On the sickles from Százhalombatta-Földvár

Microwear analysis of flint sickle inserts from the bronze age tell at Százhalombatta-Földvár

Éva Halbrucker

Figure on the front page is a close-up of one of the sickle blades from Százhalombatta-Földvár examined in this research.

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Chapter 1

Introduction

Nowadays, it is natural for us to have bread and other types of grain-based foods on our table every day. However, in the past, it was hard work yet essential to get grains. For this reason, harvesting was important to past societies, just as harvesting tools was.

The history of sickles goes back to the Epipalaeolithic Period; to the beginning of plant cultivation (Unger-Hamilton 1985, 1989, 1991) (Figure 1). They can be used as an indicator for the spread of the domestication of plants and are closely related to the spread of the Neolithic Period (Goodale *et al.* 2010; Ibáñez *et al.* 2014). Sickles became important tools and in some periods of history, they had a cultural, maybe even ritual role (Baron and Kufel-Diakowska 2013; van Gijn 2014a). In the Bronze Age, with the appearance of a new material, bronze, sickles were made from metal as well, their ritual role being even more noticeable. Bronze sickles have been found mostly in bronze hoards, without use traces (Bradley 2013; Fejér 2014; McClendon 2015) (Figure 2). However, with the appearance of bronze sickles, flint sickles did not disappear. In Northern Europe, crescent-shaped sickles, and in Central and Eastern Europe, flint-inserted sickles continued to play an important role in Bronze Age

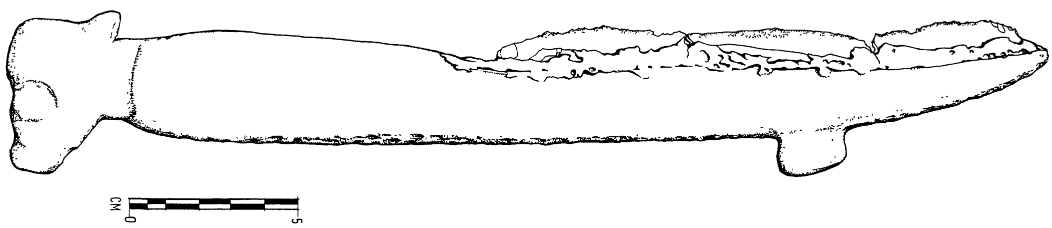


Figure 1: Natufian bone sickle from Kebara B (Unger-Hamilton 1989, 90).

agriculture (Baron and Kufel-Diakowska 2013; Gurova 2008; van Gijn 1992, 2014a) (Figure 3). In Hungary, the flint-inserted sickles were also used in daily life. However, until now, these tools, or the parts that have been most often found, sickle blades, have not yet been subject to independent study. In the few analyses carried out of Bronze Age stone tools, they are mentioned, possibly in detail described, but their use or context is not emphasised (Horváth 2004, 2005; Horváth *et al.* 2000; Priskin 2012). The current study wishes to fill this void.

The topic of the current study is a micro-wear analysis of flint sickle blades from the Late Bronze Age occupation layer of the tell settlement at Százhalombatta-Földvár, Central Hungary (Figure 4). The site itself plays an

Figure 2: Middle Bronze Age hoard from Albstadt-Pfeffingen in Baden-Württemberg, Germany (from Landesmuseum Württemberg, Photo: H. Zwietasch, CC BY-SA 2012 in McClendon 2015, 21).

Figure 3: Crescent-shaped sickles from Poland and from the Netherlands (after Baron and Kufel-Diakowska 2013, 572; van Gijn 2010, 210).

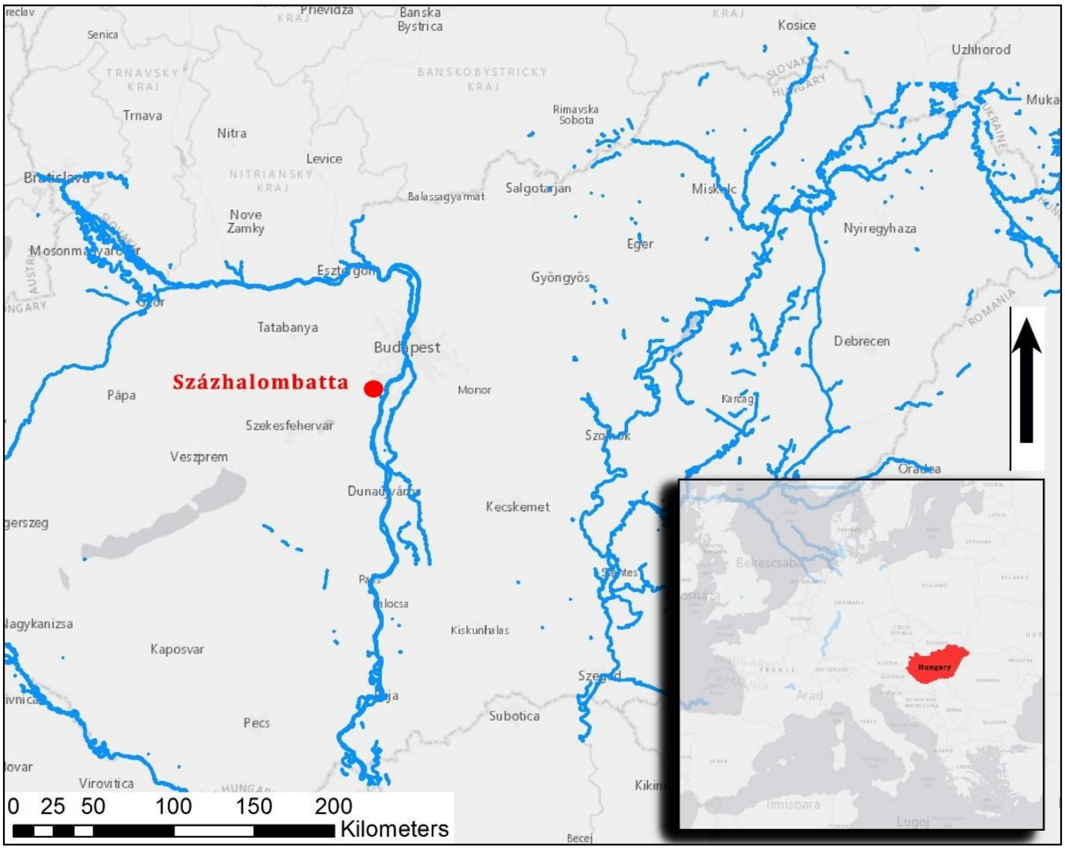


Figure 4: Map of Hungary with location of Százhalombatta (made in ArcGIS 10.2.2 (Esri 2013), base map: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community).

important role in Hungarian Bronze Age research; even more so in the research of the European Bronze Age. It is or was part of several large international projects such as *The Emergence of European Communities*, or the *Forging Identities, Mobility of Culture in Bronze Age Europe*. The project that aims to investigate the site is itself international: the University of Cambridge, the University of Southampton and Leiden University are all partners in the *Százhalombatta Archaeological Expedition* (SAX). Another international project which is part of the SAX Project is investigating the range of settlement forms in the hinterland of Százhalombatta and called the *Benta Valley Project* (Figure 5). The tell settlement at Százhalombatta-Földvár plays an important

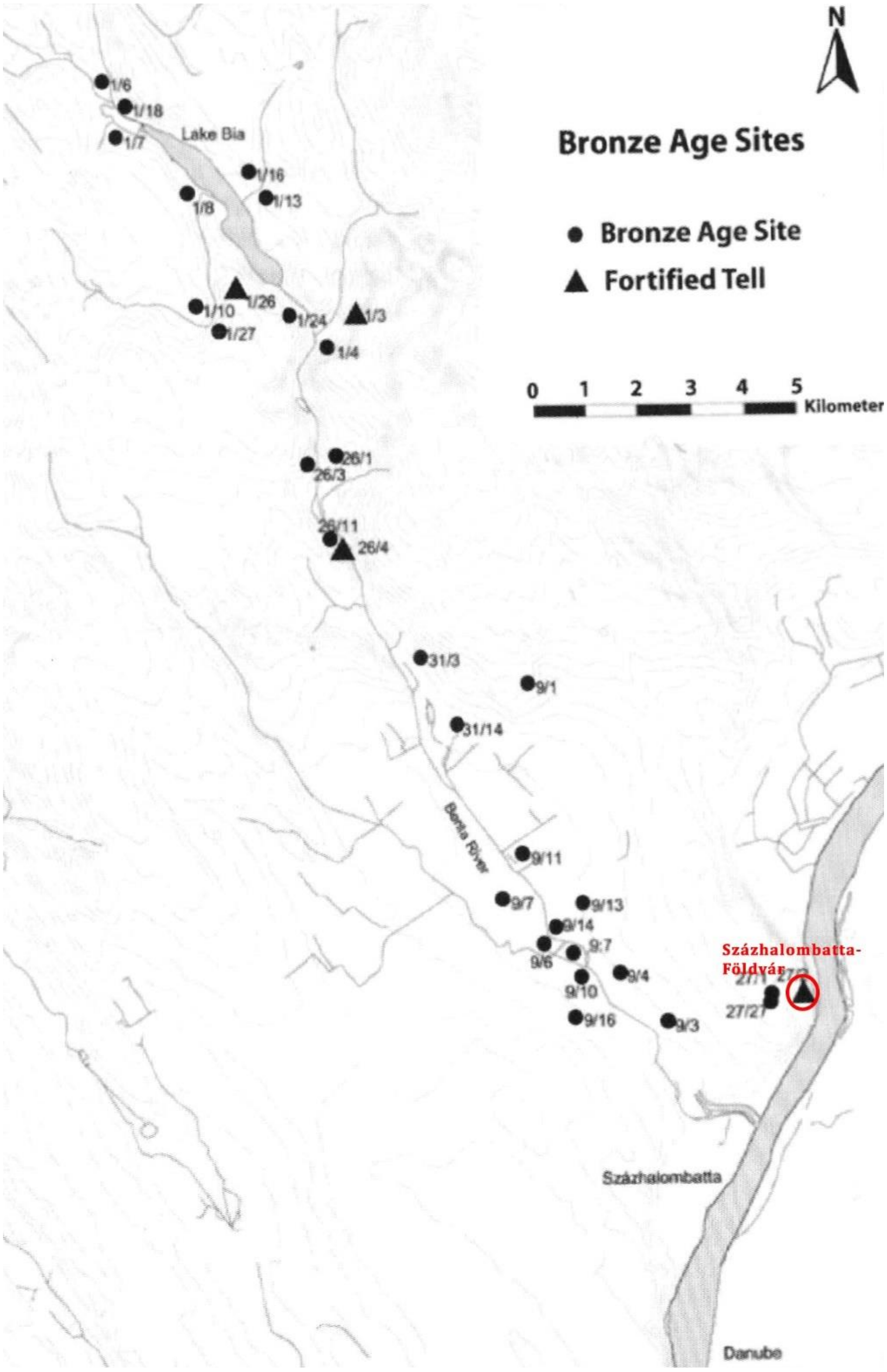


Figure 5: Map of the Benta valley with the location of Százhalombatta-Földvár in red (Vicze *et al.* 2005, 250).

role in all aforementioned projects. This importance is due on the one hand to the precise excavation method, the tenacity of the excavation (it has been ongoing since 1998) and its size; a large trench (20m by 20m) intended to go through all the extensive layers (Figure 6). On the other hand, the site is considered important because of its supposed function during the Bronze Age. According to recent interpretations, the Benta valley was part of a chiefdom of which Százhalombatta-Földvár represented the power centre (Earle and Kristiansen 2010). Therefore, the site has an outstanding role in Hungarian and, even further, European Bronze Age research. Aside from the connected research projects examining the hinterland of the site (*Benta Valley Project*) and the broader questions like political systems in BA Europe (*The Emergence of European Communities* project), the main research questions at the site concern the detection and operation of households, use of space, daily activities and crafts. Research methods cover typological and archaeometrical analysis of find classes (Budde and Sofaer 2009; Horváth 2005; Kalmár 2005; Kreiter

Figure 6: Aerial photo of the site (www.szazhalombattaexcavation.info) and close-up photo of the excavation trench from 2015 (made by author).

2005; Sofaer 2006), and features (Lakatosné Pammer 2005), archaeobotanical investigation of macro- and micro-botanical remains (Füleky 2005; Gyulai 1993; Sümegi and Bodor 2005; Terpó 2005), geological investigations (Kalmár 2005), micromorphology (Kovács 2005), archaeozoological investigation (Choyke 2000; Sólymos and Elek 2005; Vretemark and Sten 2005), and broader analysis of households and their social interpretation and representation (e.g. Sørensen 2010, 2012; Vicze 2013; Vicze *et al.* 2014). All these research methods and questions are connected to the main goal of the project: to examine the differences, similarities and connections between three different regions of Bronze Age Europe through investigating the way of living and the social structures of these communities.

One of the main activities of the site was agriculture. This is supported by the macro- and micro-botanical evidence and thousands of food processing tools from the features. The topic of this thesis concerns this particular lifestyle aspect. It aims to examine part of the agricultural activity in closer detail. One important category of agricultural tools is sickle blades. These tools were interpreted as saws in previous works (Horváth 2004, 2005; Horváth *et al.* 2000), but documented during the excavation campaigns as sickle blades. Sickles were important tools during Prehistory. They obviously had an important functional role in the harvesting of a pivotal food source, but they also had a special significance for people, sometimes being offered or treated in a special way (e.g. Baron and Kufel-Diakowska 2013; van Gijn 2014a). It is thus interesting to look at their entire life cycle, from the raw material selected for their production to the context of their final resting place. The concept of artefact biography is a helpful tool to examine the importance of sickles. The concept offers a framework to understand the various life-ways of objects via reconstruction of their life histories (Ashby 2011; Gosden and Marshall 1999; Joy 2009). It provides an understanding of the relationship between people and objects through the attributes and context of artefacts. This includes all the steps that happened from the extraction of the raw material of the object, its production, its use, possibly exchange, deposition and up to and including the 'afterlife' of the object in a museum or research project (Brysbaert 2007; Tsoraki 2011; van Gijn 2010). Through of the reconstruction of all these phases of the life history of an object, it is possible to understand the meaning of the object. The meaning which surely changed through its life, transformed and manipulated through everything that happened with the tool, e.g. its physical attributes got transformed, it changed owner/user, consumption, destruction, display of the item (Ashby 2011; Gosden and Marshall 1999; Tsoraki 2011; van Gijn 2010). Reconstructing the biographies of sickles helps to understand their social, cultural and practical role in societies. The current study aims to examine the life history of the flint sickles to reconstruct their meaning in the Bronze Age community at Százhalombatta-Földvár.

The basic objective of the recent work focused on the function of these flint blades: What was this typological category used for? To answer this question, the method of use-wear analysis was chosen. This method is barely used in Hungarian archaeological research; therefore, the recent study can be seen as pioneering. This knowledge enables me to answer the following questions:

1. *What can we infer about agriculture and farming organisation from the microwear analysis of sickle blades?*
2. *Can activity areas or workshops be discerned within the site of Százhalombatta based on the spatial analysis of the microwear data?*
3. *Can we see differences in the biographies of the sickle inserts in terms of raw material, technological features, use and discard?*
4. *Is it possible to connect sickle blades to harvested cereal types or harvesting methods?*
5. *What does microwear analysis reveal about the role of flint inserted sickles on the site or on a broader, regional scale? Is there any difference*

between sickles from Százhalombatta and those from the other sites from its hinterland?

6. *How do sickles relate to society? Did sickles have a role in social cohesion?*

In Chapter 2, a summary will be presented about the Hungarian Bronze Age to contextualise the current research project and an archaeological background will be offered about sickles. In Chapter 3, the methodology of micro-wear analysis also will be described, just like an evaluation of experimental archaeology. In Chapter 4, an archaeological background will be presented for flint sickles and the problems of interpreting sickle gloss. A typological overview of sickle insert will also be given here. In Chapter 5, the experiments that were carried out in connection with this work will also be presented and combined with the results of the analysis of the experimental tools. In Chapter 6, the presentation of the results of the analyses will appear alongside the comparison of these results with the experiments, reference collection and literature. In Chapter 7, the research questions will be answered or further research will be proposed to answer them. The spatial distribution will also be discussed in more detail, just like with the archaeobotanical data in comparison with the micro-wear results. The conclusions of the study will be presented in Chapter 8.

Chapter 2

Archaeological background

2.1 SUMMARY OF THE BRONZE AGE IN HUNGARY

The chronology of the Hungarian Bronze Age is complex and comes with various cultures whose names often look and sound foreign to people that speak Indo-European languages. To help the reader navigate this complicated topic, a short overview of the Hungarian Bronze Age will be presented, followed by a more detailed discussion of the archaeological cultures that directly relate to the subject of this thesis: the Bronze Age layers of the Százhalombatta-Földvár site.

In the Carpathian Basin, the Early Bronze Age (EBA) started around 2800/2700–2600/2500 BC and ended around 2000/1900 BC (Figure 7). The area as a whole can be characterised by two main ceramic styles: the Makó-Kosihy-

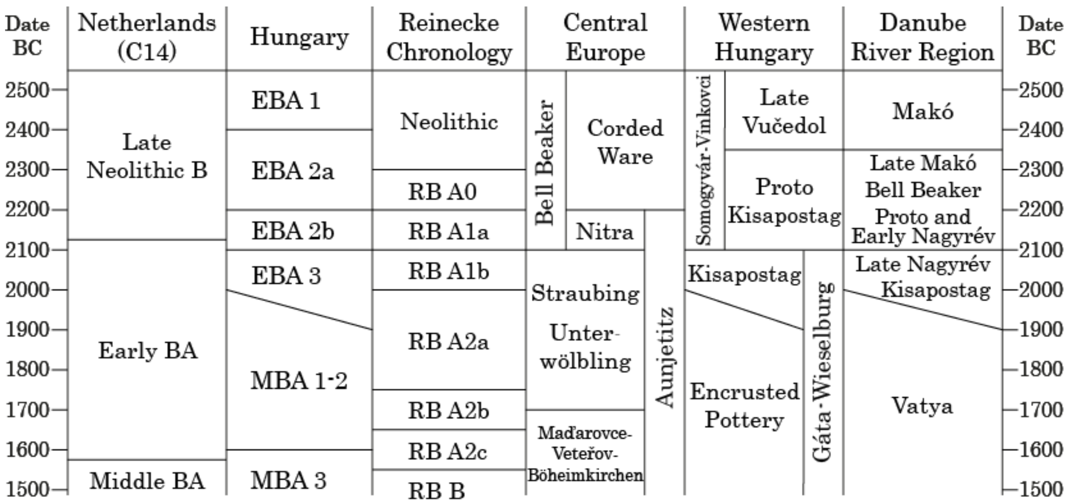


Figure 7: Synchronised chronology of the Netherlands, Central Europe and Hungary (based on Kiss 2005, 9. kép; P. Fischl *et al.* 2014, 504 Fig 1.b; Roberts *et al.* 2013, 18-9 Fig. 2.1).

Čaka style, as found on the eastern part of the Carpathian basin, and the Late Vučedol/Somogyvár-Vinkovci style, as found on the western part of the basin (P. Fischl *et al.* 2013, 355-6). During the second phase of the EBA (2500/2400-2000/1900 BC), a new stylistic unit was formed: the Nagyrév, which is known to have southern Balkan connections (Jerem 2003, 142; P. Fischl *et al.* 2013, 356). This archaeological culture is mostly known from the earliest tell settlements in the area. The distribution of Nagyrév can be traced to the middle of Hungary, the Danube-Tisza interfluve and the eastern part of Transdanubia. At the same time, the Bell Beaker culture was to be found around Budapest. This culture complex had spread to the larger area of Europe by the beginning of the Bronze Age.

Several new cultures arose during the transition from the EBA to the MBA (RB A2; from 2000/1900 BC)[1] (Jerem 2003, 142, 476; P. Fischl *et al.* 2013, 356). During this time, the north-western part of Hungary was characterised by the Kisapostag culture while, to the west, the Gáta/Wieselburg culture, which belonged to the wider Aunjetitz circle, was to be found. The eastern part of the Carpathian Basin was characterised by the appearance of the Nyírség, Hatvan, Gyulavarsánd/Otomani and Perjámos cultures; the so-called 'Tell-Cultures' (Jerem 2003; P. Fischl *et al.* 2013), who, as their name implies, had characteristic tell settlements. However, tell settlements are not present everywhere in the area that these cultures encompass since tells only seem to have emerged in areas with a sub-Mediterranean climate and an alluvial environment with mosaic patterning (Sümegi and Bodor 2000).

[1] Reinecke Bronzezeit is a chronological system for the Bronze Age of Central Europe, worked out by Paul Reinecke in the early 20th century based on finds from the South of Germany. This chronology is used in Hungarian archaeology as a benchmark and is used like that herein as well (see the relative chronologies of Europe in Figure 7).

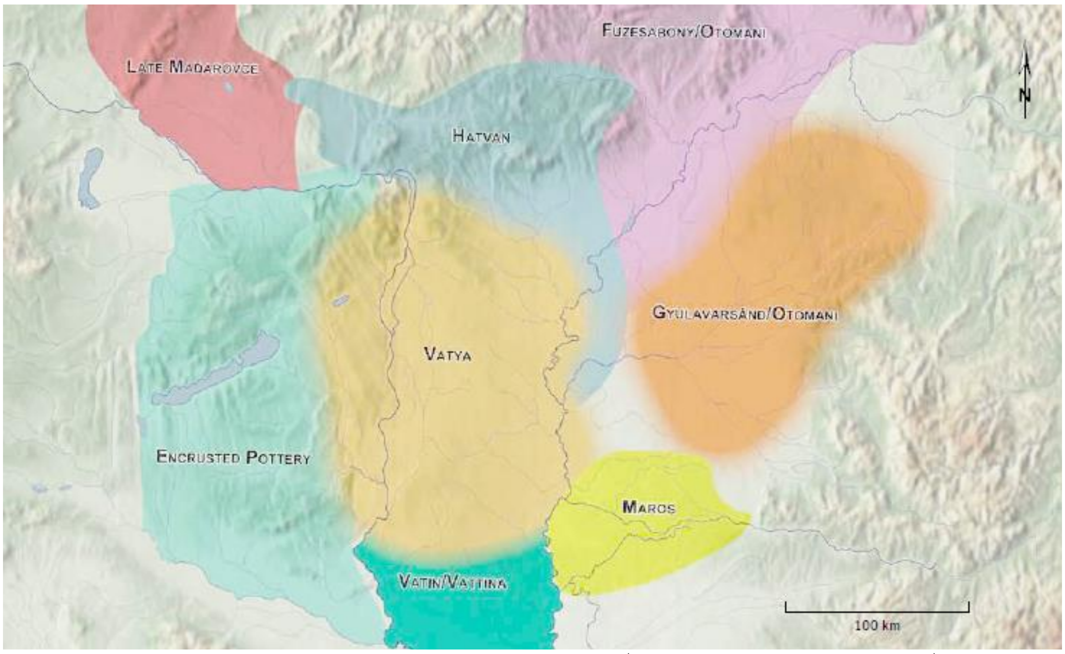


Figure 8: Middle Bronze Age cultures in the Carpathian basin (P. Fischl *et al.* 2013, 357 Fig. 2).

During the Middle Bronze Age, the cultural landscape was more unified. The Encrusted Pottery ceramic style was the most prevalent culture in the Transdanubia area, while the Danube-Tisza interfluve was occupied by the Vatya culture. The Vatya culture/ceramic style is called Vatin/Vattina in the south when it is found outside the boarders of present-day Hungary. The North Hungarian Mountains and the northern part of the Transtisza were the distribution areas of the Hatvan, the Füzesabony/Otomani, the Gyulavarsánd/Otomani and the Maros/Perjámos culture complexes (Jerem 2003; P. Fischl *et al.* 2013) (Figure 8).

The latest phase of the MBA is called the Koszider Period (RB A2C-RB B; 1800-1400 BC). The most important characteristic of this period is the appearance of new, uniformed jewellery as well as weapon and tool types that are summed up under the label 'Koszider metallurgy' (P. Fischl *et al.* 2013, 357). The new metal types are thought to be connected with the appearance of a new ceramic style, that of the Tumulus Grave Culture. The end of the Koszider period also marks the end of the Tell Cultures and the MBA.

During the Late Bronze Age (LBA), the Gáva culture occupied the territory of the former tell cultures located to the east of the Tisza. The western part of the Danube-Tisza interfluve and Transdanubia were settled on by the Urnfield culture and the area of the North Hungarian Mountains was inhabited by the Kyjatice culture during the 13th-9th centuries BC (Jerem 2003, 161-3).

2.1.1 NAGYRÉV CULTURE

Figure 9: Nagyrév ceramics (Jerem 2003, 145).

Figure 10: Nagyrév house reconstruction (Jerem 2003, 144).

The Nagyrév culture, 2500-2000 BC (Kiss 2005), is considered to have been continuously related to the cultural influences of the Balkans and to have emerged in part as a result of Balkan and local changes. The major central settlement type of this culture is tells, while small hamlets and farmstead-like settlements are also known. The most typical pottery is primarily undecorated cups with one or two handles and a tall funnel neck, as well as jugs (Jerem 2003, 142) (Figure 9). Burials mainly consisted of cremations buried in an urn while funerary gifts were rare. The main building type consisted of a timber-framed house arranged in two sections with a uniform north-to-south orientation while mud-walled structures with internal partitions are also known (Jerem 2003, 144; Poroszlai 2000, 18-20; Timothy 2008) (Figure 10).

2.1.2 VATYA CULTURE

The Nagyrév culture transformed into the Vatya culture without any significant break in continuity as a result of the interaction between the Nagyrév population and the eastwards expansion of the Kisapostag population

(Jerem 2003, 151-5). The Vatya culture was the most important civilisation of the MBA, 2000-1350 BC (Farkas 2013, 6), along the Danube and Danube-Tisza interfluve. Their settlements included single-layer and multi-layer sites. During the middle phase of the culture, they fortified their hillforts with earthen ramparts and ditches (Jerem 2003, 151-5). These hillforts are thought to have acted as the agricultural and trade centres of their local regions and integrated the regional political units to the higher range polities. The main activity was agriculture and stockbreeding; products are thought to have been exchanged for metal objects and special items. The Vatya communities had a dominant position in long-distance trade as well (Jerem 2003, 151-5; Szeverényi and Kulcsár 2012, 291-3) (Figure 12). They cremated their dead and placed the ashes in large funerary urns. The grave goods usually contained some small, decorated suspension vessels. Metal grave goods were infrequent. The urns were topped by bowls and distributed in clusters in the cemetery (Figure 11). These smaller groups outlined a boat which was perhaps a reflection of an extended family (Jerem 2003, 155-6). The most frequent house type was the timber-framed house, divided into two rooms. The last phase of the Vatya culture falls in the Koszider period. As mentioned above, this period marks the end of the MBA in Hungary. Abandonment of the settlements and bronze hoards along the rivers characterise this period. However, there is no evidence of violent destruction. Perhaps these changes were caused by some sort of social, economic and/or climate change (Jerem 2003, 155). In many cases, the ditches surrounding the fortified settlement were filled up in this period and transformed into a domestic area and settlements were expanded (Szeverényi and Kulcsár 2012, 292).

2.2 SETTLEMENT STRUCTURE OF THE MBA

Besides the chronological and cultural background of the Bronze Age, it is important to understand the settlement structures because they give an insight into the political, economic and social relations between the different sites. These relations are the main subject of current Bronze Age research as they allow for the placement of a site into a wider regional and pan-regional setting.

The settlement structures of the Bronze Age developed continuously from the EBA onwards, with some important transformations during the MBA (P. Fischl *et al.* 2013, 358-61). These transformations indicate significant changes in the social and economic systems of the time. The tell settlements changed during this time; many of them grew in size and were surrounded with enclosures, mainly earthen ramparts and/or ditches. Up until a couple of decades ago, these fortifications of the settlements were thought to have been built as a line of defence. Current researchers have reached the consensus that the explanation for the emergence of these fortifications should not be sought in violent confrontations. Hence, new studies take into account other possible explanations for the fortifications such as symbolic functions, creating an inside and an outside or separation of the domestic from the wild (Harding *et al.* 2006; Hodder 1990). Besides tell settlements, a number of open settlements can also be found in this period, mostly in the hinterland of the tells. However,

Figure 12: Reconstruction of Százhalombatta-Földvár by Brigitta Kürtösi (Earle and Kristiansen 2010, cover).

Figure 11: Vatya urn grave (Jerem 2003, 155).

these sites are hardly known and very few have been excavated. Therefore, only tendencies can be delineated from information gained from the few investigated micro-regions. In the Körös River region (Southeast Hungary), the number of sites increased by 24% in the Gyulavarsánd (Otomani II) period. Meanwhile, only a few settlements increased in size. In Central Hungary, in the Benta Valley, the same trend can be detected. There, the number of sites doubled and even the size of the settlements increased in a few cases. The size of Százhalombatta-Földvár increased from 2ha to 5.5ha during the MBA (Figure 13). In Transdanubia, at the distribution area of the Encrusted Ware culture, the same tendency for site multiplication can be seen in a number of places based on systematic surveys in Veszprém County (Western Hungary). However, there is much less information on the changes in size. In the eastern part of the country, an opposite dynamic can be observed. In the Borsod Plain (NW Hungary), the settlement density was much lower during the second part

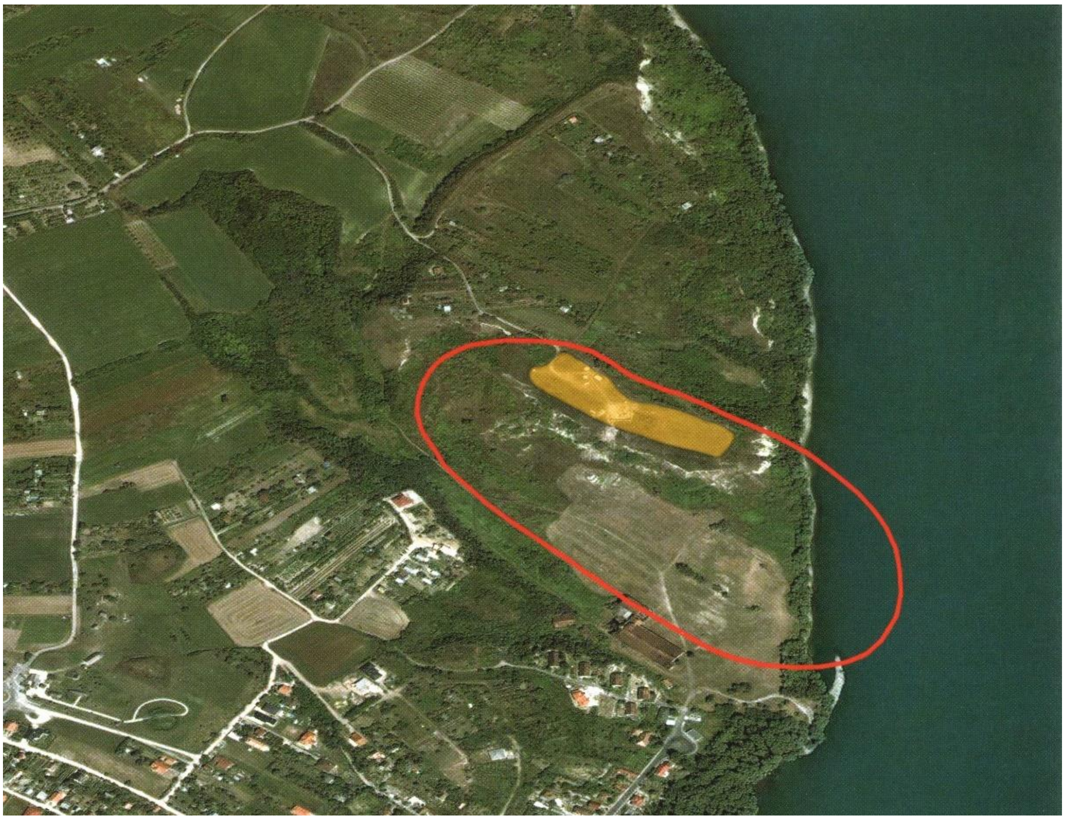


Figure 13: The possible original extent of the tell at Százhalombatta-Földvár (Vicze 2005, 70).

of the MBA. Furthermore, most tell settlements were occupied during the classical phase of the period but most did not remain so in the Koszider Period (P. Fischl *et al.* 2013, 359). The aforementioned tendencies suggest a demographic growth in the MBA, at least in the western part of Hungary. At the same time, the observations of the eastern part indicate a movement of people into larger centres; a settlement nucleation.

2.2.1 Benta Valley

In the past decades, Bronze Age research has grown increasingly interested in the differences between settlement functions and layout, as well as the organisation of settlement-systems (e.g. Earle and Kristiansen 2010; Earle *et al.* 2015). Micro-regions are the most suitable for investigating these questions. One of the most important micro-regions in Central Hungary is the valley of the Benta River, an affluent of the Danube. As a result, the study of this valley is incorporated into several international projects. The *Benta Valley Project* is part of the *Százhalombatta Archaeological Expedition* (SAX) which in turn is part of *The emergence of European Communities: household, settlement and*

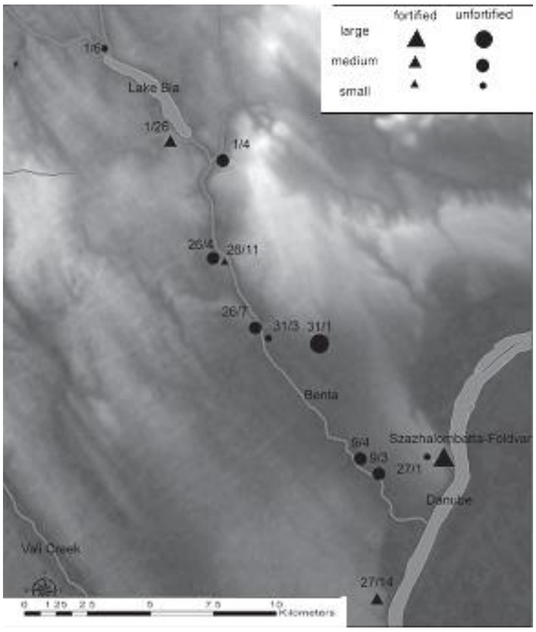


Figure 14: Settlement system in the Benta valley (Anderson *et al.* 2004; Earle *et al.* 2012, 2).

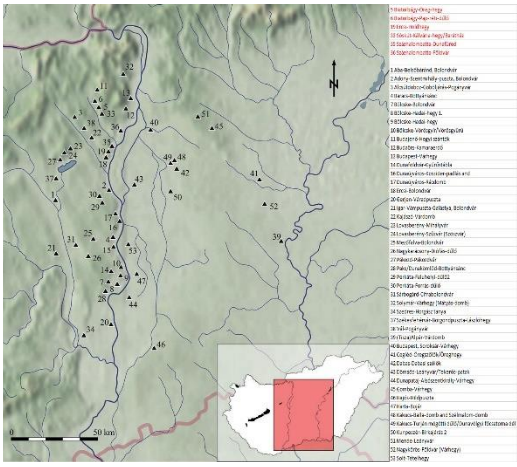


Figure 15: MBA fortified settlements and tells at the Danube region. The in-text mentioned sites with red. (after Anderson *et al.* 2004; Szeverényi and Kulcsár 2012, 289, 95, 321 Fig. 1. and Table 1 and 2).

territory in Later Prehistory (2300-300 BC). In the framework of the Benta Valley Project, thirty-two Bronze Age sites have been identified and categorised by field surveys (field-walking and geophysical surveys), shovel-testing and by exploratory excavations. The settlements were categorised according to five criteria: large, medium, small, fortified and unfortified (Earle *et al.* 2012) (Figure 14).

The SAX project and numerous other studies focusing on Vatya hillforts make it possible to outline the settlement and social structures. Százhalombatta-Földvár, the largest tell in the micro-region, is located on the eastern edge of a loess plateau that runs parallel to the Danube, on its right bank, south of Budapest (Poroszlai 2000) (Figure 4). This site is the most northern of a series of tells that are all located in a similar fashion on a loess plateau along the Danube, all the way until Gerjen-Váradpuszta in the south (Figure 15). Perhaps these sites were strategically placed to control movement and communication along the Danube (Szeverényi and Kulcsár 2012, 293-4).

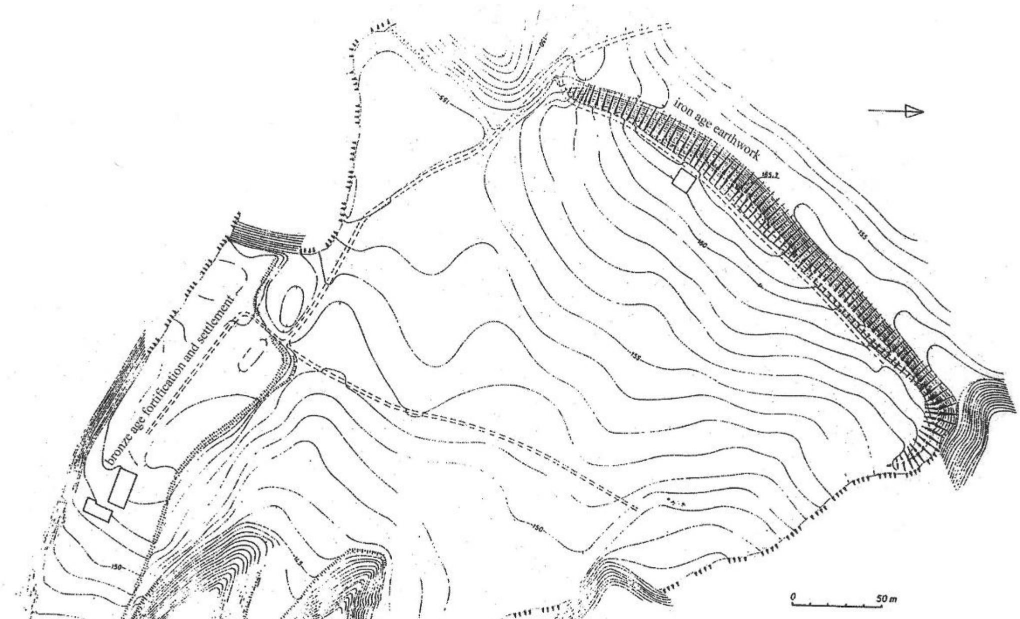


Figure 16: The Bronze Age and the Iron Age fortifications with the location of Trench I and II of Poroszlai 1989-1991 and 1991-1993 (Gurova 2014a; Poroszlai 2000, 29).

