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

ABSTRACTS VOLUME

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Subfossil oaks from alluvial deposits and their role in past fluvial activities analysis: case study East Carpathian rivers, Romania

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Dendrochronological research was conducted in Europe in several centers whereby oak trees, regardless of species, originating from various archaeological sites were studied. Thereby, several shronologies were assembled in Ireland, Germany and the UK, covering the past 7000 to 8000 years. The environment impacts on tree growth by generating higher / lower growth rates compared to the multinannual average, thus indicating extreme years. The patterns of extreme years pertaining to individual sequences are subsequently synchronized by cross-dating.

The study area consists of two rivers with different typologies but comparable in terms of size: river Moldova (braided to wandering channel in the lower reach) and river Siret (sinuos-meandering channel). Along the 100 km-long floodplain of the former and the 144 km-long floodplain of the latter we found and sampled 77 subfossil trunks from which 26 were subjected to 14C dating (Fig. 1).

Fig. 1 A typical specimen of „black oak" exhumed from a gravel mining pit: A. tree root remains; B. the trunk excavated mechanically from as deep as 4 m in the channel deposits (C); D. trunk core sampling.

The database which substantiates our argument comprises of floodplain facies mapping data, electric resistivimeter measurement data, absolute dates, dendrometric and dendrochronological data. The manner in which subfossil trunks are distributed along the river course in relation to their absolute ages exhibits some particular tendencies which will be elaborated in a short analysis (Fig. 2).

On river Moldova (tributary of r. Siret), over a length of 110 km, subfossil trunks tend to be increasingly old in the lower course of the river, as the area occupied by Quaternary deposits increases. Instead, on river Siret, over a 144 km length, the age of subfossil trunks has an inverse tendency. Although the two study reaches are comparable in terms of length, it should be noted that in the case of Siret river the investigated reach represents only a segment between two junction points (i.e. with r. Suceava to the north and r. Moldova to the south) and thus it can provide solely a partial view on this phenomenon in relation to the entire longitudinal profile. In large rivers, where the amounts of sediments are inherently greater, the chances increase that older tree trunks are preserved in their environment (as is the case with Rhine, Danube and Main, whereby fossilized trunks are as old as 5000 years, compared with smaller rivers in eastern Germany, where their ages seldom exceed 2000 years, Friedrich et al., 2004).

