AKADÉMIAI KIADÓ

Acta Archaeologica Academiae Scientiarum Hungaricae

73 (2022) 2, 191–203

DOI:
10.1556/072.2022.00015

ORIGINAL RESEARCH PAPER

Emerging mediaeval heritage: Environmental history research at Băgău (c. Alba, Romania) and the Bottomless Lake (Tăul fără fund)

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Received: June 7, 2022 • Accepted: July 20, 2022

ABSTRACT

The investigation of a 8.1 m long peat sequence from *Tăul fără fund* ("Bottomless Lake," Transylvanian Basin, Northern Romania) offers a series representing wetland development since the Middle Holocene. The most striking feature of the sequence is a cca. 900 year-long hiatus caused by peatcutting in the 14th century AD. An artificial reservoir was constructed there in the Late Middle Ages by the excavation of the uppermost peat layer, afflicting a significant environmental impact on this remote location. One of the oldest documented Hungarian settlements from the time of the Hungarian Kingdom (11th century AD, presumably with previous history) in Transylvania was discovered in the vicinity of the former reservoir by an archaeological field survey. By harmonising historical data and the exact chronological sequence of the borehole, the creation of the reservoir was inserted into the local history of the developing mediaeval settlement network at the time when some of the early settlements had been abandoned and a permanent village was established, with a church and upscale landowners, in the area of present-day Băgău in the 13th to 14th century AD. Significant environmental impacts have emerged during this transitional period around the reservoir.

KEYWORDS

Middle Ages, water reservoir, radiocarbon dating, settlement network, Transylvania

INTRODUCTION

The joint implementation of environmental historical and archaeological methods is becoming more and more common in scientific research today. Environmental archaeological research is characterised by the intentions of researchers to explore densely populated regions that are excellent for a variety of human activities and to focus on little-known historical periods. In contrast to classical archaeological research, examining remains of various settlements and cemeteries, a detailed study of their surroundings, using a variety of techniques and processes, reveals dimensions that complete and, where appropriate, redraw

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the results obtained by traditional methods. The most important research foci are agricultural activities,[1] the extraction of raw materials (wood, subsoil resources),[2] the associated deforestation, and the conversion of areas freed up for pasture by that.[3] These factors are, of course, highlighted by both classical archaeological evaluation and auxiliary sciences (e.g., analyses of animal bones, plant remains, millstones, slags, etc.) but their real environmental effects and their significance can only be judged by careful, multidisciplinary processing of undisturbed core sequences and modern radiocarbon dating of samples. These methods also help us to compare the real environmental impact of each historical era selected for research. This work also requires a cooperation of experts from several research fields. From an archeological point of view, special attention must be paid to the meaningful, continuous use of the traditional – sometimes only partially published – excavation results, the historical sources related to the sites, and their discord with the results obtained by the science of environmental archaeology.

In this respect, our work means finding a way and extending research aspects and methods. Therefore, the current study is also a discussion paper, as it corrects a recently published, scarcely founded study on our results of a core boring session at the Bottomless Lake in Băgău.[4] Our present study is completed with significantly more archaeological and historical background data, and presents its results in a more advanced phase of complex processing.

In the course of the research on the medieval and early-modern environmental history of the Carpathian Basin,[5] the sampling carried out near Băgău revealed an unusually strong human impact at the end of the Árpádian Age and the 14th century AD. These geological and field observations led to the discovery of an Early Árpádian-age settlement too. The study presents the path leading to the discovery of the site and the documentation of the recovered archaeological finds.

[1]Gaillard et al. (2018); Price (2000).

[2]Brännvall et al. (1999); Hong et al. (1996); Jakab et al. (2022); Rydberg et al. (2015).

[3]Benkő et al. (2021); Darby (1956); Hughes and Thirgood (1982); Jakab et al. (2022); Kaplan et al. (2009).

[4]Vári et al. (2020a); Vári et al. (2020b), did not take into account the significant sediment hiatus of the Late Migration and Árpád periods in the excavated sample, as well as the water layers that formed the earlier part of the sediment, and therefore the climatic and environmental reconstruction based on a flawed chronological model is completely unfounded. This is particularly unfortunate because one of the authors of these studies, Prof. Pál Sümegi, was a member of our research team, but he published some of the research results with his newly involved PhD students without informing us beforehand, and we were not able to correct his misunderstanding or make up for his lack of historical and archaeological knowledge. The ethical implications of this issue do not, of course, affect the work of doctoral students who participate in good faith.

[5]Benkő and Zatykó (2021).

STUDY SITE

Băgău (Magyarbagó in Hungarian) is located in the western part of the Transylvanian Basin, close to the confluence of the Mureș River (Maros) and its left tributary, the Rât, at approx. 300 m a.B.s.l. This region, the Fărău Hills, is the westernmost range of the Târnava Mică Hills, characterised by 400–550 m high elevations separated sometimes by relatively deep and large valleys.[6] Today, the climate of the region is temperate continental, characterised by an annual mean temperature around 9–10 °C and 500–600 mm annual mean precipitation with the highest values in the boreal spring and summer. The dominating winds are foehns from the west.[7] The hilly terrain around Băgău comprise Middle (Sarmatian) and Upper (Pannonian) Miocene siliciclastic and volcanic tuff deposits, whilst along the valleys Quaternary alluvial deposits occur.[8]

The area is situated in the lowland vegetation belt, characterised by a dominance of deciduous forests. Recent vegetation surveys have revealed the presence of sessile oak (*Quercus petraea*) and hornbeam (*Carpinus betulus*)-dominated forest communities.[9] Another characteristic landscape feature of the larger area is semi-natural, secondary originated grasslands.[10] The moderate slopes, their base, and the alluvial flatlands with soils rich in nutrients are dominated by xeric-mesic to mesic and mesic-wet grassland communities.

An important geomorphologic and landscape feature of the area is the presence of a partially silted lake, named, according to the local toponymy, *Tăul fără fund* ("Feneketlen tó" in Hungarian, meaning "bottomless lake"). The western part of the basin is ruled by an open-water lake with a total surface of 0.1 ha. The name of the site refers to the dangerously loose sediment the lake bottom consists of. The eastern part of the basin gradually silted with time, turning into a peatbog with a total extension of about 3 ha. According to local observations, during extremely humid periods the total extension of the flooded area may expand up to 6 ha. The lake raised naturally on a watershed situated at 440 m aBsl, as a result of landslides affecting the Sarmatian deposits.[11] Currently, the open water surface is engirded by a zone of floating fen with a 70–80 cm thick peat mat overgrown by *Phragmites australis, Salix cinerea, Betula pendula, Alnus glutinosa, Thelypteris palustris*, and *Dryopteris cristata.* This habitat covers approximately 2.2 ha. The central part of the wetland (of about 0.8 ha) is a *Sphagnum*-dominated peatbog.[12] The total extension of the catchment area, almost completely covered by oak and hornbeam forests, is 55 ha.

[6]Pop (2001).

[7]Bogdan (1983); Croitoru (2006); Sandu et al. (2008).

[8]Ilie (1952); Giușcă et al. (1967).

[9]Frink et al. (2018).

[10]Frink et al. (2018).

[11]Csató (1896); Pop (1960); Diaconeasa and Mitroescu (1987).

[12]Pop (1960); Diaconeasa and Mitroescu (1987); László (2006).

MATERIALS AND METHODS

Field methods and sedimentology

The analysed 8.1 m-long sediment core was retrieved from the central part of the lakebed using a modified 1 m-long "Russian corer" with steel bars[13] and overlapping core technique.[14] The used two-borehole technique involved taking alternate, overlapping core sequences from two different boreholes. While the two parallel cores had 10 cm overlaps, only 5 cm of the overlapping sequences of each core could be preserved. The borehole was positioned at the deepest, central part of the lakebed. Its overall depth was 8.6 m, including total 0.5 m water segments (0.1 and 0.4 m in the two cores, respectively) at two depths. The thickness of these water layers may vary significantly depending on weather, because the surface sediment layer of the bog floats. This fact was taken into account in the age model, and the water layers were deleted during the evaluation process.

