RADIOCARBON DATED COMPLEX PALEOECOLOGICAL AND GEOARCHEOLOGICAL ANALYSES AT THE BODROGKERESZTÚR – HENYE GRAVETTIAN SITE (NE HUNGARY)

A BODROGKERESZTÚRI HENYE-TETŐI GRAVETTI LELŐHELY COMPLEX PALEOÖKOLÓGIAI ÉS GEOARCHEOLÓGIAI ELEMZÉSE (ÉK-MAGYARORSZÁG)

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Abstract

Many radiocarbon dated loess profiles within Gravettian sites were analysed in the Carpathian Basin during last 30 years in LOGRAV (Loess and Gravettian) Project. According to sedimentological, geochemical, malacological, charcoal, pollen, phytolith, vertebrate data from 36 radiocarbon dated Upper (Weichselian) Würmian or MIS3 – MIS2 loess profiles this chronological unit determined from the inferred paleoclimatic and paleoecological changes embeds a period between 29 000 – 12 000 uncal (33 500 – 13 500 cal) BP years which is reconstructed such as the exist of the Gravettian culture communities in the Carpathian Basin. One of the most important and oldest Gravettian sites can be found on the Henye Hill at Bodrogkeresztúr village. Although the re-evalution of the Gravettian culture communities (or „Gravettian Entity") reveals several problems in using 14C dates for chronological considerations but the radiocarbon dated paleoecological and geoarcheological analyses keep a good contact with archeological layer of Gravettian site because a mass of hunted bones can be found in a spruce remains rich reddish brown color fossil soil layer material on the top of Henye Hill at Bodrogkeresztúr. This fossil soil layer called Upper Tokaj Fossil Soil Horizon which is a lithostratigraphic and paleoecological indicator layer for older horizon of the Gravettian sites on the Hungarian Upland region.

Kivonat

Az elmúlt 30 év során a Lösz és Gravetti lelőhelyek program keretében jelentős számú lelőhelyet sikerült vizsgálat alá vonni. A radiokarbon adatokkal korolt 36 felső würm (Weichselian – MIS3 – MIS2) löszszelvényen végzett szedimentológiai, geokémiai, malakológiai, anthrakológiai, pollen, fitolit és gerinces maradvány elemzések alapján a 29 000 – 12 000 uncal (33 500 – 13 500 cal) BP évek közötti rétegtani szint paleoklimatológiai és paleoökológiai változásokat rekonstruáltuk mivel ezt a horizontot tartjuk a Gravetti közösségek egzisztálási időszakának a Kárpát-medencében. A legfontosabb és legidősebb Gravetti lelőhely a bodrogkeresztúri Henye-tetőn található és bár a Gravetti kultúra közösségeinek (vagy más megközelítésben „Gravetti entitásnak") a radiokarbon adatainak újra vizsgálata néhány problémát vetett fel a radiokarbon adatok használatával kapcsolatban, de a Henye-tetőn végzett paleoökológiai és geoarcheológiai elemzések igen jó kapcsolatot mutatnak a Gravetti lelőhely régészeti rétegével. Ugyanis jelentős mennyiségű vadászott állatcsont került elő egy vörösbarna színű lucfenyő szenült fadarabokat tartalmazó fosszilis talajrétegből a bodrogkeresztúri Henye-tetőn. Ez a Tokaji Felső Fosszilis Talajszintnek nevezett képződmény egy litosztratigráfiai és paleoökológiai vezető szintet alkot az idősebb Gravetti lelőhelyek szintjéhez kapcsolódóan a Magyar Felvidéken.

Keywords: Gravettian, paleoecology, geoarcheology, Henye Hill, Bodrogkeresztúr, Hungarian Upland, indicator horizon, fossil soil layer, radiocarbon chronology

Kulcsszavak: Gravetti, paleoökológia, geoarcheológia, Henye-tető, Bodrogkeresztúr, Felvidék, vezető szint, fosszilis talaj, radiokarbon kronológia

Introduction

In the period between 1988 and 1994 samples were collected almost with weekly intervals from the road cuts at the edge of the villages of Tokaj, Tarcal and Bodrogkeresztúr (**Fig. 1**), the brickyards, quarries, and the artificial outcrops related to the construction of houses and cellars in these areas (Sümegi 1989,

