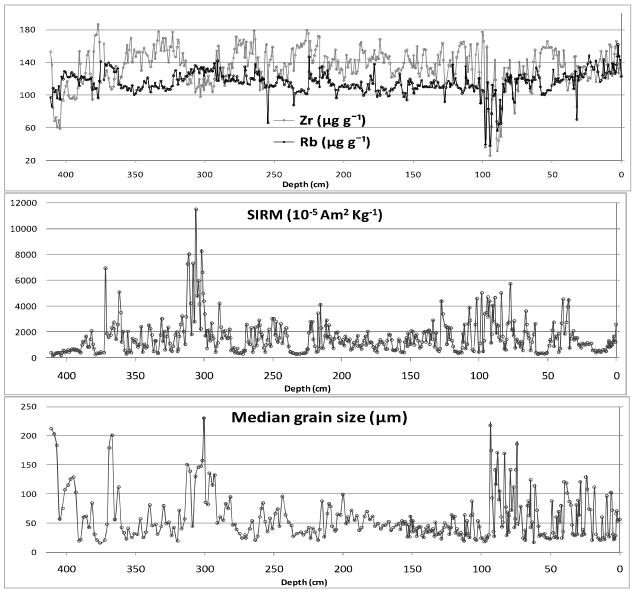

Fig. 3 Zirconium - Rubidium, SIRM and median grain size profiles for the entire sediment sequence in Iezerul Sadovei Lake, rendered as concentration vs. depth (cm).

Our preliminary results (of which selected proxies are presented in Fig. 3) show three distinct stages in the development of local environmental conditions over the past 1000 years: i) a warmer, wetter phase than today between 1050 and 1300 AD (411-270 cm depth) suggested by detrital input (Zirconium and Rubidium), in conjunction with grain size changes, geochemistry, magnetic properties and tree macrofossil profiles; ii) colder and drier conditions between 1450 to

1800 AD (220-90 cm depth) as highlighted by stability in the minerogenic input, marked reduction in median grain size, low SIRM in conjunction with the values of other magnetic parameters and also shown by the pollen iii) and the recent climatic warming over the last 100 years (top 90 cm) characterized by increased proportion of large diameter grains, high organic matter content cumulated with the total absence of tree macrofossil, variation in magnetic parameters and low preservation of pollen grains.

This multi-proxy analysis suggests that local environment reacted very sensitively to the climatic factors from 1050 to 1450 AD and during the recent period (where anthropogenic forcing compounded the effects of the climate). Due to the sensitive geological setting, the environment responded to the warm and wet climate by slope instability and soil erosion. On the contrary, during the 1450-1800 AD period there was a reduction in sediment yield delivery into the lake. The local environment appeared to have undergone a process of stabilisation. Human presence through recent deforestation of large areas and related activities seems to have enhanced the impact of climate, and thus contributed to a marked increase in erosion processes.

These phases appear to correspond well to the main local to hemispheric scales climatic conditions of the last 1000 years: the termination of Medieval Warm Period (950-1200 AD); cold and dry conditions during the Little Ice Age (1450 to 1850 AD) and the recent climatic warming (the last 100 years) (Jones & Mann, 2004).

Conclusions

The impact of rapid climate change and anthropogenic disturbance on local mid-elevation mountain forest composition, distribution and catchment erosion is ongoing. This study provides an excellent prospect to extend palaeo-environmental reconstruction into a hitherto neglected region of central-eastern Europe (North-Eastern Romanian Carpathians). This particular region also proved to be highly sensitive to past climatic variations. Combining the site geochemical and palaeoecological proxies has led to an enhanced understanding of the complex interactions between climate, local environment responses and human influence on local environmental change. It offered greater predictive capacity of future environmental changes at both an extra-local and a regional scale.

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