The lithostratigraphical description of the profiles followed the system of Troels-Smith.[15] The field description was refined by laboratory observations to obtain an accurate composition.

Radiocarbon dating, chronology

The peat fragments were AMS ^{14}C dated by Direct AMS Lab in Seattle (USA), where the primary results were calibrated using IntCal20.[16] The age-depth model was obtained with BACON, a Bayesian age modelling software package.[17] Inverse AR (sedimentation times expressed as year/cm) were estimated from prior information: accumulation (acc.)shape = 1.5 and acc.mean = 10 for gamma distribution, and memory (mem.)mean = 0.7 and mem.strength = 4 for beta distribution (describing the memory effects or autocorrelation of inverse AR). We marked one hiatus at 193 cm where the sediment was strongly humified, indicating strong temporary desiccation. Above 193 cm, the sediment changed to unhumified reed peat, marking abrupt water level rise. The top of the core (0 cm) was assigned to 2016 AD. In total, 13 radiocarbon samples were measured for the age-depth model from the core obtained from *Tăul fără fund* (Bottomless Lake). Age modelling was run to achieve a cm-range final resolution. The deposition time (DT) was calculated by the age-depth model and expressed as yr cm^{-1}.[18]

Archaeological and historical data collection

In order to evaluate the boring results from an archaeological and historical point of view, we reviewed the archaeological sites in the vicinity of Băgău and medieval and early modern written sources relating to the area within a radius of about 8–10 km, because the relatively small amount of data directly related to Băgău can only be properly interpreted by taking a broader perspective. We focused primarily on the archaeological finds and written sources including Asinip (Asszonynépe in Hungarian), Băgău (Magyarbagó), Cisteiu de Mureş (Magyarcsesztve), Ciuguzel (Fugad), Ciumbrud (Csombord), Gâmbaş (Marosgombás), Hopârta (Háporton), Lopadea Nouă (Magyarlapád), Micoşlaca (Miklóslaka), Ocna Mureş (Marosújvár), Păgida (Kisapahida), Sâncrai (Enyedszentkirály), Silivaş (Mikószilvás), Şpălnaca (Ispánlaka), Turdaş (Oláhtordos), and Uioara de Jos (Csongva) (Fig. 1).

From an archaeological point of view, the lack of systematic archaeological investigations in the area represents a difficulty. We had to rely on an archaeological repertoire containing scattered finds and sites known before 1984, with additions up to 1995.[19] More recent research has been cited in a small number of publications and on the CIMEC online database.[20] Consequently, the available set of archaeological data provides us with a basis to draw conclusions that are likely to reflect the main trends more or less correctly but are, understandably, not perfect in their details, as are based on incomplete and unfinished research.

The study area is a region of central Transylvania with very good settlement conditions and salt deposits nearby (Ocnişoara/Kisakna, Ocna Mureş/Marosújvár), where sites from all historical periods – even if with significant differences regarding settlement intensity and strategy – can be found. The present paper focuses on the period between the early Middle and Early Modern Period, while other observations and analyses of the pre-Middle Ages will provide subject for a separate study.

RESULTS AND INTERPRETATION

Medieval reservoir

According to radiocarbon data, the 860 cm long undisturbed core sequence in *Tăul fără fund* at Băgău formed during the last 8580 (cal BP) years. Conclusively, based on this series, we may outline the development history of the catchment area and its environment in the Transylvanian Basin from the Early/Middle Holocene transition phase until today. Brief descriptions of the related sedimentological zones are presented in Table 1.

The first sedimentological unit, between 860 and 829 cm, represents the initial stage of wetland formation. The marshland zone around the lake was probably weak, and a significant amount of unorganic sediment washed into the newly formed sedimentary basin. Between 829 and 823 cm, the organic content of the sediment increased, suggesting

[13] Sümegi (2001).

[14] De Vleeschouwer et al. (2010).

[15] Troels-Smith (1955).

[16] Reimer et al. (2020).

[17] Blaauw and Christen (2011).

[18] Bennett (1994).

[19] *Repertoriu Alba* (1995).

[20] Institutul Naţional al Patrimoniului, Bucureşti, https://cimec.ro

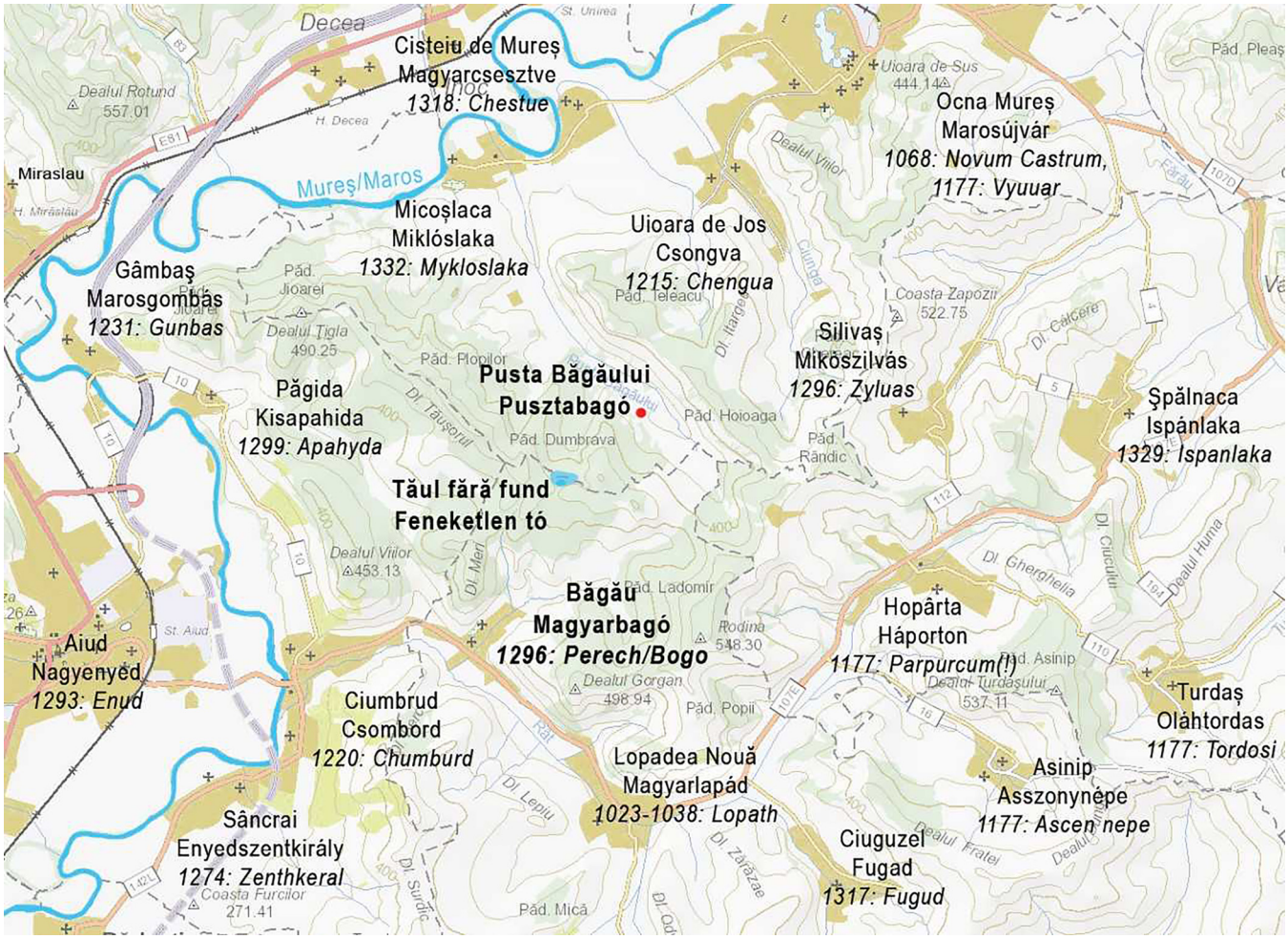

Fig. 1. Map of the investigated area around Băgău with the modern names of the settlements and the historical names sourced from their earliest mentions in medieval documents (design by Elek Benkő)

