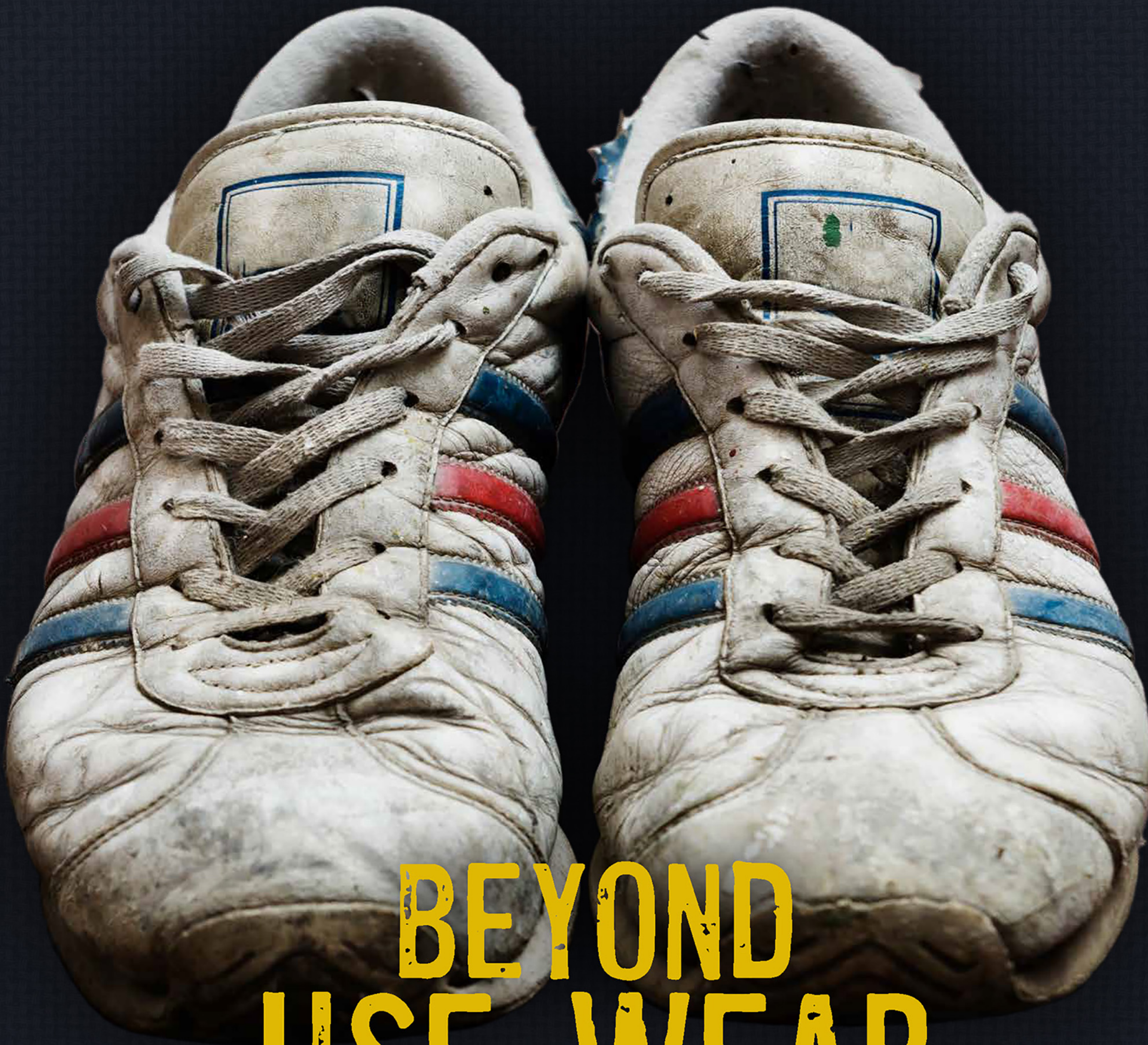

# BEYOND USE-WEAR TRACES

GOING FROM TOOLS TO PEOPLE BY MEANS OF ARCHAEOLOGICAL WEAR AND RESIDUE ANALYSES

SYLVIE BEYRIES, CAROLINE HAMON
& YOLAINE MAIGROT (EDS)

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# The curious case of House 54 from Lepenski Vir (Serbia)

## Chipped stone perspective

Anđa Petrović and Stella Nunziante-Cesaro

**Abstract**

The subject of this study is revealing the activities carried out in one of the trapezoidal houses of the Lepenski Vir site from the Mesolithic and Neolithic periods, situated in the Iron Gates region in eastern Serbia. Dominating with their specific form, these buildings are shifting the focus from a utilitarian perspective to the use of space. One of the buildings that will serve as an example for testing and complementing the former interpretations is house 54, previously argued to be the largest and most important object of the Lepenski Vir I phase. Today, we are able to contribute fresh data on processes that took place inside this particular building by analysing different archaeological artefacts found on the house floor.

New understanding of the use of space in this specific micro-study is gained on the basis of functional analysis of chipped stone artefacts found in house 54, together with ground stone artefacts, bones, and ceramics. Both ritual and utilitarian context indications were present during the occupation of Lepenski Vir houses. This study will try to show the character of the above-mentioned objects through the results of use-wear and Fourier Transform InfraRed (FTIR) analyses, combining them with dates and the house interior.

*Keywords: Lepenski Vir, Mesolithic, Early Neolithic, chipped stone artefacts, use-wear analysis, FTIR analysis*

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## Introduction

The data represented in this paper are part of wider doctoral thesis[1] research project that aims to rethink some of the previously gathered knowledge about communities and their everyday activities in the Mesolithic and Repalce Neolithic site Lepenski by Neolithic sites in the Iron Gates, by performing use-wear analysis on chipped stone artefacts.

Even though the excavations of this area were finished more than 50 years ago, this site, as well as others in the region of Iron Gates, raise challenging issues and researchers are trying to answer numerous questions and reveal new data, combining them with previously published results and following stratigraphy sequences supported by new absolute dates.

The specific charm and character of this part of South-East Europe lie in its environmental aspect. For decades, a closed econiche like Iron Gates enabled specialists to explore the transition to a sedentary life, with an exceptional record of human occupation during the Late Glacial and Early Holocene. It may be assumed, based on the newest studies (Borić and Miracle 2004; Mathieson *et al.* 2018), that the main reason for this is the encounters between migrants and the local population, represented by Iron Gates communities that stayed for longer periods of time in one location and therefore are not the stereotypical hunter-gatherers who constantly move. For their part, migrants were slowly progressing and by entering the area of Iron Gates they introduced cultivated cereals and cattle, making the situation inside the region paradoxical. Or maybe creating an easier path for the acceptance of new elements and traditions, keeping in mind the long occupation of the landscape.

The primary goal of the wider study is to systematically approach the main activities inside the available contexts in order to define work operations that show inclinations to the indigenous and traditional way of life, such as fish or wildlife processing, or towards incorporating new trends or already fully cultivated cereals and animals. House 54 is just one of the entities contributing to solving this problem. The data presented here is a small portion of the larger assemblage (around 450 artefacts) that has been analysed from Lepenski Vir site. Preliminary analysis showed various activities (such as butchering and working of hide, wood, tuber, bone, and antler) that took part in the Iron Gates area together with indications for specialization within the territory (Petrović *et al.* 2019).

1 PhD thesis entitled: *Mesolithic-Neolithic transition in Iron Gates (Serbia): human activities from a use-wear perspective*, Anđa Petrović, a doctoral candidate at Sapienza University of Rome and University of Belgrade.

