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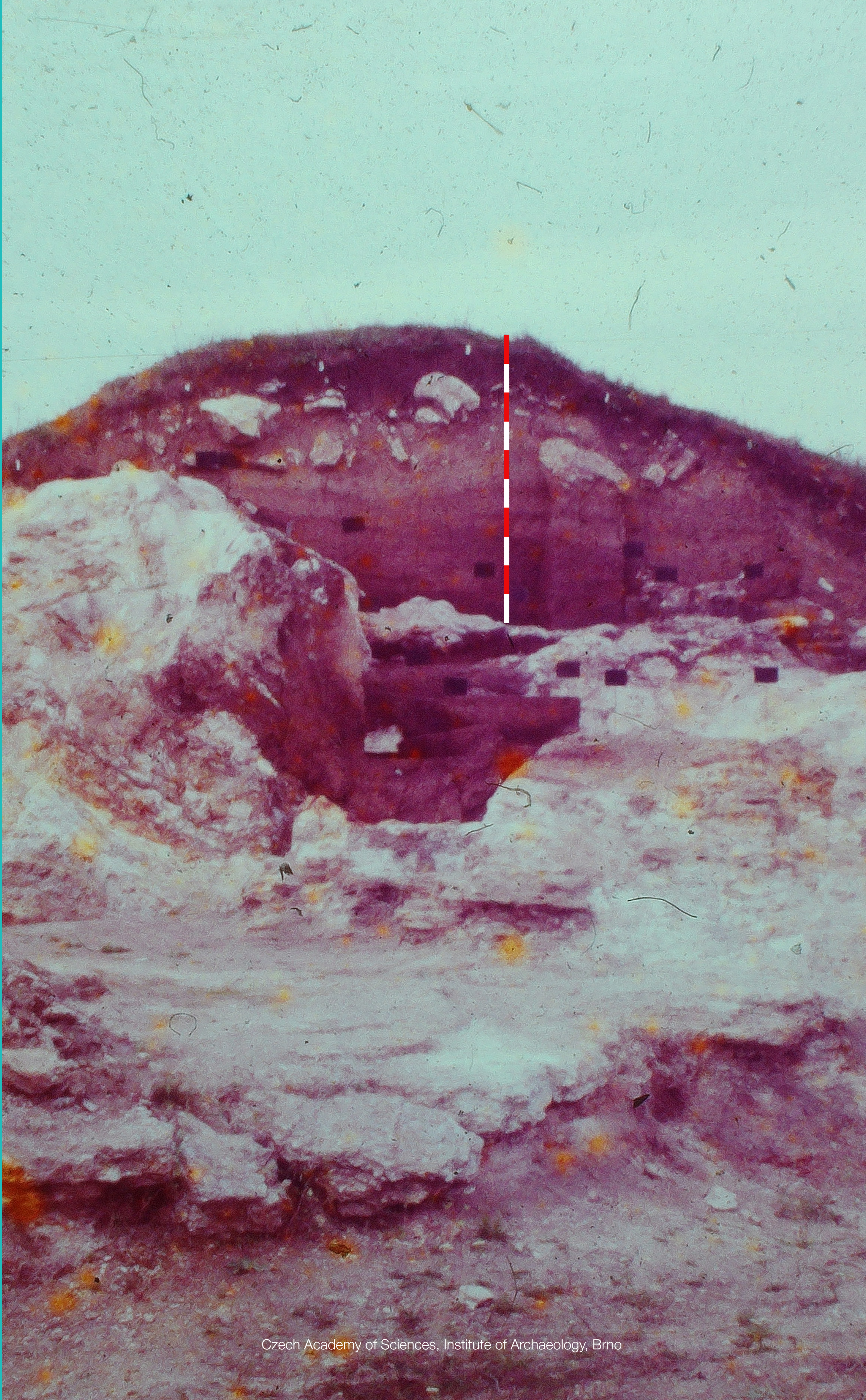
Solving Stone Age puzzles:
From artefacts and sites towards archaeological interpretations



Czech Academy of Sciences, Institute of Archaeology, Brno

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Adrián Nemergut – Martin Novák et al.

The Dolní Věstonice Studies Vol. 26

Published by
Czech Academy of Sciences, Institute of Archaeology, Brno
Čechyňská 363/19, 602 00 Brno, Czech Republic, www.arub.cz

Center for Palaeolithic and Palaeoanthropology
Sklepní 25, 691 29 Dolní Věstonice, Czech Republic

The book was published with financial support of the Czech Academy of Sciences.

The Institutional support for the long-term conceptual development of a research organisation RVO: 68081758 – Czech Academy of Sciences, Institute of Archaeology, Brno.

Translation and proofreading: Sean Mark Miller, Milan Rydvan, Matúš Benkovič and authors
Managing editors: Martina Kudlíková, Markéta Kamenská
Editorial support: Hedvika Břínková, Jakub Knobloch, Ondřej Herčík
Graphic design: Pixle
Print: Azu design, s. r. o., Bayerova 805/40, 602 00 Brno, Czech Republic

Brno 2024

Cover: Middle Paleolithic travertine site of Hôrka-Ondrej (Slovakia) excavated by Ľubomíra Kaminská in 1987–1992 and 1995. Photo by E. Javorská.

ISBN 978-80-7524-080-4 (print)
ISBN 978-80-7524-081-1 (online; pdf)

DOI 10.47382/dvs_26

ISSN 1801-7002

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Studies in Palaeoanthropology and Palaeoethnology of Eurasia

This monograph is dedicated
to Ľubomíra Kaminská

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Contents

Preface

Dear readers,

It is with great joy and pride that we present to you the book "Solving Stone Age puzzles: From artefacts and sites towards archaeological interpretations", which is the result of the collective efforts of leading Central European specialists in Paleolithic archaeology, Quaternary geology, anthropology, paleoecology and other related fields. This edited monograph gathers in 18 chapters a diverse set of knowledge that can be an inspiration for further research in the subject fields and demonstrates how putting together fragments of archaeological research, starting with a basic and patient study of archaeological sources, can enrich our understanding of the life of people in the Stone Age.

The presented publication is a tribute that pays homage not only to science and knowledge, but especially to an important personality who is still unstoppably dedicated to unravelling Paleolithic puzzles. That person is Ľubomíra Kaminská, a prominent Slovak archaeologist, whose work significantly contributed to the expansion of our knowledge about the Paleolithic and Mesolithic settlement of Slovakia and Central Europe, and thus developed the research potential for future generations of not only Slovak Paleolithic researchers. To celebrate her 70th birthday, we, her colleagues, friends, and students, have decided to collect these contributions as a reflection of her immeasurable contribution to the archaeological community and as an expression of our admiration and appreciation.

Teamwork is behind every success, so at this point we also want to express our sincere thanks to everyone who contributed to the creation of this monograph. Many thanks are owed to the reviewers of the monograph as a whole and the reviewers of individual chapters. It was their professional comments and suggestions that made an invaluable contribution and significantly improved the final form of the monograph. In this regard, Jana Mellnerová-Šuteková deserves special thanks. Our thanks also go to our colleagues from the Palaeolithic Centre of the Institute of Archaeology of the Czech Academy of Sciences in Brno, Petr Škrdla and Vitali Usyk, who provided us with important scientific feedback for some of the studies included in this book. Special thanks go out to Ondřej Herčík for the preparation and unification of the map materials, which enliven the book in many ways. No less important for us was the cooperation with the graphic studio Pixle, with Pavlína Doležalová and Filip Mond, whose creative touch gave our work visual excellence. We thank Sean Mark Miller, who proofread the text of the entire book, and also Matúš Benkovič and Milan Rydvan, who handled the translation of two chapters. Jakub Knobloch and Hedvika Břínková did an enormous amount of demanding work, especially related to the preparation and proofreading of the bibliography. And, last but not least, we must express our deep gratitude to the Brno Archaeological Institute's editorial department, Markéta Kamenská and especially Martina Kudlíková, without whose tireless work, dedication, and consistent care, this book could never have seen the light of day.

We would also like to thank the many other people who are not named here, but whose contribution is equally valuable. The individual authors have mostly thanked them in their chapters. Each of you played a key role in this project. Together, we have created a work that we hope will be a source not only of new professional knowledge, but also inspiration for further research, questions, and discoveries.

On behalf of all the authors,
Martin Novák and Adrián Nemergut

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Introduction.
Unlocking the doors… A guide through the landscape of Stone Age puzzles

Martin Novák

This book is a bridge. A bridge between generations of scientists and a bridge between the past and the present, between fragments of seemingly forgotten times and advanced interpretations that connect these tiny fragments like a puzzle and bring them to life in our imagination. It is a bridge where the paths of Stone Age archaeology, Quaternary geology, paleoecology and many other related disciplines meet and intersect, forming an interdisciplinary collaborative network to understand our ancient history and the life of past cultures.

The book brings 18 chapters, which together form a unique mosaic of knowledge and interpretations that shed light on the Pleistocene and Holocene periods from an archaeological and natural sciences point of view. Each chapter of this book, whether case studies presenting information from new excavations, results of analytical studies, or research projects of broader relevance, covers diverse areas and topics related to interdisciplinary research on the Stone Age in Central Europe. The chapters show how a wide range of archaeological sources can be interpreted in different ways and how they can be used for further research. They move from the studies focusing on entire settlement areas to case studies about individual sites, while others try to understand the technological processes of the production of individual artefacts and art objects, study the issue of sources of raw materials for the production of lithic industry, or through faunal analysis, focus on paleoecological reconstructions and subsistence strategies of prehistoric people. In this way, the monograph gradually goes through different levels of archaeological research in terms of theme and focus.

The first study by Ivana Fridrichová-Sýkorová opens avenues for future investigations into the earliest European settlements. It deals with the relic of the Lower Paleolithic cultural landscape in the basin of the Hrádecký potok in northwestern Bohemia (Fig. 1.1: 1), where systematic

doi 10.47382/dvs_26-01

research has identified a complex of Acheulian sites which can contribute significantly to understanding the behaviour of our earliest ancestors and the settlement dynamics of Europe during the Paleolithic.

The study by Amira Adaileh approaches the topic of settlement archaeology from a slightly different perspective. It examines the interpretative potential of the archaeological sites in the specific landscape of the Nördlinger Ries in southern Germany (Fig. 1.1: 2) from the perspective of Paleolithic settlement dynamics. The study discusses a different settlement pattern during the individual Paleolithic periods, considering a number of factors, including changes in land use, site preservation, and research biases. At the same time, the high number of Paleolithic sites here contrasts with the limited information and lack of specific chronological classification about them (most of which come from surface collections), thus raising questions about the true picture of the settlement. The study underlines the Nördlinger Ries's untapped potential for future Paleolithic research. It emphasises the need for a comprehensive review of the existing data to understand better the area's prehistoric occupation and its connections to the surrounding regions.

A similar problem considering the settlement areas' interpretation is also addressed in the following study by Katarína Kapustka (et al.). The study draws attention to the (marginal) territory of eastern Bohemia, which has been on the periphery of researchers' interest and poses challenges to understanding hunter-gatherer lifeways based on fragmented archaeological evidence. The chapter reviews Upper Paleolithic archaeological sites in the surroundings of the Rivers Loučná and Tichá Orlice (Fig. 1.1: 3) discovered through surface surveys, and taking into account the small size of these collections and the limited diagnostic value of the finds, discusses the potential strategies for refining their chronological frameworks. To fully understand seasonality and settlement/mobility patterns, the authors emphasise the need for further research, including structured surveys and identification of stratified findings contexts.

The chronological contextualisation of the archaeological record, as one of the key tasks of Paleolithic research, is also addressed in a study by an Austrian team led by Otto Cichocki. Alongside radiometric dating and comparative analyses of material culture, they employ a method of dendrochronology to establish contemporaneity between two Mid-Upper Paleolithic sites in the Austrian Middle Danube region: Gösing-Setzergraben and Krems-Wachtberg (Fig. 1.1: 4). By analysing floating tree ring sequences from charcoal samples, they synchronised the dendrochronological data between these sites, and demonstrated a simultaneous occupation of both sites during the Pavlovian, providing a more precise understanding of inter-site relationships and regional mobility patterns. Using dendrochronological synchronisation introduces a new approach to determining contemporaneity in Paleolithic archaeology, offering more complex insights into the raw material economies and potential interdependent functions of Upper Paleolithic sites.

The study by Paweł Valde-Nowak and his team explores the archaeological potential of caves in the Polish Tatras through a case study of the Obłazkowa Cave (Fig. 1.1: 5) and considers the reasons for the absence of significant prehistoric remains at the site (removal of sediments associated with tourism development, inaccessibility of caves due to ice cover during the Pleistocene). Given the occasional finds of Stone Age artefacts and evidence of *Neanderthal* and early *Homo sapiens* activity at the foot of the Tatra Mountains, it highlights the potential of the Tatra area for uncovering prehistoric settlements. The ongoing research in the Carpathian region and the increasing number of Stone Age sites in the Alps suggests that further exploration in the Tatras could reveal significant evidence of early human occupation.

The following two studies present new Paleolithic sites from important settlement areas in northern Hungary and western Slovakia. In the context of lacking suitable or distinctive archaeological data, they discuss their informative value and how they could still contribute to broader archaeological interpretations.

A study by Mónika Gutay and Zsolt Mester presents a new Middle Paleolithic assemblage from the site of Gyöngyöstarján in Northern Hungary (Fig. 1.1: 6). The site was discovered during a long-term systematic survey in the region of the Mátra Mountains, which revealed a large number of Paleolithic surface collections and challenged the previous assumption that this region was uninhabited during the Upper and Middle Paleolithic. Though only broken and unfinished tools were identified in the collection, they documented the first use of local limnosilicite by Middle Paleolithic groups for bifacial tool production. Diagnostic elements like bifacially backed knives and leaf points link the industry to the Micoquian or Keilmessergruppe. However, as the study points out, further field surveys and analysis are needed to fully understand this industry and its regional characteristics.

A collective study led by Ondrej Žaár focuses on a settlement area around Moravany nad Váhom in western Slovakia, known for its rich Upper Paleolithic heritage. The rescue excavation in Banka helped discover a new site of Štepnica 2 (Fig. 1.1: 7), where the unearthed lithic industry lacks a typical "fossile directeur" for precise cultural classification. The study shows how, for the site's chrono-cultural interpretation, it is possible to use indirect confirmation according to the presence of other types of artefacts, in this case, bifacial thinning flakes documenting the presence of bifacial artefacts (leaf points) at the site. Based on this, the site could be associated with the Szeletian, which also corresponds with the radiocarbon date, closely matching those from the nearby Szeletian site of Moravany nad Váhom-Dlhá. Authors also suggest perspectives of further research, e.g. in geological-paleontological analyses of loess profile samples that could shed light on the changing climatic conditions in the region and contribute to a broader understanding of the area's archaeological and geological context.

In the following chapter, Peter Škrdla and his team return to the Early Late Upper Paleolithic site of Mohelno-Plevovce (Fig. 1.1: 8), located in a deeply incised river valley in the Bohemian-Moravian Highland, which provides rare insight into the sparse human settlement of Central Europe during the Last Glacial Maximum. Recent seasons of long-term and ongoing excavation have already uncovered a fourth stone structure, interpreted as a floor pavement of a possible dwelling. The structure has yielded a specific assemblage of lithic artefacts, corresponding to other structures in terms of the raw-material preferences or techno-typological spectrum, including characteristic microlithic implements. Further research will clarify the relationships between the individual structures. This will be important for a detailed study of the spatial structure of the site and for testing hypotheses about their contemporaneity.

The study by Ondřej Mlejnek, Petr Gadas, and Jaroslav Peška summarises and reviews the findings of the lithic artefacts excavated from the prehistoric site of Hradisko u Kroměříže in central Moravia (Fig. 1.1: 9). Emphasising the critical role of context over the artefacts themselves, the study faced challenges in the determination of the artefacts due to the passage of over seventy years since the excavation (led by Václav Spurný in 1949–1956). Despite these difficulties, the authors attempt, based on the typology and raw material analysis, to categorise the lithic industry into different periods, spanning the Early Upper Paleolithic, Neolithic, and Eneolithic Periods and the Bronze Age. They emphasise the site's long history of occupation and its connections to broader prehistoric cultural processes and draw particular attention to finds of Early Upper Paleolithic artefacts, suggesting potential Paleolithic settlement or reuse by the site's inhabitants in later prehistoric periods.

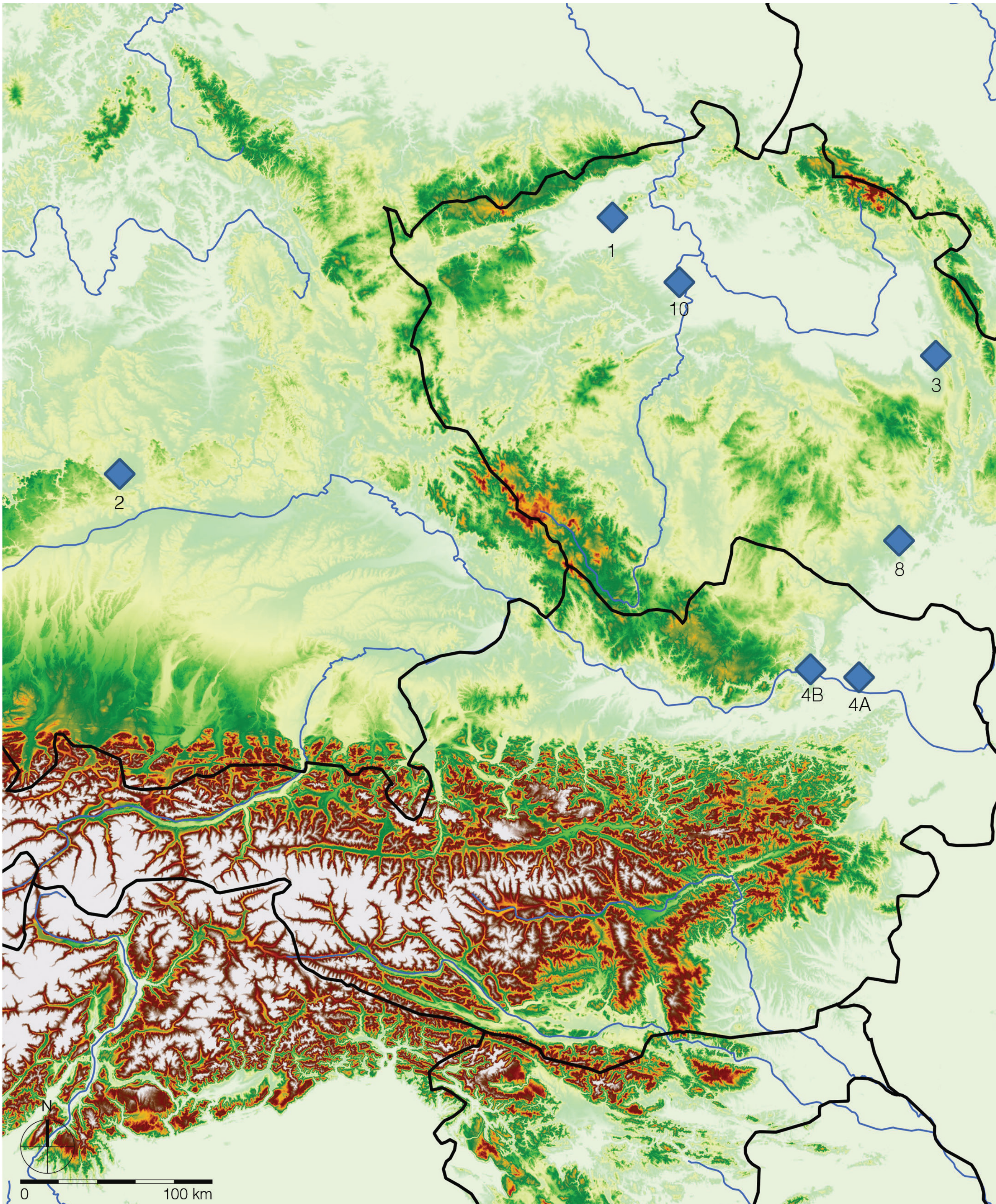
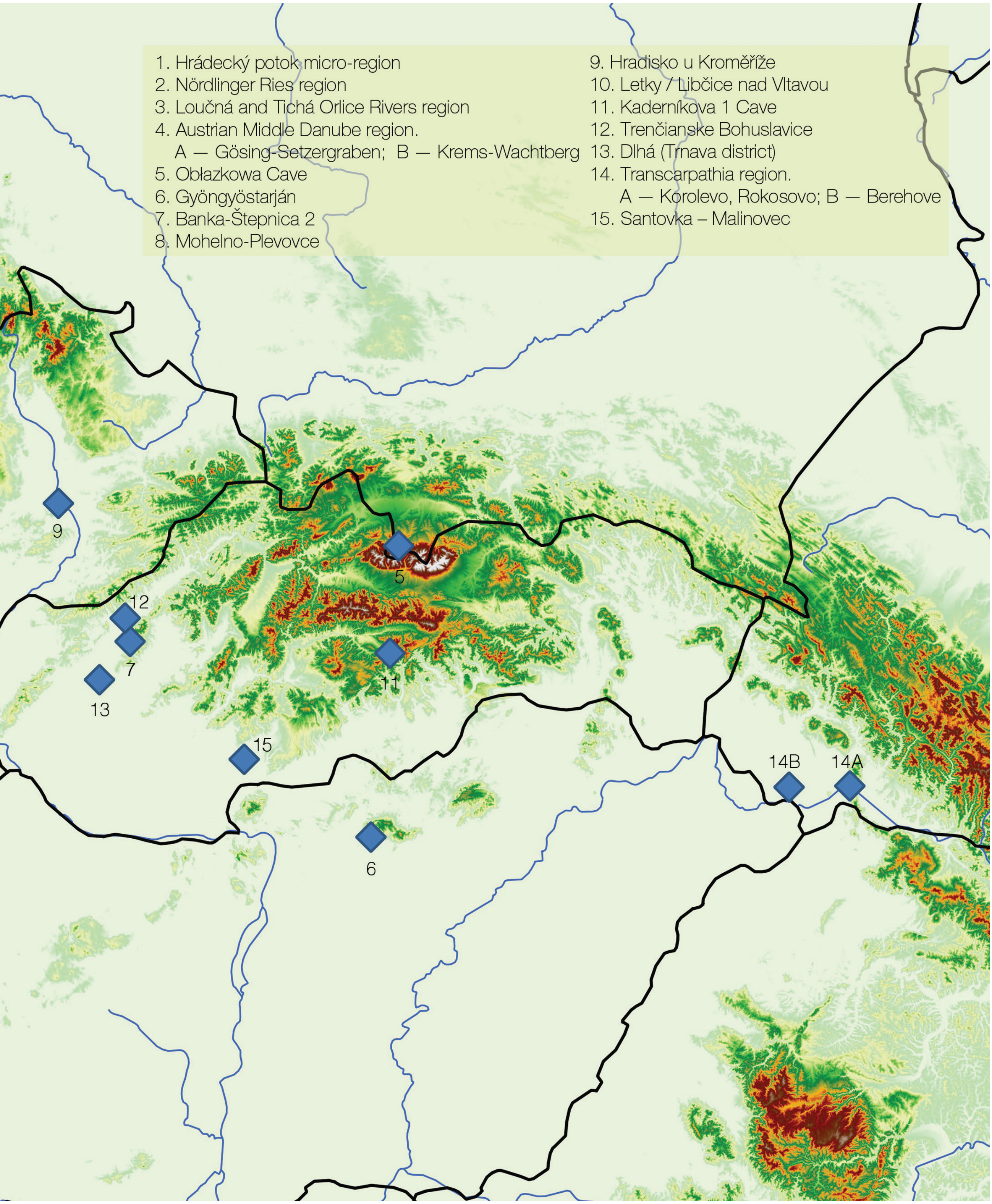


Fig. 1.1. A map of the sites mentioned in the individual chapters. Graphic by O. Herčík.