peatbog formation. At 823 cm, the organic sedimentation process was interrupted by an erosion event, in the course of which a 5 cm thick, grey Miocene clay layer deposited in the basin. In the sample core this grey clay layer is very conspicuous between the blackish peat layers. Above 818 cm, peat formation restarted. A dark brown *Sphagnum* peat layer, rich in organic and poor in inorganic particles, formed in this layer. A fine eroded and removed clay and silt rich material settled in the peat layer, and the sediment became somewhat clayey. A similar, barely visible erosion layer deposited between 760 and 744 cm. Between 744 and 655 cm, blackish peat deposited with *Sphagnum*, *Phragmites,* and *Eriophorum* remains. Between 655 and 651 cm, a conspicuous light grey, creamy clay layer interrupted the peat formation. Above 651 cm, peat formation restarted again, resulting in the formation of a dark brown homogenous *Sphagnum* peat layer rich in organic and poor in inorganic elements. Between 445 and 406 cm, peat layers were intermitted by a water layer (obviously, as the thickness of this layer depends on the actual water supply of the bog, the numbers presented in this description only represent the conditions observed at the time of boring). Above 404 cm, a dark brown homogenous *Sphagnum* peat layer formed. Above 218 cm, sediment composition changed abruptly, and stongly humified dark brown peat deposited with *Phragmites* rizomes. Later on, the humification level reduced, and raw reed peat became deposited up to 160 cm. Above 160 cm, *Sphagnum*-dominated peatbog returned to the basin, and a light brown homogenous *Sphagnum* peat layer formed. Between 100 and 90 cm, a water layer interrupted the peat sequence. Above 90 cm, *Sphagnum* peat deposited again.

Altogether 11 ^{14}C AMS measurements were obtained from Băgău, presented here in Table 2. All but one dates were included in the BACON model; the excluded one was an outlier (7709 ± 44 at 802 cm). The age-depth model of the sequence is shown in Fig. 2. According to the age-depth model, the topmost 820 cm of Băgău covers the range from 2016 AD to 7833.1 cal yr BP. The minimum value of the deposition time (DT) is 2.3 yr cm^{-1} (at 166, 168 and 169 cm), while the maximum value is 16.9 yr cm^{-1} (at 199 cm). The mean value of the DT is 8.57 yr cm^{-1}.

The age-depth model previously published for this sediment sample[21] did not take into account the hiatus and

[21] Vári et al. (2020a).

Table 1. Sediment types and stratigraphy from the undisturbed core sequence of *Tăul Fără Fund*, Băgău

Depth (cm)	Troels-Smith symbol	Sediment description
90–0	Tb3Sh1	Dark brown peat with *Eriophorum* and *Sphagnum*.
100–90	–	Water layer.
160–100	Tb2Th1Sh1	Dark brown peat with *Eriophorum* and *Sphagnum*.
203–160	Th3Sh1Tb+	Dark brown peat with *Phragmites* rhizomes and few *Sphagnum*.
218–203	Th1Sh3Gr$_{min}$+	Strongly humified dark brown peat with *Phragmites* rhizomes and some small quartz grains.
406–218	Tb2Th1Sh1Tl+	Dark brown peat with *Eriophorum*, *Vaccinium*, *Phragmites*, and *Sphagnum*. Reddish limonite spots.
445–406	–	Water layer.
620–445	Tb2Th1Sh1Tl+	Dark brown peat with *Eriophorum*, *Phragmites* and *Sphagnum*.
651–620	Tb3Sh1Th+	Black peat with *Eriophorum* and *Sphagnum*.
655–651	Ag4	Light grey, creamy clay. Washed-in Miocene sediment.
725–655	Tb2Th1Sh1	Black peat with *Eriophorum* and *Sphagnum*.
744–725	Th2Tb1Sh1	Black peat with *Phragmites* and *Sphagnum*.
748–744	Tb1Th1Sh1As1	Black peat with clay.
818–748	Th2Tb1Sh1Tl+	Black peat with *Phragmites* and *Thelypteris*, some brown moss, *Sphagnum* and wood.
823–818	Ag3Sh1Th+	Brownish grey, creamy clay. Washed-in Miocene sediment mixed with peat.
829–823	Th2Tb1Sh1	Black peat with *Phragmites* and *Thelypteris* rhizomes with some brown moss and *Sphagnum*.
860–829	As3Sh1Gr$_{min}$+	Greyish brown clay with some small quartz grains.

seasonally altering water layer thicknesses, causing the chronology presented there being completely false and the conclusions needing significant reconsideration.

The most interesting characteristic of the described borehole section is the lack of sediment formation in the Middle Ages (500–1370 AD). Based on the age-depth model, we can conclude that sometime during the centuries following the Roman era, the sediment of the lake bed was excavated around the boring point, as the sediments formed in the 5th century AD are still intact. The last dredging of the lake bottom took place in the late 14th century. However, we don't know whether that was carried out in a single or more sessions. Nor does the sediment profile provide an answer to whether this human impact meant the expansion of an existing natural bog-lake bed or the creation of a completely new one. In any case, the area was significantly affected by the 14th century AD, which might be surprising at first glance in the light of the bog's geographical location, but the details to be described in the followings will help provide a better understanding.

Medieval settlement

Based on sediment studies, the land use in the area in the Árpádian Age was unusually intensive. Deep-cut forest roads in the vicinity of the Bottomless Lake also refer to centuries of use (Fig. 3/1, 2, 4). One could rightly ask, what has caused this significant anthropogenic impact? Based on written historical sources we hypothesised the presence of an Árpádian-age village in the vicinity of the bog. This settlement was unknown by archaeology but became discovered during a field survey session on 11 May 2019 (N46° 20.454 ′E23° 49.512′; 308 m aBsl; Fig. 1, Fig. 4/18–19).

The area named Pusztabagó (meaning "deserted Bagó") in early modern written sources lays about 4 km north of today's Băgău village. It is a valley with the upper, widening part sloping towards the Mureş River in a north-westerly direction, excellent for settling. Most of this area was covered with pastures and sheep-pens, making it unsuitable for surface surveys. In contrast, the southwestern side of the valley comprises plowed terraces rising above the plateau. We found many archaeological finds in the young crop on the dark-colored soil. To our surprise, however, most of the finds did not date to the Late Middle Ages or the Early Modern Period (as expected) but, save for a few prehistoric sherds, to the 8th–12th centuries AD. The early phase of this period was represented by hand-formed pottery fragments, while the later one, covering the first half of the Árpádian Age, by sherds from slow-wheeled vessels decorated with incised straight and wavy bundles and wavy lines. We have also found some 18th–19th century-old glazed pottery. The surveyed area, from which larger quantities of ceramic fragments were found, was of approximately 1 ha; the full extent of the destroyed settlement has not yet been outlined.