## Background

Lepenski Vir was located in the eastern part of Serbia in the Iron Gates on the right bank of the Danube River (fig. 1). Excavations of the Danube Gorges began in the 1960s and continued in the 1970s (Srejović 1969). At the end of the excavations, this area was flooded for the purposes of the construction of the Đerdap hydropower plant, and the site was transferred to a nearby location. Even though the excavations ended, Lepenski Vir is still an important subject of many studies led by prominent scholars.

As mentioned, the attributes of the econiche of Iron Gates and the fact that it is a naturally closed area, gave the researchers of this zone an opportunity to further their understanding with specific analysis like absolute dating (Bonsall *et al.* 2004; Borić *et al.* 2004; Borić and Mirackle 2004; Borić and Dimitrijević 2007; Bonsall *et al.* 2008; Borić 2016; 2018; 2019), archaeobotanical analysis (Filipović *et al.* 2010), analysis of paleofauna (Bökönyi 1972; Dimitrijević 2000; Dimitrijević 2008; Dimitrijević *et al.* 2016; Živaljević *et al.* 2017), human remains analysis (Borić and Stefanović 2004; Roksandić 2012; Radović and Stefanović 2015; Borić 2016), techno-typological analysis of ground stone (Radovanović 1996; Antonović 2006) and chipped stone artefacts (Kozlowski and Kozlowski 1984; Radovanović 1996; Mihailović 2004; Šarić 2014; Mitrović 2018). As can be seen, there is a lot of interest in the Iron Gates region even nowadays which testifies how important the area and Lepenski Vir is but also it raises many questions regarding the hunter-gatherer and fisherman communities that inhabited the banks of the Danube in Prehistory.

The Lepenski Vir settlement was inhabited for a long period of time and different phases of occupation are recorded. New revised stratigraphy and chronology are trying to reconstruct these diverse phases in the development of the settlement, together with the question of (dis)continuity and the absence of any Late Mesolithic dates or occupation of the site overall (Borić 2016, 20-21; Borić *et al.* 2018, 11; Borić 2019).

The estimated time span for the beginning of the Early-Middle Mesolithic is 10360-6840 cal BC, the interval of the Mesolithic/Neolithic transition (LV I-II) is 6160-5930 cal BC, and the period from 5970-5490 cal BC is associated with the Early Neolithic at Lepenski Vir (Borić 2018, tab. 1), phase LV III (according to Srejović 1969).

Since the beginning of the research, the phase of settlement defined by the trapezoidal houses has been characterized by the controversy of dating the settlement. The discussion has focussed on the connection between the aforementioned types of buildings, which D. Srejović considered to belong to the Mesolithic period, and Early Neolithic pottery on the floor of trapezoidal house 54, the largest and best-preserved house of Lepenski Vir (Garašanin and Radovanović 2001). First excavator

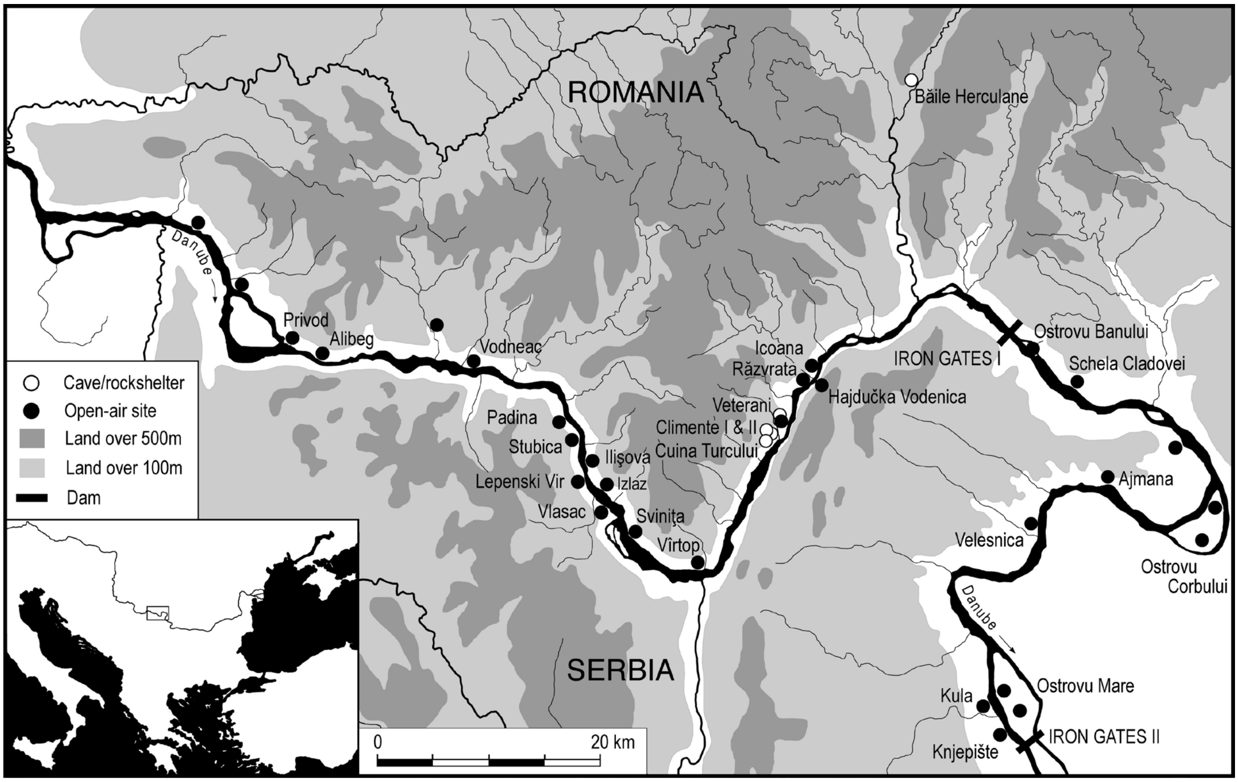


**Figure 1:** Map of the Iron Gates region (after Bonsall *et al.* 2008. Courtesy of the authors).

D. Srejović considered the found pottery on the floors of trapezoidal houses to be chronologically later intrusions, explaining the neolithization processes as a gradual transition to Neolithic, which is opposed to the model of emergence of Neolithic in the region due to the arrival of new populations who brought new traditions and technologies creating a fusion of Mesolithic and Neolithic elements (Garašanin 1987). It is very important to mention a similar situation at the nearby site Padina (Jovanović 1987), where Early Neolithic pottery ceramics are associated with trapezoidal buildings – objects of the same shape as those at Lepenski Vir, with a difference regarding the Padina settlement capacity, which is smaller.

Regarding house 54, various absolute dates available for this context were published (Quitta 1975; Radovanović 1996, 363; Borić 1999, 49, fig. 7; Borić and Dimitrijević 2007, 21). Dates that are taken as a reference for the *terminus post quem* for the construction of the building are 6393-6116 cal BC (Borić 2019, 21).

On the floor of the house 54, among the chipped stone artefacts that will be discussed in depth in this article, other artefacts were found as well: one globular vessel (Garašanin and Radovanović 2001) attributed to the Early Neolithic Starčevo culture, a dog's lower carnassial tooth, fish remains (mostly teeth), molluscs (Dimitrijević 2008), a mallet damaged by fire, a broken and reused palette, and an adze (Antonović 2006). This rather interesting background reflects the diverse activities that were happening in the house 54, in its last phase of occupation.