1. Hrádecký potok micro-region
2. Nördlinger Ries region
3. Loučná and Tichá Orlice Rivers region
4. Austrian Middle Danube region.
A — Gösing-Setzergraben; B — Krems-Wachtberg
5. Obłazkowa Cave
6. Gyöngyöstarján
7. Banka-Štepnica 2
8. Mohelno-Plevovce
9. Hradisko u Kroměříže
10. Letky / Libčice nad Vltavou
11. Kaderníkova 1 Cave
12. Trenčianske Bohuslavice
13. Dlhá (Trnava district)
14. Transcarpathia region.
A — Korolevo, Rokosovo; B — Berehove
15. Santovka – Malinovec
9
5
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14B
14A
6

The collective study by Peter Neruda, Jan Eigner, and Peter Šída moves its focus from settlement areas and sites to the individual artefacts and their significance to understand the variability and technological skills of archaic humans in the production of lithic artefacts. The chapter discusses the technological analysis of a unique Levallois core discovered in Letky/Libčice nad Vltavou in the Central Bohemian Region of the Czech Republic (Fig. 1.1: 10). It emphasises the importance of technological classification over typological classification to understand the complexity of lithic industries and acknowledges the inherent variability in stone artefacts due to factors such as knapper skill and raw material properties. It points to the challenges of distinguishing between different Paleolithic tool types and techniques, particularly within the Middle Paleolithic, where artefacts can deviate from standard forms, including the Levallois method. Considering this, the presented core is reclassified as part of the Levallois concept despite its atypical characteristics and the unsuitability of the raw material used.

In the following study, the team of authors, led by Bibiána Hromadová, also focuses on a detailed analysis of one artefact, a needle-shaped bone discovered unexpectedly in the site of Kaderníkova 1 Cave in Spiš-Gemer Karst in central Slovakia (Fig. 1.1: 11). Despite the lack of archaeological context, the authors attempt to make more general interpretations in terms of chronocultural distribution, origin, and function based on archaeological analogies and technological observations. A rare point was found in a cave with no signs of human occupation, which could suggest its accidental deposition, possibly during a hunt or by a wounded animal seeking refuge. Preliminary typological analysis and comparisons with Polish Mesolithic and Late Paleolithic sites suggest a similar date for the artefact, which provides valuable insights into the region's prehistory. However, further analysis, including direct dating, may shed more light on its origin and purpose.

A chapter by Alena Šefčáková and her colleagues deals with a similar topic as in the study of Petr Neruda et al., a reclassification of findings from older excavations. The chapter presents a rare example of early human art repurposing natural elements. It re-examines a previously classified eolith from the well-known Gravettian site of Trenčianske Bohuslavice in western Slovakia (Fig. 1.1: 12) and argues for its reclassification as a Gravettian female figurine. The authors delve into the broader context of eoliths, natural stone formations resembling human or animal figures, and challenge the traditional scepticism associated with their identification as prehistoric human-made artefacts. Macroscopic, microscopic, and spectroscopic analyses confirm that the presented calcareous nodule from the site of Trenčianske Bohuslavice has been intentionally modified to represent a female figure, using its natural shape in a manner consistent with other Gravettian female statuettes. This discovery is, therefore, significant for understanding Gravettian artistic practices and the challenges of identifying early human-modified objects.

An anthropomorphic statuette and its interpretation in a context of broader geographical and cultural interactions is also the subject of a study by Zdeněk Farkaš. The study presents the results of rescue archaeological research at the site of Dlhá (Trnava district) in western Slovakia (Fig. 1.1: 13), where two archaeological features containing ceramic material and fragments of anthropomorphic statuette were unearthed. The findings, classified into the Ib phase of the Moravian painted pottery culture, point to the connections between the regions of Bratislava Gate and Little Carpathians with those of Lower Austria and South Moravia during the development of the Lengyel culture.

A different perspective on the interpretation of archaeological data, through the analysis of lithic raw materials, is offered by two chapters geographically focusing on the areas of Transcarpathia and Carpathian Basin.

The chapter by Yuri E. Demidenko and Béla Rácz introduces a novel approach to the analysis of lithic raw material sources and their exploitation by Paleolithic human groups in Transcarpathia, Ukraine (Fig. 1.1: 14). The authors review traditional regional studies focused on the composition of raw materials within Paleolithic assemblages with limited investigation into their source areas. Based on the results of the new systematic petrographic classification of a number of raw material types known from Transcarpathia, which leads to more understanding of the raw material types' primary and/or secondary origin sources, they examine their role in supplying different human groups throughout the Paleolithic periods. The research challenges previous assumptions about the importance of strictly localised raw material regions, suggesting rather a broader significance of widely dispersed sedimentary regions across almost all Transcarpathian areas and sites.

The following chapter by Katalin Biró addresses the issue of raw material provenance analysis as an effective means of identifying the geological origin of lithic artefacts in archaeological contexts. In this case, long-distance and extra-long-distance high-quality lithic raw materials pose significant challenges due to their distant transport and potential interaction with other macroscopically similar raw materials. The study focuses on the complexities encountered in the Carpathian Basin when analysing lithic assemblages, emphasising the importance of non-destructive, non-invasive methods and the role of international collaboration in understanding the movement and exchange of high-quality lithic raw materials over large geographical areas. It also highlights the need for comprehensive databases, careful selection of analytical methods, and the importance of stable archaeological contexts.

The final three chapters of the monograph are more of a natural science nature. They are devoted to paleoecological reconstructions through analysing the Pleistocene fauna in an archaeological context.

A collective of authors, Martin Sabol, Csaba Tóth, and Martin Vlačiky, analyses Late Pleistocene mammal fossils from the Santovka – Malinovec travertine quarry in southern Slovakia (Fig. 1.1: 15), focusing on taxonomy, taphonomy, paleoecology, and stratigraphy. The mammalian fauna indicates a predominantly open landscape environment, though forest species are also represented, possibly brought to the site by predators or humans, whose activity is inferred from marks on bones and the discovery of Paleolithic artefacts. The site's paleoenvironmental significance is underlined by thermal mineral springs. They likely attracted a diverse array of wildlife and thus represented a significant factor in the accumulation of animal remains and the presence of prehistoric humans.

The study by Miriam Nývltová Fišáková investigates the paleoecology and migration patterns of animals from Central European Gravettian sites using geochemical methods, including strontium, carbon and nitrogen isotopic analyses. The study indicates that the Gravettian period in the Middle Danube region was characterised by abundant resources and supported diverse faunal populations living in a steppe to forest-steppe environment with low precipitation. The results of the presented research contradict previous hypotheses, suggesting that while mammoths showed some migratory behaviour, large herd animals like reindeer and horses did not migrate long distances but instead moved over a smaller distance of only a few kilometres. The author is therefore considering the hypothesis that Gravettian communities in the Middle Danube region may have practised reindeer herding, similar to practices observed in Siberia.

The monograph concludes with a study by Zdenka Nerudová, which summarises findings of Pleistocene megafauna, the woolly mammoth and the woolly rhinoceros, dated to the end of the Last Glacial

Maximum primarily from the Epigravettian and Magdalenian archaeological contexts. The presence of these species in such contexts indicates they were not merely randomly scavenged remains but rather part of the prolonged human subsistence strategy. This challenges the notion of these megafauna's habitats, as they were also found in cave environments unsuitable for their living. It raises questions about the Magdalenians' potential reliance on live observations for realistic depictions of these animals in art. The study also contrasts the hunting preferences of the Magdalenian with the Epigravettian (reindeer and horses vs. mammoths), suggesting the hypothesis of distinct subsistence strategies without mutual interference. In connection with the topic of the entire monograph, the author underscores the principle that "the absence of evidence does not equate to evidence of absence" and highlights the complexities of archaeological interpretation in understanding past populations and their interactions with megafauna.

The unifying element of the presented diverse collection of contributions is the effort to show how different researchers, using different approaches and methods in their work, approach the interpretation of research data. It is an attempt to show what can be deduced from the investigation of a wide range of archaeological sources and how this information can contribute to broader prehistoric interpretations and a better understanding of the meaning of archaeological data. In this, the overlap of these studies is significant, as meaningful archaeological interpretations are essential for understanding our past and shaping public memory.

Each chapter emphasises that archaeological interpretation is not a simple task. It requires careful analysis and often combined methodological approaches. The source of the data, their context, and the methodology of their acquisition are key aspects that must be considered to interpret archaeological evidence correctly. These perspectives remind us of the importance of getting back to the basics of archaeology – to the artefacts and sites themselves because within them are hidden stories waiting to be revealed.

The book "Solving Stone Age puzzles: From artefacts and sites towards archaeological interpretations" is therefore not just a scientific monograph or an ordinary compendium of scientific studies. It is an invitation to journey through time, to discover and reinterpret our ancient past together. It is a dialogue between past and present, between archaeologists and artefacts, between science and the stories these ancient remains can tell us.

Welcome inside...

02

Landscape of the Acheulian huntsmen

Ivana Fridrichová-Sýkorová

Introduction

Bohemia is an area with relatively rich archaeological evidence of the oldest human settlements in Europe (Fridrich, Fridrichová-Sýkorová 2009). In the past, systematic attention and excavation was paid to the Hrádecký potok micro-region (Fig. 1.1: 1), which is situated on the left bank of the River Ohře (Eger) covering an area of ca 100 km^2 (Fridrich 1980; 1982; 1997; 2005; 2007). The result of years of research is the discovery that the western reaches of the Bohemian Uplands, or the landscape around them, conceal an entire complex of sites. These findings illustrate the presence of protoAcheulian and Acheulian technocomplex and their cultures respectively. These early peoples exploited the banks of the great river and its tributaries, the vents of underground mineral springs, the sources of high-quality stone material, and the strategic elevated positions of Tertiary neovolcanites.

Geological and geomorphological development

The oldest settlement of Hrádecký potok (the Brook Hrádecký) micro-region is closely tied to the relatively complex dynamics of the geological development of northwestern Bohemia. An important factor in the human settlement of this area was the emergence of the so-called Ore Mountains' boundary fault, or Ohře's Rift (Eger Graben), during the Tertiary period, accompanied by pronounced tectonic activity due to the neovolcanos of the Bohemian Uplands. At the same time as the formation of these geological features, the basic water network of the area was established (Balatka, Sládek 1962; Tyráček 1994; 1995; Tyráček, Králík 1996; Chlupáč et al. 2002).

doi 10.47382/dvs_26-02

Its rift or spine became the Ohře paleocurrent, which drains the area today in the same direction of flow, i.e. from west to east. A network of smaller tributaries running roughly north and south connect to the spine. In addition, many underground mineral spring vents are found throughout the micro-region.

The region of interest consists of a flat stream valley with, until recently, a thick layer of Chernozemic (black-earth) soil. Unfortunately, the current state of the soil cover is significantly affected by wind erosion, due to the change in agricultural use of the landscape in the second half of the 20th century. The valley floor is gently undulating, furrowed by deserted creek beds. The stream gradually shifted its flow toward the southeast. From this flat valley, the boles and laccoliths (feeders) of the Tertiary volcanic formations (Bečovský vrch, Milá, Oblík, Raná, Břvanský vrch, Malá Volavka and Velká Volavka hills) stand out significantly. Neovolcanites form a closed area from the Hrádecký potok micro-region. In addition, there is an ancient formation of a gas-mud volcano, Písečný vrch, in the central position of the valley.

The flow of Brook Hrádecký was and is very closely tied to the dynamics of the Ohře paleocurrent. Over the last ¾ million years, human habitation has also adapted to this dynamic of the water network. At the time, the Ohře paleocurrent skirted the Bohemian Uplands north (present-day Brook Srpina), the confluence of the river and stream was in the area north of the Malá Volavka and Velká Volavka hills, northwest of the present-day village of Bečov. Its original trough began to leave the Ohře paleocurrent at the end of the older phase of the Middle Pleistocene. The consummation of this took place at a younger stage of the same period. This completed the geomorphological development of the landscape. The Hrádecký potok micro-region has moved definitively to the left bank of the River Ohře. Following these changes, the creek bed of Hrádecký potok gradually shifted, ceasing to wrap around Písečný vrch on its northern side, shifting the flow along the southern slopes of the hill and gradually bowing its flow towards the southeast to its present position.

General characteristics of the stone industry collections

The Paleolithic settlement of this space is evidenced by a large collection of stone artefacts, dated from the Lower Paleolithic to the Upper Paleolithic. Research to date has shown that the area of northwestern Bohemia, or the Paleoohře Basin, was one of the most sought-after destinations of Acheulian *sensu lato* bearers for a significant part of our past (Tab. 2.1).

A number of Paleolithic habitats have been identified during research into the settlement of the Hrádecký potok micro-region. They can be assigned to proto-Acheulian, Lower Prezletician (Fridrich 1997; 2005), Acheulian *sensu lato* (Fridrich 1980; 1997; Fridrich, Sýkorová 2005; Fridrich, Fridrichová-Sýkorová 2009), Mousterian *sensu lato* and the relatively undifferentiated Upper Paleolithic (Fridrich 2006; Fridrich, Fridrichová-Sýkorová 2010; Fridrich, Wiśniewski 2010) respectively. The Acheulian collection of *sensu lato* from this micro-region can be chronologically divided into the Lower Acheulian (from the period OIS 19 – OIS 17), the Middle Acheulian (from the period OIS 13 – OIS 11) and the Upper Acheulian (OIS 8). Proto-Acheulian, or the Lower Prezletician in Bohemia can be dated to the period OIS 19 – OIS 17 (Fridrich 2005, 191–227).

When evaluating individual collections of proto-Acheulian and Acheulian artefacts, great emphasis was placed on the appreciation of the typological composition (Bordes 1961; Fridrich 1982; 1997;

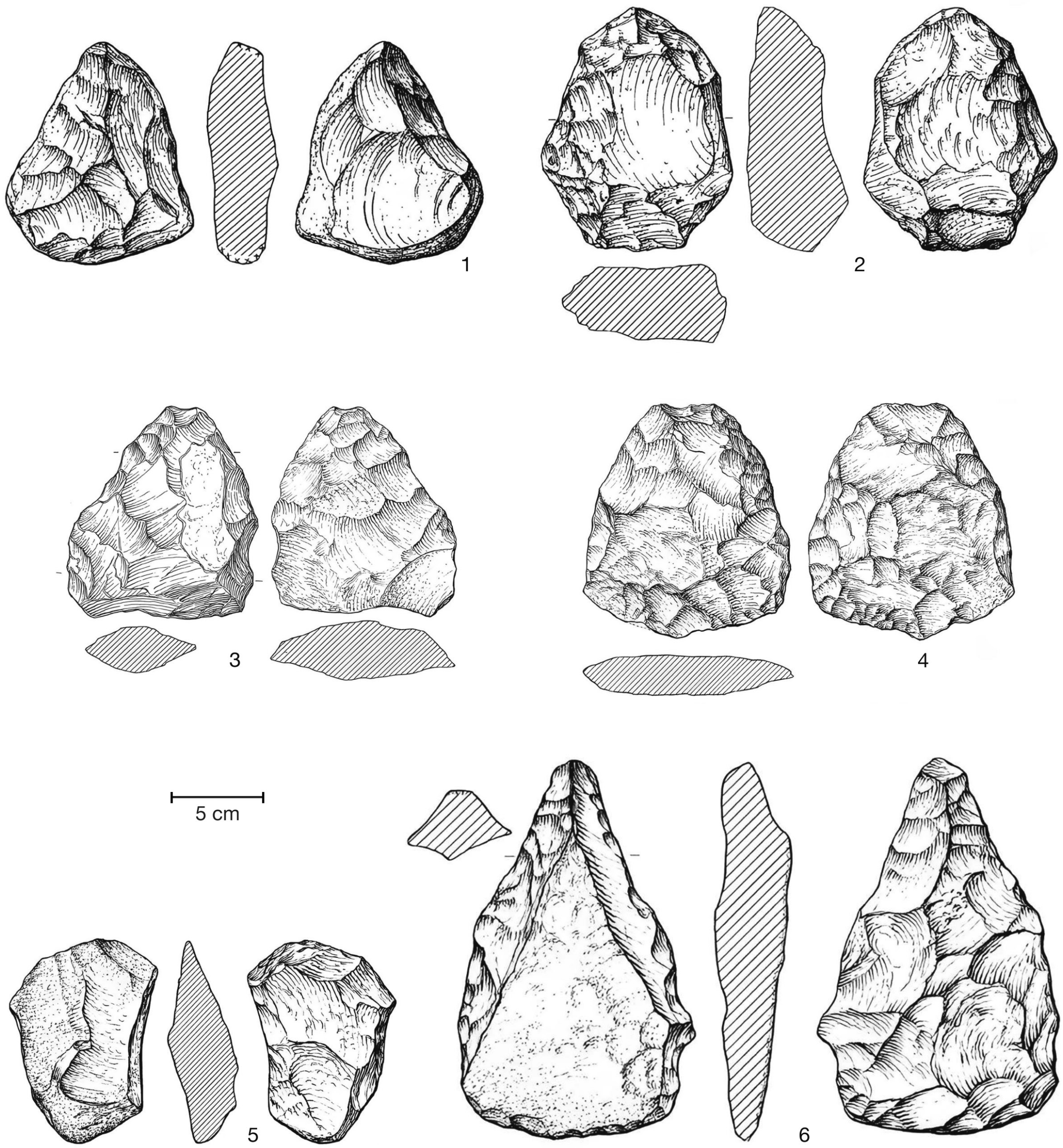

Fig. 2.1. Bifaces *sensu lato*. 1, 2 – Bečov II; 3, 4 – Bečov IV; 5, 6 – Bečov VI. Drawing by J. Fridrich.

Débenath, Dibble 1994). A total of 247 pieces from the proto-Acheulian (PA), 9,114 pieces of Lower Acheulian (LA), 3,168 pieces of Middle Acheulian (MA), and 9,370 pieces of Upper Acheulian (UA) have been obtained and evaluated in detail from various individual sites (Fig. 2.1).

Critically important for Paleolithic man was the occurrence of readily available outcroppings of the high-quality stone material, quartzite. Quartzite represents the only material in the region suitable for knapping in the manufacture of stone tools. Bečov-type quartzite comes from the outcropping on Písečný vrch and the Skršín-type quartzite occurs about 5 km from the explored settlements of the Hrádecký potok micro-region.

Tab 2.1. Basic description of Acheulian *sensu lato* from the Hrádecký potok micro-region.

