A DARK AGE SETTLEMENT AND ITS ENVIRONMENT AT RÁKÓCZIFALVA IN THE MIDDLE TISZA REGION, HUNGARY•

EGY NÉPVÁNDORLÁS KORI TELEPÜLÉS ÉS KÖRNYEZETE A KÖZÉPSŐ-TISZAVIDÉKRŐL, RÁKÓCZIFALVÁNÁL

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Abstract

Complex archeozoological, environmental historical and geoarchaeological results are presented from archeological sites of Rákóczifalva–Bagi-föld and Rákóczifalva–Rokkant-föld in Jász-Nagykun-Szolnok County. In this area several hectares of archeological excavations uncovered masses of Gepida settlement features around two oxbow lakes. According to geoarcheological and environmental historical analyses a model for local settling and lifestyle strategies of the Gepid communities can be reconstructed. Based on the results of the digital relief model, maps, historical maps and analysis of geoarchaeological drillings, the Bagi-földek are located on a deeper and younger alluvial surface with good water supply and are connected to the development of the Tisza River, while the Rokkant-földek are located on an older residual surface and are rising above the alluvium of the Tisza River. The Gepid communities settled on a point bar system located on the high-floodplain and low floodplain in a semi-circular, semi-peninsula-like protected area. These surfaces provided different farming possibilities for the Gepid communities of the Migration Period: the utilization of the gallery forest, gatherings in the area of the forests and floodplain, fishing and hunting, extensive animal husbandry on the higher, drier areas and plant cultivation around the settlements and houses. According to our data, the inhabitants of the excavated Gepid settlement fully utilized the Tisza valley environment for food production on an organic (non-industrial) level (Sólymos, 1995), or in the Anthropocene I. horizon (e.g. Crutzen & Stoermer 2000; Steffen et al. 2011) during the Migration Period in the 6th century. The environment occupied by the Gepid community, the floodplain islands and residual surfaces in the Tisza Valley was inhabited from the early Neolithic. The exploitation of their environment, from settlement strategy to gathering, has a similar system as in the case of the Gepid settlement we have described. Our publication is a precursor to a comprehensive work with archaeologists, so we did not aim to analyze the individual cultures in detail from the perspective of environmental history and archaeology. We plan to do that together with the archaeologists who carry out the archaeological excavations. As a result, our article deals specifically with the settlement, geoarchaeological, bioarchaeological, and above all, archaeozoological analysis of the Gepid communities.

Kivonat

Jász-Nagykun-Szolnok megyei Rákóczifalva–Bagi-földeken és Rákóczifalva–Rokkant-földeken végzett több hektárra is kiterjedő régészeti ásatások során feltárt, két holtág körül található gepida leletekhez kapcsolódó komplex archeozoológiai, régészeti geológiai és környezettörténeti vizsgálatok eredményeit mutatjuk be publikációnkban. A rákóczifalvi gepida lelőhelyek geoarcheológiai és környezettörténeti elemzése nyomán egy modellt adhatunk a gepida közösségek megtelepedési stratégiájára és életmódjára. A digitális domborzati modell, a térképek és a történelmi térképek, a földtani fúrások geoarcheológiai vizsgálati eredményei alapján a Bagi-földek egy jó vízellátású, mélyebb és fiatalabb, a Tisza folyó fejlődéséhez kapcsolódó alluviális felszínen helyezkedik el, míg a Rokkant-földek az allúvium fölé emelkedő idősebb maradványfelszínen. A vizsgált területen megtelepedő gepida közösségek így a magas ártéren és az alacsony ártéren található, félkörívben,

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• How to cite this paper: TUGYA, B. et al., (2019): A Dark Age settlement and its environment at Rákóczifalva in the Middle Tisza region, Hungary, *Archeometriai Műhely* **XVI/3** 215–244.

félszigetszerűen árterekkel védett övzátony sorozaton telepedtek meg. Ezek a felszínek eltérő gazdálkodási lehetőséget nyújtottak a népvándorlás kori gepida közösségek számára és a galéria erdő hasznosításától, erdei és ártéri gyűjtögetéstől, halászattól – vadászattól a magasabb szárazabb térszíneken kialakított külteljes – legeltető állattartásig és a megtelepedési pontok, házak körül kialakított növénytermesztésig. Adataink alapján a feltárt gepida település lakói teljes mértékben hasznosította organikus (nem gépesített [nem indusztriális], kemikáliákat nem használó) gazdálkodás szintjén (Sólymos, 1995), más néven Anthropocén első szintjében (például Crutzen & Stoermer, 2000; *Steffen et al. 2011), Tisza- völgyi környezetüket a népvándorlás korában, a 6. századi élelmiszer termelésük során. Maga a gepida közösség által megszállt környezet, a Tisza-völgyében megtalálható ártéri szigetek, jégkori maradványfelszínek gyakorlatilag a kora-neolitikumtól kezdődően lakottak voltak és szűkebb, tágabb környezetük kihasználása, a megtelepedési stratégiától a gyűjtögetésig hasonló rendszert mutat, mint az általunk taglalt gepida település esetében, viszont az improduktív gazdálkodás (vadászat, halászat, gyűjtögetés), illetve a produktív gazdálkodás (földművelés, állattenyésztés) aránya változott az egyes közösségek esetében. Publikációnk egy átfogó, régészekkel közös munka előfutárának tekinthető, ezért nem volt célunk az egyes kultúrák részletes elemzése környezettörténeti és régészeti szempontból, mivel ezt a régészeti feltárásokat végrehajtó régészekkel közösen tervezzük megtenni. Ennek nyomán cikkünk kifejezetten a gepida közösségek megtelepedésével, geoarcheológiai, bioarcheológiai, mindenek előtt archeozoológiai elemzésével foglalkozik.*

KEYWORDS: ENVIRONMENTAL HISTORY, GEOARCHAEOLOGY, ARCHEOZOOLOGY, HUN AGE, GEPIDS

KULCSSZAVAK: KÖRNYEZETTÖRTÉNET, ARCHEOZOOLÓGIA, RÉGÉSZETI GEOLÓGIA, HUN KOR, GEPIDÁK

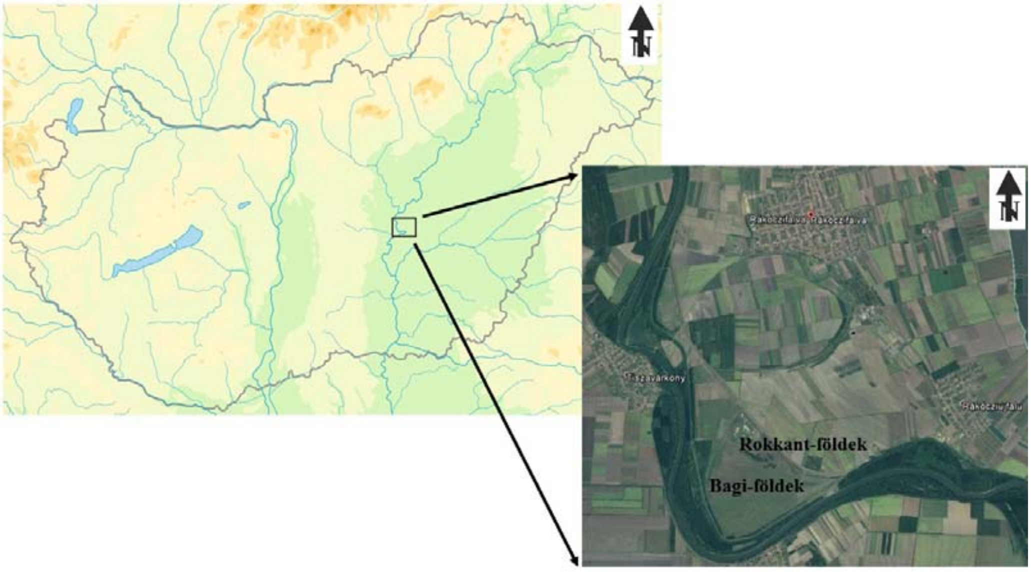

Fig. 1.: The location of the study site in Hungary and in Google Maps (scale of original maps: 1:500,000 and 1:10,000, respectively)

1. ábra: A vizsgált terület elhelyezkedése Magyarországon és a Google Maps szerint (térképek eredeti méretaránya: 1:500 000 és 1:10 000)

Introduction

We present the results of the archaeozoological, environmental historical and geoarchaeological analysis of Rákóczifalva–Bagi-föld and Rákóczifalva–Rokkant-föld (**Fig. 1.**) archeological sites in Jász-Nagykun-Szolnok County. They were discovered in the course of several hectares of archaeological excavations related to the Migration Period, especially the Hun era. A significant number of Gepid sites and finds were found in both the investigated area and the wider area of the site, in the middle reach of the Tisza valley. So the geoarchaeological and environmental historical analysis of the Gepid sites in Rákóczifalva can also provide a model for the settling strategy and lifestyle of the Gepid communities. The purpose of our work is to present how geoarchaeological and environmental historical factors impacted local settling and lifestyles in the Gepid communities (Kovács et al. 2007, 2008, Kovács and Váczi 2007, Masek 2012, 2014) during the Migration Period. In addition, to demonstrate the relationship of the Gepid communities and their environment in the Rákóczifalva site compared to other Gepid settlements in the Great Hungarian Plain (B. Tóth 1999, 2006). The composition of the domestic animal assemblage suggest the area was surrounded by extensive grazing fields, including saline pastures favorable to sheep, but the area of wet meadows and meadows was also outstanding indicated by the high ratio of cattle and horse bones in the 6th century, during the Gepid settlement. Poultry provided a significant source of meat and eggs.

The study site

Natural conditions of the area

In terms of the borders of the Rákóczifalva - Bagi-földek and Rokkant-földek sites, it can be said that it is protected from the north, south and west, as it is bordered by the Tisza River and the deeper Tisza alluvium (**Figs. 1-5.**). It is open only from the eastern direction, because the area is connected eastward to the high river bank of the Tisza River and it extends as a peninsula into the deeper Tisza floodplain. The study site belongs to the Great Hungarian Plain, including the Middle Tisza region, the Nagykunság little region group and the Szolnok-Túri alluvial plain, Szolnok-Alluvial Plain little regions. It lies in the western part of the Szolnok-Túri alluvial plain. The relative relief value of the little region is low, 2m/km^2. The slightly wavy plain in the study site and the floodplain at the edge of the Tisza River can be classified as orographic relief type (Marosi & Somogyi 1990). Examining a 1:10,000 scale map, the deepest point of the area is 79.2 m and the highest is 90 m. Despite the low relative relief value of the Szolnok-Túri alluvial plain, there is a difference of more than 10 m above sea level difference within a short distance in the study area. This value is extremely high in the Great Hungarian Plain, especially if we consider the general nature of the little region.

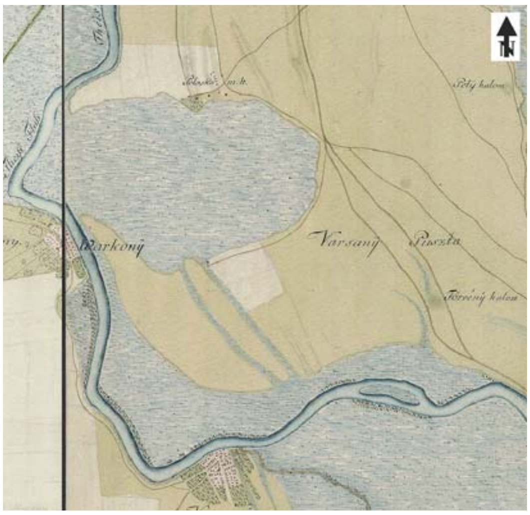

Fig. 2.: The morphological conditions and the vegetation of the study site in the First Austrian Military Survey (1782). Scale of original map: 1:28,800.

2. ábra: A vizsgált terület morfológiai viszonyai és növényzete az első osztrák katonai térképen (1782). Eredeti méretarány: 1:28 800.

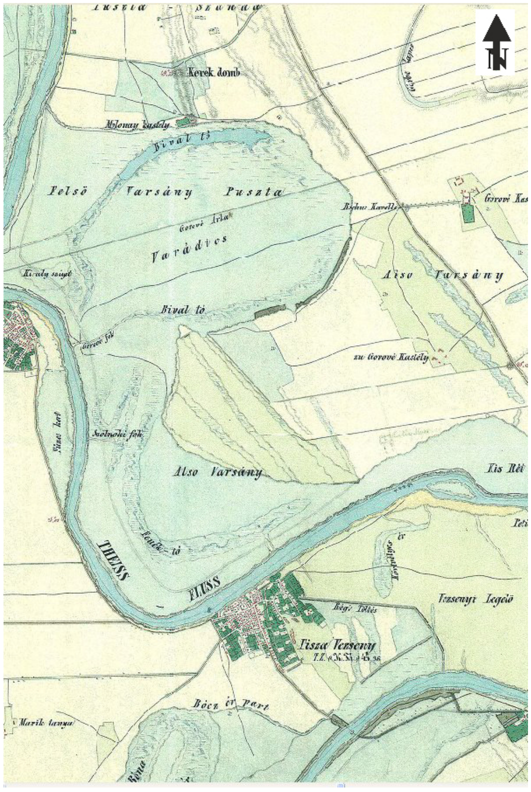

Fig. 3.: The morphological conditions and vegetation of the study site in the Second Austrian Military Survey (1869). Scale of original map: 1:28,800.