## Archaeological Material

On the floor of the house 54, eighteen chipped stone tools were found in total. Seven chipped stone tools were excluded from the analysis on the basis of poor preservation of the tools. The remaining pieces were analysed (fig. 2, tab. 1), both by a low- and high-power approach. These artefacts are labelled as material coming from Layer 1, based on the division made by D. Srejović, and adopted by Polish authors (Kozlowski and Kozlowski 1984). The assemblage represents the final chapter of the house 54 and techno-typologically observed, it is of a mixed character, consisting both of Mesolithic (trapeze), Neolithic (large standardized blade) elements and also chronologically insensitive components, such as flakes, cortical and bipolar flakes. Five types of blanks are present in the assemblage of the house 54: short blade, blade, flake, narrow blade and burin flake (Mitrović 2018, 242).

It is important to mention that some observations were made with the naked eye considering the preservation and taphonomy of the tools. One artefact (tab. 1, sample 1) was affected by water infiltration and concretions visible on the flint surface.

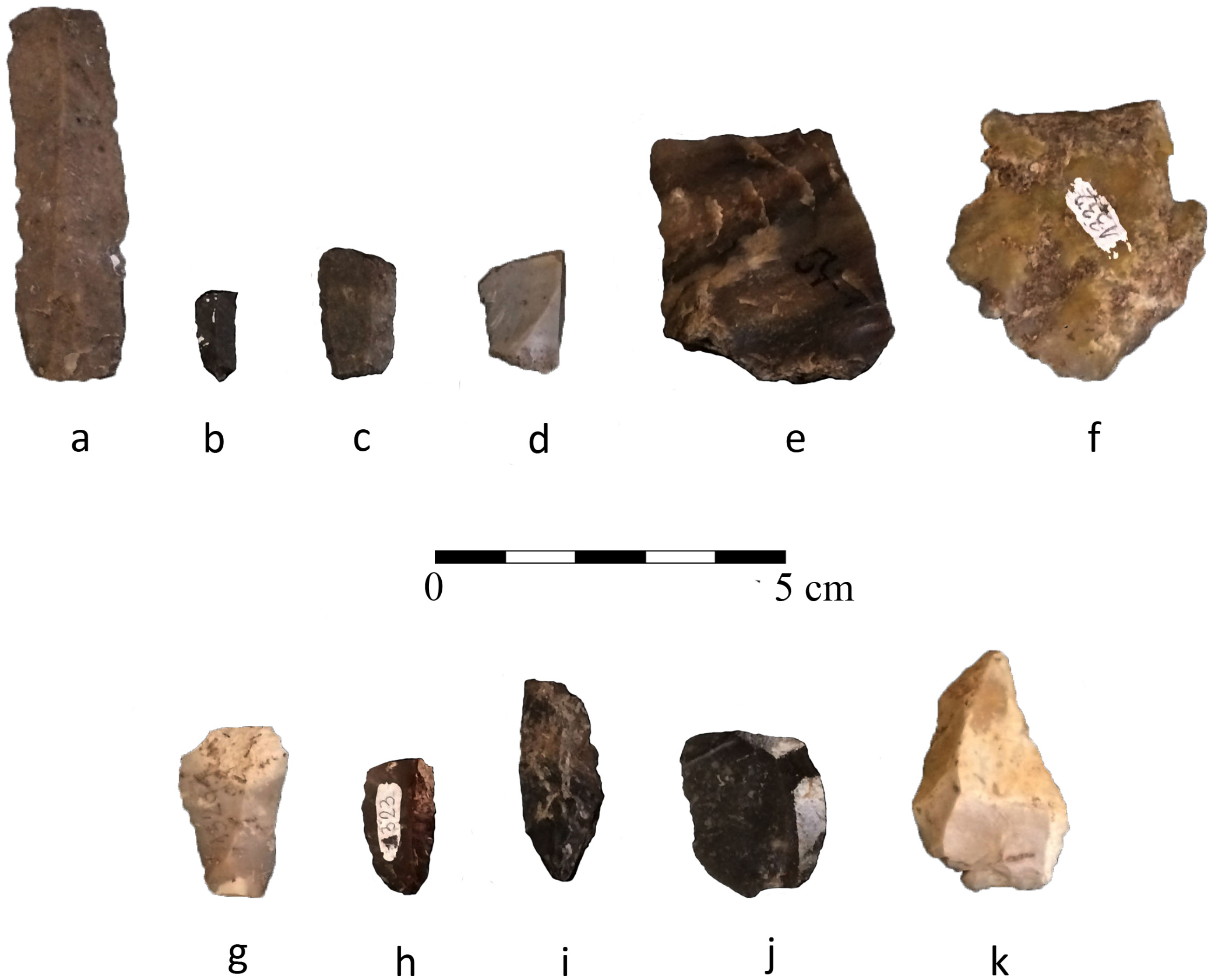


**Figure 2:** Observed chipped stone artefacts from house 54: a- Sample 1, blade, b- Sample 2, bladelet, c- Sample 3, trapeze, d- Sample 4, flake, e- Sample 5, bipolar cortical flake, f- Sample 6, cortical flake, g- Sample 7, flake, h- Sample 8, fragment of a blade, i- Sample 9, waste, j- Sample 10, bipolar flake, k- Sample 11, retouched flake.

Patina was found on three samples (tab. 1, samples 5, 6 and 11) divided into two types: glossy and dendritic patina (Glauberman and Thorson 2012, 24). Two artefacts (samples 5,6) on dorsal surfaces have a glossy patina, represented by a shiny reflective surface that covered, in both cases, the majority of the exterior (95%). Dendritic patina is noted as asymmetrical patches of white colour on sample 11.

## Methodology

The chipped stone tools were analysed with the low-magnification and the high-power approach. The analyses were completed at the Laboratory of Technological and Functional Analyses of Prehistoric Artefacts (LTFAPA) at the Sapienza University of Rome, using a Nikon SMZ -U Stereomicroscope with reflected light (x0.5 objective, x10 oculars, range of magnifications from x0.75 to x7.5) together with Toupview camera Software, a Nikon Eclipse ME 600 Metallographic microscope (x5, x10, x20, x50 objectives, x10 oculars) with transmitted and reflected light equipped with Differential Interference Contrast (DIC), and a Hirox RH 2000 Digital Microscope.

All the artefacts were cleaned, with a standard washing procedure, in an Ultrasonic tank with demineralized water and Derquim® soap for 10-15 minutes and then rewashed in demineralized water for 5-10 minutes.

The Fourier Transform InfraRed (FTIR) spectra of the stone tools were collected with a Bruker Optic Alpha-R portable interferometer with an external reflectance head covering a circular area of about 5 mm in diameter. The analysis does not require preliminary treatment of the samples. The investigated spectral range was 7500-375 $cm^{-1}$ with a resolution of 4 $cm^{-1}$ cumulating 250 scans or more.

| Sample number | Signature | Context house 54 | Type Category | Contact material (macro) | Contact material (micro) | Activity | Hafting/ prehension traces | PDSM |
|---|---|---|---|---|---|---|---|---|
| 1 | LV 1301 | house floor | blade | hard animal materia | bone | cutting | H | trampling, glossy appearance |
| 2 | LV 1304 | house floor | bladelet | soft material | butchering (only meat) | cutting, incision, engraving | P | medium glossy appearance |
| 3 | LV 1303 | house floor | trapeze | medium hard material | bone | cutting | | soil sheen |
| 4 | LV 1302 | house floor | flake | used | ? | ? | H | glossy appearance |
| 5 | LV 1014 | in the ash place | bipolar cortical flake | medium hard material | fresh hide / butchering | scraping + cutting | P | soil sheen |
| 6 | LV 1332 | house floor | cortical flake | used | animal based material | ? | | soil sheen + abrasion, roots |
| 7 | LV 1328 | house floor | flake | medium hard material | vegetal based material | cutting | | soil sheen |
| 8 | LV 1323 | house floor | fragment of blade | medium hard material | ? | cutting | | burned, glossy appearance |
| 9 | LV 1326 | house floor | waste | not used | not used | | | |
| 10 | LV 1004 | house floor | bipolar flake | medium hard material | wood | general working | P | glossy appearance |
| *11* | LV 1002 | house floor | retouched flake | medium material | dry hide | scraping | | light glossy appearance, patinated |

**Table 1:** List of samples and interpretations of use-wear analysis.

The following figures, however, show only the spectral range where absorption bands were observed. All points of the tools were examined in the same experimental conditions.