Site	Altitude	Date	Σ	Flakes +cores	%	Tools	%	Burned art.	%
HP 1	274–277 m a.s.l.	MA	119	7	5.88	112	94.12	4	3.36
		UA	69	3	4.35	66	95.65	6	8.70
HP 2	264–269 m a.s.l.	MA	44	0	–	44	100	1	2.27
		UA	16	0	–	16	100	0	–
HP 3	256–257.5 m a.s.l.	MA	40	4	10	36	90	0	–
		UA	1	0	–	1	100	0	–
HP 4	260–264 m a.s.l.	MA	25	3	12	22	88	0	–
		UA	15	2	13.33	13	86.67	2	13.33
HP 5	253–260.7 m a.s.l.	MA	80	13	16.25	67	83.75	1	1.25
		UA	64	9	14.06	55	85.94	4	6.25
HP 6	257–264 m a.s.l.	MA	40	11	27.5	29	72.5	2	5
		UA	44	16	36.36	28	63.64	3	6.82
HP 7	273–274 m a.s.l.	MA	5	0	–	5	100	0	–
		UA	15	1	6.67	14	93.33	0	–
HP 8	265–267 m a.s.l.	MA	5	0	–	5	100	0	–
		UA	15	0	–	15	100	0	–
HP 9	269–273 m a.s.l.	MA	5	0	–	5	100	0	–
		UA	14	1	7.14	13	92.86	1	7.14
HP 10	263–265 m a.s.l.	MA	234	10	4.27	224	95.73	7	2.99
		UA	109	4	3.67	105	96.33	11	10.09
HP 11	251–263 m a.s.l.	MA	108	3	2.78	105	97.22	0	–
		UA	36	6	16.67	30	83.33	0	–
HP 12	245–249 m a.s.l.	MA	297	16	5.39	281	94.61	4	1.35
		UA	98	13	13.26	85	86.74	3	3.06
HP 13	249 m a.s.l.	MA	179	16	8.94	163	91.06	1	0.56
		UA	107	15	14.02	92	85.98	5	4.67
HP 14	242–247 m a.s.l.	MA	36	5	13.89	31	86.11	1	2.78
		UA	44	8	18.18	36	81.82	2	4.55
HP 15	245–247 m a.s.l.	MA	6	3	50	3	50	0	–
		UA	10	3	30	7	70	0	–
HP 16	254–257 m a.s.l.	MA	11	0	–	11	100	0	–
		UA	5	1	20	4	80	0	–
HP 17	242–250 m a.s.l.	MA	156	14	8.97	142	91.03	9	5.77
		UA	115	14	12.17	101	87.83	4	3.48

HP 18	251 m a.s.l.	MA	4	0	–	4	100	0	–
		UA	84	10	11.91	74	88.09	4	4.76
HP 19	245–251 m a.s.l.	MA	135	13	9.63	122	90.37	3	2.22
		UA	140	16	11.43	124	88.57	5	3.57
HP 20	247–248 m a.s.l.	MA	33	4	12.12	29	87.88	0	–
		UA	9	3	33.33	6	66.67	1	11.11
HP 21 Bečov VII	247–258 m a.s.l.	MA	26	2	7.69	24	92.31	0	–
		UA	268	43	16.05	225	83.95	1	0.37
HP 22	262–274 m a.s.l.	MA	1	0	–	1	100	0	–
		UA	60	12	20	48	80	1	1.67
HP 23	254–277 m a.s.l.	MA	4	2	50	2	50	0	–
		UA	211	17	8.06	194	91.94	7	3.32
HP 24	303–314 m a.s.l.	MA	6	4	66.67	2	33.33	0	–
		UA	4	4	100	0	–	0	–
HP 25 Bečov V	250–254 m a.s.l.	MA	2	1	50	1	50	0	–
		UA	105	7	6.67	98	93.33	6	5.71
HP 26	235–243 m a.s.l.	MA	26	5	19.23	21	80.77	2	7.69
		UA	213	24	11.27	189	88.73	2	0.94
HP 27 – Bečov VI	241–249 m a.s.l.	MA	1 193	93	7.80	1 100	92.20	18	1.51
		UA	472	38	8.05	434	91.95	13	2.75
HP 28	233–235 m a.s.l.	MA	34	0	–	34	100	1	2.94
		UA	67	6	8.96	61	91.04	1	1.49
HP 29	236.5–237 m a.s.l.	MA	19	2	10.53	17	89.47	0	–
		UA	72	4	5.56	68	94.44	1	1.39
HP 30	237–242 m a.s.l.	MA	26	5	19.23	21	80.77	0	–
		UA	144	18	12.5	126	87.5	3	2.08
HP 31 Břvany II	226–229 m a.s.l.	MA	169	32	18.94	137	81.06	3	1.78
		UA	45	8	17.78	37	82.22	4	8.89
HP 32	228–229 m a.s.l.	MA	7	1	14.29	6	85.71	0	–
		UA	60	12	20	48	80	2	3.33
HP 33	230–233 m a.s.l.	MA	6	0	–	6	100	0	–
		UA	75	9	12	66	88	0	–
HP 34 Bečov IV	242–266 m a.s.l.	UA	5 577	1 526	27.36	4 051	72.64	723	12.96
HP 35	224–232 m a.s.l.	MA	2	0	–	2	100	0	–
		UA	69	9	13.04	60	86.96	1	1.45
HP 36	230–237 m a.s.l.	MA	13	0	–	13	100	0	–
		UA	330	32	9.7	298	90.3	13	3.94

HP 37	238–248 m a.s.l.	MA	24	1	4.17	23	95.83	0	–
		UA	316	19	6.01	297	93.99	6	1.9
HP 38	230–234 m a.s.l.	MA	2	0	–	2	100	0	–
		UA	116	20	17.24	96	82.76	2	1.72
HP 39	245–250 m a.s.l.	MA	38	1	2.63	37	97.37	0	–
		UA	152	24	15.79	128	84.21	3	1.97
HP 40 Bečov II	237–250 m a.s.l.	LA	1 406	157	11.17	1 249	88.83	0	–
HP 41	259–268 m a.s.l.	LA	5	1	20	4	80	0	–
		MA	8	0	–	8	100	0	–
		UA	4	2	50	2	50	0	–
HP 42 Be I B, lay. 7	298 m a.s.l.	PA	116	22	18.97	94	81.03	0	–
HP 42 Be I B, lay. 8		PA	115	15	13.04	100	86.96	0	–
HP 42 Be I B, lay. 9		PA	16	1	6.25	15	93.75	0	–

Proto-Acheulian artefacts were found in only three stratigraphical layers (7–9) of the upper abri (Bečov I B) on Písečný vrch. Layer 9 provided a collection of stone industry objects (16 pcs) exclusively made from Bečov-type quartzite. Choppers (43.75%) and scrapers (37.50%) significantly dominate the collection. Layer 8 produced 115 pieces, again only from Bečov-type quartzite. Among the artefacts, the proportion of scrapers (40.87%) is increasing, and choppers (25.22%) are decreasing. The last layer (7) contained a set of 116 pieces all made from Bečov-type quartzite. The collection contains abundant scrapers (28.45%), shrinking choppers (9.48%) and various bifaces (21.56%) *sensu lato* (hand axes – 3.45%, cleavers – 3.45%, picks – 11.21% and protobifaces – 3.45%). The collection of artefacts is not aeolic-rimmed and bears only minimal or no traces of patination (Fridrich 1997).

The Lower Acheulian artefacts have only been found in two positions (HP 40 – Bečov II) and HP 41. The collections of the Lower Acheulian processed so far show a high proportion of bifaces *sensu lato*, with choppers still appearing in the collections (e.g. in Bečov II – 7.40%) and, surprisingly, scrapers (Bečov II – 7.11%). The semi-finished product of the Lower Acheulian includes cores and flakes (Bečov II – 11.17%). The overall type spectrum is very broad and varied. Surprisingly, a preference for Skršín-type quartzite (Bečov II – 75.39%) was found. The stone industry of the Lower Acheulian is characterized as heavily aeolized and heavily patinated, leading to the typical brown coloration of the artefacts (Fridrich 1997).

The Middle Acheulian artefacts come from 39 positions (Tab. 2.1). Again, the type spectrum of artefacts is very broad. Bečov-type quartzite was preferred in the production. The stone industry of the Middle Acheulian is moderately aeolized, with the surface bearing a yellow-brown patina. In the stone-working technology of this period, we rarely see the use of the Levallois technique. The dominance of knives is characteristic, marked by the decline of scrapers, which also show very simple forms. The proportion of bifaces *sensu lato* is high (including hand axes), with a relatively abundant occurrence of polyhedrons *sensu lato*, and a decline in choppers.

We discovered Upper Acheulian artefacts in 41 positions (Tab. 2.1). Its bearers preferred a high-quality variant of Bečov-type quartzite, with distinct signs of the Levallois technique being used. The type spectrum of artefacts is significantly varied. Knives of various forms predominate including an occurrence of large blade knives. Dwindling bifaces *sensu lato* are observed; however, hand axes are elegantly shaped during this time. Compared to the Middle Acheulian, the proportion of polyhedrons *sensu lato* is increasing. Scrapers are abundant, but not very distinctive, much like the choppers. The collections of Upper Acheulian are mildly aeolized and are characterised by a white patina.

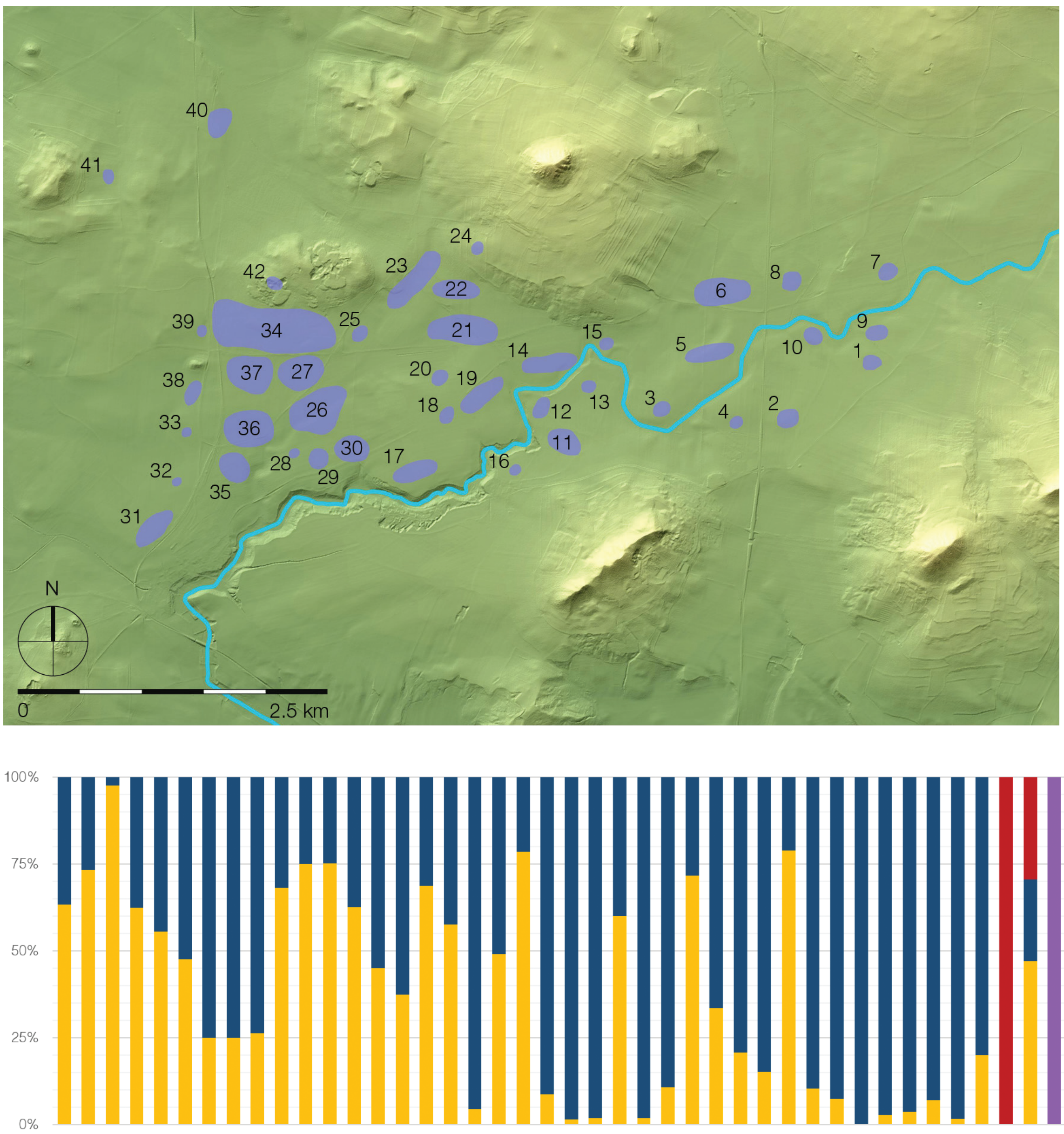

Fig. 2.2. Three-dimensional model of Hrádecký potok valley with reconstructed stream beds and marked sites of the Paleolithic age. Notes: Purple – proto-Acheulian; red – Lower Acheulian; yellow – Middle Acheulian; blue – Upper Acheulian. Sites HP 1–41 – surface position, site HP 42 – stratified position. Map source: © ČÚZK; graphic by O. Herčík, I. Fridrichová-Sýkorová.

The landscape of Paleolithic huntsmen

The collections of stone artefacts from the Hrádecký potok micro-region come from a variety of distinct habitats. Their location in the landscape reflects the thoughtful behaviour of Acheulian *sensu lato* bearers, which involves the exploitation of stone material resources and water, including the necessary strategic control of the banks of a large river (Fig. 2.2).

During the earlier phase of the Lower Paleolithic period (Fridrich 2005), there is evidence of three settlement locations within the observed micro-region. The so-called upper abri on Písečný vrch was settled repeatedly by proto-Acheulian bearers (Bečov I B – HP 42) (Fridrich 2005; 2007; Fridrich, Fridrichová-Sýkorová 2009). They preferred the strategic advantage of the higher ground to visually oversee the brook valley. Compare this to the bearers of the Lower Acheulian period, who preferred easy water access. We have detected evidence of their presence in two locations in the northwestern part of the region (Bečov II – HP 40) and a habitat at the base of slope of Velká Volavka Hill (HP 41). Based on a detailed analysis of the collections of the stone industry from these two sites (collection size, proportion of tools and workshop components, traces of burning) and considering the landscape, Bečov II is functionally interpreted as a base camp located on the bank of a smaller right tributary of the Paleoohře, whereas the second site was a strategically located transitional short-term hunting camp (see more Fridrich 2005; Fridrich, Fridrichová-Sýkorová 2009). The somewhat asymmetric location of these habitats within the micro-region is linked to the geomorphological evolution of the region. At the time of the earliest settlement of this landscape, the paleocurrent of the River Ohře was still in its original (Tertiary?) riverbed and the settlements were situated on its right bank, close to the confluence of the Paleoohře with the old brook bed of the Hrádecký potok (Fridrich 1997; 2005). Reflections on maintaining the balance of the ecosystem of nature at the time (Fridrich 1997; 2005) lead to the conclusion that the use of the landscape by bearers of two different cultural circuits (Acheulian *s.s.* and proto-Acheulian) must have been alternating during the earlier phase of the Lower Paleolithic period (Fridrichová-Sýkorová 2010; 2014).

In the later phase of the Lower Paleolithic, the micro-region was used only by Middle Acheulian bearers. They were already moving on left bank of the Paleoohře river. This section of settlement is characterised by the shifting of habitats to the upper and middle streams of the Hrádecký potok. The Bečov VI (HP 27) site, interpreted as a base camp, was situated near underground mineral spring vents. The location of habitats in positions allowing visual inspection of the landscape (HP 41) is also recorded. Quite surprisingly, there is no settlement in the Písečný vrch area. The preference for occupying the banks of a smaller stream is disrupted only by the placement of the HP 31 site into the confluence of the Hrádecký potok with the Paleoohře (north of the present-day village of Břvany). Meanwhile, the location of a hunting site at the confluence of a river and a stream represents one of the frequent uses of the landscape by Paleolithic hunters (Fridrich 1987; 1995a; 1995b; 2005; Fridrich, Fridrichová-Sýkorová, Tyráček 2010; Fridrichová-Sýkorová 2010).

The beginning of the Middle Paleolithic is closely associated with the Upper Acheulian in the micro-region studied. Its presence is significantly dominant due to the number of habitats. In addition to the Bečov II (HP 40) site, the presence of the culture's bearers is reflected in all Paleolithic habitats of the micro-region. The key site for the Upper Acheulian is Bečov IV (HP 34). It is interpreted as a base camp built at the southern base of slope of Písečný vrch, close to underground mineral spring vents (Fridrich, Sýkorová 2005).

The creators of this culture visited the banks of Hrádecký potok, but concentrated their activities mainly in the central area of the studied region, i.e. in the area of the middle flow of brook. The top of Písečný vrch probably afforded the bearers of the Upper Acheulian for improved visual inspection of the landscape (Fridrich 1982), like other habitats located at the base of the neovolcanite slopes (HP 41 habitat on Velká Volavka Hill, HP 22, 23 and 24 on Milá Hill). Moreover, the bearers of this culture strongly preferred the high-quality stone material in the form of well-bonded Bečov-type quartzite. Compared to previous and subsequent developments in this area, this is an entirely unique approach (Fridrich, Fridrichová-Sýkorová 2010).

In terms of learning more about our ancient past, northwestern Bohemia represents a key area and source of valuable information about the life of Paleolithic hunters and gatherers. For a long time, the western reaches of the Bohemian Uplands appeared to be the promised land for understanding the evolution of Central Europe in the Middle Paleolithic period. The unique preservation of the sequence of layers of Middle Paleolithic settlements in the so-called lower and upper abri on Písečný vrch has verified the proposed hypotheses of the formation and stratigraphic inclusion of individual Paleolithic cultures during this dynamic and complex period (slightly different Svoboda 2018).

Gradually, over the past fifty years, it has become possible to know and understand the settlement of a part of the landscape on the banks of a large river (River Ohře in this case) that has attracted mankind since the Lower Paleolithic. Moreover, from an expert point of view, it should be noted that thanks to systematic research in the Hrádecký potok micro-region it has been proved that central Europe has primarily been settled by Acheulian bearers. This discovery opens further fields for the future investigation of the dynamics of the earliest settlement of the European subcontinent (Fiedler et al. 2019).

03

Terra incognita? A brief overview of the Paleolithic settlement in the Nördlinger Ries

Amira Adaileh

A survey of Paleolithic sites in Southern Germany will quickly lead to the well-known site clusters in the Swabian and Franconian Jura. Geologically speaking, the Swabian and Franconian Jura are an entity: a medium altitude mountain range, disrupted by river valleys, yielding various landscapes with numerous caves and rock shelters. Therefore, it is not surprising this very rich landscape in terms of sites and finds has yielded remarkable records of Paleolithic occupation. For the time being, Paleolithic research focused on research of sites and site clusters on a small-scale context, for instance within the Altmühl, Lone or Ach Valleys. This was surely also due to the Swabian and Franconian Jura belonging to two separate federal states, namely Baden-Württemberg and Bavaria, with independent heritage departments and universities, carrying out regional studies. Within recent research, connections between the site clusters in the Swabian and Franconian Jura via raw material transports or exchange of ideas have often been revealed (cf. Maier 2015; Hess 2019; Huber, Floss 2014). Most of these attempts however bear a blind spot: The Nördlinger Ries.

The Nördlinger Ries is a more or less circular depression, the result of a meteorite impact some 14 million years ago. The impact crater, approximately 24 km in diameter, is located north of the Danube in Western Bavaria and Eastern Baden-Württemberg and represents a discontinuity within the Swabian-Franconian-Alb ridge in Southern Germany (Fig. 1.1: 2; 3.1). The base of the crater lies approximately 100–150 m beneath the surrounding tablelands. Due to the basin form and moderate altitudes in comparison to the surrounding tablelands, the Nördlinger Ries offers favourable climatic conditions with higher mean temperatures, more frost-free days, a higher annual average of sunshine hours and less precipitation (Frei 1979, 30–31). The scientific interest in historic and prehistoric sites of the Nördlinger Ries dates to the 1770s, due to the discovery of a Roman villa close to Großsorheim. A hundred years later, in 1875 the first archaeological excavations took place in the

doi 10.47382/dvs_26-03

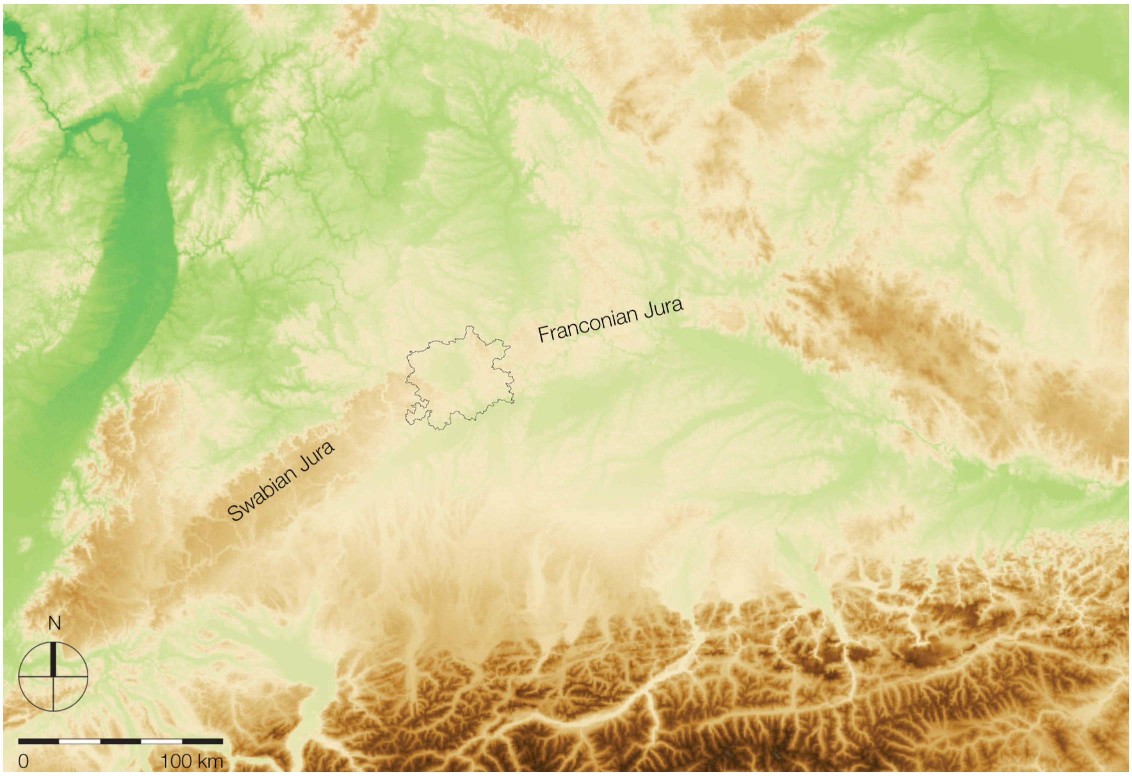

Fig. 3.1. The outlines of the study area (Geopark Ries) between the Swabian and Franconian Jura.