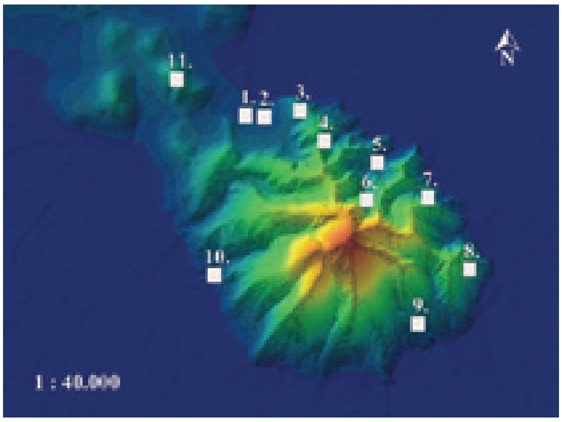

Fig. 1.: Analyzed loess – paleosoil sites around Kopasz Hill at Tokaj with Gravettian archeological site on the Henye Hill at Bodrogkeresztúr (No. 11.) in DDM

1. ábra: A vizsgálat alá vont löszszelvények a tokaji Kopasz-hegy körül és a bodrogkeresztúri Henye-tetőn található Gravetti régészeti lelőhely (11.) a digitális terepi modellen

1996, 2005). It was only then that occurred to us that some artificial ditch should be prepared on top of the Henye and Dereszla Peaks in order to make the loessy sequences of the area available for sampling and study. The presence of a reservoir on the Dereszla Peak prevented us from preparing a section there. However, we were successful in digging two probe ditches (2 m long, 1 m wide and 1 m deep) on the highest point of the Henye Peak, exposing these sequences down to the bedrock of Sarmatian rhyolite (**Fig. 1**).

Methods

The surface of the profile chosen for further study was cleaned as a first step. Then the geographical positions and elevations were recorded. Afterwards, the clean, still moist loess and paleosol horizons were macroscopically delineated based on their colour, physical and structural properties. Where it was possible the geomorphologic position of the major loessy units (loess and fossil soil horizons, layers with charcoal remains) was also depicted on 2D geological cross-sections. The locally and internationally accepted Munsell Soil Color Charts (Munsell Color Company 1992) has been used for describing the moist and dry colour of the samples (Szabolcs 1966).

The lithostratigraphical description of the profiles followed the system of Troels-Smith (1955). The grain size composition of sedimentological samples was carried out using the aerometric method (Casagrande 1934), although samples were re-analysed due to the technical development in the Department of Geology and Palaeontology, University of Szeged. The new grain-size analysis followed the laser-sedigraph method (Sümegi et al. 2015; http://www.micromeritics.com/Repository/Files/sedigraph_method_poster.pdf). The samples were measured for 42 intervals between 0.0001 and 0.5 mm using an Easy Laser Particle Sizer 2.0 (http://www.kemlab.hu/images/products/originals/cms/Easysizer-20.pdf). For LOI examination sub-samples were taken in every 5 cm intervals and loss on ignition method was applied that is commonly used for the analysis of organic matter and carbonate content on calcareous sediments (Dean 1974).

In order to correlate paleoenvironmental changes recorded in the loess profiles with other coeval terrestrial, marine archives as well as ice core sequences a new method based on the investigation of environmental magnetism, originally used in the reconstruction of sedimentation rates in catchment basins, was devised in the 1970s (Oldfield et al. 1978). Environmental magnetism in loessy sediments is based on the enhancement of magnetic minerals, primarily iron oxides and hydroxides, through pedogenesis (Heller & Evans 1995; Evans & Heller 2001; Hambach et al., 2008; Hambach, 2010). Since pedogenesis is climatically controlled, variations in the intensity of laboratory-induced remnant magnetization and magnetic susceptibility which result from this process can be linked to orbital-tuned records of climatic change from marine archives (Heller & Liu 1982, 1984; Heller et. al. 1986). The measurement of magnetic susceptibility of loessy and paleosol deposits has quickly become an effective tool of correlation between marine and terrestrial records both in international (Kukla, 1977; Thompson & Oldfield, 1986; Heller et al. 1987; Kukla et al. 1988) and in Hungarian practice as well (Horváth & Bradák 2004). Anisotropy of magnetic susceptibility within the magnetic minerals of loess sediments provides additional information relating to paleoenvironmental conditions and wind direction (Bradák 2009).

Environmental magnetic analyses were carried out on bulk samples. Samples were taken at a 2 cm interval. Prior to the start of the measurement, all samples were crushed in a glass mortar after weighing. Then samples were cased in plastic boxes and dried in air in an oven at 40 ° C for 24 hours. Afterwards, magnetic susceptibilities were measured at a frequency of 2 kHz using an MS2 Bartington magnetic susceptibility meter with a MS2E high-resolution sensor. All the samples were measured six times and the average values of magnetic susceptibility were computed and reported.

One sample of *Picea* charcoal remains was subjected to detailed radiocarbon analysis in the Radiocarbon Laboratory, Nuclear Research Institute of the Hungarian Academy of Sciences in Debrecen. Preparation of charcoal for radiocarbon dating followed Csongor & Hertelendi (1986). Measurement as made according to Hertelendi et al. (1989) method. Errors were taken into account in accordance with the procedures suggested by Hertelendi (1998).