In addition to a few uncharacteristic prehistoric (Bronze Age?) ceramics and a fragment of a late Iron-age vessel from the Dacian period, made of fine gray material, we have collected a significant amount of pot fragments dated to the first half of the Árpádian Age (Fig. 4/1–16). Their material is rough due to sand tempering. The pots had been shaped on a slow wheel, and had a burnt brown colour on the outside and grayish-brown on the inside. The fragments were decorated with bundles of horizontal or wavy lines incised with a comb-like tool and with separate horizontal and wavy lines. The pots had simple, curved rims, with the more articulated rim types, typical to the second half of the Árpádian Age, missing from the material. Some hand-formed vessel fragments

Table 2. AMS results of the core

Lab code	Depth (cm)	material	^{14}C age (years BP ± 1σ)	cal BP years (2σ range)	cal BC/AD years (2σ range)
D-AMS 017148	60	peat	284 ± 36	155–461	1489–1795 (cal AD)
D-AMS 017149	150	peat	333 ± 21	310–465	1485–1640 (cal AD)
D-AMS 020195	165	peat	393 ± 42	316–515	1435–1634 (cal AD)
D-AMS 032146	176	peat	343 ± 23	315–481	1469–1635 (cal AD)
D-AMS 032147	185	peat	315 ± 24	305–460	1490–1645 (cal AD)
D-AMS 017150	245	peat	2286 ± 29	2164–2352	403–215 (cal BC)
D-AMS 017151	350	peat	3069 ± 32	3182–3364	1415–1233 (cal BC)
D-AMS 017153	515	peat	4144 ± 24	4579–4821	2872–2630 (cal BC)
D-AMS 016726	614	peat	5665 ± 49	6314–6598	4649–4365 (cal BC)
D-AMS 016725	704	peat	6349 ± 67	7163–7423	5474–5214 (cal BC)
D-AMS 020197	783	peat	6372 ± 50	7178–7422	5473–5229 (cal BC)
D-AMS 016724	785	peat	6443 ± 38	7288–7428	5479–5339 (cal BC)
D-AMS 020198	802	peat	7709 ± 44	8415–8580	6631–6466 (cal BC)

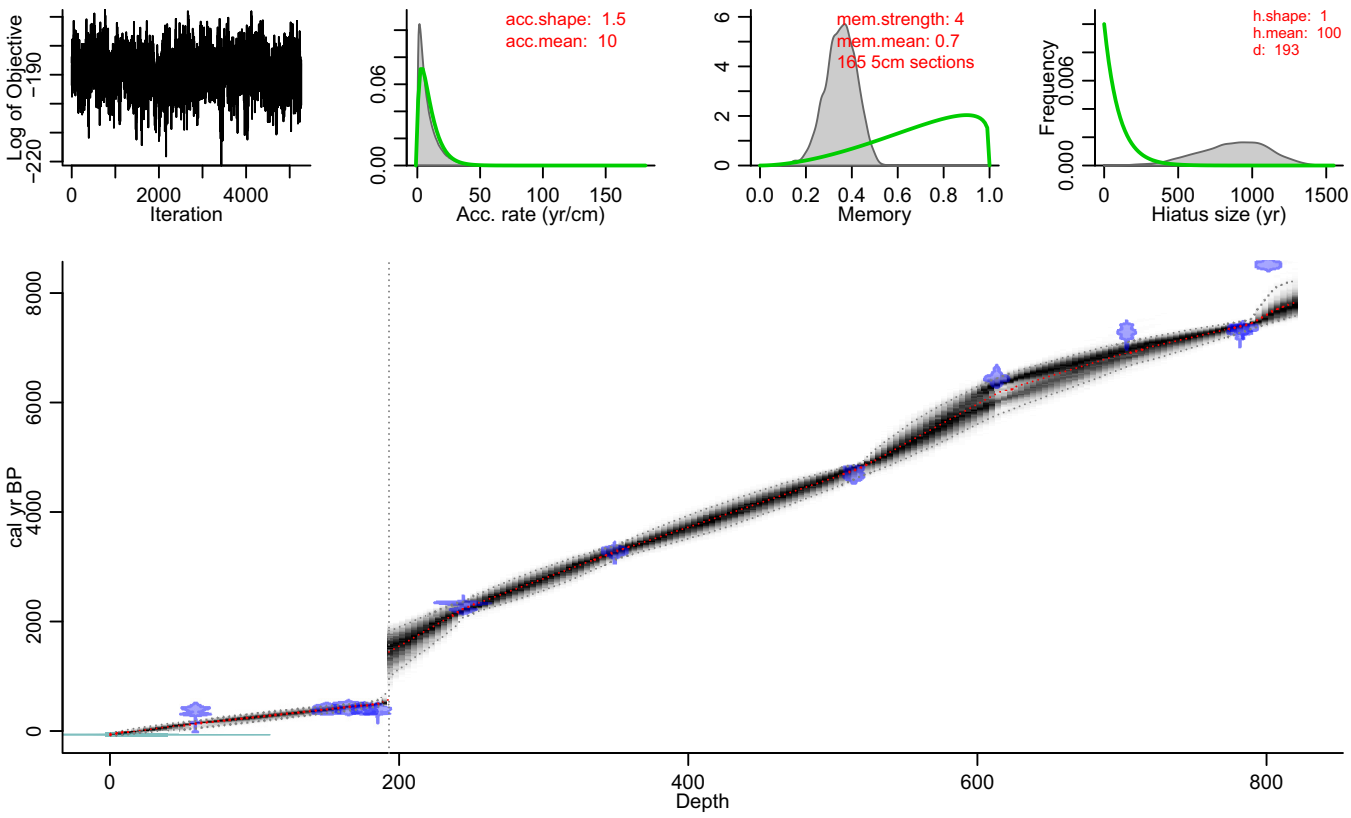

Fig. 2. Băgău-Tăul fără fund, diagram showing the age-depth model

suggest that the start of the site might be earlier than the Árpádian Age (8th–9/10th centuries AD).[22] As for its end, a fragment with shallow incisions on the side dates to the Late Middle Ages (Fig. 4/17); the iron nails collected at the site may also probably be dated to this time. Furthermore, we have also found glazed pottery from the 18th–19th centuries AD in relative abundance; their presence suggests that one must count with sporadic settling in the Pusztabagó Valley even at that time. A piece of slag,

[22] I am grateful to Miklós Takács (Research Centre for the Humanities, Institute of Archaeology, Budapest) for his comments on the evaluation of the medieval artefacts in Băgău.

Fig. 3. Traces of medieval land use around the Bottomless Lake in Băgău. 1, 2, 4: deep-cut forest roads near the lake; 3, 5: the lake bed, partly covered with vegetation

referring to iron processing, was also collected but cannot be dated.

Both the medieval settlement history of Băgău and its surroundings and our knowledge on the medieval use of the *Tăul fără fund* can be enriched with new details thanks to these observations, discussed in more detail below.

