eTopoi Journal for Ancient Studies

Special Volume 3 (2012), pp. 323–329

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in Wiebke Bebermeier – Robert Hebenstreit – Elke Kaiser – Jan Krause (eds.), Landscape Archaeology. Proceedings of the International Conference Held in Berlin, 6th – 8th June 2012

Edited by Gerd Graßhoff and Michael Meyer, Excellence Cluster Topoi, Berlin

eTopoi ISSN 2192-2608
http://journal.topoi.org

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The Lower Danube Valley through the Holocene: Environmental Changes and Their Geoarchaeological Implications

Lower Danube; Pietrele; geoarchaeology; palaeolake; fluvial geomorphology.

Geoarchaeological research has been conducted close to the settlement mound of Tell Pietrele, c. 40km south of Bucharest. The tell was occupied during the 5th millennium BC (Copper Age) and lasted as an active settlement for several hundred years.[1] It was set up on a fluvial terrace at the northern slope of the Danube valley with its base at about 8m above the present floodplain. In our study area between Giurgiu and Oltenita the bottom of the Danube valley is about 8km wide and the course of the Danube runs along its southern edge (Fig. 1). However, until about 50 years ago the floodplain was covered by a net of anabranching channels, swamps and lakes that were completely drained and cultivated in the nineteen-sixties. Archaeological records indicate that during the Copper Age Pietrele was integrated into a long-distance trading network along the Danube. The archaeologists suggest that people from Tell Pietrele had direct access to the Danube via a channel passing the tell. Furthermore, there is archaeological evidence that hunting and fishing played a major role in this community. Changes of the Danube River very likely affected the former settlement; our research therefore focuses on the reconstruction of the Holocene floodplain evolution and the ecological conditions associated with the settlement period.

In contrast to the Danube Delta[2] studies of the fluvial history and landscape development of the Lower Danube are rare. An overall view of the geomorphological and geological setting within the study area was given by Institutul De Geologie Si Geographfie Al Academiei Repbublicii Socialiste Romania.[3] More detailed geoarchaeological research has been conducted in the Teleorman Valley within the frame of the joint Romanian-British SRAP project[4] and Tomescu[5] and Lazarova and Bozilova[6] provided information regarding the regional vegetation history based on palynological studies in southern Romania and northern Bulgaria.

In order to get a closer view of the floodplain development within the study area throughout the Holocene, a variety of methods were applied. Of these the evaluation of historical topographic maps and satellite images, corings up to 17m, geoelectric profiling, sedimentological, geochemical, microfaunal and pollen analyses proved to be key

The authors gratefully thank the Deutsche Forschungsgemeinschaft (DFG) for financing this study.

1 Hansen et al. 2006.
2 e.g., Panin 2003; Giosan et al. 2006; Yanko-Hombach et al. 2007.
3 Romania 1969.
4 Howard et al. 2004; Macklin et al. 2011.
5 Tomescu 2000.
6 Lazarova and Bozilova 2001.