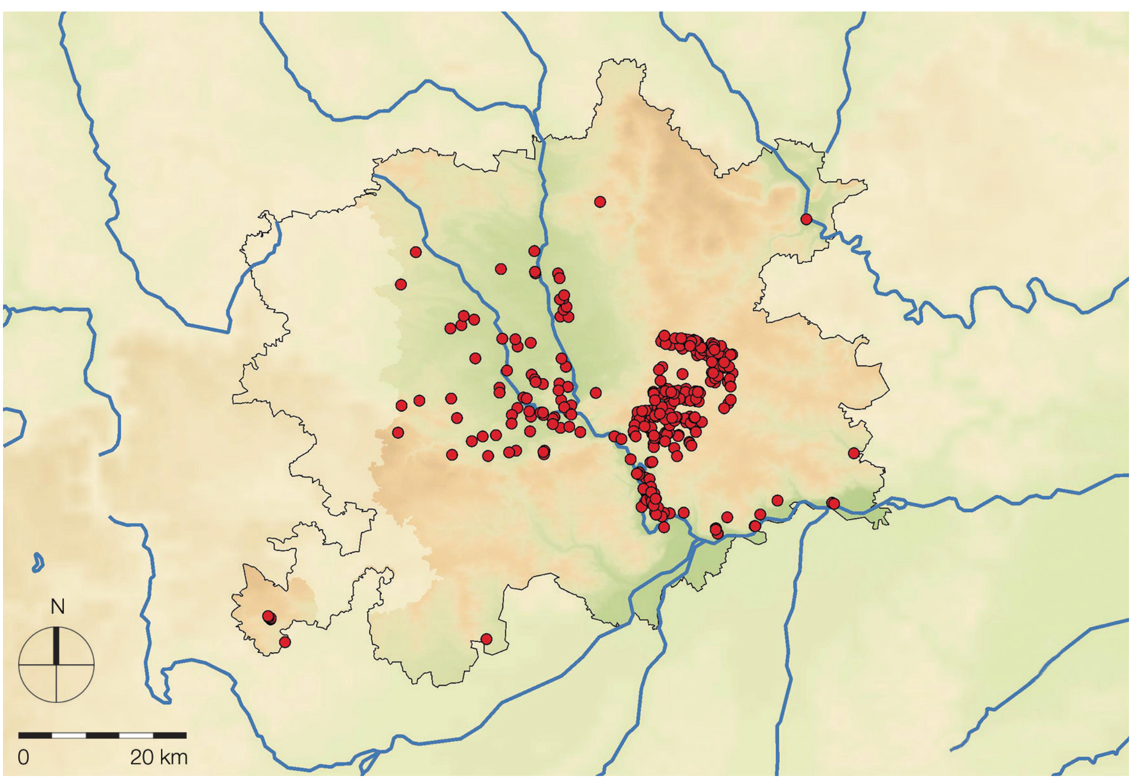

Fig. 3.2. Overview of Paleolithic sites within the study area. Source of data: Fachinformationssystem Bayerisches Landesamt für Denkmalpflege 2022.

Große Ofnet Cave by O. Fraas. Over the next decades, various excavations, mainly by E. Frickhinger, led to the discovery and research of various prehistoric sites in the area, for the Paleolithic namely the Ofnet caves, Hohlenstein and Kaufertsberg. Frickhinger published early on the results of his researches and founded the Museum in Nördlingen, which still hosts most of the archaeological finds of the Nördlinger Ries. In 1954 W. Dehn and E. Sangmeister published the first overview over the Stone Age sites and finds in the Nördlinger Ries, as a result of the systematic cataloguing of the Museum Nördlingen inventory (cf. Dehn, Sangmeister 1954). From the second half of the 20th century on, a combination of voluntary service and systematic heritage management, led to a rising number of excavations but also newly discovered sites. Intensive surveys of the area multiplied the number of prehistoric and therefore also Paleolithic sites. Today, the archives of the Bavarian State Heritage Department (BLfD) comprise over 1200 records for Paleolithic sites and finds within the Nördlinger Ries area. Unfortunately, to this day most of these sites and/or finds have neither been published, nor scientifically analysed. Hence, the knowledge about the Paleolithic of the Nordlinger Ries is limited to only a few sites. Evidence in terms of chronology and chorology, land-use patterns, raw material procurement or connections to the well-known areas of the Swabian and Franconian Jura is scarce. Therefore, this brief study shall provide a short overview over the state of knowledge within the Paleolithic occupation of the Nördlinger Ries. The study area compasses the outlines of the Geopark Ries, which comprises the crater itself, the periphery of the crater as well as the ejecta (Fig. 3.2). The Geopark Ries stretches across the modern districts of Donau-Ries, Dillingen and Weißenburg-Gunzenhausen in Bavaria and Ostalbkreis and Heidenheim in Baden-Württemberg. Since the broad majority of the Nördlinger Ries is located in today's Bavaria and data from Baden-Württemberg were not accessible in detail, this study shall focus on the data from Bavaria.

The Middle Paleolithic

According to the data of the BLfD, 196 records are listed with Middle Paleolithic artefacts within the Nördlinger Ries (Fig. 3.3). Since there are (so far) no records of Lower Paleolithic sites or artefacts, the Middle Paleolithic marks the oldest human occupation of the area. The majority of these sites comprise of surface collections from open-air sites that were never fully analysed and/or published. The assignment of the artefacts to the Middle Paleolithic is therefore mainly based on typological and/or technological criteria, although it must be mentioned that these collections span from single artefacts to assemblages with several thousand pieces. Moreover, most of these sites yielded chronologically diverse artefacts, which further complicates the attribution of chronologically indifferent pieces, especially in those cases where younger Paleolithic, Mesolithic and/or Neolithic material is present. Consequently, for most sites it is not possible to provide further information beyond a likely attribution to the Middle Paleolithic based on typological and/or technological criteria. In order to approach an overview, a few sites and artefacts should first be introduced.

The earliest proof for the Middle Paleolithic occupation of the Nördlinger Ries so far stems from a ridge southeast of Mündling, city of Harburg. The single find is of greyish Jurassic chert, roughly 16 × 8 × 4 cm in size and fragmented at the base (Schorer 1963, 141). According to Zotz, the bifacial tool was made on a large flake or tabular chert, since a platform remnant is visible at the base of the piece (Zotz 1965, 24). Due to the similarity to a piece known from Ried (cf. Freund 1963, 28–30), Zotz argues in favour a dating to the Late Eemian (Zotz 1965, 25). Another single find comes from Harburg-Großsorheim. It was found in 1979 at the foot of Rollenberg Mountain in Großsorheim, close to the town of Harburg. The piece was made of greyish Jurassic chert, probably from an area at the southern edges of the Ries crater (Krippner, Reisch 1981, 11). The piece measures 8.9 × 5.9 × 2.5 cm

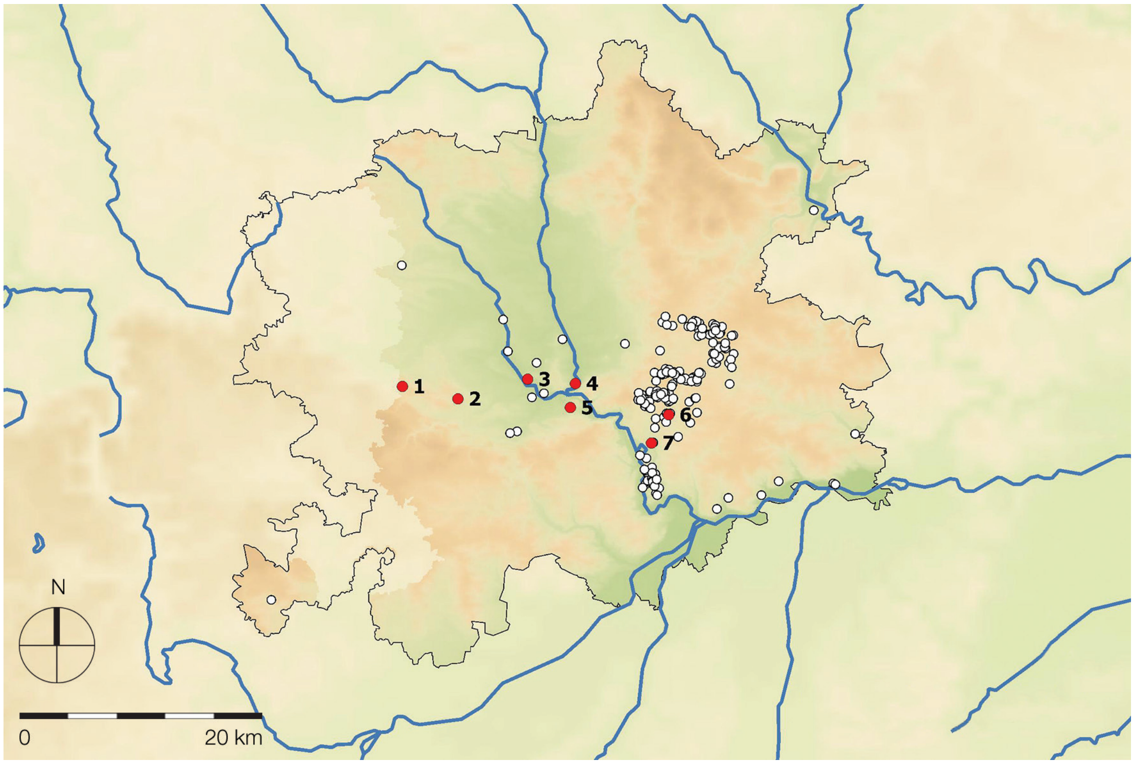

Fig. 3.3. Middle Paleolithic sites in the study area. 1 – Ofnet Caves, 2 – Kirchberghöhle, 3 – Hahnenberg, 4 – Schrattenhofen, 5 – Großsorheim, 6 – Mündling, 7 – Brünsee. Source of data: Fachinformationssystem Bayerisches Landesamt für Denkmalpflege 2022.

and is of subtriangular shape (Krippner, Reisch 1981, 11) (Fig. 3.4: 2). The tip is fragmented and the whole artefact reminds Krippner and Reisch of La Micoque type hand axes, although the recurrent retouch is missing, which is typically alternating for those pieces (Krippner, Reisch 1981, 11–12). Chronologically the hand axe of Großsorheim might be assigned to the early stage of the Weichsel (Würm) Glaciation (Krippner, Reisch 1981, 12), between 115,000 and 70,000 BP.

The site of Harburg-Brünsee was discovered in the 1970s and comprises around 12,000 lithic artefacts from surface collections. Next to sidescrapers, notched and denticulated pieces, the inventory also yielded Levallois flakes and points (Fig. 3.4: 3), whereas bifacial tools are quite rare (Reisch 1976, 11–12). Furthermore, the relatively high amount of blades seems noteworthy (Reisch 1976, 11–12). The raw material comprises different varieties of Jurassic chert, quartzite, radiolarite and alpine quartz (Reisch 1976, 12). Other than the Middle Paleolithic material, the site also yielded a smaller number of Upper Paleolithic tools (Reisch 1976, 12). In 1975, the University of Erlangen-Nuremberg conducted a small test excavation in order to clarify whether the inventory shows a palimpsest of different Middle Paleolithic (and Upper Paleolithic?) occupations and gain more information on the geochronological attribution of the lithic material. Unfortunately, the small-scale excavation did not yield the desired results (Reisch 1976, 12). Due to the high number of blades, one might be tempted to date the site within the Late Middle Paleolithic (cf. Krippner 2000, 37–38), in terms of somewhat transitioning towards the bladefocussed technology of the Upper Paleolithic. According to Connard, it is however not correct to assume blade production being a feature related to the Upper Paleolithic or anatomically modern humans (Connard 2012, 262). Based on other blade bearing Middle Paleolithic sites in Germany as Rheindahlen or Tönchesberg, he places the heyday of Middle Paleolithic blade production in

Europe within the MIS 5 and thus the Early Weichselian (Würm) (Connard 2012, 249). Hence, a more detailed chronological attribution of the Brünsee site within the Middle Paleolithic is currently not possible.

The most famous middle Paleolithic occupation within the Nördlinger Ries is probably from the Ofnet Caves. The two karstic caves are located at the western edge of the Nördlinger Ries close to Holheim, a subdivision of Nördlingen. They were repeatedly excavated at the end of the 19th, and beginning of the 20th centuries by A. Fraas, F. Birkner, E. Frickhinger and R. R. Schmidt (Freund 1963, 71–72). According to these early researches at both caves the stratigraphy spans from Aurignacian, Solutrean, Magdalenian, and Mesolithic up to Neolithic, Iron Age, and Medieval layers (cf. Freund 1952, 166). Although most of the literature focusses on the very famous Mesolithic skull depositions from Große Ofnet, the site also yielded interesting Paleolithic assemblages. What is important is that R. R. Schmidt's stratigraphic approach was based solely on typological aspects since he could not

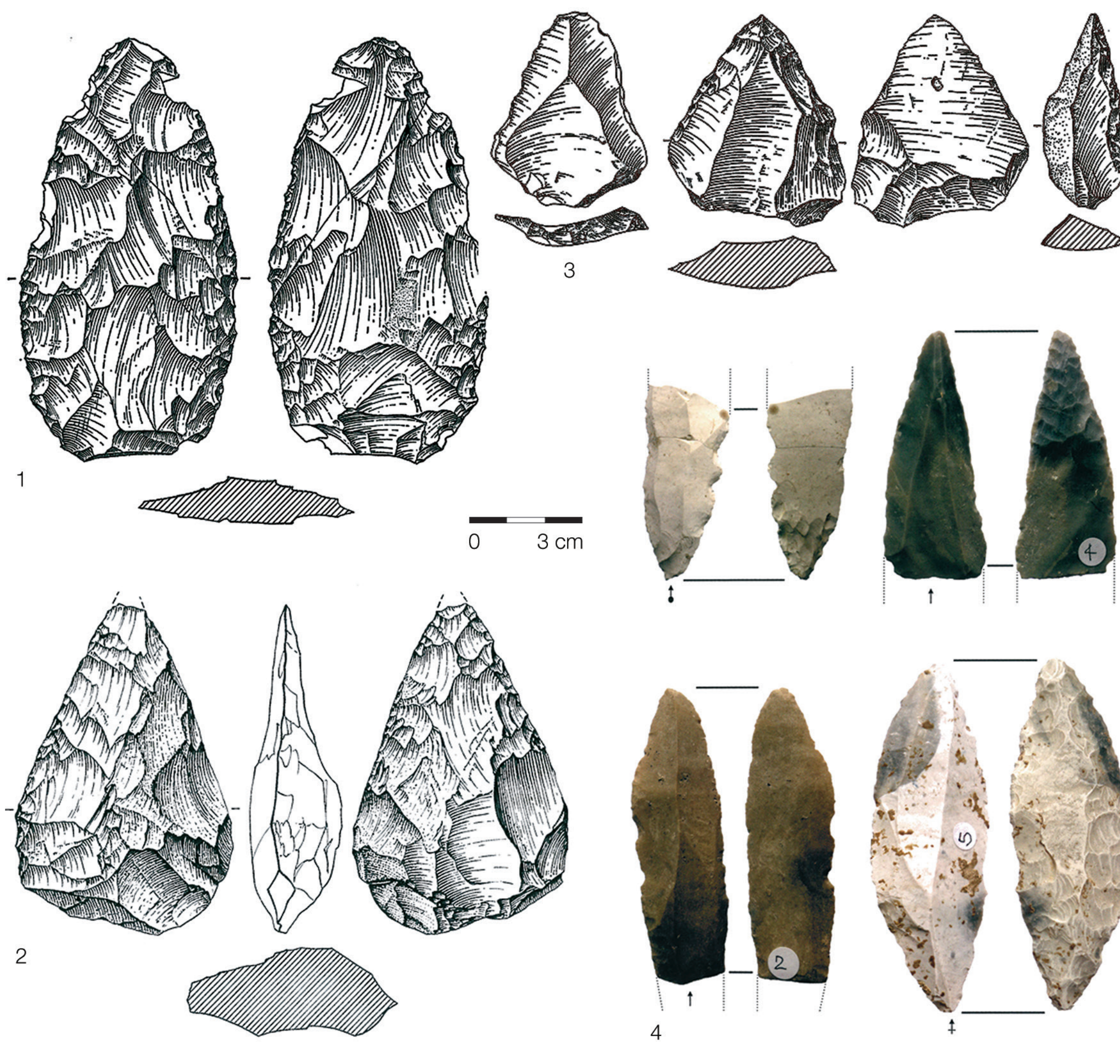

Fig. 3.4. Middle Paleolithic artefacts from the Nördlinger Ries. 1 – Leaf point from Schrattenhofen (after Reisch 1979); 2 – hand axe of Großsorheim (after Krippner, Reisch 1981); 3 – levallois flakes and point from Brünsee (after Krahe zgst. 1976); 4 – fragmented blade and Jerzmanowice points from Kirchberghöhle (after Uthmeier et al. 2018).

identify petrographic or sedimentary differences between the layers. It was however observed that the soil became darker and more clayey towards the lower layers (Freund 1952, 167). Research conducted in Kleine Ofnet and the cave entrance area showed more or less the same stratigraphic situation: Aurignacian, Solutrean, and Magdalenian, followed by Neolithic, Iron Age, and Medieval layers (Freund 1952, 168). Again, the differentiation of the single layers was based on typological observations and not on sedimentary features. As Freund writes, not a single artefact is therefore secure in terms of stratigraphic attribution (Freund 1952, 168). This is a very important remark since the attribution of one of the layers to the Solutrean was based on the numerous occurrences of leaf points. As Freund points out, that layer indeed yielded Upper Paleolithic artefacts (probably of Aurignacian or Magdalenian origin), the leaf points however do not belong within this assemblage, neither typologically nor in terms of stratigraphy (Freund 1952, 168f.). Furthermore, Frickingher's excavation in the 1930s, including also the excavation material from the previous researches, led to the conclusion, that numerous lithics from Aurignacian and Magdalenian layers were overlooked, as well as a whole Mesolithic layer in Kleine Ofnet and a bunch of typical Mousterian artefacts. The latter point to the conclusion that there might have been a Mousterian layer as well (Freund 1952, 169). New trenches closer to the cave entrance of Kleine Ofnet Cave have yielded a Mousterian layer beneath the Aurignacian. However, the leaf points were still problematic to attribute, since according to Schmidt two leaf points were found within the Aurignacian layer (Freund 1952, 170). Many researchers however doubt the typological classification as leaf points (cf. Freund 1952; Uthmeier 2004). A third leaf point fragment with biconvex cross section comes from unknown stratigraphic context. Uthmeier suggests that the leaf point could have been associated with Upper Paleolithic tool types and in that case might be classified as Middle Paleolithic with leaf points (Uthmeier 2004, 156f.).

Another single leaf point was found in the 1950´s in Schrattenhofen, near Heroldingen. The piece was made of brown chert of unknown origin and measures 11.4 × 6 × 1.5 cm (Reisch 1979, 14). Reisch claims, that the piece is – although bigger than usual – due to the technique and overall impression (Fig. 3.4: 1), quite easily within the range of Late Middle Paleolithic leaf points (Reisch1979, 14).

The Hahnenberg open-air site was discovered in the 1950s or 1960s and yielded a smaller surface collection of Middle and Late Paleolithic artefacts. The site itself is located close to the village of Appetshofen on one of the last elevations (435 m a.s.l.) before the Nördlinger Ries lowland. Unfortunately, the assemblage has so far only been published in the form of a brief report. Most of the lithics are from the western slope of the hill (Schönweiß 1963, 95), although total numbers are not given. Among the Middle Paleolithic artefacts, Schönweiß mentions leaf points, respectively leaf point fragments and sidescrapers (Schönweiß 1963, 100). The existence of leaf points might indicate a dating within the Late Middle Paleolithic for the Hahnenberg site.

The Kirchberghöhle site is located approximately 200 m northwest of Schmähingen. The cave itself was heavily affected by a quarry and is therefore only partially preserved. The site was initially known for its very rich record of faunal remains, which has led to several paleontological surveys since the 1980s. More than a thousand faunal remains from 42 different species indicate a grassy steppe vegetation (Uthmeier et al. 2018, 21–22). Three 14C-AMS data gained on bison, mammoth, and horse remains yielded ages of 40,700 ± 986 calBP (Erl-20423), 41,830 ± 440 calBP (Erl-20424) and 46,417 ± 1.703 calBP (Erl-20425) (Uthmeier et al. 2018, 22–23). Next to the faunal remains, only five lithic artefacts were found. A piece of debris and four blades or blade fragments. Three of the slightly curved blades and blade fragments have retouches on the dorsal and/or ventral side. These retouches can be traced on both the proximal and terminal parts, which leads to pointed ends of the blanks (Fig. 3.4: 4). All three retouched blades also show signs of ventral thinning (Uthmeier et al. 2018, 22–23). Therefore, these pieces were typologically determined as Jerzmanovice points, known from the Lincombian – Ranisien – Jerzmanovicien – Complex (LRJ-Complex) (Uthmeier et al. 2018, 25). Chronologically this typological attribution suits well with the two younger C14 dates from the Kirchberghöhle faunal remains, although Uthmeier et al. remark that the database on the dating of the end of the LRJ-Complex is very scarce so far (Uthmeier et. al 2018, 26).

