Chronological, cultural and population relations of Transdanubia and the Great Hungarian Plain during the Late Neolithic. Multidisciplinary comparative analysis of the material from Pusztataskony-Ledence, site no. 1 and its surroundings (PD 116711)

End report

1. Implementation

With this project, we attempted to define the character of the Transdanubian Lengyel culture's presence and its probable origin as appearing in the archaeological record of the Late Neolithic settlement at Pusztataskony-Ledence 1, as well as to reveal the character of the two complexes' interaction in the territory of Northeast Hungary. Our aims were to be obtained through a detailed, multidisciplinary processing and joint evaluation of the diverse find groups and phenomena. The implementation was carried out according to the provided work plan, thus the majority of the grant was spent on material analyses (thin section, isotopes, DNA), except for a sum allocated for the translation and readership costs of a planned manuscript. This manuscript is currently under preparation; according to our agenda, it will be published by July 2020 as a volume of the BAR International Series, with the publisher of which a preliminary agreement was obtained last year.

2. Participants

The project necessitated the participation of specialists from different fields of archaeology, who not only carried out the processing of the relevant archaeological sources, but also agreed upon preparing their studies as chapters of the monograph, and provided a summary of their work and results for this report as presented below.

3. Investigation and results

The investigations took us way further than expected, offering insight, beside the circumstances of the settlement's everyday life and special activities, into social relations, thinking about materiality, levels and character of identity, and regional and long-distance connections of the community of Pusztataskony, as well as offering an extensively renewed picture on the cultural relations of Eastern Hungary during the Late Neolithic. The results of diverse fields, when combined, outlined a Late Neolithic community that had founded a riverside settlement around 4800 BC in the Middle Tisza Region, and whose members maintained active connections, embraced foreign customs and ideas, and perhaps even had intermarriage relations with both nearby settlements and communities in distinct territories for generations.

The structure of this report broadly follows that of the planned book; fields that are yet fully unpublished are explicated in more detail with regard to both methods and results.

3.1 Settlement location, structure and microregion (Sebők Katalin, SEBŐK–FARAGÓ 2019)

Pusztataskony-Ledence 1 is stretching on top of a peninsula-like elevation along the right bank of the river Tisza, west of Pusztataskony (Middle Tisza Region, Hungary). It was a major settlement in a local network of at least three, approximately coeval ones (with Kisköre-Gát, Abádszalók-Berei rév), covering about 18 to 30 ha during its life course. The excavated part, a single

longitudinal cross-section on its western fringes covering about 18–29% of the whole settlement included a central area next to a baylike, protected curve in the pristine shoreline, where features of many of the 11 archaeological periods present were concentrated (which resulted in a considerable damage of Late Neolithic features).

The inner structure of the settlement, except for the density of phenomena, is rather homogenous, with no distinguished central part, separated area, or empty spaces, resembling Middle Neolithic Linear Pottery traditions. It repeats similar 'house clusters', i.e., in spatial terms more-or-less separable groups of phenomena comprising irregular rows of residential buildings with pits of diverse size and occasionally a few burials around them. The number of buildings in the excavated part cannot be properly estimated due to the above-mentioned damage: it must have been around 25–30. The reconstructed buildings are all of the same type: timber-framed, two-roomed houses standing NNW–SSE, with an occasional post-supported auxiliary structure at either end. The only phenomenon suggesting above-house cluster level organization or regulation in the settlement is the overall lack of wells: only one was found in the excavated area. In morphological terms, no special phenomenon was identified in the excavated area (e.g. a circular ditch or a special building).

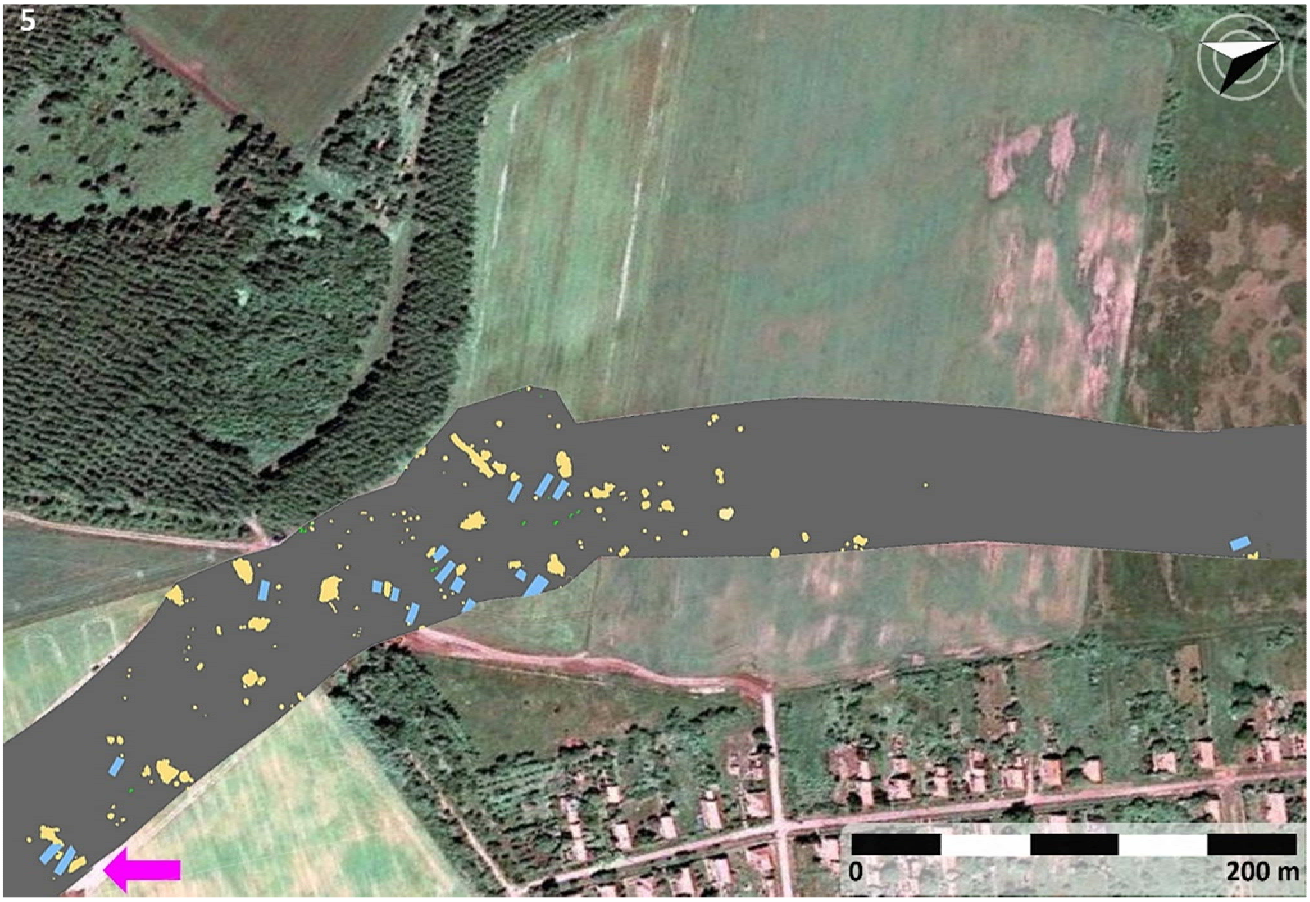

Fig. 1. Pusztataskony-Ledence 1. Blue-houses, yellow-pits, green-burials. (SEBŐK-FARAGÓ 2019, fig. 1)

The single special phenomenon on the settlement was a round storage pit, of about 1.15 m in diameter and 0.40 m deep. The infill contained absolutely no finds except for a three-handled jug, which was placed right in the middle of the pit's flat bottom. An attempt was made to learn about its original content via archaeobotanical and geochemical analyses, but it only turned out that diagenetic contamination destroyed the sample completely (a small rodent decomposed in it). The phenomenon shares some basic characteristics with the well deposits of Polgár-Csőszhalom, including internment of intact (useable) vessels and vessel type, which altogether allow the phenomenon to be interpreted as an offering.