Samples for charcoal analyses were obtained from the same quantities of sediments, from 1 dm^3 and were washed to release the charcoal fragments (Rudner & Sümegi 2001). Investigation of wood anatomy used 1 dm^3 (cc. 2.65 kg) of sediment dried at 100 °C, then washed through a 0.5 mm mesh and sieved to separate the charcoal. The charcoal remains were then left to dry at room temperature, measured, and placed in small labelled glasses stoppered with cotton-wool. The size of collected charcoal remains varied between 0.05 and 2 cm but only the 0.2 – 2.0 cm fraction was examined (Rudner & Sümegi 2002). A stereomicroscope (up to magnification of x 100), with reflected light (X 600 – 800) was used, as well as a scanning microscope (to take photos at magnifications X 400 – 800). Three fractures were examined, namely transverse, longitudinal-radial, and tangential. The samples were fractured by hand, and the literature used in the identification included the works of Greguss (1955, 1959, 1972) and Schweingruber (1978, 1990).

A charcoal-rich sediment sample from archeological layer of Henye Hill was used to analyse for phytolith content. A modified version of the heavy-liquid extraction was adopted in the analysis of the paleosoil developed at the Department of Geology and Paleontology, University of Szeged (Persaits 2010; Persaits & Sümegi 2011; Piperno 2006). 5 g of the sample was air dried and was shaken with the addition of Calgon solution to remove the organic matter and the carbonates from the sediment sample. It was followed by the removal of the clay fraction and those of with a grain size higher than 250 micrometer. A flotation with a heavy liquid of 2.3 g/cm^3 enabled for the separation of plant opals (phytoliths) from other non-vegetal quartz grains. The retrieved phytoliths were sorted in an Eppendorf tube in glycerine for further study. For determination process individual slides were prepared and opals were counted at a magnification of 500 X under a biological stereomicroscope type Nikon Eclipse line by line. All identified phytolith types of the studied sample were also