Although of 196 Middle Paleolithic records, only the seven above have been published to an extent that allows at least a few statements, it is still possible to obtain some very careful and preliminary observations:

1. The Middle Paleolithic occupation of the Nördlinger Ries can be dated roughly between the Late Eemian up to the end of the Middle Paleolithic, i.e. between 115,000–40,000 BP.
2. Within the datable inventories, Late Middle Paleolithic assemblages seem to prevail slightly. This, however, might be a biased observation, due to the very small number of at least partially analysed and/or published sites.
3. The majority of the Middle Paleolithic sites in the Nördlinger Ries cluster at the southeastern part of the region. It is however possible that this simply reflects a research gap, respectively favoured survey areas.

Upper Paleolithic sites

According to the database of the BLfD, there are 20 records of Upper Paleolithic sites in the study area (Fig. 3.5). The quantity of records for the Upper Paleolithic is therefore significantly smaller compared to the preceding Middle Paleolithic. Like the Middle Paleolithic, the Upper Paleolithic assemblages also vary from single artefacts to more numerous collections, again stemming mostly from open-air site surface collections that were not fully analysed and/or published. Furthermore, as with the Middle Paleolithic inventories, most of these assemblages feature lithic artefacts of different periods, which again causes difficulties in attributing chronologically similar pieces. A few sites however do provide further information. The complicated stratigraphic situation in the Ofnet caves, due to the early excavation by O. Fraas and R. R. Schmidt in 1875/1876 respectively 1907/1908, was already mentioned above. For the Upper Paleolithic record, it is however necessary to dive a little deeper. According to Schmidt, underneath the most recent, humic part and a Magdalenian layer in Große Ofnet, layers III–IV followed, in total only 20 cm thick (cf. Freund 1952, 167). Within these layers R. R. Schmidt identified Initial, Middle and Late Aurignacian horizons. Hahn however was convinced that there might have been only one Aurignacian horizon (Hahn 1977, 81). Since the stratigraphy is very unclear, Hahn attributes only a few pieces conditionally to the Aurignacian: a few endscrapers (some with lateral retouches), burin(s) on truncation, points (partially borer-like), retouched blades and splintered pieces. A split-based point and an awl are mentioned among the organic tools (Hahn 1977, 81). For Kleine Ofnet, Hahn further argues that the Solutrean layer might rather represent an Aurignacian horizon, since that layer yielded no bifacials (Hahn 1977, 82). In terms of artefacts, Hahn assigns an endscraper, a carinated piece, a burin on truncation, a borer and a pointed blade to the Aurignacian (Hahn 1977, 82). A further 109 artefacts from Frickhingers excavation in 1934 very certainly come from the Aurignacian layer, among whose endscrapers, laterally retouched blades, pointed blades, burins and borers were the most numerous tools (Hahn 1977, 82; Uthmeier 2004, 197–198). Apart from the Aurignacian, the initial reports from both Ofnet Caves also report Magdalenian artefacts. This attribution must however remain unclear, since no typologically and/or technologically significant Magdalenian feature has so far been detected within the material (cf. Maier 2015).

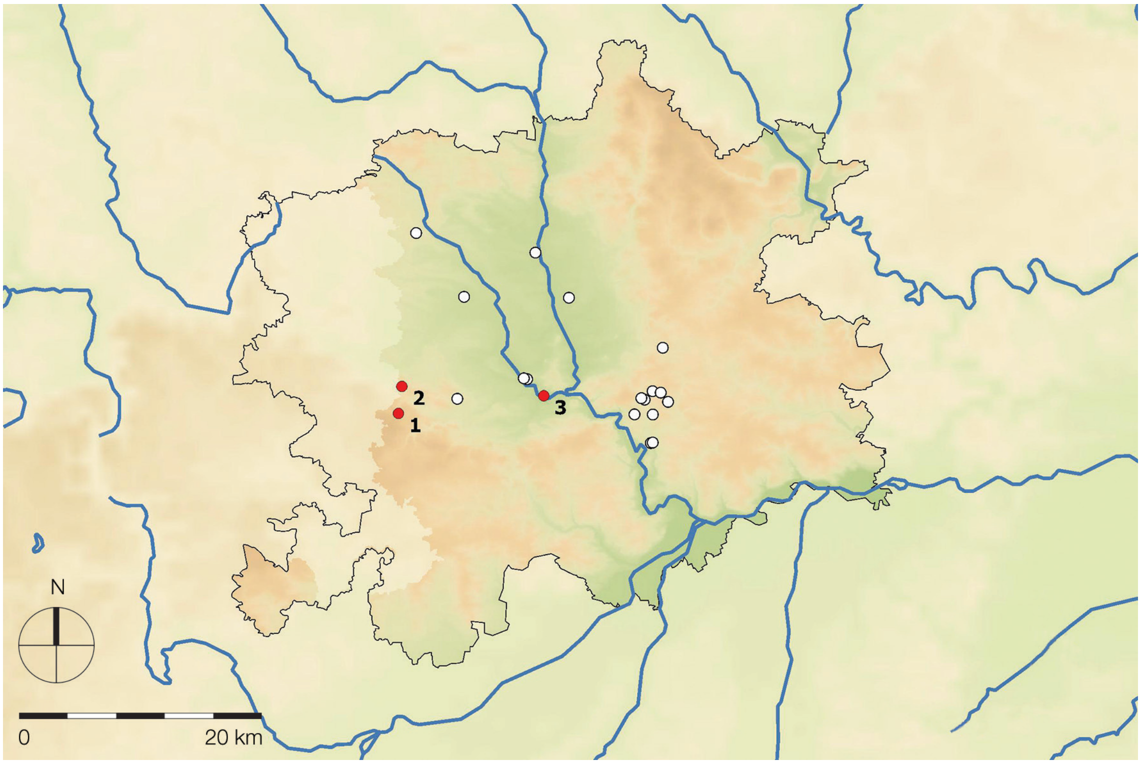

Fig. 3.5. Upper Paleolithic sites in the study area. 1 – Hohlenstein Cave, 2 – Ofnet Caves, 3 – Kaufertsberg / Hexenküche. Source of data: Fachinformationssystem Bayerisches Landesamt für Denkmalpflege 2022.

Hexenküche Cave as well as a neighbouring abri (both at the Kaufertsberg), near Lierheim, were excavated in 1913 by F. Birkner. Whereas the cave sediments showed no evidence for a Paleolithic occupation, the abri yielded several cultural horizons. In this context, especially layers K1 and K2 are of interest. The lower level K1 comprised a large number of different types of burins, subsequently followed by backed bladelets, endscrapers and borers (Kaulich 1983, 61). The inventory also yielded a few backed points (Kaulich 1983, 61). Furthermore, a half-round rod (Fig. 3.6) and a single bevelled point were identified among the organic artefacts of K1 (Kaulich 1983, 66). The presence of Lacan type burins and backed points speak in favour of an attribution of K1 to the Late Magdalenian. Within the upper horizon K2, a somewhat smaller assemblage was found. Here backed bladelets clearly prevail over burins, endscrapers and a comparably high number of backed points (Kaulich 1983, 79). Among the organic industry only a single bevelled point shall be emphasized (Kaulich 1983, 82). For K2 the presence of Lacan burins, a short scraper as well as some backed points suggest a rather Late Magdalenian or even maybe an admixture with younger – possibly Late Paleolithic – material. This was also discussed by B. Kaulich, who considered a short Mesolithic occupation on basis of a geometric artefact, small sized cores, and the head burial (Kaulich 1983, 93). A C14 date from the Kaufertsberg level K1 however yielded an age of 12,610 ± 90 BP, OxA-5751 (Housley et al. 1997, 30) which ascertains the Magdalenian age of the assemblage.

Hohlenstein names two caves located one after another. The front cave was excavated in 1911 by F. Birkner and E. Frickhinger. A horizon with lithic artefacts, cut marked bones, and perforated shells were found under a layer with prehistoric pottery, which is not defined in detail (Narr 1965, 1). Approximately 50cm beneath one another and a few meters apart, borers and an awl were found along with diluvial faunal remains. Further excavations in 1912 yielded "remnants of a Magdalenian" as well as engraved limestones (Narr 1965, 1). These engravings show three female figurines of the

Gönnersdorf style. The lithic artefacts comprise mainly borers, backed bladelets, burins, and end-scrapers (Narr 1965, 2). Furthermore, two single bevelled points were found (Narr 1965, 3). On this basis, it seems reasonable to assign Hohlenstein Cave to the Magdalenian, probably to a later phase due to the presence of Gönnersdorf style female engravings (cf. Gaudzinski-Windheuser, Jöris 2015).

Out of 20 records within the archives of the BLfD, only the three sites described above were published and/or analysed to an extent that permits further insights. The rest of the sites and/ or finds were classified as generally Upper Paleolithic on the basis of typological and/or technological criteria. Although the database is even smaller compared to the Middle Paleolithic, the following observations can be cautiously summarized:

1. The Upper Paleolithic occupation in the Nördlinger Ries can, as far as detectable, be attributed to the Aurignacian and the Magdalenian techno-complexes. Ascertained proof of a Gravettian or LGM occupation is lacking.
2. It is noteworthy that the number of sites and finds is significantly lower compared to the Middle Paleolithic record.
3. Contrary to the distribution of Middle Paleolithic sites, the clustering within the southeastern part of the Nördlinger Ries is not as prominent. On the other hand, this might be related to the generally lower number of sites.

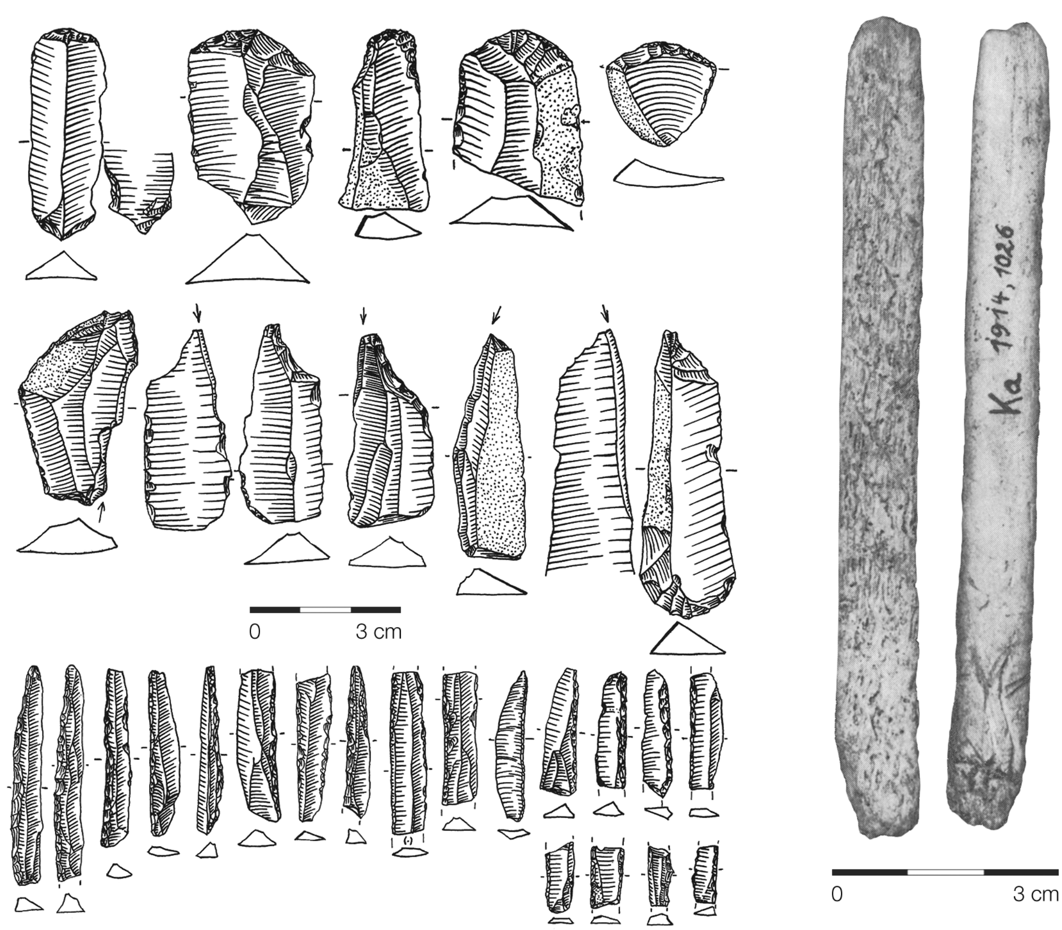

Fig. 3.6. Half-round rod and lithic artefacts from Kaufertsberg. After Kaulich 1983.

Late Paleolithic

Within the data of the BLfD, only four records were attributed to the Late Paleolithic within the study area (Fig. 3.7). Most of these are surface collections that yielded mixed material also with Mesolithic and/or Neolithic components. Of these four sites, only two have been published briefly and were already mentioned above: The Hahnenberg site and the Kaufertsberg, respectively Hexenküche. For the first one Schönweiß describes, along with the Middle Paleolithic artefacts, also typological forms he attributes to the Epipaleolithic – nowadays rather the Late Paleolithic. This attribution was based on the occurrence of what Schönweiß calls Gravette points and Federmesser (Schönweiß 1963, 101). Next to those, general Upper Paleolithic forms like burins and endscrapers are present. What Schönweiß called Gravette points might nowadays rather be referred to as curve-backed points, which is a common feature in European Late Paleolithic assemblages (cf. Schönweiß 1963). Although Schönweiß states that the Epipaleolithic comprises a larger fraction of the surface collection as compared to the Middle Paleolithic, total numbers of the inventory are not given (Holzkämper et al. 2013). The second site that mentioned a Late Paleolithic occupation is Kaufertsberg, near Lierheim. B. Kaulich claims that the artefacts from Layer K2 were similar to the Late Paleolithic material from Hahnenberg (Kaulich 1983, 93). As explained above, K2 yielded typical Magdalenian artefacts, such as a Lacan burin, next to Late Paleolithic features such as backed points. Since Late Upper Paleolithic features occur quite regularly within the Late Magdalenian, it is not possible to determine whether K2 represents a Late Magdalenian or a mixed layer of Late Magdalenian and Late Paleolithic.

Although there is sufficient evidence for the presence of the Late Paleolithic in the Nördlinger Ries, the database is unfortunately too small for further statements.

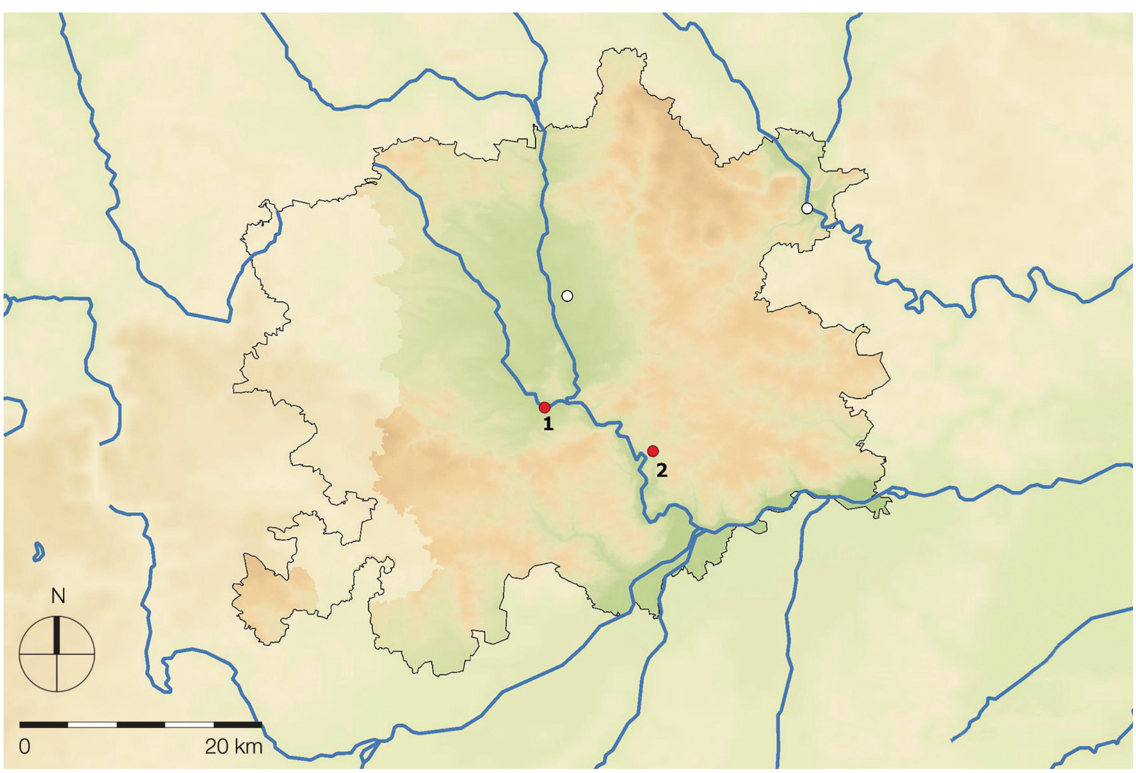

Fig. 3.7. Late Paleolithic sites in the study area. 1 – Kaufertsberg / Hexenküche, 2 – Hahnenberg. Source of data: Fachinformationssystem Bayerisches Landesamt für Denkmalpflege 2022.

Summary

Out of 1,200 Paleolithic records for the Nördlinger Ries, only a little over 200 sites and/or finds could be further determined in terms of chronology. Of these, the overwhelming majority is attributed to the Middle Paleolithic (196 records). From the transition to the Upper Paleolithic onwards, it seems that the number of sites and finds (20 for the Upper Paleolithic, 4 for the Late Paleolithic) is visibly decreasing. Furthermore, within the Upper Paleolithic material, there is a significant gap in the occupation of the study area of approximately 18,000 years. The distribution of all Paleolithic records shows two clusters, one within the crater itself and the second on the southeastern crater edges (Fig. 3.2). Whereas this geographical distribution is traceable with the Middle Paleolithic records, the numbers for the Upper and Late Paleolithic are too small to provide reliable patterns. The question therefore is: Do these observations reflect the real picture?

It is important to highlight that so far only a sixth of the known Paleolithic sites and finds in the Nördlinger Ries were further distinguished to an extent, which allows an attribution to a specific phase or techno complex within the Paleolithic. That leaves us with the problem of small numbers. Additionally, the vast majority of these records come from open-air surface collections, that yielded mixed material more often than not. In addition, surface collections themselves bear the potential for bias. They are tight-knit to the accessibility of the areas, mostly given in highly agriculturally used areas, and somewhat reflect favoured (neighbouring?) areas of volunteers. The study region might therefore not reflect the real site distribution, but rather highlight frequently surveyed and/or accessible areas. Whereas this might point towards an explanation for the site distribution within the Nördlinger Ries, it does not explain the chronology. Even with admixed assemblages, Upper and Late Paleolithic forms should be determinable as far as they are present. Nevertheless, the Middle Paleolithic material clearly prevails. This observation was also made by Elvers, Dirian and Obst, who analysed 360 surface collections from the southeastern part of the study area (Elvers et al. 2019). Within their study Upper Paleolithic material is clearly underrepresented, (Elvers et al. 2019, 30). Late Paleolithic forms are nearly non-existent (Elvers et al. 2019, 37). While reasons for this picture can vary from different land-use patterns (due to differing climatic and environmental conditions), over differences in site preservation to research gaps, a conclusive answer on the question why the Upper and Late Paleolithic seem to be underrepresented in the Nördlinger Ries area cannot be given on basis of the present data.

In summary, this brief study on the Paleolithic of the Nördlinger Ries shows that this area has a high potential for future research. The large number of Paleolithic sites in this area contrasts the picture of a "gap" between the site clusters in the Swabian and the Franconian Jura. However, the knowledge about the Paleolithic occupation of the study area is at a minimum and many questions remain unanswered. A first step towards more information must therefore lay in the review of the known Paleolithic record, to obtain more information on the sites and finds that up to now have been classified as generally Paleolithic. A better understanding of the Paleolithic occupation of the Nördlinger Ries area and its relations to the neighbouring areas would undoubtedly benefit the Paleolithic research in Southern Germany.

04

Contribution to the Upper Paleolithic settlement of Eastern Bohemia

Katarína Kapustka, David Vích, Matthew Walls

Introduction

Eastern Bohemia is a hilly region with higher mountains on its borders situated in the Czech Republic. For the long time this region remained outside the general interest of professional archaeologists. In a recent summary of the Paleolithic settlement of Eastern Bohemia, P. Čechák (2019) makes an important observation that research on this region has long been neglected.

Of particular concern is a tendency to underpublish data on sites and collections associated with this vast time period, leaving little opportunity to understand key cultural and evolutionary developments. In this article we respond to this challenge by presenting and analysing sites from the surroundings of the Rivers Tichá Orlice and Loučná (Fig. 1.1: 3) which offer important insight into the densities and distributions of Paleolithic sites which can be utilised to better understand settlement patterns.

Within this selected study area, all the known sites we discuss have been identified from surface survey, which is a typical characteristic of Paleolithic assemblages from the wider region of Eastern Bohemia. The geology and geomorphology of this region, unfortunately, do not lead to the development and preservation of well stratified contexts from the Paleolithic era, stratified sites from the Upper Paleolithic are extremely rare in this region. The underlying bedrock is typically covered by quite shallow sediments that extend only a few dozen centimetres below surface. We have conducted test pitting at a number of locations, including the sites of Zářecká Lhota 3 and Čistá 5 without any useful results in terms of stratified contexts. It is possible that future survey projects may be designed to identify and test deeper loess deposits in the hope of finding Pleistocene deposits. However, surface scatters will likely remain the primary pathway through which the importance of this region during

doi 10.47382/dvs_26-04

the Upper Paleolithic can be understood. In the past, material from surface survey was often seen as something of inferior informational value. Today we try to place its results in the wider frame of complex knowledge of the region (e.g. Sullivan 1998; Vencl 1995).