3.2 Absolute chronology (Zsuzsanna Siklósi)

Up to date altogether 17 samples were AMS dated from the site by the Poznan Radiocarbon Laboratory: 6 human bones from burials, and 11 disarticulated animal bones from closed settlement contexts (there was no possibility to sample articulated animal bones). The results of two measurements were excluded from the series for being significantly younger (Poz-97311 and Poz-97302). The results were calibrated using the IntCal13 calibration curve, with Oxcal 4.3.2. As there was no observed stratigraphic connection between the features, the data were rendered first in one sequence in a single phase. As several measurements proved to be inconsistent with this model, the evaluation was repeated by rendering the three youngest dates in a separate, second phase. The combined data was used in the case of 1-342 (pit), as both measurements reflect the first phase of the settlement. As a contrary, the two data from 2-25 (pit) were calibrated in separate phases, as their joint calibration yielded an inconsistent result. Both of these measurements are of disarticulated bones; the older one fits the first settlement phase, while the younger one is marking that at least some part of the feature was still in use during the second settlement phase. Based on the available data the life of the settlement started around 4810 (68.2%) 4735 cal BC. The duration of the first phase is about 115 (68.2%) 205 years, and of the second phase approximately 5 (68.2%) 65 years. Life on the settlement ceased around 4545 (68.2%) 4450 cal BC.

Further analyses were carried out to reveal the use pattern of the southern and northern settlement parts, as well as the chronological relations of the burials and the settlement activity.
In the northern settlement part, both settlement features and burials were dated. Activity in this area started probably around 4775 (68.2%) 4650 cal BC; the duration of the first settlement phase is approximately 35 (68.2%) 130, while of the second about 0 (68.2%) 55 years. This part of the settlement was finally abandoned around 4530 (68.2%) 4410 cal BC. In the southern settlement part, all samples were collected from settlement features, and only one of the measurements belongs to the second settlement phase. Activity in this area started approximately around 4860 (68.2%) 4715 cal BC, continued for about 45 (68.2%) 195 years, and ended around 4695 (68.2%) 4515 cal BC. In summary, the southern zone of the settlement was inhabited first, then activities were carried out in both parts, while those in the second phase were mainly restricted to the northern area. The two settlement phases were reflected by both the separate settlement and burial data series.

Settlement data series put the start of settlement activities to around 4840 (68.2%) 4740 cal BC, render a duration of about 70 (68.2%) 175 years to the first, and 0 (68.2%) 75 years to the second phase, and date its end to about 4550 (68.2%) 4400 cal BC.

The first burials are somewhat younger than the start of the first settlement phase, dating between 4755 (68.2%) 4630 to 4640 (68.2%) 4485 cal BC. As only one of the burials marks the second settlement phase, only the duration of the first phase can be estimated as 0 (68.2%) 105 years.

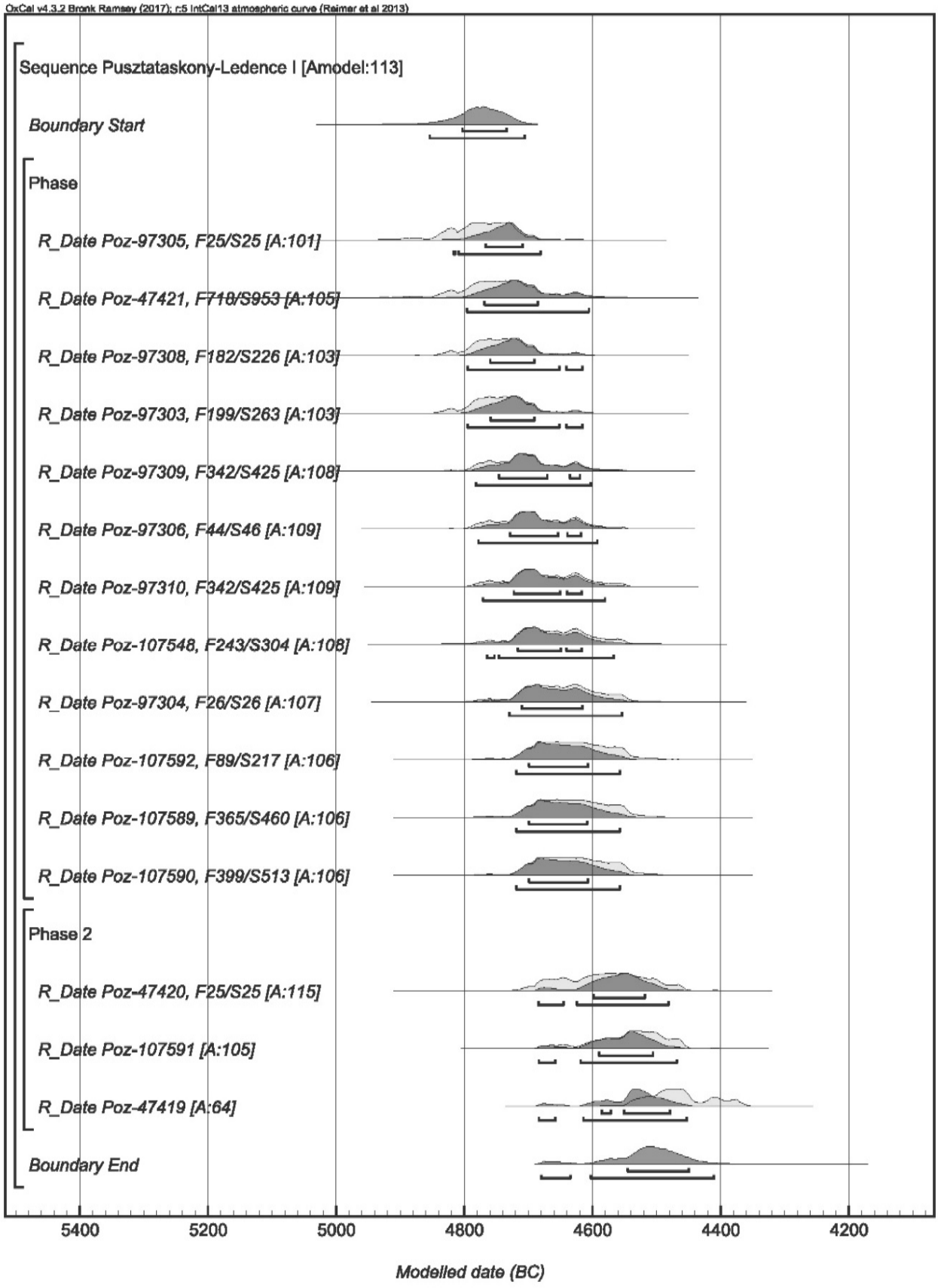

Fig. 2. Radiocarbon data from Pusztataskony-Ledence 1.

3.3 Human remains

3.3.1 Contexts of human remains (Katalin Sebők; SEBŐK 2012)

Altogether 14 burials and an irregular deposit of human remains were recorded amongst the Late Neolithic features. The basic characteristics of the burials are identical with the funerary rite of the Tisza culture: the single-grave skeleton burials of women, men and children are positioned around house clusters. The grave goods include limestone bead belts for women, wild boar tusk plates for men, and stone tools and ochre for both sexes. The low number of burials marks a selective funerary practice, a characteristic of Tisza communities. The foreign element in the local funerary practice is the fitting of the burials with funerary vessel sets, a custom originating in the early Lengyel culture.

One of the bodies (2-89.217), an adult woman was found at the bottom of a large pit next to a building, laying on a patch of household waste and sherds, but with most of the legs and a part of the right pelvis missing probably due to post-interment disturbance. Her position shows traces of care: she was laid on her back with the left hand bent back to the neck and the right bent in 90 degrees to the left elbow. The feet were probably also slightly bent to the left; altogether the placing corresponds to the regular burials. There was no item of attire, jewellery, or grave good found associated with the body.

3.3.2 Osteomorphological analysis (Zsuzsanna Zoffmann †; Tamás Hajdu; Kitti Köhler)

A detailed osteomorphological analysis was carried out on the skeletal remains of 11 individuals: 9 women, a man and a child (the anthropological material of two neonati were too fragmented for examination). In two cases morphological sex was overwritten by genetic results (see below), but in one of the cases the sex determination based on secondary markers of sexual dimorphism was uncertain. Beside the two neonati, the series included an infans 1, a juvenis, a juvenis-adultus, four adultus, two adultus-maturus and a maturus individual. No further conclusions may be drawn about the population or demographic relations due to the low number of burials.