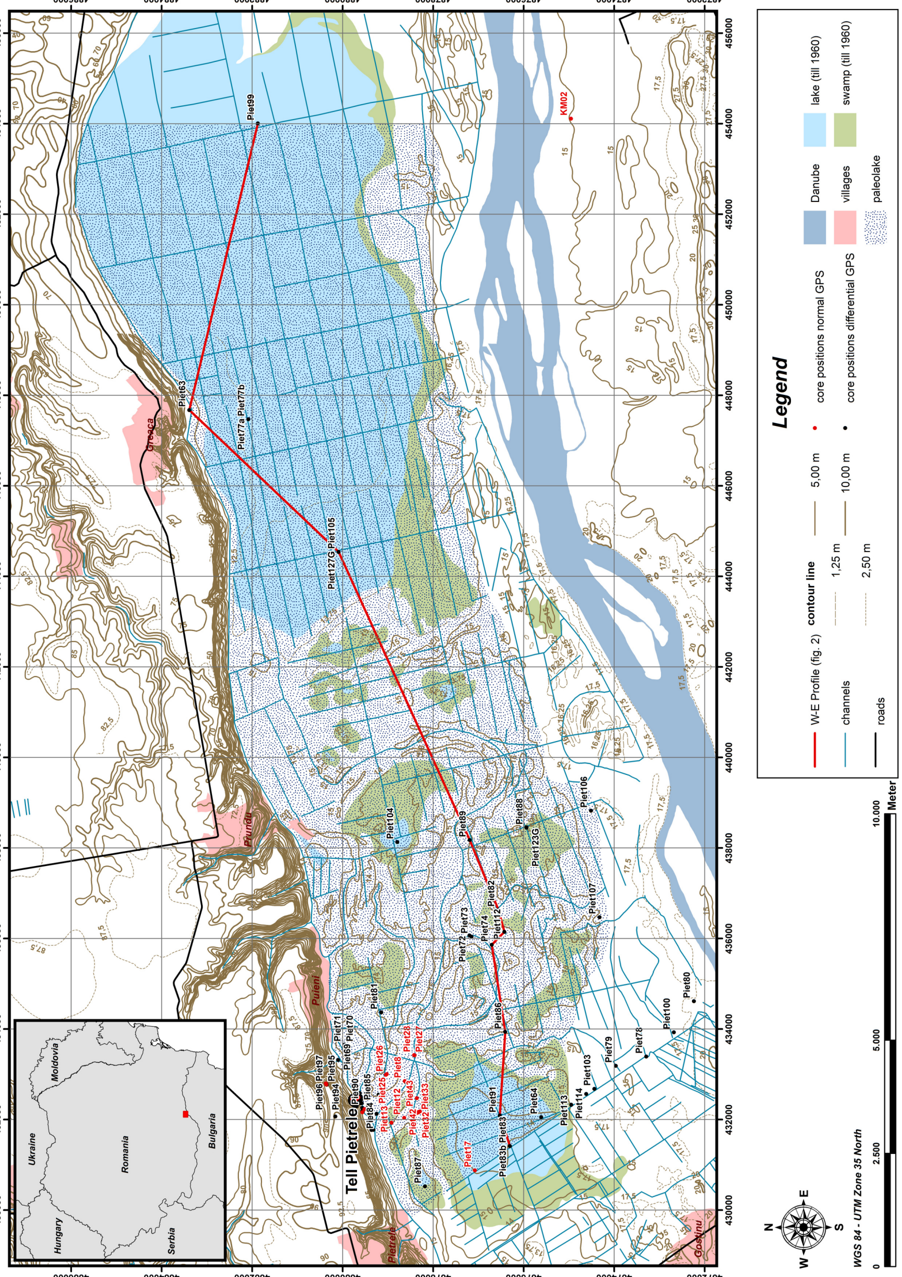

Fig. 1 | Topographic map of the study area at Tell Pietrele showing locations of corings, position of former lakes and extent of the supposed paleolake that might have existed during the settlement period during the 5th millennium BC.

elements in our approach. To date, more than 130 sediment cores have been taken from the tell itself and the surrounding floodplain of the Danube river. Different facies units representing distinct depositional environments were distinguished and AMS- ^{14}C- and OSL datings provide the chronological framework to elaborate their spatiotemporal associations.