## Results of use-wear analysis

The general results showed a variety of used contact materials from soft to hard. Noted activities are cutting, scraping and engraving, with longitudinal motion as the most common among the tools. Atypical artefacts were utilized to their maximum for different activities. For example, the lateral side of a bladelet (tab. 1, sample 2) was used for cutting, but the distal end was used for engraving using the corner of the tool. Hafting and prehension zones were noted on five out of eleven samples in the shapes of patches.

Alterations found on the artefacts limited the study because some of the artefacts were heavily damaged by glossy appearance (fig. 3e-f) and modern roots (fig. 3a-d). In both cases, the alterations covered the used surface. Unfortunately, the distinction between micro-traces on the working edges, confirmed by macro-observations, and glossy appearance was not possible, since the alteration covered the surface completely. The best example is a possible insert (tab. 1, sample 4, fig. 3e). Another problem regarding the roots is that they damage the flint surface both mechanically and chemically as seen on samples 11, 3, 2 and 10 (fig. 3a-d). These are the most common alterations that affected the Lepenski Vir sample overall and are not only connected with the situation from house 54.

Macro-observations obtained by stereomicroscope as already stated showed a diversity of used materials. Bearing in mind the alterations that affected the surface and micro-observations were very limited, in some cases, the interpretation is based mostly on the macro-traces since they were not altered by post-depositional surface modifications (PDSM). Some of the artefacts' scars that could indicate the worked material were very poorly preserved and the only possibility was to state that tool was used, but not for which activity (tab. 1, sample 4).

Contact with hard materials was found on two pieces (tab. 1, sample 1 and 3), including the large standardized blade (fig. 4a-b). Besides the interpretation of work on hard animal material, more specifically bone, the large blade from the assemblage is unique regarding the working areas and zones. On both edges of the blade, there are two zones of activity and on the right side, it is very visible that zone 2 (medial and proximal part of the blade) was used before the activity on the zone 1 (distal end). Edge damage is described by large snap and step scars localized both on the dorsal and ventral surfaces with a close regular distribution creating an edge rounding that is very pronounced. Smooth polish that remained in some of the areas indicates bone working, based on the flat topography with the presence of striae. The burin-like stroke on the proximal end of the right edge of the blade partially removed the use-wear traces.

The different zones of the artefact were used in a different time period. They were used, then discarded and then reused again, with a very straightforward argument for the chronology of the usage of edge areas. Another indicator for extensive use of the blade is hafting patches on the left side of the blade that are vaguely diagnostic since they formed on a layer of use, devastated by glossy appearance. This is important to note and underline since it is shifting our focus to the efficiency of the tool and to the fact that they were changing the used edges whenever needed and in different chronological periods. Another piece that worked on bone material is a trapeze made on a blade (tab. 1, sample 3). Macro-scars with half-moon and feather terminations with a very pronounced edge rounding and oblique bidirectional direction of the scars imply cutting as the performed motion on a medium to medium-hard material. Micro-traces are characterized by the rough to smooth texture, flat topography on higher parts, and domed to granular topography on lower parts together with half-tight linkage indicating bone working.

Use on medium and soft-to-medium materials was most common among the tools from house 54, while contact activity with soft materials was found on one piece. Macro-traces of soft material are described as a small step with close regular distribution and oblique unidirectional motion, and the polish is defined by granular topography

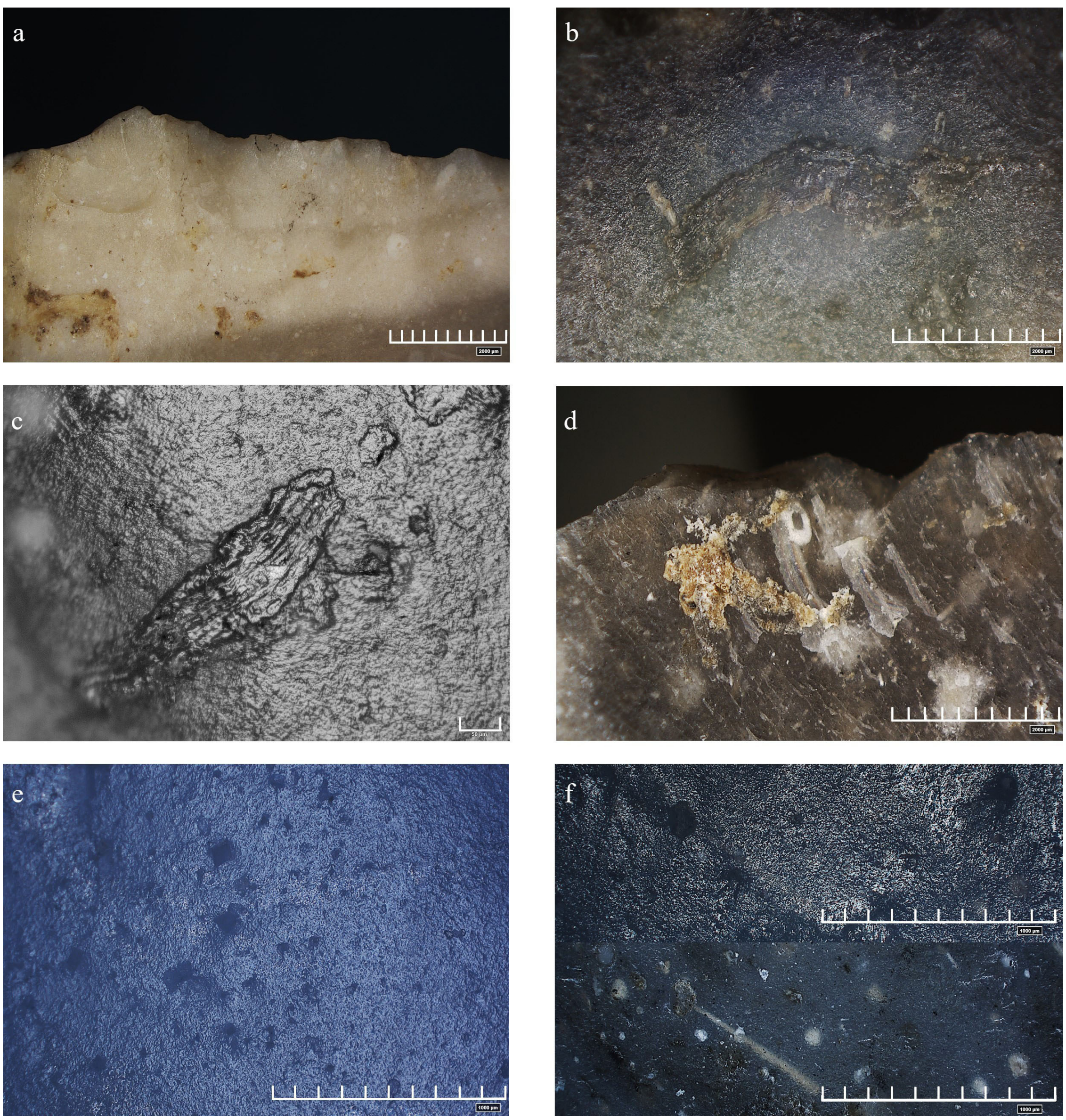


**Figure 3:** Post-depositional alterations of the sample tools. Root alterations a- sample 11, b- sample 3, c- sample 2, d- sample 10 and glossy appearance, e- sample 4, f- sample 2.