The anthropological material is rather fragmented, which makes it harder to characterize the individuals. Measurable craniae, i.e. ones suitable for a taxonomical analysis reflect an inhomogeneous population: 1-419 and 1-718 are hyperdolichocrans with a leptoprosop viscerocranium, while 2-89 is mesochran with mesoprop face. The average stature is semishort-medium, while 2-89 was semitall-medium. All this reflects a prevalence of Mediterranean elements with occasional Nordic infusions, in correspondence with the recent taxonomical picture on the culture.

The observed pathological lesions are also congruent with the overall picture of Late Neolithic populations in the area. Two healed fractures were recorded (1-399, maturus man; 1-243, adult woman). The man broke both of his forearms, probably defending his face during an accident or an attack. The woman only broke her left ulna, but the injury healed with inflammation and fistulae. Spondylolysis was recorded on 1-718 (adult woman), and 1-365 (maturus woman) also shows marks of degenerative arthritis. The woman in 2-89 stands out again of the series: her scapula and pelvis show marks of enthesiopathy, a stress marker indicating the overburdening of the affected areas (usually appearing on the talus and patella). Furthermore, there was an endocranial lesion on

her skull that may have been caused by tuberculosis, meningitis, increased pressure due to endocranial bleeding, etc.

Partially due to the fragmentary state of the anthropological material the number and proportion of recorded dental diseases is low. The abrasion of the teeth by age group corresponds to the expectations: 1-365 (maturus woman) lost three teeth during her life, had one worn out to the root apex, and had a cist as well. 1-399 (maturus man) lost one of his teeth during his life. Two individuals had caries (2-89, juvenis woman, 1-718, adultus woman).

To sum up, the mixed taxonomical character of the Pusztataskony community, as reflected by the anthropological remains of the interred individuals, fits the general picture of the Tisza culture as outlined previously. The reasons behind this heterogeneity probably include the persistence of local Middle Neolithic populations, and their blending with foreign elements, arriving perhaps, as Zs. Zoffmann's investigations suggested, from the western parts of the Carpathian Basin.

3.3.3 DNA analysis (Anna Szécsényi-Nagy)

Methods of the DNA analysis

Ancient DNA analyses of 12 Neolithic individuals from Pusztataskony were performed in the ancient DNA facilities of the Anthropological Institute of Johannes Gutenberg University in Mainz, between 2010 and 2014 (KEERL 2015). The ancient DNA work was carried out following earlier published protocols (BRANDT ET AL. 2013). Victoria Keerl amplified the HVS-I (np 16000-16409) and HVS-II (np 35-394) regions of the mitochondrial genome by standard PCR techniques, then she detected the DNA with Sanger sequencing and cloning techniques (SZÉCSÉNYI-NAGY ET AL. 2015; KEERL 2015). Besides the hyper variable regions, further 22 Single Nucleotide Polymorphisms (SNPs) were detected in the coding region of the mitochondrial genome, in order to ascertain the mitochondrial haplogroup classification. Two of these eleven individuals (samples PULE 1.24, 1.26, buried in graves 1-365 and 1-419) were also part of a larger paleogenomic study where whole genome SNP datasets were generated at the Harvard Medical School, Boston (LIPSON ET AL. 2017).

Two samples (from graves 1-709 and 1-718) were additionally processed in Budapest, in the Laboratory of Archaeogenetics, Institute of Archaeology, Research Centre for Humanities, Hungarian Academy of Sciences in 2016–2017. These samples were treated according to the protocol described in LIPSON ET AL. 2017. Whole mitogenome sequencing and shallow shotgun sequencing of the total DNA content were performed in Budapest as described in CSÁKY ET AL. 2018.

Results and discussion of the DNA analysis

The mitochondrial DNA (mtDNA) of 13 individuals assigned to the Tisza culture at Pusztataskony was successfully typed. Four individuals were analysed for genetic sex markers in Boston and Budapest. The genetic sex of both individuals lying in grave 709 and 718 could be defined as females, based on shallow shotgun sequencing of their genomes; these results correspond to the osteological observations. On the other hand, individuals from grave 1-365 and 1-419 were both described as genetically female, in contrast to the anthropological results.

The mitochondrial haplogroup composition of this group of individuals from the Tisza period of the Pusztataskony site contains frequent Neolithic mtDNA types of the Carpathian Basin, such as haplogroups J (4), T2 (3), K (3), and HV0 (1). Furthermore, two U8b haplogroups are also detected, which were somewhat rarer in Neolithic populations, and occurred mostly in the Late Neolithic period of the Carpathian Basin. One haplogroup U8b1 from grave 1-251 of Pusztataskony has parallels in Alföld Linear Pottery and Sopot culture environments, but no direct haplotype matches have been discovered in the Carpathian Basin so far. The other haplogroup U8b1a from grave 1-718 has direct sequence match with grave 15 at the Lengyel culture site at Veszprém-Jutasi street in Transdanubia, which connects genetically the populations of the two cultures. These two identical mitochondrial genomes however do not necessarily vindicate direct kinship, although their maternal ancestry lines certainly converged in the recent past.

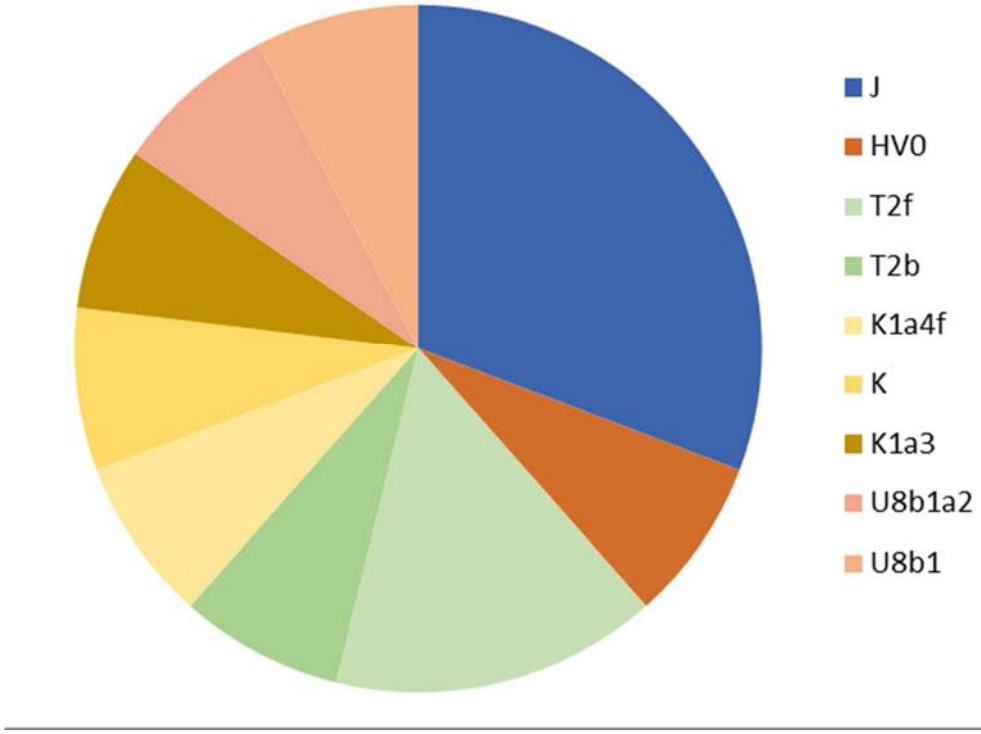

Fig. 3. Mitochondrial haplogroup composition of the Tisza period population (n=13) at Pusztataskony-Ledence 1.

Individuals in graves 1-17, 1-36, 1-243 (two adult females and an infans II child) share the same mtDNA J haplotype on the HVS-I region, they were probably maternally related to each other. Similarly, individuals from graves 1-231 and 1-419 (infans I child and an adult female) share also the same haplotype of haplogroup T2f. The third connection is between graves 1-365 and 1-399. The complete mitochondrial genome of the Individual from grave 1-365 was sequenced (LIPSON ET AL. 2017), resulting in a more detailed haplogroup definition (K1a4f), than was determinable from the HVS-I fragment in the case of grave 1-399. The elderly female (365) and male (399) were probably maternally related as well, but the degree of the kinship cannot be determined by mtDNA analyses alone.