3. ábra: A vizsgált terület morfológiai viszonyai és növényzete a második osztrák katonai térképen (1869). Eredeti méretarány: 1:28 800.

Fig. 4.: The morphological conditions and the vegetation of the study site in the Third Austrian Military Survey (1875). Scale of original map: 1: 6,250.

4. ábra: A vizsgált terület morfológiai viszonyai és növényzete a harmadik osztrák katonai térképen (1875). Eredeti méretarány: 1:6250.

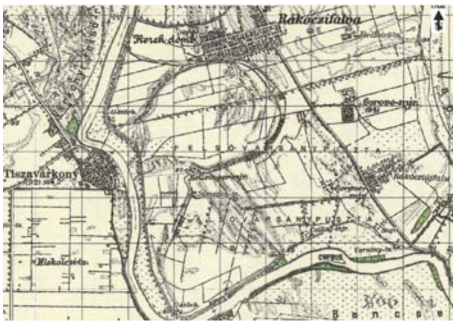

Fig. 5.: The morphological conditions and the vegetation of the study site in the Hungarian Military Survey (1943). Scale of original map: 1:5,000.

5. ábra: A vizsgált terület morfológiai viszonyai és növényzete a magyar katonai térképen (1943). Eredeti méretarány: 1:5000.

The above-mentioned little regions have a moderately warm-dry climate, close to the warm-dry climate. The annual sunshine duration is between 1970 and 2010 hours. The average annual temperature is 10.9 ºC, the mean temperature of the vegetation period is 17.3-17.4 ºC. Today the frost-free period begins on 7-8th April, the first autumn frosts are expected around 20th October. So the frost-free period is 196 days long. Annual precipitation is 510-540 mm, the growing period's precipitation is 300 mm. The aridity index is 1.3-1.38. The area is a dry, heavily anhydrous area. Precipitation is 150 mm less than the local value of the potential evaporation (Marosi & Somogyi 1990). Based on the data of the Szolnok meteorological station and the Walter-Lieth diagram (Walter & Lieth, 1960; **Fig. 5.**), the area belongs to the driest areas of the Great Hungarian Plain. On the basis of the average annual rainfall of 500 mm and the distribution of rainfall (**Fig. 6.**), there is a significant risk of drought in the second half of summer and in autumn. This occurs especially when continental and/or sub-Mediterranean climate effects develop resulting maximum monthly temperature conditions (**Fig. 6.**) in the examined area. In this case evaporation exceeds rainfall at the end of summer and early autumn and periodic steppe climatic conditions develop.

Based on the bioclimatic analysis of the Carpathian Basin (Szelepcsényi et al. 2014, 2018), the study site belongs to the central part of the Pannonian forest steppe zone (**Fig. 7.**). At the same time, the little regions belong to the Tiszántúl flora region located on the left bank of the Tisza River. Potential forest associations are willow-poplar-alder gallery forest, oak-ash-elm gallery forest, alkaline oak forest and loess-mantled terrain (*Aceri tatarico-Quercetum*) in the floodplain (Marosi & Somogyi 1990).

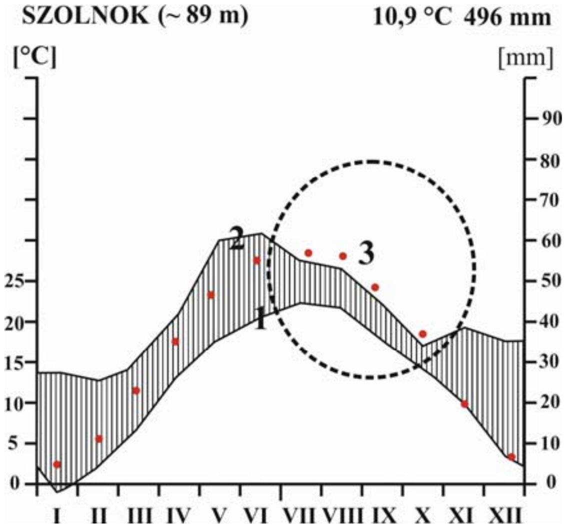

Fig. 6.: Walter-Lieth diagram based on the data from the meteorological station in Szolnok

1 = monthly average temperature values, 2 = monthly average precipitation values, 3 = dashed circle, drought period, red circle = monthly maximum temperature values

6. ábra: A vizsgált terület Walter-Lieth diagramja a szolnoki meteorológiai állomás adatai alapján

1 = havi átlagos hőmérsékleti értékek, 2 = havi átlagos csapadék bevételi értékek, 3 = szaggatott kör, aszály-veszélyes időszak, vörös körök = havi maximális hőmérsékleti értékek

Vegetation development and its change will be analyzed later, as we have a pollen core from the area that was revealed by the Department of Geology and Paleontology of the University of Szeged. Based on the recent plant associations the examined area is a cultivated steppe: pastures with weeds, poplar and black locust plantations, in deeper areas swamp vegetation mixed with weeds or with saline plants occur.

On the basis of the cores of the Department of Geology and Paleontology, University of Szeged two types of recent soils can be distinguished in the area. One of them is the chernozem (black earth) soil that can be found on natural elevations, the other is the alkaline meadow soils (**Fig. 8.**) which have a significant water effect.

The results of the Kreybig soil mapping (1933) and pedological mapping (**Fig. 8.**) were used to characterize the soils of the examined area (Kreybig 1937). In this historical map alluvial meadow, chernozem, alkaline and sandy soil types were identified in the study site, but in a different spatial extension compared to our results.

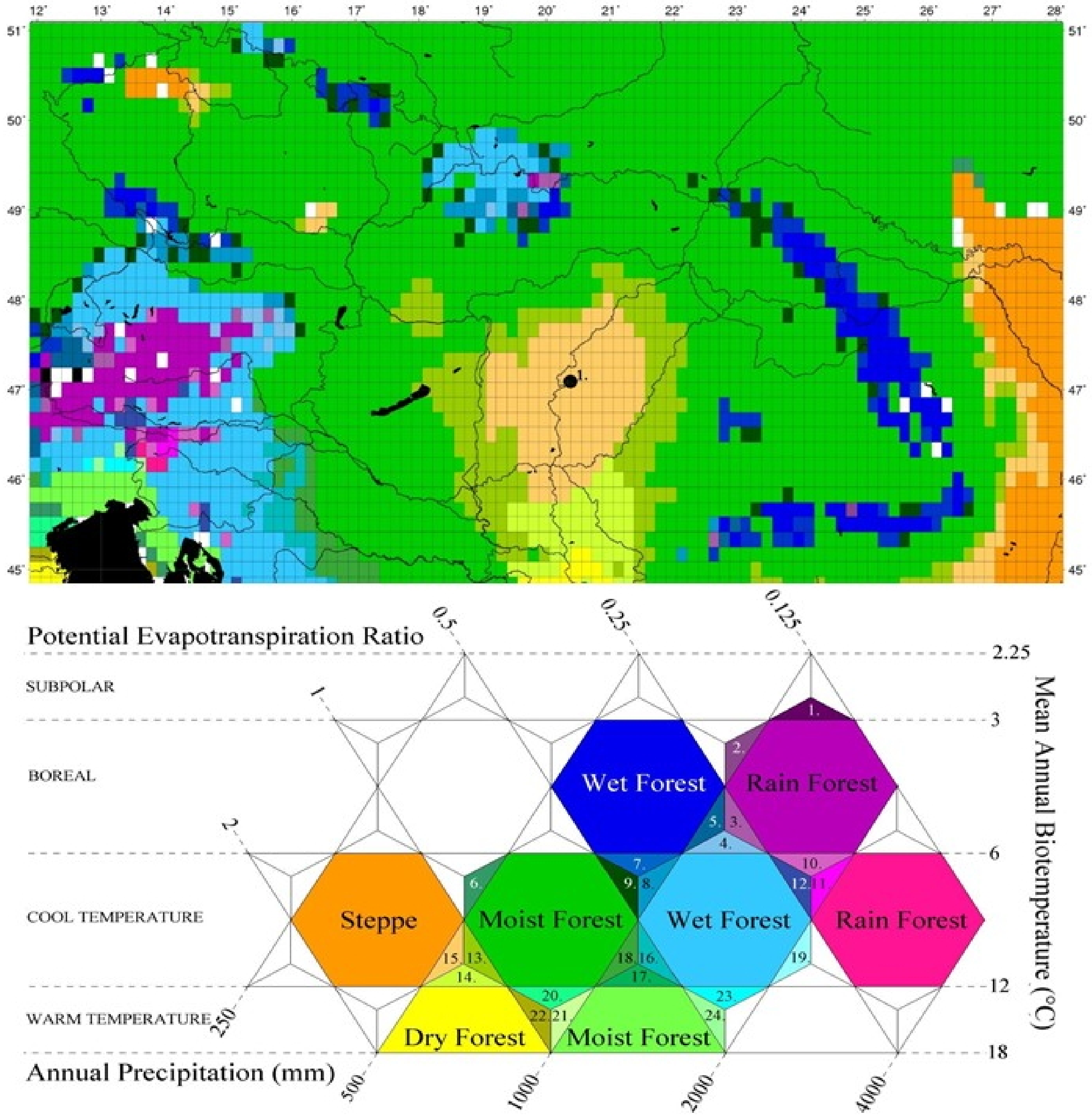

Fig. 7.: The position of the analyzed region within Holdridge's modified bioclimatic system (after Szelepcsényi et al. 2014, 2015, 2018)

7. ábra: A vizsgált terület elhelyezkedése a Holdridge féle módosított bioklimatikus rendszerű térképen (Szelepcsényi et al. 2014, 2015, 2018 nyomán)

Fig. 8.: Pedological map by Lajos Kreybig (1937) showing the study site (indicated as Felső and Alsó Varsány-puszta in the map) – brown color = chernozem soil, blue color = hydromorphic soil, purple color = alkaline soil, yellow color = sand soil. Scale of original map: 1:25,000.

8. ábra: Kreybig Lajos (1937) talajtani térképe a vizsgálati területről (a térképen Felső és Alsó Varsány - pusztaként jelölve) – barna szín = mezőségi talaj, kék szín = hidromorf talaj, lila szín = szikes talaj, sárga szín = homoktalaj. Eredeti méretarány: 1:25 000.

Geology and evolution of the area

Since only Quaternary formations could be detected on the surface of the examined area (**Figs. 9-10.**), the geological development history of the area is presented by discussing Quaternary events. The bedrock of these Quaternary formations is Tertiary sediments lying more hundred meters deep from the surface. Among these the most significant layer is the Törteli Formation (Juhász 1992) that developed at the end of the Tertiary, in the last phase of the Pannonian filling up. On the Törteli Formation the Zagyva Formation developed (Juhász & Magyar 1992; Juhász 1992). Thin-layered clay, aleurite and sandstone layers accumulated indicating a delta background, presenting marshy and floodplain environment. Its upper level evolved in an alluvial plain, in a fluviolacustrine environment. After the fluviolacustrine state the water network of the Great Hungarian Plain changed and was significantly different from the current water network: the Tisza River flowed more toward the east than nowadays. The Danube River met the Tisza at the height of Csongrád (Sümeghy 1944, 1953; Miháltz 1953; Molnár 1965). According to the latest data (Timár et al. 2005) the Tisza valley was formed about 20,000 years ago. The Tisza River, which until then followed the valley of the Körös and Berettyó Creeks, bypassed the Nyírség from the north and took its current direction (Sümeghy 1944). Thus, in the Tisza region, the Tisza River became significant regarding morphology and sedimentology from the Upper Würmian (MIS2, Sümegi et al. 2018). Due to tectonic movements sediments (of Tisza origin) of different age in different altitudes can be found in the area (Rónai 1972, 1985; Timár et al. 2005). So it is not surprising that the surface is covered by upper Pleistocene-Holocene sediments in Rákóczifalva - Bagi-földek and Rokkant-földek sites and older Pleistocene layers and the Pliocene bedrock sediments (clay, sand) are only known from drilling (Rónai 1972, 1985).

The most widespread upper Pleistocene sediment on the surface is loess; the type of loess that is connected to rivers and floodplains, i.e. a Pleistocene floodplain sediment (Sümegi 2005; Sümegi et al. 2015), formerly known as loess like Pleistocene alluvial sediment or better known infusion loess (alluvial loess). Infusion loess differs from typical loess in its porosity, carbonate and clay content and biofacies (Horusitzky 1898, 1899, 1903, 1905, 1909, 1911; Pécsi 1993; Sümegi et al. 2015).