However, they were not alone since a series of smaller settlements surround them. They probably constituted all together larger polities. Százhalombatta-Földvár is thought to be the centre of the polity along the Benta and the Váli-víz in the Benta Valley (Earle *et al.* 2012; Earle and Kristiansen 2010; Earle *et al.* 2015; Szeverényi and Kulcsár 2012). This major tell had been fortified, extended and was occupied during the entire Bronze Age (Figure 16). In the EBA, most of the population seems to have lived on the site of Százhalombatta-Földvár in an unfortified but large, open settlement near Sóskút (Szeverényi and Kulcsár 2012, 294). With the increase of the population during the MBA, a new hierarchy of fortified settlements can be observed. These are thought to be secondary centres. They are located upstream of the Benta at Sóskút-Kálvária-hegy, Biatorbágy-Öreg-hegy and Biatorbágy-Pap-Réti-dűlő. (Figure 15). There is another fortification without exact dating at Biatorbágy-Nagy-hegy. These secondary fortified settlements are theoretically surrounded by large and intensive open settlements. In two cases, Biatorbágy-Öreg-hegy and Sóskút-Kálvária-hegy, this theory has been proven by surveys, geophysical investigation and excavations. Another dominant open site was identified in the middle of the valley at Tárnok-Szőlő-hegy. All these sites were surrounded by further smaller villages and hamlets (Szeverényi and Kulcsár 2012, 294-8). The relationship between the different types of settlements is unclear as of yet but the investigation of this is ongoing and aims to provide data with regard to Bronze Age settlement patterns and hierarchies. In the valley of the Benta, there are other tells. At Százhalombatta-Dunafüred, mostly MBA material was found on a ca. 2ha large site (Figure 15). It is thought to be part of the Benta Valley polity as well (Szeverényi and Kulcsár 2012, 298). At Ercsi-Holdhegy, a ca. 8ha site was recently found with habitation from the EBA 2/3 until the end of the MBA. The site is fortified by two almost parallel ramparts and may have been the primary centre of another polity. The connection between any of these fortified settlements is unclear in this micro-region at this point in time. North of the valley, on the edge of and overlooking the Zsámbék Basin, a large fortified settlement and a ca. 10ha single layer settlement dating to the Koszider Period has been found (Szeverényi and Kulcsár 2012, 298). A similar organisation as in the Benta valley can be identified in the valley of the Váli-víz. Systematic surveys and further subsurface testing are missing from this area so there is much less information available. In other areas, unfortunately, the Bronze Age settlement patterns do not follow such an easily recognisable geographical logic as with the river valleys. Therefore, the organisation of those polities is even more unclear (Szeverényi and Kulcsár 2012, 298-300).

2.3 SZÁZHALOMBATTA-FÖLDVÁR

The town of Százhalombatta is situated on the right bank of the Danube, 30km south of Budapest (Figure 4). Being so close to the river made this geographical position excellent for prehistoric communities to settle; excavation data suggests some kind of occupation from the Neolithic onwards. The main occupations of this area were: the Bronze Age, the Iron Age and the Roman Age. For this study, the most important period is the Bronze Age as it is from those layers that the studied material comes from. Three important sites must be referred to here: an earthen fortification on a mound close to the Danube from the EBA Nagyrév culture, an urn cemetery from the Vatya culture and most importantly, the tell settlement of Százhalombatta-Földvár (Poroszlai 2000, 13-4). The first rescue excavation at this site was carried out by Tibor Kovács in 1963 (Kovács 1969). At this excavation, all the occupation levels were unearthed. The first inhabitants of the tell belong to the Nagyrév ceramic tradition with the next level attributed to the Vatya culture. After a long abandonment phase from the end of the Koszider Period, a Celtic occupation can be observed, mixed with some Early Iron Age pottery (Kovács 1969). The largest part of the tell was destroyed by the exploitation of clay for the production of bricks during the 20th century at the south—south-eastern part. Hundreds of archaeological finds were collected by civilians during this time. There are two well-known bronze hoards as well from this site. Hoard I consisted of 118 pieces, axes, pins, bracelets, pendants, buttons and bronze sheets, dated to phase III of the Vatya culture. Hoard II was deposited in a two-handled pot and contained sickles, daggers, pedants, arm spirals, bracelets and gold rings (Poroszlai 2000, 14-5). Nowadays, the site is under archaeological protection but due to severe destruction over the centuries, only a small part remains for archaeological research. The eastern part of the plateau was destroyed by erosion caused by the Danube. The territory of the tell has been owned by the Százhalom Foundation since the 1980s and they stopped cultivation on the site. Because of this, original vegetation returned to the site and it was made into a protected nature reserve. The first planned excavation was carried out between 1989-1991 by the local 'Matrica' Museum, directed by Ildikó Poroszlai (Poroszlai 2000). The trench was opened near to the area where hoard II was found, at a part of the settlement where the whole sequence of the development of the tell can be examined. The following levels were identified and separated from each other:

Level I: Celtic level mixed with a few Iron Age finds and more MBA Koszider finds;

Level II: Koszider phase of the Vatya culture;

Level III: Vatya culture;

Level IV: Vatya culture;

Level V: Nagyrév culture;

Level VI: Nagyrév culture (Poroszlai 2000, 16).

After the excavation, during studies of the ground plans and profiles, a sublevel was separated, Level V/b, a level where a previous house was built on the same place as House 2 from Level V. The first house was found in Level IV. In general, this excavation gave the following information: There was no break between the Nagyrév and the Vatya cultures, which is suggested by the thickness of the fill between the two cultures which was the same as the fill between the two Nagyrév levels. The houses of the two cultures were of the same type, just as their structure and building technique. Also, the settlement structure was the same in the Early and Middle Bronze Age. The walls' thickness increased from the oldest house to the youngest; however, in each house, small stake holes were found inside the walls to strengthen them (Figure 17). In the Vatya layers, the number of pits was extremely high which made it difficult to recognise houses and floors. The number and function of the pits suggest that the valuable seeds had to be protected within the settlement. Ovens and hearths were found at each level. From pottery typology, it is clear

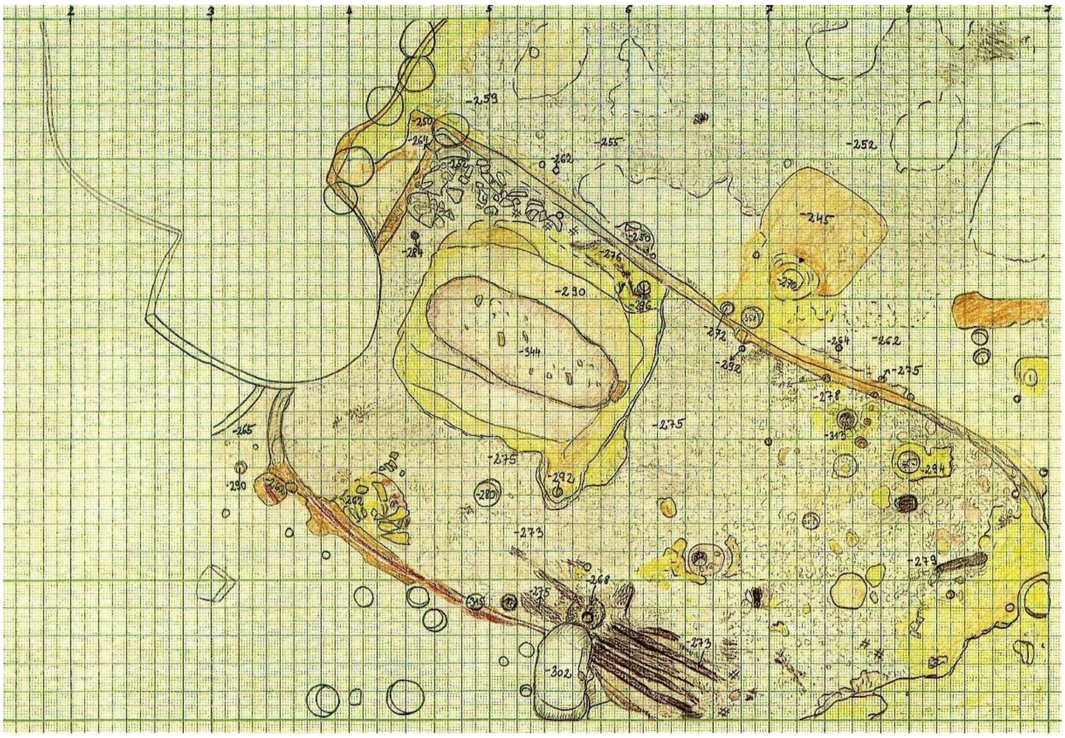


Figure 17: House plan from Level VI (after Poroszlai 2000, 35 Fig. 13).

that the Level I was a mixture of Celtic and Vatya-Koszider phases, along with a small number of Urnfield cultures. Level II belongs to the Rákospalota group of the Vatya-Koszider phase, Level III is the classical Vatya and Level IV is the early Vatya. Level V is the 'transition level'; however, a break could not be observed neither in the settlement features nor in the archaeological finds. The important dividing element is the presence of Transdanubian Incrusted Ceramic ware (Figure 18). This level belongs to the Kulcs phase of the Nagyrév culture. Level VI is the very end of the classical Nagyrév culture; both the Szigetszentmiklós and the Kulcs types of ceramics were found at this level.[2] A long and peaceful development took place at the site during the about 400 years of continuous inhabitation of it without any violent disturbance. The main activities were crop cultivation and animal husbandry. Hundreds of grinding stones and seed remains prove the importance of cereals in the community. The most important cereals were einkorn (*Triticum monococcum*), barley (*Hordeum vulgare*) and emmer (*Triticum dicoccum*). In addition, they cultivated leguminoses (i.e. horsebean, peas and lentils). Near the settlement, dry meadow can be reconstructed from the pollen data of *Rumes crispus* (curly dock) and *Medicago lupulina* (black medick). The local bronze industry is

Figure 18: Transdanubian Incrusted Ceramic ware from Százhalombatta-Földvár (Jerem 2003, 154).

[2] For detailed description of the levels and pottery typology see Poroszlai 2000, 21-4.

proved by moulds, bronze sheets, pins, clay tuyères and the bronze hoard. The end of the occupation of the settlement in the Bronze Age is marked by the Koszider bronze hoard (Hoard II above), three Koszider pottery depots and Pit 2 with numerous nicely decorated vessels in it. The hidden wealth suggests that the people were afraid of an attack and hid their values but the settlement itself did not burn down; therefore, the inhabitants probably left before an attack and for some reason they never returned (Poroszlai 2000, 20-5).

After the aforementioned excavation campaign, a second one took place between 1991-1993, also directed by Ildikó Poroszlai. During this excavation, a larger surface (15x20m) was opened but it became clear that a surface like this couldn't be handled by one archaeologist alone. Therefore, the excavation was stopped for a bigger project and more archaeologists and scientists were sought for participation (Poroszlai 2000, 26).

2.3.1 SAX PROJECT

In the Bronze Age, different parts of the continent were linked together through exchange networks (Figure 19). These networks provided the spreading of technological innovations between societies and through this, probably social institutions as well. According to the most recent theory, in this time period, regional cultural identities formed and polities developed at the level of archaic states or complex chiefdoms with well-organised settlements (Kristiansen 1999). At the end of the 1990s, a new research strategy was needed to study these developments. Much new evidence was accumulated at that time but mostly from rescue excavations which were often only partial. The new strategy tended to include the different levels of settlement organisation, from individual households to the settlement structure and its territory and combine international and interdisciplinary teams' work (Kristiansen 2000). This was the base of *The emergence of the European Communities* project, of which the *Százhalombatta Archaeological Expedition*

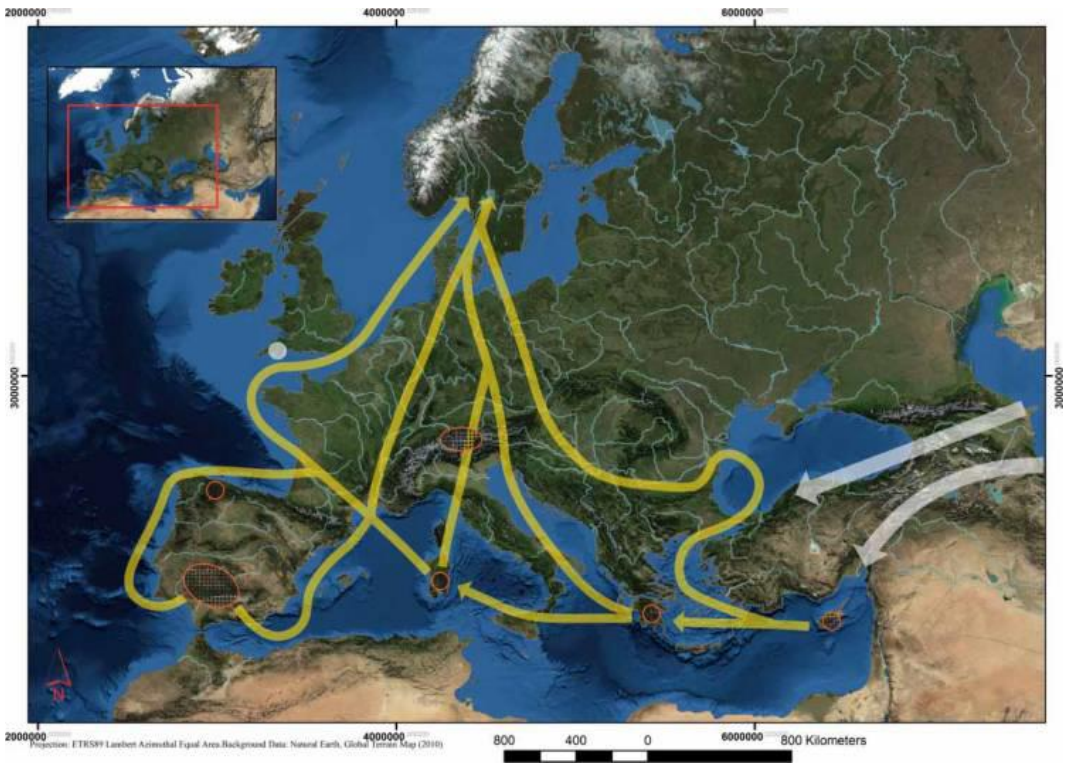


Figure 19: Networks in BA Europe (Earle *et al.* 2015, 641 Fig. 4).

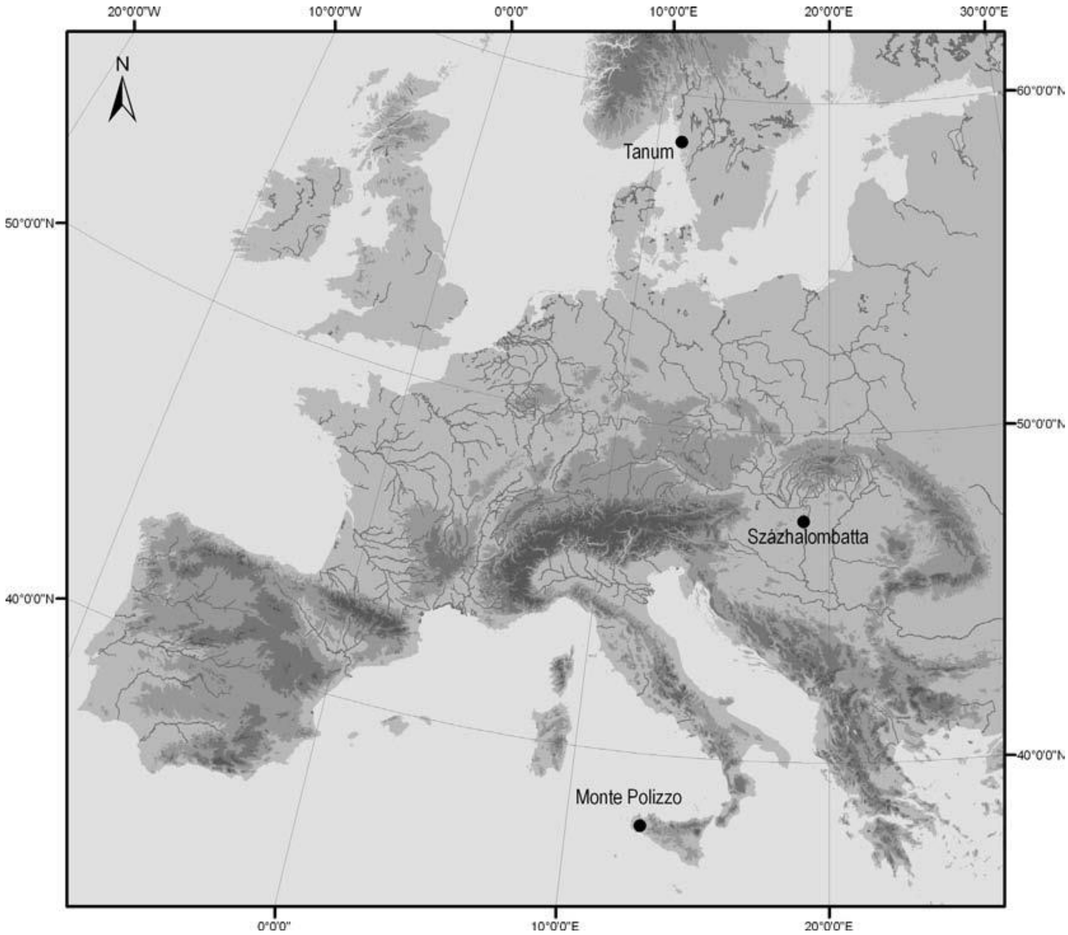


Figure 20: Location of the three sites of *The emergence of the European Communities* project (after Earle and Kristiansen 2010, 23 Figure 1.7.).

(SAX) project is part of. *The emergence of the European Communities* project, led by Kristian Kristiansen, intended to study households, settlements, territories, and networks through the comparative research of three parts of Europe: the Mediterranean, Central Europe and Scandinavia (Earle and Kristiansen 2010). The participant sites were: Monte Polizzo, Sicily; Százhalombatta, Hungary and Tanum, Sweden (Figure 20). The project's aim was to understand long-term political trajectories from the perspective of micro-regional studies. The field works were based on the same documentary system, the INTRASIS, and a similar documentation procedure and research design.

The elements of this design were:

- Full geographical, topographical and archaeological mapping of the areas onto a GIS database (INTRASIS);
- Intensive surveying of the micro-region with plough zone screening and phosphate analysis;
- Excavation of the central settlement/settlements with an interdisciplinary research strategy including flotation, micromorphology, pollen analysis and archaeozoological analysis;
- Documentation system based upon total station and the UV's (The Swedish National Heritage Board, Excavation Division);
- Annual reports (Kristiansen 2000, 10).

The time period was set at a period of 2000 years between 2300-300 BC to analyse long-term changes. The regional contexts of the three sites are also important in understanding the interaction of urban societies in the East Mediterranean and the well-organised village and farming societies in Central and Northern Europe (Figure 21). Sicily served as a connecting link between Mycenaean/Greek culture, Italian-Central European influences and local cultures. Monte Polizzo is a fortified, urban settlement, untouched since antiquity. It was occupied between 1000-3000 BC and has a unique condition of preservation surrounded by a network of roads built for the transportation of heavy goods. In Central Europe, the Danube embodies the main east-west communication channel. Thanks to rich natural sources like ore depositions, the Carpathian Basin witnessed rapid development from the Early Bronze Age. It was characterised by the formation of complex settlement systems centred around fortified tell settlements ranging from the Black Sea to Slovakia. Despite similarities, distinct local and regional cultures developed. Százhalombatta is a fortified, semi-urban village settlement, probably with a

Figure 21: Landscapes of the three sites in *The emergence of the European Communities* project (after Earle and Kristiansen 2010, 27, 9 Plate 1.1.a and Plate 1.2.; Erikson; Lundberg 2000).

central function, as described above. It represents an internal division between a supposed acropolis and the village. The Nordic region took part in the metal exchange network of the early 2nd millennia BC. This led to the emergence of the Nordic Culture. Here, the settlement structure was based upon single farms, in contrast to other parts of Europe. Tanum is part of the World Heritage, the aim of the project here to identify and excavate the Bronze Age and Early Iron Age sites in the area as well as to interpret rock carvings and reconstruct their environment (Kristiansen 2000, 8-9) (Figure 21). In this large, international project, the household is a unit for understanding the social significance of artefacts and through this, understanding the context and variation of them. Households are also starting points for understanding the social and political roles of a central settlement such as Százhalombatta (Earle and Kristiansen 2010, 4). This is one of the reasons why the main research questions of the SAX project concern households; namely, how the household and related activities functioned on the tell (Vicze 2005, 65). The SAX Project itself is an international cooperation currently led by Magdolna Vicze [3], Marie-Louise Stig Sørensen[4], and Joanna Sofaer[5]. As is understandable with an international project, the SAX Project also experienced several difficulties at the beginning but it follows guidelines which combine the knowledge and practices of all the participating nations and researchers. Although the written guideline is under constant improvement and develops with new situations and experiences, it serves well the needs of such extended, outstanding and detailed

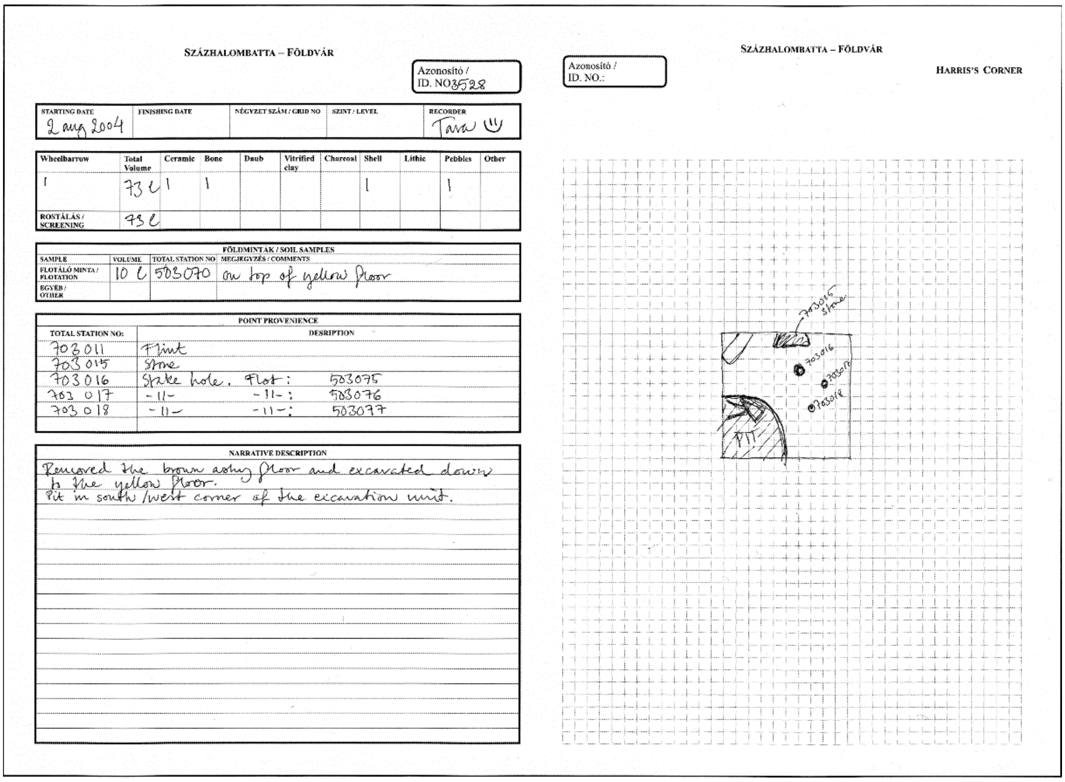
Figure 22: Photo of the excavation trench from 2014 (made by Rita Deák, property of Matrica Museum, Százhalombatta).

[3] „Matrica" Museum, Százhalombatta, Hungary

[4] Department of Archaeology, University of Cambridge

[5] Department of Archaeology, University of Southampton

research. The project combines several research methods such as geo-archaeological investigation, morphological surveys, geochemical analyses, vegetation mapping, pollen analysis and various archaeometrical studies on found materials. The most important part is obviously the excavation, the strategies of which are briefly presented herein. The size of the trench is 20m by 20m, situated almost in the middle of the present-day site (Figure 6). The walls of the trench are oriented in all four cardinal directions. This trench is the largest ever excavated on a major Bronze Age tell settlement in the framework of a planned excavation. The trench is divided up into a 2m by 2m grid system which provides a basic guideline for both the excavators and the digital documentation system (Figure 22). The 2m by 2m squares are divided into 1m by 1m units and are being excavated. Smaller features such as hearths, ovens, special working areas, house-floors or house-debris fragments are considered as one entity and excavated under their own identification number (ID). Pits, as well as post- and stake-holes are also excavated separately. All


SZÁZHALOMBATTA – FÖLDVÁR

Azonosító / ID. NO 3528

STARTING DATE	FINISHING DATE	NÉGYZET SZÁM / GRID NO	SZINT / LEVEL	RECORDER
2 aug 2004				Tara

Wheelbarrow	Total Volume	Ceramic	Bone	Daub	Vitrified clay	Charcoal	Shell	Lithic	Pebbles	Other
1	73 l	1	1				1		1	
ROSTÁLÁS / SCREENING	73 l									

FÖLDMINTÁK / SOIL SAMPLES

SAMPLE	VOLUME	TOTAL STATION NO	MEGJEGYZÉS / COMMENTS
FLOTÁLÓ MINTA / FLOTATION	10 l	503070	on top of yellow floor
EGYÉB / OTHER			

POINT PROVENIENCE

TOTAL STATION NO:	DESRIPTION
703011	Flint
703015	Stone
703016	Stake hole. Flot: 503075
703 017	-11- -11-: 503076
703 018	-11- -11-: 503077

NARRATIVE DESCRIPTION

Removed the brown ashy floor and excavated down to the yellow floor.
Pit in south/west corner of the excavation unit.

SZÁZHALOMBATTA – FÖLDVÁR

Azonosító / ID. NO.:

HARRIS'S CORNER

Figure 23: Example of recording sheet used in the SAX project (Vicze 2005, 72).

ID numbers have their own recording sheet and all finds from the unit are recorded under that number. The excavator notes down on the recording sheet the amount of soil removed, the number and type of the find-bags, the point provenience of the soil sample (10 litres of soil is taken as a flotation sample from every unit), the point provenience of the special finds, gives a narrative description to explain the characteristics of the unit and draws a sketch of the unit with every smaller feature and special find marked on it (Figure 23). Pits are given special attention because of their important role in Vatya settlements. All pits are excavated as one entity. Those smaller than 1m in diameter are excavated layer by layer and all changes in the soil are documented and given a new number. Each identified layer has its own soil sample and finds are collected in separate bags. The pits bigger than 1m in diameter are cut in half. After all the layers are identified in the profile, the second half is excavated with the same method as the smaller pits. All the removed soil is dry-sieved on-site and the finds are packed into the units' find bags. The special finds such as whole vessels, antlers, bronze finds, stone tools, etc., are always left in-situ until they are drawn, measured with total station and then packed separately (Vicze 2005, 69-72). In this way, special finds have their own point provenience number and their location is known down to the nearest millimetre. This is the case with most of the sickle blades studied in this thesis. Complex sampling strategy is going onto the site with specialised analysis. Macro-fossils coming from the soil samples are collected in light and heavy fractions and analysed by archaeologists, zoologists, malacologists and archaeobotanists. Micromorphological samples are taken from special activity areas and different sections of house floors, walls and debris. A micromorphologist works on-site during the excavation seasons and analyses the samples after the seasons. Phytolith sampling is also a common practice for pits and special areas; for example, around grinding stones (http://szazhalombattaexcavation.info/about/research-excavation-methods/).

Two types of documentation are in use on the site: so-called traditional documentation and digital. The traditional method includes the recording sheet filled out by the excavator, a classic photo and coloured drawing. For this, a colour-code chart has been worked out and is used. Digital documentation is done by a one-man-controlled total station. All the measurements on-site are done this way and all the geo-data is registered with software called INTRASIS. With this software, different databases can be connected to the drawings and find spots. In this way, contextualised site maps can be made during the excavation and taken to the site as prints (Vicze 2005, 73).

The preliminary results of the early seasons showed a more than two-metre-thick Koszider occupation layer comprising six occupation levels (Vicze 2013, 71-2). The aforementioned assemblage belongs to this level. There were specialised food processing, storage, activity-specialised feature areas and other facilities in this layer. Several houses were found whose general direction was orientated NW-SE and the average size remained between 5-6 metres in width and 8-12 metres in length. A so-called main street could be identified on the western part of the trench which has endured over generations. The width of it varies from 5m to 8m in length and it runs through the whole trench, marked by deep wheel-ruts. The distance between the wheel-ruts was 120cm, suggesting the road was used for heavy wagons (Vicze *et al.* 2014, 3). Furthermore, the area was divided by smaller passageways, open areas and alleys between the houses. The space of these smaller dividing areas slightly changed periodically. The treatment of house rubble was constant among the inhabitants and always carefully contained, left on the top of the house itself. House rubble was never found on the main road. There was no difference between burnt and un-burnt, larger and smaller houses in terms of their treatment. This suggests a purposeful, conscious and orderly debris treatment on the site (Vicze 2013, 72-3). The internal dynamic of minor but continuously ongoing changes suggests a living community. However, the construction and maintenance of the main road suggest some kind of central decision making.

Yet, there is no evidence to reveal how such decisions were made but possibilities vary from communal to elite control (Vicze *et al.* 2014, 3).

The aforementioned details and preliminary results of the ongoing project contextualise the assemblage that is studied in this thesis. There are previous studies about typological and geological analysis of the chipped stone material of the site. Over the following pages, these analyses will be discussed in detail to give a background of the sickle blades that are used for micro-wear analysis.

2.3.2 Chipped stone tools from Százhalombatta-Földvár

Stone finds were examined from the first 4 years of the excavation of the SAX Project, 1998-2001, by Tünde Horváth (Horváth 2004, 2005). This work contained not only the chipped but also the polished stone tools. It is a techno-typological analysis and does not contain all the stone tools found during those years. Horváth examined 376 stone tools; from them, 279 were chipped stone tools. Her conclusions are that the number of items, especially the small ones, significantly increased compared to the previous excavation. The main raw material of the chipped stone tools is the Buda chert, which varies in shades and forms. This could mean the raw material did not come from the same geological source (mine) or, more likely, that there was great diversity within a geological source. Most of the tools from Buda chert were in contact with fire. It is known that this raw material becomes more homogenous and can be easier worked after heat treatment. The proportion of other raw materials is also higher than in the previous collections. For example, limnic quartzite from the Horn (Garam) valley appears. The valley of the Horn is outside the borders of the Vatya culture, therefore, this raw material should be interpreted as an import (Horváth 2005, 149-50). Horváth has interpreted the sickle blades as saws but she also suggests they were used on cereal stalks. Her interpretation for the larger pieces is that they are more likely in-hand tools and only the smallest ones would be inserted into sockets or handles. The saw edge (serrated cutting edge) was made over more phases: first of all, it was thinned and then there was the retouching of the serration. The majority of the tool surfaces are covered in cortex or patina which was probably caused partly by the archaeological, partly by the geological environment (Horváth 2005, 150-1).

The stone assemblage of the SAX Project was given to the author of this thesis for examination in 2014. In the first working phase, between 2014-2015, the typological analysis of the first six levels of occupation, the Koszider layer, took place. This work included a revision of the whole collection of stone items with the recording of the division of the finds. The revision was done on chipped stones, polished stones, ground stones, building stones and pebbles. Some preliminary results of the chipped stones were presented on a poster presentation in 2014 at the 20th Annual Meeting of the European Association of Archaeologists in Istanbul. The results of the other stone types are as of yet unpublished. Herein, the results of the chipped stones will be presented, with attention given to the similarities and differences to the previous study. In total, 660 chipped stones were analysed. In addition to the typological description, special attention was given to the raw materials and tool types. Both categories were projected to the maps of the excavation in order to observe the spatial distribution. Spatial distribution is a main research question of the project because of the study of activity areas. Maps of the distribution of the categories were made by levels in order to examine the change in use of space. At Level 6, the oldest of the analysed levels, the number of lithic finds distributes throughout the whole excavated area; the middle, north-western part of the trench seems to be exceeded (Figure 24). In Level 5, the picture is similar: tools come from everywhere except the part that is interpreted as a possible clay 'preparation' area (Figure 25). In Level 4, lithic comes from the north and eastern half of the trench (Figure 26). In Level 3, there is no significantly exceeding area that can be observed (Figure 27). In Level 2, the number of stone artefacts expressively increases and the densifications of the artefacts are located in archaeological features, including the house wall (Figure 28). In Level 1, most of the lithic items are from pits. A manufacturing area seems to clearly concentrate in the south-east corner of the trench. The ration of burnt artefacts decreases (Figure 29).

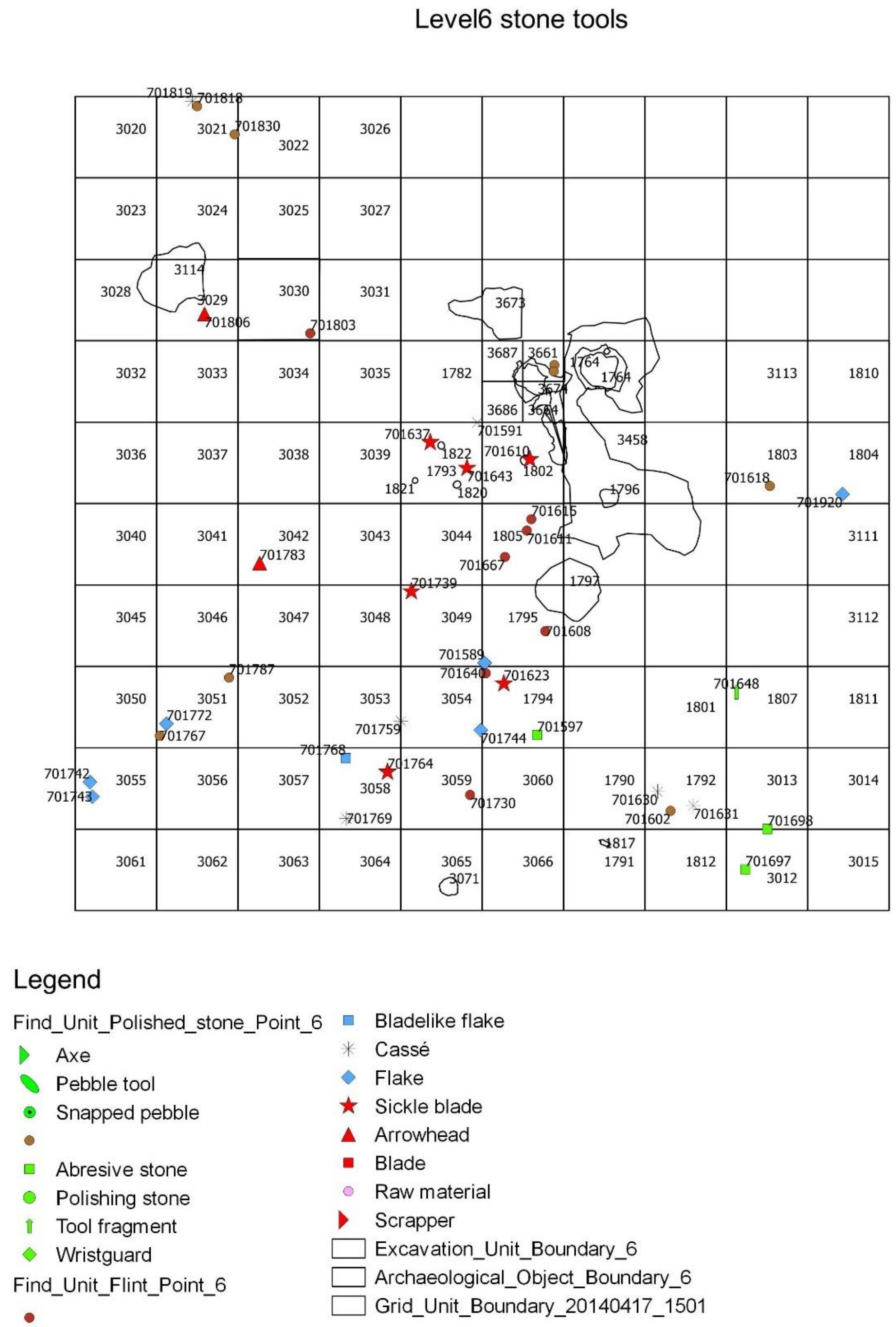


Figure 24: Spatial distribution of stone tools in Level 6.

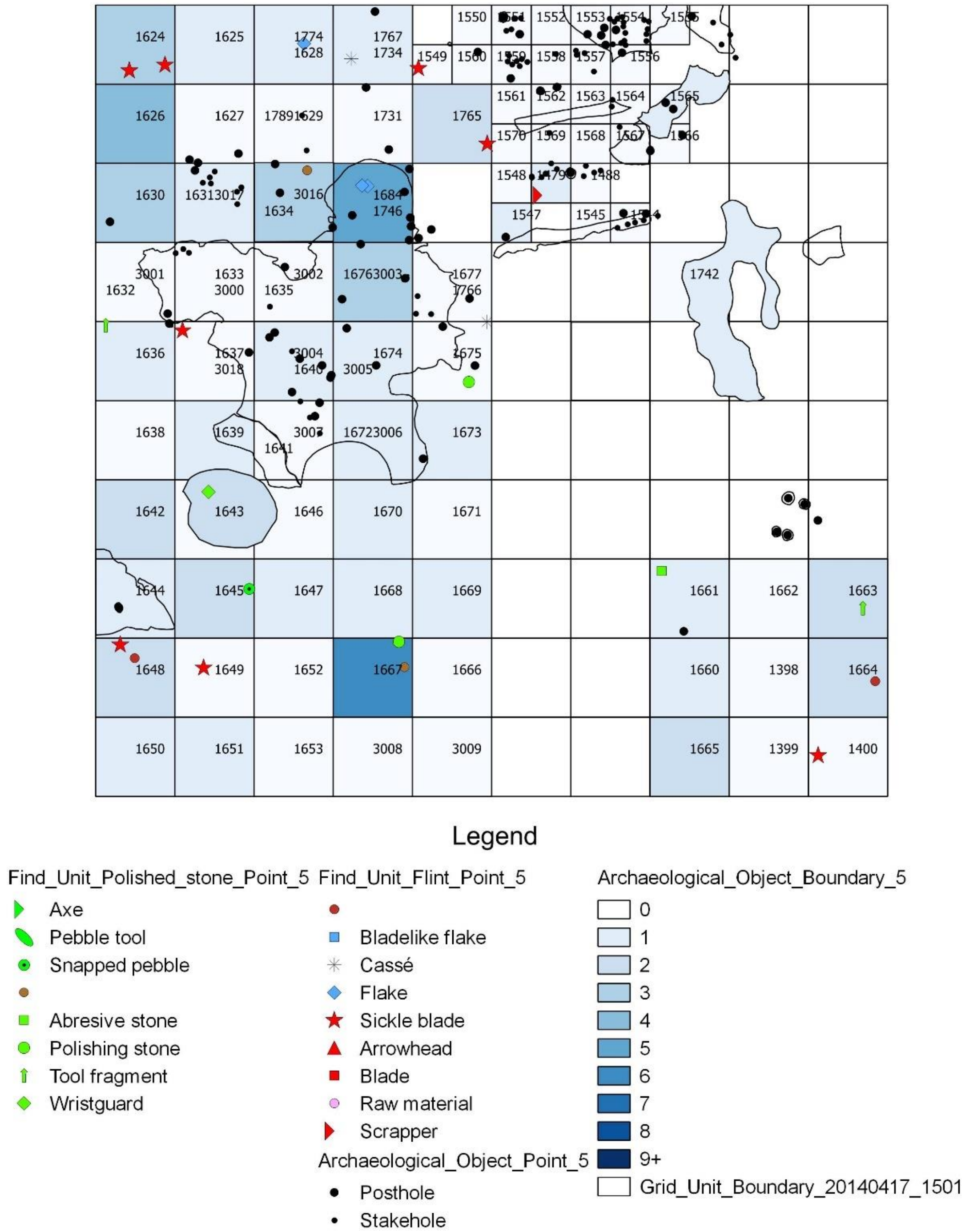


Figure 25: Spatial distribution of stone tools in Level 5.