The interpretation of Corona satellite images from 1962 to 1968 and topographic maps dating back to the first half of the 20th century allowed the detection of channel patterns and ancient lakes which existed before the floodplain was drained. It has been suggested that the courses of the anastomosing branches and the lakes might have been stable with only minor changes throughout the Holocene. However, our results of the corings and geoelectric soundings indicate that major changes of the environmental conditions occurred. The sedimentary records show that fluvial processes and lacustrine conditions alternated within the floodplain. Generally, a sequence of three facies units was detected which differ in thickness from place to place (Fig. 2). The lowermost sandy to gravelly deposits (Unit I) of unknown thickness occur about 3 to 8m below surface. The sediments can be attributed to fluvial, and/or aeolian processes. As yet the period of their accumulation is unknown. Several OSL-datings are in progress to solve this. In most cases, the sandy and gravelly unit is overlain by a clayey and silty sequence of up to 8 metres in thickness (Unit II), locally showing even coarser intercalations (Unit IIa). These fine grained sediments (Unit II & IIa) were deposited in a lacustrine environment. Unit II is subdivided by distinct dark horizons (DL I-III) which are a valuable means of correlating the different cores. This correlation was chronologically substantiated by a total of 32 AMS-^{14}C-datings of mostly terrestrial organic material,[7] which was selected from samples of Unit II and III. For the lowermost part of Unit II a maximum AMS-^{14}C-age of 4690–4270 cal. BC[8] was obtained in core Piet 63 (Fig. 2). This age corresponds well to the main settlement period at Tell Pietrele. As the dated sample was taken nearly at the base of Unit II it can be assumed that the deposition of the fine grained lacustrine sediments of Unit II & IIa did not set in much earlier. Finally, the sediments covering Unit II indicate a further change to fluvial conditions. Stratified sand and silt deposits in many cores are typical of levees along branches of the Danube River (Unit III). Only at some locations did lakes persist until the floodplain was drained and cultivated in the 1960s.

Lithological logs along a west-east cross-section (Fig. 2) show the facies units in their spatial context. The cross-section runs 23km from core Piet 83, which is located in the ancient Lake Pietrelor, to core Piet 99 in the former Lake Greaca (Fig. 1). The profile shows that in Piet 83 and Piet 99 Unit III is missing. At these locations lacustrine conditions prevailed until the lakes were drained in the nineteen-sixties. The dark coloured index horizon (DL I) was identified in the sedimentary records except for Piet 89. In this core the top of the sandy facies of Unit I was registered at 3.10m below surface. This might hint at Unit I having an irregular surface that was inundated and covered by lacustrine sediments.

As it is most likely that Unit II reflects the environmental conditions during the Copper Age settlement period at Tell Pietrele, attention has been focused on this sequence. Sediment analyses indicate that the fine-grained deposits accumulated in a palaeolake environment covering vast parts of the floodplain within the environs of the tell. However, grain size analyses alone lack significance for the differentiation of fluvial and limnic accumulations. Lake sediments exhibit different grain size distribution depending e.g. on the position between the profundal and the shoreline and on the origin of sediments. Means

7 Hansen et al. 2006; Hansen et al. 2007; Hansen et al. 2009; Hansen et al. 2010.

8 Number of dated sample: Piet 63/844–848, lab.-name: KIA41256; dated material: charcoal; RC-age: 5620 ± 90 BP; δ^{13}C: 31.97 ± 0.49‰, Hansen et al. 2010.