In the Middle Tisza region there was also sand movement, which can be observed today north of the examined area in Szolnok-Szandaszőlős. The sandy area of Tiszaföldvár at the southern part of the Szolnok-Túri alluvial plain is the continuation of the sandy area of the Danube-Tisza Interfluve (Halaváts 1895; Miháltz 1953; Molnár 1965; Rónai 1972, 1985).

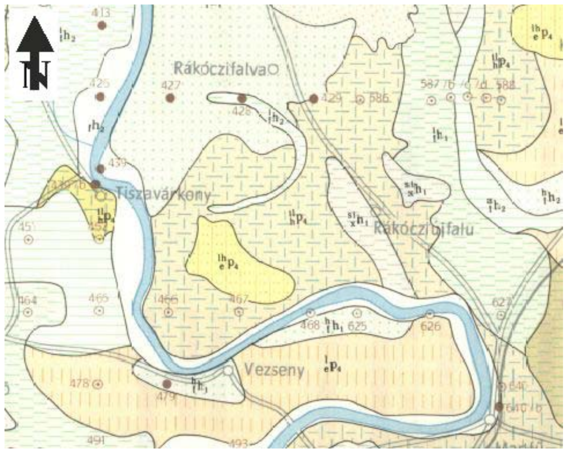

Fig. 9.: Geological structure of the study site (based on the 1:100.000 scale geological map of the Hungarian National Geological Institute, 1969)
lep4 = aeolian loess, terminal phase of Pleistocene, lhep4 = aeolian loessy sand, terminal phase of Pleistocene, ilhp4 = infusion loess, terminal phase of Pleistocene, lfh2 = fluvial fine silt from second phase of the Holocene, hfh2 = fluvial sand from second phase of the Holocene, sixh1 = alluvial silty rich sand sediment from Early Holocene, numbers = core points

9. ábra: A vizsgált terület földtani felépítése (MÁFI 100.000 földtani térképe nyomán, 1969)
lep4 = eolikus lösz, pleisztocén végi, lhep4 = eolikus löszös homok, pleisztocén végi, ilhp4 = Pleisztocén végi infúziós lösz, lfh2 = holocén második felében lerakódott fluviális finom kőzetliszt hfh2 = holocén második felében lerakódott fluviális homok, sixh1 = kora holocénben lerakódott alluviális kőzetlisztes homok, számok = fúráspontok

The results of the geological mapping were compared with the results of the geological map of József Sümeghy and András Rónai. The 1:200.000 scale geological map of the Tiszántúl (1941) by Sümeghy and the complex maps of the Great Hungarian Plain (**Fig. 9.**), the 1:100.000 scale Szolnok map sheet made by András Rónai. In the Sümeghy's map 'old-Holocene' and 'new-Holocene' alluvial soil surrounded the island-like 'upper Pleistocene lowland loess' formation. The expansion and position of the loess formation in the Great Hungarian Plain is very similar to that of the alkaline soil 'island' surrounded by alluvial soil in the map by Kreybig (1937).

The results of the mapping of the Great Hungarian Plain led by András Rónai are similar, although it showed a more inaccurate result in the examined area (Rónai 1969, 1972, 1985). Their cross-section of several drillings is slightly south of our study area (**Fig. 10.**); two drillings were conducted in the study site (**Fig. 10.**). Based on their map, an infusion loess covered (floodplain sediment) surface was explored in the area, and the residual surface was surrounded by deeper Pleistocene and Holocene channels and beds filled with fine grained sediments and still developing alluvial plains (**Figs. 9-10.**).

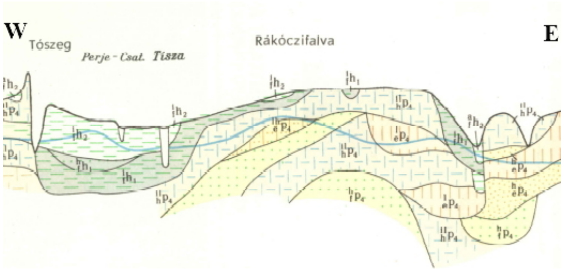

Fig. 10.: Geological cross section of the study site (based on the 1:100.000 scale geological map of the Hungarian National Geological Institute, 1969)
lfh2= fluvial sand from second phase of the Holocene, lfh1 = fluvial sand from Early Holocene, hfh1 = Early Holocene fluvial silty sand, hfp4 = fluvial sand from terminal phase of Pleistocene lep4 = aeolian loess, terminal phase of Pleistocene, lhep4 = aeolian loessy sand, terminal phase of Pleistocene, ilhp4 = infusion loess, terminal phase of Pleistocene, lfh2 = fluvial fine silt from second phase of the Holocene, hfh2 = fluvial sand from second phase of the Holocene, sixh1 = alluvial silty rich sand sediment from Early Holocene, Perje csat. = Perje canal, Tószeg, Rákóczifalva = recent settlement, Tisza = Tisza oxbow lake

10. ábra: A vizsgált terület földtani keresztszelvénye (MÁFI 100.000 földtani térképe nyomán, 1969)
lfh2 = késő-holocén fluviális homok, lfh1 = kora holocén kőzetlisztes fluviális homok, hfh1 = kora holocén fluviális homok, hfp4 = pleisztocén végi folyóvízi homok, lep4 = eolikus lösz, pleisztocén végi, lhep4 = eolikus löszös homok, pleisztocén végi, ilhp4 = Pleisztocén végi infúziós lösz, lfh2 = holocén második felében lerakódott fluviális finom kőzetliszt hfh2 = holocén második felében lerakódott fluviális homok, sixh1 = kora holocénben lerakódott alluviális kőzetlisztes homok, Perje csat. = Perje csatorna, Tószeg, Rákóczifalva = települések, Tisza = Tisza meander

The geological surveys before our study pointed to Pleistocene muddy loess and infusion loess (floodplain) sediments in the Rákóczifalva – Bagi- and Rokkant-földek sites. In the middle of this sediment Pleistocene loessy sand was found, according to these maps. In the northern part of the area semi-circular shaped Holocene aleurite appeared (**Fig. 9.**). East of this area the residual surface is covered by Pleistocene muddy loess and infusion loess. The southern area is not so uniform in a geological point of view. From east to west the map indicates loess (aleurite rich sediment), muddy loess, infusion loess (floodplain sediment), riverine sand, loessy sand and close to the Tisza River muddy, infusion loess occurs again.

Methods

Analysis of historical maps of the site

Examination of the maps before and after river regulations (1847) revealed the following. Although the study site can be recognized in the maps of Ptolemy (Fehér 2004), *Tabula Peutingeriana* from the end of Antiquity (Tóth 2004), Angelino Dulcert from the medieval period (1339; Írás 2013) and in the map of Lázár deák from 1528 (Török 1996), the first maps that can be evaluated from an environmental historical point of view are the maps from the 18th century. The first (1782), the second (1869) and the third (1875) Austrian Military Survey and the Hungarian military survey maps (Stegena 1981, Timár et al. 2006) from the Second World War were used in our study. We also used the Middle Tisza region map (Sugár 1989) of Lietzner-Sándor (1970) by János Lietzner Keresztelő, the county engineer of Heves-Külső Szolnok. By analyzing historical maps, we tried to reveal the development of the area and the effect of human impact.

Exogenous geological analysis

An EOV (Unified National Projection System: Völgyesi 1997) map with a scale of 1:10,000 is available from the area. Using this map we have calibrated the measurement points using ArcView 3.2 software. After that we created the digital relief model of the area (1:10,000 EOV map) using ArcGis software. The digital relief model was used for the geomorphological analysis of the study site. In addition, we used the aerial photographs prepared by the Archaeological Institute of the Eötvös Loránd University to map the local surface of the area. The purpose of the exogenous geological-morphological analysis was to reconstruct the environment of the site as accurately as possible.

Geoarcheological analysis

During geoarcheological analysis 300 shallow (3-5 m deep) cores were taken at 5 cm intervals by a spiral drilling machine (Sümegi 2001, 2002, 2013) in Rákóczifalva–Bivaly-tó, Bagi-földek and Rokkant-földek sites. Boreholes were created along geological sections parallel to each other in such a way that all exogenous geological-geological-pedological units were explored. We used the international nomenclature of Troels-Smith (Troels-Smith 1955) during sediment description.

Undisturbed samples were taken by a Russian corer (Belokopytov & Beresnevich 1955) by overlapping technique (Sümegi 2001, 2002, 2013) in a filled up point bar channel at the boundary of the Rokkant-földek and Bagi-földek sites. Samples were cut lengthwise and stored in the usual manner at 4˚C (Sümegi 2001, 2002, 2013). Evaluations of size distributions, organic material, carbonate content (loss on ignition, LOI) and pollen analyses were carried out. In describing the colors of the sediment the Munsell soil color charts were used (Munsell Colour Company 1954). Sedimentological analysis was carried out using an Easy Laser Particle Sizer 2.0. laser particle sizer (42 grain fractions) after proper sample preparation (Sümegi et al. 2015).

During magnetic susceptibility analysis the magnetizable element content of the sediment is measured. For this purpose air-dried and powdered samples are prepared to measure the loss of mass. Bartington MS2 Magnetic Susceptibility Meter was used at 2.7 MHz (Sümegi et al. 2015) that is suitable for laboratory and field analysis as well. Three measurements were done for each sample and values were averaged.

Dean's method (1974) was used for the determination of carbonate and organic material content. Sedimentological and LOI analyses were carried out and interpreted at 4 cm intervals. We presented the sedimentological data and succession, and the cross section of geoarcheological data using the Psimpoll software by Keith David Bennett (1992, 2005).

Pollen analyses

Pollen analytical analysis was carried out on the undisturbed samples of the core taken from the point bar channel. The retrieved cores were also subsampled at 1-2-4 cm intervals for pollen analysis. A volumetric sampler was used to obtain 2 cm^3 samples, which were then processed for pollen (Berglund & Ralska-Jasiewiczowa 1986). Lycopodium spore tablets of known volume were added to each sample to determine pollen concentrations. A known quantity of exotic pollen was added to each sample in order to determine the concentration of identified pollen grains (Stockmarr 1971). A minimum count of 500 grains per sample (excluding exotics) was made in order to ensure a statistically significant sample size (Iversen & Fægri 1964; Fægri & Iversen 1989; Punt 1976-1995; Moore et al. 1991). The pollen types were identified and modified according to Moore et al. (1991), Beug (2004) and Punt et al. (2007), Kozáková & Pokorny (2007), supplemented by examination of photographs in Reille (1992,1995, 1998) and of reference material held in the Hungarian Geological Institute, Budapest. Percentages of terrestrial pollen taxa, excluding Cyperaceae, were calculated using the sum of all those taxa. Percentages of Cyperaceae, aquatic and pteridophyte spores were calculated relative to the main sum plus the relevant sum for each taxon or taxon group. Calculations, numerical analyses and graphing of pollen diagrams were performed using the Psimpoll 4.26 software package (Bennett 2005). Local pollen assemblage zones (LPAZs) were defined using optimal splitting of the information content (Birks and Gordon, 1985), zonation being performed using the 20 terrestrial pollen taxa that reached at least 5% in at least one sample. Paleovegetation was reconstructed using the works of Sugita (1994), Soepboer et al. (2007), Jacobson & Bradshaw (1981), Prentice (1985) and Magyari et al. (2010).

Pollen extraction was carried out in the former laboratory of the Hungarian Geological Institute. We express our gratitude to the geologist Tibor Csernyi for having organized the pollen extraction.

Macrobotanical analysis

The archeobotanical material (anthracological) was obtained from the samples collected by 4 to 10 cm, flotated from uniformly 1 dm^3 (cc. 2.7 kg) of samples. The quantity of the samples is in accordance with the German standards (Jacomet & Kreuz 1992). In obtaining and processing the samples we followed the guidelines of Ferenc Gyulai (2001) regarding the sampling and flotation process. In flotating the samples the dual flotating method and 0.5 mm and 0.25 mm sieves were used (Náfrádi & Sümegi 2013).

Charcoal material was analyzed using a Zeiss Jenapol optical microscope at 10, 20, 50 and 100x magnification (Náfrádi & Sümegi 2015). Wood identification was carried using the reference book of Greguss (1945, 1972) and Schweingruber (1990) and the web based identification work of Schoch et al. (2004).