Whole genome SNP dataset was generated from a mature female buried in grave 1-365. The hunter-gatherer component was estimated to be 10.4 ± 1.9% of her total genome. The rest of her

genome had Near Eastern farmer ancestry. Her farmer ancestors of probably Anatolian origin (based on the genomic data) admixed local hunter-gatherers in the Carpathian Basin or other farmers with significantly more hunter-gatherer ancestry ca. 18 ± 7.2 generations before her lifetime (LIPSON ET AL. 2017). These values fit into our archaeogenetic knowledge about the group of other Late Neolithic individuals that lived in the Great Hungarian Plain. The hunter-gatherer ancestry proportion in the individuals of the ALP and Tisza cultures is somewhat higher than was observed in people living in the Neolithic in Transdanubia. Probably more hunter-gatherers lived in the Early Neolithic period in the Eastern part of present-day Hungary, and they had a larger contribution to the gene pool of the Middle Neolithic period population of the region. The admixture between groups of different genetic origin did not stopped in the early phases of the Neolithic period, but continued for more than a millennium.

3.3.4 C/N isotope analysis (Alexander Mörseburg)

Methods of C/N isotope analysis

We obtained carbon and nitrogen isotope data from 14 individuals and evaluated them for dietary information. The analytical procedure followed MÜLDNER–RICHARDS 2005 with modifications as given in KNIPPER ET AL. 2013. Duplicates of 0.5 to 2 mg from each sample of filtered and freeze-dried collagen were weighted into tin capsules and combusted to CO2 and N2 in an elemental analyser (vario EL III, Elementar Analytical Systems) connected to an IsoPrime High Performance Stable Isotope Ratio Mass Spectrometer (VG Instruments) at the Johannes Gutenberg University in Mainz. The isotope values are given in δ notation in per mille relative to the standards V-DPB for carbon and AIR for nitrogen. The normalisation of the raw data was achieved by a two-point calibration based on USGS 40 or IAEA N1 and IAEA N2 for nitrogen and CH6 and CH7 for carbon. The analytical error, as calculated from repeated analyses of internal and international standards, was 0.2 ‰ for δ^{15}N and 0.1 ‰ for δ^{13}C.

Results of the dietary reconstruction

All 14 human samples fulfil the primary quality criterion applied here i.e. their atomic C/N ratio lies between 2.9 and 3.6. The observed δ^{13}C values span a range from -20.9 ‰ to -19.7 ‰, which is consistent with a diet obtained from a terrestrial (European) C3 ecosystem. Adults (n=10) from Pusztataskony have a mean of -20.3 ± 0.1 ‰. Nitrogen isotopes values from the site vary between 9.6 ‰ and 12.8 ‰ with an adult mean of 10.7 ± 0.8 ‰.

The latter value is high enough that a substantial contribution of animal protein to the diet of most individuals from Pusztataskony appears biologically plausible. A more precise quantification of this fraction would require local faunal isotope data. However, even in cases where the latter is available such estimates need to reflect the uncertainties regarding the trophic offset between human collagen and different dietary protein sources and the extent of ^{15}N enrichment in cereals due to manuring.

In terms of internal structure the unbalanced sex distribution and small overall sample size do not allow meaningful inferences about potential sex-specific dietary patterns. The four non-adult individuals fall mostly within the adult range except one infant (1-231) who exhibits a nursing signal with a δ^{15}N value of 12.8 ‰. Notably, two very young children (1-36 and 1-352) have identical

nitrogen isotope values to the adults; most probably these individuals died as neonates or very soon after and therefore would have been too young for detectable $\delta^{15}N$ enrichment due to nursing.

ANOVA analyses suggest that there are significant differences among adults (*n*total = 156) when the site of Pusztataskony is included in a comparison of (grouped) sites from the Hungarian Neolithic sampled in previous studies (*Fdelta_*$^{13}C(3,152) = 4.431$, $p = 5.13^{*}10\text{-}3$; *Fdelta_*$^{15}N(3,152) = 27.33$, $p = 3.43^{*}10\text{-}14$).

The adult individuals from Pusztataksony exhibit a more significantly negative $\delta^{13}C$ relative to the TLBK site of Balatonszárszó-Kis-erdei-dűlő as well as the ALBK sites from the Lifeways project. This result does not fit into the macro-regional trend observed for Central European Neolithic sites across larger distances where $\delta^{13}C$ becomes more positive with increasing longitude, most likely due to drier climatic conditions. The most plausible explanation for the outcome here is that these climate parameters do not vary enough across the area of modern Hungary to cause a measurable effect. Identifying the drivers behind the observed micro-regional differences in $\delta^{13}C$ at Pusztataskony vs LBK sites from both the Alföld and Transdanubia is particularly challenging because of the aforementioned absence of local faunal data. Both a small but non-zero contribution of aquatic resources to the human diet at Pusztataskony as well as a canopy effect at this site could be relevant factors. The latter could either reflect local variation in forest cover or differences in animal husbandry strategies.

For the $\delta^{15}N$, the adults from Pusztataskony show a more positive value than those from the Transdanubian site of Balatonszárszó-Kis-erdei-dűlő and are indistinguishable from the other sites also located in the Alföld.

Again, it should be cautioned that without local comparative faunal data it cannot be ascertained whether this reflects genuine differences in the proportions of animal protein in the human diet or other site-specific effects. The latter could indicate differences in manuring intensity, which would affect the cereals consumed by humans and/or the fodder for domestic herbivores and therefore cause elevated $\delta^{15}N$ in the tissues of the respective consumers. There is evidence for inter-site variation in $\delta^{15}N$ enrichment in the collagen of domestic herbivores from the LBK sites from the Lifeways Project (Hedges et al. 2013) as well as the set of Alföld sites from later stages of the Neolithic and Copper Age included here (Giblin 2011), which can be interpreted as evidence for the role of these factors.

3.3.5 Sr isotope analysis *(Marc Fecher, Katalin Sebők, Norbert Faragó)*

Altogether 10 measurements of local fauna samples and 16 human tooth + 4 human bone samples were included in the evaluation. As both separate series failed to show normal distribution, the evaluation was basically restricted to violin plots and boxplots. The small number of data points per set also limits both their relevance and interpretability.

Local Sr isotopic range

The series of animal remains included a Cervus elaphus (M2), two Sus scrofae (M2, M2), an Ovis/Capra (M3), two Sus domesticae (M2, PM4), as well as two Bivalvia shells. Both the boxplot and a kernel density analysis pointed out both Sus scrofae as outliers. The single Cervus elaphus sample also showed a significant deviation — not surprisingly, as the bocks of this species are known to

cover great distances upon reaching adulthood to establish their own territories. The IQR of the domesticated set, representing most probably the site and its immediate vicinity, mark a relatively narrow range between 0.7096–0.70967, with a median at 0,70963. The range of relevance in spatial terms may be grasped by comparing the available radiogenic isotope data from the territory of Eastern Hungary (GIBLIN 2013). J. Giblin, beside a sketch map of the Pannonian-Carpathian region's isotope variability, also makes raw data sets of several Late Neolithic communities available, with the results of 10 individuals from the nearest coeval settlement, Kisköre-Gát among them. This site is located at a distance of only 3.3 km, and, by C/N ratio, the population's diet must have been similar to that of the people at Pusztataskony (GIBLIN–YERKES 2016, Table 1). Regrettably, only a human data set is available, which but shows a fundamental difference compared to the similar set of Pusztataskony, suggesting an isotopically mosaic microregional background. The presence of such a higher spectrum nearby might explain some of the higher values in the Pusztataskony data set: the violin plots of the two sets seem to complete each other, and the combined plot shows a lognormal distribution, which might be interpreted as corresponding with the actively used (wider) environmental range of the two communities.

The correctness of such an interpretation might be also underlined by a comparison of separate Sr data sets of the two sites selected by age reference, M1 representing younger childhood (2.5–6 years) and M3/bone sets representing adolescence and adulthood. While the M1 and fauna series from Pusztataskony match well, the M1 series from Kisköre and Pusztataskony show a significant difference (Kruskal–Wallis p= 0,009572, α=0.05). The small ranges of the series might reflect the reduced mobility of small children while giving a hint on the isotopic background of their nearest locality.