DISCUSSION

The sedimentological and radiocarbon results suggest that the sediment deposition in the basin of the *Tăul fără fund* at Băgău started in the Early Holocene, during Late Mesolithic when a mass downslope movement (translational or rotational landslide) developed on the sloping, Miocene sandy

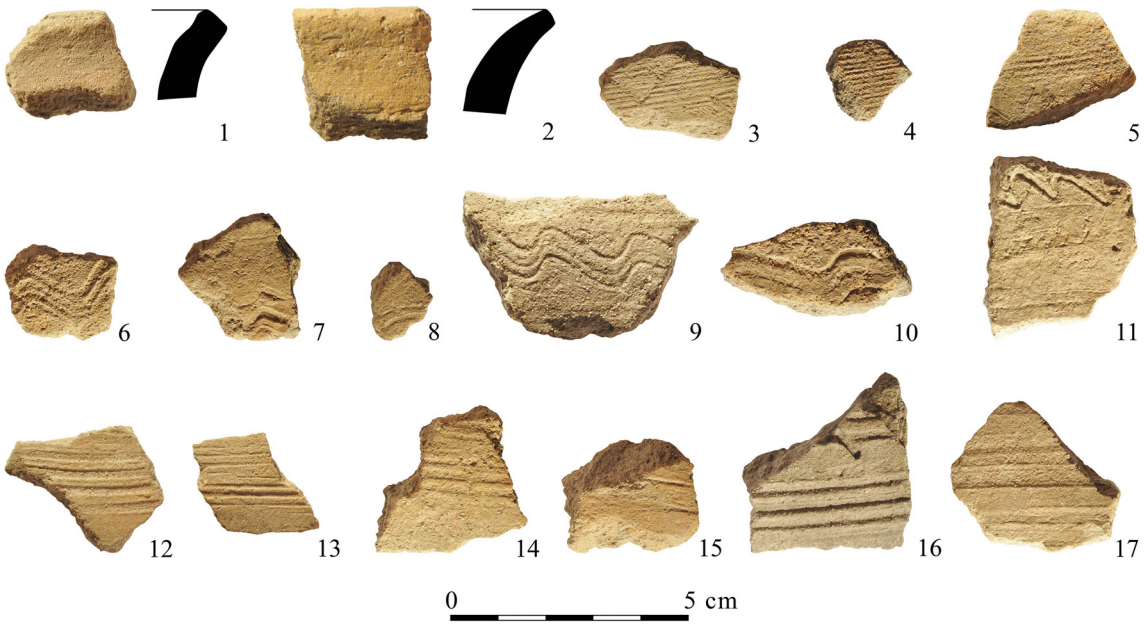

Fig. 4. 1–17: Medieval finds from the Pusztabagó Valley; 18: the Pusztabagó Valley with the medieval settlement; 19: the Pusztabagó Valley with the location of the medieval settlement (b) and the Bottomless Lake above it (a)

and silty carbonate-rich marine (marl) sediment-covered land surface. As a result the debris flow closed the Băgău valley, resulting in the formation of a long but narrow catchment basin. Later on, during the first period of the Middle Holocene, *Sphagnum*-peat formed and the organic-rich peat layer gradually accumulated in the site. The most striking feature of the sediment is a 900-year hiatus between 500 and 1370 AD.

Neither recent field observations nor the medieval written data available to us suggest that earthworks to form a new artificial lake bed were carried out at the Bottomless Lake in the Middle Ages. The open water surface in the lake bed is considered to be a natural formation. Based on the age-depth model, the bed was deepened sometime before the 14th century AD, when a significant amount of sediment became removed. We cannot determine the date of the first dredging works as subsequent interventions have removed the traces. The lake bed soon became overgrown, and reed began to reclaim the water surface. The age-depth model shows extremely rapid sediment accumulation in the 15th century AD, which can be explained by an attempt to restore the open water surface by removing expanding reedmat in the borehole's area. The present peatmoss floating bog has formed on this accumulated sediment from the middle of the 15th century AD on. Floating bogs can form rapidly in a natural way,[23] and we also know of modern examples from the Carpathian Basin of the formation of a floating bog on excavated peat after dredging.[24]

We do not have specific evidence of the exact purpose of these earthworks. Based on its location, the lake may have been used to collect drinking water for grazing animals in this basically dry area, as the pastures were at a distance from the village, in the outskirts of the settlement. There are few publications on the construction of fishponds and reservoirs in medieval Hungary, but in recent years, an increasing number of artificial lakes, established in the Middle Ages, have been found.[25] Taking these into account, the construction of Băgău's *Tăul fără fund* in the 14th century AD is not extraordinary. The establishment of ponds and reservoirs in the Carpathian Basin in the 14–15th centuries AD is presumably due to a drought period.[26]

Although – due to the lack of related sediment sequence in the sample core obtained from the Bottomless Lake – we do not have environmental data relating to the Early Middle Ages, it is important for general reasons to briefly summarise the pre-Middle Age settlement history of the area from the Roman times on.

At least 19 sites represent the Roman Period in the study area, and stone walls, fragments of brick, roof tiles and carved stones have also come to light at several places. The most significant remains are known from the area of Ocna Mureș, where, according to the researchers, the Roman settlement of *Salinae*, referring to salt mining in its name, lay. The Gothic (Marosszentanna-Chernahov culture) and Gepidic Period, following the abandonment of Dacia province, was characterised by a sharp decline in the number of archaeological finds (three sites), and the same can be told for the 6th and 7th centuries AD, i.e., the early Avar Period (represented by cemeteries in Gâmbaș and Lopadea Nouă).[27]

The fundamental shortcoming of information forced us to work with relatively old data and rather uncertain age determinations. This is especially true for the last third of the first millennium AD, as the 8th–10/11th century finds have often been described, rather cautiously, as "prefeudal." It is still striking, however, that the findings of this era, including several 8th–9/10th-century cemeteries (Ciumbrud, Turdaș, Uioara de Jos)[28] show a significant increase in population compared to the previous period. They indicate (e.g., the Ciumbrud cemetery) that the area was inhabited before the Hungarian Conquest and the settlement network has become significantly denser with the mass influx of Hungarians. In addition to the remains of early Árpádian-age settlements,[29] a small 10–11th-century cemetery was excavated on the southern slope of the Gorgány Hill (498.8 m aBsl) between Băgău and Lopadea Nouă.[30]

An exceptionally early charter from the time of King St. Stephen (1001–1038) reveals a lot about the formation of the early Árpádian village network and the royal and ecclesiastical estate organisation within in the study area. At that time, the sources only mention specifically the neighboring Lopadea village (Fig. 1) but not Băgău. A document from the 15th century, listing the lost estates and incomes of the St. Moritz Monastery in Bakonybél (Veszprém County, Hungary) mentions the village of Lopadea in Transylvania (*in Transsilvanis partibus villam Lapat*) as owned by Queen Gisela, the wife of King Stephen I (Saint), and donated to the monastery of Bakonybél between 1023 and 1038 AD with the consent of the king (*Stephano rege favente*).[31]

The queen's former estate consisted of more than one village. To the east of Lopadea Nouă lies the village of Asinip, whose old Hungarian name (Asszonynépe, "the woman/queen's people") means a queen's estate. It seems that this estate remained in royal hands for long time even after Gisela's death, while parts of it were transferred later to various church institutions. The village of Asinip became the property of St. Martin's provostship in Arad, its boundary was described in detail in 1177. It is clear from this document that by the 12th century, a dense settlement network had developed in the countryside, mostly with border names in Hungarian.[32] It is worth noting that the

[23] Balogh (2000); Balogh (2001).

[24] Váldi (2011).

[25] Benkő (2015); Benkő (2016); Jakab et al. (2018); Sümegi et al. (2021); Zatykó (2011).

[26] Kiss and Nikolić (2015).

[27] *Repertoriu Alba* (1995).

[28] Dankanits and Ferenczi (1959); *Repertoriu Alba* (1995) 79, 193, 196.

[29] *Repertoriu Alba* (1995) passim.

[30] Gál (2013) 311–312.

[31] DHA (1992) I., 120; EO (1997) I., 123 (nr. 1).