Archeozoological analysis

Over 6000 pieces of animal remains were collected from ten archeological cultures in the study sites, spanning from the middle Neolithic (Alföld LBK) to the medieval Period of the Árpád Dynasty (10th–13th century AD). So the area was often inhabited for thousands of years. In addition, there were also features from Copper Age (Tiszapolgár culture, Bodrogkeresztúr culture), Bronze Age (Tumulus culture, Gáva culture), Celtic, Sarmatian and Avar finds with varying numbers of vertebrate remains. Most of the finds are well preserved, only some of the prehistoric bones were in poor condition, often heavily laced, which made the determination difficult. Altogether 979 pieces were found in Gepid archeological features that were in excellent condition. Identification was carried out using the reference books of Sisson (2014) and Schmid (1972), and the work of von den Driesch (1976) was followed in taking bone measurements. The archeozoological compositon view was reconstructed using the works of Bartosiewicz (2006, 2017), Bartosiewicz & Choyke (2002) and Bartosiewicz & Bonsall (2004).

Results

Historical maps

The analysis of historical maps (**Figs. 2-5.**) clearly shows the transformations of landscape utilization in the study sites before and after river regulation processes (1847). Although in the first Austrian Military Survey (**Fig. 2.**) the nomenclature is still very poor and the morphological survey was not entirely accurate, in addition, the mapping of the Tisza coast was rough, it was obvious that in the coastal area of Tisza River (in the Bagi-földek site, according to the archeologists) there were only gallery forests suitable for floodplain farming and marshy, boggy areas. It was also clearly visible in the first Austrian Military Survey (1782; **Fig. 2.**) that in the Rokkant-földek (as it is called by archeologists) in the area called Varsány Puszta (in the later survey Alsó Varsány (**Fig. 3.**) and Alsó Varsány puszta - **Fig. 4.**) there are two periodic creeks between the Bivaly Lake and the Tisza Valley. The first Austrian Military Survey map does not indicate the name of the Bivaly Lake; only a temporary, swampy area is marked. An abandoned, over-developed, unregulated curve of Tisza River can be reconstructed from its drawing (**Fig. 2.**).

In other parts of the area scattered gardens, arable lands, grazing fields representing extensive animal husbandry are indicated in the first Austrian Military Survey (**Fig. 2.**). In addition, several mounds that help the identification of locations are shown in the study area (**Fig. 2.**).

The second Austrian military survey (1869) is very important in an exogenous geological and morphological point of view (**Fig. 3.**). Bivaly Lake has been shown in this map, which clearly shows that it is an earlier over-developed curve of the Tisza River, which was connected to the regulated Tisza River through water outlet (canal) only periodically, during floods (**Fig. 3.**). From this area of the Bivaly Lake (Felső (Upper) Varsány puszta), through Alsó (Lower) Varsány puszta, four deeper, canal-like formations led to the actively developing valley of the Tisza (called Bagi-földek in our work). There was a lake in the area of Bagi-földek, according to the map Lake Fenék, which was connected to the active Tisza River through the water outlet of Szolnok. Based on the map, the Bagi-földek were a suitable area for fishing, gathering, waterfront farming (gathering of gallery forest crops, sedge, reed, construction and wood utilization for energy) before river regulations. On the basis of exogenous geological characters the Bagi-földek were an point bar series of the unregulated Tisza River (**Fig. 3.**).

At the same time, in the second Austrian Military Survey map, Rokkant-földek (Alsó (Lower) Varsány) is an older (probably Pleistocene) residual surface, a point bar series rising a few meters above the alluvium of Tisza River and it did not affect the development of the Tisza alluvium at the end of the Pleistocene and during the Holocene, rather it seems to be a terrace level (**Fig. 3.**). The second Austrian Military Survey (1869) clearly showed the traces of groundwater regulation, the groundwater drainage ditches and the artificial barrier system along the active riverbed of the Tisza River (**Fig. 3.**). At the same time, settlements and the associated gardens and arable lands are extensive, while grazing fields and pasture lands can be observed in smaller regions further from the settlements and are more clearly defined than in the first Austrian Military Survey (**Fig. 3.**).

Based on the map prepared by the second Austrian Military Survey (1869), it is clear that north from the Bagi-földek, on the alluvium of the Tisza River called Varsány puszta, there is a large abandoned Tisza River channel, the Bivaly Lake, which has been transformed into an oxbow. At the same time, south from the Bagi-földek the point bar series in the riverbed of the Tisza River (that is younger than the Bivaly Lake) is called Fenék Lake (**Fig. 3.**). In the Bagi-földek (Alsó-Varsány) in the second Austrian Military Survey) that is emerging from the Tisza alluvium there are more channel like hollows (**Fig. 3.**), older point bar channels a few hundred meters apart from each other. Bagi-földek are located in a peninsula-like form in the Tisza alluvium. Its eastern part has already been utilized as a plough land, but the surface above the point bar channels has been utilized as pasture land (**Fig. 3.**).

The third Austrian military survey (1875) shows the impact of river regulation, the drainage channels, the formation of a barrier system along the Tisza River, the development of the floodplain area between the dams and the development of settlements. In addition, the geographical names and the exogenous geological units that were already noticed and described in the second Austrian Military Survey (**Fig. 4.**) can be observed.

In the Hungarian military survey (1943) a dam-system is shown that protected settlements, roads. The extension of arable land and garden cultures can be observed in the landscape transformed by the agricultural system resulting from river regulation and groundwater drainage (**Fig. 5.**). The nomenclature of the Hungarian military survey was used by geologists of the Hungarian Royal Geological Institute, later the Hungarian Geological Institute during the geological and pedological mapping of the Great Hungarian Plain (**Figs. 8-10.**).

In the Lietzner-Sándor's map of 1790 the recording of the Middle Tisza region was completed (Sugár 1989). In this map the emerged location of the point bar structure of the Rokkant-földek and the deeper location of the Bagi-földek associated with the Tisza alluvium can be clearly seen.

In addition to the analysis of historical maps, we prepared the digital elevation model (**Fig. 12.**) of the area to understand the exogenous geological situation and morphological conditions. The 1:10,000 scale digital elevation model clearly demonstrates the existence of a point bar series in a deeper position that is related to the unregulated Tisza riverbed and developed in the curve of the

Tisza River over a few centuries. To the northeastern direction in an elevated position (residual surface or terrace level) a series of an older point bar can be found (**Fig. 12.**).

Based on the digital elevation model, the Bagi-földek site is located in the deeper and younger alluvium of the Tisza River characterized by good water supply while the Rokkant-földek site in an older residual surface rising above the alluvium. In this older point bar series only periodic flood water flew through the point bar channels from the direction of the Bivaly Lake towards the Tisza alluvium (**Fig. 12.**). So Gepid communities settled in the point bar series of the high and low floodplain. These surfaces provided different farming possibilities for the Gepid communities of the Migration Period: the utilization of the gallery forest, gatherings in the area of the forests and floodplain, fishing and hunting, extensive animal husbandry on the higher, drier areas and plant cultivation around the settlements and houses.

As our goal was to reconstruct the environmental history of the Gepid settlement as complex as possible, we conducted geoarcheological drillings (**Fig. 12.**) along a double geological section that explored the deeper (Bagi-földek) and the higher (Rokkant-földek) point bar series as well (**Fig. 12.**). Based on these drillings, the geological and pedological conditions of the exogenous geological and geomorphological units could be mapped and the environmental, geological and pedological characters of the Gepid communities could be specified (**Fig. 13.**).

After the formation of the geological profile (**Fig. 13-14.**) it was confirmed that the point bar series in the Rokkant-földek developed at the end of the Pleistocene. This is proved by the loess-like sediment layers of the point bar channels excavated by drillings, the relatively high position, and the carbonate and coarse aleurite rich sedimentary environment. The deeper geological position of the Bagi-földek is of Tisza alluvium origin, its clay and organic material rich geological layers support its Holocene formation and development (**Fig. 14.**).

The Bagi-földek got continuous water supply through the water outlet system of the Tisza, until to the Tisza River regulation processes and dam building; so in the Migration Period, at the time of the settling of the Gepids, there could not be permanent settlements in this area only in higher elevations (Rokkant-földek), in the semi-peninsula-like Pleistocene point bar series (**Figs. 11-14.**). Since the Pleistocene higher, flood-free surface is semi-circular, peninsula-like (**Figs. 12.-13.**), the settling of archaeological cultures, including the Gepid houses and settlements in the Rokkant-földek, follows a camber form (**Figs. 15-16.**).

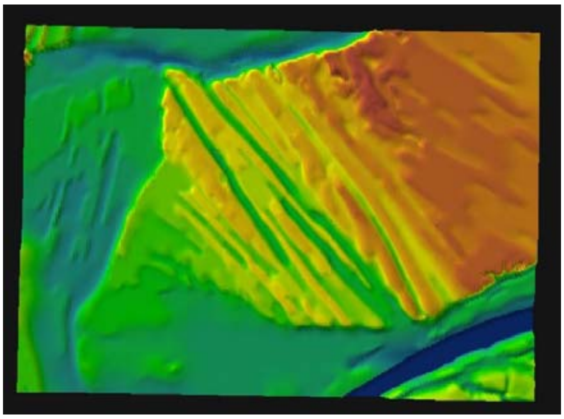

Fig. 11.: Digital elevation model of the study site

11. ábra: A vizsgált terület DDM térképe

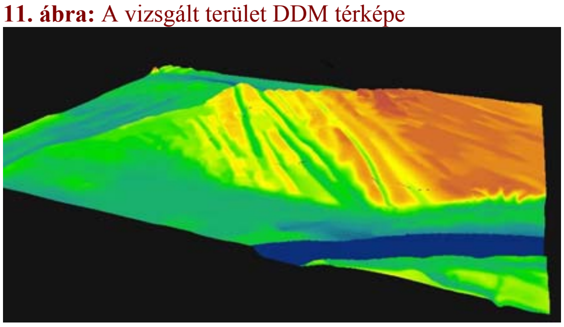

Fig. 12.: 3D drawning of the study site on the basis of the digital elevation model

12. ábra: A vizsgált terület 3D megközelítésű DDM rajza

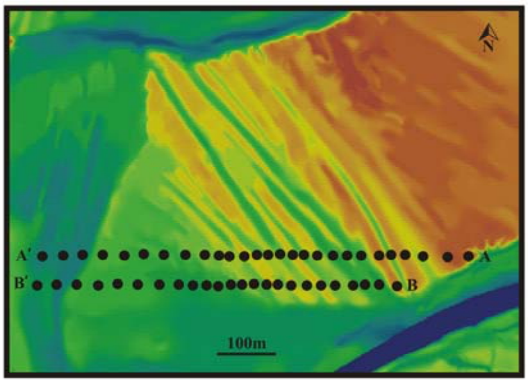

Fig. 13.: The location of parallel geological sections and geoarchaeological drilling points in the digital elevation model of the site

13. ábra: A párhuzamosan kialakított földtani szelvények és a szelvényeket alkotó geoarcheológiai fúráspontok elhelyezkedése a vizsgált területről készült DDM térképen

So, the Gepid communities lived in the boundary of two different local ecoregions, on a local ecoton spot (Sümegi, 1995, 1996, 2016; Sümegi et al. 2012) in the edge of a flood-free area that has good water supply, in a protected, elevated area surrounded by living waters (**Figs. 11-12., 14.**).

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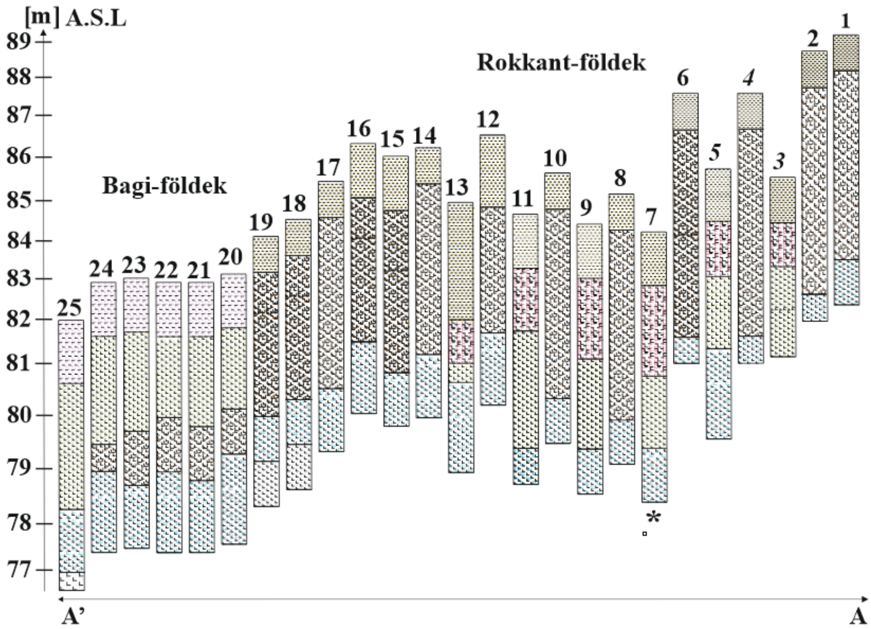

Fig. 14.:

Geological section of the Bagi-földek and Rokkant-földek in Rákóczifalva and the layers of the cores (Troels-Smith, 1955 symbols)