Outliers

The main goal of the Sr analysis was to determine outliers amongst members of the community. We were working with the hypothesis that there will be outliers, and also, that the woman in grave 1-718 will most certainly be among them. In this respect, the evaluation brought some surprises, as 1-718 proved to be the individual whose Sr ratio fits best the local pattern, with almost matching medians and low deviation, meaning that she was definitely raised in this settlement (samples from M1, M3).

Another individual, the adult woman in grave 1-365, is definitely an outlier: her values are way too high for the local range, and borderline high compared to the combined range of human samples with Kisköre. Based on J. Giblin's sketch on average Sr base values of Eastern Hungary, her values are characteristic either to Vésztő in the Southern Alföld area, or to the Bükk Mountains range in the north; based on the contacts outlined by other sources in the site's archaeological record, as well as on the lack of significant southern connections, this latter one seems to be way more probable.

The Sr values of two other individuals, an adult man in grave 1-399, and a 15–19 years old young woman in grave 1-709 are also a bit too high compared to the local range, but similar to those of the Kisköre population. Nevertheless, interpretation in these cases is highly hypothetic.

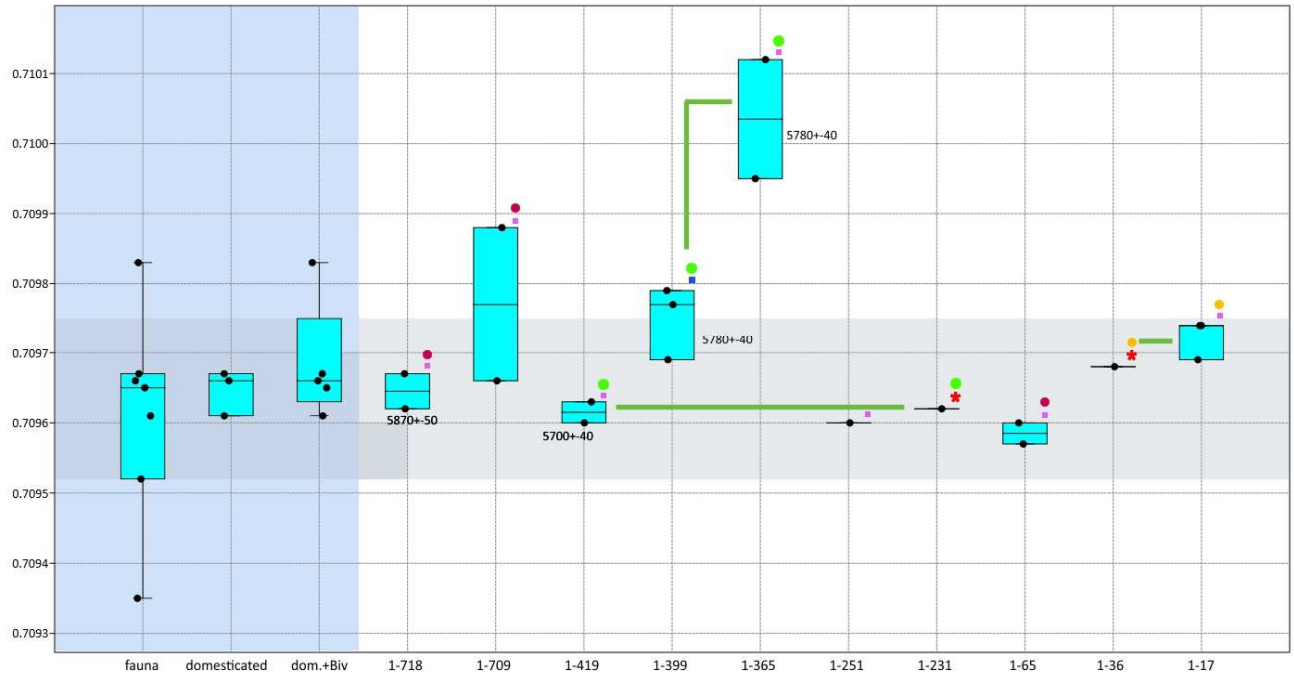

Fig. 4. Sr isotope data and auxiliary informations from Pusztataskony-Ledence 1. Horizontal grey zone: local range; green line: maternal connection; squares/asterisk: gender (pink-female, blue-male, asterisk non-identifiable); dots: house group (same colour marks the same house cluster).

As for the man in grave 1-399, a detailed examination of his individual Sr values, together with available supplementary data might reveal a bit more about his life. Genetic analysis revealed that he is maternally related to the outliner woman, and radiocarbon measurements suggest that they lived contemporaneously (both their radiocarbon age is 5780±40 BP). A morphological analysis suggests that he was somewhat younger (47–51 y.o. at death) than the outlier woman (49–55). Besides, his Sr values decline with time, the bone value, more-or-less representing adulthood, falling perfectly in the local range: 0.70979 (M1), 0.70977 (M3), 0.70969 (bone). Taking into consideration that first molars develop between 2.5–6 years, while full development/enamel formation of the third molars takes place between 2.5/6–15 years, the whole scene might be interpreted, utilizing all available data, as the following: as all his values are somewhat lower than hers, the man in grave 1-399 might had arrived to the settlement as a small boy (before the completion of the development of the first molars) together with the outlier woman (1-365) from possibly the Bükk area or a zone with similar Sr base values, and lived here henceforth. It must be however underlined that the measured differences are small, even if above the error margin; the Kruskal-Wallis test only showed a somewhat significant difference of medians when the values of 1-399 were compared to the narrow domesticated set.

Mobility and intrasite connections

Individual mobility analysis was only possible to be carried out in the case of the only adult male (explicated above), as other individuals were not sampled accordingly. In the case of presumed locals, the series of M1 and M3 samples seem to fit the expectations: the M1 series mark a narrow

range between 0.709615–0.729675, fitting perfectly the local range, reflecting the limited mobility of younger children, while the values for the M3 series vary in a considerably wider range, suggesting that young adult women (15–19) were involved in diverse activities regularly taking them away from the settlement. A comparison of the available age-representative series (M1, bone) from Kisköre shows a different pattern, a simple shift, but this picture alone cannot be interpreted: bone values in both series are higher compared to first molars.

In the case of the two small children, additional data may be of help again. The approximately 3 year-old-child in grave 1-231 shows a strong nursing signal, while his/her single strontium value matches extremely well that of the woman in grave 1-419, to whom s/he was related maternally, suggesting, perhaps, a direct connection between them. The other small child, a neonatus in grave 1-36 must show a maternal isotopic pattern, but the single obtained value differs from the span of the woman in grave 1-16, suggesting that their maternal relation is not direct.

3.3.6 Evaluation of the features with human remains (Katalin Sebők)

Despite being found in a waste disposal pit the placing of the woman 2-89.217 showed traces of care, which means this phenomenon, together with the other, 'regular' ones, may be interpreted as a burial. Even with this one included, the number of burials is way too low for the expected number of residents, indicating a selective funerary practice, while the relative abundance of prestige markers regardless of sex or age suggests that the individuals in the graves represent a distinguished group inside the community, perhaps also reflecting, as the combined results of scientific investigations suggest, diverse (maternal) lineages associated with house clusters.

The homogeneity of details in the local funerary practice as appearing in 'regular' burials of the settlement suggests a strong identity shared by the individuals of the group behind. This identity, just like the taxonomical constitution of the population, seems to root in diverse times and traditions. The oldest elements are perhaps ochre painting and offerings, the fitting of burials with a stone tool (axe or blade) below the head, and the placing of a small cup in the head area, customs originating in the Alföld Linear Pottery culture. Compared to these, the addition of items reflecting wealth, prestige or social position (e.g. jewellery) is a relatively new element in the funerary practice, gradually evolving during the Middle Neolithic, and becoming general by the dawn of the Late Neolithic, probably as a kind of answer to continuously increasing social stress. The foreign element comes from a contemporary source: the addition of funerary vessel sets to burials is a custom characteristic to communities of the early Lengyel culture in the first place. This element seems to persist in the local practice for generations with no significant change, suggesting the persistence of the concept behind, altough original Lengyel-type vessels only appear in the set in the oldest dated burial (1-718).

Gender also seems to appear as part of the funerary rite, as some grave goods seem to be gender-specific: only women got limestone bead belts, while men seem to be correlated with stone tools below the head, and wild boar tusk plates. Based on this distinction the gender of two of the unidentified small children may be guessed: 1-470 was probably a girl, as a few limestone beads engirded her waist, and 1-231 was a boy, as there was a wild boar tusk plate fragment tucked into the ochre paint filling of a small vessel in his grave.