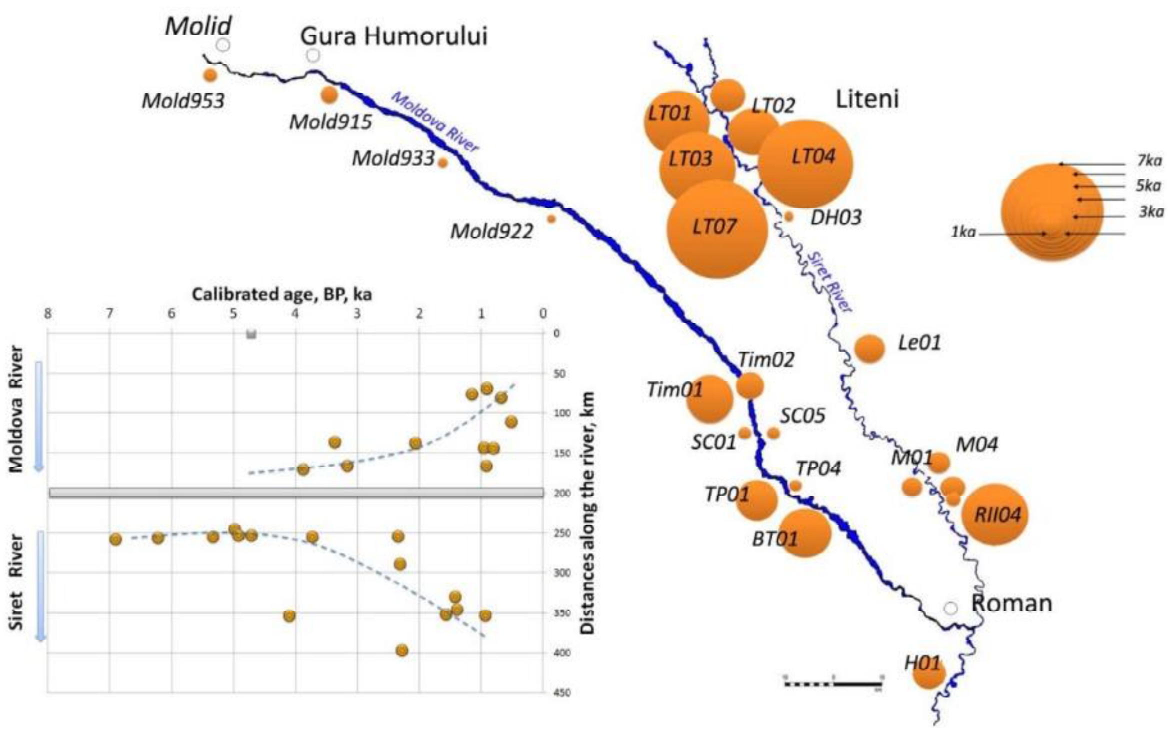

Fig. 2 Age of subfossil trunks (ka BP) along the two studied rivers.

After examining the subfossile trunks in the context of two different environments of tree incorporation, transport and sedimentation, we conclude that:

(i) the vigorous fluvial environment pertaining to river Moldova (generated by the slope gradients, the capacity to carry significant amounts of coarse materials, the braided type of channel) was a characteristic preserved throughout the entire Late Holocene, thus allowing the river to incorporate from the area adjacent to the channel a large variety of tree species, and of impressive dimensions. Once uprooted, the trunks were not transported over long distances (as all the trunks have preserved their roots, as well as sapwood and bark to a large extent) and were eventually buried at maximum depths up to 5 m.

(ii) comparatively, the fluvial enviroment of river Siret (lower slope gradients, sinuous to meandering channel style, finer channel material) was less apt to perform large scale fluvial activity. The most significant trunk „deposit" is located just downstream of the junction with river Suceava (a Carpathian tributary, similar to Moldova). All the dendrometrical features of trunks indicate this predominantly allochtonous source of the trees. River Siret incorporated and distributed them in the gravel lobes at maximum depths up to 7 m. Along the river there are trunks originating in its own floodplain, as well, aged over 100 years, albeit their diameters are relatively small (mainly oak and elm, rarely alder).

Applying the dendrochronology method on subfossil trunks confirmed their potential as high-resolution environmental archives. By employing reference series we dated trees with ages overlapping timeframes whereby climate instrumental records are available, as well as trees older than these records. Thus, we were able to infer that flood events with 100 years recurrence interval on river Moldova, and 200 years recurrence interval on Siret were the most effective in terms of riparian trees felling.