A.S.L. =Above Sea Level, * = undisturbed core sequence, A – A' = geological section

14. ábra:

A rákóczifalvi Bagi-földek és Rokkant-földek területét átszelő földtani szelvény a fúrások rétegsorozataival (Troels-Smith, 1955 szimbólumokkal)

A.S.L. =tengerszint feletti magasság, * = zavartalan magfúrás, A – A' = keresztszelvény

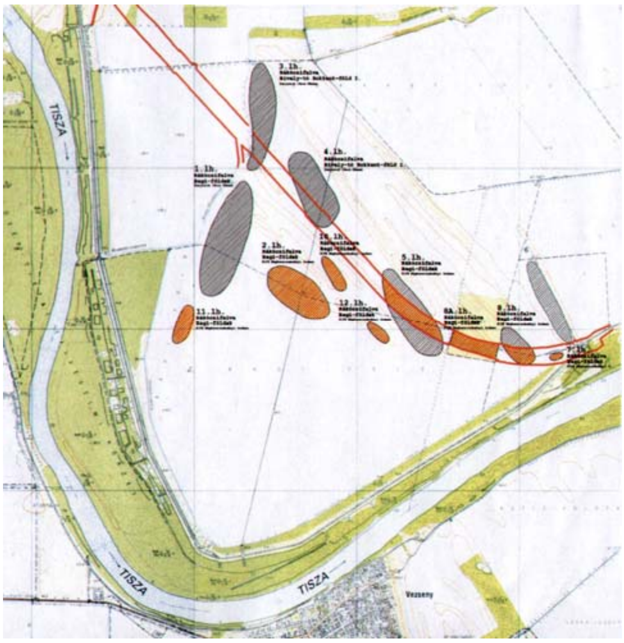

Fig. 15.:

The location of archeological sites in Rákóczifalva and the Gepidian settlement

15. ábra:

A rákóczifalvi régészeti lelőhelyek, köztük a gepida megtelepedések elhelyezkedése a vizsgált területen

This settling strategy, the closeness of living water, the high position, the flood-free island-peninsula-like Pleistocene residual surface for settling, animal husbandry and plant cultivation in the Great Hungarian Plain was established since the Early Neolithic. The first data on this type of land utilization was published by Tibor Mendöl, a Hungarian social geography researcher in 1928 and 1929, before the recognition and phasing of the Early Neolithic Körös culture (Mendöl 1928, 1929).

Mendöl made a colored contour map of Szarvas and its surroundings, including the so-called Érpart within a Neolitic settlement. He recognized that the Pleistocene loess covered higher, flood-free surfaces and ascribed them to the area of Neolithic settling, farming and livestock breeding.

He also described the periodically flooded floodplains that were covered by reed, gallery forest and tussock sedge that could be utilized for hunting and gathering. This theory has been repeatedly reinforced during environmental and geoarchaeological research along the Tisza River and its adjacent valleys (Nandris 1970, 1972, Kosse 1979, Sherratt 1982, 1983, Cremaschi 1992, Sümegi 2003, 2004, Sümegi & Molnár 2007, Sümegi, 2012, Sümegi et al. 2012). As a result, the elevated chernozem soil covered surfaces (cereal cultivation, gardens) and areas of alluvial soils (floodplain forest management, grazing, gathering, meadows fields), saline soils (sheep grazing), the canal lakes, living waters (fishing) and water outlet channels (wells) were located within 5 km, approximately one hour walk (Site – Catchment Analysis = SCA: Higgs & Vita-Finzi 1972; Vita-Finzi & Higgs 1970; Bailey & Davidson 1983) from the Gepid settlements. So, all food-producing areas were reached by the members of the Gepid community within an hour walk (within a 5 km radius). In addition, the semi-circular, peninsula-like settling in the Tisza floodplain and alluvium provided significant protection in the Great Hungarian Plain (**Fig. 15.**).

Sedimentological analysis

At the 7th drilling point of the first geological core section a 3 m deep undisturbed core was taken with overlapping technique in the Pleistocene point bar channel. During the drilling, the cores sequences layers were described by the method of Troels-Smith (1955). Magnetic susceptibility, particle size analysis, LOI and water soluble element content analysis were investigated. The Late Holocene near surface part that is significant regarding the Gepid age and Migration Period was sampled at 2 cm intervals for sedimentological and water soluble elements content, while the Pleistocene and Early Holocene bedrock level at 4 cm intervals (**Fig. 16.**).

In the bedrock between 300 and 240 cm yellowish grey (Munsell color 10 YR 7/4) slightly cross-laminated sandy silt, silty sand developed. The layer gradually transformed towards the surface, parallel laminated structure appeared, fine sandy coarse silt, coarse silt fine sand dominated sediment layer developed. In this level carbonate filled root structures appeared, called biogalleries. Grain size indicate coarse grains, although grain size distribution is variable; the organic material content is low and the carbonate content is the highest. Magnetic susceptibility (MS signal) and the sediment and LOI content indicate minimal changes in the development of the layer, but the changing values of water-soluble elements suggest significant water cover and cyclic drying periods.

The development of laminations occurred at a maximum thickness of 1 cm, and it is likely that in this interval we could have reconstructed stronger cycles of sedimentation and development due to the sedimentological changes of the sample. The development of the layer can be linked to the active evolving stage of the Pleistocene point bar and to the late phase of the channel filling up. Due to its emerged position, its high carbonate content and water-soluble Ca and Mg content, the point bar did not belong to the sedimentation area of Tisza River (Molnár 1965). Probably the development of the point bar was the result of the development of the catchment area of the Danube River.

Grain size distribution changed between 240 and 160 cm. Sand content decreased in this level of the profile and yellowish brown (10 YR 5/6) fine silty coarse silt, coarse silty fine silt dominated layer developed. In the near surface part of this level a significant sand fraction rise occurred that can be linked to an extraordinary flood period. The carbonate content increased considerably as well as organic material content, however this latter less in the color of the sediment appeared. De the slightly reddish shade was associated with the increase of water-soluble iron.

Based on the development of the sediment and sediment parameters, the point bar could gradually emerged due to the appearance and incision of the Tisza River. As a result, the active development of the point bar was completed and transformed to a drainage system at the end of the Pleistocene. In this level of the profile a flood cycle could be detected on the basis of a significant sand intercalation according to grain composition analysis. This level developed at the end of Pleistocene; however this whole layer was clearly evolved in a stagnant water environment. The development, appearance and facies of the sediment are specific to point bar loess, floodplain sediments formed at the end of the Pleistocene (Sümegi et al. 2015).

Between 160 and 70 cm (10 YR 4/2) clayey fine silt accumulated. The organic material content increased, the carbonate content was steady indicating major soil formation and weathering at the early stage of Holocene. At the same time among water soluble elements Fe content decreased. This may indicate a deeper groundwater location and post-movement of elements after water regulation processes of the 20th century, and the cyclic change of groundwater level may be indicated by the cyclic change of other water-soluble elements. The development of this sediment layer can be linked to soil formation and more favorable weather conditions at the beginning of the Holocene; in addition, to the leaching of sediments with significant clay and organic material content. However, element composition could have change as a result of groundwater level decrease associated with modern water regulation as well.

Between 70 cm and the surface a slightly polyhedron structured, blackish brown (10 YR 3/1), clay-rich fine silt with significant organic material content developed and soil formation have started. This layer may be marshy-eutrophic lake sediment originally, but its element composition has changed as a result of soil formation and modern water regulation. The latter is primarily shown by the reduction of water soluble Fe content and the less significant MS signal. Although the layer where soil formation have started represent hydromorphic soil formation characters (polyhedron structure), the significant water-soluble Na and K content indicate salinisation and an upward moving groundwater system with significant water-soluble elements in the capillary zone. As a result, besides hydromorphic soil formation, saline soil development started in the area as well. These processes were observed already in the 20th century during the geological survey and agrogeological (pedological) mapping of the area (Sümeghy 1944, 1953; Kreybig 1937).

Pollen analysis

According to the pollen analysis carried out on samples of the point bar channel, 10 pollen units (pollen horizons) were separated in the profile (**Fig. 17.**).

The first pollen horizon developed between 300 and 240 cm (from the core surface). Pollen material did not occur in statistically meaningful quantities, only a few samples contained scattered *Gramineae* and *Pinus* pollen indicating drying processes.

The second pollen horizon evolved between 240 and 210 cm. Statistically meaningful amounts of terrestrial pollen material were found that reached the recommended minimum of 500 pieces of pollen grains (Magyari et al. 2010). In this level the non-arboreal pollen (NAP) material exceeded 60% while arboreal pollen (AP) grain ratio was below 40% with *Pinus* subgenus *Pinus* taxa, which can spread to significant distances (**Fig. 17.**). On the basis of the pollen composition a Pleistocene open parkland with scattered pine trees and willow-alder trees existed. In addition, a grassy cold steppe vegetation developed in the environment of the area at this time.

The third pollen zone occurred between 210 and 170 cm. Basically, the pollen composition did not change, but the proportion of AP exceeded 50% (**Fig. 17.**). This indicates a cold forest steppe (Allen et al. 2000; Prentice et al. 1996) at the end of the Pleistocene (**Fig. 17.**). The rise of woody vegetation ratio was caused by an increase in the proportion of *Pinus* genus, which can spread to significant distances. Thermo- and mesophilous elements could not be detected among deciduous trees only narrow-leaved trees appeared such as willow and alder with higher tolerance-level. Compared to the previous zone humidity increased.

The fourth pollen horizon was identified between 170 and 130 cm. AP ratio was between 50 and 60%; although the amount of deciduous trees and shrubs, especially birch (*Betula*) and hazel (*Corylus*) is higher. Mixed forest steppe developed. Among woody vegetation coniferous trees and birch (*Betula*) dominated while herbaceous taxa indicate grasses-wormwood-pigweed dominated. Cold steppe, forest steppe existed with patches of trees.

The fifth pollen zone developed between 130 and 110 cm. The ratio of coniferous trees remained significant, while the proportion of deciduous trees and shrubs increased, especially the ratio of birch (*Betula*; **Fig. 17.**). Thermo-mesophilous (oak, ash, elm, lime) pollen appeared and AP ratio rose to 60-70%, which corresponds to the forest steppe phase (Allen et al. 2000; Prentice et al. 1996) and to the northern part of the Eurasian forest steppe zone (Magyari et al. 2010); in addition to the forest steppe zone mixed with taiga in the drier basins of the Altai region (Sümegi 1996; Sümegi et al. 1999, 2013a; Magyar et al. 2014; Törőcsik & Sümegi 2016). This pollen horizon corresponds to the transition phase of the Pleistocene and Holocene.

The sixth pollen zone developed between 110 and 80 cm (**Fig. 17.**). The ratio of coniferous elements decreased, as well as that of herbaceous taxa. AP ratio decreased to 50-60% that corresponds to a temperate forest steppe (Allen et al. 2000; Prentice et al. 1996) at the beginning of the Holocene, similarly to other residual surfaces in the Tisza valley (Sümegi et al. 2005). In other words, the climatic, pedological, relief and bedrock conditions in the area led to the development of a mild continental climate, temperate forest steppe development after the cold forest steppe phase at the end of the Pleistocene. These data clearly disprove the theories that forest steppes in the Great Hungarian Plain are the result of human transformation of a forest environment (Bernátsky 1914; Rapaics 1918; Chapman 1994, 1997, 2017; Chapman et al. 2009; Magyari et al. 2012). On the basis of these publications, human impact has been continuously increased in the Great Hungarian Plain from the emergence of Neolithic farming. This led to the creation of cut-off areas in the forest environment that had expanded due to technical development and growing population. So a mosaic-like forest steppe vegetation has stabilized in the Great Hungarian Plain probably already in prehistoric times, before the emergence of land cultivation. Our data from the Rákóczifalva sites together with our previous data (Sümegi 1989, 1995, 1996, 2005; Sümegi et al. 2012, 2013b) clearly demonstrates the natural development of the temperate forest steppe in the Great Hungarian Plain (Pannonian forest steppe biogeographic unit). This pollen horizon is the level of hardwood gallery forest (oak-ash-elm), forest steppe (oak-lime-hazel) and grassy steppe mosaics, without human impact.