In this context an interpretation of the 'irregular' burial in feature 2-89 might be attempted. The morphological characteristics (semitall-tall stature, mesochran face) of the interred were different to the individuals in 'regular' burials (semishort-short stature, thin face), as were the 'wearmarks' on her body: she was the only one with stress markers from overburdening the shoulder and pelvic regions, and in an exceptionally bad health (lost teeth, inflammation and cists in the mouth, extended intracranial lesion due to infection or disease, i.e. tuberculosis). These markers are not characteristic for the individuals in the 'regular' burials either, suggesting altogether a lower social position of the woman in feature 1-89. This being the case, her appearance in this context might be interpreted as a kind of cheat: she was given final honours in a way she was probably not entitled to, by internment next to a house (cluster), inside the settlement.

3.4 Find material

3.4.1 Pottery

The mixed character of the ceramic record was clear from the start, as post-firing painted vessels appeared in relative abundance among ceramic sherds in household contexts. The identification of a foreign cognitive element in the burials, together with the results of the thin section analyses by A. Kreiter raised the possibility of local production of Lengyel type vessels (SEBŐK 2012). Further stylistic and thin section analyses were carried out as part of this project to reveal the character and duration of the presence of Lengyel elements in the ceramic inventory of the Tisza culture settlement at Pusztataskony.

3.4.1.1 Stylistic analysis (Katalin Sebők, SEBŐK–FARAGÓ 2019*)*

Theoretical background and methods

Our current understanding on the relation between a material object and the culture is explicated in detail in SEBŐK 2019. The ceramic find group requires a holistic approach integrating diverse related aspects: information structure, production background (applied technology and social embedding of production), utilization (symbolic and utilitarian functions and their changes), and find context. Interpretations must be formed with respect to the structure of ceramic inventory as a medium of symbolic communication, and the possible roles of objects together with the social level or field of their working (individual, household, community etc.). The joint interpretation of the related markers must be carried out, if possible, at both object and type level to provide insight into the intricate social and cognitive web behind the object.

As for the statistical method required to unfold the necessary data, the details were already published in several case studies (RACZKY–SEBŐK 2014, RACZKY ET AL. 2015, SEBŐK–FARAGÓ 2019). The method was developed for the coeval material of Polgár-Csőszhalom-dűlő, and applied here following minor adjustments due to the different character of the starting hypotheses. The analysis was constructed in order to answer specific questions on the constitution of the local inventory, the distribution and frequency of types representing a foreign tradition, and type integrity (the detection of one-time and recurring deviations as well as hybrids i.e. types or one-time occurrences exhibiting a stylistically mixed character).

Typology and type integrity

Typological expectations were formed on the basis of two coeval sites: the homogenous Tisza culture record of the nearby Kisköre-Gát, and the multicultural Polgár-Csőszhalom. Marked differences pop up amongst the bowls at the type level: in every known site of the (northern) Tisza tradition the leading type between fine bowls is that of the biconical bowl with a more or less carinated belly at the middle of their height, where the upper part is vertical or slightly in- or outward-inclining (T4 type). Simultaneously, biconical bowls with a low bellyline and outcurving upper walls (T3, T6 types) are characteristic types of the local inventory. These Lengyel-influenced forms seem not to be present either in the inventories of coeval Tisza culture settlements or known culturally mixed settlements in the north, except for Polgár-Csőszhalom. There is a great number of typically base fragments which might belong to either local or T3/T6 types. Other, typical Lengyel forms also appear in the material, even if rarely: fragments of tripartite vessels, a straight-walled biconical cup type with sharp, low carination, and a variation of the T3 bowls with an even lower bellyline, strongly outcurving rim, and sharp carination, which probably served as a model for a less definite local variation.

The rest of the local inventory matches the relevant types of Kisköre-Gát, and, to some extent, Csőszhalom as well. There is a fair number of conical, middle-sized or larger, relatively closed storage vessels, and large containers or bins. A single example with a bulging 'Samborzec' neck underlines the site's northern connections: its analogies appear rarely but regularly in the ceramic record of Polgár-Csőszhalom dűlő. Among jugs and jars only the more or less high-shouldered variants seem to be present, but not those with a low shoulder, oval, or egg-shaped body. The seeming scarcity of these large vessels is probably largely due to fragmentation distortion, as suggested by their abundance in feature 1-431 containing a part of the vessel set of a nearby house, together with a large amount of burnt debris. The abundance of fine, bomb- or tulip-shaped cups again is a result of fragmentation distortion due to their unique technological markers. Among the flowerpot type variants, there is a significant prevalence of the variant with a slightly curvy, round or rounded quadrangular base and outcurving rim.

Even the complex decorated types appear in the material undegraded, suggesting the persistence of the background ideas behind their graphic canons. The abundance of decorated ware is surprising not only with regard to technique (diverse combinations of incision, red, white, sometimes yellow post-firing painting, tar painting and coating, and plastic applications), but also to type variants, each reflecting diverse spatial and temporal connections, linking the local pottery tradition with the earliest Tisza horizon as well as with the northern interference zone and the Lengyel tradition.

*3.4.1.2 **Thin section analysis** (Attila Kreiter)*

Thin section analysis was focused on revealing connections in raw material and temper of vessel types reflecting diverse utilitarian groups and pottery traditions. The results were evaluated in the context of Middle and Late Neolithic technological traditions, and compared to coeval settlements. The samples were ordered in six technological groups.

The preferred material for tempering is grog, but organic temper also appears in small numbers. Grog temper is a characteristic of the era, appearing and prevailing first in the Late

Neolithic of the Carpathian Basin (e.g. Szemely-Hegyes, Belvárdgyula, Hódmezővásárhely-Gorzsa, Aszód). Contrary to this, organic (chaff) tempering gradually decreases during the Middle Neolithic in both the Linear Pottery and the Vinča culture's pottery traditions, vanishing completely by the Late Neolithic. The tempo of the process seems to be different by region: there are no chaff tempered vessels in the early Lengyel materials of Zengővárkony and Belvárdgyula, while at the coeval Szemely-Hegyes (Lengyel) and Hódmezővásárhely-Gorzsa (Tisza) this thousand-year-old practice still persists.

The majority of the analysed samples (39) belongs to vessels prepared following the Tisza culture pottery tradition. The majority of the vessels (32) was tempered with grog, one with admixed grog and sand, while six samples did not contain temper. Organic material was present in minimal quantity in some samples, due either to a natural organic content of the source clay, or as a last memento of a vanishing custom where chaff is only added in symbolic quantities (see Heather Lechtman's theory on technological style). Four of the six Lengyel type vessels was grog tempered, one with sand, while one was untempered. Their raw materials, except for a small tripartite vessel, were identical to the Tisza vessels'.

Eight samples form a distinct technological category. These vessels are usually larger containers, except for a medium-size, closed one, made of the same clays as the rest of the types in the inventory. The large ones unanimously contained a mixture of grog and organic temper, thus reflecting both the new and the archaic traditions.

The petrographic profile of all the Tisza style vessels and the majority of the Lengyel types is similar: they appear in the same composition categories, thus their raw materials and the applied technology is similar. The appearance of chaff temper in the large vessel's group may be interpreted as a significant technological variation in the local pottery tradition. The only element of the series showing marked technological differences is a small Lengyel type tripartite vessel.

3.4.1.3 Summary of the pottery analysis (Katalin Sebők)

The persistence of graphic canons and the lack of new, hybrid decorated types bearing characteristics of both cultures suggests that despite the challenging cognitive environment in which they were created the concepts and ideas behind each type remained at least relatively intact. Of the Lengyel tradition only those types appear in this new context which probably played the biggest role in symbolic communication, suggesting the very diverse social embedding and utilization pattern of diverse vessel types. The presence of these type variants thus might mark the introduction of new customs, activities, or contents in the daily life of the local Tisza community, probably as a result of the arrival of new members with at least partial Lengyel identity, which, at least for some time, persisted in a fundamentally unchanged form side by side with the practices of the locals. Without sufficient radiocarbon data, temporal changes of the inventory may only be outlined by statistical methods, an attempt currently underway.