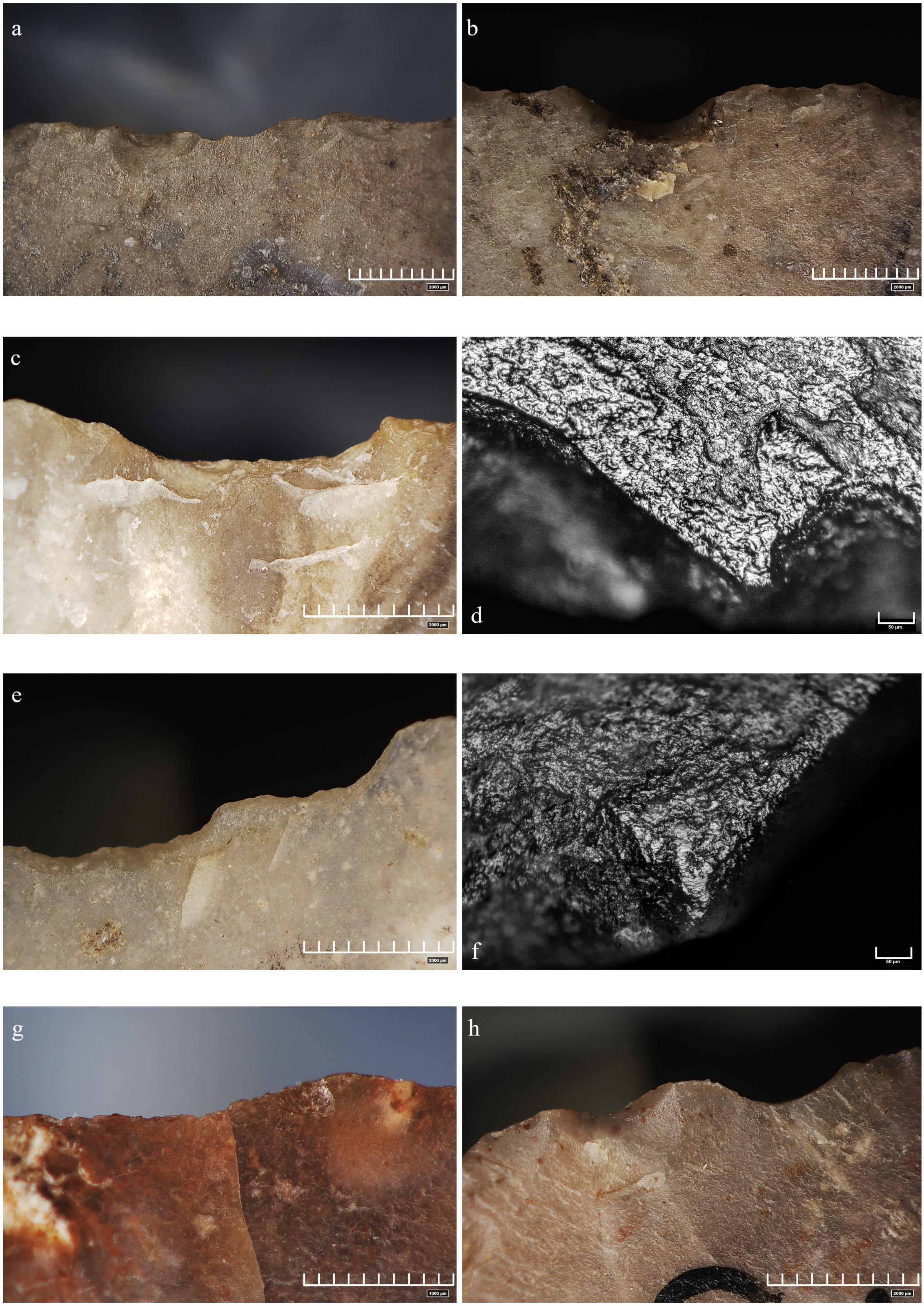


**Figure 4** (next page): Macro- and micro-use-wear traces on artefacts from house 54, a, b- Sample 1, two zones of activity, c, d- Sample 5, use on fresh hide/butchering, e, f- Sample 7, use on vegetal-based material, g, h- Sample 8, macro-traces preserved on the burned artefact.

and half-tight to tight linkage with smooth texture, indicating contact with meat and butchering activity.

The micro-traces of preserved polish showed that majority of the sample were used for working on animal materials and one artefact was used for processing of wood (tab. 1, sample 10) and one for unidentified vegetal-based material (tab. 1, sample 7). The remains of micropolish indicate vegetal-based material as a general category (fig. 4e-f), and unfortunately, it is not possible to distinguish the specific plant based on preserved traces. Edge rounding is present in the form of a mixture of small snap, step and half-moon scars with oblique bidirectional motion of cutting in both the cases of vegetal material. In the case of the bipolar flake (tab. 1, sample 10) the polish is described by a smooth texture, predominantly domed topography with some flat areas together with tight linkage and pronounced micro rounding indicating wood working.

Among the presence of hard animal materials like bone on two above-mentioned artefacts (tab. 1, sample 1 and 3, fig. 4a-b), the tools were used also on animal materials of medium hardness. Use of the tool for the processing of fresh hide (tab. 1 sample 5, fig. 4c-d) was observed together with the presence of both cutting and scraping motions. Macro-traces are represented by snap, half-moon transitional motions and polish is located on the edge. Characteristics of the polish are described as rough with flat and domed topography and half-tight linkage. Another artefact was identified as used on dry hide (tab. 1, sample 11). Edge damage, in this case, is very similar to that present on the tool that was used for fresh hide (half-moon scars with a transitional direction as the most pronounced one) with a difference in the polish characterization. In this specific case, the texture is rough which is connected with use on dry skin.

Sample 8 (tab. 1) was burned, which was noted based on the cracked look of the surface, change of colour (fig. 4g-h), and glossy appearance that completely covered the micropolish. The exact same cracking and colour change were also noted in primary phases of thermal stress experimentations. Based on the fact that the artefact did not become matt or white and there were no breakages that fragmented the tool, we can conclude that the artefact was not in direct fire, but that it was near the hearth exposed to lower temperatures. What is important is that the tool was used after the thermal stress, but unfortunately, because of the glossy appearance that covered the surface, the exact worked material cannot be identified except that it can be interpreted as use on a medium-hard material based on the small feather, half-moon and hinged scars that are bidirectionally oblique.

## Results of FTIR Analysis

The spectroscopic analysis was performed in order to ascertain the presence of micro residues on the flint items and to identify them. The spectroscopic analysis cannot define the origin of the residues without suggestions from use-wear, and the FTIR analysis in the case of the Lepenski Vir assemblage is representing a complementary approach applied in order to possibly support the identification of the used materials.