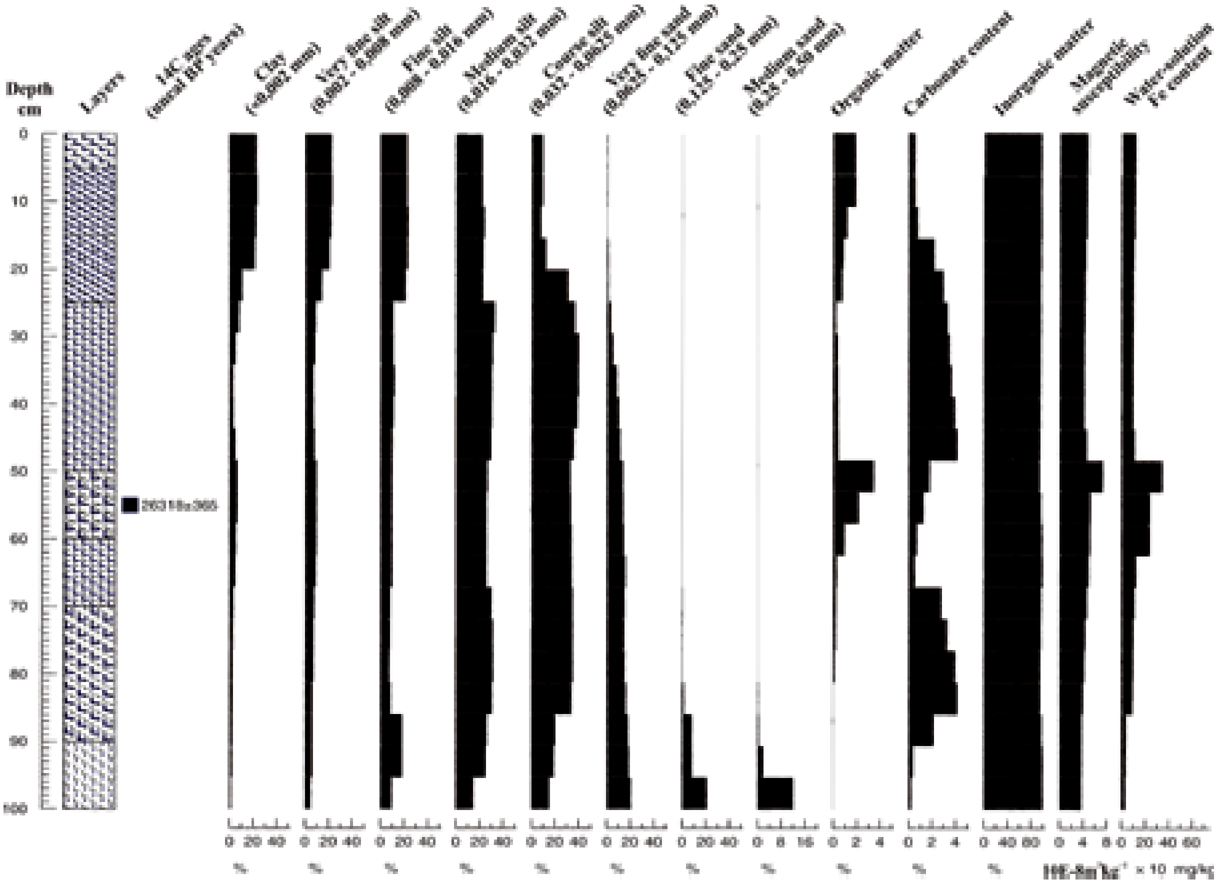

Fig. 2.: The results of the sedimentological analyses from the geological profile on the Henye Hill at Bodrogkeresztúr

2. ábra: A bodrogkeresztúri Henye-tetőn kialakított geológiai szelvény szedimentológiai vizsgálatának eredményei

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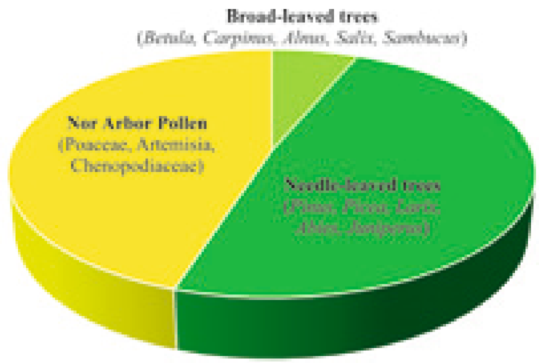

Fig. 3.: The pollen groups percentage from the spruce charcoal-rich archeological layer (55–60 cm) of the geological section on the Henye Hill at Bodrogkeresztúr

3. ábra: A bodrogkeresztúri Henye-tetőn feltárt, lucfenyő faszenekben gazdag régészeti réteg (55–60 cm) pollen csoportjainak dominancia-viszonyai

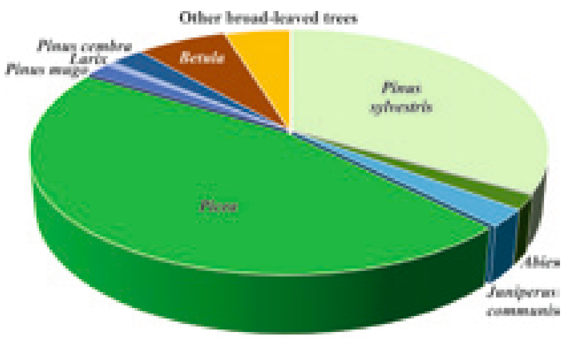

Fig. 4.: Arbor pollen taxa percentage from the spruce charcoal rich archeological layer (55–60 cm) of the geological section on the Henye Hill at Bodrogkeresztúr

4. ábra: A bodrogkeresztúri Henye-tetőn feltárt, lucfenyő faszenekben gazdag régészeti réteg (55–60 cm) fás szárú pollen (AP) anyagának dominancia viszonyai

photographed. Altogether 200 counts were made and double-checked preceding final quantification of the results. Besides the general morphological characterization, secondary features of the identified phytoliths have also been documented following the works of Golyeva (2001).

The geological profile was sampled for pollen at 5-cm intervals. Samples of 200 g wet sediment were prepared for pollen analysis in using standard methods (Zhou et al. 1999). Pollen and spores were identified and counted under light microscope at 400-1000x magnification. Minimum 300 pollen grains were counted but only one sample, the *Picea* charcoal rich archeological layer had enough pollen grains to the pollen-based vegetation reconstruction. In several cases low pollen concentration and poor pollen preservation was encountered. A sample was considered pollen-sterile if less than 80 grains were found. In such cases only the observed taxa were recorded. For the identification of pollen and spores the reference database at the Department of Geology and Paleontology, University of Szeged and pollen atlases and keys were used (Moore et al. 1991; Beug 2004; Kozáková & Pokorny 2007; Reille 1992, 1995, 1998; Punt et al. 2007). The point-count method of Clark (1982) was applied to determine micro-charcoal concentrations.

Results

According to macroscopic investigations, sedimentological analyses the following layers could have been observed within the geological ditches (**Fig. 2**):

The rhyolite bedrock was covered by a 10 cm-thick regolith layer containing pebbles and weathered fragments of rhyolite (1.0-0.9 m), overlain by yellowish brown (10 YR 6/4), non-fossiliferous, highly calcareous fine-silty coarse silt layer embedding carbonate concretions, and which must correspond to a postgenetically altered loess due to carbonate migration (0.9-0.7 m).