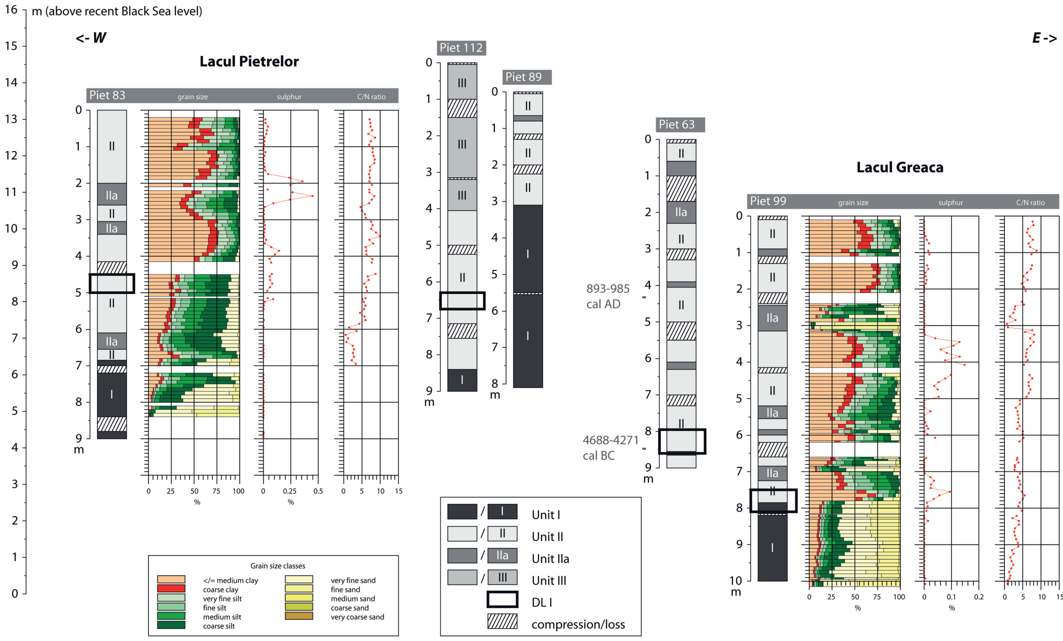

Fig. 2 | Schematic lithological logs along a W-E-profile (Fig. 1) showing the stratigraphic units, marker horizon DL I and radiocarbon datings (Piet63) as explained in the text. For selected cores grain size distribution, content of sulphur and C/N ratios are displayed.

of microfaunal and palynological investigations are more indicative for the depositional environment. Initial results of the microfaunal investigations, which are still in progress, give evidence for a huge, at some places shallow, standing water body. This is corroborated by analyses of pollen and macro remains.[9]

Furthermore, a multi-proxy geochemical approach has been applied in order to identify autochthonous material that has been produced in the lake itself, and allochthonous material from the entire catchment area. Therefore, elements such as aluminium, magnesium, calcium, strontium, iron, manganese and copper have been measured. Additionally, we analysed the content of organic and inorganic carbon, phosphate, sulphur, nitrogen, pH-value and the conductivity. The ratio of total organic carbon and nitrogen allows terrestrial and aquatic sediments to be distinguished.[10] Characteristic C/N ratios of nonvascular aquatic plants, such as simple algae, amount to 4 to 10; whereas vascular terrestrial plants like grass, shrubs and trees show C/N ratios of more than 20. Some broad-leafed trees even reveal C/N ratios of more than 250 and some conifers of more than 500.[11] In a lake environment, C/N ratios normally increase with proximity to the shore due to the input of terrestrial material. But sediments of Unit II show values of the C/N ratio that do not exceed 10, indicating permanent aquatic conditions (Fig. 2).

As the contents of typical autochthonous elements like sulphur show similar vertical trends in different cores from all over the study area (Fig. 2), it can be inferred that one single palaeolake covered an area of at least 20km in length and at places more than 8km in width. This can be corroborated by similarities of the nitrogen record, the conductibility, and the overall occurrence of the lowermost dark index layer (DL I, Fig. 2).

The dark marker horizons (DL I-III) probably represent distinct phases with ecological conditions that differed from the overall trend. According to the radiocarbon age of DL I in core Piet 63 (Fig. 2), the dark layer developed during the main settlement period

9 Hansen et al. 2010; Wunderlich et al. 2012.
10 Meyers and Ishiwatari 1993.
11 Meyers and Ishiwatari 1993, 871.

at Tell Pietrele. It can be assumed that this characteristic layer marks a drastic event in the lake's evolution. Its origin possibly lies in an increasing input of terrestrial organic material as a consequence of human settlement or in the establishment of eutrophic conditions due to changing lake characteristics.

Based on the available results, the sedimentary and environmental history of the study area can be summarised as follows. During the first half of the Holocene the valley bottom in the study area was covered by sandy and gravelly sediments that were deposited by a braided river and locally dune formation was likely (Unit I). At the latest in the Mid-Holocene, the surface of the valley bottom was inundated and a lake developed in the reaches of the study area. Lake sediments were deposited on the sandy surface of Unit I, documenting the change of the ecological conditions. It can be deduced that the northern shoreline of this lake ran close to the settlement of Tell Pietrele. People associated with the tell may have centred their lives on the lake and the Danube River, as both satisfyingly served basic needs of transport and nutrition. Later on anabranching channels prograded into the palaeolake. As a consequence the palaeolake diminished and several smaller lakes formed between the channels which existed until the floodplain was cultivated in the last century.