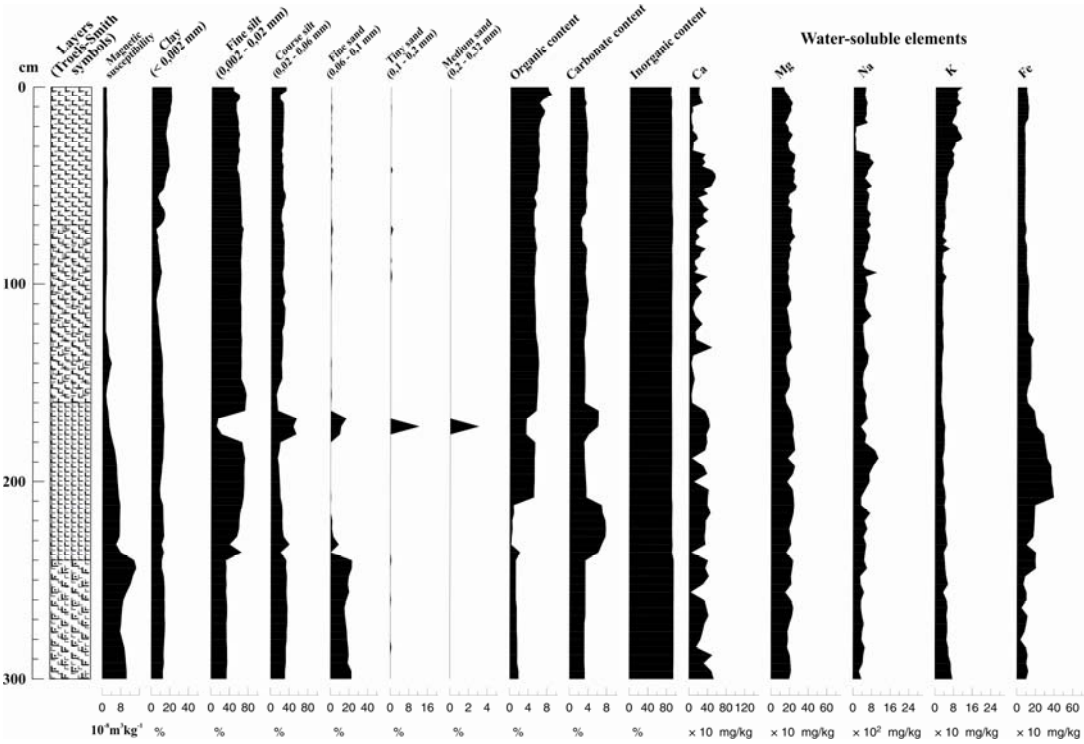

Fig. 16.: Sedimentological and geochemical results from the undisturbed core sequence of an infilled point-bar channel in Rokkant-földek at Rákóczifalva

16. ábra: A rákóczifalvi Rokkant-földek feltöltődött övzátony rendszerébe mélyített zavartalan magfúráson végzett üledékföldtani és geokémiai vizsgálat eredményei

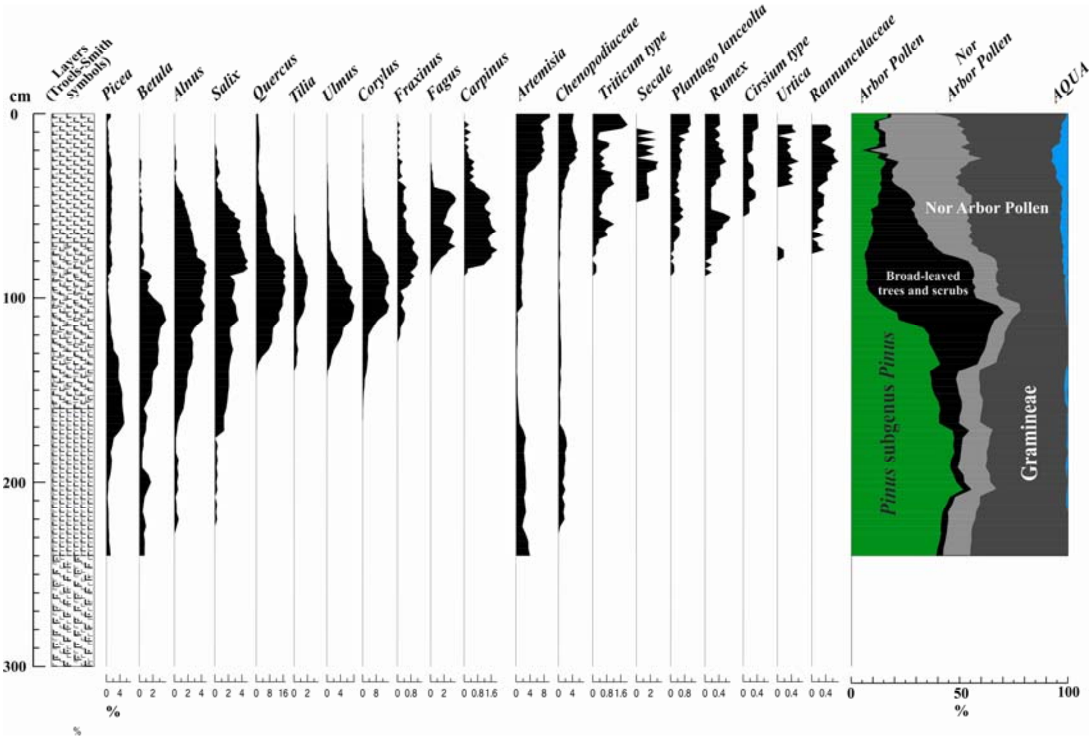

Fig. 17.: Pollen analytical results from the undisturbed core sequence of an infilled point-bar channel in Rokkant-földek at Rákóczifalva

17. ábra: A rákóczifalvi Rokkant-földek feltöltődött övzátony rendszerébe mélyített zavartalan magfúráson végzett pollenanalitikai vizsgálat eredményei

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The seventh pollen zone developed between 80 and 60 cm (**Fig. 17.**) when hornbeam (*Carpinus*) and beech (*Fagus*) appeared and became dominant. Parallel to this, pollen indicating crop production and animal husbandry, cereals and pollen of weeds appeared in the section. It is likely that this pollen level is in accordance with the Neolithic and the beginning of the Copper Age, i.e. with the first plant cultivation and weed vegetation phase.

The eight pollen horizon evolved between 60 and 40 cm (**Fig. 17.**). Beech (*Fagus*) and hornbeam (*Carpinus*) pollen dominate among woody vegetation elements. At the same time, weed composition has changed dramatically and the proportion of herbaceous pollen (NAP) exceeded 60%. In this level the natural forest steppe became anthropogenic steppe vegetation, where woody vegetation (in the form of gallery forest) subsisted only in the active Tisza floodplain, in deeper locations with high groundwater level. Both crop production and animal husbandry could have been significantly increased on the basis of the pollen ratio of cultivated plants and weeds. This horizon can be identified with the end of the Copper Age and the entire Bronze Age.

The ninth pollen zone developed between 40 and 25 cm where arboreal pollen ratio decreased to below 30% (**Fig. 17.**). This significant change began in the Hungarian Great Plain at the end of the Bronze Age and the beginning of the Iron Age.

The tenth pollen horizon evolved between 25 and 15 cm that is the level of the Migration Period. The ratio of cultivated plants such as *Triticum* type, *Secale*, cereal show significant fluctuations. At the same time, the proportion of weeds (*Rumex*, *Urtica*, *Plantago lanceolata*, *Ranunculus*, etc.) spreading to trampling, chewing, grazing and the pollen of grasses, wormwood, pigweed has become dominant. AP ratio was below 20% in this level of the profile. The pollen zone of the medieval period developed from 15 cm to the surface. It is probable that post-medieval levels have dried up and destroyed during soil formation processes. During the Medieval period the impact of crop production is stronger and more stable. Weed vegetation transformed compared to the Migration Period and as a result mosaics and zones of crop production and animal husbandry could develop and stabilize in the area. It is likely that house groups or farm-like settlements with stable dirty roads evolved in the area during the medieval period.

Interpretation of pollen results

Based on the exogenous geological, geomorphological and sedimentological data, the pollen profile was formed in a Pleistocene residual surface, i.e. in a point bar channel of a point bar series rising above the Tisza alluvium. The Pleistocene point bar is probably of Danube origin and consequently its mineral composition and sedimentological development was separated from the sedimentary systems of the Tisza River. We were able to carry out a comprehensive sedimentological and geochemical study of the full development of the point bar channel. In addition, we could evaluate the development of the study area on the basis of the environment historical analysis of the profile from the end of the Pleistocene to the end of the medieval period. In spite of the outstanding geomorphological and sedimentological results regarding human settlements, the most significant environmental historical data were provided by pollen analytical results. The pollen material was moderately well and well preserved and statistically evaluable from the end of the Pleistocene to the end of the medieval period.

The most important feature of pollen material is that pollen composition indicates forest steppe vegetation (Allen et al. 2000; Prentice et al. 1996; Magyari et al. 2010; Törőcsik et al. 2018) from the end of the Pleistocene, through the late glacial/post-glacial transition period until to the early Holocene period. On the basis of our results this pollen composition corresponds to the northern part of the Late Pleistocene Eurasian forest steppe zone mixed with coniferous trees, or to the mixed-leafed taiga forest steppe in the Altai basin (Sümegi 1996, 2001, 2005; Sümegi et al. 1999, 2013a; Magyar et al. 2014, Törőcsik et al. 2015, Törőcsik & Sümegi 2016). These pollen data clearly support the models based on quartermalacological data (Sümegi 1989, 1995, 1996, 2005, 2007). According to these in some regions of the Great Hungarian Plain, in the Pannonian forest steppe zone, there was a natural shift from cold forest steppe (in the Late Pleistocene) to temperate forest steppe (in the Holocene) on a regional and local level as well.

In areas of hundreds of square kilometers at the regional level and in some square kilometers at the local level, it could be proven that a natural temperate steppe-forest steppe evolved in some parts of the Great Hungarian Plain (Sümegi 1989, 1995, 1996, 2005) at the end of the Pleistocene and at the beginning of the Holocene. Based on the previous results and analysis of different areas, due to the mosaic environmental conditions small local temperate steppe regions and patches developed in the forest steppe zone at the beginning of the Holocene; based on our previous data, mainly due to edaphic reasons (Sümegi 1989, 1996, 2011; Sümegi et al. 2005, 2012, 2013b; Törőcsik et al. 2015; Törőcsik & Sümegi 2016). In other words, parallel vegetation development evolved in the basin caused by mosaic environmental conditions. Despite increasing human effects, this parallel development has survived until to the 19th century, until to the spread of industrial civilization and

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water regulation. The parallel vegetation development was, of course, influenced by human effects as well; but their development and the magnitude of human effects were very different from each other and were not homogenous as it was suggested by John Chapman (Chapman et al. 2009; Chapman, 2018). There was not a general system in the development of the vegetation of the Great Hungarian Plain as a result of the different ecoregions (Sümegi 1996, 2005, 2011, 2016; Sümegi et al. 2012, 2013b).

The mosaic effect persisted in the vegetation despite the gradually increasing human impact at the beginning of and during the Neolithic. At the same time, as a result of plant cultivation, animal husbandry, human settlings and paths in the study area, a diverse composition of weed vegetation developed between the Neolithic and the medieval period. Cereals, including *Triticum* type and *Secale*, indicate a significant fluctuation in the level of the Migration Period and the level of the Hun era (c. 410-453/455 AD years) and Gepid Kingdom (453/455-567 AD years) in the Carpathian Basin. At the same time, the ratio of weeds (*Rumex*, *Urtica*, *Plantago lanceolata*, *Ranunculus*, etc.) spreading to trampling, chewing and grazing and the amount of grasses, wormwood and pigweed has become dominant. Arboreal pollen ratio was below 20% in this horizon of the profile (**Fig. 17.**).

During the Migration Period and the rule of Hun era (c. 410-453/455 AD years) and the Gepid Kingdom (453/455-567 AD years) the area was continuously inhabited and the alternating communities carried out extensive animal husbandry that was supplemented by cereal cultivation, the latter with varying intensity. Millet remains have been found among archaeobotanical finds in the Gepid settlements (Galántha 1981; Bálint 1991; B. Tóth 2003, 2004; Cseh 1999b) on the Great Hungarian Plain, but we cannot provide pollen data for this. Plant remains of millet (*Panicum miliaceum*) from the migration period found on the Great Hungarian Plain and in other parts of Eastern Europe show that the most important cereal cultivated by nomadic and semi-nomadic peoples was millet, whose cultivation requires relatively little attention. Consequently, millet meal, or porridge, must have been among the most important foods of these peoples (Wasylikowa et al. 1991). These data support the plant remains (millet, wheat, barley) of a Gepid site called Sándorfalva-Eperjes (Galántha 1981; Bálint 1991) and the local cereal cultivation (B. Tóth 2003, 2004) in Szolnok-Zagyvapart site (Cseh 1999b). It is likely that the good relief, protective features, the diverse and fertile soil conditions and the proximity of rivers and creeks have played a prominent role in the continuous use of the area. Similar settlements (Cseh 1986, 1990, 1992, 1993, 1999b) with a completely similar morphological situation can be found in several places in the Middle Tisza region (Tiszapüspöki, Kengyel, Szolnok, Törökszentmiklós). Though, these similar exogenous geological features have so far been ignored in the interpretation of the settling of Gepids.