On top of this layer a dark brown when wet (10YR 4/3), and reddish brown when air dry (10 YR 5/6) paleosoil developed. This paleosoil was completely woven by roots of the recent vegetation contain in also scattered minor bone, silica fragments as well as considerable amount of charcoal between 0.5–0.6 m (Sümegi et al. 2000).

The retrieved charcoal was cleaned with months of tedious work and subjected to radiocarbon analysis with the help of Ede Hertelendi (**Table 1**). The received dates were published elsewhere (Sümegi 1996; Sümegi & Hertelendi 1998; Sümegi et al. 2000). The observed features as well as the numer-

Table 1.: Mass radiocarbon data from Gravettian archaeological layer from geological section on the Henye Hill at Bodrogkeresztúr

1.táblázat: Tömeges radiokarbon-mérés eredménye a bodrogkeresztúri Henye-tetőn feltárt Gravetti régészeti lelőhelyről

cm	uncal BP years	cal BP years	cal BC years	Code
55–56	26 318 +/- 365	30 376 +/- 715	29 141 – 27 712	deb-2555

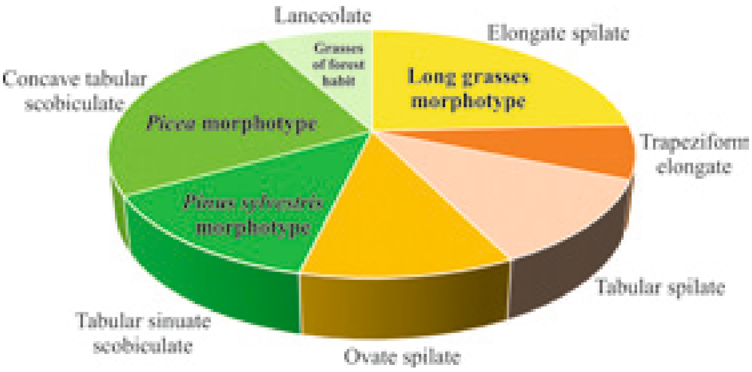

Fig.5.: The dominance of the phytolithic taxa from Gravettian layer (55–60 cm) from the geological profile on the hilltop of Henye Hill at Bodrogkeresztúr

5. ábra: A bodrogkeresztúri Henye-tetőn feltárt, lucfenyő faszenekben gazdag régészeti réteg (55–60 cm) fitolit anyagának dominancia viszonyai

ous charcoal remains recovered seem to corroborate our assumptions, according to which we have managed to penetrate the cultural horizon first excavated and published by László Vértes from the area (Vértes 1966; Krolopp, 1977). Vértes (1966) received highly similar dates to ours from the analysis of the charcoal remains (28,700 +/- 3000 BP years). All of the studied charcoal belonged to the genus spruce (*Picea*), which is congruent with former anthracological results on the area identifying considerable amounts of spruce charcoal from the Henye Peak of Bodrogkeresztúr (Stieber 1968). The radiocarbon data suggest that the analyzed archeological (Gravettian) horizon from the paleosoil layer developed during the terminal phase of Marine Isotope Stage 3 (MIS3) level (NorthGRIP-Members 2004; van Meerbeeck et al. 2009).

The near surface part of the paleosoil layer was overprinted by modern pedogenesis yielding a polygenetic soil horizon to a depth of about 30 cm from the surface, which was highly disturbed and ploughed. The whole profile was free of mollusk shells. The modern soil was free from pollen and phytolithic remains but there could be found the pollen and phytolithic remains in the uppermost layer of fossil soil which was suitable for statistical analyses could separate only burnt spruce (*Picea*) and vertebrate bones remains rich archaeological layer (**Tables 2, 3, 4** and **Figs. 2, 3, 4, 5**).

Macrobotanical remains indicate the total local vegetation (Evans & O'Connor 1999). Macrobotanical analyses show that mass brake and burnt part of branches, tree trunks but only spruce (*Picea*) remains could be found in situ stratigraphic position in the analyzed layers on the top of Henye Hill at Bodrogkeresztúr. These macrobotanical data suggest that spruce forest formed on the analysed hill but the density of charcoal remains (Rudner & Sümegi 2002) was very low so an open parkland (forest steppe) type of spruce forest reconstructed during older Gravettian Age (Rudner & Sümegi 2001; Sümegi & Rudner 2001; Willis et al. 2000) around the analyzed site. These spruce open parkland forests can be found on the boreal region today

Table 2.: The abundance and dominance of the pollen taxa from charcoal-rich Gravettian archaeological layer (55–60 cm) of the geological profile on Henye Hill at Bodrogkeresztúr village

i = the number of the pollen grain (abundance), % = percentage of the pollen grain (dominance)