In all spectra (fig. 5) a very intense absorption band is observed at 1157 $cm^{-1}$ and two medium intensity bands at 798 and 469 $cm^{-1}$ are attributed to Si-O stretching and O-Si-O and\or O-Si-Al bending modes, respectively, since cryptocrystalline silica is the principal constituent of the analysed items (Madejová 2003; Vaculíková and Plevová 2005).

All peaks show an up-down reversal due to the reststrahlen effect (Madejová 2003, Vaculíková and Plevová 2005).

Doublets at 1575\ 1536 and 2915 \2848 $cm^{-1}$ are clearly observed in all spectra, with the exception of that of sample 10 (fig. 5f) where both features are hardly visible. They are respectively attributable to the C-O and C-H stretching modes of fatty acids salts (palmitate and/or stearate) (Hénichart *et al.* 1982; Gönen *et al.* 2010).

The mentioned compounds are present both in vegetal (Raíces *et al.* 2003; Woodfield *et al.* 2017), and animal tissues. In the latter case, their presence is due to the transformation of animal body fat into a greasy lipid mixture called adipocere (Stuart *et al.* 2000). Their survival on archaeological artefacts is mainly due to the insolubility of fatty acids and their salts in water and their waxy consistency which allow them to penetrate the micro holes of the microcrystalline flint. The mentioned doublets 1575\ 1536 and 2915 \2848 $cm^{-1}$ can be quite intense (sample 1, 2, 3, 4 and 5) in the case of animal origin material, but normally they are very weak in the case of material of vegetal origin, as in the case of sample 10, whose trace analysis suggests contact with wood.

It is very important to underline that the intensity of the doublets varies in the analysed points of each sample. In the case of contamination, the bands would show a constant intensity. Therefore, detected residues are not due to the contamination of the sediment. The fact that the archaeological excavations were finished more than 50 years ago prevents us from doing a sediment analysis for comparative purposes. Contamination through the sediment would only be possible if a large number of dead animals were found in the same context on the top of the analysed tools, which did not happen in our case, keeping in mind the reuse of the house in different periods.

Spectra of samples 1 – 4 (fig. 5a-d) show a broad band approximately having maximal intensity peaks at about 1460 and 1420 $cm^{-1}$ and a weak one at 877 $cm^{-1}$. In few cases, bands in the 1400 $cm^{-1}$ region appear overlapped. These features suggest the presence of micritic limestone, a carbonated material dominated by fine-grained calcite ($CaCO_3$) (Poduska *et al.* 2012).

## Discussion

The sample of artefacts analysed comes from the house floor marked in the first interpretation as Lepenski Vir Ib (Srejović 1969) or transitional/Early Neolithic phase (I-II) (Borić and Dimitrijević 2007, 51), when the house was centrally positioned and considered as the core of the settlement. Chipped stone artefacts were extensively used for cutting, scraping and engraving on a variety of materials from soft, such as butchering of meat, to hard materials, such as bone.

An important indicator of everyday life in this house is the exploitation of the tools to their maximum. Most of the artefacts were used for a long period of time, and some of the tools were used, then discarded and then reused again which contributes to a picture of the recycling behaviour of the Prehistoric communities in the Iron Gates region. Reuse of the tools attests to the use of these artefacts during

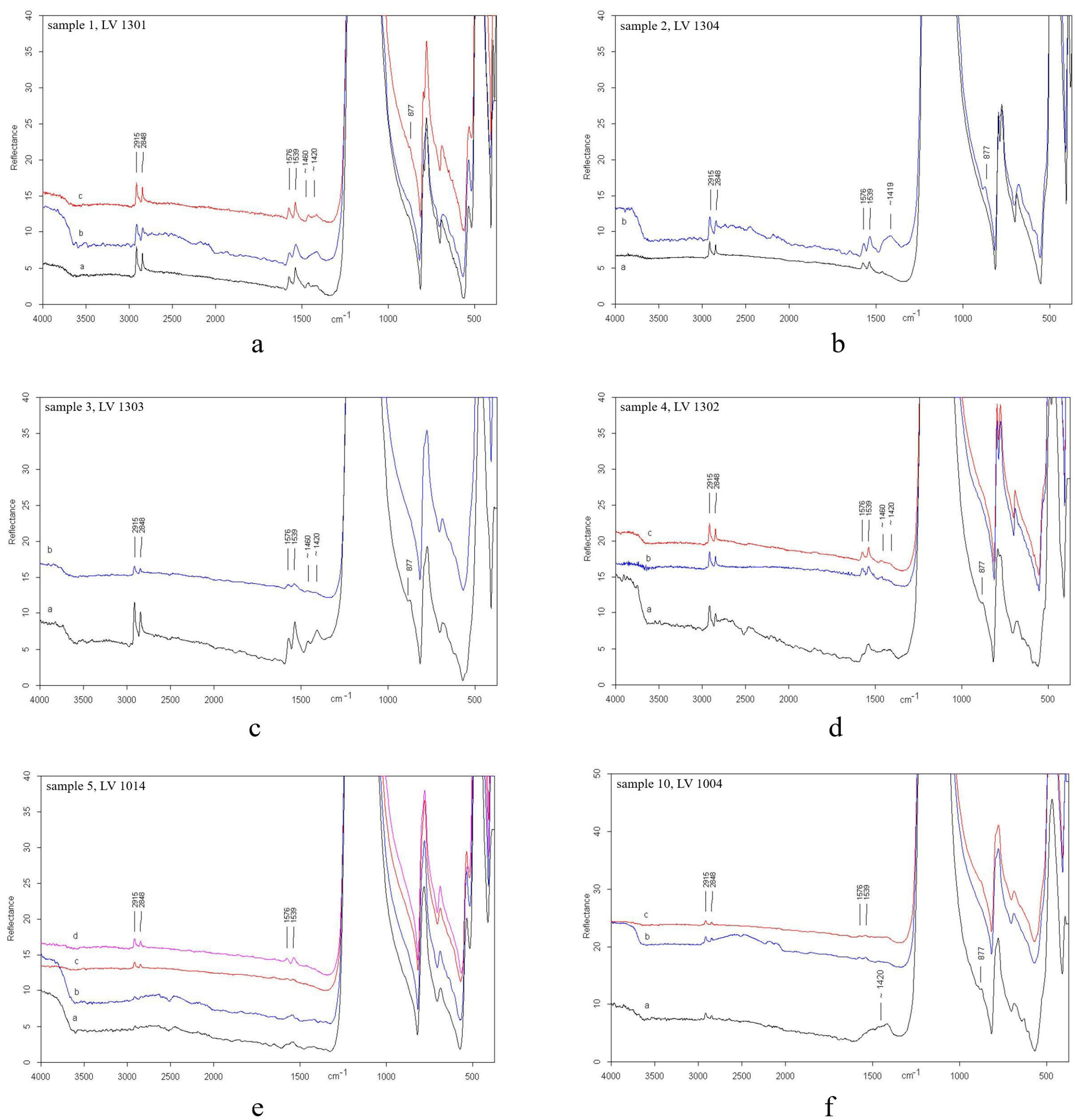


**Figure 5:** Micro-FTIR spectra of a- Sample 1, b- Sample 2, c- Sample 3, d- Sample 4, e- Sample 5 and f- Sample 10.

different phases of house 54, but these hypotheses could only be tested on the Mesolithic elements. The existence of *older* and *younger* working zones on Neolithic blades can also be interpreted as reuse but with the limitation of not being able to determine the time span. All these activities do not deny the importance of the house but could indicate a number of activities which may be secondary to everyday processes, without neglecting the possibility that these activities also had a certain sacred character, bearing in mind the position of the house and the original interpretation.