Based on our data, Gepids settled in a completely altered Holocene vegetation environment in the peninsula-like residual surface of the Tisza valley that had a great importance with respect to protection and natural factors. We were not able to determine the vegetation environment of the Gepids more precisely, even using radiocarbon analysis, because the margin of error of these dates covers the 5th and 6th centuries, when Gepids settled in the area. This could only be refined by the archeobotanical and archeozoological analyses of samples from Gepid features, including wells. With the exception of our data, we do not have such comprehensive data regarding Gepid settlements at the moment, only archeozoological (Szabó & Vörös 1979) and sporadic archeobotanical data (Bálint 1991; B. Tóth 2003, 2004).

It is clear from the archeobotanical (anthracological) analysis of Gepid features of the Rákóczifalva site that construction wood derived from the hardwood gallery forest in the Tisza alluvium, while archeozoological finds suggest remarkable livestock in the era of the Huns (c. 410-453/455) then in the era of the Gepid Kingdom (453/455-567 AD years) (Szabó & Vörös 1979).

At the end of the Migration Period and during the Middle Ages, the stabilization and increase of land cultivation was observed. As a result, a significant, though diffuse structured settlement and permanent roads could develop in the study area (Cseh 1991) and one of the greatest of human impact evolved in the archaeological site of Rákóczifalva.

Macrobotanical analysis

Although anthracological material has been found in the archaeological sites of Rákóczifalva since the Neolithic, most of the wood residues were recovered from the features of the Migration Period, more exactly from Gepid features (Náfrádi & Sümegi 2015). Anthracological material of the Gepid features is as follows (**Table 1.**).

A total of 1069 pieces of charcoal fragments were found and identified in 13 samples from Gepid (6-7th century) features. 64.4% (688 pieces) of the charcoal fragments belong to oak (*Quercus*) genus.

Table 1.: The charcoal remains from Gepidian objects at Rákóczifalva

1. táblázat: Szenült fák maradványai a rákóczifalvi gepida objektumokból

Rokkant föld archaeological site	Gepid	
	%	i
Abies alba (fir)	1.7	18
Acer (maple)	3.6	39
Fraxinus (ash)	29.1	311
Quercus (oak)	64.4	688
Ulmus (ulm)	1.2	13
SUM (individuals = i)	100.0	1069

Ash (*Fraxinus*) is also represented in a significant proportion with a value of 29.1% (311 pieces). In addition, the ratio of maple (*Acer*) is lower which accounts for 3.6% (39 pieces) of the total material; the ratio of fir (*Abies*) is 1.7% (18 pieces), while the ratio of elm (*Ulmus*) is 1.2% (13 pieces). Charcoal fragments clearly indicate the presence of a hardwood gallery forest (oak-ash-elm) in the vicinity of the settlements. At the same time, the presence of fir (*Abies*) is a particular surprise, as it is an alien element in the Great Hungarian Plain, especially in its center of warm and dry climate (**Fig. 6.**). However, in the eastern part of the Gepid Kingdom, in the higher mountains encircling the Transylvanian Basin, including the Carpathians and Transylvanian mid-Mountains, there are larger forests of this species at a height of 1300 meters (Feurdean & Willis 2008). As a result, the presence of fir charcoal indicates exportation and it cannot be excluded that fir trees (that originate clearly from mountainous areas) have been utilized in connection with a ceremony or settlement, house warming.

Archeozoological analysis

The vertebrate fauna analysis from the Gepid features supported the combined use of the deeper Tisza alluvium that has good hydrological characters, oxbows and water outlets, and the flood-free, dry surfaces suitable for grazing fields, animal husbandry and plant cultivation. This is in concordance with the results of pollen analysis.

Most of the mid-size (979 pieces) animal bones recovered from the 11 Gepid features can be interpreted as food waste (**Tables 2-3. and Table 4.**). It was hard to find complete bones that indicates that meat and bones were cut together during cooking. In spite of this most of the bones could be identified. Only 28 bones were unidentifiable and found to be remnants of large or small mammals.

Table 2.: Excavated cultures within the Gepidian site, numbers of excavated objects and numbers of the bones at Rákóczifalva

2. táblázat: A Rákóczifalván feltárt kultúrák a gepidákkal, a feltárt objektumok számával és feltárt csontok számával

Age/Culture	Features with bones	Number of bones
Early Modern Age	2	2
Period of the Árpád Dynasty	18	533
Avar Period	66	1059
Gepids (Migration Period)	11	1012
Migration Period	1	11
Sarmatians + Gepids	1	47
Late Sarmatians	11	244
Sarmatians	88	886
Prehistoric	5	25
Celts	9	628
Scythians	1	18
Bronze Age	1	1
Gáva culture	3	31
Tumulus culture	4	79
Copper Age	2	64
Hunyadihalom group	2	31
Bodrogkeresztúr culture	13	219
Tiszapolgár culture	1	26
LBK	16	245
Non-identifiable cultures	13	592

The finds contained the remains of domestic animals, wild birds that could not be identified on a species level, fish and other aquatic animals. That suggests hunting or flowing and fishing, although antler fragments did not turn up.

This is the one and only archaeological period in the Rákóczifalva site, where the bones are not the most common; although the amount of neat bones are not much less than the number of ruminants (sheep, goat, cattle). The remains of all domestic mammals were found among the finds. Horses were rarely eaten - probably because of their high value.

Poultry remains were also found, mostly hen bones, but some goose bones were identified as well. In addition to the remains of meat-producing animals, bones of dogs and cats were also discovered.

Table 3.: Bones of animals from Gepidian features at Rákóczifalva

3. táblázat: A rákóczifalvi gepida objektumokból származó állatcsontok

Animal name	**GEPID**		
	NISP	**%**	**Number of individuals Min./Max.**
Cattle (*Bos taurus*)	275	28.9	8 / 22
Sheep (*Ovis aries*)	10	31.9	2 / 2
Goat (*Capra hircus*)	1		1 / 1
Sheep or goats (Caprinae)	292		9 / 19
Pig (*Sus domesticus*)	94	9.9	8 / 18
Horse (*Equus caballus*)	43	4.5	3 / 9
Hen (*Gallus domesticus*)	38	4.0	4 / 11
Dog (*Canis familiaris*)	108	11.4	5 / 5
Cat (*Felis catus*)	5	0.5	1 / 1
Domestic animals	***869***	***91.1***	***41 / 88***
Magpie (*Pica pica*)	4	0.4	1 / 1
Goose (*Anser* sp.)	4	0.4	1 / 1
Wild or pet birds	***8***	***0.8***	***2/ 2***
Pond turtle (*Emys orbicularis*)	2	0.2	1 / 2
Catfish (*Silurus glanis*)	2	0.2	1 / 2
Pike (*Esox lucius*)	2	0.2	2 / 2
Fish	40	4.2	1 / 5
Aquatic vertebrates	***46***	***4.8***	***5 / 11***
Rodents (Rodentia)	4	0.4	1 / 2
Birds (Aves)	27	2.9	3 / 6
Other species	**31**	**3.3**	**4 / 8**
Mussels (Bivalvia)	20	-	-
Snails (Gastropoda)	13	-	-
Small and large ungulate	28	-	-
Sum	**1012**	**100.0**	**52 / 109**

Table 4.: Meat regions of animals from Gepidian features at Rákóczifalva

4. táblázat: A rákóczifalvi gepida objektumokban feltárt állati húsrégiók

Bones/Animal	Cattle	Sheep	Goat	Sheep/goat	Horse	Pig	Hen	Dog	Anser	Bird
Cornus	4	-	1	-	-	-	-	-	-	-
Skull	22	1	-	10	2	9	2	3	-	-
Nasale	3	-	-	-	-	-	-	-	-	-
Hyoid	4	-	-	-	-	-	-	-	-	-
Maxilla	12	-	-	10	-	14	-	2	-	-
Premaxilla	2	-	-	1	-	-	-	-	-	-
Mandibula	12	-	-	22	4	18	-	3	-	-
Dentes	22	-	-	25	4	17	-	5	-	-
Atlas	4	-	-	1	-	1	-	1	-	-
HEAD REGION	**85**	**1**	**1**	**69**	**10**	**59**	**2**	**14**	**-**	**-**
Axis	-	-	-	-	-	-	-	-	-	-
Cervical vertebra	1	-	-	4	9	-	-	-	-	-
Thoracic vertebra	8	-	-	5	-	1	-	5	-	-
Lumbar vertebra	6	-	-	2	1	-	-	10	-	-
Sacrum	1	-	-	1	1	-	1	1	-	1
Caudal vertebra	-	-	-	-	-	-	-	-	-	-
Vertebra	-	-	-	-	-	2	-	-	-	1
Rib	41	-	-	27	3	6	-	38	-	-
Sternum	-	-	-	-	-	-	1	-	-	1
Coracoid	-	-	-	-	-	-	2	-	2	-
Clavicle	-	-	-	-	-	-	-	-	-	5
Pelvis	20	-	-	5	-	3	1	4	-	-
TRUNK	**77**	**-**	**-**	**44**	**14**	**12**	**5**	**58**	**2**	**8**
Scapula	7	2	-	7	1	4	-	-	-	2
Humerus	8	4	-	7	1	6	2	5	2	3
Radius	4	-	-	16	1	3	3	6	1	2
Radius+ulna	-	-	-	-	-	-	-	-	-	-
Ulna	3	-	-	3	1	1	1	5	1	2
Femur	12	-	-	16	4	3	5	4	1	1
Patella	-	-	-	-	-	-	-	-	-	-
Tibia	13	-	-	39	4	3	8	3	1	2
Tibia+fibula	-	-	-	-	-	-	-	-	-	-
Fibula	-	-	-	-	-	1	-	1	-	-

Table 4.: Meat regions of animals from Gepidian features at Rákóczifalva, cont.

4. táblázat: A rákóczifalvi gepida objektumokban feltárt állati húsrégiók, folyt.

Bones/Animal	Cattle	Sheep	Goat	Sheep/goat	Horse	Pig	Hen	Dog	Anser	Bird
MEATY LIMB REGION	**47**	**6**	**-**	**88**	**12**	**21**	**19**	**24**	**6**	**12**
Carpale	4	-	-	1	-	-	2	-	-	-
Metacarpus	8	1	-	13	-	-	-	-	-	4
Malleolare	-	-	-	-	-	-	-	-	-	-
Astragalus	6	-	-	3	-	1	-	-	-	-
Calcaneus	4	-	-	-	-	1	-	1	-	-
Tarsale	5	-	-	-	-	-	-	-	-	-
Metatarsus	2	2	-	18	1	-	10	-	-	3
Metacarpus/metatarsus	2	-	-	1	-	-	-	11	-	-
DRY LIMB REGION	**31**	**3**	**-**	**36**	**1**	**2**	**12**	**12**		**7**
Phalanx proximalis	3	-	-	5	1	-	-	-	-	-
Phalanx media	3	-	-	3	2	-	-	-	-	-
Phalanx distalis	3	-	-	2	-	-	-	-	-	-
Sesamoideum	3	-	-	-	1	-	-	-	-	-
TERMINAL BONES	**12**	**-**	**-**	**10**	**4**	**-**	**-**	**-**	**-**	**-**
Long bone fragment	22	-	-	45	2	-	-	-	-	-
Flat bone fragment	1	-	-	-	-	-	-	-	-	-
Total NISP	**275**	**10**	**1**	**292**	**43**	**94**	**38**	**108**	**8**	**27**

Probably dogs gnawed several bones; there are tooth marks on 16 finds including bones of cattle, small ruminants, pigs and even hens. It is not possible to estimate the number of bones that have been fully eaten. The cartilagenous epiphyses of young poultry bone, especially hens, could be easily consumed by cats or even by humans resulting in taphonomic loss. Significant numbers of fish bones indicate fishing and the extensive use of the alluvium. Fishing covered several species, the larger catfish, pike and smaller fishes.

We calculated the minimal and maximal number of individuals for each species. In the first case we calculated the number of bones for all of the same species of the site, and in case of the maximum number of individuals we took the features into one-one unit, calculated separately for each feature and then summed up the results. The actual number of individuals of each species can be between the two values; the minimum number of individuals is certainly under- and the maximum is overestimated due to the possibility of aggregation effects.

In the vicinity of the settlement, a grazing livestock of 23-53 individuals (sheep, goats, cattle, horses) was required. These numbers do not seem to be significant, especially since we do not have information about how many years the Gepid settlement was inhabited. But still the continuous catering, grazing and winter feeding of a few dozen animals could be challenging. It should also be taken into account that not the entire Gepid settlement was excavated so the number of individuals was definitely higher.

The difference between the numbers of cattle and small ruminant remains (sheep and goats) is only 28 bones (the number of small ruminants is higher), so their proportions can be considered as equal. There is little or no difference between the minimum and maximum number of individuals either. Small ruminants include sheep and goats. Because of the high degree of similarity between the bones of the two species, it is difficult to distinguish them. 10 bones of the 303 small ruminant bones were identified as sheep, one from a goat, and 292 from either of these species. In general, sheep are more common in every period of time and goats are less frequent. Among the sheep/goat findings there are several bones that were chewed by dogs, most of them come from meat-rich regions of the body. The age distribution of individuals was diverse. Two sheep and one goat were adults; the age distribution of the only sheep/goat individuals was mixed.