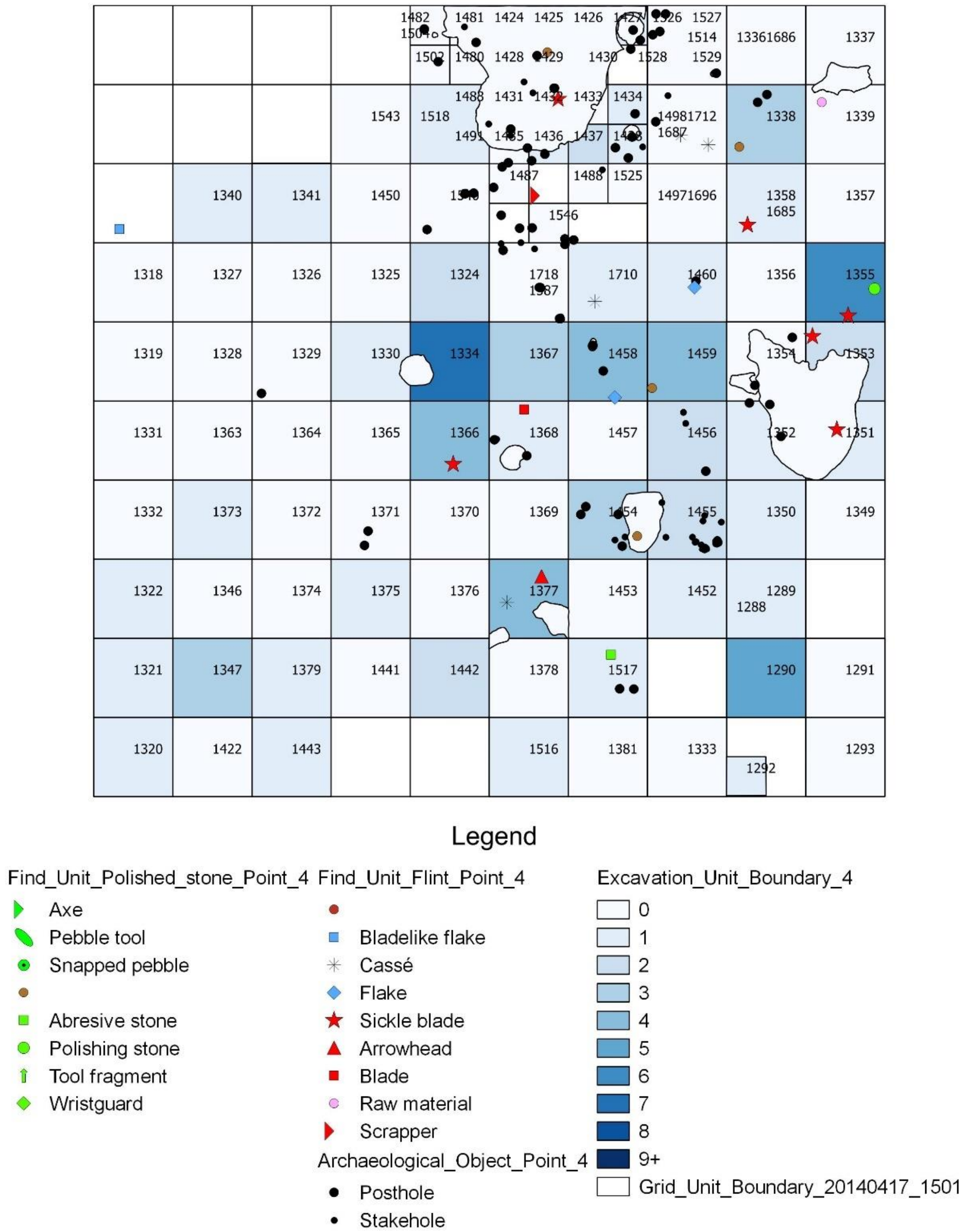


Figure 26: Spatial distribution of stone tools in Level 4.

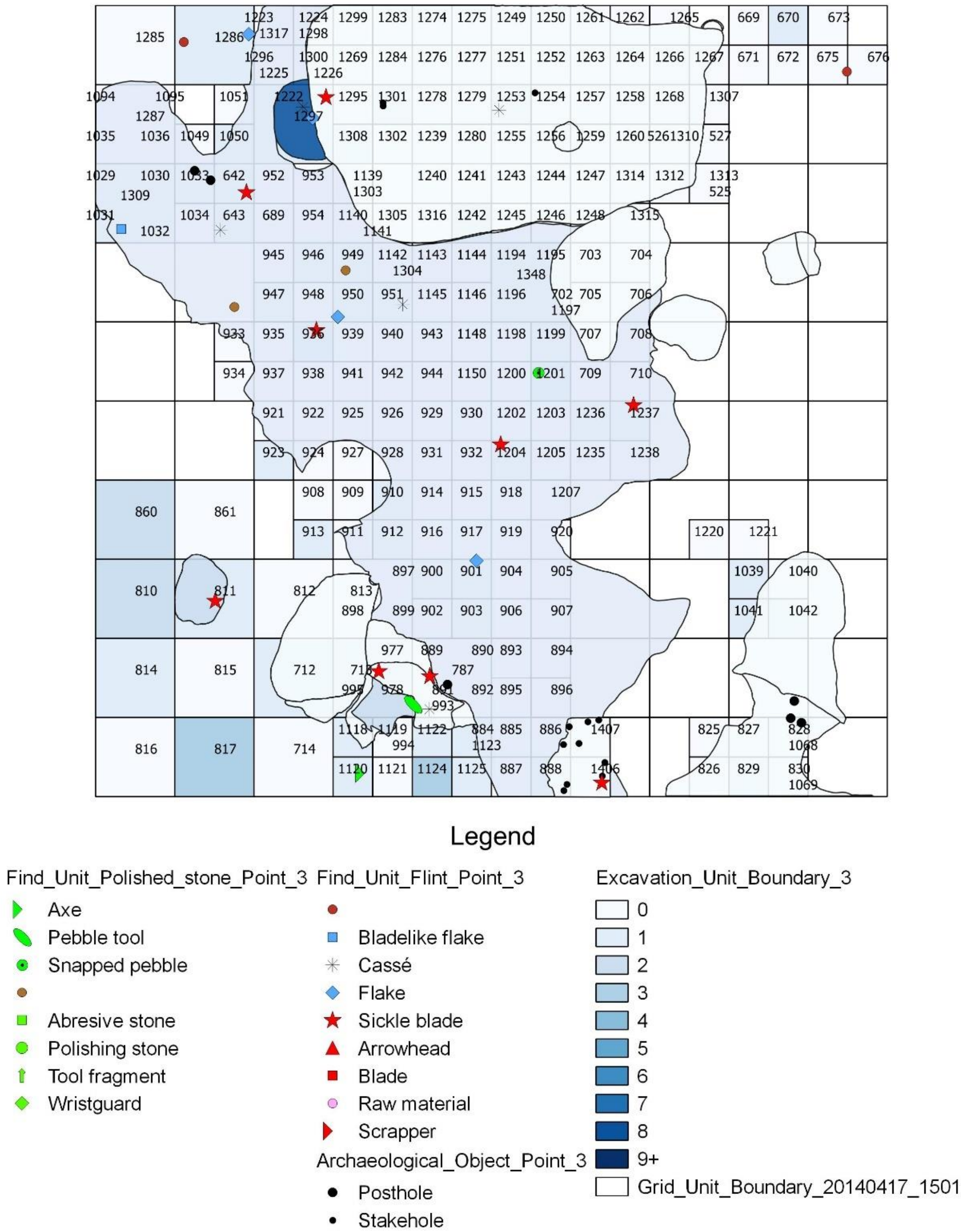


Figure 27: Spatial distribution of stone tools in Level 3.

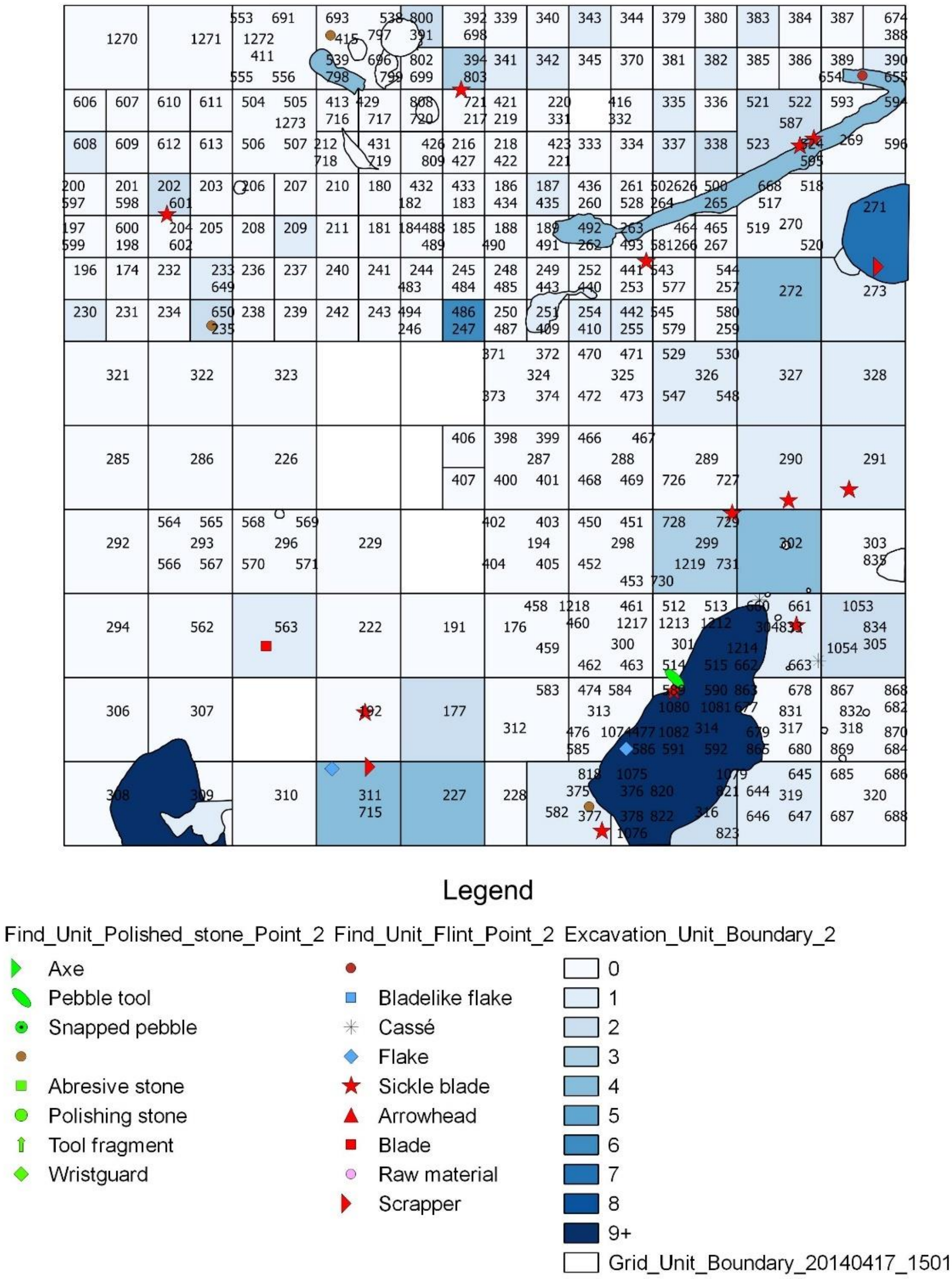


Figure 28: Spatial distribution of stone tools in Level 2.

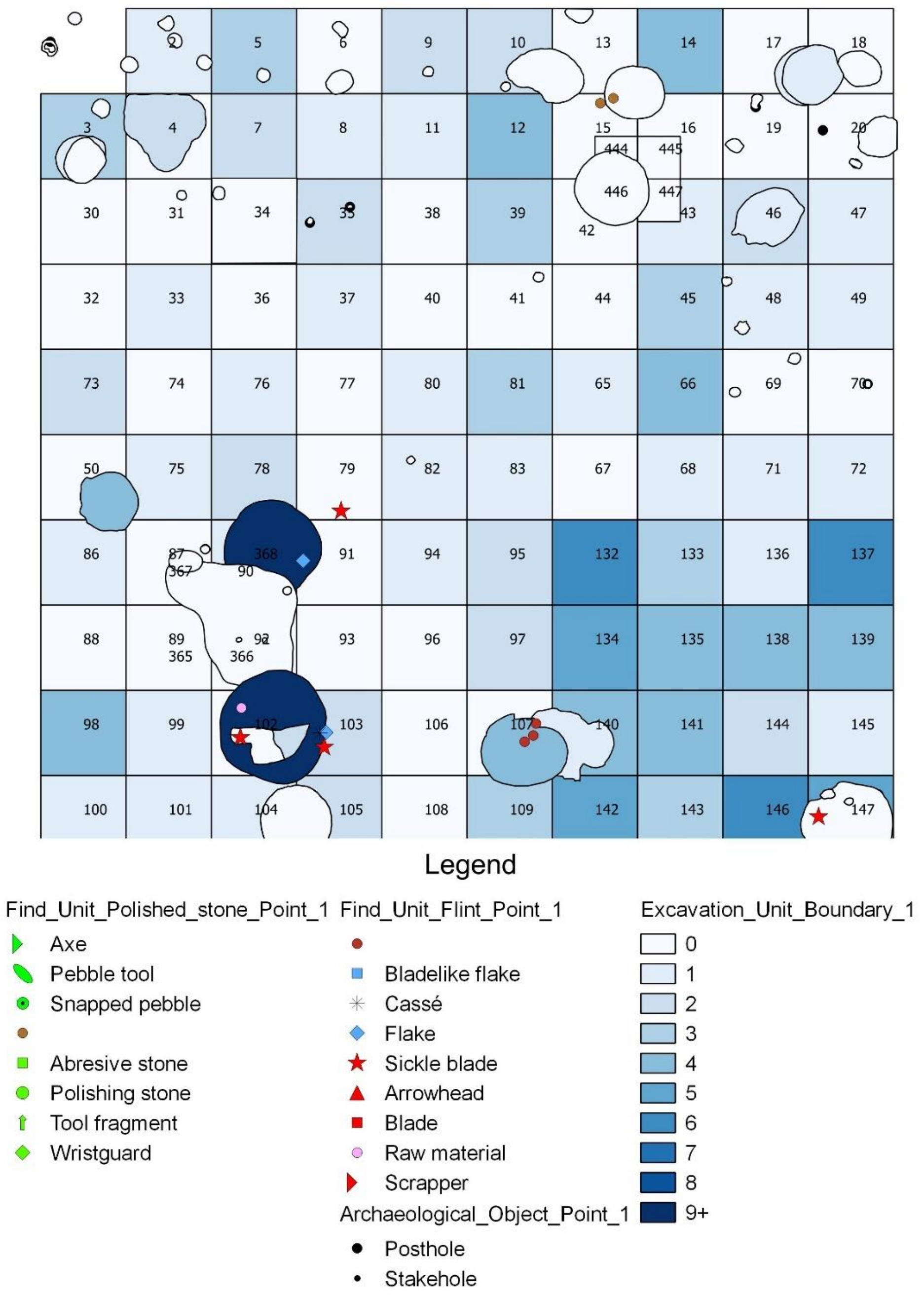


Figure 29: Spatial distribution of stone tools in Level 1.

In general, it can be concluded that the manufacturing area of chipped stones seems to move from the north, north-western part of the trench to the south-eastern part; however, in the older levels (6-3), the separation of such an area is not that clear. This can be as a result of the lower number of artefacts or the change in the excavated area per season. In the aspect of raw materials, Buda chert is the main raw material of chipped stones. This raw material is local; the geological source is at a 10km linear distance from the site. The properties of the stone are not the most suitable for knapping and tool making. It is often cracked, heterogenic, the CaCO content of it high and the geological source is heterogenic. This raw material accounts for 67% in the first 6 levels as chipped stone raw material while the other 20 types of stone types share 22% of the remainder. 11% of the artefacts are undetermined in raw material because of contact with fire, development of patina or the surface covered by cortex (Figure 30). There are several exotic and 'import' raw materials in the assemblage, even if only at a low amount. Stone types count as import/exotic when their geological source is outside the borders of the Vatya culture. These were perhaps valuable pieces. The shaping of them also suggests this theory. The rock-crystal, the Jurassic Krakow flint, the obsidian, the greenstone, the Mecsek radiolarite and the Bakony radiolarite are considered import. The ratio within the levels is certainly similar. The second main raw material is hydroquartzite. Other types are rare at every level but the variability is high in all.

The variety of tool types is relatively constant (Figure 30). Most of the items are chips and flakes, i.e. by-products, waste of flint knapping and pieces for tool-making. In general, within all 6 levels, the chips and flakes add up to 59% of the assemblage, 26% flakes and 33% chips. The next subclass is the sickle blades with 22%; all the other types are represented by 5% or less. However, if the two by-product subclasses are not counted and just the actual tools are examined, sickle blades represented 54% of the whole tool-assemblage, followed by blades at 12%, cores at 11%, pebble tools at 9%, scrapers at 5% and the eight other subclasses at 2% or less. This ratio is true within levels as well.

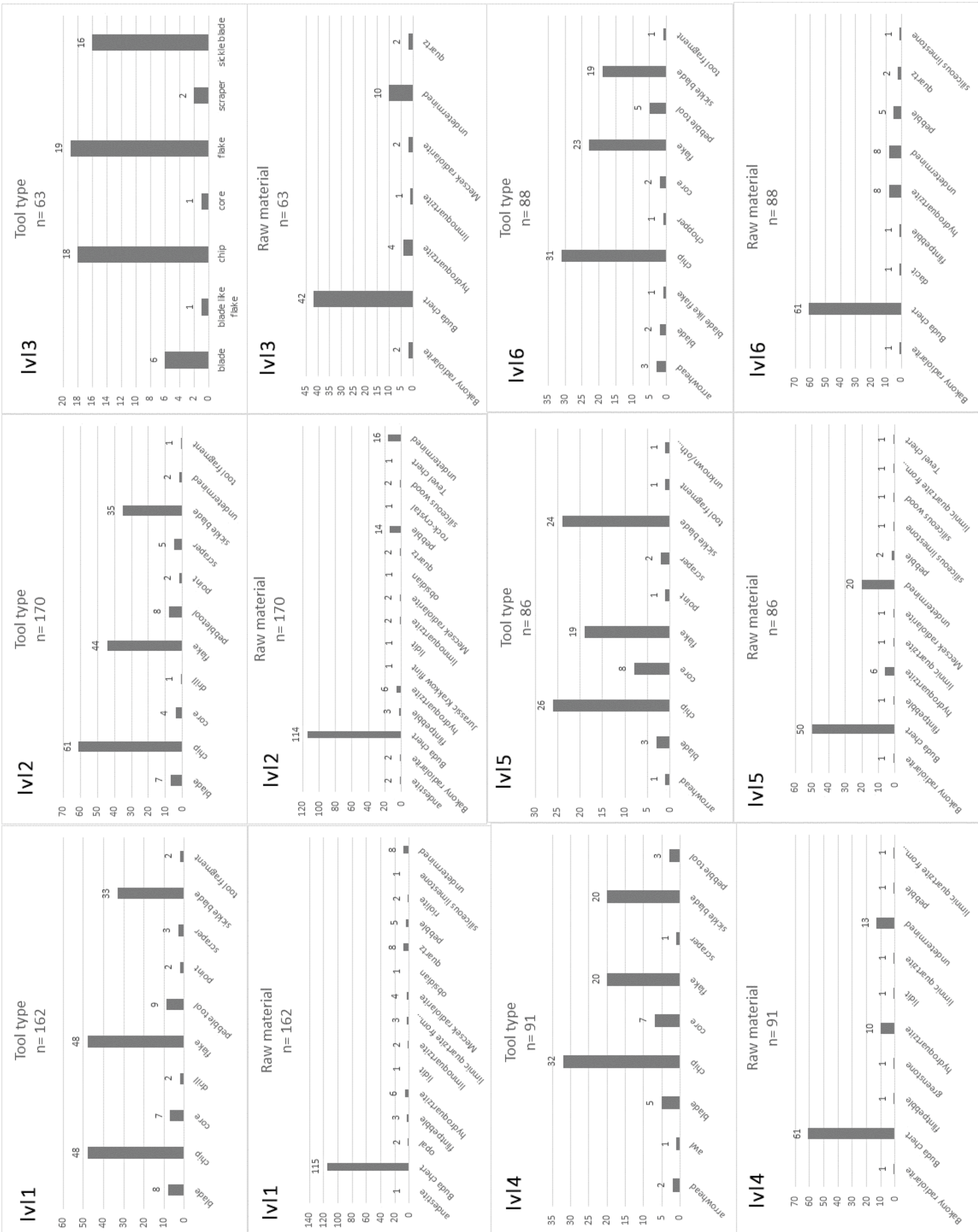


Figure 30: Histograms of tool type and raw material occurrences in the different studied levels.

Chipped stone tools were used on the tell at Százhalombatta-Földvár at the end of the Bronze Age during the Koszider phase. The main tool type was the sickle blade. The number of these tools exceeds any other. This suggests a specific role and importance of these items. The aim of this study is to examine these tools, give new information about their use and through this, suggest explanations as to what that specific role was.

Chapter 3

Archaeological background of flint sickles: problematic of sickle gloss and agriculture in Bronze Age Central Europe

3.1 INTRODUCTION

There are two main types of flint sickles; one of them is when the whole cutting part of the sickle is made from one piece of flint, e.g. a crescent-shaped sickle (e.g. Baron and Kufel-Diakowska 2013; van Gijn 1992) (Figure 1), used to cut either by some type of handle or bare hand and a flint sickle which contains flint inserts. It can be one or multiple flint flakes or blades fixed into a wooden, bone or antler handle (e.g. Gurova 2008; Kadowaki 2005; Unger-Hamilton 1985) (Figure 31). The latter was commonly used in Central and Eastern Europe during the Bronze Age, including Százhalombatta-Földvár. The present chapter will focus on the flint-inserted sickles, their history, typology and problems regarding their interpretation. That said, the other type, namely the crescent-shaped sickles, also played an important role during the Bronze

Figure 31: whole sickle with haft from Százhalombatta-Földvár from 2010 (property of the Matrica Museum, Százhalombatta) and flint inserted sickle replicas from the Archaeological Park of Százhalombatta (photo by author).

Age where they were used in Northern Europe. Apart from the geographical differences, both the functional and social interpretations of them can be used as a parallel for the inserted sickles.

The flint-inserted sickles were primarily reconstructed from the flint blades, however, there are a few archaeological sickles known from well-preserved sites such as Karanovo, Bulgaria (Gurova 2008). A complete sickle was also found at Százhalombatta-Földvár in 2010[6] which gives the perfect parallel for reconstructing the design of sickle blades from the site (Figure 31). Nevertheless, from the occupation level that was analysed for the current study, only flint inserts are known. These items have been recognised and interpreted as sickle blades because of their design and the gloss on their edge; so-called sickle gloss or sickle shine. The sickle blades are made of flakes or blades, often with a triangular cross-section. The cutting edge consists of coarse or semi-coarse serration, mostly with a glossy polish. The band of polish varies between 0.3-1cm in width, depending on the size of the blade and the distributional shape of the polish. The distribution of the gloss varies from parallel, to the working edge, to oblique. This can tell us something about the way that the inserts were hafted. They range from 1-4cm in length (e.g. Figure 32 and Figure 33).

[6] Unpublished, with the permission of Dr. Magdolna Vicze, 'Matrica' Museum, Százhalombatta

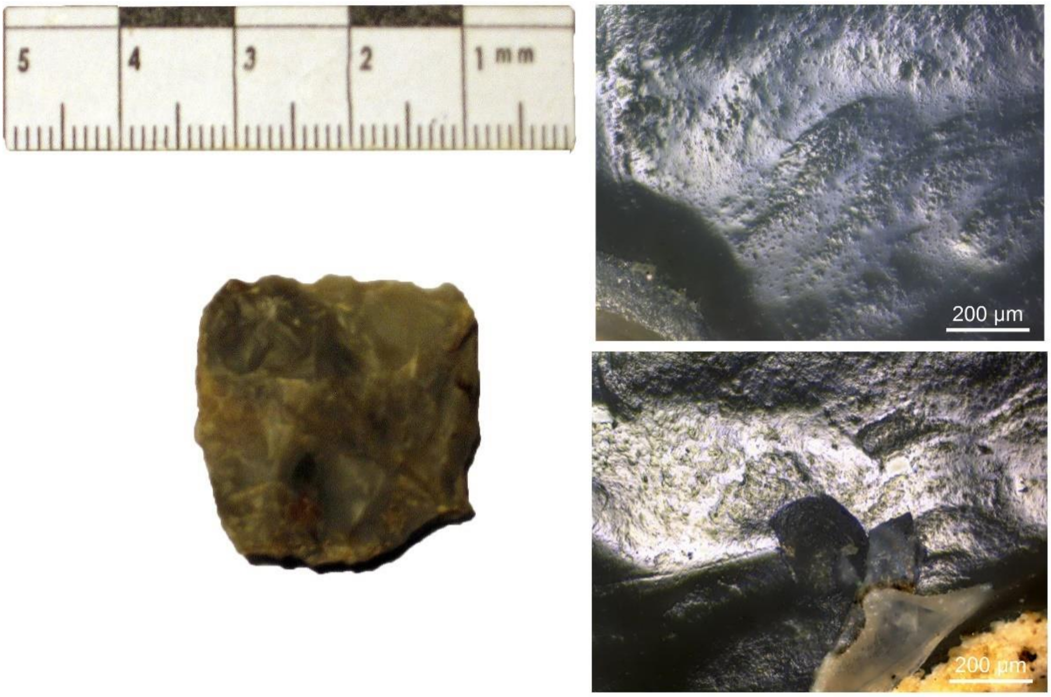


Figure 32: ID 132 sickle blade with microscopic photos of its microwear.

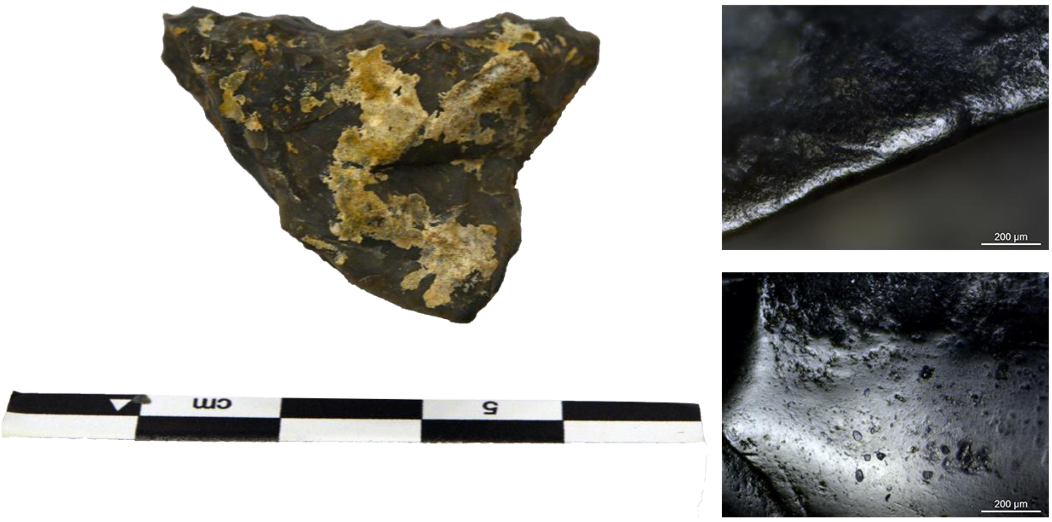


Figure 33: ID 35 sickle blade with microscopic photos of its microwear.

3.2 SICKLE BLADE TYPOLOGY

Serrated sickle elements were already being used in the Neolithic in the Near East. Therefore, the typology of the blades is based on those Neolithic assemblages of Muhata, Isreal by Gopher (1989). Later studies used also this typology (Kadowaki 2005). Gopher differentiated eight types and from the eight types, five of them have a denticulated working edge: Type A - Type E (Gopher 1989, 95):

Type A: Coarsely denticulated working edge, generally rectangular or sometimes triangular in shape, bifacial flat retouch on one or both surfaces of the working edge, the other edge is rarely retouched or backed, both ends are either plain or truncated by semi-abrupt or regular retouch on the dorsal face (Figure 34).

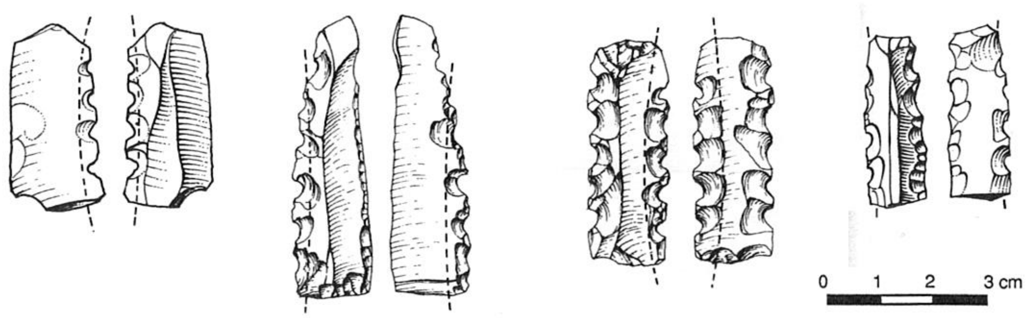


Figure 34: Sickle blades of Type A (after Gopher 1989, 97-101).

Type B: Denticulated working edge, invasive retouch that covers part or all of both faces of the tool, rectangular, curved trapezoidal or triangular shape, slightly concave or straight working edge, coarse or spaced serration fashioned by bifacial invasive retouch, slightly convex or straight other edge usually with bifacial retouch (Figure 35).

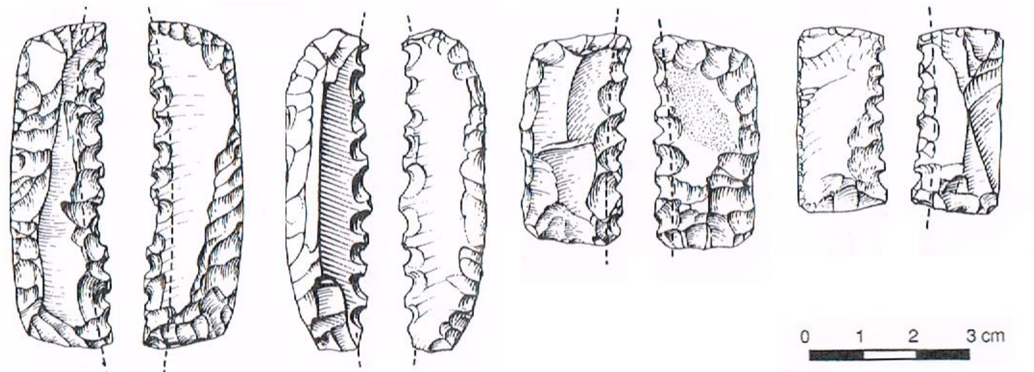


Figure 35: Sickle blades of Type B (after Gopher 1989, 97-101).

Type C: Regularly serrated or finely serrated working edge, rectangular or trapezoidal shape, back and both ends abruptly or semi-abruptly retouched, surfaces are free from retouch (Figure 36).

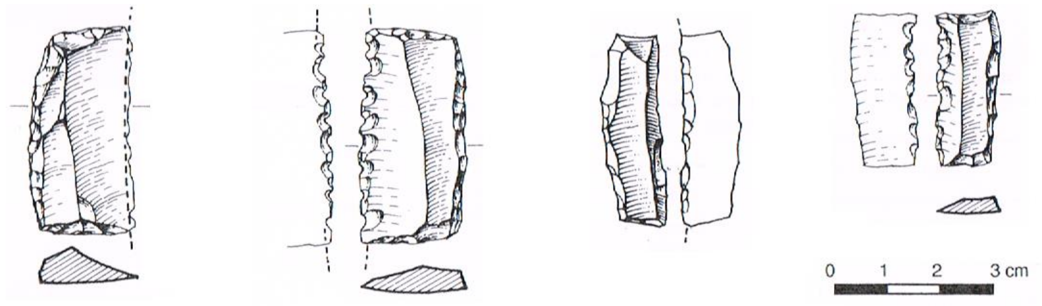


Figure 36: Sickle blades of Type C (after Gopher 1989, 97-101).

Type D: Finely or irregularly denticulated working edge shaped by direct, regular, fine retouch or nibbled, rectangular or trapezoidal shape, thick, heavy blade sections, conspicuously thick back, truncated ends abruptly retouched (Figure 37).

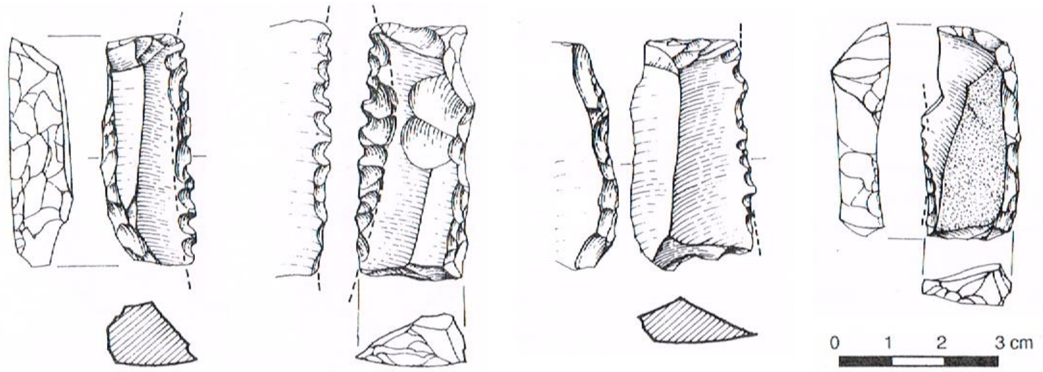


Figure 37: Sickle blades of Type D (after Gopher 1989, 97-101).

Type E: Plain, nibbled or finely serrated working edge, rectangular or trapezoidal shape or long blades, either retouched or truncated back and ends (Figure 38).

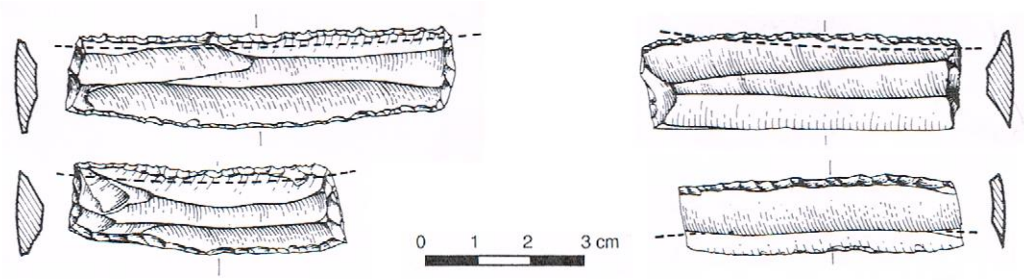


Figure 38: Sickle blades of Type E (after Gopher 1989, 97-101).

According to Gopher's typology, the sickle blades from Százhalombatta belong to Type B or Type D. As is mentioned above, they are made of flakes or blades, mostly with a triangular cross-section. They are trapezoidal or sometimes rectangular in shape. The working edge is coarsely or semi-coarsely serrated, mostly covered by sickle gloss. The other edge is sometimes convex. Both the surfaces are heavily retouched in most of the cases. They range from 1-4cm in length (Table 1).

Denticulated blades appeared in Europe, particularly in the Balkans, at the end of the Copper Age-beginning of the Bronze Age as a technical innovation in the flint tool repertoire (Gurova 2008, 540). Perhaps they spread from here to the Carpathian Basin and Central Europe. However, the serrated blades from Bulgaria slightly differ from the ones known from Százhalombatta-Földvár. The Bulgarian ones have finely or delicately denticulated working edges fashioned by bifacial retouch. They are made of blades or sometimes blade-like flakes (Figure 39). Despite typological differences, the function of these blades has been interpreted as sickle blades just like the Hungarian ones. Both of them show the typical so-called 'cereal polish' with gloss (Gurova 2008, 540).