[32] EO (1997) I., 127 (nr. 14).

charter describing the boundaries of the settlement south of Asinip mentions a saltwater stream (*Sossed*) and a (salt)mine (*Acna*) in the area of today's Ocnişoara, which refers to a salt deposit of local significance. The northern border of Asinip was the village of Tordos (1177: *villa Tordosi de Vyuuar*), whose name at that time ("Tordos belonging to Újvár = New Castle") suggests that Asinip was part of a small 11–12th-century territorial unit (comitatus). This formation was later merged into the vast Alba County of southern Transylvania.[33]

At least 25 villages and settlements developed during the Middle Ages in the 8–9 km–radius area around Băgău, several of which were destroyed or became renamed during the Middle Ages (Fig. 1). 13 of them (52%) had Roman Catholic church buildings already before 1332 AD. Archaeological finds from early Árpádian age-settlements in the study area also reveal that the life of some villages started much earlier than the first written mentions. In other cases, traces of further medieval settlements can be observed in the area (for example, in Lopadea Nouă, where the remains of two settlements have been discovered even without modern archaeological topographic research: one inside the present-day village around the Reformed church of Árpádian-age origin, while another in the north-western fringes of the village (Telek), where early Árpádian ceramics were found).[34]

Băgău only appears first in written sources at the end of the Árpádian Age, in 1296. Băgău, together with Lopadea, was the property of the Óbuda provostry at that time, but their ownership was disputed for some reason by the nobles who owned the neighbouring Sâncrai. It is striking that Lopadea at that time was no longer the property of the Benedictines of Bakonybél, but belonged to the provostry of Óbuda;[35] however, these estates changed hands often. The provostry of Óbuda must have realised that it could make little use of its distant Transylvanian estate, was also a subject to litigation, and, presumably, sold it to or exchanged it with the local nobles.

Before that, however, Băgău may have had a longer history, which can be revealed by adding the archaeological observations presented above.

From settlement historical point of view, it is a very important fact in the charter from 1296 that the area was formerly known as *terra Perech*, but "recently" is called *Bago*. The change of name *Perech-Bago* is probably related to the new owners, the noblemen of Sâncrai and their property development (1296: *in possessionibus eiusdem ecclesie Budensis Lapad et Perech nunccupatis, que quidem terra Perech nunc Bago dicitur appellari, et cum inter ipsos prepositum et capitulum Budense ab una parte et nobiles eiusdem partis Transilvane de Zenthkyral super facto earundem terrarum seu possessionum gravis questio dicitur fuisse suscitata*).[36] It seems probable – but, obviously, has yet to be confirmed by further field research – that initially, several settlements emerged in the area of the former *terra Perech* in the Árpádian Age. It is noteworthy that the settlement called *Pusztabagó*, *Pusztafalu* in the Modern Age (meaning "deserted Bagó" or "deserted village"; its original name, like the lands around it, may have been *Perech*) was one of the earliest settlements in medieval Transylvania, along with the neighbouring Lopadea Nouă and Asinip (Fig. 1).

The name *Perech*, considered to be of Slavic origin, does not appear again in written sources after 1296, neither can be found among the modern border names of Băgău. This change may be closely related to the later history of the Băgău estate. Sometime before 1317 Băgău ceased to be the possession of the Óbuda provostship of Buda and became a secular property.[37] The nobles of Ciumbrud, who owned it at that time, were relatives to the noblemen of Sâncrai who had already claimed ownership of the village before. In 1319 the owner of the village was a certain Miske from the broader kinship of these families, who maintained a noble manor house here (*Myske de Bogou*).[38] In 1329 Miske was a servant and supporter of the Transylvanian Voivode Thomas.[39] His descendants called themselves the sons of Miske, and from the 15th century on, the name of the ancestor raising the family became a family name. The Miske family has split into several branches, each renaming themselves after their estate centres, so there were distinguished Miske families from Băgău, Cisteiu de Mureş (Alba County) and Mociu (Cluj County). The Miskes occasionally played a role in their county's administration. From the end of the 15th century on, the Miske family gradually lost ownership of properties in Alba County. In the case of Băgău, this took place before 1520. The village had several successive owners during the 16th century, but this is of little significance for our research topic. It is important, however, that the village did not change its location or name between the late Middle Ages and the Modern Age. Its church building was of Árpádian-age origin; after the Reformation, it was reconsecrated as Reformed. Finally, it became demolished in 1803 and a new one was built in its place.[40]

As already mentioned, written sources from the 17th–18th century mention a part of Băgău's fringes as Pusztabagó ("deserted Bagó"). The location of these lands was determined relatively well in 1793: it lay not very close to the present-day village but much further north, towards Cisteiu de Mureş ("*az m:Tsesztvei határ felől valo Puszta Bago nevezetű terrenum*"). This description facilitated considerably for us to identify the site in the area at upper third of the valley to Micoşlaca and Cisteiu de Mureş, northeast of Băgău (Fig. 1).[41]

Băgău and the valley called Pusta Băgăului (Pusztabagó), both excellent for cultivation, are separated by the Băgău

[33] ÁMF (1987) II., 131.

[34] *Repertoriu Alba* (1995) 118.

[35] EO (1997) I., 313 (nr. 553).

[36] *Bp* (1936) I., 271–272. (erroneously dated to 1291); EO (1997) I., 311 (nr. 548).

[37] EO (2004) II., 123 (nr. 278).

[38] EO (2004) II., No. 139–140 (nr. 328).

[39] EO (2004) II., 245–246 (nr. 658).

[40] Léstyán (1996) II., 117–118.

[41] Szabó (2001) 102.

Hill with the Bottomless Lake (*Tăul fără fund*) at its top. The mountain range was once crossed by dirt roads. Most of them connected Băgău and Pusta Băgăului in a north–south direction, but there were also roads running north–west (Păgida) and south–east (Hopârta). It must be noted that these roads intersected at Bottomless Lake, suggesting it played a certain role (Fig. 3/1, 2. 4). Although these roads can only be identified on maps from the 18th century AD (the Bottomless Lake itself has only been indicated in written sources since 1764 AD), they are much older – as marked by the fact that near the lake at the mountain edge they cut into the surface remarkably deep. In such cases, archaeological research tends to assume centuries of use.[42] These pathways indicate that the human presence around the lake may have been more intensive than today.

Although the human impact around the lake in the Middle Ages was greater than expected, it was surprising that a significant portion of the lake's sediment was once removed. In the light of our current research, this procedure is unparalleled in Transylvania in the Middle Ages and, therefore, needs to be explained. The former extent of the dredged lake may have been about 0.3–0.5 ha (the open water surface today is only about 0.1 ha). During the field-work session, no traces of dams and canals were observed around the lake. The literature on Băgău mentions that there are significant water level fluctuations in the lake bed, depending on the amount of precipitation. We can only guess a reason behind the medieval re-creation of the lake bed: it could have served as a safe supply of drinking water for animals grazed on the low mountain range not abundant in water. In principle, it could also be used for fish farming (the locals still fish here today). The neighbouring villages in the area, on the banks of the Mureș River, certainly fished the river and its backwaters in the late Middle Ages. According to a data from 1578 AD, a backwater of the Mureș on the border of the neighboring Sâncrai, known as Sulymos-tó ("lake with water chestnut"), has been freely fished by local nobles and peasants for centuries, and they were free to collect the fruit of the aquatic plant *Trapa natans* as well (*… holt maros, kyt maas newel Swlmos tonakys hynak … az peres Swlmos tho mind az Zent kjralyaknak mind paraztnak nemesnek zabad wolt mind halazny mind swljmot benne zednj soha senkiteol tilalmas nem volt*).[43] However, Băgău was not directly adjacent to the Mureș River and historical data do not indicate fishponds elsewhere on the border.

Nevertheless, such an excavation of the lake bottom, exceeding by far the usual cleaning operations of fishponds, is unprecedented in our area. Neither do we know whether the excavated peat sediment was used for anything, nor can we think of using peat as fuel in an environment full of wood. Therefore, at the present stage of research, we restrict ourselves to recording the event sequence of the 14th century AD, at a time when the owners of the village came from a strong, extensive noble kinship, and were affluent enough to invest a significant amount of labour in the outskirts of the village as well.