2. táblázat: A pollen vizsgálat (abundancia és dominancia-eloszlás) eredménye a bodrogkeresztúri Henye-tetőn feltárt lelőhely Gravetti régészeti rétegéből (55–60 cm)

i = abundancia (virágporszemek darabszáma), % = dominancia (virágporszemek százalékos megoszlása)

Taxon	*Pinus sylvestris*	*Pinus mugo*	*Pinus cembra*	*Picea*	*Abies*	*Larix*	*Juniperus communis*	*Betula*	*Carpinus*	*Alnus*	*Salix*
i	55	3	4	76	3	1	4	11	1	3	3
%	18,33	1,00	1,33	25,33	1,00	0,33	1,33	3,67	0,33	1,00	1,00

Taxon	*Sambucus*	*Poaceae*	*Artemisia*	*Chenopodiaceae*	SUMMA	Broad-leaved trees and scrubs	Needle-leaved trees	Nor Arbor Pollen
i	1	105	15	15	300	18	147	135
%	0,33	35,00	5,00	5,00	100,00	6,33	48,67	45,00

Table 3.: The abundance and dominance of the phytolithic (plant opalite) forms from charcoal-rich Gravettian archaeological layer (55–60 cm) of the geological profile on Henye Hill at Bodrogkeresztúr village

i = the number of the phytolithic grain (abundance), % = percentage of the phytolithic grain (dominance)

3.táblázat: A fitolit vizsgálat (abundancia és dominancia-eloszlás) eredménye a bodrogkeresztúri Henye-tetőn feltárt lelőhely Gravetti régészeti rétegéből (55–60 cm)

i = abundancia (fitolit szemcsék darabszáma), % = dominancia (fitolitszemcsék százalékos megoszlása

Elongata psilate	Trapesiform elongate	Tabular psilate	Ovate psilate	Tabular sinuate scobiculate	Concave tabular scobiculate	Lanceolate
i	i	i	i	i	i	i
72	21	34	33	39	75	24
%	%	%	%	%	%	%
24.16	7.05	11.41	11.07	13.09	25.17	8.05

with trees mostly of *Picea, Pinus sylvestris, Pinus cembra*, *Betula, Carpinus, Salix* and *Juniperus communis* (Shugart et al. 1992) but only spruce remains from the archeological layer suggest that an anthropogenic selection might be formed around or in the forest trees . The structure of fired-embedded fossil *Picea* branches, fragments and the sediment can be seen to have been burned around the charcoal branches and trunks remnants.

Pollen and spore grains indicate the regional vegetation (Evans & O'Connor, 1999). Pollen spectra from Gravettian archeological layer (55–60 cm) show high relative frequencies of arboreal pollen types (55 %) with *Pinus, Picea* and *Betula* being the most abundant (**Table 2** and **Figs. 3, 4**). This suggests boreal wooded steppe vegetation formed around the analysed older Gravettian site on Henye Hill at Bodrogkeresztúr. Wooded areas around the site likely included *Pinus sylvestris*, *P. mugo* (*P.* Dyploxylon type pollen), *Pinus cembra (P.* Haploxylon type pollen*), Juniperus* and *Larix*. Although *Pinus sylvestris* is a well-known mass pollen producer usually over-represented in relative pollen frequency diagrams of the forest tundra, forest steppe and polar tundra zones (Peterson 1983; Hicks 1991; Seppä et al. 2002), so its relative abundance > 70% infer local populations (Peterson 1983).

In addition to *Pinus*, *Picea* displayed frequencies around 20–25 % (**Table 2** and **Figs. 3, 4**) in this zone suggesting local occurrence on habitats with more humid conditions, likely on the foothill region of the Henye Hill, very close to the floodplain zone of Paleo-Bodrog river system (Sümegi 1996; Sümegi & Hertelendi 1998). The pollen and macrobotanical data from the older Gravettian archaeological layer of Henye Hill suggest that a hydro-series following vegetation formed around the analysed site from the lower and humid boreal mixed leaved gallery forest covered floodplain zone to open spruce parkland vegetation cover drier hilltop surface. The sporadic appearance of broad-leaved deciduous tree pollen like *Betula*, *Carpinus betulus, Alnus, Salix* is also characteristic for this zone and indicates scattered presence of these trees in the lowland pine woodlands.

Non-Arbour-Pollen assemblage from spruce charcoal and vertebrate bone-rich archaeological layer is characterized by a mass dominance in xerophilous and heliophyl elements, such as *Poaceae, Chenopodiaceae, Artemisia* (**Table 2**). These likely formed drier steppes or steppe spots on the top part of Henye Hill. Relative frequencie of *Poaceae* is about 30 % while *Artemisia* and *Chenopodiaceae* about 6 % suggesting a cold continental grassy steppe spots within *Artemisia*, *Chenopodiaceae* in this zone.