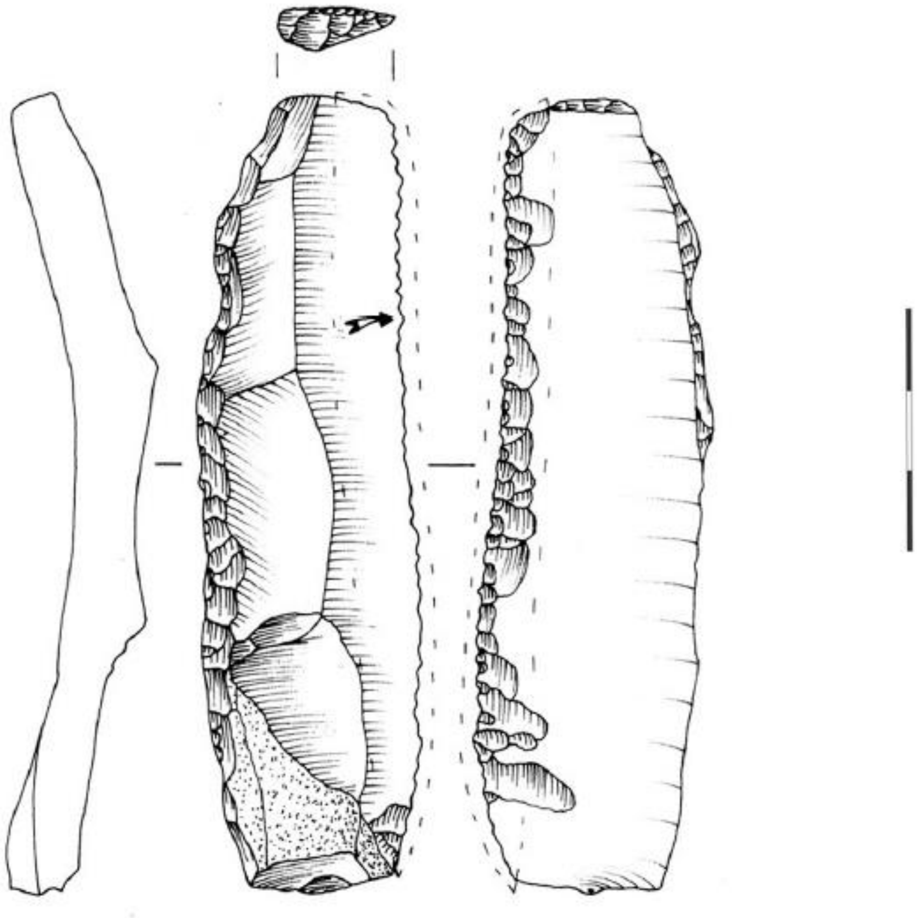


Figure 39: Sickle blade from Kamenska Čuka, Bulgaria (Gurova 2008, 540, Fig. 2).

Table 1: Analysed sickle blades from Százhalombatta-Földvár with typological, raw material, and microwear data.
The header "PP" stands for "Point Provenance number", "lvl" stands for "level", and "W×H×T" stands for Width × Height × Thickness. In the table, a "–" indicates there was no information on the subject (except in the "Burnt" column, there it means the object was not burnt); and "N/A" means it was not interpretable.

ID	PP	lvl	W×H×T (cm)	Raw material	Technique	Striations	Striation description	Polish	Burnt
2	–	1	4,49×3,81×1,23	Limnic quartzite from Horn valley	made on blade	yes	parallel and transversal (dorsal), thin, shallow, medium lenght	well-developed cereal	–
5	–	1	2,16×1,72×0,5	N/A	made on blade	no	–	well-developed cereal	burnt
7	–	1	2,05×1,64×0,7	Buda chert	–	yes	transversal, thin, shallow, long,	weak plant	–
9	–	1	2,38×1,75×0,76	Buda chert	made on blade	yes	parallel, thin, "filled-in", long,	well-developed cereal	–
14	–	1	2,38×1,43×0,7	Buda chert	made on blade	yes	parallel	well-developed cereal	–
24	–	1	3,18x1,94x0,72	Buda chert	made on blade	no	–	weak cereal	–
35	–	1	2,53×1,52×0,36	Mecsek radiolarite	made on blade	no	–	well-developed cereal	–
39	–	1	2,49×2,48×0,58	Buda chert	–	no	–	weak cereal	–
46	–	1	2,76×1,66×0,58	N/A	–	no	–	well-developed cereal	burnt
78	–	1	2,65×1,77×1,01	Buda chert	–	yes	parallel, thin, shallow, long	well-developed cereal	–
95	–	1	3,7×2,93×1,02	Buda chert	–	no	–	well-developed cereal	–
103	–	1	2,32×1,9×0,73	Buda chert	–	no	–	weak cereal	–
109	–	1	2,51×2,04×0,88	Hydroquartzite	–	no	–	weak cereal	–
132	–	1	2,5×2,48×0,82	Buda chert	–	no	–	well-developed cereal	–
135.2	–	1	2,08×2,03×0,77	Buda chert	made on flake	yes	parallel, thin, shallow, medium length,	well-developed cereal	–
135.4	–	1	1,8×1,61×0,48	Buda chert	–	yes	parallel, thin, shallow, short	well-developed cereal	–
160	700687	1	1,54×1,73×0,4	Radiolarite	made on blade	–	–	N/A	–
164	701010	1	2,36×1,68×0,83	Buda chert	–	yes	transversal, deep, wide, long,	weak cereal	–
290	700566	1	2,12×2,24×0,95	Hydroquartzite	made on flake	yes	parallel,thin, shallow, medium lenght,	well-developed cereal	–
291	700570	1	2,77×2,24×0,8	Buda chert	made on flake	no	–	well-developed cereal	–
377	700565	2	2,02×1,93×0,58	Buda chert	made on flake	yes	parallel	weak cereal	–

ID	PP	lvl	W×H×T (cm)	Raw material	Technique	Stria-tions	Striation description	Polish	Burnt
441	700519	2	2,89×1,58×0,71	N/A	made on flake	yes	parallel, thin, deep, short,	well-developed cereal	burnt
587	700580	2	3,03×2,55×1,06	Buda chert	made on blade	yes	parallel, thin, shallow, long	well-developed cereal	–
587	700586	2	1,97×1,77×0,81	Buda chert	made on flake	yes	transversal, thin, deep, long,	well-developed cereal	–
601	700579	2	2,46×1,37×0,62	Buda chert	made on flake	no	–	weak cereal	–
642	700596	2	3,02×2,4×0,98	Buda chert	made on flake	no	–	well-developed cereal	–
677	–	2	2,43×2,09×0,63	Buda chert	made on flake	yes	transversal,wide, deep, long,	well-developed cereal	–
713	700613	2	1,6×0,91×0,55	N/A	–	no	–	weak cereal	burnt
729	700607	2	1,46×1,02×0,68	N/A	–	no	–	well-developed cereal	burnt
833	700685	2	2,71×2,44×0,8	Buda chert	made on flake		–	N/A	–
851	700749	2	1,98×1,51×0,53	Buda chert	–	no	–	weak cereal	–
862	700812	2	1,83×1,84×0,46	N/A	made on flake		–	N/A	burnt
889	700734	3	2,27×1,54×0,93	N/A	made on flake	no	–	well-developed cereal	burnt
936	700731	3	3,2×1,74×0,74	Buda chert	–	yes	transversal on ventral, parallel on dorsal,thin, shallow, long	well-developed cereal	–
1003	700827	3	2,35×1,93×0,79	N/A	made on flake	no	–	well-developed cereal	burnt
1072	700838	3	3,11×3,16×1	N/A	–	no	–	well-developed cereal	burnt
1204	700860	3	1,63×1,69×0,68	Bakony radiolarite	made on blade	no	–	well-developed cereal	–
1237	700872	3	2,55×1,89×0,79	Buda chert	made on flake	no	–	weak cereal	–
1353	701451	3	2,61×1,57×0,81	Buda chert	made on flake	no	–	well-developed cereal	–
1353	701455	3	3,51×1,89×0,51	Buda chert	made on flake	no	–	well-developed cereal	–
1355	701474	4	2,94×2,35×0,84	Buda chert	made on flake	no	–	well-developed cereal	–
1358	701517	4	1,34×1,36×0,68	Buda chert	made on blade	no	–	well-developed cereal	–
1366	700932	4	2,46×2,01×0,88	Buda chert	–	no	–	well-developed cereal	–
1395	700950	4	2,62×2,13×0,83	Buda chert	–	no	–	well-developed cereal	–
1432	700956	4	2,18×1,6×0,86	N/A	made on flake	no	–	well-developed cereal	burnt

ID	PP	lvl	W×H×T (cm)	Raw material	Technique	Stria-tions	Striation description	Polish	Burnt
1436	700977	4	2,52×2,45×1,12	Buda chert	made on flake	yes	parallel, thin, shallow, medium lenght	well-developed cereal	–
1442	–	4	2,55×2,15×0,74	N/A	made on flake	no	–	well-developed cereal	burnt
1444	701125	4	2,51×2,28×0,78	Buda chert	–	–	–	N/A	–
1624	701307	5	2,35×2,15×1,01	Buda chert	made on flake	no	–	weak cereal	–
1624	701306	5	2,5×1,97×0,77	Buda chert	made on flake	yes	parallel, thin, shallow, long	well-developed cereal	–
1637	701430	5	2,46×1,26×0,29	N/A	made on flake	no	–	well-developed cereal	burnt
1647	–	5	2,53×1,52×0,36	Mecsek radiolarite	made on blade	no	–	well-developed cereal	–
1648	701733	5	3,12×2,22×0,68	N/A	made on flake	no	–	well-developed cereal	burnt
1667	701427	5	2,5×1,74×0,68	Buda chert	made on flake		–	N/A	–
1734	701487	5	2,93×2,72×1,04	Buda chert	–	no	–	well-developed cereal	–
1765	702561	5	2,71×1,9×1,03	Hydroquartzite	made on flake	no	–	well-developed cereal	–
1793	702646	6	2,47×1,92×0,81	Buda chert	made on flake	no	–	weak cereal	–
1793	701637	6	1,67×1,76×0,36	Buda chert	–	yes	parallel, thin, shallow, long	well-developed cereal	–
1794	701623	6	4,43×2,83×0,7	Buda chert	made on flake	–	–	N/A	–
1802	701610	6	2,28×3,18×0,97	Buda chert	made on flake	yes	parallel, thin, shallow, short	well-developed cereal	–
1812	701643	6	2,25×1,73×0,61	Buda chert	made on flake	no	–	well-developed cereal	–
3049	701739	6	2,9×2,27×1,23	Buda chert	made on flake	no	–	well-developed cereal	–
3058	701764	6	2,03×2,04×0,65	Buda chert	made on flake	–	–	N/A	–

3.3 PROBLEMATIC OF SICKLE GLOSS

It has been proven for more than a decade now that sickle gloss is not always related to harvesting. The problem of interpreting sickle gloss emerged first in relation to the so-called Canaanean Blades (Anderson *et al.* 2004). Canaanean blades were systematically used during the third millennium BC at numerous sites in Levant. They are mostly long in size and regular in shape, especially in width and thickness. They have a trapezoidal cross-section, a straight-edge

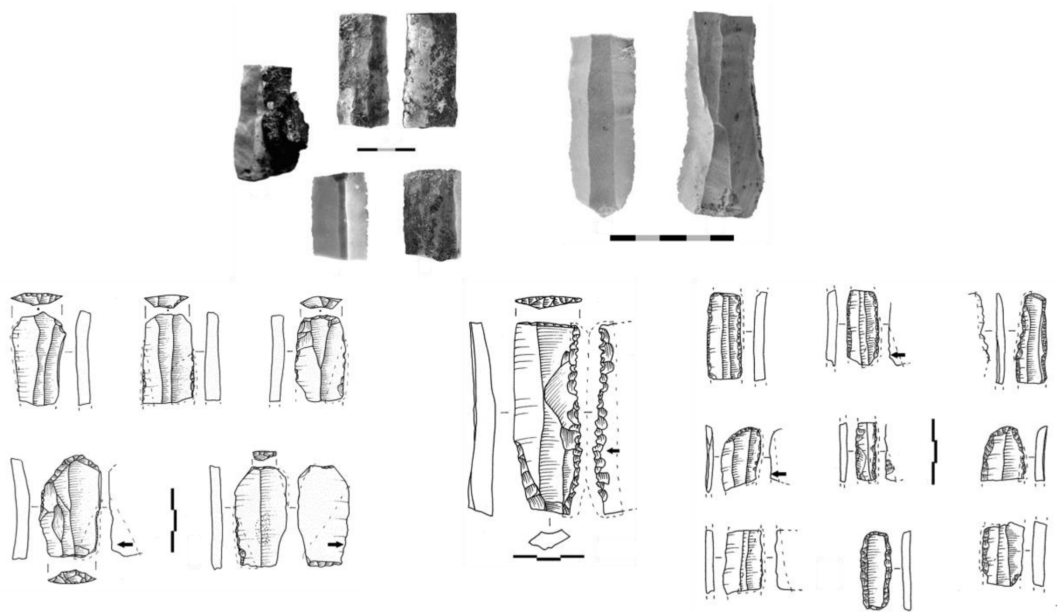


Figure 40: Canaaean blades from the Near East (after Anderson *et al.* 2004, 89, 94 Figure 1, Figure 3; Gurova 2014a, 93 Figure 1).

profile and parallel edges and raised areas (Anderson *et al.* 2004, 88; 91) (Figure 40). The segments of Canaanean blades are traditionally interpreted as agricultural tools, particularly harvesting tools (sickles), mainly because of the gloss on their edges (e.g. Anderson 1980; Rosen 1983, 1997). Experimental use-wear studies have shown that this 'sickle gloss', i.e. a highly glossy surface on flint, can be produced by a variety of uses. These uses include cutting silica-rich plants and treatment of these, wood-working, working with soft stone, scraping clay, cutting soil and some hide-working procedures (e.g. van Gijn 1988; van Gijn 1992). However, microscopic attributes of the macroscopic gloss allow a distinction among the different functions. The distinctions are supported by experiments as well. In the case of Canaanean blades, the polish topography is flat and distributed in a wide band along the edge which indicates contact with silica-rich plants, for example, cereals (Anderson *et al.* 2004, 96). This would support the sickle interpretation. However, there are more functions during cereal processing such as threshing. This activity can be done in several ways but there is one main way which includes the use of flint: the flint inserted into threshing sledges (tribulum). Other possibilities for threshing are to tramp the crops with animals (Anderson 2014b), or, later, with the use of flails (Calderón 2014), beating or lashing bunches of crops or the use of wooden mallets (Pena-Chocarro 2014). Most of these variations were carried out on a threshing floor; a clean, hard surface with simple architecture, mostly separated from inhabited areas (Whittaker 2014b). However, the main threshing technique known and investigated from archaeological evidence is the use of a 'tribulum'. There are variously designed threshing sledges. This morphological variety is mainly known from ethnographical evidence (e.g. Anderson 2014a; Gurova 2014b, 2014c; Shippers 2014; Whittaker 2014a). Canaanean blade segments were used in an extensive experimental project in threshing sledges (Anderson *et al.* 2004) (Figure 41). This experiment resulted in distinctive attributes in microwear traces between harvesting traces and threshing traces. The examined ethnographical and experimental threshing sledge inserts produced "smooth, bright areas interrupted by zones with rough, abraded and pitted topography; characteristic linear features such as long troughs drawn from large irregular pits in the surface" (Anderson *et al.* 2004, 98). The investigated Canaanean blades in the aforementioned study displayed

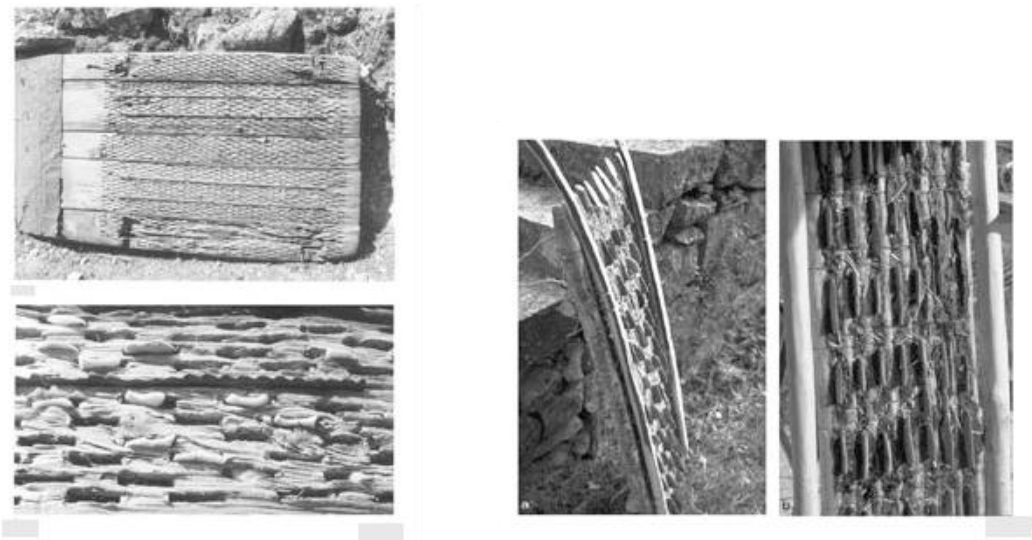


Figure 41: On the left ethnographic threshing sledge from Spain, on the right experimental threshing sledge (after Anderson *et al.* 2004, 101-2 Figure 6, Figure 7).

the same kind of wear; therefore, they have been interpreted as threshing sledge elements in the Near East, mainly in Mesopotamia. However, Canaanean blades were used in a broader area and there are variable results from studies carried out in Bulgaria and Israel (Gurova 2013). Gurova examined Canaanean blades from five Bronze Age settlements in Israel and ethnographical threshing sledges and archaeological blades from Bulgaria. In these assemblages, the blades produced a bright polish with smooth and flat topography and texture and many depressions, some of them comet-shaped (Gurova 2013, 190-2). The polish is parallel to the cutting edge and there is no symmetry in the distribution of the polish on the two sides of the edge. The striations vary from invisible to fine and abundant, parallel to the working edge. The common feature of the examined polishes is that they are pitted. Therefore, these tools have been interpreted as sickle elements not threshing sledge inserts (Gurova 2013, 192). However, Gurova mentions the uncertainty in differentiation of the sickle versus tribulum inserts. One of them is the lack of agreement over the distinction of microwear traces caused by the different processing of cereals like harvesting, threshing and ground-stem cutting, therefore she does not see reliably established patterns for differentiating the microwear traces of sickle and threshing sledge elements (Gurova 2013, 180). The deep, comet-shape depressions have long been considered an indicator of sickle use (e.g. Skakun 1994), however, in the studies of Anderson and her team, this appears as an indicator of tribulum (e.g. Anderson *et al.* 2004). Although in Gurova's analysis, comet-shape depressions have been found on both sickle inserts and threshing sledge inserts, she considers it a common and diagnostic feature of tribulum elements (Gurova 2013, 180). One of the possible explanations for the high similarity between these inserts is that the blades were first used as sickle elements and later on inserted into threshing sledges (Anderson and Inizan 1994, 98; Gurova 2013, 196). This highly likely scenario makes the differentiation between tribulum and sickle inserts even more difficult.

Threshing sledges are also known thanks to ethnoarchaeological and archaeological sources in the Balkans but they differ in several respects from those reconstructed and used in the experiments of Anderson and her team (Figure 41). The significant differences lie in the body construction and insertion strategy. No adhesive residue has been observed neither on Bulgarian blade elements nor on tribulum inserts from this area. The flint elements also differ morphologically; they have a distinctive elongated ovoid shape obtained by intentional retouch (Gurova 2013, 183). From the cultural and stone industrial similarities between the Balkans and Hungary during the Bronze Age, it can be assumed that this type of tribulum could have been used in Hungary as well. However, there is yet no archaeological evidence of any kind of threshing sledge in Hungary. There are several types of explanation for this lack of evidence: They might have used threshing sledges from organic material i.e. wood without flint insert, or threshing floors. Threshing could have been carried out outside of the inhabited area of the settlements or even in the open fields, areas that are usually not excavated (Gurova 2013, 183). As the most trivial explanation, the evidence of such flint inserts are overlooked in the analyses. In the assemblage from Százhalombatta-Földvár, no tribulum element was found.

Chapter 4

Methodology

4.1 INTRODUCTION

Microwear studies already have a history of several decades (Semenov and Thompson 1964). Microwear studies already have a history of several decades (Keeley 1980), but nowadays, the raw materials of the analysed items include almost all types of ancient and historic raw materials (Buc 2011; Cristiani and Borić 2012; Jin and Shipman 2010; LeMoine 1994; Marreiros *et al.* 2014; McClendon 2015; Soffer 2004; van Gijn and Lammers-Keijsers 2010; Varela *et al.* 2002). During the last circa 50 years, more examination procedures have been worked out and are in use yet terminology is still not strictly defined, neither is the name these types of analyses refer to, nor in descriptive terms. In the beginning, two main approaches were followed: the low-power approach and the high-power approach (Keeley 1980; Semenov and Thompson 1964). Later, researchers argued over using a combination of the two approaches (van Gijn 1990), and nowadays, that is the primarily followed methodology. The importance of experimentation has been recognised (Vaughan 1981) and become more pronounced. Experimental reference collections have been built up and are still growing at present. A good microwear study includes experiments as well, or at least comparisons with reference collections (van Gijn 2012). New materials and new traces all require an experimental exploration. Whereas at the beginning, microwear analysis was used to answer questions about form, function and site typology, recently, it has steadily come into contact with the framework of material culture studies. The new perspectives attach microwear analysis with studies of cross-craft interaction and the biography of objects, where this method plays a key role. Microwear studies are addressing questions about the "life of the object, the transformations it underwent through time and possibly also what happened to it upon deposition, loss or discard" (van Gijn 2012, 276). With a combination of other approaches such as provenience studies, technological studies and examining the depositional context, microwear analyses are best suited to studying the interconnectivity of different craft activities and the possible meaning and role the object had during its lifetime and its possible changes (van Gijn 2012, 276). Another change of the development of microwear analysis refers to an overall problem of archaeology, namely the tradition of specialists in different material culture categories. During the early years of microwear studies, researchers concentrated on one material complex which was mostly flint and chert at first. Other objects, tools and raw materials were overlooked in research. From the early 2000s, tool kits became a focus of microwear analysis. The tool kit is defined by van Gijn as: "a set of tools used in the same *chaîne opératoire*" (van Gijn 2008, 219).

As can be seen, microwear analysis has developed considerably over the last few decades and is far-reaching in pursuance of the addressed questions. These circumstances make it necessary to have a detailed presentation of the microwear study as a method and its terminology as used in this study.

The analysis method has been described as "for directly inferring tool use from the microscopic traces of wear left on their edges" (Keeley, 1980, 1). As materials come into contact with one another, they leave macroscopic and microscopic traces on both of the contact surfaces, indicative of the mechanical attributes of that contact. Elements like the amount of pressure, the duration of contact, the angle and the type of materials that are in contact affect the shape of the traces left behind. These traces range from fractures, the removal of material and deep cuts visible with the naked eye, to tiny alterations of the surface visible only with microscopes (Keeley 1980; Semenov and Thompson 1964; van Gijn 1990; Vaughan 1981). Suggestions can be given about the way archaeological artefacts were used in the past by comparing the traces found on these tools with the ones found on experimental tools (Keeley 1980; van Gijn 1990; Vaughan 1985). Through this, it is possible to draw up biographies of objects and in connection to provide information for a better understanding of human behaviour in the past (e.g. van Gijn 2010). That is the reason why microwear analysis has been chosen as a method for this study.

This type of analysis is referred to in different terms in different studies such as *use-wear*, *use wear*, or *microwear* (Marreiros *et al.* 2014). The term traceology has also been used, especially in French areas, since the word comes from the French term *tracéologie*. In the present thesis, the term microwear is used because it refers not just to traces of use but also to other traces. When looking for traces on the surface of the tool that have impacted the life of the tool, it is important to include post-excavation traces and any kind of relevant markings that are visible. The analysis is a visual process performed with the naked eye and the help of microscopy. The used microscopes are stereo- and metallographic microscopes with a magnification of up to 1000x (van Gijn 2014b, 166).

4.2 TERMINOLOGY

The microwear traces mentioned above are in fact damages to the surface or edge of an object. There are many different types of traces, each with different aspects. There are four main categories of wear: edge-removals, edge-rounding, polish and striations. The specifics of these damages and the combination of these specifics give us information to interpret the function or even life of the analysed tool after exhumation (van Gijn 1990, 3). Different types of traces require analysis using different magnifications; this is the reason why an analysis using both the low- and high-power approaches is considered standard. For a better understanding of microwear, a description will be given since it is important to go into detail with the terminology. The below-used terminology is based on the work of van Gijn (van Gijn 1990).

Along with damages, there are different types of traces that can be observed. There are edge damages as well as edge-removal and edge-rounding traces.

4.2.1 Edge-removals

Although edge-removals, often referred to as micro-retouches or use retouches, have a descriptive system (Odell 1975), there are important difficulties with this kind of damage (van Gijn 1990, 4). The most important thing is not only that impacts against the worked material can cause fracturing but also that there are intentional retouches, for example: to produce a cutting or scraping edge. Besides, there are non-intentional removals either during or after the time of inhabitation, for instance: transporting, accidental dropping,

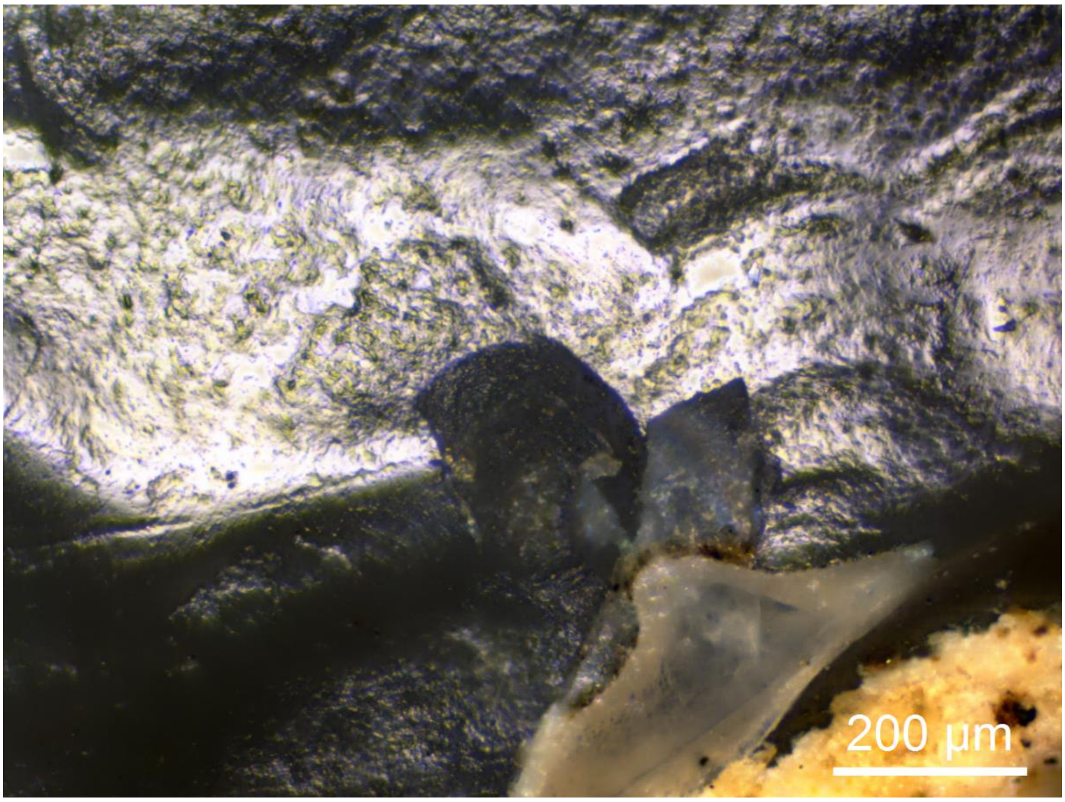


Figure 42: Edge-retouch during use on ID 132.

excavation or post-excavation damages. Thirdly, the variation in micro-retouch morphology is far larger than it was originally claimed in early studies of the low-power approach. Last but not least, micro-retouch is often not developed, especially upon brief contact or with soft materials. Therefore, used areas and function have to be interpreted from the additional information of micro-scarring, polish, striations and edge-rounding all together. The following attributes are observed in relation to edge-removals: the location (ventral only, dorsal only, dorsal and ventral altering, dorsal and ventral bifacial), the distribution (subjective phenomena including overlapping, close/regular, close/irregular, wide/regular, wide/irregular, not applicable), the width (short or marginal, long, invasive, covering), the form (scalar well-defined, scalar vague, lamellar, half-moon, trapezoidal, square, other, unsure) and the termination (step, hinge, feather, snap, other, unsure) (van Gijn 1990, 4; 17-8) (Figure 42).

4.2.2 Edge-rounding

Edge-rounding is a rather vague aspect; however, the degree of rounding can indicate the type of contact-material. It has been shown in experiments that hide-working correlates with extensive edge-rounding while bone-working doesn't usually cause much rounding. Post-depositional environments also affect the rounding of the edges. The description of this aspect is rather subjective; it can be sharp, slightly rounded, very rounded or nibbled (van Gijn 1990, 8; 19) (Figure 43).

4.2.3 Polish

The use-polish type of trace is a very fascinating aspect of the analysis while also being a source of great speculation and debate. As a definition, Vaughan described the micropolish as 'an altered flint surface which reflects light and

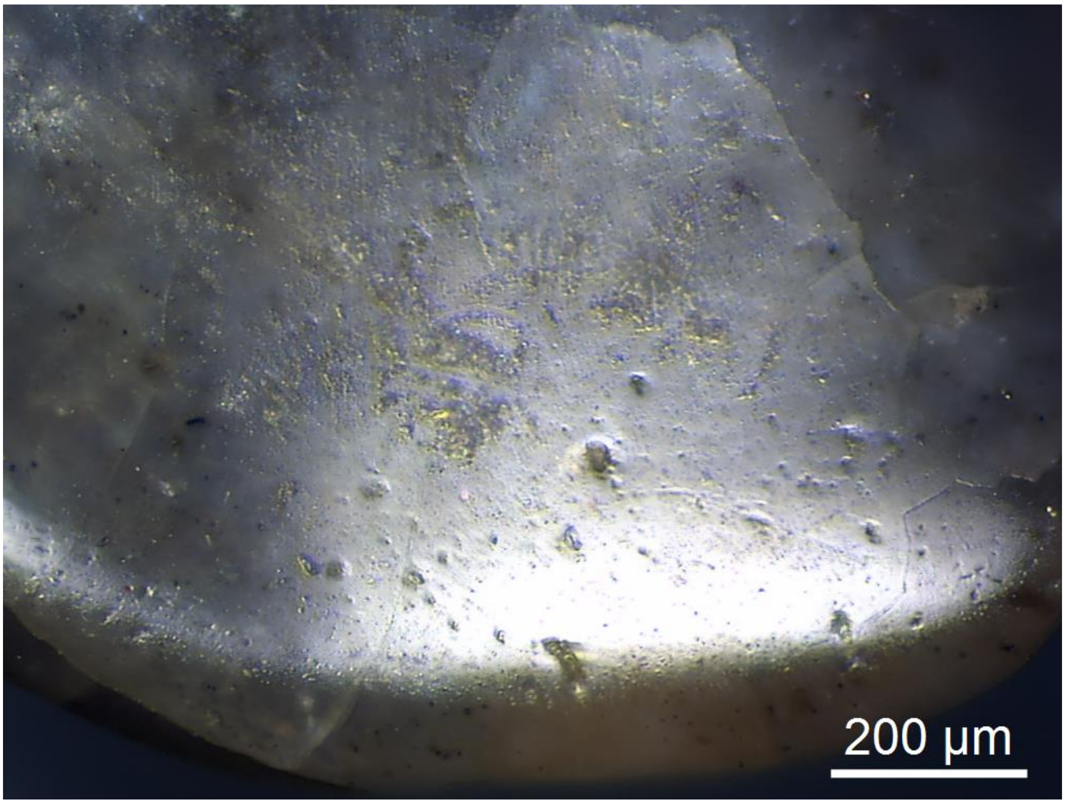


Figure 43: Very rounded edge on ID 1204_700860.

which cannot be removed with acids, bases and solvents' (Vaughan 1981, 132). However, this definition is problematic. It has been proven that some chemical solvents *can* affect polishes which led van Gijn to suggest adding the term 'weak' before acids, bases and solvents in the definition (van Gijn 1990, 5). One has to be aware that residues and polishes are hard to separate because both reflect light. If the reflective spot can be removed chemically, then it is residue. Although polish is a vague term, it can be described in terms of various attributes (Figure 44). These attributes are:

1. Location: dorsal and ventral but dorsal more; dorsal and ventral but ventral more; dorsal and ventral equal; only dorsal; only ventral. The location of the polish and its relative extent could give information as to the life of the tool.

2. Distribution: isolated spots, a thin line along the edge, banded along the edge, banded away from the edge, spread or spread in the background. The distribution is closely related to the type of worked material.

3. Texture: the category includes smooth, smooth and greasy, smooth and matt, rough, rough and greasy, rough and matt and not applicable. The texture is also closely related to the contact-material.

4. Brightness: it can be very bright, bright or dull. The brightness is also a very subjective category and correlated with the contact-material.

5. Topography: again, specific contact-materials are associated with certain topography. The characteristic of it can be domed, flat, corrugated, cratered, pitted, bubbly, comet-tails, bevelled or not applicable.

6. Directionality: this is good indicator as to the movement of how the tool was used. Categories include absent, perpendicular, parallel, diagonal, random and unsure. (van Gijn 1990, 5-7; 18-20)

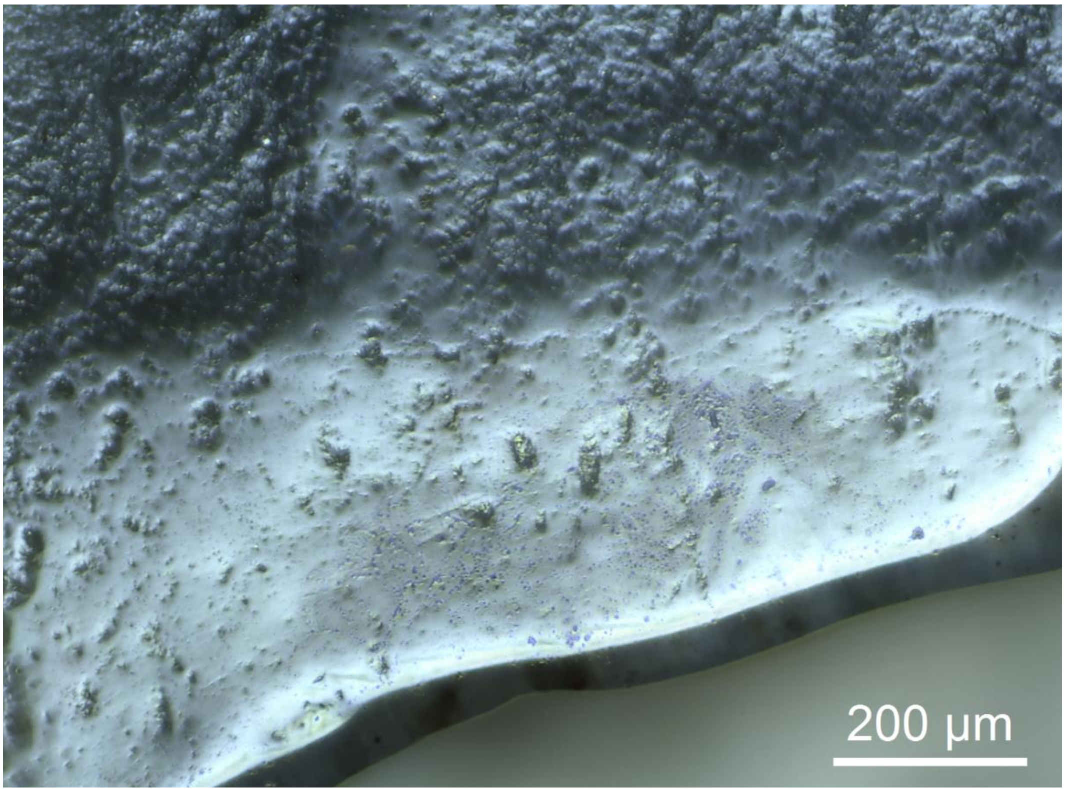


Figure 44: Well-developed polish on the dorsal aspect banded along the edge and spread in the background with smooth and matt texture, flat and pitted topography and parallel directionality to the edge in ID 1355_701474.

4.2.4 Striation

"Striations are the result of the presence of abrasive particles between tool and contact material" (van Gijn 1990, 7). These scratches are only visible on polished surfaces. Their appearance is connected to the worked material and the circumstances under which the activity was carried out. The orientation of the striae and their distribution on the tool indicate the working motion. They are described in terms of their length, width and depth. Categories include long, medium, short; thin and wide, shallow and deep (Figure 45).

4.3 Required Instruments

Traditionally, the field of microwear inquiry has been split into two approaches: the *low-power* and *high-power approaches*. *Low-power approach* refers to analyses concentrating on edge-damage in the form of micro-retouch

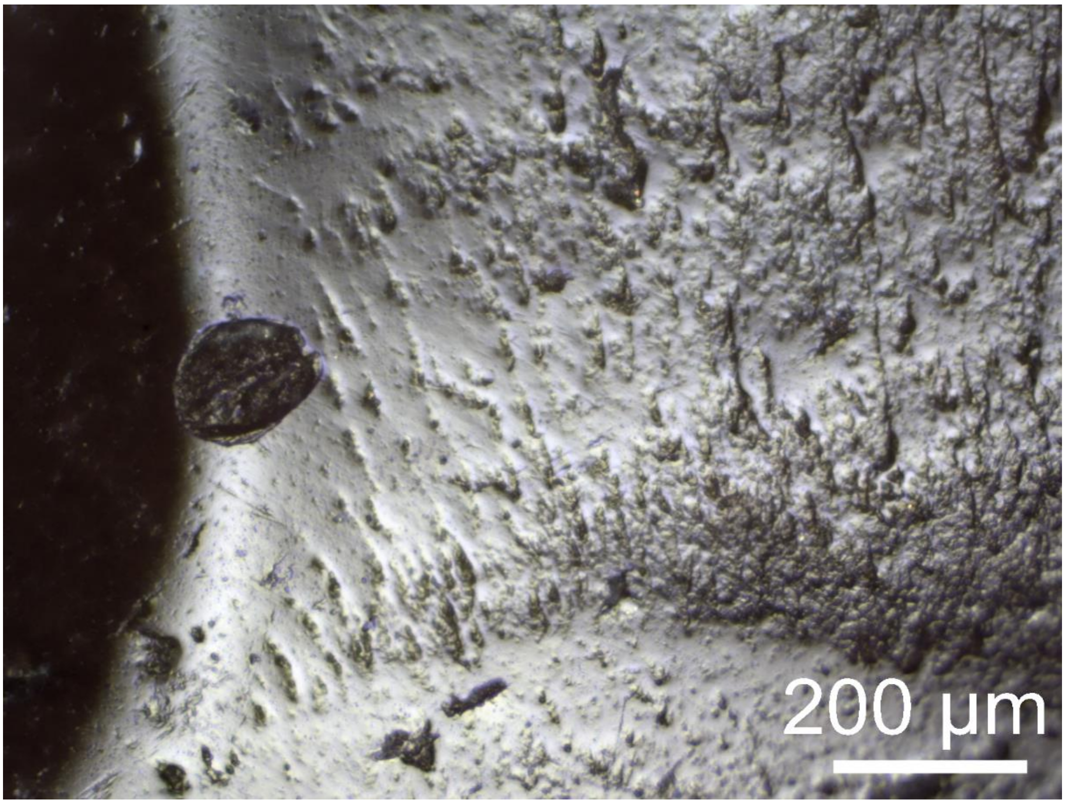


Figure 45: Micropolish with transversal striation on the ventral aspect of ID 936_700731.

that can be studied with a magnification of up to 100x (van Gijn 1990, 3). *High-power approach* means the analysis of microwear traces with a magnification of up to 1000x. The aim is to interpret the use (motion and material worked) of the ancient tools (Unger-Hamilton 1989, 89). In some other studies, the magnification lying between 100-400x is defined as belonging to the *high-power approach* (van Gijn 1990, 3). At the present time, a combination of the two approaches is more common. The standard methods involve research using both stereo microscopes and metallographic incident light microscopes (van Gijn 2014b, 166). The surface of the tool has to be positioned at an exact 90° angle to the source of the light to be able to analysed, because the traces only become visible in this way (van Gijn 2014b, 167).