CONCLUSIONS

The authors examined the area of the Bottomless Lake in Băgău using archaeological and environmental historical methods, this time focusing on the Middle Ages. As a result of field surveys in Pusztabagó in the village's outskirts, a medieval settlement has been identified, which proved to be, based on the recovered archaeological finds, one of the earliest villages in Transylvania. Fortunately, the medieval Băgău and its owners are relatively well documented, as is the history of the neighbouring villages. By clarifying the radiocarbon dating of the organic sediment from the boring of the Bottomless Lake – these data were misinterpreted by previous research – we were able to make important new discoveries for the Middle Ages, which could be extended by archaeological exploration of the lake's close area.

Research has shown that the Bottomless Lake, although relatively far from today's settlements, may have played a significant role in medieval land use strategies as a water reservoir. This hypothesis is also supported by the medieval roads connecting Băgău and Pusztabagó, cutting deep into the ground, as well as other medieval settlements in the area. The role of the lake is probably related to grazing in the lands around, an absolutely unsurprising development in the light of the settlement history of other basins. According to our current knowledge, the massive excavation of the sediment from the bed of the Bottomless Lake in Medieval times and the resulting striking hiatus of sediment is a most unusual and unique phenomenon. The exact reason behind, just as the precise extent and details of the related works are unknown. The goal was obviously to create a larger, single free water surface for secure water supply for animals grazed at an otherwise water-deficient altitude even in the event of a prolonged drought, and possibly to allow for fish to settle there. In the light of the historical data at hand, this may have taken place after the end of the Árpádian Age, sometime in the second half of the 13th and the 14th centuries AD, when the settlement network became fully established and the noble families emerging in the Băgău area were able to provide a sufficient number of serfs even for large-scale earthworks.

ACKNOWLEDGEMENTS

The background research of the study was supported by the Hungarian National Scientific Fund (OTKA/NKFI 112318)

REFERENCES

ÁMF (1963–1998). Györffy, Gy: *Az Árpád-kori Magyarország történeti földrajza – Geographia historica Hungariae tempore stirpis Arpadianae, I–IV*. Akadémiai Kiadó, Budapest.

[42] Németh (2014).

[43] Szabó (2001) 55–60.

Balogh, M. (2000). Az úszóláp szukszesszió kérdései I (On the succession of floating bogs 1). *Kitaibelia*, 5(1): 9–16.

Balogh, M. (2001). Az úszóláp szukszesszió kérdései II (On the succession of floating bogs, 2). *Kitaibelia*, 6(2): 291–297.

Benkő, E. (2015). Udvarházak és kolostorok a pilisi királyi erdőben (Mansion houses and monasteries in the royal forest of Pilis). In: Benkő, E and K. Orosz (Eds.), *In medio regni Hungariae. Régészeti, művészettörténeti és történeti kutatások „az ország közepén" – Archaeological, art historical, and historical researches "in the middle of the kingdom"*. MTA Bölcsészettudományi Kutatóközpont Régészeti Intézet, Budapest, pp. 725–753.

Benkő, E. (2016). Történelem sárból és iszapból (History from mud and silt). In: Horn, I. and Várkonyi, G. (Eds.), *Művészet és mesterség. Tisztelgő kötet R. Várkonyi Ágnes emlékére, II*. L'Harmattan, Budapest, pp. 11–22.

Benkő, E. and Zatykó Cs. (Eds.) (2021). *A Kárpát-medence környezettörténete a középkorban és a kora újkorban (Environmental history of the medieval and early modern Carpathian Basin)*. Bölcsészettudományi Kutatóközpont Régészeti Intézet and Archaeolingua, Budapest.

Benkő, E., Sümegi, P., Törőcsik, T., Bodor, E., Sümegi, B., and Jakab, G. (2021). Marosszentkirály: egy középkori pálos kolostor és környezete [Marosszentkirály (Sâncraiu de Mureș): a Pauline monastery and its environment in the Middle Ages]. In: Benkő, E. and Zatykó Cs. (Eds.) *A Kárpát-medence környezettörténete a középkorban és a kora újkorban (Environmental history of the medieval and early modern Carpathian Basin)*. Bölcsészettudományi Kutatóközpont Régészeti Intézet and Archaeolingua, Budapest, pp. 331–355.

Bennett, K.D. (1994). Confidence intervals for age estimates and deposition times in late-Quaternary sediment sequences. *The Holocene*, 4: 337–348.

Blaauw, M. and Christen, J.A. (2011). Flexible paleoclimate age-depth models using an autoregressive gamma process. *Bayesian Analysis*, 6: 457–474.

Bogdan, O. (1983). Regiunile climatice și topoclimatele [Climatic regions and topoclimates]. In: Badea, L., Gâștescu, P., and Velcea, V.A. (Coord.), *Geografia României, Vol. 1: Geografia fizică*. Editura Academiei Republicii Socialiste România, Bucharest, pp. 277–279.

Bp (1936). Gárdonyi, A. (Ed.), *Budapest történetének okleveles emlékei – Monumenta diplomatica civitatis Budapest*. A Székesfőváros kiadása, Budapest.

Brännvall, M.L., Bindler, R., Renberg, I., Emteryd O., Bartnicki, J., and K. Billström (1999). The medieval metal industry was the cradle of modern large-scale atmospheric lead pollution in Northern Europe. *Environmental Science & Technology*, 33: 4391–4395.

Croitoru, A-Z. (2006). *Excesul de precipitații din Depresiunea Transilvaniei* [Excess of precipitations from the Transylvanian Depression]. Casa Cărții de Știință, Cluj-Napoca.

Csató, J. (1896) Alsófehérvármegye növény és állatvilága [The flora and fauna of Alsó-Fehér County]. In: *Alsófehérvármegye monografiája, I*. Cyrner és Lyrner könyvnyomdája, Nagy-Enyed, pp. 187–224.

Dankanits, Á. and Ferenczi, I. (1959). Săpăturile arheologice de la Ciumbrud (Les fouilles archéologiques de Ciumbrud). *Materiale și cercetări arheologice*, 6: 605–615.

Darby, H. C. (1956). The clearing of the woodland in Europe. In: Thomas, W.L., Jr. (Ed.), *Man's role in changing the face of the Earth*. University of Chicago Press, Chicago.

De Vleeschouwer, F., Chambers, F.M., and Swindles, G.T. (2010). Coring and sub-sampling of peatlands for palaeoenvironmental research. *Mires and Peat*, 7: 1–10.

DHA (1992). Györffy, Gy. (Ed.) *Diplomata Hungariae antiquissima, I*. Akadémiai Kiadó, Budapestini.

Diaconeasa, B. and Mitroescu S. (1987). Analize de polen în mlaștina „Tăul fără fund", jud. Alba [Pollen analyzes of the "Tăul fără Fund" peat bog, county Alba]. *Contribuții Botanice*, 27: 69–74.

EO (1997–2021). Jakó, Zs,. Hegyi, G., and W. Kovács, A. (Ed.). *Erdélyi okmánytár – Codex diplomaticus Transsylvaniae, I–V*. Akadémiai Kiadó, Budapest.

Frink, J.P., Muncuș-Nagy, K., Paul, E., and Oprica, N. (2018). *Raport de activitate pentru lunile aprilie-septembrie în cadrul proiectului POIM „Elaborarea a 3 planuri de management pentru situri Natura 2000 din județul Alba" (cod MySMIS 102369)* [Activity report for the months of April-September within the POIM project "Elaboration of 3 management plans for Natura 2000 sites in Alba County"]. Manuscript.

Gaillard, M. J., Morrison, K.D., Madella, M., and Whitehouse, N. (2018). Past land-use and land-cover change: the challenge of quantification at the subcontinental to global scales. *Past Land Use and Land Cover*, 26(1): 3.