Mass of microcharcoals and burnt macrocharcoals indicated some natural or anthropogenic fire episodes in the boreal type spruce open parkland during the terminal phase of the MIS3 but these fire prints show the climate might form in drier stage in this phase.

The phytolith (plant opal) material indicates absolute local vegetation (Persaits et al. 2015; Piperno 2006). The plant opal (phytolith) sample originates from a paleosol within Gravettian site on the top of the Henye Hill at Bodrogkeresztúr. In the sample Concave tabular scobiculate, Elongata psilate, Tabular sinuate scobiculate phytoliths are dominant (**Table 3**).

Elongate psilate indicates the long grass land based on the phytolith analyses of the Hungarian loess sections (Engel-di Mauro 1995; Persaits 2010; Persaits & Sümegi 2011) while Tabular sinuate scobiculate originated from *Pinus sylvestris* trees. Concave tabular scobiculate phytolithic grains indicate *Picea* trees and Lanceolate phytolithic grains originated from forest habitat grasses (**Fig. 5**). All the phytolithic content from the Gravettian archeological layer suggest that an open boreal type spruce parkland forest

4. táblázat: A bodrogkeresztúri Henye-tetőn feltárt Gravetti régészeti lelőhely feltárt vadászott gerinces anyag archeozoológiai vizsgálatának eredményei (Vörös, 2000 nyomán)

Table 4.: The results of the archeozoological analysis of bones of prey from the Gravettian archaeological site of Bodrogkeresztúr Henye Hill (after Vörös 2000)

Prey type	Habitat type	No. of bones	Ratio of bones (%)	Specimen No.	Dominance (%)	Meat yield (kg)	Meat yield (%)
Equus remagensis *Equus germanicus*	steppe	483	62.97	50	42.37	9430	46.01
Alces alces	taiga	224	29.20	48	40.68	4550	22.24
Bison priscus	forest steppe	10	1.30	7	5.93	1400	6.48
Mammuthus primigaenius	forest steppe	42	5.48	8	6.78	4600	22.48
Cervus elaphus maral	taiga	5	0.65	3	2.54	360	1.76
Lepus	steppe	1	0.13	1	0.85	2	-
Leo	steppe	2	0.26	1	0.85	120	0.58

within some Scots pine trees and grasses covered spots formed on the top of Henye Hill during terminal phase of MIS3. Thus the results macrobotanical, phytolitih remains and pollen analyses showed in good agreement with paleo-vegetation reconstruction so the drawn pictures of the open boreal spruce dominated parkland forest around older Gravettian site of Henye Hill seems realistic.

Discussion and Conclusion

A geological profile was evolved on the surface of the Henye Hill at Bodrogkeresztúr, very close to the older archaeological excavation profile which in an Upper Paleolithic (Gravettian) archeological layer could be found (Vértes 1966; T. Dobosi 1994). According to macroscopic investigations and sedimentological analyses a reddish brown spruce charcoal rich fossil soil within scattered minor bone, silica fragments can be found in the geological profile. The geoarcheological and paleoecological data suggest that this fossil soil layer formed on a loess layer surface and under a spruce dominated mixed-leaved forest steppe (open parkland) environment during the terminal phase of the Marine Isotope Stage 3 (MIS3) level. This paleosoil layer can be found around the Kopasz Hill at Tokaj on the loess covered surface and on some loessy areas in the Hungarian Upland region (Sümegi 1996, 2005; Sümegi & Hertelendi 1998).

According to our paleobotanical data, a mixed taiga, dominated by spruce, must have emerged in the area of the Northern Mid-mountains and its foothills during this time. It might be important to know in reconstruction of the surrounding environment of the Paleolithic hunters, that several *Picea* charcoal remains studied by *Edina Rudner* (Willis et al 2000; Rudner & Sümegi 2001) have been recovered from the Paleolithic sites themselves (Bodrogkeresztúr –Henye-tető: 26,318 +/- 365 BP years; Megyaszó, Szeles-tető: 27,070 +/- 680 BP years; Püspökhatvan –Diós, Öregszőlő: 27,700 +/- 300 BP years; Hont–Parassa III/Orgonás: 27,350 +/- 610 BP years).