For the analyses represented in this paper, the following instruments were used: The stereo microscope used for this research is a Nikon® SMZ800.

Figure 46: Left Leica® DM1750M microscope with 2.5 Megapixel HD Microscope Camera Leica® MC120 HD camera, right Nikon® SMZ800 stereomicroscope with Schott KL200 light.

(Figure 46 right). The magnification of the microscope is up to 63x. The lights are separated and can be set with flexible arms; this allows us to look at the artefact from every direction and angle. The light is a Schott KL200.

For the high-power approach, a Leica® DM1750M was used, capable of magnification of up to 200x (Figure 46 left).

The micro-photos were made with Leica® Application Suit 4.5 software and a 2.5 Megapixel HD Microscope Camera Leica® MC120 HD.

The photos were made with a Nikon® D5100 with AF-S Micro NIKKOR 60mm lens.

4.4 ANALYTICAL PROTOCOL

4.4.1 SAMPLING

Because it is a time-consuming method and a full analysis of each piece is required for a well-founded interpretation, most of the time, some sort of sampling is required. There are two levels of sampling possible: at the level of assemblage (i.e. selecting the artefacts that will be studied) and at the level of individual artefacts (i.e. selecting the areas of the artefact that will be analysed). For sampling, we have to know the specific archaeological questions, no matter on which level the sampling will be done. For this study, the primary question was the usage of the typological category: sickle blades. In detail, other questions were proposed such as how the flint pieces were hafted, the method of harvesting, the harvested cereal species, etc. (Figure 47).

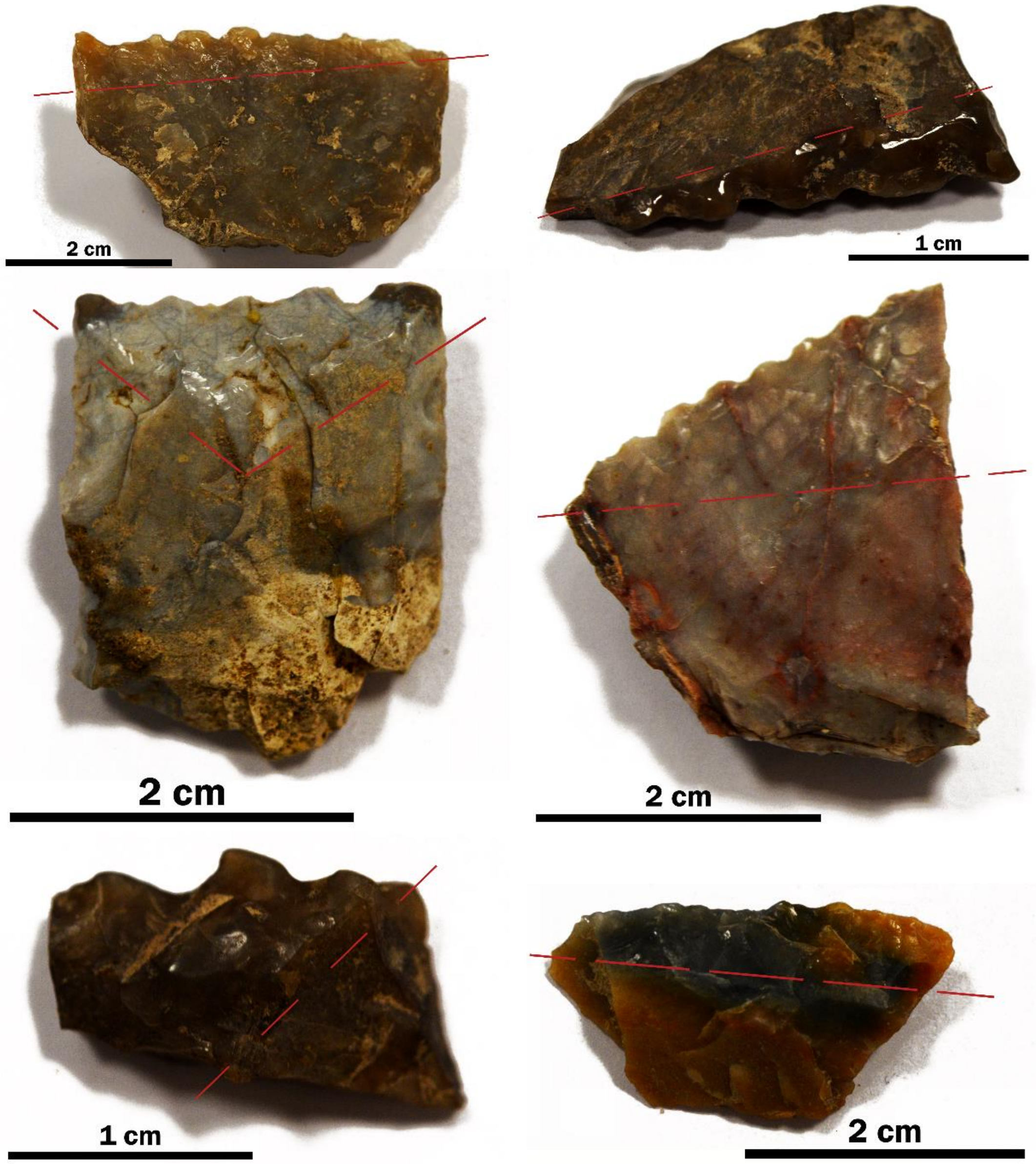


Figure 47: Traces of hafting on the archaeological sickle blades. Different ways of hafting are evident. The red striped lines indicate the transition from harvesting traces (gloss) to where the artefact had been in the haft.

For the assemblage level of sampling, the most important criteria should ideally be that the sample has to contain microwear traces, that it is well-documented, that it has not been affected by post-excavation damage and that it is representative (Keeley 1980, 84). Unfortunately, in order to detect patterns, we need to study large samples which requires a lot of time and resources. Thus, the representability of a sample is very important when trying to infer the function of a site from a selection of its material. At this level, the recent assemblage was sampled according to the following criteria: All levels of the analysed occupation layer should be presented at the same ratio and the best information of the spatial location should be available. According to these criteria, there were 20 pieces out of a possible 33 from Level 1, 12 out of a possible 35 from Level 2, 8 out of a possible 16 from Level 3, 8 out of a possible 20 from Level 4, 8 out of a possible 24 from Level 5 and 7 out of a possible 19 from Level 6 selected. Except for 19 pieces, the whole assemblage has a point provenience number which shows the spatial position to millimetre accuracy in the GIS database (Figure 48).

At the individual artefacts level, to help with sampling, a low-magnification stereo microscope can be used. This enables the detection of areas with possible traces of wear that require more detailed study. Using a stereo microscope also allows for the detection of the most residue on the tool and gives a rapid, critical

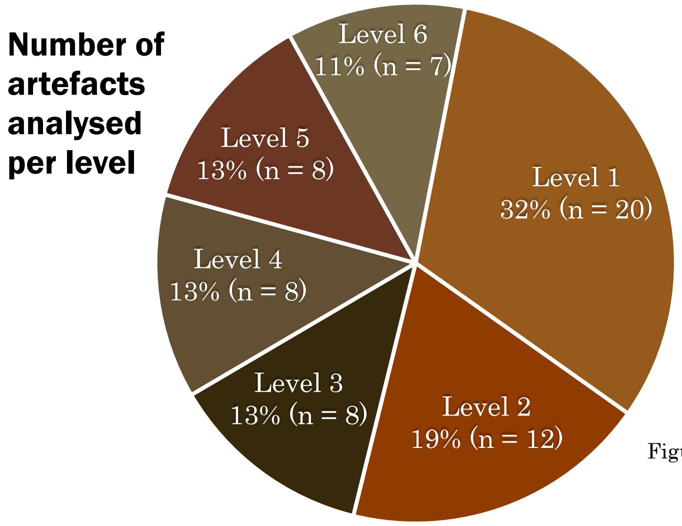


Figure 48: Pie chart of the number of artefacts analysed per level.

knowledge of wear trace patterns in our assemblage (van Gijn 2014b, 167). The studied flint tools were sampled by stereo microscope. The edges which showed wear traces were examined in detail and the indications of haft were recorded with this method as well.

4.4.2 Cleaning

The cleaning of the artefacts is the next step once the samples have been chosen. Both sampling and residue analyses should be carried out prior to cleaning, especially before any kind of chemical cleaning. Different opinions about cleaning procedures are available in the relevant literature; mostly, it depends on individual cases (Evans and Donahue 2005; Keeley 1980; van Gijn 1990; Vaughan 1985). Cleaning with water and soap and carefully wiping with a paper towel is sometimes enough. However, it is commonly necessary to wipe the artefact with alcohol or lighter fluid to remove finger grease (Keeley 1980; van Gijn 1990, and van Gijn pers.com.).). If this is not enough, chemical cleaning is necessary. For this, the piece should be immersed in an HCl solution and a KOH solution[7]. It is also recommended to use the HCl in an ultrasonic tank for 3-5 minutes. This is especially true for experimental tools as they will be more prone to being covered by residues. Archaeological artefacts can be cleaned in an ultrasonic tank with pure water. Drying, especially after the use of alcohol or soap, is recommended with a paper towel but only careful patting, not rubbing, as the paper can introduce new traces (van Gijn 1990, 2014b). Regular cleaning of the tool is absolutely essential during examination using water and soap/alcohol/lighter fluid to avoid incorrect determinations (Keeley 1980; van Gijn 1990, 2014b). In the recent project, the experimental tools were cleaned in the solution recommended by van Gijn (1990, 11). For the archaeological artefacts, the initial cleaning was performed with water and

[7] Keeley (1980) recommended warm 10% HCl and first 20-30% NaOH solution, which he substituted later with KOH. According to Van Gijn (1989), this is unnecessary and recommends a weaker solvent with 3.6% HCL solution and a very small amount of KOH per one litre of water.

soap, followed by alcohol or lighter fluid to remove grease. In some cases, chemical cleaning in the HCl solution and/or ultrasonic cleaning had to be used to remove sediment from the surface of the objects. After cleaning, the pieces were carefully patted dry with a paper towel. Then, the microscopic analysis of the tools was carried out. The traces found on the items were described as per the aforementioned terminology.

4.5 PROBLEMS AND DISADVANTAGES

4.5.1 QUALITATIVE VS. QUANTITATIVE

The main problem of microwear analysis is that it is an inherited qualitative method. By not being a quantitative method, it is hard to be accepted and understood by scientists from other fields. Trying to quantify the method is problematic for two reasons. Firstly, we do not know how microwear traces, notably polish, develop exactly (van Gijn 2014b, 2). Secondly, because of the comparative nature of the method, the analysed attributes are inherently qualitative, sometimes being fairly subjective (Goodale *et al.* 2010, 1194). Even so, there are new studies underway to try and develop a quantitative method for measuring microwear (Goodale *et al.* 2010).

4.5.2 DURATION OF USE

In many cases, to use a tool in an experiment for as long as it would have been used in ancient times is hardly practical. For example, it would take a long time before a reasonably intense gloss developed on an experimental harvesting tool but that time (10,000 strokes or 7-16 hours) is probably still far less than the duration of time that the archaeological tools were used for (Goodale *et al.* 2010; Unger-Hamilton 1989).

4.5.3 Time-consuming

Consequently, for these reasons, microwear studies are hugely time-consuming (Goodale *et al.* 2010; Unger-Hamilton 1989; van Gijn 1990, 2014b), even if we apply sampling at both assemblage and artefact level. Ideally, every type of raw material, tool, contact material and motion would be tested with an experiment. Thus, every type of trace could be verified. Unfortunately, because this is not practically attainable, some inferences will have to be made on incomplete reference collections.

4.6 Experimental archaeology and reference collections

The next step of the analysis is the comparison of the observed traces with those already known and seen on experimental tools. To better understand the comparison process, it is advisable to briefly discuss the relevance, advantages and disadvantages of experimental archaeology.

Since the highly influential work of Semenov (Semenov and Thompson 1964), experiments have formed the basis of the training for every wear-trace student. Experiments are necessary to understand the use of tools and produce reference collections. For performing the experiments and model-building, ethnographic parallels are used. From this kind of information, we can reconstruct the possible ways tasks were carried out. It also allows for an understanding of the different procedures required and the scheduling of subsistence tasks. We have to use this information to perform our experiments (simple references which are usually done in a very generalised way) because conditions have to be controlled(van Gijn 1990, 23-6).

The experiments serve as a reference for microwear analysis. Their results can be evaluated in light of the character of the wear-traces present on the archaeological artefact, their distribution, for example, but possibly even the efficiency of the tool, amongst other things. By gathering the experimental tools, reference collections are built. Analysis of the reference collections helps us to interpret the traces of the archaeological tools (van Gijn 1990, 23-6).

When previously unknown traces are identified, experiments are the only way to get a grasp on the possible causes behind these traces. If new experiments give the possibility of a positive inference, these experiments can be added to the reference collection for an ever-growing collection of comparative material.

4.6.1 Experienced vs. non-experienced experimentation

The experiments also introduce some difficulties. As the experiment has to mimic the task as it was performed in the past, thus recreating the actions of a person living in the past, it is essential to understand that these people were living in a vastly different world. They would have been just as experienced in using their everyday tools as we are with ours, or even more so. However, when people in the present try to use technologies of the past, it is unlikely that they can manage with the same kind of ease. Thus, there is the question of the representability of experienced and non-experienced people who carry out the experiment. Experience does not only influence the efficiency of the activity but also the traces achieved (Pomstra and van Gijn 2013; van Gijn 2014b).

4.6.2 Experiments: variety in material and practice

Experimental tools are used on one type of contact material and usually entail one type of motion which is simple and mechanical. However, clearly this is not the case for how many of the archaeological tools would have been used. Re-use, re-sharpening, storage, carrying around, destruction and a number of other activities may have left traces on the tool that would influence the analysed damages (van Gijn 2014b).

4.6.3 Controlled vs non-controlled experience

Experiments offer the possibility of controlling some of the diverse variables that are involved in activities and the use of materials in the past. This control lies on a scale from controlled lab settings to 'natural' field settings (Marsh and Ferguson 2010, 4). Placement on this scale highly depends on the research foci and potential. For more effective research, it is necessary to integrate lab, 'natural' and even ethnoarchaeological observations, thereby providing data which has a direct bearing on archaeological interpretation. Controlled lab experiments are replicable, focus on few variables that are highly controlled and therefore produce more scientific results whereas field experiments replicate more closely any possible prehistoric circumstances at the expense of tight controls over the variables. It results in less replicability and more subjectivity. The research questions of the experimental projects specify the settings of the approach. Highly controlled settings are mainly related to focusing on the physical and mechanical properties of materials, the research questions often far removed from archaeological interpretations. Therefore, they describe more the universal properties of materials and the applicability of their results does not defend any cultural context. These types of experiments are often used in relation with use-wear studies because they give a more direct interpretation of the traces. However, they have to be connected to other experiments and archaeological observations (Marsh and Ferguson 2010, 4-5). Lesser controlled experiments are related to generating hypotheses and conducting related controlled experiments. They rely more on the human user, the most difficult variable to control and are more suited to answering questions like how real people used real tools to complete real tasks in the past. However, these experiments are less repeatable and prone to a range of complications (Marsh and Ferguson 2010, 4-5).

4.6.4 Relation of experiments with archaeological research questions

The reason to do experimental research is closely related to a keen desire for understanding or testing hypotheses that have been developed during the study of archaeological materials. Therefore, the experiments are highly connected to the archaeological research questions for which researchers already have the questions in-hand to be answered via the experiments (Marsh and Ferguson 2010, 9). This requires that the development of the experiment aim to quantify the answer which itself can be a source of guided methods and observations. It is important to keep an open mind and pay attention to any possible results which may not directly be related to the research question.

4.7 INTERPRETATION

For the time being, it is not possible to determine a use from microwear traces. A well-supported interpretation can be given from comparisons with experimental tools but not a determination. There are several reasons for this: It can never be known with 100% certainty how a tool was used in the past. Multiple reuse, different worked materials, much longer duration of usage, daily usage, etc. all affect the microtraces which cannot be perfectly reconstructed. In experimentation, time is mostly limited, therefore, experimental tools are used for a shorter time than can be presumed for archaeological tools. People have different skills and know-how than people in the past which also creates differences in the uses of experimental and archaeological tools. Moreover, skills and know-how cause differences among different experiments as well. These attributes result in an uncertainty in microwear analysis, combined with the other problems as mentioned above, such as quantity. Therefore, the result of microwear analysis is an interpretation of the usage, not a determination – at least for the time being.

4.8 CONCLUSION

Microwear analysis comes with its own problems and disadvantages, just like any other scientific method, the biggest problem being that it is not a quantitative method, thus hugely affecting the comparability which is vague and subjective at best. We need specialised researchers to do the analysis, relatively expensive equipment (although microscopes are less expensive than most of the other scientific methods employed in archaeology) and considerable amounts of time per artefact studied. On the upside, with good researchers who are aware of the aforementioned problems, this is the most useful and reliable method for understanding the use of tools and their life history.

Chapter 5

Experiments

5.1 Introduction

Experiments are an important part of microwear analysis because it is a comparative, qualitative study that gives the observations on the archaeological pieces meaning. In order to do proper comparisons, it is essential to do experiments in line with prehistoric conditions. To help the analysis discussed in the current study, experiments were performed in July, 2015. The experiments focused on harvesting with flint blades. They were carried out in Hungary at the Archaeological Park in Százhalombatta, a few kilometres away from the site of Százhalombatta-Földvár (Figure 49). The experiments had two main goals: to differentiate between high and low

Figure 49: Location of the Archaeological Park and the Bronze Age tell settlement at Százhalombatta.

harvesting, and between the three types of cereals that are cultivated in the Archaeological Park. High harvesting means cutting the stems near to the head (Figure 50). Low harvesting is when the stems are cut near to the ground (Figure 51). In the experiments unused flit flakes were used without hafting. The experiments took part in two sessions, due to they got ripe/mature for harvest in more than one-week difference.

5.2 PROBLEMATICS OF FLINT AND SICKLES

The research topic of the sickle blades is challenging in its own specific way. Therefore, it is important to mention the main problems of the interpretation of flint sickle blades. First of all, the raw material influences the developing

Figure 50: High harvesting technique with Exp. no 9. Figure 51: Low harvesting technique with Exp. no 1.

traces, different flint types acquire micropolish and microtraces and gloss form at different rates. For example, finer-grained flint tends to gloss quicker and more extensively than coarser-grained flint (Quintero *et al.* 1997, 266; 77). The temperature also interferes with the properties of the flint. Heat treatment was a common method in flint tool manufacturing. This modifies the texture and fracture properties of the flint. It also affects glossing in both the time and degree of its appearance (Quintero *et al.* 1997, 266; 78).

5.3 AMBIGUOUS GLOSS AND THE INFLUENTIAL FACTORS

A fundamental issue in microwear studies is the ambiguous nature of wear and gloss and their multiple possible causes, as mentioned above in Chapter 3. It is now evident that many other contact materials other than silica-rich plants cause glossy polish on stone tools such as wood or clay. These glossy surfaces are similar in appearance; therefore, the wear traces of different materials can look alike and many variables can affect glossing patterns and their rates of development (Quintero *et al.* 1997, 264; Unger-Hamilton 1989, 90). Such influential factors are the environmental conditions of the processed plant and related plant structure, the climate, the environment and, consequently, the plant structure which may have been different in the past than today (Unger-Hamilton 1989, 91). Therefore, this may affect the development of the polish and gloss. Researchers experimentally replicate cereal harvesting with local wild species and modern species as well (e.g. Anderson 1991; Goodale *et al.* 2010; Ibáñez *et al.* 2014). Besides, this is the main reason why the present experiments were carried out on cereal growth from seeds from ancient DNA banks (Bálint 2008).

The onset and intensity of gloss formation are also affected by the moisture content of the plants being cut. Therefore, there is a difference in microwear traces between different types of harvested cereals and cereals from different climates (Quintero *et al.* 1997, 267). Experimental evidence suggests that it is possible to distinguish traces of harvesting of different plant types through the study of microwear. However, because of the main variables involved in the formation of microwear traces, large-scale experiments and large-scale archaeological samples are needed for this type of study (Unger-Hamilton 1991). The moisture content of the plants is affected by the moment in the life of a cereal that it is harvested; this also influences the developing traces. Reaping dough-stage cereals causes more gloss than dry cereals. On top of this, some types of modification of the edge of a blade, namely serration, is more effective on dry cereals, causing it to gloss even faster and at a higher rate (Quintero *et al.* 1997, 279).

5.4 Cereal cultivation experiments in the Archaeological Park

In the Archaeological Park of Százhalombatta, experimental cereal cultivation has been underway since 1995 (Bálint, 2008; Jerem, et al., 2011, 68-69). The experiment has two phases. The first one was between 1995 and 2004. At the beginning, two types of cereal were cultivated: emmer (Triticum dicoccon) and spelt (Triticum spelta) and since 1999, experiments with einkorn (Triticum monococcum) have commenced as well. During this phase, every type of cereal was cultivated in six 5m by 5mm plots and between the plots 1m width routes were left. For sowing, they used seeds from harvesting from previous years. 350g of seeds were sown in every plot. Harvesting has taken place every year in the second half of July when ripening was complete. In this phase, harvesting was accomplished by hand, bronze sickles, half-moon-shaped stone sickles and scythes.

The second phase has been underway since 2005. The experiment takes place in 9 4m by 4m plots (Figure 52). Each type of cereal is sown in the same plot every year. The harvesting is usually carried out with flint-inserted sickle replicas by cutting the stems right under the ear of the corn. After this, the cereal is dried for 1-3 weeks and thrashed by trampling and wooden tools. The cereals are stored in metal containers and Bronze Age storage jar replicas.

The crop yield, the harvesting time and methods are documented and analysed every year.

5.5 HARVESTING EXPERIMENTS

In 2015, only tree plots were sown because of space management. The plots were 4m by 4m in size and no weeding was carried out during the year. The size of the parcels limited the duration of the harvest.

Figure 52: Experimental harvesting in 2010 (made by author).

Nine unused flint flakes were used for the experiments without hafting because of a lack of experienced crafters who could make hafted tools for us, not to mention time constraints. The experimental tools were not made out of the same raw material that occurs most commonly in the archaeological assemblage because nowadays it cannot be collected in a form which is suitable for tool production. Instead, we used flakes produced by experienced flint knappers during a previous knapping experiment and which were stored at the Archaeological Park. The tools used for the experimental programme were made mostly of Polish flint; a fine-grained, transparent, grey flint type from Volhynia, but also chert and quartzite pebbles. The most effective pieces were used for the experiment. The flakes were held by hand, therefore larger pieces were needed in a hand shape and with at least one sharp edge to be efficient for cutting.

Experiment no 1 is made of a large quartzite pebble, used for low cutting einkorn (*Triticum monococcum*) for 48 minutes (Figure 53).

Figure 53: Experiment no 1 flake.

Experiment no 2 is made of Polish flint, used for cutting off the heads of the grains of einkorn (*Triticum monococcum*) for 45 minutes (Figure 54).

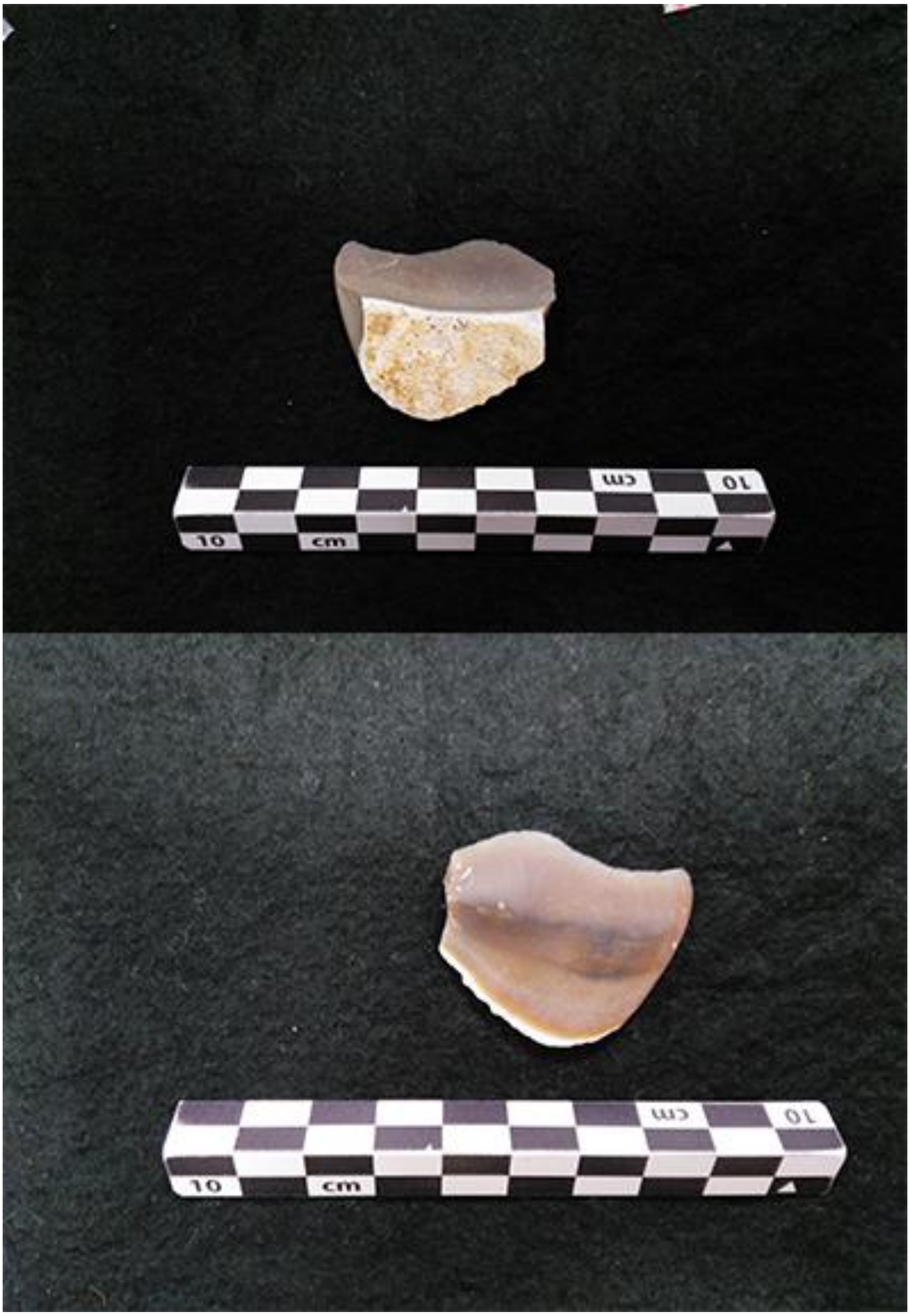


Figure 54: Experiment no 2 flake.

Experiment no 3 is made of quartz, used for cutting off the heads of the grains of einkorn (*Triticum monococcum*) for 45 minutes (Figure 55).

Figure 55: Experiment no 3 flake.

Experiment no 4 is made of Tevel chert, used for low cutting spelt (*Triticum spelta*) for 54 minutes (Figure 56).

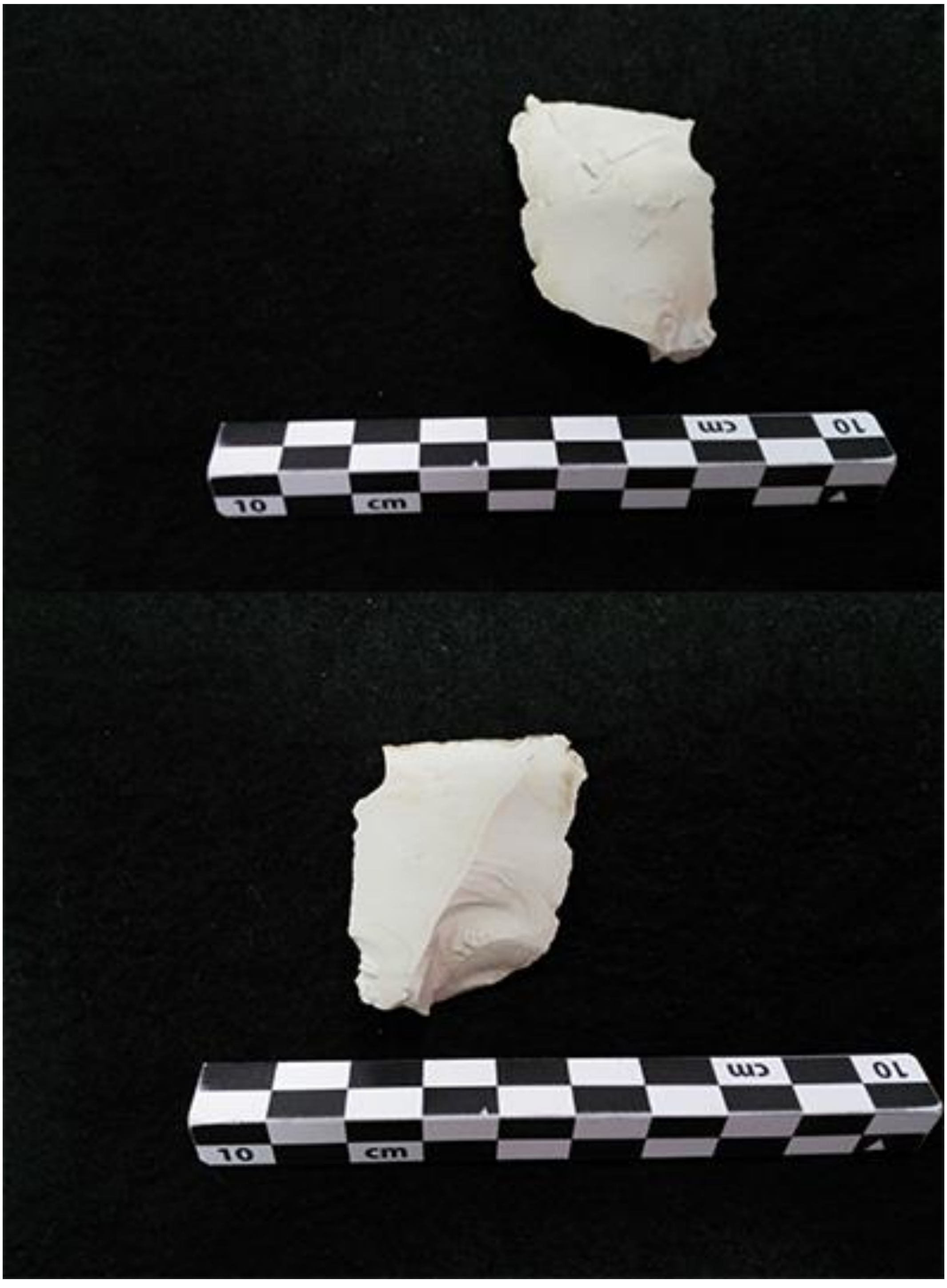


Figure 56: Experiment no 4 flake.

Experiment no 5 is made of Polish flint, used for high cutting emmer (*Triticum dicoccum*) for 39 minutes (Figure 57).

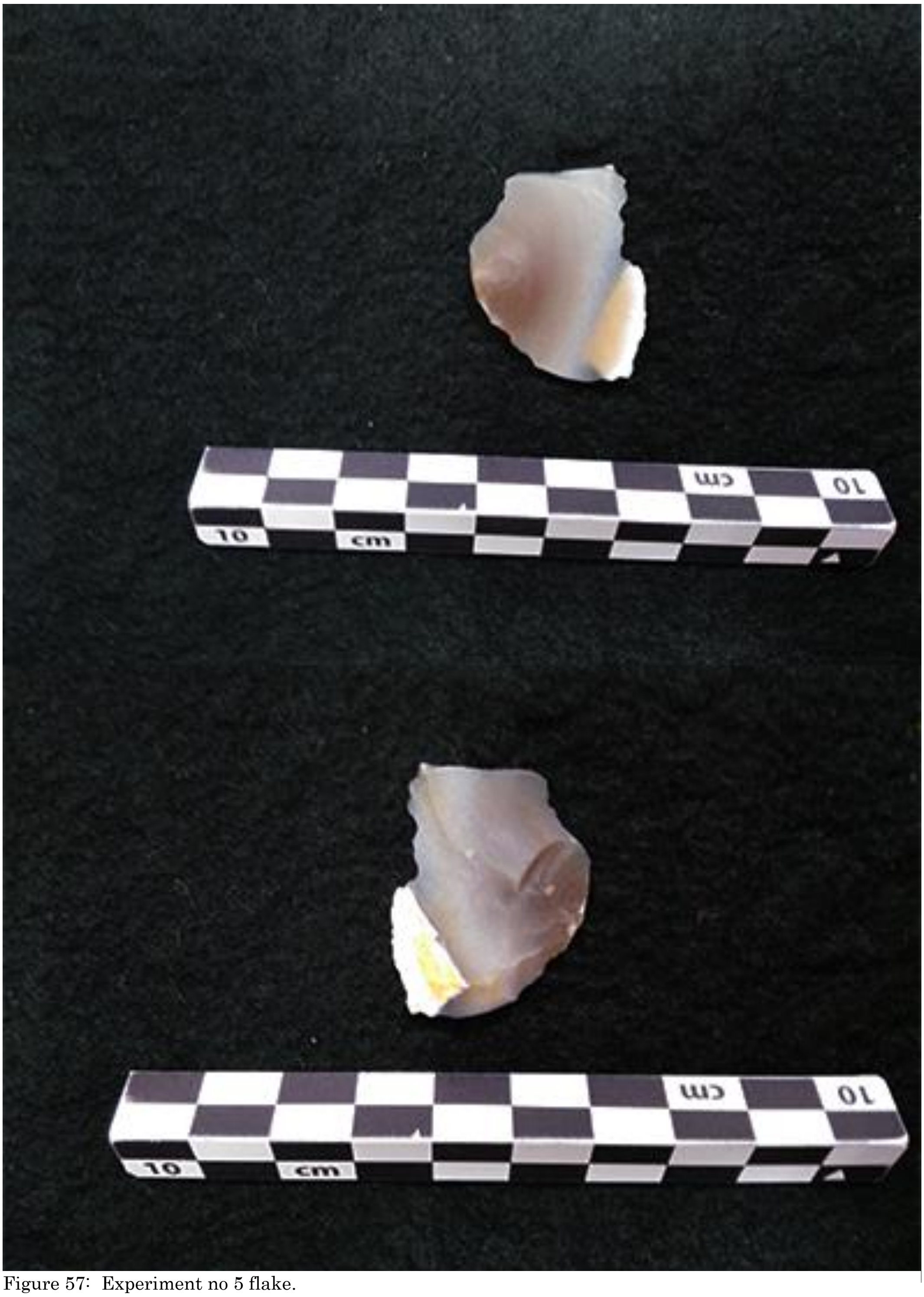


Figure 57: Experiment no 5 flake.

Experiment no 6 is made of Polish flint, used for low cutting emmer (*Triticum dicoccum*) for 39 minutes (Figure 58).

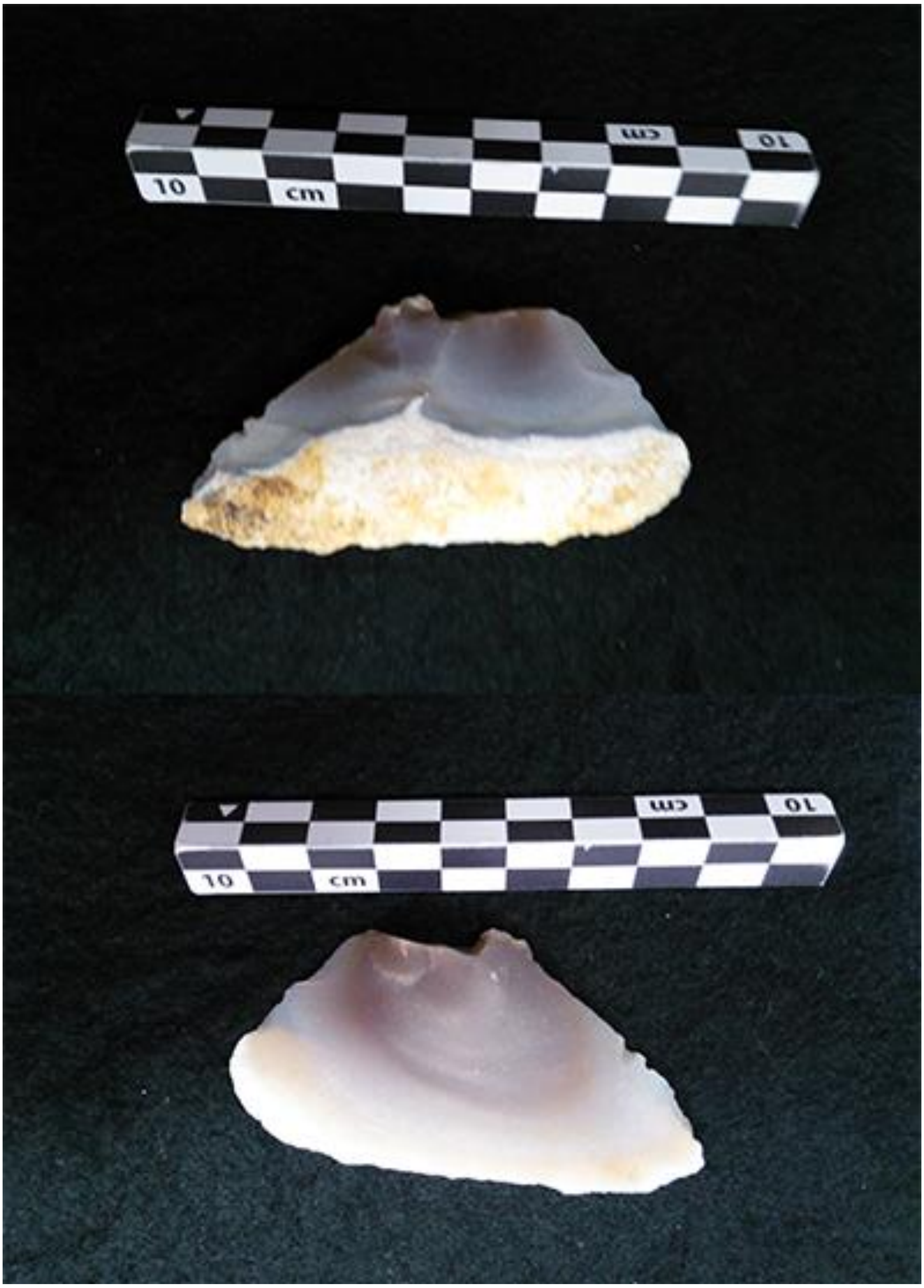


Figure 58: Experiment no 6 flake.