It is very crucial to single out a secondary product like the bladelet, that was used for butchering and processing very small portions of hide. This indicates a strong need for the use of all the immediately available tools. The usage of tools, smaller in dimension, for complex activities, is also connected to the recycling behaviour stated above. This is based on the fact that a lot of tools were reused and exploited to their maximum. Layers of prehension were observed on some of the activity areas, indicating the shift of the working zone from one to another edge when the used margin became inefficient.

It is necessary to underline that the chipped stone tools were found together with other fragmented and reused objects, creating a picture of the universal habit of recycling that can be observed also in a broken and subsequently used grinding stone palette found on the house floor.

Infrared spectroscopic measurements of samples from house 54 revealed the presence of residues of fatty acid salts, supporting the evidence from use-wear analysis for items that worked animal-based materials whose fat tissues have transformed into adipocere.

A very small amount of fatty acid salts, however, can also be observed on the tools that worked some kind of plants, as in the case of sample 10 (fig. 5f) whose use-wear traces suggest contact with vegetal materials. Therefore, it is possible that the tool was used for plants rich in lipids but it cannot be excluded that it worked both animal and vegetable tissues and that previous traces have been deleted by alterations. Modifications, like a glossy appearance, in our case, can eliminate the softer traces, like animal tissues.

Regarding the artefacts which according to use-wear analysis worked hard animal materials (bones), spectroscopic analysis showed the presence of adipocere residues, while residues of the mineral component of bones were never observed. They were probably too scarce to be detected or were removed by alterations to the item's surface.

## Conclusion

The most important conclusion is that based on very little *mobilier* and chipped stone artefacts we are not able to determine the exact purpose of the house itself. But it is important to underline that the small sample indicates the complexity of the house which is apparent in the recycling of the artefacts and prolonged use. Given the central position and its dimensions and activities that took place inside of it, the utility of the house is further complicated. The observed activities could also emphasize the social dynamics of the house as a place of various contacts and regular, everyday tasks that connected the community.

The results of house 54 will be discussed with data from other houses from the settlement, but also with artefacts from the Padina and Vlasac sites to compare the regional diversity in everyday activities and site specialization. The presented results showed that even if we are looking at a small number of tools, the applied activities are quite specific and we are dealing with a wide range of worked material, and thus a variety of tasks, that were performed in house 54. So far, the stratigraphy and architecture of the buildings at Lepenski Vir are very well-known, but this is the first time we are able to have a glance at the inside routines of Iron Gates communities.

This insight provides a base and general information for further analysis but it also creates a perception of the potential to apply use-wear analysis on chipped stone tools from the Lepenski Vir site and Iron Gates area.


## Acknowledgements

We are grateful to professor Cristina Lemorini (LTFAPA, Sapienza University of Rome), professor Dušan Mihailović (University of Belgrade) for all the encouragement, patience and help, and to the Archaeological Collection (Faculty of Philosophy, University of Belgrade) for permission to analyse the artefacts from Lepenski Vir. We are thankful to MAECI – Ministry of Foreign Affairs and International Cooperation (Ministero degli Affari Esteri e della Coperazione Internazionale) for financial support of this research.


## References


Antonović, D. 2006. Stone tools from Lepenski Vir. *Cahiers des Portes de Fer, Monographies* 5, Belgrade: Institute of Archaeology.

Bökönyi, S. 1972. The vertebrate fauna, in: Srejović, D. (ed.) *Europe's first monumental sculpture: new discoveries at Lepenski Vir*. London: Thames and Hudson, 186-189.

Bonsall, C., Cook, G.T., Hedges, R.E.M., Higham, T.F.G., Pickard, C. and Radovanović, I. 2004. Radiocarbon and stable isotope evidence of dietary change from the

Mesolithic to the Middle Ages in the Iron Gates: new results from Lepenski Vir, in: Sparks, R. J. and Beavan-Athfield, N., (eds.) Proceedings of the 18th International Radiocarbon Conference. *Radiocarbon* 46/1, 293-300.

Bonsall, C., Radovanović, I., Roksandić, M., Cook, G.T., Higham, T.F.G. and Pickard, C. 2008. Dating burials and architecture at Lepenski Vir, in: Bonsall, C., Boroneanţ, V. and Radovanović, (eds.) *The Iron Gates in Prehistory: New Perspectives*. Oxford: Archaeopress, 175-204.

Borić, D., Grupe, G., Peters, J. and Mikić, Ž. 2004. Is the Mesolithic-Neolithic subsistence dichotomy real? New stable isotope evidence from the Danube Gorges. *European Journal of Archaeology* 7/3, 221-248.

Borić, D. and Miracle, P. 2004. Mesolithic and Neolithic (dis) continuities in the Danube Gorges: New AMS dates from Padina and Hajdučka Vodenica (Serbia). *Oxford Journal of Archaeology 23*/4, 341-371.

Borić, D. and Stefanović, S. 2004. Birth and death: infant burials from Vlasac and Lepenski Vir. *Antiquity* 78, 526-546.

Borić, D. and Dimitrijević, V. 2007. Apsolutna hronologija i stratigrafija Lepenskog Vira, *Starinar* 57, 9-55.

Borić, D. 2016. *Posmrtni obredi na Lepenskom Viru: obrasci pogrebne prakse. Iskopavanja Dragoslava Srejovića / Deathways at Lepenski Vir: Patterns in Mortuary Practice. Excavations of Dragoslav Srejović*, Beograd/ Belgrade: Serbian Archaeological Society.

Borić, D., Higham, T., Cristiani, E., Dimitrijević, V., Nehlich, O., Griffiths, S., Alexander, C., Mihailović, B., Filipović D., Allue, E. and Buckley, M. 2018. High-Resolution AMS Dating of Architecture, Boulder Artworks and the Transition to Farming at Lepenski Vir. *Scientific reports* 8/ 14221.

Borić, D. 2019. Lepenski Vir Chronology and Stratigraphy Revisited. *Starinar LXIX*: 9-60.

Dimitrijević, V. 2000. The Lepenski Vir fauna: bones in houses and between houses. *Documenta Praehistorica* 27, 101-117.

Dimitrijević, V. 2008. Lepenski Vir animal bones: what was left in the houses? in: Bonsall C, Boroneanţ V and Radovanović I (eds.) *The Iron Gates in prehistory*. New perspectives. Oxford: Archeopress BAR International Series 1893, 117-130.

Dimitrijević, V., Živaljević, I. and Stefanović, S. 2016. Becoming sedentary? The seasonality of food resource exploitation in the Mesolithic-Neolithic Danube Gorges. *Documenta Praehistorica* 43, 103-122.

Filipović, D., Allue E.A. and Borić, D. 2010. Integrated carpological and anthracological analysis of plant record from the Mesolithic site of Vlasac, Serbia. *Journal of Serbian Archaeological Society* 26, 145-161.

Garašanin, M. 1987. Remarques sur la néolithisation dans le Sud-Est européen et au Proche Orient, in: *Philia eipe. Hommage G. Mylonas,* Athens: Société archéologique de Grèce, 110-16.

Garašanin, M. and Radovanović, I. 2001. A pot in house 54 at Lepenski Vir I. *Antiquity 75*/287, 118-125.

Glauberman, P.J. and Thorson, R. M. 2012. Flint patina as an aspect of flaked stone taphonomy: A case study from the loess terrain of the Netherlands and Belgium. *Journal of Taphonomy* 10, 21-43.