The geological setting of our study area consists of outcrops and bedrock associated with the Czech Cretaceous Basin (Chlupáč 2002), which is bordered by the Svitavské Uplands and Orlické Mountains. The bedrock within the basin consists of spongolites, claystones and sandstones, which date to the middle and upper Turonian to Coniacian (Chlupáč 2002). Local spongolites are important from an archaeological perspective as they were a source of raw material during the Mesolithic Period. However, despite this availability, these do not, at present, appear to have been utilized during the Upper Paleolithic period. Surface sediments and soils consists mostly of brown soils (especially brown earth, Tomášek 2007). Paleoenvironmental reconstructions of the local environment are lacking for the mid-late Pleistocene, but that as with much of the Czech Republic would have generally been comprised of dry steppe tundra.

History of the research

Research on the Upper Paleolithic of Eastern Bohemia started in the second half of 19th century; as with many other places, it was initially the work of local enthusiasts. In these times M. Lüssner and A. Frič obtained a number of isolated finds associated with the Upper Paleolithic, even though their attention was directed at Prehistory in general (Sklenář 2008, 11). These earliest finds were never published in a detailed way, and their provenance is not known, so it is difficult to discuss the value of these initial discoveries. An important moment for knowledge of the Eastern Bohemian Upper Paleolithic, came through the work of L. Šnajdr and J. N. Woldřich, who recorded a mammoth kill site associated with the Gravettian in Svobodné Dvory near Hradec Králové in 1903 (Šída et al. 2006, 772).

The professionalisation of archaeology in Czechoslovakia did initially have a great impact on furthering Upper Paleolithic research in Eastern Bohemia, as attention was directed primarily at other regions that yield better stratified contexts. A basic list of sites in this region was published (Vencl 1978), but it presents only very limited information on sites. Indeed, most of the sites we will present in this article were identified after S. Vencl's 1978 list was published. The only exception is the site of Zářecká Lhota, which was identified by collaborators of S. Vencl in 1965. S. Vencl's cooperation with local amateur archaeologists was a critical development, which lead to interest and improved prospection of all periods in Eastern Bohemia. Since 1980, surface survey in this region was more frequent and systematic, proving that there was significant Upper Paleolithic activity in the surroundings of the Rivers Orlice and Loučná. Most of the sites we discuss in this article are an outcome of this locally driven work. It should be noted that a persistent problem, however, is that most of the survey which lead to Upper Paleolithic finds was focused on finding contexts associated with agricultural Prehistory.

Methodology

As was noted above, all the finds come from surface survey that had the general purpose of enlarging collections, and with an emphasis of those for later periods. Prospection was typically conducted by a single individual who directed the recovery efforts at areas where it seemed to them settlement would be most probable, rather than systematically testing the landscape to understand variability in

Tab 4.1. Description of the sites.

ID	Site	Latitude (coordinate format: S-JTSK)	Longitude (coordinate format: S-JTSK)	Distance from the nearest waterflow (m)	Orientation of a site	Altitude (m a.s.l.)	Elevation above waterflow (m)	Chronology
1	Česká Třebová – Rudoltičky	600191	1081511	250	SW	396	35	Upper Paleolithic (?)
2	Čistá 11	609303	1091190	1000	NNE	440	40	Upper Paleolithic
3	Horní Sloupnice 5a	609833	1078563	300	SW	400	20	Epigravettian/Gravettian (?)
4	Horní Sloupnice 36b	609020	1078599	300	SW	420	25	Epigravettian/Gravettian (?)
5	Javorník 1	621371	1079750	150	NE	375	20	Upper Paleolithic (?)
6	Koldín 5	613529	1064282	600	W	350	30	Upper Paleolithic
7	Kornice 1	611224	1080939	500	SE	365	15	Epigravettian/Gravettian (?)
8	Lozice	631697	1076600	400	E	290	20	Upper Paleolithic
9	Mravín 1	628846	1073937	250	W	300	15	Upper Paleolithic (?)
10	Nedošín 7	614655	1081892	200	W	320	15	Upper Paleolithic
11	Němčice 1	609912	1081632	300	S	390	20	Upper Paleolithic (?)
12	Osík 4	614191	1084646	5	SE	343	2	Upper Paleolithic
13	Pekla 1	617681	1078815	300	S	330	10	Upper Paleolithic
14	Sedlec 4	626040	1073059	200	NE	365	35	Upper Paleolithic (?)
15	Stradouň 1	627746	1069599	600	NE	250	12	Epigravettian/Gravettian (?)
16	Suchá Lhota 2	621131	1082350	1400	SW	428	50	Upper Paleolithic
17	Suchá Lhota 5	620444	1078400	100	NE	421	2	Upper Paleolithic (?)
18	Štěnec 6	629652	1075269	200	N	291	2	Upper Paleolithic (?)
19	Tisová 2	618148	1074622	300	W	282	12	Upper Paleolithic (?)
20	Tisová 3	618358	1074881	100	NE	285	6	Upper Paleolithic
21	Tisová 17	617224	1075364	50	NE	285	2	Upper Paleolithic
22	Tisová 18	618545	1073604	300	SW	275	15	Upper Paleolithic
23	Trstenice 1	609719	1091407	100	NW	435	40	Upper Paleolithic
24	Vraclav 3b	625597	1072794	350	S	355	15	Upper Paleolithic (?)
25	Vraclav	626501	1070123	350	NW	256	6	Upper Paleolithic (?)
26	Vysoké Mýto 2	619906	1072373	300	S	300	30	Upper Paleolithic
27	Vysoké Mýto 8	620798	1072520	250	S	273	25	Upper Paleolithic (?)
28	Vysoké Mýto 15	621844	1071443	30	E	269	2	Upper Paleolithic (?)
29	Vysoké Mýto 27	621079	1072158	400	W	270	2	Upper Paleolithic (?)
30	Zálší	615683	1073999	150	W	288	2	Epigravettian/Gravettian (?)
31	Zářecká Lhota	614770	1069493	350	NW	320	50	Epigravettian/Gravettian (?)

how past populations organised their activities. This survey strategy could be described as the "identification of the sites" method (Kuna 1994, 50; Kuna ed. 2004, 324–325). Thus, it should be emphasized that the distributions presented here were not established through a research design that is sensitive to post-Pleistocene transformations of the landscape. As the research started in 1980, prior to the availability of hand-held GPS, most of the sites were recorded by the traditional system when their position was drawn into maps (ZM 1 : 10 000). Within each cadastral territory, sites were numbered according to the time sequence of their identification. Sometimes sites were divided to micro-sites which were labelled by number and letter (for details, see Vích 2001). In the sites we analyse here (section 4.1.), we note the original recorded coordinates, and in Tab. 4.1, we show coordinates converted to S-JTSK. For the distribution of the sites around the landscape, see Fig. 4.1.

The sense of the term "site" has been a significant point of archaeological discourse over time. For our purpose in this article, we understand it as a localized concentration of the artefacts which is spatially determined at a particular place within the landscape. Ideally, a site should be associated with a particular chronological period, and its general purpose should be identified (e.g. campsite, kill site, production centre etc.). However, within the presented collection, this is not typically possible.

Our analysis of the Upper Paleolithic collections produced through this sort of prospection followed a standard format. All the finds were measured and weighed, the raw material was identified, and everything was then sorted according to techno-typological categories. Traces of use wear, heat modification, and patination were recorded. Typological features were the primary tool used to identify the relative age of finds, which we then used to assign chronological context to sites. To augment this (especially in the analysis of the Zářecká Lhota site), we also deployed a technological approach to determine chronological context by examining patterns in the production processes represented in each collection. This analysis of production techniques focused on the correspondence of finished tools and blanks. Where homogeneity of production techniques within a collection was identified, we used this as a rough indicator of the temporal integrity of the sample.

The lithic artefacts we discuss below are sorted into the following categories: 1) tools and retouched pieces, 2) blades and blade fragments, 3) cores and core fragments, 4) production waste (including microburins, tablets, and crested blades etc.), and 5) other waste (chips, flakes, flake fragments). Tools and retouched pieces are the finished products, which allow us to see the intentions behind the observed production processes. Blades and blade fragments are also quite informative in demonstrating the general strategies of blank production. They also allow us to see some intentions of the producers, and can sometimes help in identifying the tools used for percussion etc. Cores and core fragments can help confirm general lithic production activities associated with the site, which are also sensitive to temporal trends. The informational value of the other waste, however, is quite low, as these do not reveal any specific intentions or production processes other than the general act of flint-knapping.

Patination was taken in account as one of the markers of the chronology of the collections. Authors are quite aware of the fact that the conditions under which patina could develop vary (Balirán 2014), however patina is from time to time used as a sign of collection chronology (Glauberman, Thorston 2012). There were difficulties with appropriate material association where the level of patination was considered as one of the signs of the collection age. Patination was evaluated only macroscopically, and

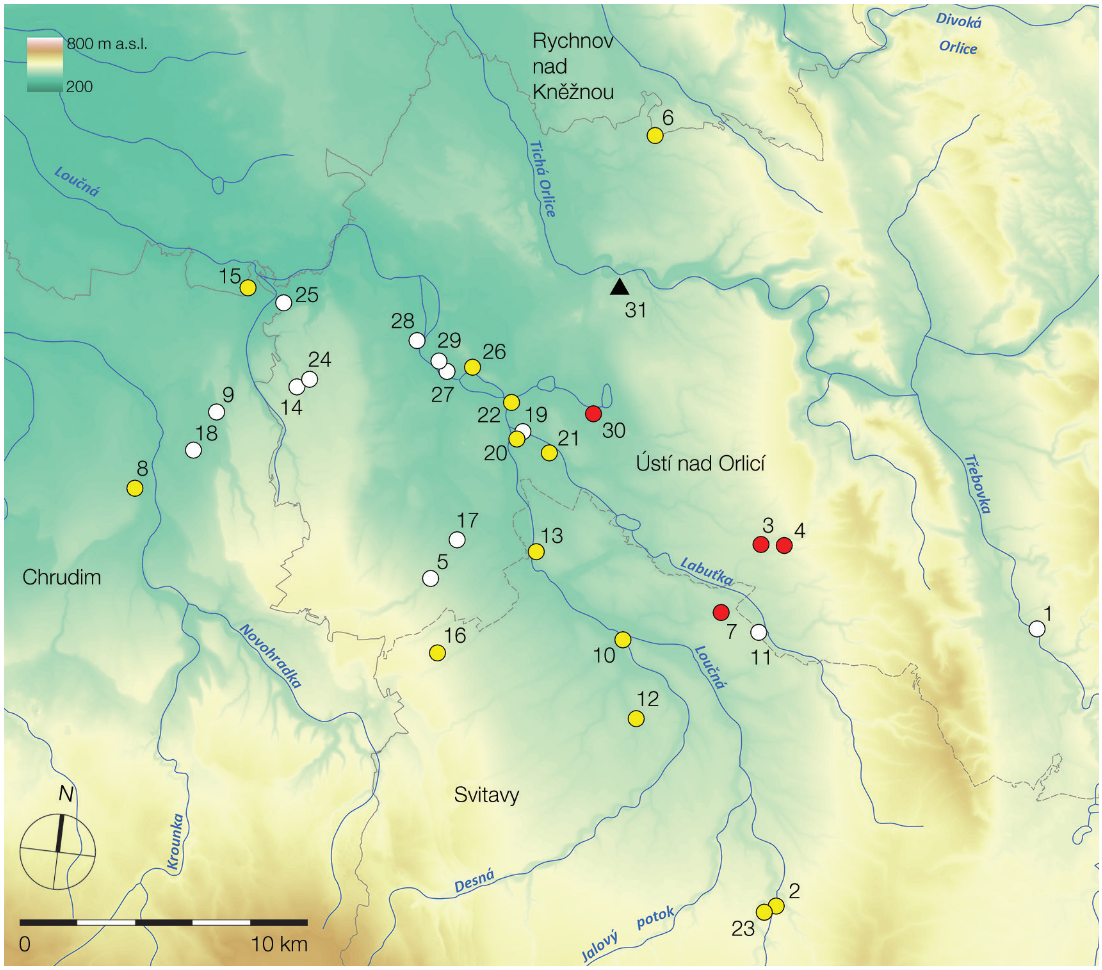

Fig. 4.1. Map of the sites within the studied region (black – Zářecká Lhota; red – Epigravettian/Gravettian (?) sites; yellow – sites with an Upper Paleolithic component; white: sites with a probable Upper Paleolithic component), numbers in the map indicate description of the site within Tab. 4.1 and the catalogue of the sites. Compiled by Č. Čišecký.

its level was recorded. According to the percentage of surface of the piece which was covered by patination and level of severity (depth, colour) which affected the piece level of patination was described as: no patina, light patination, moderate patination and heavily patinated collection. As outline below, associating material with a specific period within the Upper Paleolithic was a challenge, and as a result, the chronological position of collections is not always certain. Within Upper Paleolithic assemblages, we focused analysis mostly on pieces that have characteristic that allow such associations. These determinations, as discussed above, were based on typology, production techniques, metrics, and patination. Some collections can be generally associated with the Upper Paleolithic, while others had the potential for more precise subdivision.

Materials

In this section, we first present a short catalogue of known sites within the study area, which can be associated with the Upper Paleolithic. We will then direct more detailed discussion towards the largest collection from the Zářecká Lhota site. Overview of the information on the lithic material from mentioned sites is in Tab. 4.2.

Tab 4.2. Characteristics of the presented lithic collections (used abbreviations: comb.: combined; e. flint: erratic flint; O. chert: chert of Olomučany type; ret.: retouched; RM: Raw material; S.s. chert: chert of Stránská skála type; UP: Upper Paleolithic).

Description		Size of collection		Raw materials		
ID	**Site**	**Number of UP finds**	**Lithics total**	**Present in collection**	**Pc – e. flint (UP)**	**Other RM (UP)**
1	Česká Třebová – Rudoltičky	1	1	chert	0	1 chert
2	Čistá 11	1	6	e. flint	1	0
3	Horní Sloupnice 5a	1	187	e. flint	1	0
4	Horní Sloupnice 36b	1	1005	e. flint	1	0
5	Javorník 1	5	267	e. flint	5	0
6	Koldín 5	1	4	e. flint	1	0
7	Kornice 1	1	98	e. flint	1	0
8	Lozice	1	1	e. flint	1	0
9	Mravín 1	4	14	e. flint, rock crystal	4	0
10	Nedošín 7	1	1	e. flint	1	0
11	Němčice 1	1	15	e. flint	1	0
12	Osík 4	1	7	e. flint	1	0
13	Pekla 1	2	2	e. flint, Polish Jura chert	1	1 chert
14	Sedlec 4	1	5	e. flint	1	0
15	Stradouň 1	2	4	e. flint, obsidian, chocolate flint	2	0
16	Suchá Lhota 2	1	3	e. flint	1	0
17	Suchá Lhota 5	1	1	e. flint	1	0
18	Štěnec 6	1	1	e. flint	1	0
19	Tisová 2	1	13	e. flint	1	0
20	Tisová 3	3	25	e. flint	3	0
21	Tisová 17	1	7	e. flint	1	0
22	Tisová 18	3	37	e. flint	3	0
23	Trstenice 1	1	2	e. flint	1	0
24	Vraclav 3b	2	9	e. flint	2	0
25	Vraclav	1	19	e. flint	1	0
26	Vysoké Mýto 2	3	25	e. flint	3	0
27	Vysoké Mýto 8	5	9	e. flint	5	0
28	Vysoké Mýto 15	2	20	e. flint	2	0
29	Vysoké Mýto 27	1	7	e. flint	1	0
30	Zálší	1	2	e. flint	0	1 spongolite
31	Zářecká Lhota	268	562	e. flint, O. chert, S.s. chert	239	6 S.s. chert, 15 O. chert, 8 quartz, 4 ?

Production categories				Types				Level of patination
Tools	Cores	Waste	Blanks	Points	Scrapers	Burins	Other	
0	0	1	0	0	0	0	0	heavy
0	0	0	1	0	0	0	ret. blade	heavy
1	0	0	0	1	0	0	0	light
1	0	0	0	0	0	0	comb. tool	moderate
0	0	5	0	0	0	0	0	heavy
1	0	0	0	0	0	1	0	light
1	0	0	0	1	0	0	0	no
1	0	0	0	0	1	0	0	light
0	0	3	1	0	0	0	ret. blade	light
1	0	0	0	0	1	0	0	heavy
1	0	0	0	0	1	0	ret. flake	no
0	0	0	1	0	0	0	0	heavy
1	1	0	0	0	1	0	0	light
0	0	0	1	0	0	0	0	moderate
0	1	1	0	0	0	0	0	heavy
1	0	0	0	0	1	0	0	heavy
0	0	1	0	0	0	0	0	heavy
0	0	0	1	0	0	0	0	moderate
0	1	0	0	0	0	0	0	heavy
1	0	2	0	0	1	0	0	moderate
1	0	0	0	0	0	1	0	moderate
1	1	1	0	0	1	0	0	moderate
1	0	0	0	0	1	0	0	moderate
0	0	1	1	0	0	0	0	moderate
0	0	0	0	0	0	0	0	heavy
1	0	1	1	0	1	0	0	heavy
0	0	3	1	0	0	0	0	heavy
0	1	1	0	0	0	0	0	moderate
0	0	0	1	0	0	0	0	moderate
1	0	0	0	1	0	0	0	light
35	16	134	83	2	9	6	18	moderate

Site overview

Site description of all sites consists of the following data: *Context* = description of the place in the landscape, where lithics were found; *Paleolithic Assemblage* = number of lithics which can be associated with the Upper Paleolithic, with the total number of lithic artefacts also reported if there were finds from other periods; *Artefact descriptions* = brief description of relevant finds; if all dimensions are given, they are always in order of length × width × thickness; *Other periods* = list of other periods, which material was identified within particular site; *Survey information* = when and who conducted the survey; *Deposition* = where the collection material is stored; *Bibliography* = published works, where relevant notes are accessible; *Notes* = all other important information on the site. Only categories with some information are mentioned at each site.

- **Česká Třebová – "Rudoltičky"** (Ústí nad Orlicí District)
  Context: Slope above Třebovka Valley, 250 m SW from the watercourse at 396 m a.s.l.
  Paleolithic assemblage: 1pc (total 1pc)
  Artefact descriptions: eolised core fragment? of yellow chert with a negative flake scar, patinated: 61 × 43 × 28 mm, weight: 81 g; high degree of patination was counted as an indication of Paleolithic age of the artefact
  Survey info: T. Záruba 26th December 2015
  Deposition: Regional Museum in Vysoké Mýto
  Notes: Association with Upper Paleolithic is not clear, and possible the artefact came from an earlier period.

- **Čistá 11** (Svitavy District)
  Context: NE oriented terrace, 40m above the River Loučná, watercourse 1 km east of the site, altitude of the site is 440 m a.s.l.
  Paleolithic assemblage: 1pc (total 6pc)
  Artefact descriptions: Fragment of heavily patinated blade made of glacial? erratic flint, dimensions 44 × 14 × 6 mm, weight 3.6 g; post depositional damage and there are traces of use wear
  Other periods: Mesolithic
  Survey info: D. Vích 1999
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2015; Vích 1999

- **Horní Sloupnice 5a** (Svitavy District)
  Context: Southern slope above Sloupnický potok, which is situated 300 m to the south, altitude 400 m a.s.l.
  Paleolithic assemblage: 1pc (total 187pc)
  Artefact descriptions: Lightly patinated fragment of a point made of erratic flint, dimensions: 22 × 10 × 4 mm, weight: 0.8g; precise production, use wear traces, regular abrupt retouch on both sides, as a blank for this tool served regular blade
  Other periods: Mesolithics, Neolithics, Eneolithics
  Survey info: D. Vích 1989–2004
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2013; 2015; Kalferst 1995, 88; Kalferst et al. 1991–1992; Vích 1999; Vích, Vokolek 1997; Vokolek, Vích 1993

- **Horní Sloupnice 36b** (Svitavy District)
  Context: Ridge between Sloupnický potok and occasional watercourse, elevation 420 m a.s.l.
  Paleolithic assemblage: 1 pc (total 1,005 pc)
  Artefact descriptions: Combined tool scraper/burin made of erratic flint, dimensions: 42 × 25 × 24 mm, weight: 16.6 g; cortex less than 25%, robust scraper on a flake, in basal part burin spall, traces of use wear, heavily patinated
  Other periods: Mesolithics
  Survey info: D. Vích 1989–2014
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2010; 2013; 2015; Vích 1999; Vích, Vokolek 1997; Vokolek, Vích 1993

- **Javorník 1** (Ústí nad Orlicí District)
  Context: NE slope above Blahovský potok Valley, elevation 375 m a.s.l.
  Paleolithic assemblage: 5 pc (total 267 pc)
  Artefact descriptions: 5 small flakes and its fragments made of erratic flint, length: 19–42 mm, weight: 2.2–5.9 g; everything heavily patinated, high degree of patination was taken as an indication of the Paleolithic age of the artefacts
  Other periods: Mesolithics
  Survey info: D. Vích, M. Severa 2005–2009
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Čechák 2019; Čuláková 2015; Hrubeš et al. 2010

- **Koldín 5** (Ústí nad Orlicí District)
  Context: SE slope 600 m to the N from Skořenický potok, elevation 350 m a.s.l.
  Paleolithic assemblage: 1 pc (total 4 pc)
  Artefact descriptions: Burin on the blade, with broken basis, light bluish patination, erratic flint, 38 × 19 × 4 mm, weight: 3.0 g
  Other periods: Prehistory
  Survey info: M. Pleska 2011
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Pleska 2011, 61

- **Kornice 1** (Svitavy District)
  Context: N slope above occasional watercourse, elevation 365 m a.s.l.
  Paleolithic assemblage: 1 pc (total 98 pc)
  Artefact descriptions: Point on a blade made of erratic flint, retouched on both sides, retouch is abrupt, dimensions: 29 × 15 × 6 mm, weight: 3.9 g
  Other periods: Mesolithics, Neolithics, Eneolithics, Late Bronze Age, Roman Age, Prehistory, Middle Ages
  Survey info: J. Čermák, V. Posel, L. Vacek, D. Vích 1989–1998
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2015; Kalferst et al. 1994; 1995; Vích 1999; Vích, Vokolek 1997
  Notes: Originally divided into microsites 1a-e, according to the agricultural work in terrain, for the purposes of this article described as a single site.