All these data seem to underlie that the earliest Gravettian hunting groups appearing during an interstadial at the end of the Marine Isotope Stage 3 (MIS3) in the Carpathian Basin (Gáboriné-Csánk 1980; T. Dobosi 2000) must have populated spruce woodlands containing thermomesophilous arboreal elements (*Carpinus* – hornbeam, *Salix* – willow, *Alnus* – alder, *Betula* – birch, *Pinus sylvestris* – Scots pine and possibly *Corylus* – hazelnut, *Tilia* – elm, *Quercus* – oak) as well. Sporadic changes in the dominance of shade-loving mollusk species, as well as the scatteredness of the charcoal remains forming major spots refer to the presence of variegated mixed taiga woodland containing steppe elements (forest steppe). The differences in exposure between the slopes might have contributed to the emergence of minor spots, characterized by warmer conditions harbouring thermomesophilous arboreal elements within the spruce woodland. A modern analogy of this spruce woodland can be found in the Altai Mts. where a mixed spruce woodland of loose stands can be found at lower elevations containing such elements as Scots pine, alder, willow and oak (*Quercus mongolica*) (Sümegi 1996, 2005; Sümegi et al. 1999).

According to the gained information from the literature, our findings cannot be treated as unique to the Carpathian Basin by any means. Since numerous charcoal remains of *Picea* and those of *Pinus cembra, Larix-Picea, Pinus silvestris, Juniperus, Abies, Taxus baccata* have been recovered from various sites in the layers dated between 25-32,000 BP years in Moravia, the Alps and the Vienna Basin (Sümegi 2005). Besides the coniferous elements, remains of several deciduous elements have also been retrieved (*Betula*, *Salix, Tilia cordata*, *Ulmus betulus*, *Populus*, *Fagus silvaticus*, *Quercus robur*, *Coryllus avellana*) implying the development of favorable microclimatic conditions and a warming of the climate. The pollen charts containing information from this studied interstadial interval all indicated the appearance and expansion of thermomesophilous elements along with a strong advent of the coniferous forms during this period. The complex, systematic comparative archeological and environmental historical investigations implemented at the sites of Pavlovi and Dolnì Věstonice (Mason et al. 1994; Damblon 1997; Rybníccková & Rybnícek 1991) have univocally justified the development of gallery forests dominated by pines but containing several thermomesophilous elements as well at the end of Denekamp interstadial, beginning of the Upper Pleniglacial in the valley of the Dyje creek. While the loessy hills elevated over the creek's alluvium and giving the settlement site of the Gravettian hunters was harbouring forest steppes with loose stands of dominantly *Picea* pines. Several thermomesophilous arboreal elements also populated these pine woodlands. The higher areas were covered by steppes containing stands of spruce and cembra pines. Consequently, the distribution of the oldest Gravettian sites and paleovegetation data seems to be closely linked to that of the spruce parkland.

This may refer to the development of a close-knit relationship between the fauna and ecological conditions of these pine woodlands and the life strategies of the oldest Gravettian hunting groups. In order to elucidate something about this special relationship, we were trying to find connections between the prey animals and the former vegetation using information from the literature. The oldest Hungarian Gravettian site is that of Bodrogkeresztúr Henye-tető (Vértes 1966; T. Dobosi 2000). This site yielded numerous vertebrate bones assigned into the Istállóskő fauna (Kretzoi 1953; Jánossy 1979), studied by Kretzoi & Vörös (Vörös 2000). The bones recovered from a surface of 258 m^2 by Viola T. Dobosi and that of 165 m^2 sampled by László Vértes (Table 4) were dominantly those of wild horses, moose, mammoths and buffalos, both in terms of specimen numbers and the amounts of meat yields (Vörös 2000). When we have a look at the habitat preference of the individual vertebrate species (**Table 4**), we can clearly see that the highly complex, mosaic-like patterning in the environment inferred from the results of malacological studies (Sümegi 1996; Sümegi & Hertelendi 1998) and macrocharcoal analysis (Rudner & Sümegi 2001) is also corroborated by the findings on the vertebrate fauna. However, the extraordinary proportions of steppe elements, especially those of the wild horses calls for further explanation. The camp site of the Gravettian hunters at Henye-tető was located in a spruce dominated woodland on the hill. Several drinking sites must have been present on the underlying floodplain along a river, which must have occupied the site of the present-day Bodrog River, at a distance of only 1.0-1.5 km, where the herds of animals dwelling in different habitats must have gathered increasing the chance of a successful hunt for the humans.

It is rather interesting that the local environment of the oldest Gravettian sites was characterized by similar natural endowments at each and every Hungarian site (Püspökhatvan Diós, Püspökhatvan–Öregszőlő, Verseg, Hont–Parassa I.-II.-III.: T. Dobosi 1994) with a creek valley harbouring mixed taiga woodlands surrounded by loess-covered hills of steppes and spruce forests, the latter giving the camp sites of the hunters, similarly to the coeval sites along the Morava at Dolnì Věstonice and Pavlov. It's also worth noting that not a single artefact belonging to the Gravettian culture has come to light from the areas located south of the Hungarian Upland and the belt of spruce woodlands within this chronological period.

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