The relatively high proportion of foreign elements, the fact that one cannot distinguish between fragments of the T3 and T4 bowl types based only on technology, and the appearance of a local type variant group inspired clearly by bowls of Lengyel origin together seem to underline the results of thin section analyses suggesting local production of foreign type vessels at the site.

3.4.2 Lithics (Norbert Faragó, SEBŐK–FARAGÓ 2019)

Raw material distribution and basic technology

The archaeological record of the Late Neolithic settlement of Pusztataskony-Ledence is scarce in lithics, especially compared to the coeval Polgár-Csőszhalom or Aszód. Altogether 449 chipped pieces came to light from clear Late Neolithic contexts from Pusztataskony-Ledence. The most frequent raw materials arrived here from a northern direction, from a distance of 350–450 km. These pieces can be identified either as chocolate flint from the Holy Cross Mountains or in some cases as Cracow Jurassic flint; their sum adds up to 43% of the lithic record. The second largest group by raw material (23%) consists of several different limnosilicite types from the North Hungarian Range. The majority of these pieces originates in the Tokaj Mountains, located at a distance of 90–100 km. A specific variant, the Mezőzombor type, can be easily identified by its greyish-bluish silky colour and banded texture, so it was handled separately from the rest: pieces of this type add up to 6% of the whole assemblage. Obsidian also arrived from the same region: 15% of the chipped pieces were made of it. In most cases, obsidian finds can be categorized as Carpathian 1 subtype according to cortex and translucency. Another diagnostic northern flint variant is the Volhynian flint from Western Ukraine at a distance of 400–450 km, giving 2% of the sample set. Beside these, a minor part of the lithic record consists of radiolarites from the Klippen Belt in the Carpathian Mountains without any other specific character (1%), as well as silicified sandstone, i.e., Felnémet type from Egerbakta in the western part of the Bükk Mountains (2%), while a small part of about 8% comprises exemplars made of other undiagnostic flint types of unknown origin.

A comparison of the different raw materials by main technological categories reveals an overall lack of raw nodules or blocks in the assemblage, which places the initial phases of the knapping activity rather off-site. It seems that cores were similarly infrequent in the settlement; they appear in the greatest number among different types of limnosilicites with both corticated and uncorticated variants. Both variants made of Cracow Jurassic flint/chocolate flint and obsidian are also present, but only in minor quantities. Moreover, uncorticated obsidian cores are in a minority, which is rather the consequence of the natural, small pebble form of this material. The high ratio of obsidian corticated debitage products can also be explained with this characteristic. Such debitage products are frequent among the Volhynian flint too, but the uncorticated pieces are in general more abundant in every group. The rest of the raw materials like radiolarite, Felnémet type, and other undiagnostic pieces are not representative enough to envisage the whole chaîne opératoire at the settlement.

Summary of the lithic analysis

The prevalence of long-distance materials in the lithic record of the settlement is unique in the era. Cracow Jurassic flint/chocolate flint, different types of limnosilicites and obsidian formed the basis of a moderate, though focused knapping activity. From a technological point of view, obsidian seems to be a little bit different, but this could be an effect of the starting form of this material. This supposition is strengthened by a yet unpublished evaluation of the lithic record of Polgár-Csőszhalom, in the course of which similar differences were observed.

Considering the internal distribution of the material at the site, it is interesting that among the archaeological features only three pit complexes contained 54% of the whole assemblage, which

suggests a very concentrated activity at the settlement. It is hard to find coeval sites for comparison, however necessary that would be for interpretation. As of the lithic material of Kisköre-Gát, little was published, and the two pieces analysed in more detail by E. Bácskay can be linked with the classical Alföld Linear Pottery settlement at the site rather than the Tisza horizon. The situation at Aszód is different: as it is one of the best-studied chipped stone assemblages in the Hungarian Neolithic, it became a reference for any comparative raw material analysis. Its assemblage is distributed among Transdanubian, North Hungarian, and Transcarpathian (long-distance) sources, but the most frequent materials are obsidian and limnosilicites. A detailed typological and functional analysis of the lithic record is currently underway.

*3.4.3 **Bone tools** (Zsuzsanna Tóth)*

Altogether 114 worked antler, tusk, and shell objects were recorded at the Late Neolithic settlement at Pusztataskony. Their spatial distribution is uneven: 24 pieces were found in the larger subsite 1, while 90 in subsite 2. The raw materials include Spondylus gaederopus shell (2 pcs), red deer antler, and in one case seldom used roe deer antler (33), red deer tooth and wild boar tusk (13), and bone of mainly small ruminants as well as pigs, and cattle (66). Spondylus and red deer canine appear as beads in burials, while other types were obtained from everyday context (waste disposal pits). Ewe, goat and roe deer bones were formed mainly into awls. Tusks of wild boars and pigs were transformed into scrapers. Of cattle bones ribs were preferred for manufacturing smoothers. Antler tools show an abundance of types: the majority of red deer antler tools are punch or pressure flakers (marking the local stoneworking practice as well as the widespread use of pressure flaking technique), but four harpoons, three heavy duty axes, an antler- and a tine tip, and six pieces of waste were also found. The four harpoons represent top quality Neolithic workmanship not only by strict raw material and skeletal element choice, but by the multi-staged manufacturing chain, too. The number of axes is somewhat lower than expected. This is perhaps due to the fact that tools of similar function were prepared of diverse materials (wood, stone), and the proportions might change by settlement. The presence of production waste and half-finished products representing diverse stages of manufacturing provide insight into the chaine opératoire, thus being especially important in understanding the roles of diverse tools and tool kits.

In contrast to the fact that Late Neolithic assemblages are usually dominated by large ungulates (cattle, auroch, red deer), the most frequent raw material choice at Pusztataskony is small ruminants (probably in connection with the unusual frequency of tips). At the same time the number of otherwise generally frequent bone smoothers and hide beamers, usually made of bones of large ungulates, is unexpectedly low. The proportion of teeth (mainly tusk) and antler tools meets the expectations, but the percentage of manufacturing waste is higher.

*3.4.4 **Animal remains** (Péter Csippán)*

Altogether 3004 animal bone fragments associated with the Late Neolithic settlement were analysed to date, of which the species was determined in 2155 cases. The general condition of the archaeozoological material is good, but heavily fragmented.

Quantitative and qualitative composition of the archaeozoological record

In accordance with the usual picture of historic periods in the Carpathian Basin, cattle was the most important livestock in the Late Neolithic settlement at Pusztataskony (815 pcs, 70.07%). This proportion is certainly even higher as a large number of long and flat bone fragments of non-specified large ungulates are probably also to be associated with this species. The fragmented state of the archaeozoological record deprives us of the bulk of otherwise accessible information on the size of these animals. Based on the average local withers height (125.9 cm) obtained by the few measurable metapodiums, the local stock fits the average range of the period, but above the mean, marking the presence of larger animals. Based on ossification and teeth abrasion patterns, about 79% of the animals was butchered at an adult age, about four times more than young ones (21%). This butchery pattern suggests the maintenance of livestock and secondary utilization of the animals (e.g. for milk or as draft animal).

The number of small ruminants (Ovis/Capra) and pig, acting as shift species is minimal compared to cattle. Little was learned on their sizes: the average withers height of ewes is 59.6 cm, while of pigs the smaller variants were preferred. The low count of pigs may be explained by the butchery pattern: almost half of these animals was slaughtered before reaching adulthood. As a contrast, small ruminants were usually butchered at an adult age, suggesting (again) their secondary utilization. There were most certainly differences between the ways of utilization of goats and ewes, but the description of these would require a precise determination of species in each case, which is both cumbersome and ineffective. A common exploitation point explaining elevated ages at death could have been (beside the maintenance of the livestock) the consumption of milk.

The occurrence of horse bones is relatively high (18 pcs) compared to the period's average. As there were no domesticated horses in the Carpathian Basin during the Late Neolithic, their appearance in the assemblages is either due to later disturbance, or they represent a wild variant. The fragmentary state of the bones and the lack of references make the clarification of this question currently impossible.