- **Lozice** (Chrudim District)
  Context: Slope oriented towards east above the River Novohradka,
  elevation 290 m a.s.l.
  Paleolithic assemblage: 1 pc
  Artefact descriptions: Scraper (blank flake), erratic flint (?), heavily patinated,
  dimensions, 29 × 31 × 10 mm, weight: 8.7 g
  Survey info: O. Sotona 2013
  Deposition: Chrudim Regional Museum

- **Mravín 1** (Chrudim District)
  Context: S slope above the Stream Malonín, elevation 290–300 m a.s.l.
  Paleolithic assemblage: 4 pc (total 14 pc)
  Artefact descriptions: Flake, dimensions: 26 × 20 × 9 mm, weight: 4.8 g; flake, dimensions:
  13 × 12 × 3 mm, weight: 0.5 g; blade, dimensions: 39 × 16 × 5 mm, weight: 3.6 g; basal fragment
  of a flake/robust blade, dimensions: 38 × 37 × 12 mm, weight: 22.1 g everything made
  of erratic flint and patinated
  Other periods: Neolithics-Eneolithics, Late Bronze Age, Iron Age, Roman Age,
  Prehistory, Middle Ages
  Survey info: D. Vích, L. Víchová and collaborators of the Regional Museum
  in Vysoké Mýto 2006–2018
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Bek, Vích 2015, 241

- **Nedošín 7** (Svitavy District)
  Context: Flat hill between the Rivers Desná (200 m in a SW direction) and Loučná
  (300 m north), the elevation is ca 15 m above the watercourses, elevation of the site
  is 320 m a.s.l.
  Paleolithic assemblage: 1 pc
  Artefact descriptions: Heavily patinated two-sided scraper made of erratic flint,
  dimensions: 28 × 16 × 8 mm, weight: 3.5 g
  Survey info: V. Posel 1990
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2015; Kalferst et al. 1995; Vích 1999

- **Němčice 1** (Svitavy District)
  Context: Terrace elevated ca 20 m above the Stream Končinský, site is 300 m south
  of the site, elevation 390 m a.s.l.
  Paleolithic assemblage: 1 pc (total 15 pc)
  Artefact descriptions: Fragment of retouched flake, erratic flint,
  dimensions: 42 × 26 × 11 mm, weight: 12.6 g
  Other periods: Mesolithics, Neolithics
  Survey info: D. Vích 1989–1993
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2015; Kalferst et al. 1994; Vích 1999

- **Osík 4** (Svitavy District)
  Context: SE slope above occasional watercourse, elevation 343 m a.s.l.
  Paleolithic assemblage: 1 pc (total 7 pc)
  Artefact descriptions: Medial part of blade, erratic flint, dimensions: 19 × 11 × 4 mm, weight: 1.1 g; heavily patinated, there are visible traces of the use
  Other periods: Mesolithics, Middle Ages
  Survey info: D. Vích 1994–1997
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čuláková 2015; Kalferst et al. 1995; Vích 1999; Vích, Vokolek 1997

- **Pekla 1** (Svitavy District)
  Context: Long flat hill above the River Loučná 300m far from it, elevation: 330 m a.s.l.
  Paleolithic assemblage: 2 pc (total 1463 pc)
  Artefact descriptions: Scraper made of erratic flint, dimensions: 23 × 17 × 10 mm, weight: 5.1 g, cortex: 50%; two platform bladelet core made of silicites from Polish Jura dimensions: 46 × 30 × 25 mm, weight: 36.9 g; both lightly patinated
  Other periods: Mesolithics
  Survey info: V. Posel, S. Vencl, D. Vích, J. Sigl, V. Vokolek 1978–2014
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2015; Kalferst et al. 1991–1992; 1993; Vích 1999; Vích, Vokolek 1997

- **Sedlec 4** (Ústí nad Orlicí District)
  Context: Terrace above valley of the Stream Zbraň, elevation 365 m a.s.l.
  Paleolithic assemblage: 1 pc (total 5 pc)
  Artefact descriptions: Blade with broken terminal part made of patinated erratic flint, dimensions: 40 × 12 × 4 mm, weight: 2.3 g
  Other periods: Late Bronze Age, Iron Age, Prehistory
  Survey info: D. Vích 1997–2011
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Vích 2012, 147

- **Stradouň 1** (Ústí nad Orlicí District)
  Context: Slope oriented towards N, above the Stream Bětnický and its confluence with the River Loučná, elevation of 250 m a.s.l.
  Paleolithic assemblage: 2 pc (total 4 pc)
  Artefact descriptions: Robust flake most of the dorsal side is covered by cortex, dimensions: 62 × 52 × 24 mm, weight: 66.4 g; one platform core, dimensions: 34 × 33 × 28 mm, weight: 35.0 g; both heavily patinated erratic flint
  Other periods: Late Bronze Age, Iron Age, Roman Period, Early Middle Ages
  Survey info: D. Vích 2011
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Vích 2007, 177; Vích 2012, 148
  Notes: Other lithic finds at this place could be Upper Paleolithic (two platform cores from burnt silicite and one platform obsidian core for the production of microbladelets).

- **Suchá Lhota 2** (Svitavy District)
  Context: SE oriented slope 35 m from occasional watercourse, elevation 428 m a.s.l.
  Paleolithic assemblage: 1 pc (total 3 pc)
  Artefact descriptions: Scraper from heavily patinated erratic flint, dimensions: 33 × 27 × 5 mm, weight: 5.1 g
  Other periods: Mesolithics, Prehistory
  Survey info: M. Hrubeš 2006–2007
  Deposition: Regional Museum in Litomyšl
  Bibliography: Hrubeš et al. 2010, 153, Fig. 1: 1

- **Suchá Lhota 5** (Svitavy District)
  Context: Slope with no watercourse in its surroundings, elevation 418–424 m a.s.l.
  Paleolithic assemblage: 1 pc
  Artefact descriptions: Heavily patinated flake from erratic flint, dimensions: 20 × 23 × 7 mm, weight: 3.8 g
  Survey info: M. Hrubeš 28th January 2008
  Deposition: Regional Museum in Litomyšl
  Bibliography: Hrubeš et al. 2010, 154

- **Štěnec 6** (Chrudim District)
  Context: Ridge between the Stream Řepnický stream and a nameless stream, elevation 288–294 m a.s.l.
  Paleolithic assemblage: 1 pc
  Artefact descriptions: Terminal part of the blade, with white patination from erratic flint, dimensions: 26 × 17 × 4 mm, weight: 1.8 g
  Other periods: Iron Age
  Survey info: J. Uhlíř 2011–2013
  Deposition: Regional Museum in Vysoké Mýto

- **Tisová 2** (Ústí nad Orlicí District)
  Context: Slope pending towards W above the valley of the Stream Sloupnice, 120 m from the stream, elevation 282 m a.s.l.
  Paleolithic assemblage: 1 pc (total 13 pc)
  Artefact descriptions: Double platform heavily white patinated core of erratic flint, dimensions: 36 × 30 × 31mm, weight: 32.7 g
  Other periods: Mesolithics, Iron Age, Early Middle Ages
  Survey info: D. Vích 1999
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2015; Vencl 1978; Vích 1999

- **Tisová 3** (Ústí nad Orlicí District)
  Context: NE slope above the valley of the Stream Sloupnice at an elevation of 285 m a.s.l.
  Paleolithic assemblage: 3 pc (total 25 pc)
  Artefact descriptions: Small flake fragments from erratic flint, length: 27–28 mm, weight: 6.8–8.5 g; scraper from erratic flint, dimensions: 21 × 17 × 11 mm, weight: 4.6 g, cortex 25%; everything patinated
  Other periods: Mesolithics, Iron Age, Roman Age, Early Middle Ages
  Survey info: D. Vích 1997–2002

Deposition: Museum of Eastern Bohemia in Hradec Králové
Bibliography: Čechák 2019; Čuláková 2015; Kalferst et al. 1994; Vích 1999

- **Tisová 17** (Ústí nad Orlicí District)
  Context: NE pending slope above floodplain of the Stream Sloupnice,
  elevation: 285 m a.s.l.
  Paleolithic assemblage: 1 pc (total 7 pc)
  Artefact descriptions: Burin on the blade, blade made by direct organic percussion, heavily patinated erratic flint, it has traces of use wear, dimensions: 41 × 22 × 13 mm, weight: 10.1 g
  Other periods: Mesolithics, Prehistory, Early Middle Ages
  Survey info: D. Vích 1998
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2015; Vích 1999
  Notes: Originally divided into microsites 1a-e, according to the agricultural work in terrain, for the purpose of this article, it is described as a single site.

- **Tisová 18** (Ústí nad Orlicí District)
  Context: Site 300 m from confluence of the Betlémský potok and the River Loučná,
  elevation 275 m a.s.l.
  Paleolithic assemblage: 3 pc (total 37 pc)
  Artefact descriptions: Scraper on a flake, dimensions: 34 × 31 × 11 mm, weight 13.1 g; fragment of a core, dimensions: 37 × 30 × 27 mm, weight: 31.8 g; fragment of a flake, dimensions: 18 × 12 × 7 mm, weight 1.3 g; everything made of erratic flint and heavily patinated
  Other periods: Mesolithics, Neolithics, Eneolithics, Iron Age, Roman Age, Early Middle Ages
  Survey info: D. Vích 1998
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2015; Vích 1999

- **Trstenice 1** (Svitavy District)
  Context: Slope cca 40 m above deep valey of the River Loučná, elevation 435 m a.s.l.
  Paleolithic assemblage: 1 pc (total 2 pc)
  Artefact descriptions: Scraper on flake, back side is covered by cortex, heavily patinated, erratic flint, dimensions: 25 × 18 × 8 mm, weight: 3 g
  Other periods: Mesolithics?
  Survey info: D. Vích 14 th September 1997
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Vích 1999, 154; Bláha et al. 2004, 120

- **Vraclav 3** (Ústí nad Orlicí District)
  Context: Slope cca 15 m above the valley of the Stream Sedlecký,
  elevation 355 m a.s.l.
  Paleolithic assemblage: 2 pc (total 9 pc)
  Artefact descriptions: Flake, dimensions: 32 × 24 × 7 mm, weight: 4.7 g; fragment of blade, dimensions: 28 × 24 × 5 mm, weight: 5.2 g, both from erratic flint, patinated
  Other periods: Mesolithics, Late Bronze Age, Iron Age, Early Middle Ages
  Survey info: D. Vích 1998–1999
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Čechák 2019; Čuláková 2015; Vích 2013, 255; 2014, 239

- **Vraclav** (Ústí nad Orlicí District)
  Context: NW oriented slope above the Stream Bětnický 300 m from it, elevation 256 m a.s.l.
  Paleolithic assemblage: 1 pc
  Artefact descriptions: Robust renewal blade from the edge of the core, highly patinated, erratic flint, dimensions: 60 × 22 × 14 mm, weight: 27.0 g
  Survey info: D. Vích, T. Bek 20 April 2016
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Bek, Vích 2018b, 232

- **Vysoké Mýto 2** (Ústí nad Orlicí District)
  Context: S slope of socalled Bučkův hill above the floodplain of the River Loučná, elevation 300 m a.s.l.
  Paleolithic assemblage: 3 pc (total 25 pc)
  Artefact descriptions: Scraper, dimensions: 13x15x5 mm, weight: 1g; blade with recently broken terminal part, dimensions: 41 × 38 × 8 mm, weight 2 g; recently broken flake, dimensions: 40 × 14 × 3 mm, weight: 7.6 g; everything heavily patinated and made of erratic flint
  Other periods: Mesolithics, Neolithics/Eneolithics, Late Bronze Age, Iron Age, Early Middle Ages
  Survey info: D. Vích 1989–1999
  Deposition: Museum of Eastern Bohemia in Hradec Králové
  Bibliography: Čechák 2019; Čuláková 2015; Kalferst et al. 1991–1992; 1993; 1994; 1995; Vích 1999; Vích, Vokolek 1997

- **Vysoké Mýto 8** (Ústí nad Orlicí District)
  Context: Hill above the floodplain of the Loučná, elevation 270–276 m a.s.l.
  Paleolithic assemblage: 5 pc (total 9 pc)
  Artefact descriptions: Blade 26 mm long; broken flake 32 mm long; flake 23 mm long; robust flake dimensions: 66 × 52 × 15 mm, weight: 52.4g; small flake from the edge of the core, dimensions: 28 × 11 × 6 mm, weight: 1.9 g; everything from erratic flint and patinated
  Other periods: Mesolithics, Iron Age, Prehistory, Early Middle Ages
  Survey info: D. Vích 1995–2012
  Deposition: Museum of Eastern Bohemia in Hradec Králové, Regional Museum in Vysoké Mýto
  Bibliography: Vích 1999, 186; Kalferst et al. 1999, 27; Vích 2006, 221

- **Vysoké Mýto 15** (Ústí nad Orlicí District)
  Context: Slope near the floodplain of the River Loučná, elevation 266–272 m a.s.l.
  Paleolithic assemblage: 2 pc (total 20 pc)
  Artefact descriptions: 2 platform cores, heavily patinated, erratic flint, dimensions: 33 × 34 × 15 mm, weight: 18.7 g; flake bluish patination, erratic flint dimensions: 19 × 16 × 7 mm, weight: 1.8 g
  Other periods: Eneolithics, Bronze Age, Iron Age, Roman Period, Migration Period, Prehistory, Early Middle Ages
  Survey info: D. Vích 2007, 2015
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Vích 2008–2009, 67; Bek, Vích 2018a, 174

- **Vysoké Mýto 27** (Ústí nad Orlicí District)
  Context: Terrace above the floodplain of the River Loučná, elevation 270 m a.s.l.
  Paleolithic assemblage: 1 pc (total 7 pc)
  Artefact descriptions: Short flake, patinated, erratic flint, dimensions: 25 × 17 × 6 mm, weight: 2.3 g
  Other periods: Roman Period, Prehistory
  Survey info: D. Vích 2008
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Vích 2006, 22; 2007, 177–178; 2012, 151

- **Zálší – "Za Rybníky"** (Ústí nad Orlicí District)
  Context: Hill in a wetland, today changed into ponds, elevation 288 m a.s.l.
  Paleolithic assemblage: 1 pc
  Artefact descriptions: 2 sides retouched point of an arrow, light patination, dimensions: 21 × 14 × 3 mm, weight: 0.8 g
  Survey info: F. Pácl 24 November 2014
  Deposition: Regional Museum in Vysoké Mýto
  Bibliography: Bek, Vích 2016, 249

- **Zářecká Lhota** (Ústí nad Orlicí District)
  Context: Site is situated at flat terrace above the River Tichá Orlice (Fig. 4.2), which winds around, it is about 350 m from the site and the site is situated 50 m above it. There were sites with different numbers, but there were shifts in it, so it went a little bit unclear, and since there were no natural divisions between them, we finally decided to describe this material as one site.
  Paleolithic assemblage: 268 pc (total 562 pc)
  Artefact descriptions: See chapter 4.2.1
  Other periods: Mesolithics, Middle Ages
  Survey info: D. Vích 1990–2014
  Deposition: Museum of Eastern Bohemia in Hradec Králové (part in exposition in the Orlice Museum in Choceň), Regional Museum in Vysoké Mýto, The Museum of East Bohemia in Pardubice
  Bibliography: Čechák 2019; Čuláková 2015; Vích 2010

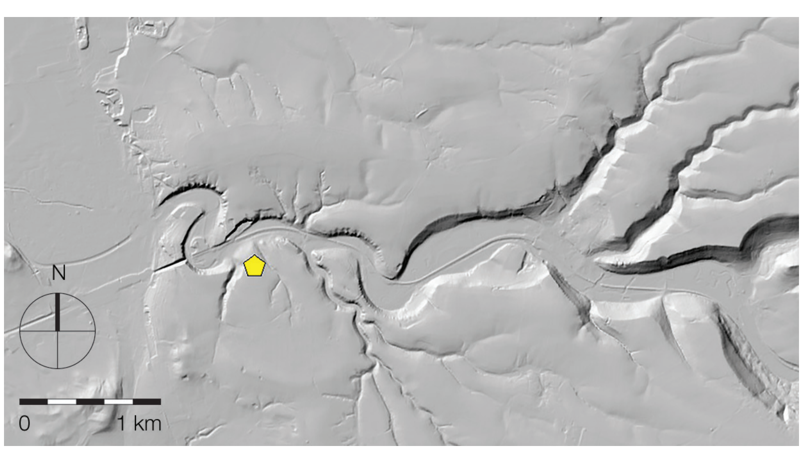

Fig. 4.2. Position of the site of Zářecká Lhota. Author K. Kapustka.

General overview

The majority of the site assemblages examined only contain features that allow for a general determination of Upper Paleolithic in terms of chronological position. The primary exception is the collection from Zářecká Lhota (Fig. 4.3, 4.4), which we discuss in more detail below. Further exceptions include Horní Sloupnice 5 (Fig. 4.5: 12), Kornice 1 (Fig. 4.6: 1) and Zálší (Fig. 4.5: 11), which are each represented by projectile points that demonstrate chronologically sensitive features, allowing more detailed discussion.

Zářecká Lhota

Zářecká Lhota is the largest collection and is the only site in the study area where artefacts from all the categories mentioned in section three are represented. Although most of the presentation of the site is focused on the lithics it is important to note, that site is located on a quite distinctive river terrace, situated high above the river (see Fig. 4.2). The entire lithic collection includes 562 artefacts contained pieces from both the Mesolithic and Upper Paleolithic. The chronological determinations, as outlined above, were primarily made through technological and typological determinations with consideration of patination, and we determined that 177 pieces (about 30% of the assemblage) are strongly associated with the Upper Paleolithic. Material choice is an important point of the difference with the Mesolithic component dominated by local available spongolites, and the Upper Paleolithic component by imported erratic flints. Another 91 artefacts were determined to possibility be associated with the Upper Paleolithic with lower confidence due to ambiguous features. We focus our initial discussion on the first part of the assemblage with higher chronological confidence.

The raw materials identified in this assemblage were dominated by highly patinated erratic flint, which represented 88% of the artefacts. The remaining identifications comprise materials that are is well documented for the Upper Paleolithic in Bohemia: 6% consisted of Olomučany type chert, 3% quartz, 2% Stránská skála type chert, and 1% of the raw material in the assemblage was unidentifiable. Representation of different typo-technological categories consists of 13% retouched tools, 31% blanks (blades/bladelets and its fragments), 6% cores and core fragments, 13% production waste, and 37% other waste (see Fig. 4.7, 4.8). There did not appear to be correlation between typo-technological category and raw material, which is likely due to the low representation of materials other than erratic flint.

The specific typo-technological composition of artefacts made of erratic flint at Zářecká Lhota is interesting in a broader regional perspective. Compared to the other sites, there is very high percentage of blanks and cores. This could be related to the means through which the sample was produced, which consisted entirely of surface collection. However, this pattern could also indicate that cores were transported to the site in a prepared stage of production, and then further refined to tool blank at the site. Exhausted cores were discarded at the site, but there is little evidence of debitage associated with early-stage core production. Small waste (shatter and small flakes) is certainly underrepresented in the sample due to the collection method and lack of excavation/screening.