Based on the minimum number of individuals, one of them was 1-2 years old, one 1-1.5 years old. Three animals were young (less than 2.5 years old), one nearly adult (2.5-3.5 years) and three adults. On the basis of the other individual count, the number of the two sheep and one goat did not change. In case of the 19 sheep/goats, young and adult animals were found in nearly half-half ratio: 9 specimens were juvenile (young), one of them was between 1 and 2 years old, one of them less than 1.5 years old and one between 2 and 3 years old. The age of the other 6 young animals could not be identified more precisely, but they are certainly less than 2.5 years old. Three animals were of subadult age, i.e. nearly mature and 6 were adult specimens. The age of one animal could not be identified. Interestingly, the bones of very young animals, younger than 1 year, were not found. The slaughter of young animals indicates meat production as milk and wool use is only possible in the case of adult domesticates. The majority of animals were slaughtered in the excavated area of the settlement that is indicated by the anatomical distribution.

The 275 neat bones of cattle represent 28.9% of the identifiable finds. The bones come from at least 8 up to 22 animals, their age distribution is mixed. Out of the 8 individuals one was juvenile, which is 1-3 years old in case of neat. One was subadult, that is, 3-4 years old, 3 individuals were adults, so over 4 years old. One individual was 6-7 and one was 6-8 years old, already mature. One specimen died or was slaughtered as an old animal. The number of gnawed bones was small in the Gepid material. Of the seven finds there were 4 phalanges, 1 astragalus, 1 calcaneus and 1 tibia. The number of cut cattle bones was two, one is a tibia and the other is a 5 cm long horn-core attached to a skull fragment with parallel trimming and pole-axe traces.

The age distribution was slightly different in the case of the 22 individuals, more heterogeneous. The number of young animals was 7, 3 were nearly adults, 7 were adult, 2 matured, 2 were old, and 2 were undetermined. A metatarsus bone of a neat could be used to calculate the withers and to determine the sex of the animal. The 236 mm long bone derived from an approximately 126 cm tall cow (Nobis 1954; Calkin 1960). This cow is considered to be large compared to other samples from different periods. Bones suitable for withers calculation from Celtic, Sarmatian, Late Sarmatian, bones from the 4th-5th century, late Migration Period and Period of the Árpád Dynasty occurred and were used for calculation; each animal was a cow. The height of the Celtic individual was small, around 107 cm. The Sarmatian cows were 111 and 117 cm tall, the AD 4th-5th century animals were 114-115 cm, from the late Migration Period they were 106, 114, 116 and 122 cm tall. The cow from the Period of the Árpád Dynasty was small, only 108 cm at the withers. The skull fragment with the horn-core also originated from a cow.

Among the meat-producing animals, ruminants are followed by domestic pigs: 94 of their bones account for 9.9% of the finds. Regarding the number of individuals, the lowest number is 8, the highest is 18. Compared to the amount of bones, this number is very significant, as it approximates those of small ruminants and cattle. The age distribution of individuals is mixed. In the case of pigs, it is common that very young animal remains appear among the finds, as they are short-lived, fast-growing animals that have more piglets at the same time, making it easy to replace slaughtered animals. Compared to other domestic species pigs are meat producing animals, they have no other forms of utilization.

Based on the minimum number of individuals, one pig was only ½ years old and one was ¾ years old when it was slaughtered. A 1 year old animal can be considered as young as well. There were a few specimens that could not be precisely defined: one 2-3 years old, a younger than 2.5 years old, one 2.5-3.5 years old and 2 adult pig, including a male animal.

The number of individuals per feature (the maximum number of individuals) was as follows. It added 10 animals to the above mentioned: the number of juvenile pigs (less than 2.5 years old) was not one, but 4, there were 2 individuals that were 2.5-3.5 years old and 3 individuals (instead of 2) were adult. The age of 5 animals could not be defined.

On the basis of charcoal analysis, hardwood gallery forest existed in the vicinity of the settlement, mostly with oak trees. Oak acorn served as the basis for pig feeding. In October and November pigs ate fallen acorns in the forest, while in the case of early heavy snowfall they ate the rest of the acorns during the spring.

The number of horse bones is 43 that represents 4.5% of the identifiable bones. The number of individuals is at least 3 (one juvenile, one subadult and one adult), maximum 9. The age distribution of the 9 individuals indicates 6 adult individuals, 2 young (1-3 years), and one subadult, i.e. nearly mature. Complete long bones for withers height calculation could not be found in the bone assemblage. The minimum number of individuals was at least 4, maximum 11. Based on the minimum number of individuals, 2 specimens were not yet mature and there were 2 adults, including one male and one female. Based on the number of individuals per feature (maximum number), 11 specimens could be identified, of which 4 were non-mature, 7 were adults including 3 female and one male.

From one feature (No. 194, a building) 8 bones of an adult goose-like bird were found. In addition, the number of dogs and cats were the same for both calculations.

Five dog bones were identified. One of them was newborn, one was a young puppy, one subadult and 2 were adults. Withers height calculation could be done on the basis of a complete thigh bone (Koudelka 1885). A short, 24-29 cm tall dog with slightly curved legs could be identified. Such small dogs are very rare during this period and can only be observed during the Roman Period in Pannonia. This animal can be categorized as a small-sized dog (Bökönyi 1974, 323). The five bones of one cat originated from the same feature, a pit, and were identified as adult animals. Their role could be to keep rodents away in the vicinity of houses and crop storage pits. Based on the composition of domestic animals the Gepid settlements were surrounded by extensive pastures, including saline pastures that are more favorable for sheep. Furthermore, the ratio of wet meadows and meadows was also outstanding due to the high number of cattle and horse remains.

The number of fish bones was 44 in the manually collected samples. It would have been possible to multiply this quantity by the sieving of the fill from features. The remains included 2 catfish and 2 pike bones (Figs. 19, 20). The catfish is common in slow-flowing rivers and lakes while the pike favor lakes and oxbows with fresh water income and rich vegetation. The catfish is a large fish; its meat is delicious, fat-rich, and bone free. The advantage of the pike is that it does not pit in winter, so it can be fished from below the ice. Its meat is white, clean, tasty, but rich in bones. The quality of the meat is influenced by the purity of the water and the taste of small fishes eaten by the pike. The minimum number of fish individuals was 4, of which 1 catfish, 2 pikes and a non-identifiable species could be identified. According to the maximum calculation 2 catfishes, 2 pikes and 5 unidentified fishes were found in the Gepid features.

The shell remains of the European pond turtle were also discovered. This turtle is the only native turtle species in the Carpathian Basin. It favors shallow, muddy stagnant water that could be found in the vicinity of Rákóczifalva as well. As a reptile, it favors sunny places, dense forest lakes and oxbows surrounded by gallery forest. Only turtle shell fragments occurred among the finds, which may indicate the consumption of turtle meat.

Bone artefacts did not turn up, although a cattle cervix (15.2 cm) with signs of diaphysis was found, with rubbing-like abrasion signs on its back side, its distal end was gnawed (**Tables 2-3.** and **Table 4.**).

Fig. 18.: Gepidian horse jaw used as a bone anvil

18. ábra: Gepida csontüllő ló állkapocsból

Fig. 19.: Catfish vertebra from Gepidian object

19. ábra: Egy gepida objektumból származó harcsa csigolya

Fig. 20.: Pike dentale from a Gepidian feature

20. ábra: Egy gepida objektumból származó csuka dentale

HU ISSN 1786-271X; urn: nbn: hu-4106

An interesting find, a bone anvil was found made from a horse's jawbone (**Fig. 18.**). On the flat surface of the jawbone, the mold of sickle teeth blade appears in rows. The bone anvil was used when the sickle teeth was repaired or recovered, or when the broken teeth of a metal anvil was replaced by a bone anvil.

This feature has already been known in the Mediterranean region from the Greek-Roman period, and Medieval age (Idoia 2012; Gál & Bartosiewicz 2012; Anderson et al. 2014; Crassi 2016; Vuković-Bogdanović & Bogdanović 2016; Valenzuela et al. 2017) but in Hungary the earliest bone anvil appeared from the Period of the Árpád Dynasty (Bartosiewicz 2010; Gál 2010; Gál et al. 2010; Kvassay & Vörös 2010; Tugya 2014). In Rákóczifalva, besides the Gepid anvil, Late Sarmatian anvils occurred as well. The significance of bone anvils is that they carry information about both animal husbandry and bone processing, offer evidence that blacksmith operated in the settlement, where metal tools were maintained and they indicate cereal production as well (Lichtenstein et al. 2006; Lichtenstein & Tugya 2009; Tugya & Lichtenstein 2014; Tugya, 2014, 2015).

We know very little about Gepid animal husbandry and hunting so the archaezoological research of as many archeological excavations as possible and their publication of results is very important. At the site of Battonya in Southeast Hungary, farm-like Gepid settlements were excavated (Szabó & Vörös 1979). The archeozoological material of some houses and pits were revealed and the same environmental historical finds were discovered as in the case of Rákóczifalva. The most important livestock were cattle, sheep and goats. Pig was not important in Battonya, but in Rákóczifalva the number of pig bones was significant. Dog, cat and chicken remains occurred in Battonya as well. There is no proof of hunting in Rákóczifalva while in Battonya red deer hunting was observed. Fishing, which could supplement the amount of meat obtained from the slaughter of domestic animals, can be observed in both sites of the Great Hungarian Plain.

Summary

Geoarcheological, archeobotanical and archeozoological analysis have been carried out in the central Tisza valley, one of the hottest parts in the Great Hungarian Plain. A Gepid settlement and its surroundings were excavated. Based on the results of the digital relief model, maps, historical maps and geoarchaeological analysis of geological drillings, Bagi-földek are located on a deeper and younger alluvial surface with good water supply and are connected to the development of the Tisza River, while Rokkant-földek are located on an older residual surface and rising above the alluvium.

The Gepid communities settled on a point bar series located on the high-floodplain and low floodplain in a semi-circular, semi-peninsular area. These surfaces provided different farming possibilities for the Gepid communities of the Migration Period: the utilization of the gallery forest, gatherings in the area of the forests and floodplain, fishing and hunting, extensive animal husbandry on the higher, drier areas and plant cultivation around the settlements and houses. The area was continuously inhabited during the Migration Period and the communities continued to carry out extensive livestock farming and cereal production in varying intensity (Willis et al. 1995, 1998; Bartosiewicz 2001, 2003, 2004, 2006, 2017; Bartosiewicz & Choyke 2002; Tugya & Lichtenstein 2014).

Pollen data from point bar canal core sequence in the analyzed region suggest there was a natural shift from cold forest steppe (in the Late Pleistocene) to temperate forest steppe (in the Holocene) on a regional and local level as well. Similar pollen composition and vegetation changes formed in some regions of the Great Hungarian Plain, in the Pannonian forest steppe ecoregion (Sümegi et al. 1999, 2006, 2012, 2013a,b; Magyari et al. 2010; Törőcsik et al. 2018). Thus, the concept that explains the development of the entire forest steppe zone with human effects (Bernátsky 2014; Rapaics 2018; Chapman 2017; Chapman et al. 2009) in the Great Hungarian Plain, although this theory has survived to the present day, cannot be sustained anymore. Therefore the Gepid communities utilized one of the most important features of the Great Hungarian Plain, i.e. its local (few hundred m^2 to a few km^2), mosaic-like nature. Thus, the settlements were in a transition zone regarding geomorphological situation (**Fig. 15.**).

According to our data, the inhabitants of the excavated Gepid settlement fully utilized the Tisza valley environment for food production on an organic level during the Migration Period, in the 6th century. The environment occupied by the Gepid community, the floodplain islands and residual surfaces in the Tisza Valley was inhabited from the early Neolithic. The exploitation of their environment, from settlement strategy to gathering, has a similar system as in the case of the Gepid settlement we have described. However, the ratio of exploiting natural resources (hunting, fishing, gathering), and productive farming (land cultivation, animal husbandry) was different in the life of these communities.

According to our data, during the Migration Period, during the existence of the Gepid Kingdom (453/455-567 AD years: Nagy 1999; B. Tóth 1999), an organic material rich lake-swamp system appeared in the examined area. This layer has transformed due to soil formation that was the result of recent river and groundwater regulation.

Acknowledgement

We express our gratitude to dr. Judit Tárnoki archeologist (Head of Archeological Department, Damjanich Museum, Szolnok) for her help. The work of the University of Szeged, Interdisciplinary Excellence Centre, Institute of Geography and Geology, Long-term Environmental Changes research team was supported by the Ministry of Human Capacities, Hungarian grant 20391-3/2018/FEKUSTRAT.

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