The constitution of the bone assemblage reveals a subsistence pattern based heavily on cattle, but where daily meat requirements were obtained from both domesticated and wild species: the second biggest group represented in the archaeozoological material was that of wild mammals. Their quantity (944 pcs, 31.42%) gains up to that of domesticated mammals. Red deer (457 pcs) and wild boar (389 pcs) are the most important wild species hunted for meat, while roe deer (74 pcs) and wild boar (8 pcs) only represented a variety in the menu. A few bones of common beaver (2 pcs), brown hare (7 pcs), fox (3 pcs), and bear (4 pcs) mark their occasional hunting. An estimation of size was only possible in the case of wild boars: the average withers height of the hunted animals is 91.26 cm, suggesting the presence of a population with large animals during the Late Neolithic. Size, ossification and tooth abrasion patterns congruently suggest adults to be the targets of hunt. A few bird and fish bones, as well as large quantities of shell mark the availability of aquatic resources.

Summary of the archaeozoological analyses

The meat consumption pattern at the Late Neolithic settlement at Pusztataskony, as reflected by the quantity and composition of the mammal remains in the archaeozoological assemblage, corresponds to coeval regional trends (i.e. Polgár-Csőszhalom). The record shows evidence of

exploitation of diverse animal resources, and the increased importance and utilization of wild and aquatic reserves.

3.5 Summary and interpretation (Katalin Sebők)

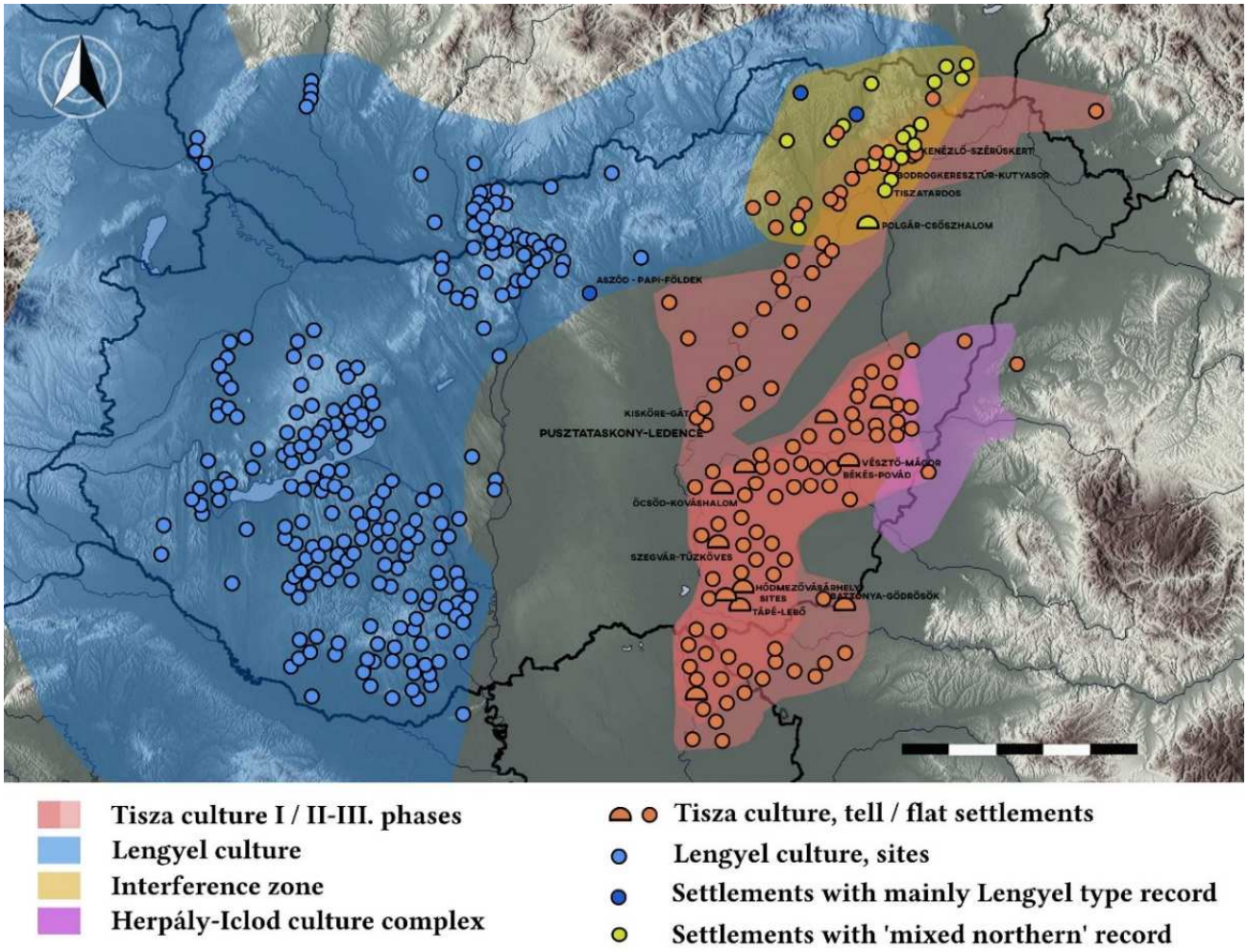

Fig. 5. Cultural map of the Late Neolithic in the Carpathian Basin.

The results of diverse investigations outline a community that has settled in the Middle Tisza Region around 4800 BC, and lived there for about two centuries. The founders were people of the Tisza culture, reaching the area as part of a northward expansion. The community seems to have maintained active connections with currently unidentified settlements of mixed cultural character in the Northern Mountain Range as reflected by the lithic record, the local ceramic style, as well as by some customs and practices. The nature of this connection may only be guessed, but the appearance of individuals originating in that area raises the possibility of economic migration, occasional symbolic marriages as well as the formation of intermarriage circles. This connection was most certainly lasting: there is a gap of approximately 3–5 generations between the oldest burial, 1-718 with a Lengyel type funerary vessel set (where the foreign custom appears in both the ceramic record and the genetic structure of the individual) and the probably northern outlier (1-365) identified by the Sr isotope analysis. The unit of interaction was the local community from

Pusztataskony's side, and probably settlement-level on the other side as well. The intermixing effect of cultural interaction seems also to be local, as there are no Lengyel elements in the material of the coeval neighbour, Kisköre-Gát. This distinction underlines the importance of community- or settlement-level organization and identity as an agent of Neolithic communication, emphasized earlier by several researchers.

Little is known about the precise relations of Pusztataskony and Kisköre: the distribution of available Sr data of humans, as well as some elements of the ceramic record suggest a closer connection between the two.

An additional implication of the situation is the appearance of a secondary production point of Lengyel type vessels in the distribution area of the Tisza culture, along one of the main communication and exchange routes, as it is reflected by e.g. the lithic record and Spondylus distribution, connecting northern and southern regions of Eastern Hungary. As Lengyel type vessels were most probably produced at several points along this route (Bükk area, Pusztataskony), the interpretation of 'Lengyel imports' in coeval materials of sites in Eastern Hungary seems to require reevaluation.

The joint evaluaton of results of diverse fields also made it possible for us to learn more about settlement organization and subsistence. A joint mapping of the distribution of the burials, together with the genetic relations of the individuals revealed the presence of a connection between locality and maternal lineage, as biological relatives are in all three cases interred in the same house cluster. The seeming gap in the life of the settlement, suggested by radiocarbon data, is perhaps due to an overexploitation of environmental resources nearby: the C/N analysis, the archaeozoological and toolkit (bone, lithic) analyses, together with the lack of phytolits of cultivated plants in the very limited archaeobotanical record all suggest a subsistence pattern heavily reliant on meat and wild reserves.

The cultural admixing is not reflected by the morphological characteristics of the community members, probably due to the already taxonomically mixed character of the local population, the morphologically very similar character of the Lengyel population, and the fact that the outliers arrived from an area where the lineages from communities of the Tisza and Lengyel cultures are already present admixed. It must be noted, however, that the examined individuals — the ones interred in graves around house clusters in the settlement — seem to represent a distinguished group of the local society, as underlined by the occasional abundance of wealth and prestige markers in their burials regardless of age, as well as by the overall lack of malnutrition (but not deficiency) and stress markers due to heavy work on their bodies, both general characteristics of coeval populations in the Great Hungarian Plain.

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Csippán P. 2019: *Nálatok laknak-e állatok? Szarvasmarha-állományok a késő neolitikumban — Do you have animals at home? Cattle populations in the Late Neolithic.* ΜΩΜΟΣ XI — Őskoros Kutatók Összejövetele: Környezet és ember. 10–12 April 2019, Aquincum Museum of the Budapest History Museum, Budapest. Section: People and environment.

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