Gönen, M., Öztürk, S., Balköse, D., Okur, S. and Ülkü, S. 2010. Preparation and Characterization of Calcium Stearate Powders and Films Prepared by Precipitation and Langmuir-Blodgett Techniques. *Ind. Eng. Chem. Res* 49, 1732-1736.

Hénichart, J.P., Bernier, J. L., Roman, M. and Roussel, P. 1982. Identification of calcium palmitate in gallstones by infra-red spectroscopy. *Clinica Chimica Acta* 118, 279-287. doi.org/10.1016/0009-8981(82)90014-6.

Jovanović, B. 1987. Die Architektur und Keramik die Siedlung Padina B im eiserner Tor, Jugoslawien. *Germania* 65, 1-16.

Kozlowski, J. and Kozlowski, S. 1984. Chipped stone industries from Lepenski Vir. *Preistoria Alpina* 19, 259-293.

Madejová, J. 2003 FTIR techniques in clay mineral studies. *Vib Spectrosc* 31, 1-10.

Mathieson, I., Alpaslan-Roodenberg, S., Posth, C., Szécsényi-Nagy, A., Rohland, N., Mallick, S., Olalde, L., Broomandkhoshbacht, N., Candilio F., Cheronet, O., Fernandes, D., Ferry, F., Gamarra B., González Fortes, G., Haak, W., Harney, E., Jones, E., Keating, D., Krause-Kyora, B., Kucukkalipci, I., Michel1, M., Mittnik, A., Nagele K, Novak, M., Oppenheimer, J., Patterson, N., Pfrengle, S., Sirak, K., Stewardson, K., Vai, S., Alexandrov, S., Alt, K., Andreescu, R., Antonovic, D., Ash, A., Atanassova, N., Bacvarov, K., Balázs Gusztáv, M., Bocherens, H., Bolus, M., Boroneant, A., Boyadzhiev, Y., Budnik, A., Burmaz, J., Chohadzhiev, S., Conard, N., Cottiaux, R., Čuka, M., Cupillard, C., Drucker, D., Elenski, N., Francken, M., Galabova, B., Ganetsovski, G., Gély, B., Hajdu, T., Handzhyiska, V., Harvati, K., Higham, T, Iliev, S., Jankovic, I., Karavanić, I., Kennett, D., Komšo, D., Kozak, A., Labuda, D., Lari, M., Lazar, C., Leppek, M., Leshtakov, K., Lo Vetro, D., Los, Dž., Lozanov, I., Malina, M., Martini, F., McSweeney, K., Meller, H., Menđušić, M., Mirea, P., Moiseyev, V., Petrova, V., Price, D., Simalcsik, A., Sineo, L., Šlaus, M., Slavchev, V., Stanev, P., Starović, A., Szeniczey, T., Talamo, S., Teschler-Nicola, M., Thevenet, C., Valchev, I., Valentin, F., Vasilyev, S., Veljanovska, F., Venelinova, S., Veselovskaya, E., Viola, B., Virag, C., Zaninović, J., Zauner, S., Stockhammer, P., Catalano. G., Kraus, R., Caramelli, D., Zarina, G., Gaydarska, B., Lillie, M., Nikitin, A., Potekhina, I., Papathanasiou, A., Borić, D., Bonsall, C., Krause, J., Pinhasi, R. and Reich, D. 2018. The Genomic History of Southeastern Europe. *Nature* 555, 197-203.

Mihailović, D. 2004. Chipped stone industry from horizons A and B at the site of Padina in the Iron Gates, in: *Late Foragers and Early Farmers of the Lepenski Vir – Schela Cladovei Culture in the Iron Gates Gorges*. A metamorphosis of Technologies or Acculturations (Acts of the XIVth UISPP Congress, Liege 2001). Oxford: Archeopress BAR International Series 1302, 61-68.

Mitrović, M. 2018. *Knapped stone industries in the Iron Gates Mesolithic*. PhD. Dissertation, University of Belgrade, Faculty of Philosophy, Department of Archaeology.

Petrović, A., Lemorini, C., Mihailović, D. and Nunziante-Cesaro, S. 2019. Behind the scenes. Introduction to the human activities in the Iron Gates region. Preliminary use-wear analysis of chipped stone artefacts from Lepenski Vir and Padina (Serbia), in: *12th International Symposium on Knappable Materials – Program, Abstracts and Field Guide, Magyar Nemzeti Múzeum*, Budapest, 82.

Poduska, K., M., Regev, L., Berna, F., Mintz, E., Milevski, I., Khalaily, H., Weiner, S. and Boaretto, E. 2012. Plaster characterization at the Ppnb Site of Yiftahel (Israel) including the use of 14C: implications for plaster production, preservation, and dating, in: Boaretto E., Rebollo Franco and N., R. (eds.) *Proceedings of the 6th International Radiocarbon and Archaeology Symposium,* Radiocarbon 54/3-4, 887-896.

Quitta, H. 1975. Die Radiocarbondaten und ihre historische Interpretation. in: Srejović D. (ed.) *Lepenski Vir. Eine vorgeschichtliche Geburtsstätte europäischer Kultur*, Bergisch Gladbach, 272-285.

Radović, M. and Stefanovic, S. 2015. An Osteobiography from Lepenski Vir: Paramasticatory Use of Teeth and Musculoskeletal Stress of a Woman dated to the Early Neolithic. in: Bicho, N., Detry, C. and Price, D.T. (eds.) *Muge 150th The 150th Anniversary of the Discovery of Mesolithic Shellmiddens*. Cambridge: Cambridge Scholars Publishing, 267-278.

Radovanović, I. 1996. *The Iron Gates Mesolithic*. Ann Arbor, MI: International Monographs in Prehistory.

Raíces, M., Rubén Gargantini, P., Chinchilla, D., Crespi, M., Téllez-Iñón, M., T. and Ulloa, R., M. 2003. Regulation of CDPK isoforms during tuber development. *Plant Molecular Biology* 52, 1011-1024.

Roksandić, M. 2012. Mobile and Terrestrial but Firmly Rooted on the River Banks: Biological Anthropology of Lepenski Vir and the Iron Gates Gorge Mesolithic. *Advances in Anthropology 2*/3, 117-124.

Srejović, D. 1969. *Lepenski Vir: Nova praistorijska kultura u Podunavlju*, Beograd.

Stuart, B., Forbes, S., Dent, B. and Hodgson, G. 2000. Studies of adipocere using diffuse reflectance infrared spectroscopy. *Vibrational Spectroscopy* 24, 233-242.

Šarić, J. 2014. *Artefakti od okresanog kamena u starijem i srednjem neolitu na tlu Srbije*. Belgrade: Institute of Archaeology.

Živaljević, I., Popović, D., Snoj, A. and Marić S. 2017. Ancient DNA analysis of cyprinid remains from the Mesolithic-Neolithic Danube Gorges re-veals an extirpated fish species *Rutilus frisii* (Nordmann, 1840). *Journal of Archaeological Science* 79, 1-9.

Vaculíková, L. and Plevová, E. 2005. Identification of clay minerals and micas in sedimentary rocks. *Acta Geodyn. Geomater* 2, 167-175.

Woodfield, H. K., Sturtevant, D., Borisjuk, L., Munz, E., Guschina, I., A., Chapman, K. and Harwood J. L. 2017. Spatial and Temporal Mapping of Key Lipid Species in *Brassica napus* Seeds. *Plant Physiology* 173, 1998 – 2009.

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