Experiment no 7 is made of Polish flint, used for high cutting spelt (*Triticum spelta*) for 54 minutes (Figure 59).

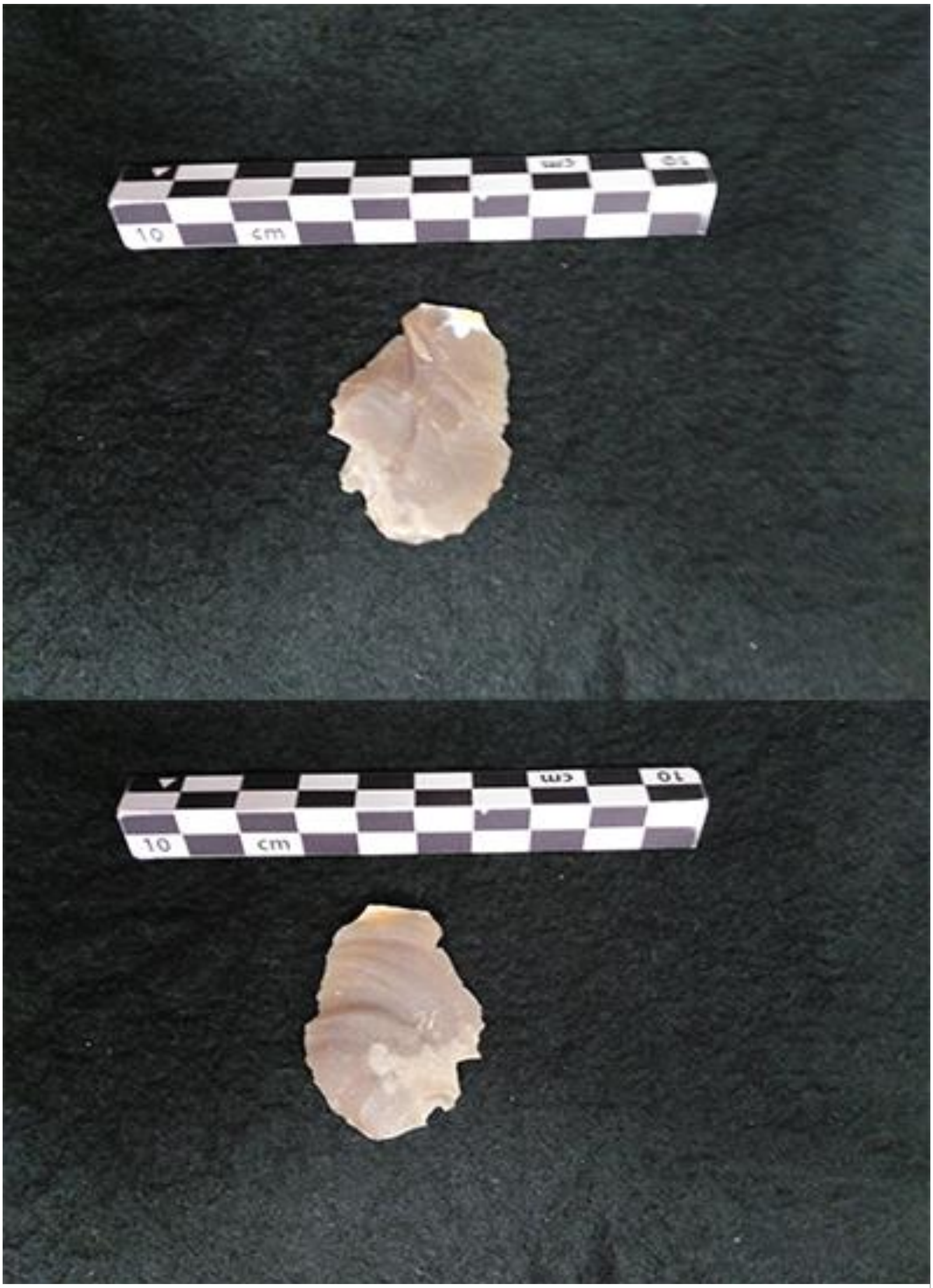


Figure 59: Experiment no 7 flake.

Experiment no 8 is made of limnic quartzite from the Horn valley, used for high cutting einkorn (*Triticum monococcum*) for 27 minutes (Figure 60).

Figure 60: Experiment no 8 flake.

Experiment no 9 is made of Polish flint, used for high cutting einkorn (*Triticum monococcum*) for 78 minutes (Figure 61).

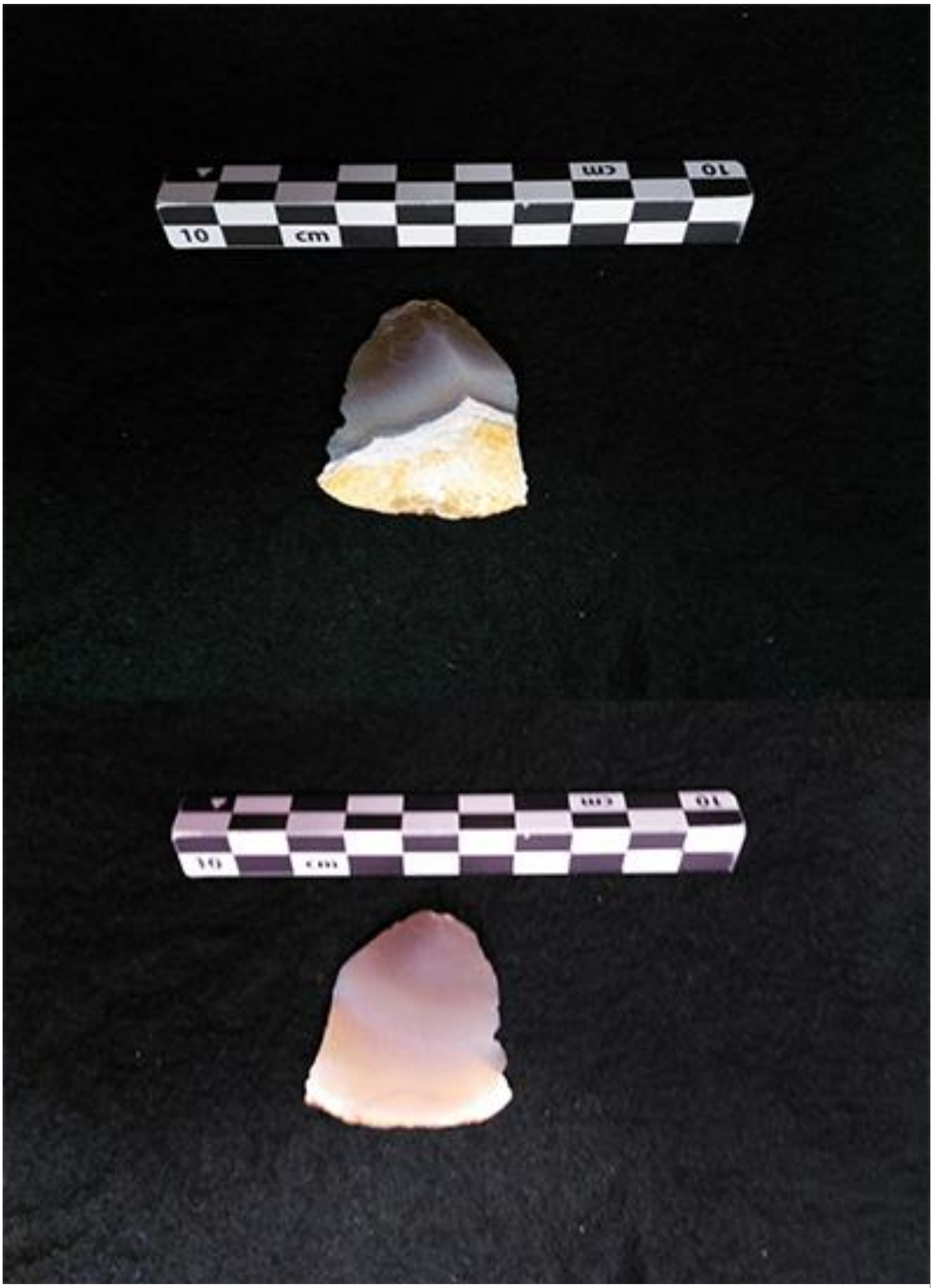


Figure 61: Experiment no 9 flake.

The experiment took place over two sessions due to the cereal ripening at different times. In the first session, the einkorn (*Triticum monococcum*) was harvested with the tools of experiments no. 1, no. 2, no. 3, no. 8, no. 9. Experiment no. 1 was used for 48 minutes for low cutting by grabbing a bunch of stems close to the ground and pulling slightly, then sawing them through with the edge of the flake (Figure 51). Experiment no. 2 was used for 45 minutes cutting off the heads of the grains by sawing through a bunch of stems (Figure 62). Experiment no. 3 was used in same way, 45 minutes, cutting off the heads. Experiment no. 8 was used for a short time, 27 minutes for high cutting by folding the stem over the edge of the flake and tearing it off. This tool was used for just a short time because it was a small piece and cut the hand of the user every time. Experiment no. 9 was used for the longest duration, 78 minutes for also high cutting by grabbing the stem and making a cutting motion at the base of the grain (Figure 50). Except experiment no 8, all of the tools were used until the activity was finished. The second session took

Figure 62: Cutting of the heads with Exp. no 2.

place nine days later. This time, the emmer (*Triticum dicoccum*) and the spelt (*Triticum spelta*) were harvested. Four flakes were used, two for the emmer and two for the spelt. The tools were used until the one-one parcel was finished which resulted in differences in the time of use. Experiment no. 4 was used for 54 minutes to harvest spelt (*Triticum spelta*) with low cutting by grabbing a bunch of stems, small cracking down motions, cutting partly while standing on the bunch, diagonal cracking down, cutting motions (Figure 63). Experiment no. 7 was also used for cutting spelt (*Triticum spelta*) for 54 minutes but high by holding 1-2 stems and sawing them off (Figure 64). Experiments no. 5 and no. 6 were used for harvesting emmer (*Triticum dicoccum*), both tools for 39 minutes, experiment no. 5 for high cutting by pressing the stem against the edge and pulling the grains down (Figure 65) and experiment no. 6 for low cutting by grabbing the stems with one hand, twisting, taking a blade and sawing through them with the other hand (Figure 66).[8]

Figure 63: Low harvesting with Exp. no 4.

Figure 64: High harvesting with Exp. no 7.

Figure 65: High harvesting with Exp. no 5.

Figure 66: Low harvesting with Exp. no 6.

[8] See short videos about the reaping motions on the USB appendix.

5.6 RESULTS OF THE EXPERIMENTS

Afterwards, the experimental tools were analysed microscopically to record the microwear traces.

5.6.1 HARVESTING METHOD: TEST 1

There are several harvesting variations. Some of them do not even involve tools (sickles). These methods are hard to examine in archaeological records but they are well-known from ethnographical data; therefore, it is reasonable to suggest that they were known and used in the past as well. These 'invisible' methods are: pulling up, picking up, in some cases stripping off and breaking off or plucking done just by hands as well (Anderson and Sigaut 2014). Harvesting with sickles is a more suitable method for archaeological investigation. However, there are variables in harvesting with sickles. The distinguished methods are the high reaping and low reaping. Low cutting means cutting the stems close to the ground, usually 20-30cm above it. In this case, the harvesting tool would come into contact with the soil and prickly weeds most probably (Anderson 1992; Unger-Hamilton 1985, 1989). This harvesting method is associated with a deeper, longer striation in the micropolish (e.g. González Urquijo *et al.* 2000; Ibanez *et al.* 2008; Unger-Hamilton 1989). In the case of high cutting, the stems are grasped at the level of the base of the lowest ears and cut below hand level (Anderson 1992, 125). This method is mostly interpreted with a more flat and smooth polish, mainly without striation (Unger-Hamilton 1989, 93).

In the experiments presented here, flint flakes were used for harvesting cereals with different heights. They were used for high harvesting (n = 4; experiment no. 5, 7, 8, 9), for low harvesting (n = 3; experiment no. 1, 4, 6) and for cutting off the heads of the grains (n = 2; experiment no. 2, 3) (Table 2). As this last category is very similar to high cutting, it will therefore be discussed as a subdivision of that.

Table 2: Use of the experimental tools.

Exp no	Cereal species	Low harvest	High harvest	Cutting of the heads
1	Triticum monococcum (einkorn)	48 min		
2	Triticum monococcum (einkorn)			45 min
3	Triticum monococcum (einkorn)			45 min
8	Triticum monococcum (einkorn)		27 min	
9	Triticum monococcum (einkorn)		78 min	
5	Triticum dicoccum (emmer)		39 min	
6	Triticum dicoccum (emmer)	39 min		
4	Triticum spelta (spelt)	54 min		
7	Triticum spelta (spelt)		57 min	

5.6.1.1 High harvesting

These tools did not produce any gloss that was visible to the naked eye. The microwear traces include some striations, polish and edge damage. The polish is mostly flat and matt, bounded on the edge. It developed more on the higher

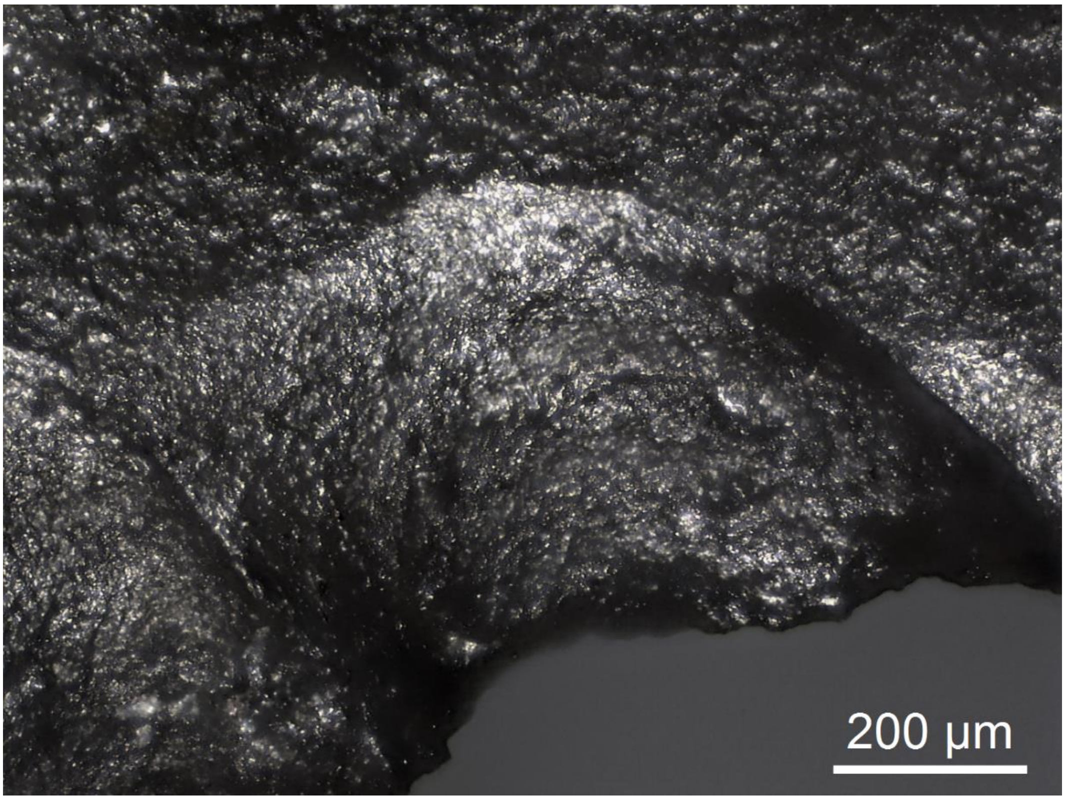


Figure 67: Microscopic photo of Exp. No 5.

parts but did not spread in the background. The polish is smooth in two cases: no. 5 and no. 9. However, in the other two cases, no. 7 and no. 8, it is rough. Experiment no. 8 slightly differs in brightness; it has a very bright polish whereas on the other tree tools, the polish developed a brightness. Edge removals developed during use on almost every tool except experiment no. 8. The edges are rounded in all cases (Figure 67).

5.6.1.1.1 Cutting off heads of grains

These tools did not produce any gloss that was visible with the naked eye. The microwear traces again include striations, polish and edge damage. A matt, flat, smooth, pitted polish is observable on the flakes, mostly on the higher parts. The cutting edges are rounded but to different extents. However, the two flakes differ from each other in some aspects. Experiment no. 2 has a well-developed polish spread in the background with striations parallel to the edge

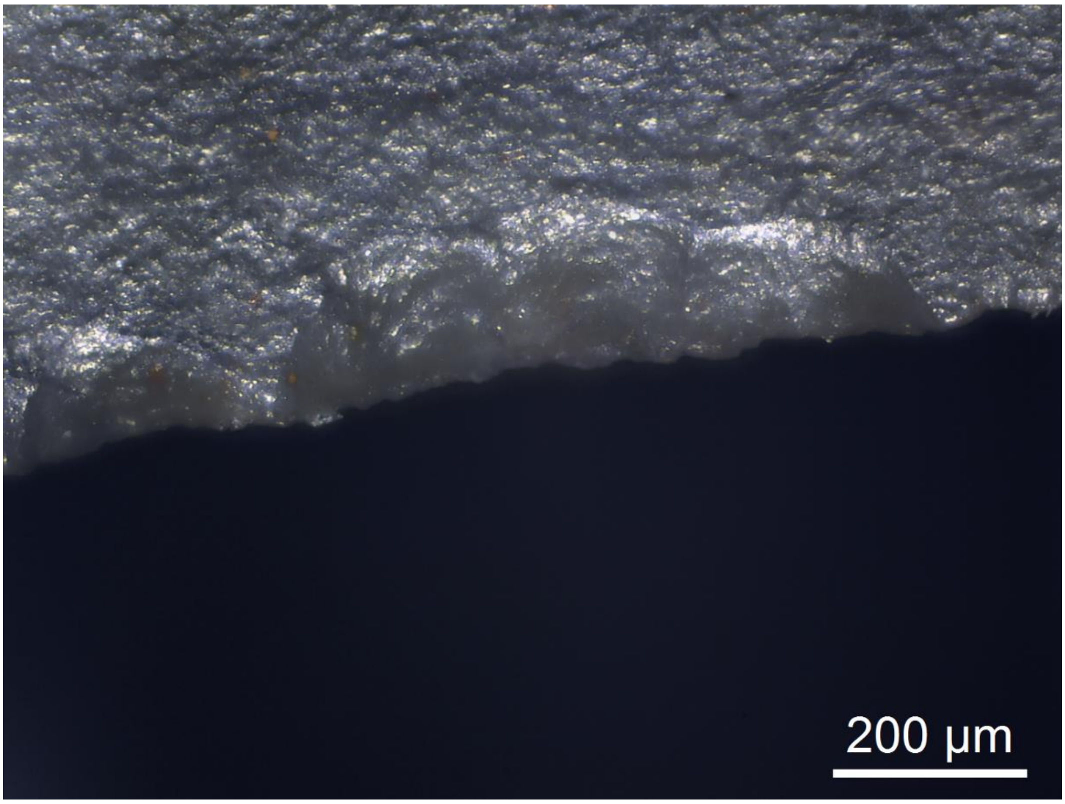


Figure 68: Microscopic photo of Exp. No 2.

and some removals on the edge whereas experiment no. 3 exhibits a developed polish spotted along the edge and no striations (Figure 68).

5.6.1.2 Low harvesting

These tools did not produce any gloss that was visible to the naked eye. The microwear traces include some striations, polish and edge damage. A smooth, matt, flat, pitted polish is apparent on the cutting edges in this category. Striations are only visible in experiment no. 4. The edges of the tools were damaged during use. In distribution, there is a difference between the tools; in experiment no. 3, the wear is spotted along the edge whereas in experiment no. 1 and no. 4, the polish is along the edge, spread in the background and the polish is more developed on the ventral sides of the tools. Experiment no. 1 has a greasy polish with a mostly transversal directionality to the cutting edge (Figure 69).

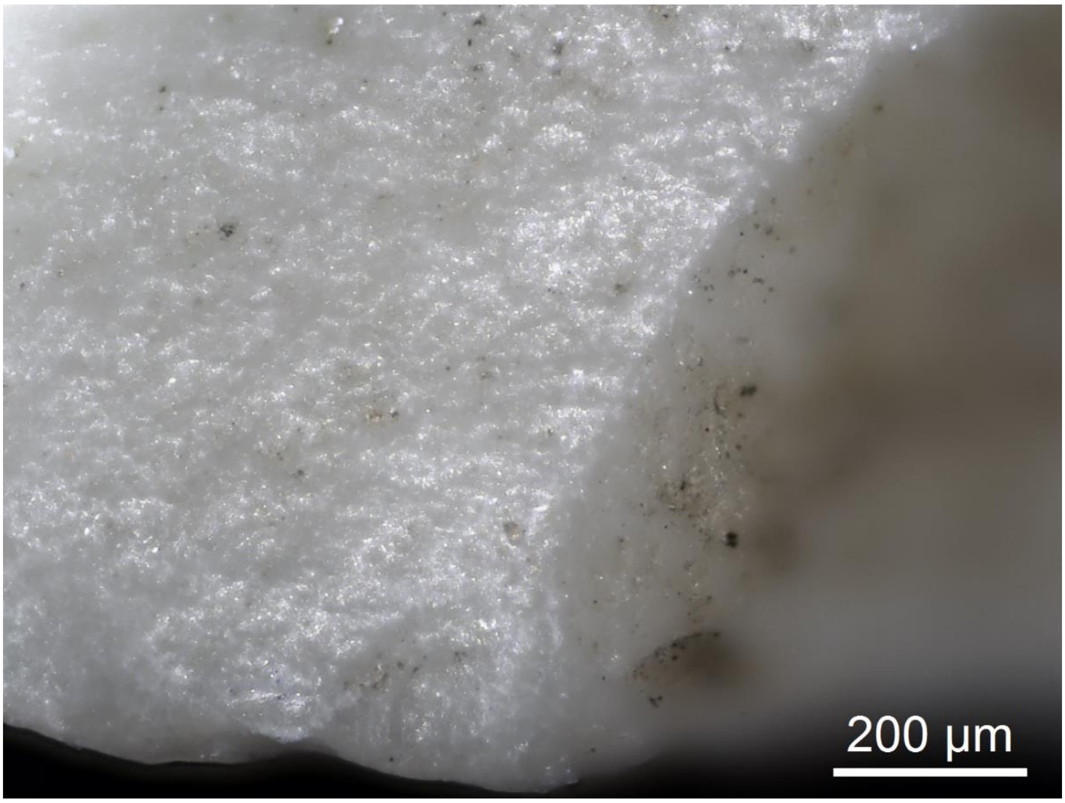


Figure 69: Microscopic photo Exp. no 4.

5.6.2 Species of cereal: Test 2

The other type of classification is the subdivision of cereal species. They were used on einkorn (*Triticum monococcum*; n = 5; experiment no. 1, 2, 3, 8, 9), emmer (*Triticum dicoccum;* n = 2; experiment no. 5, 6) and spelt (*Triticum spelta;* n = 2; experiment no. 4, 7) (Table 2).

5.6.2.1 Einkorn

These tools did not produce any gloss that was visible with the naked eye. The microwear traces include some striations, polish and edge damage. The common denominator of the microwear traces is that the polishes are flat and smooth and that the edges are rounded. In the case of experiment no. 1 and experiment no. 2, the polish is spread in the background whereas for experiment no. 8 and experiment no. 9, it forms a continuous band along the edge. Experiment no. 3 has isolated spots of polish along the edge. In experiment no. 1, 2, and 3, the polish is developed or well-developed whereas in experiment no. 8 and 9 it is only weakly developed. In experiment no. 1 and 2, the directionality is observable. However, in experiment no. 1, it appears as transversal to the edge whereas in experiment no. 2, it is parallel to the edge. Edge damage can be noticed on two tools, experiment no. 2 and 9 (Figure 68).

5.6.2.2 Emmer

These tools did not produce any gloss that was visible to the naked eye. The microwear traces include some striations, polish and edge damage. A flat, matt, pitted, bright polish appears on the tools used for reaping emmer. The polish is well-developed and spread in the background. In experiment no. 5, the polish is smooth, in experiment no. 6, it is rough. As for the latter, deep striations are visible in transversal and parallel directions to the edge. Although the other tool does not have striations, edge damage is apparent (Figure 67).

5.6.2.3 Spelt

These tools did not produce any gloss that was visible to the naked eye. The microwear traces include some striations, polish and edge damage. A weak, flat and matt polish appears on the higher parts of the tools. Edge damage during use appears on the rounded edges. Contrary to the other types of cereal, striations appear on every piece. However, while they are parallel, long, shallow and thin in experiment no. 4, in experiment no. 7, they are transversal, short, shallow and thin. The polish appears different as well, since experiment no. 7 has smooth polish and experiment no. 4 has rough polish (Figure 69).

5.6.3 DISCUSSION

None of the experiments produced any gloss that is visible to the naked eye but all of them have microwear traces that include striations, polish and edge damage. In comparison between low harvest and high harvest, it is seen that the polish is smooth with low cutting and cutting off the heads but in the high harvest category, it differs; smooth in two cases and rough in the other two cases. Striations are more characteristic in cutting off the head of the grains and low harvesting categories. Comparing the species of cereal with each other, we can observe that flat polish and a rounded edge is characteristic but the texture of the polish varies. According to these comparisons, it can be argued that these groups are indistinguishable from each other.

5.7 CONCLUSION

Neither of the tested methods show well-separable classes; there is no clear, observable difference between inter- and intra-group variability. From this experiment, neither the high nor low cutting, nor cereal species can be distinguished clearly by microtraces. All the tools show plant polish, specifically cereal polish and a mostly flat, smooth, matt, bright polish, as was expected. It can be argued that the differentiation between the aforementioned groups is not convincing. It seems that the harvesting method or the worked material does not have a distinguishable effect on the produced microwear traces in this experiment. However, previous studies have shown these distinguishable effects between harvesting methods or cereal species but those experiments had a reasonably longer duration of time than the experiments discussed herein. It is possible that the relatively short duration of use of these tools caused the unclear results. Now, the results will be compared with other experiments in detail.

5.7.1 COMPARISON OF THE RESULTS WITH OTHER EXPERIMENTS

In comparison with other experiments performed to harvest cereals, some remarks should be made. Harvest experiments have a long history in experimental archaeology and especially in connection with use-wear studies. Most of the experiments are aimed at distinguishing traces caused by cutting wild plants, wild cereals and traces caused by cutting domesticated cereals. Lately, researchers have also paid attention to the difference between flint used in sickles and in tribulum (threshing sledges). Another direction for the experiments is to examine the different methods of harvest; namely, low cutting and high cutting. As a comparison, the results of some of these experiments will be mentioned here. After the first experiment, which was carried out to investigate characteristics of the plant polish in general (e.g. Keeley 1980; Vaughan 1985), experiments focused on distinguishing. It was suggested that microwear analysis can be used to differentiate plant groups (wild, domesticated, grass, silica-poor, silica-rich), harvesting methods (where the stems had been cut), circumstances of harvest (whether loose soil had been present during harvesting), maturity stage of the plants, moisture stage of the plants, duration of time of reaping and hafting (Unger-Hamilton 1985, 1989). Unger-Hamilton experimented with 295 flint blades in order to help her research the origin of plant cultivation. She used hafted and unhafted pieces to reap three different groups of cereal types. The first group consisted of wild progenitors of the earliest cultivated species: emmer (*Triticum dicoccoides*), einkorn (*Triticum boeoticum*) and barley (*Hordeum spontaneum*). The second group consisted of the domesticated variations of these three (*Triticum dicoccum*, *Triticum monococcum*, *Hordeum vulgare*) and the last group consisted of variations of domesticated wheat such as bead wheat (*Triticum aestivum*) and macaroni wheat (*Triticum durum*) (Unger-Hamilton 1989, 90). The experiment, carried out with 187 flint blades on the same species, suggests that there is a possible relation between how the plants were harvested and the microscopic striations on the micropolish. In the present study, einkorn (*Triticum monococcum*) and emmer (*Triticum dicoccum*) were also harvested. Unger-Hamilton proposes that the striations were caused not by the plant itself but by loose soil trapped at the base of the stem that came between blades and the stem when the plant was cut close to the ground. Thereby, low and high cutting can be distinguished. The number of strokes and the moisture content of the plant also influences the number of striations. The polish looks domed when green stems were harvested and flatter when the same type of stands were ripe. The edge damage can give a suggestion as to the flexibility of the stem. The macroscopic gloss is related not only to the duration of time of harvest but also to the harvested plant species. The abrupt demarcation between the sickle gloss and the unexposed flint surface proposes how the blades were hafted (Unger-Hamilton 1989, 93-5). In my experiments, only mature crops were harvested but no clear difference could be observed between the species.

In her experiments, van Gijn examined tools used for cutting wild plants and domesticated cereals (van Gijn 1990, 38-41). Three categories of soft plants were reaped with 35 tools over a total work period of 16 hours and 57 minutes. The three categories are: siliceous wild plants, non-siliceous green plants and roots. In four experiments that were performed on root crops, the resulting polish was smooth and matt in texture and the edge-damage was scalar with feathered or hinged terminations. The non-siliceous green plants did not cause almost any polish, edge-removals or edge-rounding. Experiments on siliceous wild plants showed only a slight edge-rounding and micro-scarring occurred only on pieces used for cat's-tail with comet-tails and for dry reed. Horse-tail and fresh reed produced a slight edge-rounding and a highly reflective polish, were matt and smooth in texture, domed in topography, and formed a band. In general, there are no striations to be observed; however, the polish displayed directionality. Twenty-one implements were used to reap domesticated cereals in this experiment series. The harvested species are: barley, emmer, bread wheat and oats.[9] Only six tools showed use-retouch; feather-shaped scars with hinged termination. Edge-rounding mostly developed but it was varied which seems to be related to the duration of work-time and the coarseness of the flint. The polish is distributed in a rather wide band. The polish is highly reflective, matt and smooth, and it has a parallel directionality to the edge. The shortly used tools display rather domed topography, while the longer duration of use relate with a flat topography. Shallow striations are developed only in a low number of experiments. There is no evidence for differentiate barley and emmer in these experiments, but it was possible to distinguish microwear on tools used for cutting soft plants and those used for reaping domesticated cereals.

Lately, new photogeometrical methods are also used to examine microwear on flint sickle elements. One of these studies investigated the discrimination of wild versus domestic cereal polish via laser confocal microscopy (Ibáñez *et al.* 2014). For this high-power method, experiments of wild cereal harvesting and domesticated cereal harvesting were carried out in Syria and Asturias. The wild species were *Triticum dicoccoides* and *Hordeum spontaneum*. The reaped cultivated species was the *Triticum spelta*. The wild cereals were cut while the plants were still not completely mature to avoid the loss of grain. Four fine-grained flint elements were inserted in a haft and this sickle was used 4 hours prior to harvest. Spelt was reaped with two Karenovo-type sickles. One of the

[9] The Latin names are not given by the author.

sickles was used for a total 7 hours while the other was used for 4 hours and 30 minutes. The stems were cut off at a height of around 20cm above the ground surface (Ibáñez *et al.* 2014, 97-8). Afterwards, zones where the polish was most developed were analysed with a laser scanning confocal microscope. Wild and domesticated cereals were discriminated by ten parameters of surface roughness. These parameters were: the arithmetical mean height; the standard deviation of the height distribution; the height between the highest peak and the mean plane; the depth between the mean plane and the deepest valley; the height between the highest peak and the deepest valley; the ratio of the area of the material at a specified height (cut level at 1mm under the highest peak) to the evaluation area and the extreme peak height (Ibáñez *et al.* 2014, 99). Depending on these ten parameters, the discrimination of the sickle inserts used for reaping wild cereals from those used for cutting domestic cereals is statistically significant. The duration of time was not significant as a discriminate parameter; tools used on domesticated cereals grouped together, independently, were used for 270 or 450 minutes and those used on wild cereals discriminate even though they were used for 240 minutes. However, it is worth mentioning that the authors used those areas for the analysis which showed a similar degree of development of the micropolish (Ibáñez *et al.* 2014, 101). In my experiments, spelt (Triticum spelta) was also reaped when the plants were completely ripe but the duration of time was reasonably less.

In another study, scanning electron microscopy (SEM) was used to examine the degree of edge rounding on experimental sickle inserts (Goodale *et al.* 2010). Here, four blades were used for cutting in total 10, 12, 14 and 16 hours. The blades were analysed once during the experiments as well as after 3, 5, 7 and 9 hours. These times are broken down per blade. The most important result of this work for the recent study is that the experimental tools' edges only started to accumulate polish and rounding compared to the archaeological tools used in the research after even a rather long duration of time of use (Goodale *et al.* 2010, 1196-7). This result suggests that my experiments are not well-comparable with the majority of the archaeological tools because of the duration of time.

Comparing the aforementioned studies with the present experiment discussed herein, it can be concluded that there is a possibility to distinguish the harvesting methods and the cereal species that were tested in the current experiments. The lack of success for discriminating in this experiment can be blamed on the short duration of use of the flakes. The time of use was also limited by the available crops. The parcels of experimental cereal cultivation were used for harvesting because those cereal species are the closest to the ones which were cultivated by the inhabitants of the studied tell in the Bronze Age. However, these plots were rather small, as is mentioned above, which caused a limitation in the availability of crops. It is reasonable to perform new experiments where larger parcels are available with much more stems in the hope for a better degree of development of the use-wear. However, in this case, perhaps modern cereals have to be used. Besides this lack of success in discrimination, it can be shown that all the experimental tools developed polish that is characteristic for harvesting domesticated cereals.

Chapter 6

Results of the analysis of the archaeological tools and comparison with experiments

6.1 INTRODUCTION

63 archaeological artefacts were analysed. All of them belong to the sickle blade typological category. The raw material distribution is: n=42 Buda chert, n=3 hydro-quartzite, n=1 limnic quartzite from the Horn valley and n=4 radiolarite from different sources. Thirteen pieces were burnt, therefore the raw material is not identifiable (Table 3). This distribution corresponds to the raw material ratios in the whole assemblage.

Table 3: Number of analysed sickle blades per raw material type.

Raw material	N=63
Buda chert	42
Hyroquartzite	3
Limnic quartzite from the Horn valley	1
Radiolarite	4
Not interpretable	13

Amongst the archaeological tools analysed (n=63), a range of wear traces was found. There were seven pieces which did not have interpretable traces. The rest of the tools had use-wear ranging from sickle gloss that is visible to the naked eye and from weak to well-developed microwear. The brightness of the polish ranges from dull to very bright, the polish texture from smooth and matt to rough and matt and the polish distribution from a band along the edge to spread in the background. Striations in the polish developed in some cases;

they are parallel to the edge or transversal and they move on a scale from short, very thin, shallow to long, thin and deep. Edge damage is visible on all the tools, retouch appears in most of the cases and edge rounding moves on the scale from sharp to very rounded.

6.2 RESULTS OF ANALYSIS

The appearance of the microwear traces varies across the pieces. In this way, one category, cereal polish, is not enough; some kind of categorisation is needed for more detailed interpretations. First, the same categorisation would be the logical choice as in the performed experiments. The experiments that were performed for this study did not produce successful results, as we saw in Chapter 5. As shown above, the groupings tested in the experiments did not yield differentiating results so these groupings could not be applied to the archaeological pieces based on these experiments. However, it has also been shown that other experiments had more success in differentiating (e.g. González Urquijo *et al.* 2000; Ibanez *et al.* 2008). The main distinguishing attribute are the striations, their appearance and characteristics. Hence, it is reasonable to investigate this attribute on the archaeological assemblage as well. Besides, a big difference can be observed along the microwear traces which is the development of the traces. The main used edge showed cereal polish on all the tools where traces could be interpreted as it is suggested above from the comparison with the literature and the experimental collections.

The typical wear along the analysed tools can be described easily: it produces sickle gloss that is visible to the naked eye. The microwear traces include striations, polish and edge damages. The striations are not observable on every tool. The polish is flat, smooth, matt, pitted, varied between bright to very bright, spread in the background and well-developed but more on the higher parts. It forms a band along the edge and develops on the dorsal and the ventral side, mostly equally. The directionality is mostly parallel but in some cases transversal to the edge. Edge damages during use appear on the rounded edges. Retouches are also visible both before and during use. Resharpening is usually observable. Differences occur in relation to the development of the microwear traces. In the case of weakly developed traces, the sickle gloss could be really weak, the distribution of the polish could be limited to a band along the edge, the development of the polish usually weaker on the ventral side of the edge and the directionality is less observable (e.g. Figure 43; Figure 44).