Gáll E. (2013). *Az Erdélyi-medence, a Partium és a Bánság 10–11. századi temetői, szórvány- és kincsleletei – 10th and 11th century burial sites, stray finds and treasures in the Transylvanian Basin, the Partium and the Banat*. Magyarország honfoglalás kori és kora Árpád-kori sírleletei, 6. SZTE Régészeti Tanszék, Magyar Nemzeti Múzeum, and MTA BTK Régészeti Intézet, Szeged and Budapest.

Giușcă, D., Bleahu, M., Lupu, M., Borcoș, M., Lupu, D., Dimian, M., and Dimitrescu, R. (1967). *Harta geologică a Republicii Socialiste România, scara 1:200.000. Foaia 18. Turda (L-34-XVIII)* [Geological map of the Socialist Republic of Romania, scale 1:200,000, sheet 18, Turda]. Comitetul de Stat al Geologiei, Institutul Geologic, București.

Hong, S., Candelone, J.P., Patterson, C.C., and Boutron, C.F. (1996). History of ancient copper smelting pollution during Roman and medieval times recorded in Greenland Ice. *Science*, 272: 246–249.

Hughes, J.D. and Thirgood, J. (1982). Deforestation, erosion, and forest management in ancient Greece and Rome. *Journal of Forest History*, 26(2): 60–75.

Ilie, M.D. (1952). Cercetări geologice în regiunea Cluj-Cojocna-Turda-Ocna Mureșului-Aiud [Geological research in the region of Cluj-Cojocna-Turda-Ocna Mureșului-Aiud]. *Anuarul Comitetului Geologic*, 24: 303–364.

Jakab, G., Silye, L., Sümegi, P., Törőcsik, T., Tóth, A., Sümegi, B.P., and Benkő, E. (2018). The environmental history of a former salt town in Transylvania (Sic, Northern Romania). *Acta Archaeologica Academiae Scientiarum Hungaricae*, 69(1): 185–206.

Jakab, G., Pál, I., Silye, L., Sümegi, P., Tóth, A., Sümegi, B., Frink, J.P., Magyari, E.K., Kern, Z., and Benkő, E. (2022). Social context of late medieval and early modern deforestation periods in the Apuseni Mountains (Romania) based on an integrated

evaluation of historical and paleobotanical records. *Environmental Archaeology*, in press.

Kaplan, J.O., Krumhardt, K.M., and Zimmermann, N. (2009). The prehistoric and preindustrial deforestation of Europe. *Quaternary Science Reviews*, 28(27–28): 3016–3034.

Kiss, A. and Nikolić, Z. (2015). Droughts, dry spells and low water levels in medieval Hungary (and Croatia), I: The great droughts of 1362, 1474, 1479, 1494 and 1507. *Journal of Environmental Geography*, 8(1–2): 11–22.

László, E. (2006). Vegetation of the "Tăul fără Fund" peat bog from Băgău village (Alba county, Transylvania, Romania). *Contribuții Botanice*, 41(2): 67–76.

Léstyán F. (1996). *Megszentelt kövek. A középkori erdélyi püspökség templomai, I–II* [Sacred stones. The churches of the medieval Transylvanian bishopric]. Gloria, Kolozsvár.

Németh, K.A. (2014). Adatok Tolna megye középkori útjainak kutatásához – Data to the research of the medieval roads of Tolna County. In: Rácz, T.Á. (Ed.), *A múltnak kútja. Fiatal középkoros régészek V. konferenciájának tanulmánykötete – The fountain of the past. Study volume of the Fifth Annual Conference of Young Medieval Archaeologists*. A Ferenczy Múzeum kiadványai, A. sorozat: Monográfiák, 3. Ferenczy Múzeum, Szentendre, pp. 177–188, 408, 457.

Pop, E. (1960). *Mlaștinile de turbă din Republica Populară Română* [The peat bogs of the People's Republic of Romania]. Editura Academiei R.P.R., București.

Pop, G.P. (2001). *Transylvanian Depression*. Presa Universitară Clujeană, Cluj-Napoca.

Price, T.D. (2000). *Europe's first farmers*. Cambridge University Press, Cambridge.

Reimer, P.J., Austin, W.E., Bard, E., Bayliss, A., Blackwell, P.G., Ramsey, C.B., and Talamo, S. (2020). The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon*, 62(4): 725–757.

Repertoriu Alba (1995). Moga, V. and Ciugudean, H. (Red.), *Repertoriul arheologic al județului Alba* [Archaeological repertory of Alba County]. Bibliotheca Musei Apulensis, 2. Alba Iulia.

Rydberg, J., Rösch, M., Heinz, E., and Biester, H. (2015). Influence of catchment vegetation on mercury accumulation in lake sediments from a long-term perspective. *Science of the Total Environment*, 538: 896–904.

Sandu, I., Pescaru, V.I., and Poiană, I. (Coord.) (2008). *Clima României* [The climate of Romania]. The Publishing House of the Romanian Academy, Bucharest.

Sümegi, P. (2001). *A negyedidőszak földtanának és őskörnyezettanának alapjai* [Fundamentals of Quaternary geology and palaeoecology]. JATEPress, Szeged.

Sümegi, P., Jakab, G., and Benkő, E. (2021). A pilisi királyi erdő a középkorban [The Pilis royal forest in the medieval period]. In: Benkő, E. and Zatykó Cs. (Eds.) *A Kárpát-medence környezettörténete a középkorban és a kora újkorban (Environmental history of the medieval and early modern Carpathian Basin)*. Bölcsészettudományi Kutatóközpont Régészeti Intézet and Archaeolingua, Budapest, pp. 249–330.

Szabó, T.A. (2001). Hajdú, M and Janitsek, J. (Eds.), *Szabó T. Attila erdélyi történeti helynévgyűjtése, I: Alsófehér megye* [Collection of Transylvanian historical place names by Attila T. Szabó]. Magyar Nyelvtudományi Társaság, Budapest.

Troels-Smith, J. (1955). Karakterisering af lose jordater [Characterization of unconsolidated sediments]. *Danmarks Geologiske Undersogelse*, 4(3): 1–73.

Váldi N. (2011). *A Ráckevei- (Soroksári-) Duna-ág revitalizációja* [The revitalization of the Ráckeve (Soroksár) branch of the Danube]. Dissertation, BCE Kertészettudományi Kar, Menedzsment és Marketing Tanszék, Budapest.

Vári, T.Zs., Molnár, D., Sümegi, P., Sümegi, B.P., Törőcsik, T., Szakál, E., and Benyó-Korcsmáros, R. (2020a). Holocene environmental history of the Bottomless Lake (Tăul fără fund) sphagnum peat bog in Băgău, Romania. *Studia Quaternaria*, 37(2): 69–77.

Vári, T.Zs., Sümegi, P., Sümegi, B.P., Törőcsik, T., Tapody, R.O., Molnár D., and Benyó-Korcsmáros, R. (2020b). A magyarbagói Feneketlen-tavi tőzegmohaláp negyedidőszak végi környezettörténete [The late Quaternary environmental history of the Bottomless Lake peat bog in Băgău]. In: Törőcsik, T., Gulyás, S., Molnár, D., and Náfrádi, K. (Eds.), *Környezettörténet. Tanulmányok Sümegi Pál professzor 60 éves születésnapi köszöntésére*. Geolitera, Szeged, pp. 549–560.

Zatykó, Cs. (2011). Aspects of fishing in medieval Hungary In: Klapste, J., Sommer, P. (Eds.), *Ruralia 8: Processing, storage, distribution of food – Food in the medieval rural environment*. Brepols, Turnhout, pp. 399–408.