Bibliography

Giosan et al. 2006
L. Giosan et al. “Young Danube Delta Documents Stable Black Sea Level since Middle Holocene. Morphodynamic, Paleogeographic, and Archaeological Implications”. *Geology* 9 (2006), 757–760.

Hansen et al. 2006
S. Hansen et al. “Pietrele. Eine kupferzeitliche Siedlung an der Unteren Donau. Bericht über die Ausgrabung im Sommer 2005”. *Eurasia Antiqua* 12 (2006), 1–62.

Hansen et al. 2007
S. Hansen et al. “Pietrele. Eine kupferzeitliche Siedlung an der Unteren Donau. Bericht über die Ausgrabung im Sommer 2006”. *Eurasia Antiqua* 13 (2007), 43–112.

Hansen et al. 2009
S. Hansen et al. “Pietrele. Der kupferzeitliche Siedlungshügel “Măgura Gorgana” und sein Umfeld. Bericht über die Ausgrabungen und geomorphologischen Untersuchungen im Sommer 2008”. *Eurasia Antiqua* 15 (2009), 19–100.

Hansen et al. 2010
S. Hansen et al. “Pietrele, ‘Măgura Gorgana’. Bericht über die Ausgrabungen und geomorphologischen Untersuchungen im Sommer 2009”. *Eurasia Antiqua* 16 (2010), 43–96.

Howard et al. 2004
A.J. Howard et al. “Late Glacial and Holocene River Development in the Teleorman Valley on the Southern Romanian Plain”. *Journal of Quaternary Science* 19 (2004), 271–280.

Lazarova and Bozilova 2001
M. Lazarova and E. Bozilova. “Studies on the Holocene History of Vegetation in the Region of Lake Srebarna (Northeast Bulgaria)”. *Vegetation History and Archaeobotany* 10 (2001), 87–95.

Macklin et al. 2011
M.G. Macklin et al. “River Dynamics and the Neolithic of the Lower Danube Catchment”. In *The Lower Danube in Prehistory. Landscape Changes and Human-Environment Interactions. Proceedings of the International Conference, Alexandria, 3–5 November 2010*. Ed. by S. Mills and P. Mirea. Bucureşti: Editura Renaissance, 2011, 9–14.

Meyers and Ishiwatari 1993
P.A. Meyers and R. Ishiwatari. “Lacustrine Organic Geochemistry. An Overview of Indicators of Organic Matter Sources and Diagenesis in Lake Sediments”. *Organic Geochemistry* 20.7 (1993), 867–900.

Panin 2003
N. Panin. “The Danube Delta. Geomorphology and Holocene Evolution. A Synthesis”. *Géomorphologie. Relief, Processus, Environnement* 4 (2003), 247–262.

Romania 1969
Institutul De Geologie Si Geografie Al Academiei Republicii Socialiste Romania, ed. *Geografia Vaii Dunarii Romanesti*. Bucureşti: Editura Academiei Republicii Socialiste Romania, 1969.

Tomescu 2000
A.M.F. Tomescu. “Evaluation of Holocene Pollen Records From the Romanian Plain”. *Review of Palaeobotany and Palynology* 109 (2000), 219–233.

Wunderlich et al. 2012
J. Wunderlich et al. “Landschafts- und Flussgeschichte der unteren Donau im Umfeld des Siedlungshügels Magura Gorgana, Südrumänien”. In *Verzweigungen. Eine Würdigung für A.J. Kalis und J. Meurers-Balke*. Ed. by A. Stobbe and U. Tegtmeier. Frankfurter Archäologische Schriften. Bonn: Rudolf Habelt, 2012, 333–350.

Yanko-Hombach et al. 2007
V. Yanko-Hombach et al., eds. *The Black Sea Flood Question. Changes in Coastline, Climate and Human Settlement*. Dordrecht: Springer, 2007.

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