6.2.1 Smooth

The majority, 37 pieces of the tools, produce a smooth polish, without striation. Within this category, 27 tools have well-developed traces with sickle gloss that is visible to the naked eye. In general, the aforementioned microwear applies to these tools; the microwear traces include polish and edge damage. The polish is smooth and matt in texture, flat but pitted in topography and bright or very

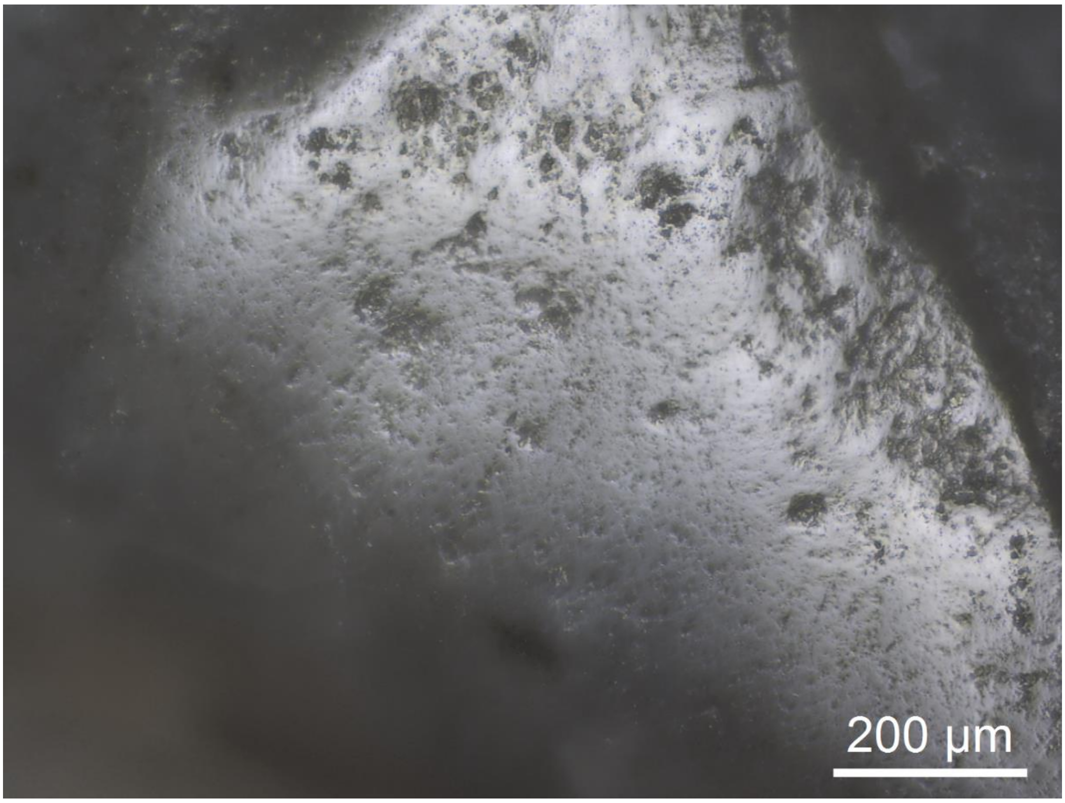


Figure 70: Microscopic photo of ID 1731_701487 with smooth, well-developed micropolish.

bright. It is located on the dorsal and ventral side equally, distributed in a band along the edge, but also spread in the background; however, more so on the higher parts. The directionality is observable in some case; it is mostly parallel to the edge. The edge is very rounded with edge-removals also usually observable. Retouch before use is common but removals during use also appear first of all on the dorsal aspect (Figure 70).

Ten tools produced smooth but weakly developed traces. The visibility of sickle gloss to the naked eye divided equally: five tools show weak sickle gloss while five items do not show any gloss that is visible to the naked eye. The microwear traces include polish and edge damage. The polish is flat in topography and smooth and matt in texture. The brightness of the polish varies between bright

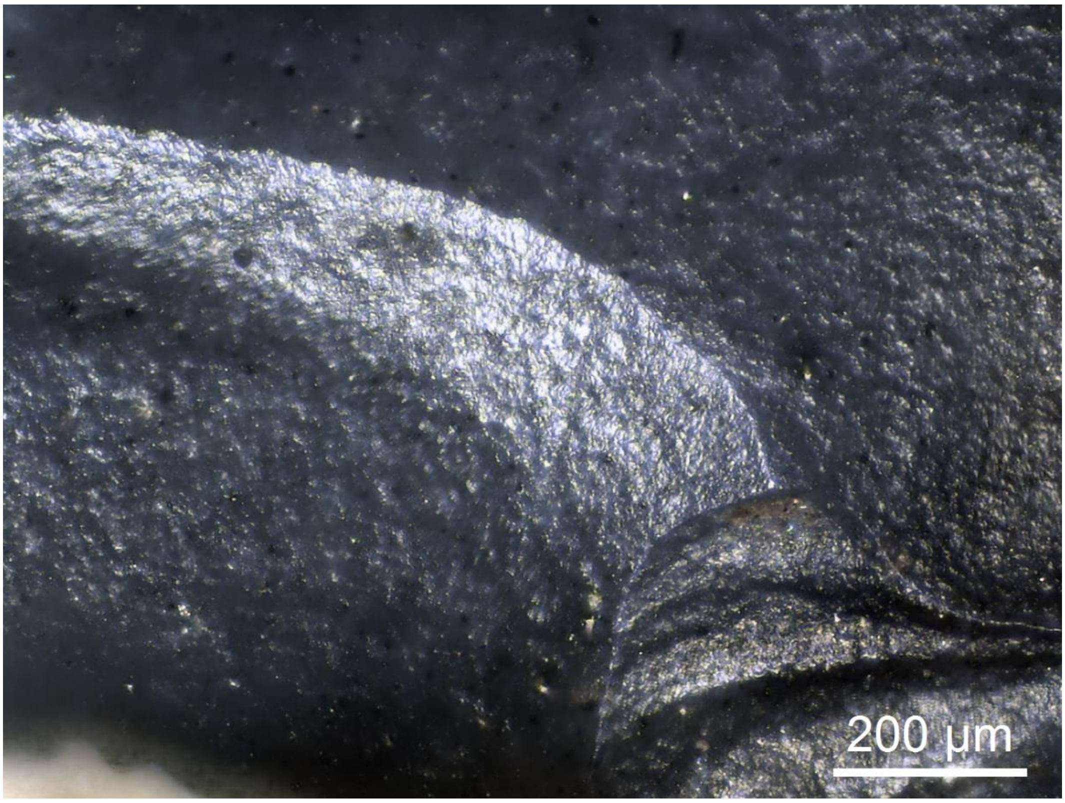


Figure 71: Microscopic photo of ID 1624_701307 with smooth, weakly developed micropolish.

and very bright. It is distributed in a band along the edge but for half of the tools, it spreads in the background. It developed on the higher parts, dorsal and ventral side but the ventral side is weaker in most of the cases. Directionality is visible on only one tool (ID 24) where it is parallel to the edge. Edge damages during use appear on the slightly rounded edges. Resharpening or other retouches during use are not visible (Figure 71).

6.2.2 Striated

On 19 pieces, striation is observable. The majority of these tools produced well-developed traces; only three pieces (ID 7, ID 164_701010, ID 377_700565) have weakly developed traces. However, two of them, ID 7 and ID 164_701010, produced a sickle gloss that is visible with the naked eye. The microwear traces include polish, edge damages and striation. The polish is rough and matt in

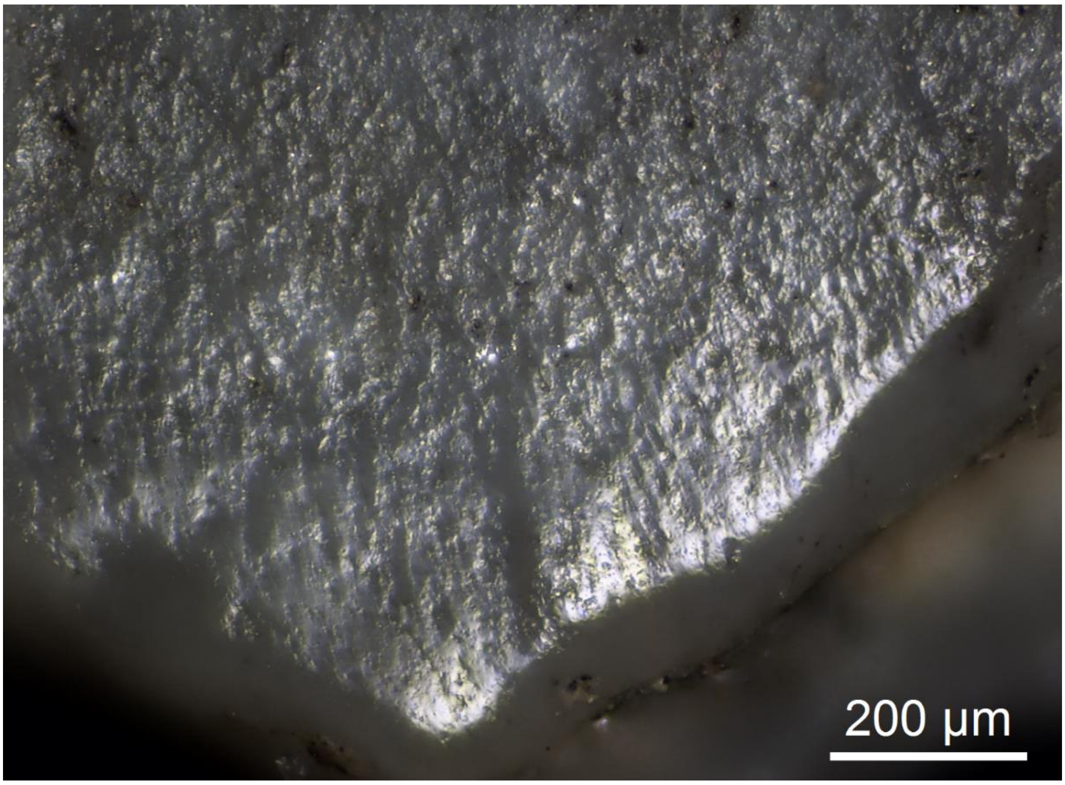


Figure 72: Microscopic photo of ID 164_701010 with weakly developed, striated micropolish.

texture, flat in topography and bright. It is developed on the higher parts, dorsal and ventral but more ventral and distributed in a band along the edge in an oblique shape. The edge is rounded, retouch is observable either before or during use, resharpening also appeals. Striations in two cases transversal (ID 7, ID 164_701010) to the edge, and on the ID 377_700565 they are parallel to the edge. On ID 7 striae are thin, shallow and long, while on ID 164_701010 they are deep, wide and long (Figure 72).

The other 16 pieces produced well-developed microwear traces. All of them produced a sickle gloss that is visible to the naked eye. The microwear traces include polish, edge damages and striation. The polish is smooth and matt in texture, flat but pitted in topography. It is very bright, in a few cases, bright. The polish is distributed in a band along the edge but also spread in the background. It is developed on dorsal and ventral aspects equally and in the background it is located mostly on higher parts. Sometimes directionality is observable, parallel to the edge. Edge damages during use appear on the rounded edges. Retouches are also visible both before and during use. Resharpening is usually observable. Striation is mainly parallel to the edge, on ID587_700586 and ID 677 it is transversal to the edge (Figure 73) and on ID 2 the striae are parallel on the ventral and transversal on the dorsal aspect, on ID 936_700731 they are parallel on the dorsal and transversal on the ventral aspect (Figure 74). The striae are thin, except ID 677, where they are wide. In general, striae are shallow, except ID 9 where they are 'filled-in' and ID 441_700519, ID587_700586 and ID 677 where they are deep. The stripes are mainly long or medium in length, they are short only on ID 134/2, ID 441_700519 and ID 1802_701610 (Figure 75).

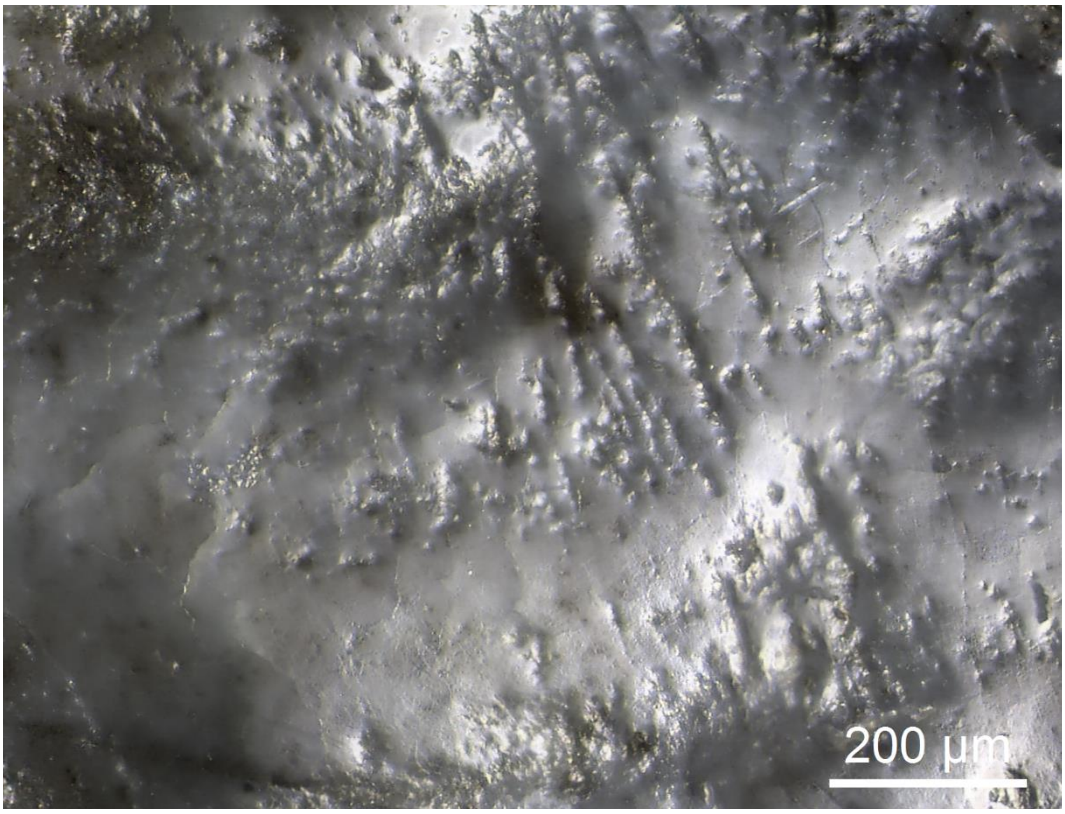


Figure 73: Microscopic photo of ID 677 with transversal, wide, deep, long striation.

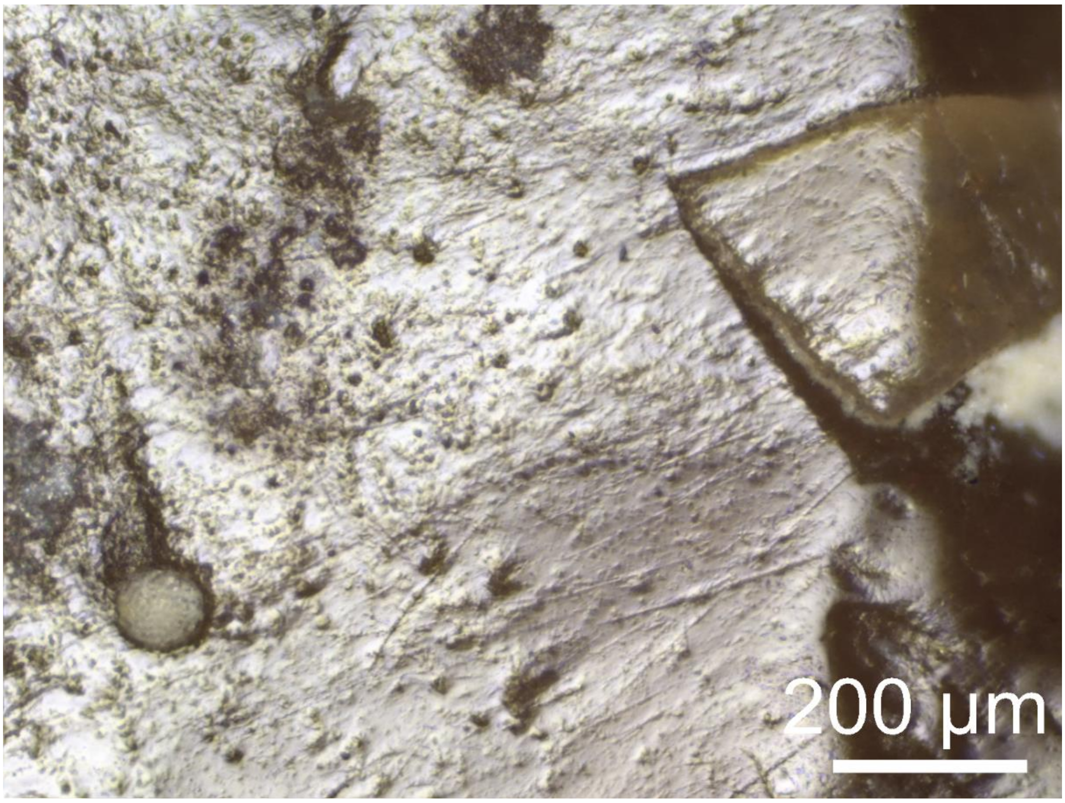


Figure 74: Microscopic photo of ID 936_700731 with transversal, shallow, long striations.

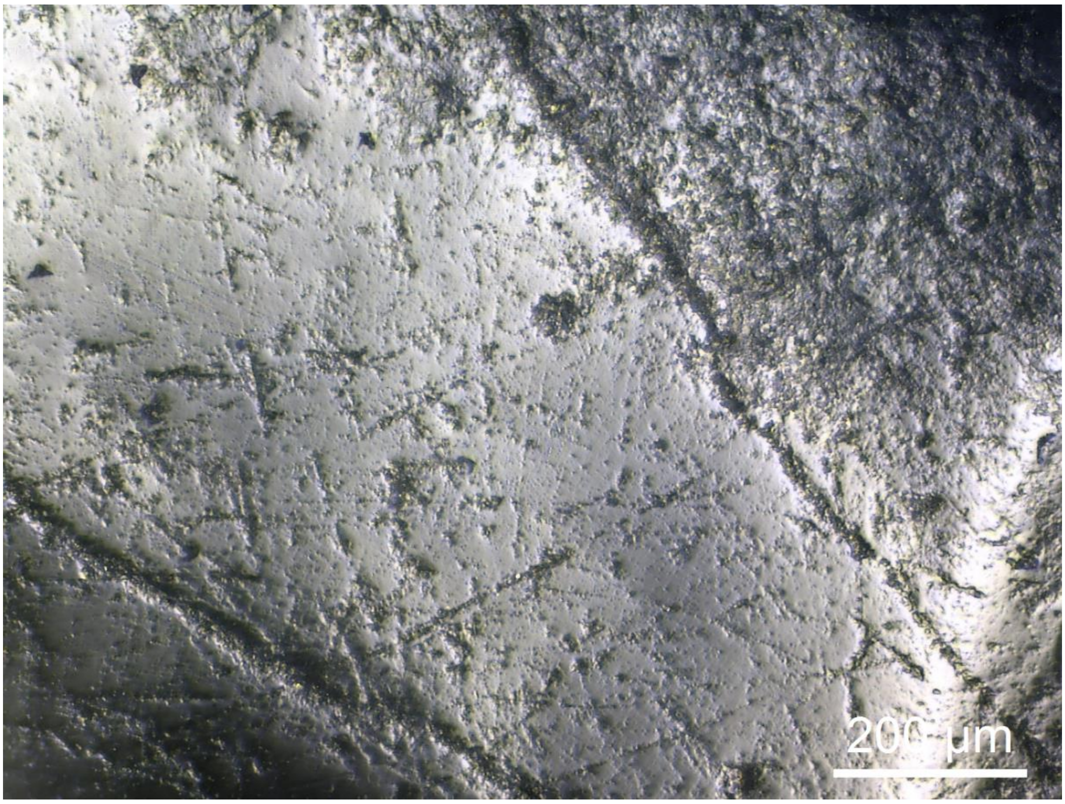


Figure 75: Microscopic photo of ID 1802_701610 with parallel, thin, shallow, short striations.

6.2.3 NOT INTERPRETABLE CATEGORY

Seven tools did not produce sickle gloss that is visible to the naked eye. Microwear traces are not observable at all, or not interpretable. Some generic weak polish and edge-rounding are visible in some cases (ID160_700687, ID1444_701125, ID833_700658, ID1794_701623, ID865_700812, ID3058_701764), mostly on the ventral side, except in the case of ID862_700812 where a generic weak, flat, matt, smooth polish is observable on the higher parts in a band along the edge.

6.3 HAFTING

The pieces (n=56) are interpreted as sickle insert; this is also supported by the microwear. The tools have some indication about hafting. . In most of the cases, it concerns a distinct and abrupt end of the distribution of the sickle gloss and the micropolish. From this distribution, it can be suggested how the blades were hafted and on which part of the cutting edge of the sickle they were placed. The microwear traces on the hafted part of the tools suggest that the serrated sickle blades were hafted in wooden handles. Adhesive was used to fix the blades to the handle. Adhesive residues are visible on several pieces (ID 135/4, ID 164_701010, ID 642_700596, ID 1353_701455, ID 1355_701474 and ID 1436). The adhesive residue is black. It is observed both on the dorsal and the ventral part, especially on the opposite side to the cutting edge. It is possibly some kind of tar compound (Dr. Geeske Langejans pers. comm.) but for the exact composition, further analysis is needed (Figure 76).

Figure 76: Black residue, most likely a glue used to haft the tool, on a sickle blade (ID 642_700596).

6.3.1 Biography of objects

The concept of the biography of objects is demonstrated on one tool where a secondary use was also observable. This tool is the ID1353_701455; it is made of blade from grey Buda chert. Its bulb of percussion is broken, the cutting edge is coarsely denticulated with bifacial retouch, heavily worn and sickle gloss is visible with the naked eye. This serrated sickle insert was fixed with adhesive in a haft and used for reaping cereals. The microwear traces include polish and edge damage. The polish is flat, pitted, smooth, matt, bright and well-developed. It forms a band along the edge, more developed on the higher parts, and spreads in the background. Edge damage during use appears on the highly rounded edge. These traces suggest a long duration of time of use (Goodale *et al.* 2010; van Gijn 1990, 40). It was modified into a scraper at a later phase of the life of the tool. A scraping edge was created on the distal end of the blade. On this edge, some weak hide polish appears which is rough, greasy and flat. It is developed as a thin line along the edge. Some weak hide-like polish also appears on the opposite edge of the serrated edge which is probably related to the hafting of the scraper. Post-excavation damages are observed in the form of scratches of a metal tool on the ventral side at the serrated edge (Figure 77).

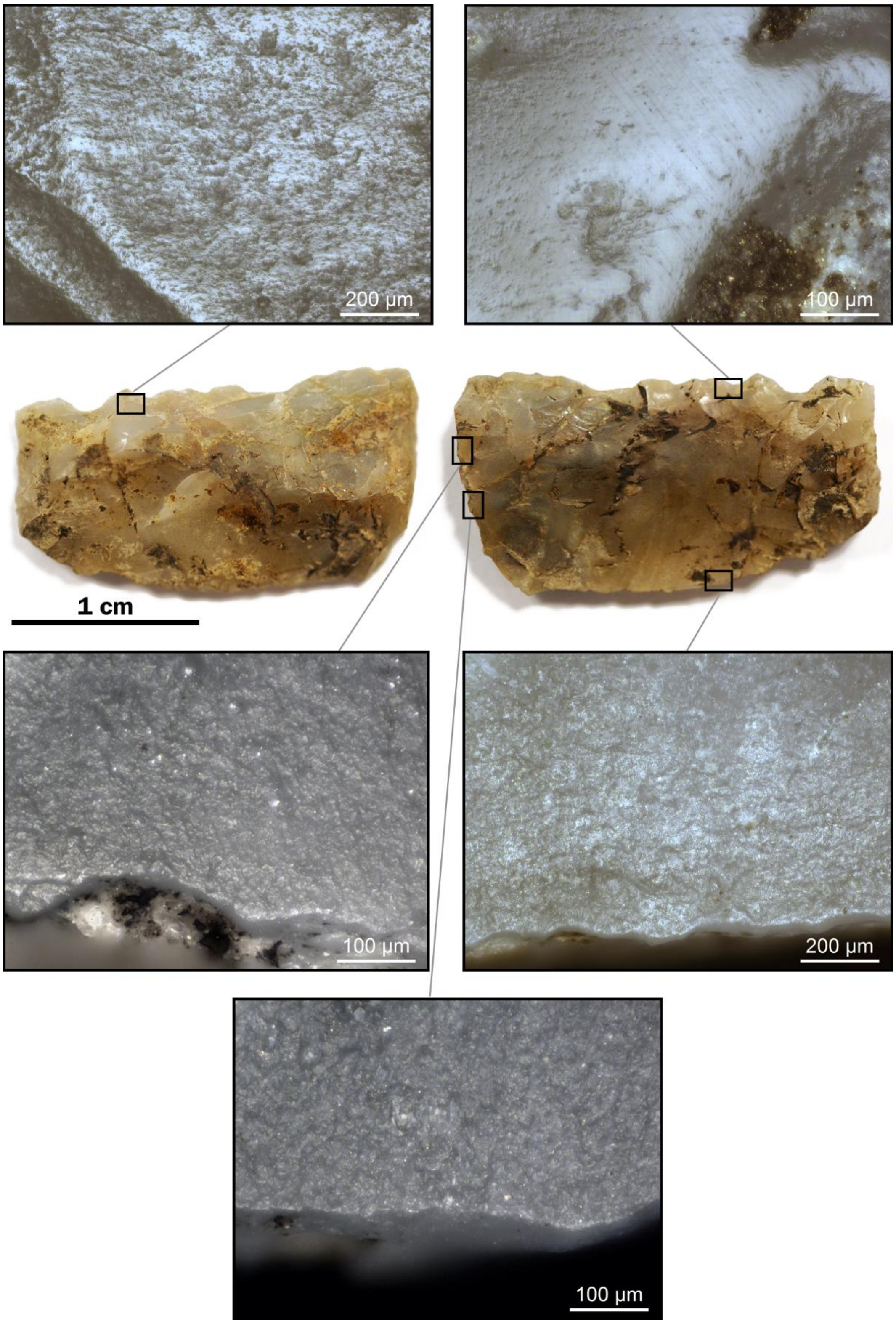


Figure 77: Biography of artefact ID1353_701455 viewed through microwear.

6.4 COMPARISON

The wear traces that appeared can be compared with the experimental tools. Although the differentiation among the tools is large, the common characteristics relate to the experimental tools; namely, the microwear polish is flat, matt, banded along the edge (extending into the tool's surface) and in most of the cases, the polish is smooth and bright. Striations are not common but when they develop, they mostly appear as long – medium length, thin and shallow. Edge damages always develop in the form of edge rounding, in most of the cases also as retouch. In the case of the experimental tools, the common characteristics are seen as the polish being smooth, matt, flat and pitted with rounded edges, as discussed in Chapter 5. The traces of the archaeological tools are also comparable with other experiments as well as the experimental collection of the Laboratory of Artefact Studies at Leiden University. From the literature, it is known that domesticated cereals cause a smooth, matt, highly reflective, flat polish with a directionality parallel to the edge (Keeley 1980, 60-1; van Gijn 1990, 40). Edge-rounding usually appears but it seems to be varied in relation to the duration of use and the relative coarseness of the raw material. The polish is pitted, mostly with 'comet tail' shaped pits; striation does not appear in every case but when it develops, it is shallow. This description matches with the results of the analysed archaeological artefacts. The experimental tools from the collection of the Laboratory of Artefact Studies show similar traces. These tools were mostly used on barley, emmer and einkorn. Some of them were used for a longer time than the experiment performed related to this thesis. Those tools with longer durations of use show clearer parallels for the archaeological tools from Százhalombatta-Földvár. Some of the experimental tools also developed sickle gloss that is visible to the naked eye. The polish of them is more flat, more spread in the background and brighter in general. These data suggest that the archaeological tools were used to harvest cereals; at least those which are interpretable. Therefore, the microwear analysis seems to support the preconception of the typology;

namely, these flint tools were used as sickle inserts. Besides, it is clear from the microwear analysis that the analysed pieces were not used on other types of material, at least not for their primary function. Therefore, the previous interpretation of them as saws (Horváth 2005) is not supported by the microwear analysis.

The pieces that produced striation can be compared with the literature. In general, it can be concluded from experiments and literature that striation is rare on tools which were used for the high harvesting of cereals. Although low harvesting is often associated with striation, those striae tended to be deep and long. Striae on the analysed archaeological tools are long but they are mainly shallow and thin. Therefore, it is not clear if they could be associated with the low harvesting method. To be able to distinguish the harvesting method, it is necessary to carry out new experiments with a longer duration of time but in similar environmental conditions to the site itself, as was kept in mind for the experiment described herein.

6.5 CONCLUSION

The microwear analysis helped to understand how the typological group of the archaeological assemblage, the sickle blade/sickle insert, was used. The results of this research method supports the most common preconception of this tool type; namely, that they were used for harvest cereals (Goodale *et al.* 2010; Kadowaki 2005; Keeley 1980; van Gijn 1990). It also confutes the other interpretation of the analysed pieces as saws (Horváth 2005). There is no evidence to support that these tools were used in other activities than reaping cereals, unless they were modified and reused as other types of tools (i.e. in the case of ID 1353_701455, the secondary use was as a hide-scraper). It is also clear from the comparison with experimental tools that more experiments and longer-used experimental tools are needed for a better understanding of their use; mostly the duration of use of these types of tools, as well as perhaps the harvesting method. The degree of polish on the pieces suggests these tools were used for a long time and resharpening suggests regular maintenance at the Százhalombatta-Földvár site. It is reasonable to assume they were an important part of a Bronze Age toolkit on the site. It is clear from the result of the microwear analysis that this research method should play an important role in the research. Microwear studies can give a better understanding of inter- and intra-site agricultural activity. Broader interpretations can also be given for Bronze Age agricultural activity and even for the society of the region. With these interpretations, this work connects to the broader theories of the Bronze Age society in Europe. Examples will be given in the following chapters.

Chapter 7

Discussion

7.1 Introduction

After analysing the assemblage from Százhalombatta-Földvár and comparing it with experimental works, there are two different scales against which the results can be interpreted and discussed. One of them is a site-scale and the other a regional-scale. In the site-scale discussion, questions will be reviewed regarding the meaning and role of sickles on-site, spatial organisation, connection with households and the social significance of the inhabitants of the tell. In the regional-scale discussion, possible interpretations of the sickles will be argued regarding their role in the region and how this importance could have had an effect on the meaning of the site in the region. Afterwards, how the interpretations of sickles can be connected to the interpretation of the site shall be discussed.

7.2 Site-scale discussion

Concerning the use of sickle blades/sickles, some inter-site questions can be posed. Was there a special place to make or use these tools? How were they treated? What did this mean in the context of daily life, agricultural activity and the social structure of the settlement? To answer these questions, a spatial analysis has to be carried out. There has been precise spatial documentation being created for the site since the beginning of the *SAX Project*. As is described in Chapter 2, the excavation is carried out in a 20m by 20m trench which is divided up by a 2m by 2m grid system. One excavation unit is usually 1m by 1m and special finds are measured by total station and have a centimetreprecise point provenience using GIS data. The excavation follows the occupation levels; therefore, occupation levels are differentiated and above these layers are layers comparable with cultural layers. The analysed finds are from different levels of the occupation layer of the tell. Most of the finds have point provenience numbers (PP) but the provenience of those that do not have a PP are known to 1m precisely. The analysed pieces are from the first occupation layer of the tell, the Koszider Phase. This layer can be divided into to six levels. If all the finds are displayed on one map of the excavation trench, there is no special place that can be seen for finding (Figure 78). However, it seems that the non-interpretable pieces are located reasonably close to each other at the south-western corner of the trench. If the sickle blades are displayed on the map by levels, some more information can be ascertained. Most of the analysed pieces belong to Level 1. There is no pattern to be seen in the spatial distribution of the sickle blades (Figure 79). In Level 2, the tools are localised to the eastern side of the trench. This level contains the highest number of blunt pieces but there is no clear difference between pieces with or without striations (Figure 80, Table 1). The least number of tools are from Level 3; this level is the thinnest among the examined levels. The distribution of the sickle inserts is scattered; there is only one tool with striations (Figure 81). In Level 4, most of the tools are located in the north-eastern quarter of the trench. Except tools, all of the inserts have microtraces without striation (Figure 82). In Level 5, the western side of the trench seems to contain primarily the tools; however, it has to be emphasised that the eastern part of the trench was just partly unearthed during those seasons when Level 5 was being excavated. There is again only one tool with striations in the micropolish (Figure 83). In Level 6, the densification of the pieces is in the middle of the trench (Figure 84). As can be seen, the distribution of the sickle blades changes along the levels. In the first four levels (the latest occupations of the tell), the tools seem to be more concentrated on the eastern part of the excavation trench. In Level 5 and Level 6, this pattern changes to the middle, western part of the unit. Other changes are also visible between the levels; in manufacturing processes, blades at the base of sickle inserts seem to be more significant in the younger levels. As has already been mentioned, the number of burnt pieces also increases in these levels. It is interesting to see these changes between Level 3 and Level 4 and between Level 4 and Level 5 because the settlement structure also shifted in Level 4 (Vicze pers.com). In microtraces, the middle levels differ. In Level 1, Level 2 and Level 6, there are closely the same amount of pieces with and without striations in the micropolish while in Level 3, Level 4 and Level 5, only one non-striated piece has been analysed. That said, there is no clear grouping between striated and non-striated sickle blades in the levels. This can be concluded if the degree of the wear is examined (Figure 85). In general, the well-developed category always greatly outnumbers the others in the levels. From literature (Goodale *et al.* 2010) and experiments, it is known that the development of wear traces and the intensity of the sickle gloss exponentially increase with the time of use. It is reasonable to assume from this information that the sickle inserts were intensively used and so was the case for a long time at the Bronze Age tell of Százhalombatta-Földvár. Resharpening is also generally observable on the tools which goes a long way in supporting this assumption. It can probably be concluded that sickles were intensively used on the tell. This information suggests, when supplemented by the tool-type distribution data, that sickle blades are the most common tools among the flint tools; that sickles had an important role within the community. In other words, agriculture had an important role on the tell. However, to understand this role, other tool-types connected to agriculture have to be examined. Comparisons with grinding stones and micro- and macro-archaeobotanical data will help to have a better insight into how agricultural activities were organised and how this organisation reflected society.

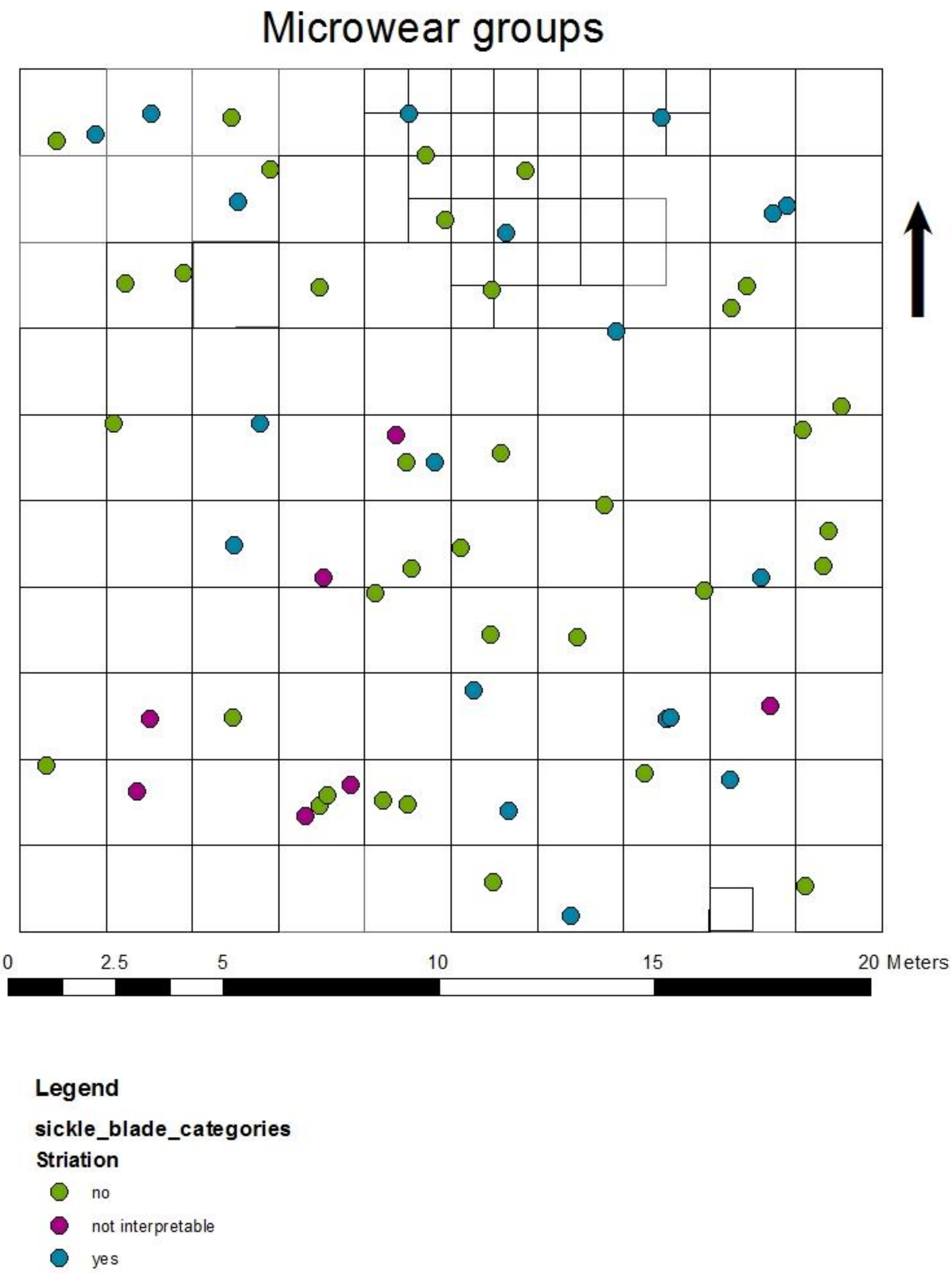


Figure 78: Spatial distribution of analysed sickle blades with microwear categories from all six levels.