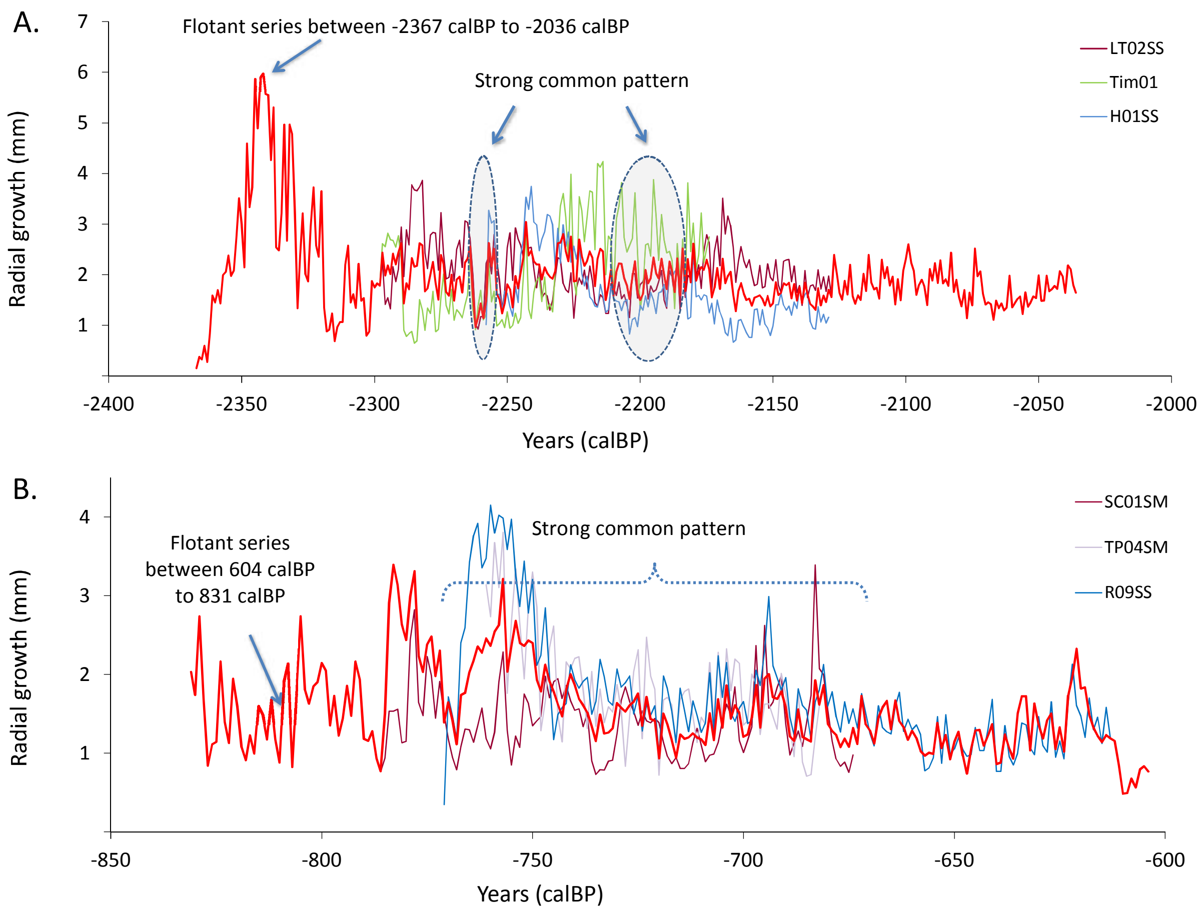

Fig. 3 Floating series obtained from subfossil trunks sampled along rivers Siret and Moldova. A. 331-years sequence assembled by cross-dating three dendrochronological series; B. 127-years sequence assembled by cross-dating four dendrochronological series.

By employing both dendrochronology methods and 14C dating several annual tree-ring series were cross-dated. This is the first tree-ring chronology to cover such a long timeframe (nearly 7000 years, based on incomplete information), albeit with many gaps, in our geographical region. As noted by Becker (1993), 95% of riparian trees can rarely provide series longer than 400 years, which is directly linked to the frequency of flood events destroying floodplain forests. We believe our longest tree-ring series (322) ranges within the margin cited by this author for oaks vegetating in floodplain forests. In this stage of the research we were able to cross-date several trunks covering intervals ranging from 97 to 331 years (e.g., fig. 3), dispersed throughout the past 7000 years BP. Cross-dating offers the benefit of higher resolution (annual), difficult to achieve with other dating methods.

Subfossil trunks are an indicator of exceptional hydrological events (Starkel et al., 2012). We were able to identify growth and felling periods with a high degree accuracy (annual), and we determined 25-, 50- and 100-year long phases of the intensification of river activity, which indicate wetter periods separated by dry periods. The most distinctive felling phases were documented in trees which vegetated between 3500 and 2900 years BP, 2200 and 2075 years BP, and 1000 and 800 years BP. These phases correspond to a large extent with periods of intense fluvial activity and confirm the results obtained thus far for Moldova river (Chiriloaei et al., 2012). Fluvial activity phases were interspersed with less humid phases (e.g., 3172 or 2775 years BP, the late Medieval Warm Period, 1400 years BP or 1000 to 800 years BP).

Overall, the major clusters of subfossil trunks embedded in the channels of the two rivers coincide with two established wet periods, i.e. the Bronze Age, and in the Iron Age extending to LIA, respectively, during which significant flood events occurred resulting in major changes in the fluvial domain (avulsion, sedimentation) and riparian forests were strongly affected.

References

Becker, B., 1993. An 11,000 –Year German Oak and Pine Dendrochronology for Radiocarbon Calibration, Radiocarbon, 35/1: 201-213.

Chiriloaei, F., Rădoane, M., Perșoiu, I., Popa, I., 2012. Late Holocene History of Moldova River Valley, Romania, CATENA, 93: 64-77.

Friedrich, M., Remmele, S., Kromer, B., Hofmann, J., Spurk, M., Kaiser, K.F., Orcel,C., Küppers, M., 2004. The 12,460- year hohenheim oak and pine tree-ring chronology from Central Europe–A unique annual record for radiocarbon calibration and paleoenvironment reconstructions. Radiocarbon 46(3),1111–1122.

Starkel, L., Michczyńska, D., Krąpiec, M., Margielewski, W., Nalepka, D., Pazdur, A., 2012. Progress in the holocene chrono-climatostratigraphy of Polish territory, Versita Central European Science Journals, Geochronometria, 40/1: 1-21.