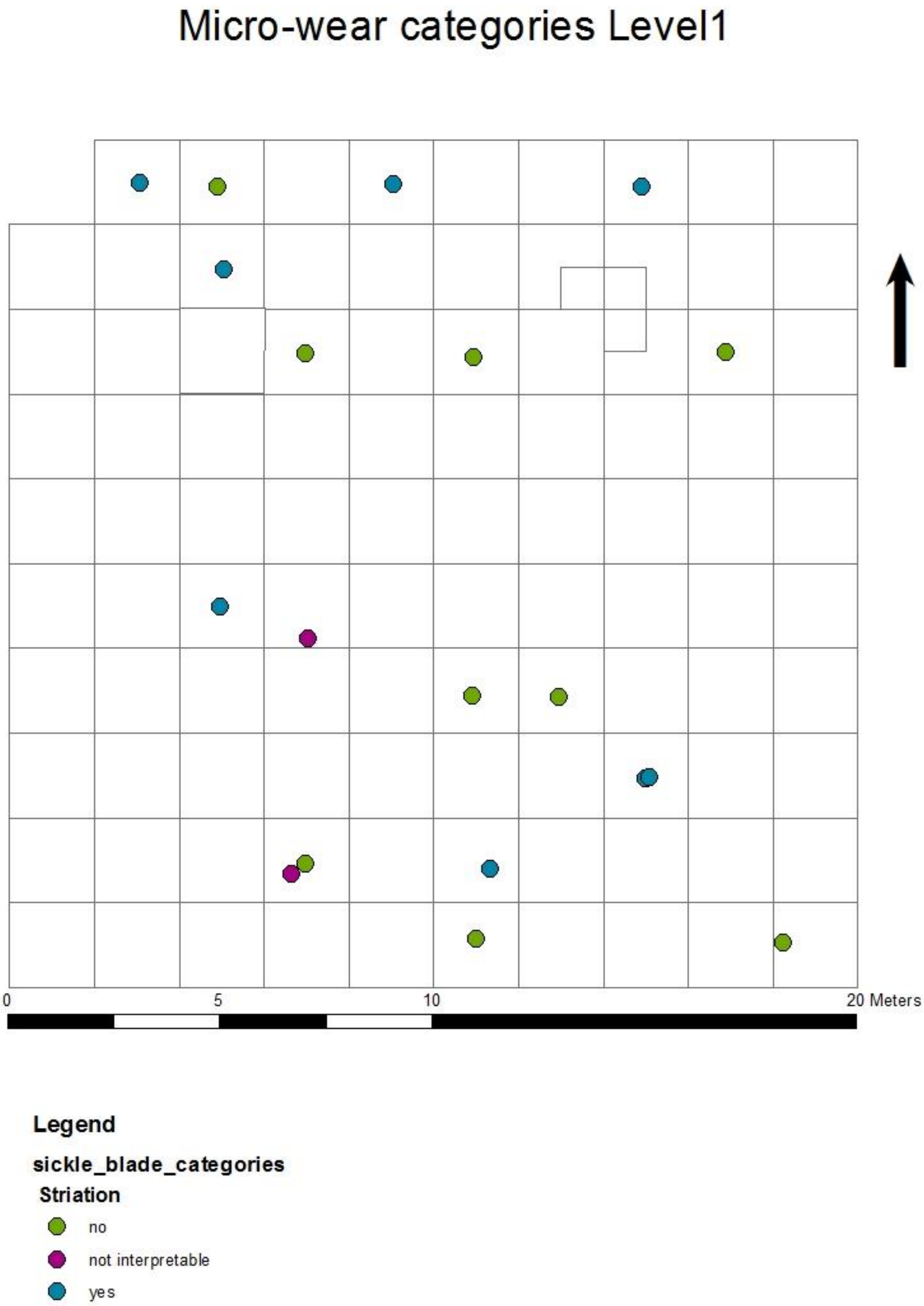


Figure 79: Spatial distribution of sickle blades from Level 1.

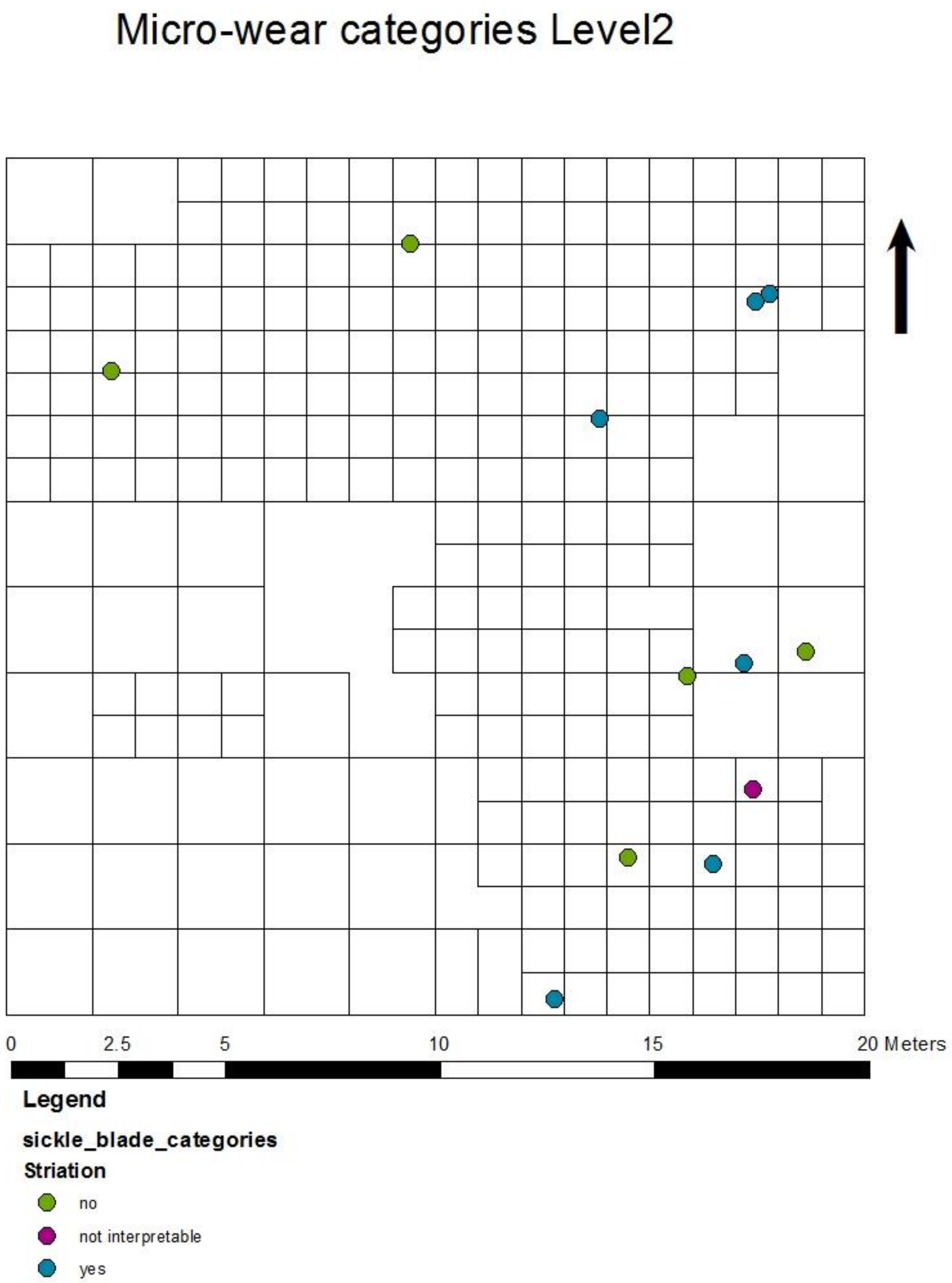


Figure 80: Spatial distribution of sickle blades from Level 2.

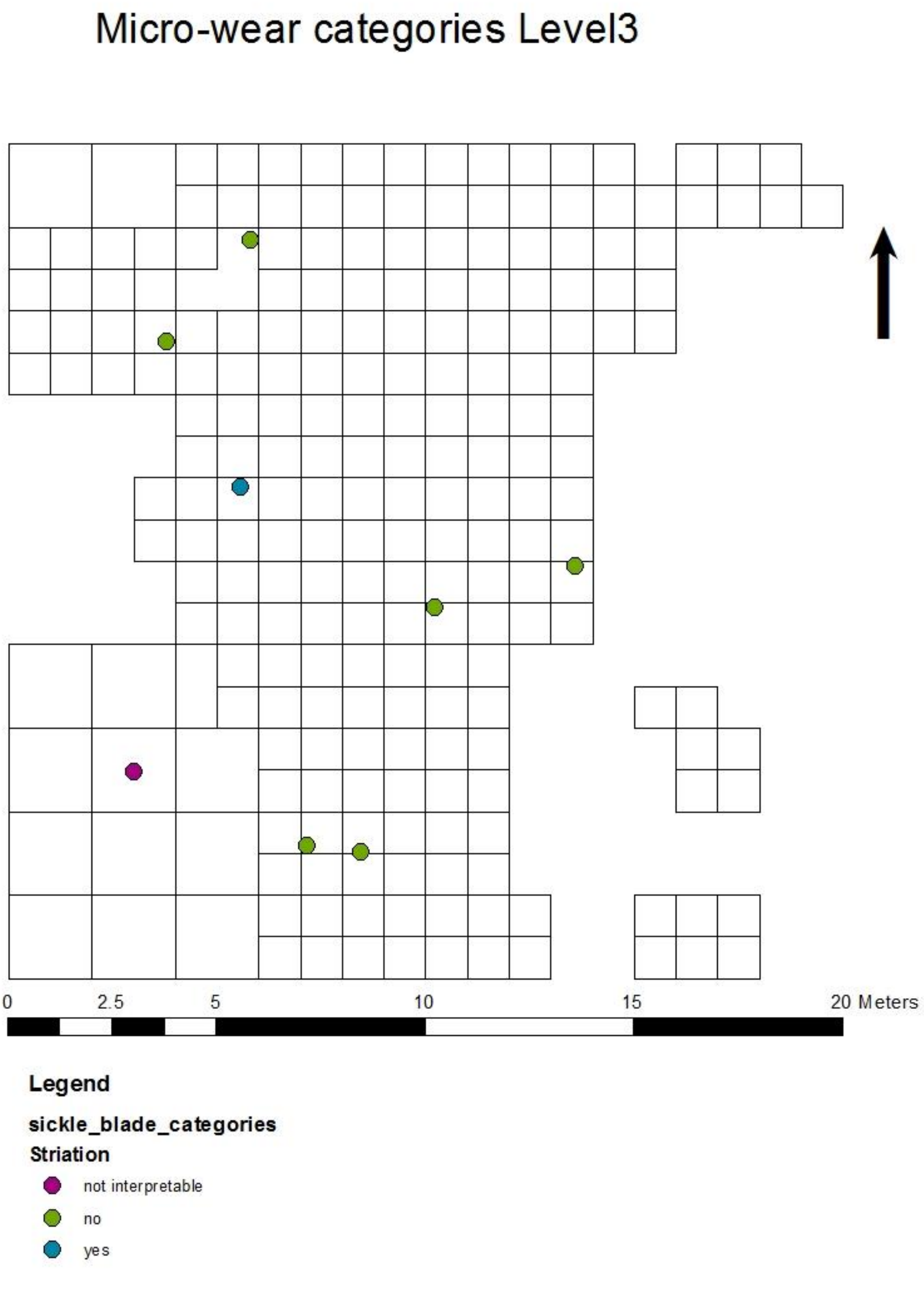


Figure 81: Spatial distribution of sickle blades from Level 3.

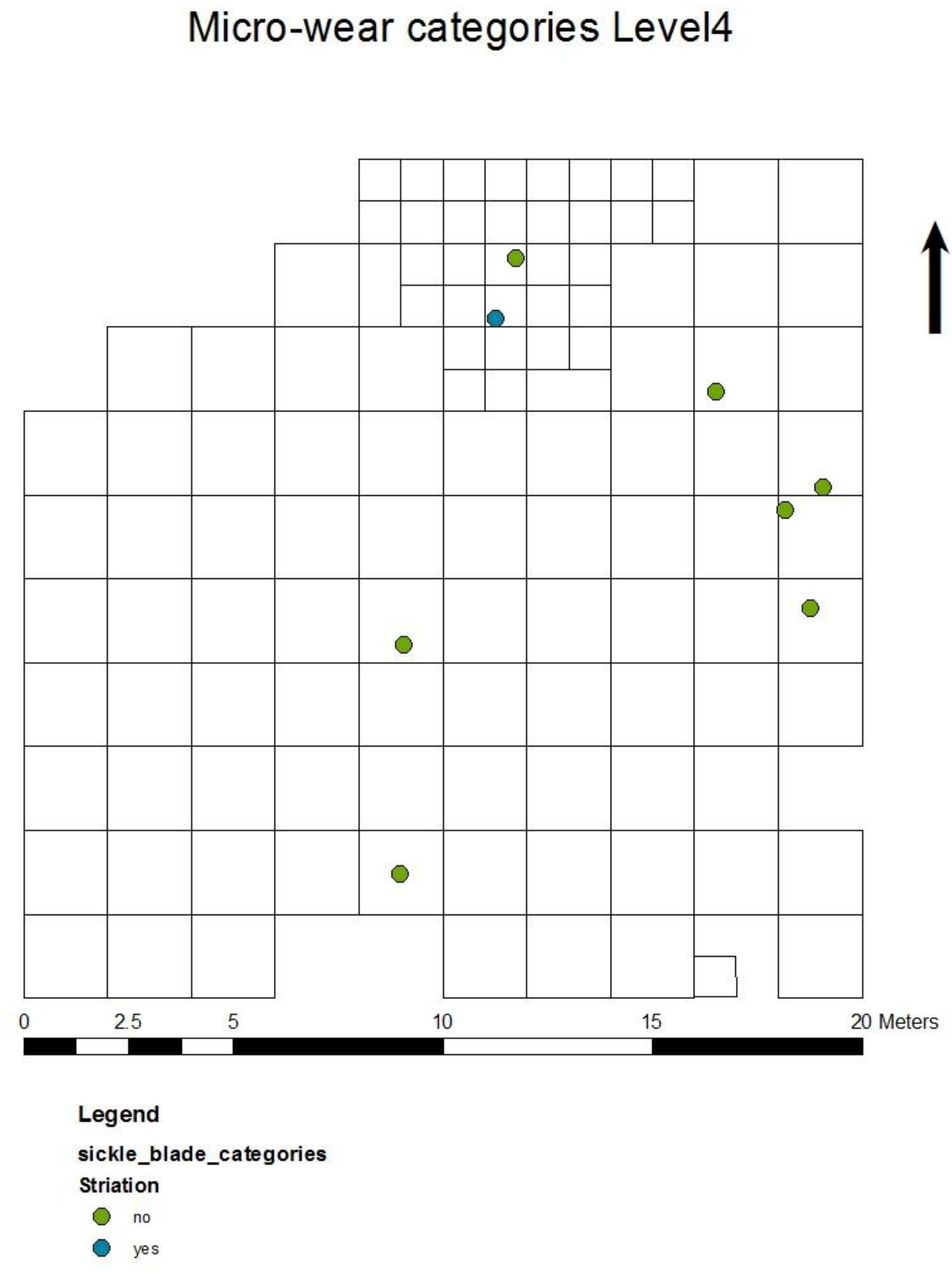


Figure 82: Spatial distribution of sickle blades from Level 4.

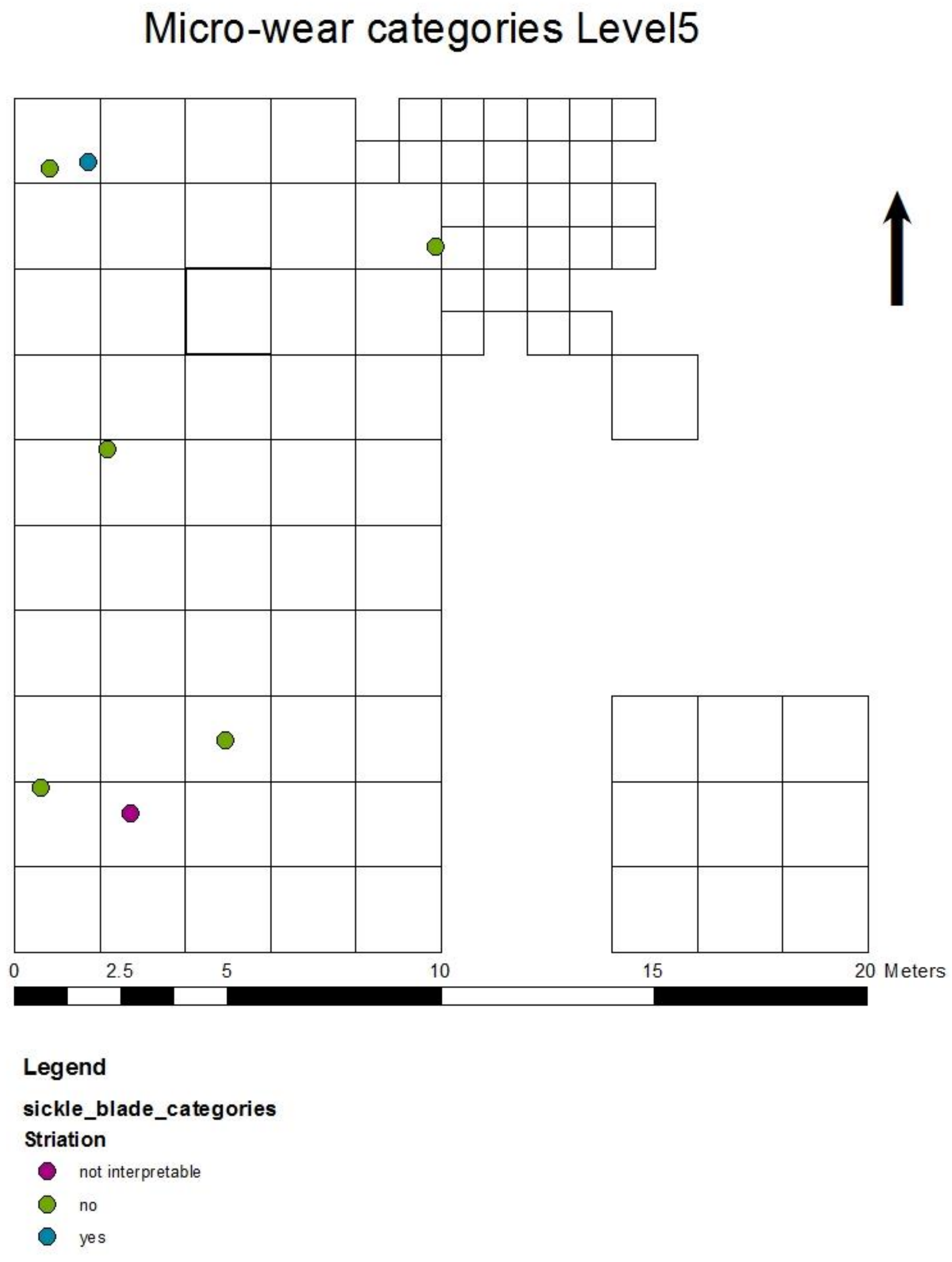


Figure 83: Spatial distribution of sickle blades from Level 5.

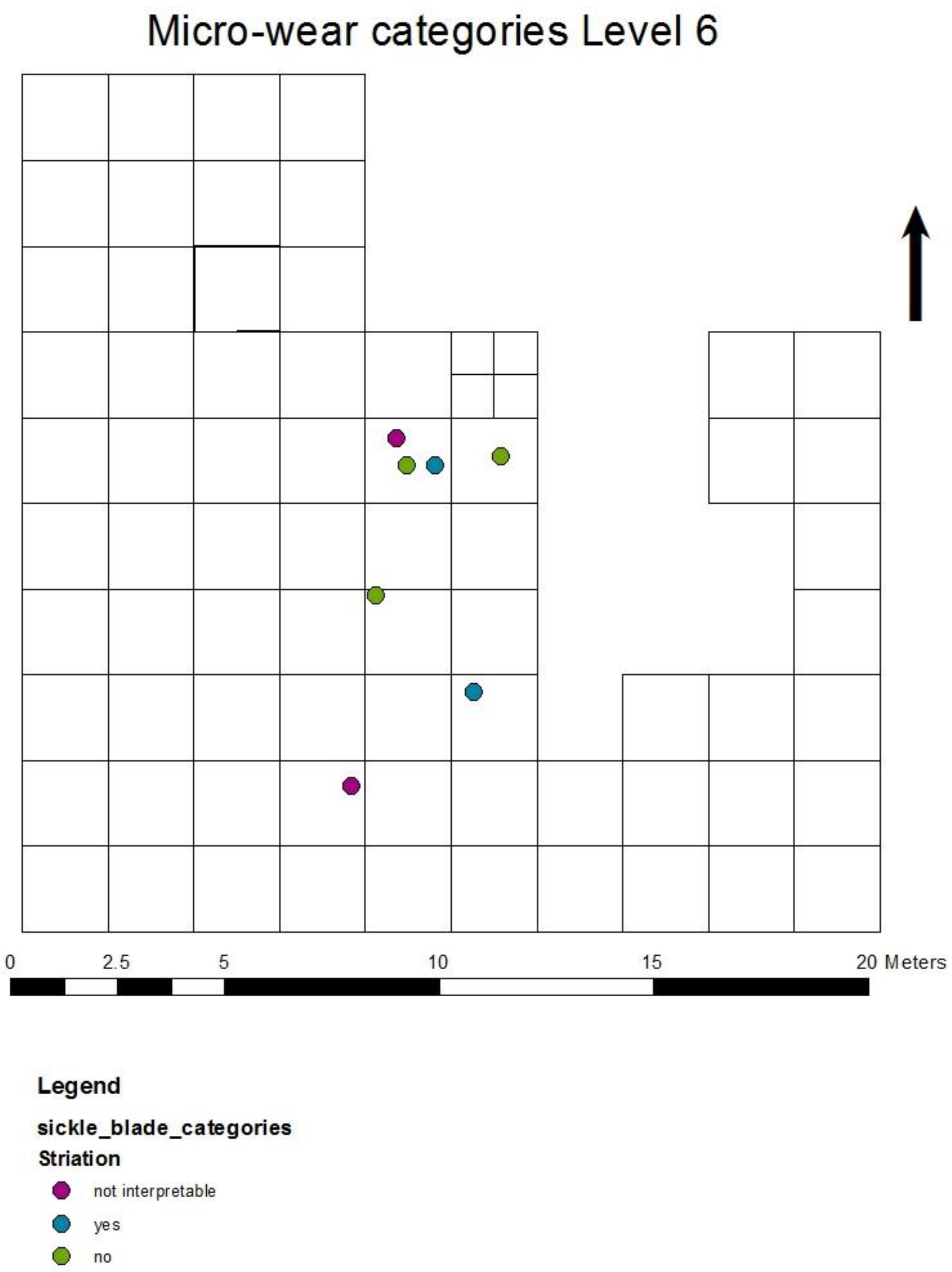


Figure 84: Spatial distribution of sickle blades from Level 6.

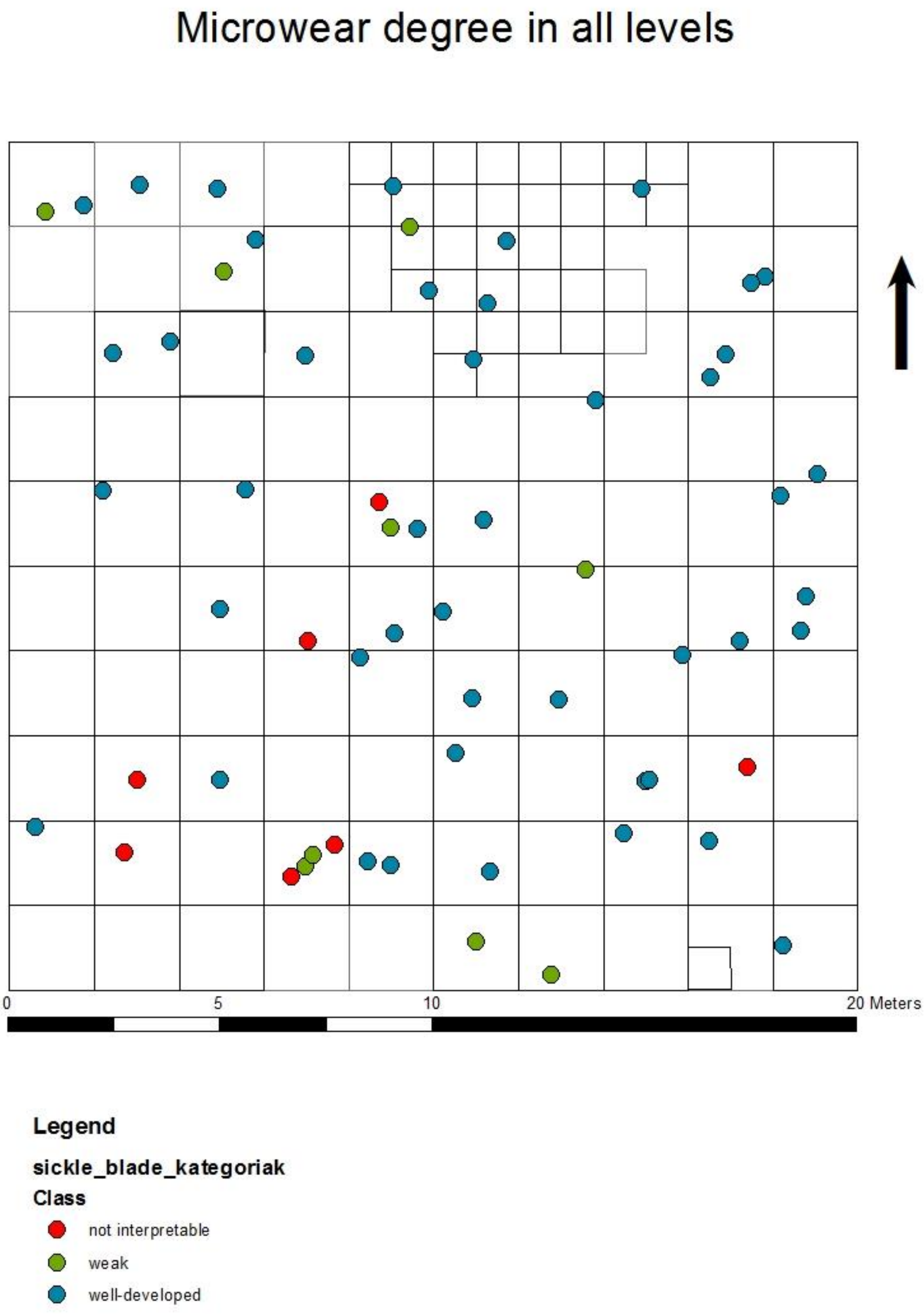


Figure 85: Spatial distribution of analysed sickle blades with degree of microwear from all six levels.

7.2.1 ARCHAEOBOTANICAL DATA

From macrobotanical data, it is known that, on tells of the Vatya culture crop, cultivation was at a high level, einkorn (*Triticum monococcum*) was the most important cultivated species, barley (*Hordeum vulgare*) was in second place, emmer (*Triticum dicoccum*) had a minor role and that spelt (*Tricitum spelta*) exists only in the form of sporadic finds (Gyulai 1993, 22). Out of this, at Százhalombatta-Földvár, einkorn had an overruling role: a 98-100% contribution can be detected, with emmer also appearing in the data but with only an equal or smaller than 1% ratio. At Százhalombatta-Földvár, spring sowing was common. This suggests a summer harvest around July. On this site, botanical remains of nude, long-eared barley (*Hordeum vulgare subsp. distichum var. nudum*) have also been found (Gyulai 1993, 23-7). In general, the climate was drier and warmer in the Middle Bronze Age than the Late Bronze Age in the Carpathian Basin but cereal pollens increased during the second half of the Bronze Age. The explanation for this increase is an expanding plough-land cultivation. Species of rye appeared for the first time in the Carpathian Basin during this period. A geographical distribution can be detected within the species of the *Triticum* genus. The two major regions are: the eastern and north-eastern section of Transdanubia with the northern region between the Danube and the Tisza rivers and the left bank of the Tisza River and the eastern section of the region between the Danube and the Tisza rivers. In the first region, einkorn was the dominant species while emmer and common wheat (*Triticum aestivum*) played a secondary role. In the second region, emmer was the dominant wheat species and einkorn and common wheat played an equally minor role. In the overlapping area between the two regions, einkorn and emmer were cultivated in comparable proportions (Gyulai 1993, 25).

7.3 REGION-SCALE DISCUSSION

The archaeobotanical data suggests that cereal cultivation had an equally important role on every Bronze Age settlement. It is reasonable to assume that sickles also had equal distribution across the sites. However, the archaeological data shows a significantly different pattern. From the region of Százhalombatta-Földvár, the Benta valley, data from four other Bronze Age sites are known. From field surveys, 4 pieces were found at the Bia 1/26 site which represents 14.8% of the flint tools. At the Tárnok 31/1 site, 3 pieces were found in a field survey which represents 9.6% of the flint tools and 2 pieces are known from excavation which represents 16% of the whole flint assemblage. At the Sóskút 26/4 site, 3 sickle blades were found during excavation which represents 9% of the whole assemblage and at the Érd 9/4 site, 8 sickle inserts were found which represents 19% of the chipped stone tools (pers.com. Priskin). For comparison, the analysed levels contained 146 sickle blades which represents 59% of the chipped stone tools. These numbers break down to levels as follows:

Level 1: 33 sickle blades (62%);

Level 2: 35 sickle blades (64%);

Level 3: 17 sickle blades (61%);

Level 4: 20 sickle blades (54%);

Level 5: 24 sickle blades (56%);

Level 6: 19 sickle blades (68%).

It seems clear that the number of sickle inserts is over-representative at every level of the tell at Százhalombatta-Földvár. Nevertheless, the site represents other settlement-types and not completely from the same period of the Bronze Age; the aforementioned sites from the Benta valley are the best parallels for

Százhalombatta. They existed during some part of the occupation of the tell and they are thought to be a dependent site from Százhalombatta-Földvár (Earle and Kristiansen 2010). Note that it has to be emphasised that data from the Benta valley is coming from mostly field surveys and small-sized excavation trenches, therefore the numbers of finds are not perfectly comparable. These large differences raise some questions: What does the significant dominance of sickle blades mean at Százhalombatta-Földvár? Why can this dominance not be seen at the other sites? Did Százhalombatta stand at a higher level of hierarchy? Did it organise or centralise the harvest in the region? Did it distribute the sickles or the sickle inserts? Was Százhalombatta-Földvár the centre of manufacturing for this tool-type? To answer these questions, more comparative analyses have to be carried out and wider investigations of the Benta valley site are needed.

7.4 INTERPRETATION OF THE SITE

Data currently suggests Százhalombatta-Földvár had a different stage in the hierarchy. This matches up with recent interpretations of the Benta valley that it was part of a chiefdom in which Százhalombatta-Földvár represented the power centre (Earle and Kristiansen 2010). However, detailed research of the site itself is challenging this view, just as the research presented herein is doing. Comparisons of the material culture with other site-types show little indication of a difference in hierarchy. Hence, the aforementioned results suggest that, instead of political differences between sites, they may in actual fact be economical. Other works in-progress also examine this possibility and current research questions deal with the settlement lay-out, changes in the use of space, households and activities related to everyday life and social organisation.

Chapter 8

Conclusion

In the preceding chapters, a complex analysis of a flint assemblage from Százhalombatta-Földvár, Hungary, was presented. The analysis focused on sickle inserts from the Late Middle Bronze Age occupation layers of the site. Microwear analysis was carried out on the sickle blades. The results of the analysis were compared to experimental work, literature and combined with typological and spatial analysis. The results concerned wider research of the tell settlement and social as well as cultural conclusions were proposed.

As a result of this, it is possible to answer the research questions that were proposed at the begging of this thesis.

1. *What can we infer about agriculture and farming organisation from the microwear analysis of sickle blades?*

The substantial majority of the sickle blades were used to harvest cereals, the microwear analysis showed. In addition, huge amounts of macrobotanical evidence also supports that extensive cereal cultivation was taking place at the tell during the Bronze Age; harvesting was an important activity. Sickles with flint inserts were used for harvesting. Sickle blades were used for a long time and their regular maintenance can be proven. However, it could not be proven whether or not there were different treatments for different types of cereals or what kinds of harvesting methods were adopted.

2. *Can activity areas or workshops be discerned within the site of Százhalombatta based on the spatial analysis of the microwear data?*

The spatial distribution of sickle blades does not follow a pattern. Therefore, clear activity areas or workshops cannot be discerned in any of the analysed levels. However, there are tendencies such as the place of the non-interpretable pieces or in the change of the distribution pattern between the first four and the older two levels. For a better understanding of these tendencies, further investigation is needed.

3. *Can we see differences in the biographies of the sickle inserts in terms of raw material, technological features, use and discard?*

The comparison of microwear results with the raw materials has shown that there is no visible difference among sickle biographies in terms of raw material. However, sickle inserts made on blades seem more often to have a secondary use. In terms of use, the pieces with well-developed traces were regularly maintained while those with a lower development of traces were not resharpened. There is no special discard of sickle blades that can be observed; however, burnt pieces are frequent, a process which probably happened after the use of the sickles.

4. *Is it possible to connect sickle blades to harvested cereal types or harvesting methods?*

The experiments aimed at proving these theories were unsuccessful; however, the analysis of the archaeological artefacts suggests some kind of possibility for the differentiation. To answer this question more accurately, further research is needed.

5. *What does microwear analysis reveal about the role of flint inserted sickles on the site or on a broader, regional scale? Is there any difference between sickles from Százhalombatta and those from the other sites from its hinterland?*

From microwear analysis, it is proven that flint inserted sickles were used at the Százhalombatta-Földvár site. Those sickles were used for a long time and with regular maintenance. The number of sickle blades outweighs every other tool type on the site. This information suggests that sickles had an important role at the site. From data from other sites of the hinterland of Százhalombatta, it is reasonable to assume that sickles had a distinctive role at Százhalombatta but not at the other sites.

6. *How do sickles relate to society? Did sickles have a role in social cohesion?*

From the previous information, it can quite confidently be concluded that sickles had a special, notable role in society at the site. It appears that this social role was concentrated to the tell. One of the possible explanations for this can be that harvesting was a centralised communal activity controlled by Százhalombatta-Földvár. In this sense, sickles would be a material evidence of intra- and inter-site social cohesion.

As the above shows, microwear analysis is a useful approach for examining the use of tools and through this, it is possible to study the relationship between community and material culture. As with every other scientific method, microwear analysis also has its own problems and disadvantages. However, with thorough investigation and contextualisation of the results, it is an essential tool for studying cultures in the past. The research method is closely linked to experimental archaeology and ethnoarchaeology. To interpret the results of microwear analysis, it is essential to compare them with experimental and ethnoarchaeological data as was performed as part of the research presented herein. With the help of microwear analysis, the research questions of this thesis were answered or, at the very least, partly answered. The research is connected to other research that is going on in the framework of the *SAX Project* because it gives supplementary data to archaeobotanical questions; questions about activity areas and the broader interpretation of the site. Beyond this, the present study sheds light on how the experimental archaeological project that is ongoing in the Archaeological Park of Százhalombatta can be linked to the archaeological research of the tell settlement. With the outstanding number of sickle blades and their relation to other sites in the hinterland of the tell, it has been shown how the microwear analysis can give extra information to answer the main research questions connected to Százhalombatta-Földvár and help to understand the role of the settlement in the Bronze Age. However, the results presented here are only the beginning of much larger research. The method of microwear analysis combined with experiments is a pioneer approach in Hungarian archaeology, meaning that good parallels are missing for comparison. Furthermore, the analysed assemblage is only a small part of the available finds, meaning that further investigations are needed and future directions should be laid out in order to get a better understanding of the region as a whole.

8.1 Future directions

There are several directions to continue the research presented here, even if only the six levels of the settlement are investigated that are used in this thesis. A first step would be to analyse all the sickle blades from these levels, not just a sample. It might help to explore activity areas at the site and better understand the variability of micropolish on the sickle blades so that a better grasp on how the sickles were used may be acquired. It would also be reasonable to analyse other tool types: chipped stone tools and ground stone tools. These can give a better understanding of the variety of activities which took place on the site and as part of the agricultural process. Furthermore, comparisons with other material culture categories like pottery, bone tools and organic materials would help to give a more complete interpretation of the occupation layers and a better understanding of the changes between levels. As a matter of fact, it would be wise to subject all the previously excavated cultural layers of the tell to the aforementioned analyses as there is a treasure of information to be uncovered that could shine some light on the many questions regarding these younger layers. However, to do a complete analysis on the whole assemblage of Százhalombatta-Földvár would be extremely time-consuming and expensive so is not very realistic Another possibility is to concentrate on special find complexes; areas such as households or pits and do a thorough analysis of them. Or, if attention remains on sickle blades, it would be interesting to analyse coherent find groups such as the aforementioned complete sickles with haft, or other haftless sickle blades that were found in relation to each other which indicates that they were in the same haft.

It should be noted that if there is an interest in examining more find layers and doing so thoroughly, the cost will eventually go down. If a reference collection is made, maintained and grown by continuously adding experiments, while the expertise of the method is incentivised, the analysis of similar find groups would be increasingly less time-consuming.

The present study has proven that microwear analysis is an important approach to examining tools and that Százhalombatta-Földvár is an extremely suitable site for that, as well as doing complex studies in which microwear analysis can be connected to broader research. Therefore, it would be reasonable to continue the ongoing research that has been presented herein.

Abstract

Százhalombatta-Földvár, located in Central Hungary, is a Bronze Age tell-settlement along the Danube River, at the delta of the Benta river. The Bronze Age in Hungary is the period between 2800-2700 BC and 800 BC (Kiss 2005), from which Százhalombatta represents 2000-1400 BC (Vicze 2013). This archaeological site has an important role in the Bronze Age research in Hungary – and abroad. Due to its size and geographical position, Százhalombatta-Földvár can be considered the head of the Bronze Age chiefdom in the Benta valley, according to the model proposed by Earle and Kristiansen (2010). However, detailed research of the site itself is challenging this view. Comparisons of the material culture with other site-types show little indications of a difference in social hierarchy within each site. Hence, instead of political differences, they might be economical. The present study aims to give additional information for the interpretation of the site through microwear analysis of sickle inserts. Microwear analysis is not yet an established approach in Hungary, making the present research a pioneer and offering a fully new approach to understanding the site. In the research presented here, a sample of sickle blades has been analysed, coming from the last occupation layer of the tell, the Koszider Phase (1500-1400 BC) (Vicze 2013). Sickle blades are the most common flint tools found on the site, which underlines their importance in the daily life and society. In order to properly introduce this new method into the current research, it was essential to conduct experiments as references, because the archaeological microwear traces have to be compared with traces on experimental tools. As such, harvesting with experimental flint flakes was carried out. The experiments focused on the difference between harvesting methods and cereal types. Furthermore, the archaeological tools were also compared to literature and the experimental reference collection of the faculty of archaeology. The microwear analysis strengthens the interpretation that the sickle blades had been used to harvest cereals and that they were used for a long time and regularly maintained. Unfortunately, the experiments did not yield the hoped-for differentiating information, while the archaeological tools do show a greater variability. As a result, it is not possible to draw conclusions about the harvesting method or harvested cereal species at this stage of the research. Nevertheless, it was possible to give some interpretation about social organisation. From the microwear analysis it can be suggested that sickles were important tools and that the harvest might have been organised and centralised by Százhalombatta-Földvár in the chiefdom of the Benta valley.

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