As noted, the cores found in the collection are mostly exhausted examples (Fig. 4.3, 4.4), varying from 25 to 91 mm (mean of 47.7 mm) and 8.3 to 152 g (mean of 54.6 g), which is significant as these are quite small in comparison to other sites. Most cores were made of erratic flint, but there were also examples of Olomučany chert (Fig. 4.3: 1). The Olomučany chert cores are considerably smaller (mean length 29 mm and mean weight 15.6 g) Another interesting feature of the Olomučany chert cores is that all examples demonstrate changes in the direction of flake removal, suggesting a different production

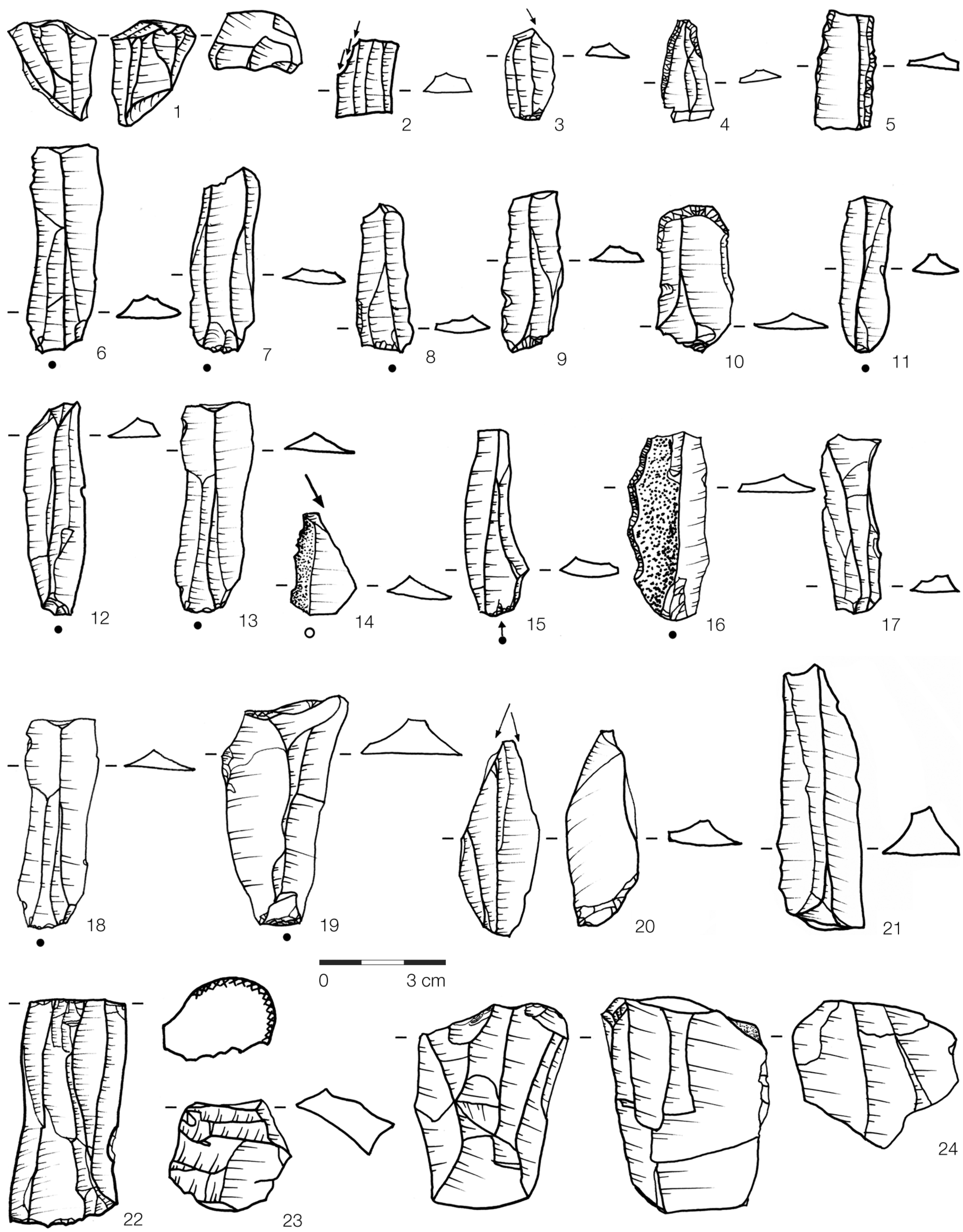

Fig. 4.3. Drawings of the selected lithics from Zářecká Lhota. Raw material erratic flint: 1, 22–24 – cores; 6–9, 11–13, 15, 17–19, 21 – blades. Tools: 2, 3, 14, 20 – burins; 10 – scraper; 4, 5, 16 – retouched blades. Drawing by K. Kapustka.

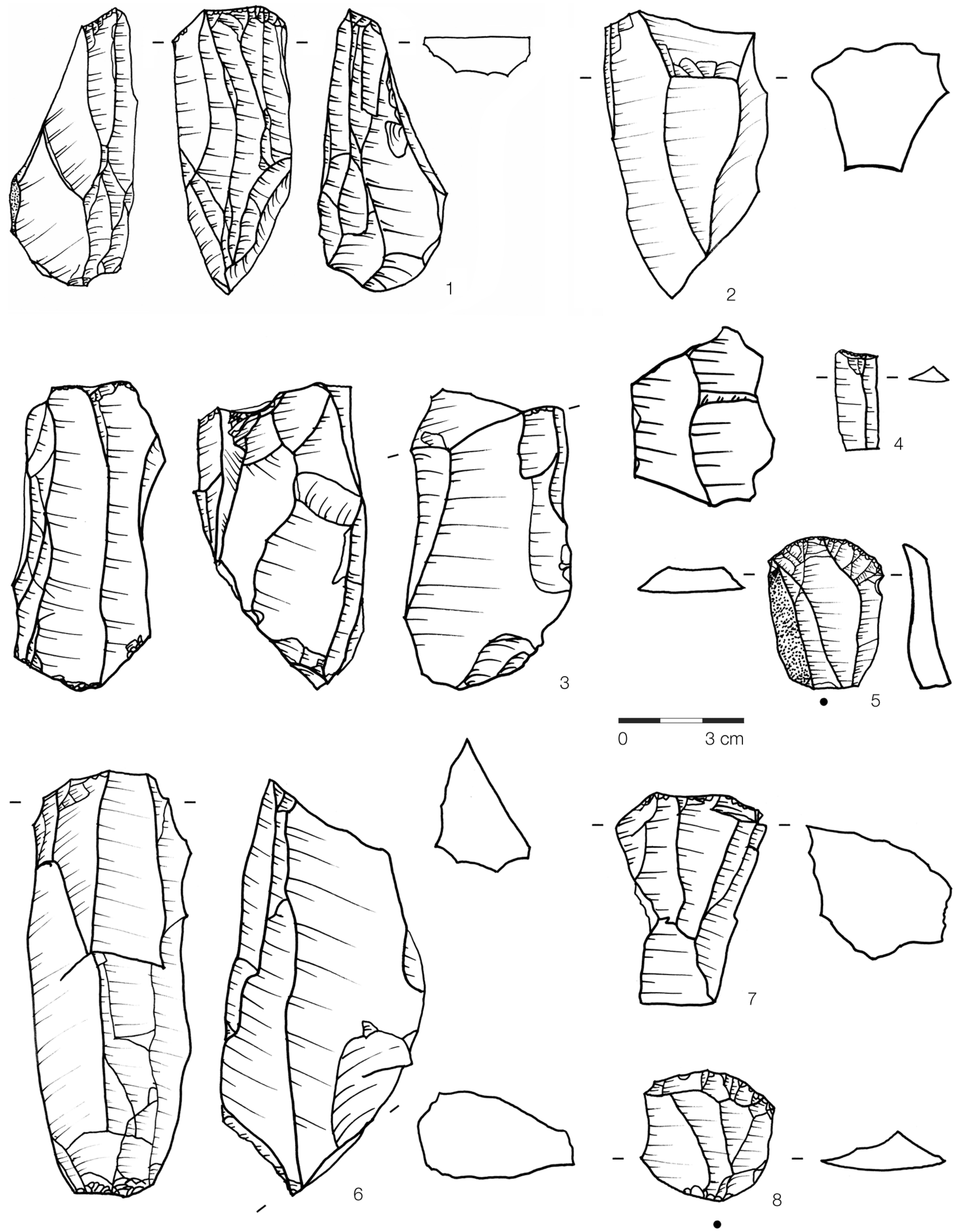

Fig. 4.4. Drawings of the selected lithics from Zářecká Lhota. Raw material erratic flint; 1–3, 6, 7 – cores. Tools: 4 – retouched blade; 5, 8 – scrapers. Drawing by K. Kapustka.

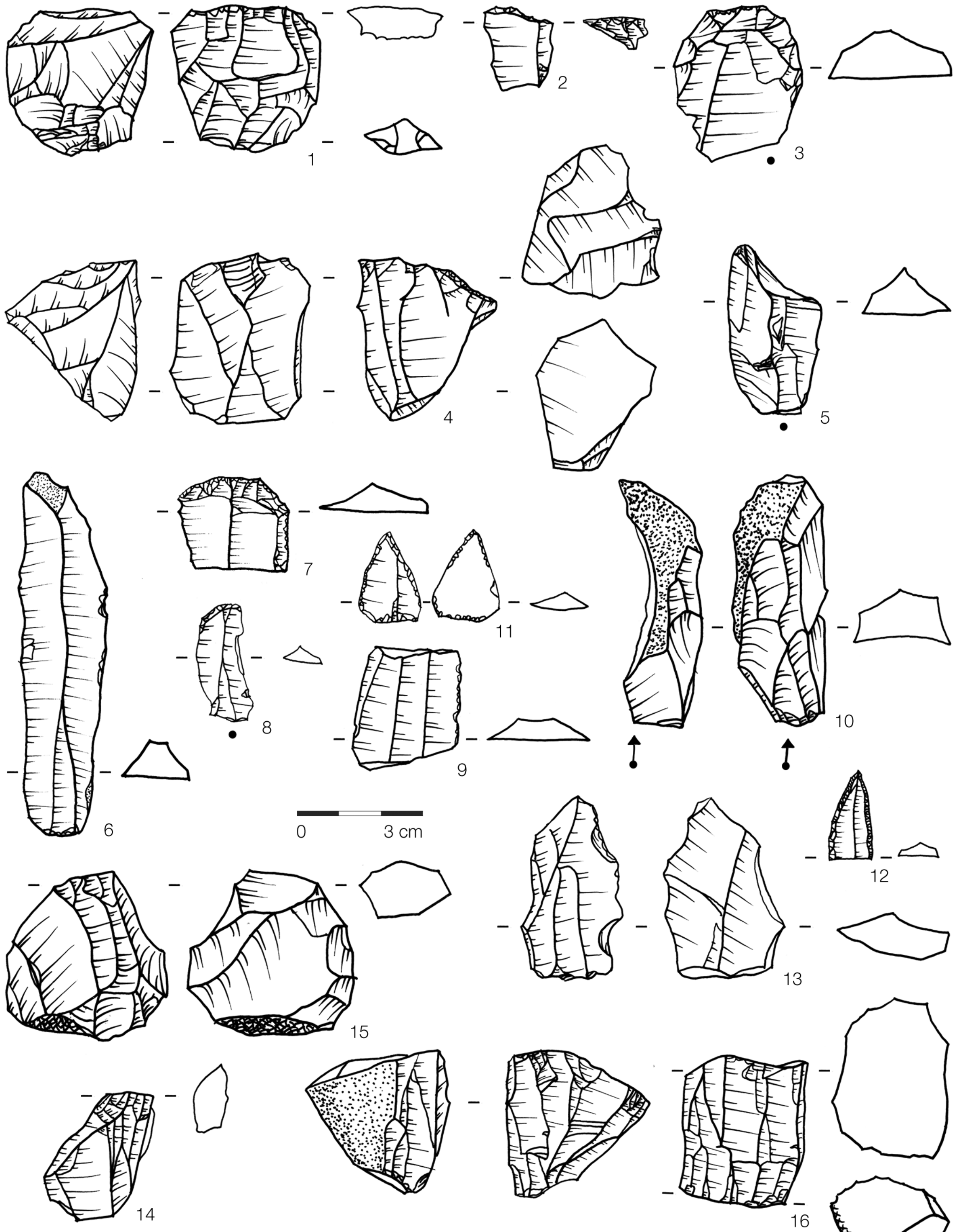

Fig. 4.5. Drawings of the lithics from the sites: Horní Sloupnice 5 (number 12), Choceň (numbers 6–8), Němčice 13 (number 13), Stradouň 1 (number 14–16), Tisová 2 (number 2), Tisová 17 (number 5), Vysoké Mýto 15 (number 1, 2), Vraclav 3 (9, 10), Zálší (number 11). Raw material erratic flint: 1, 4, 14–16 – cores; 6, 9 – blades. Tools: 11, 12 – points; 2, 3, 7, 8 – scrapers; 5 – burin (?). Drawing by K. Kapustka.

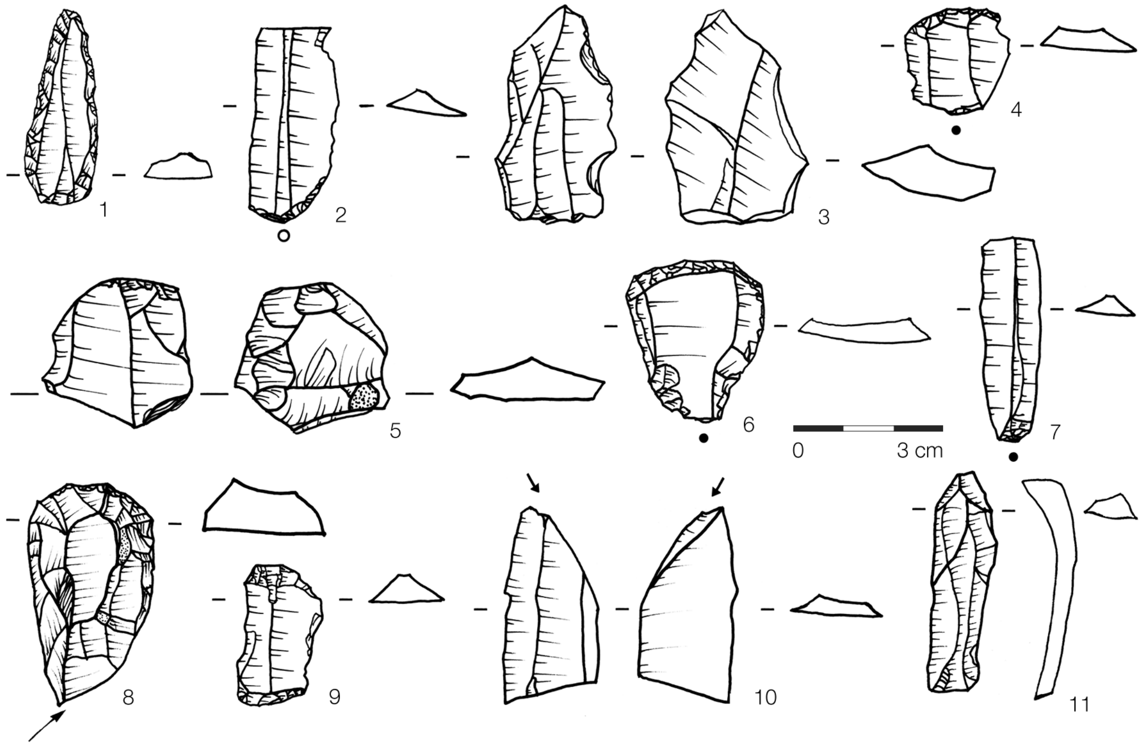

Fig. 4.6. Drawings of the lithics from the sites: Čistá 11 (number 12), Horní Sloupnice 36 (number 9), Koldín 5 (number 11), Kornice 1 (number 1), Lozice (number 6), Mravín 1 (number 2), Nedošín 7 (number 10), Sedlec 4 (number 8), Suchá Lhota 2 (number 7), Zářecká Lhota (number 3, 5). Raw material erratic flint: 8, 12 – blades. Tools: 2 – retouched blade; 11 – burin; 1, 3,5 – point; 6 – retouched flake; 4, 7, 9, 10 – scraper.
Drawing by K. Kapustka.

process. They could be characterised as bi-directional cores, which are typical for many different Upper Paleolithic complexes. Within the erratic flint cores, the composition is different and more variable; there are four one-platform cores, four two-platform cores, two cores with changed orientation, and three examples where we are not able to associate them with any core category. As the Olomučany chert cores are smaller and treated in a different way, it is possible that there are multiple temporal components represented in the assemblage. One possible explanation is that Olomučany chert was further exhausted than erratic flint because it had more value – this does not seem to be very probable, because the quality (if considering the characteristics for knapping) of erratic flint is better. Alternatively, these smaller cores could belong to a different period – potentially the Mesolithic – and are not associated with the Upper Paleolithic component. Upper Paleolithic collection in the Czech Republic tends to be produced from high quality raw materials, because blade production was a key point in lithic knapping during this period. All three raw materials which can be associated with Epigravettian part of collection are of quite high quality and were used in a large area and transported over long distances. However, even here are differences. In terms of knapping could be as a best of them described chert from Stránská skála, followed by erratic flint and as the last of them would be chert of Olomučany type.

For the blanks where it was possible to examine how they were produced, it seems that the process was standardized. Larger blades, burins, and scrapers were produced by direct organic percussion, and smaller bladelets through soft hammerstone, which corresponds well with typical

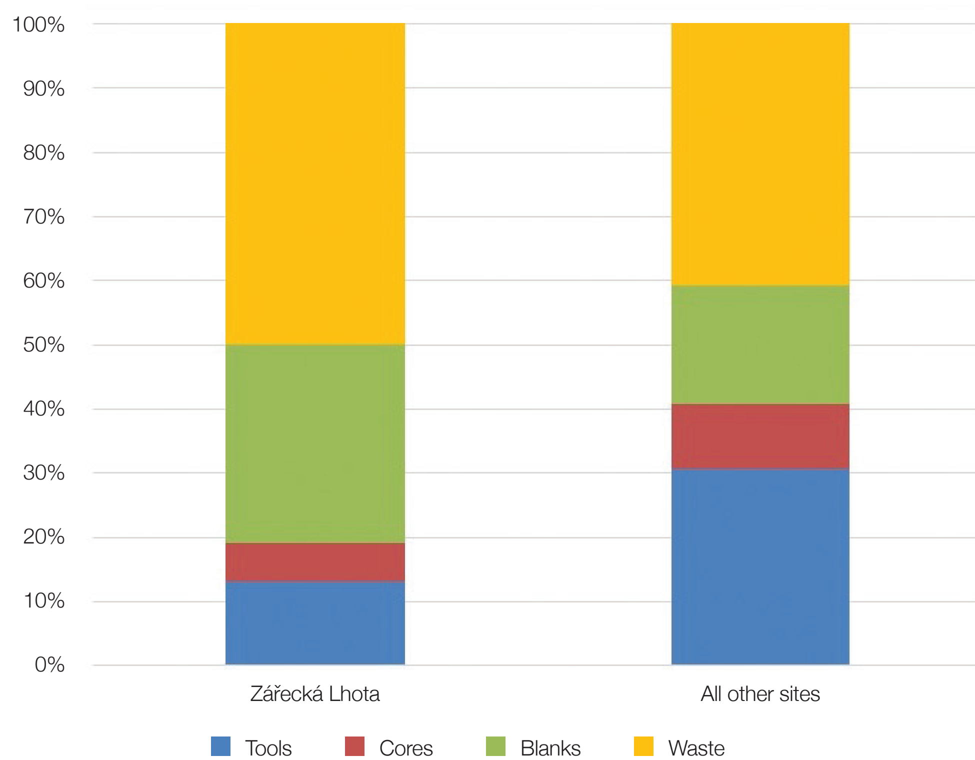

Fig. 4.7. Comparison of the production categories from the site of Zářecká Lhota and the sum of the production categories at all other sites. Author K. Kapustka.

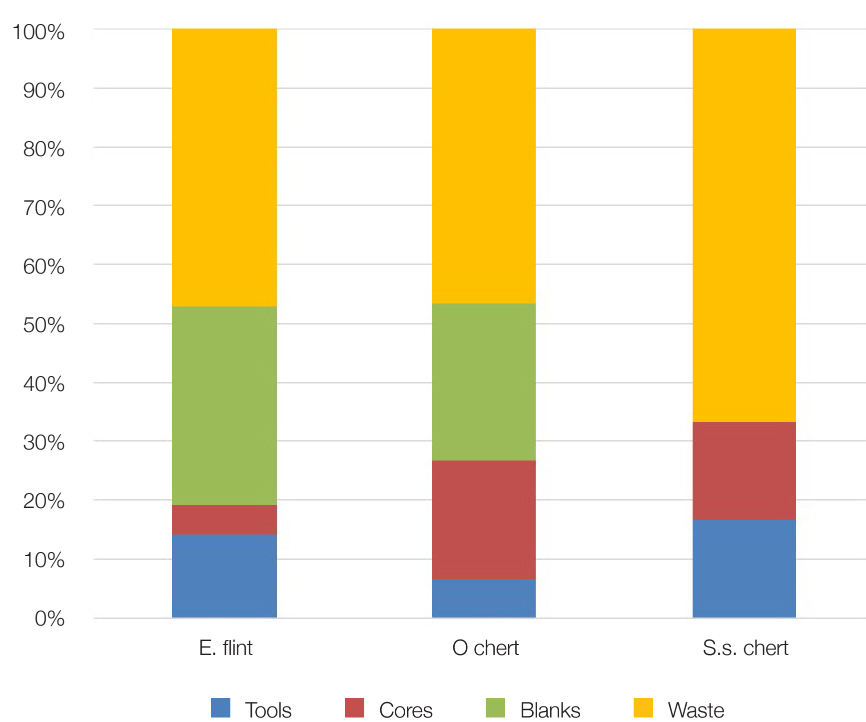

Fig. 4.8. Comparison of the production categories from different raw materials used at the site of Zářecká Lhota. Author K. Kapustka.

strategies associated with the Upper Paleolithic and specifically the Gravettian. Unfortunately, all hammerstones recovered at the site were made of quartz, and do not correspond with the identified production strategies. Organic percussion tools, of course, would be unlikely to have been preserved, and soft hammerstones are not typically identified (and collected during surface survey), in the region where is lack of the raw material for its production it is also possible, that they were taken with the knapper to another place, when the site was abandoned by the group.

Production waste forms 13% of the collected assemblage and includes pieces from a variety of categories which demonstrates that while it does not appear to have been a primary activity, some limited lithic production was actively performed at the site. The production waste was quite variable, and significantly was only associated with erratic flint in terms of material. Flakes associated with core maintenance and modification accounted for 34% of production waste. 19% of the production waste included flakes and flake fragments associated with other stages of production, and 17% were fragments of the early-stage reduction of raw material with significant representation of cortex. Lower representations include crested bladelets (8%), cortical pieces (8%), tablets and bladelets from the edge of the core (6%) and plunging blades (2%). We interpret this distribution as a clear indication that the production and modification of a blanks and blade production was occasionally practiced at this site.

Another indication that production activities were occasional and mostly limited to blank adjustment and blade production is the presence of cortex on pieces within the entire Upper Paleolithic assemblage. 16% of the artefacts had some representation of cortex, and most of these were those made of erratic flint. The exception to this was quartz hammerstones which also had significant representations of cortex. Within the erratic flint artefacts with cortex, 64% had a low percentage (>25%) of dorsal surface coverage, 25% had a medium percentage (25–50%) and only 11% had a high percentage (50–75%). This corresponds well with other characteristics of the assemblage, and likely demonstrates that material was brought to the site in a pre-prepared stage of reduction.

Sometimes flakes were used as blanks too (scrapers, retouched flakes), however lithic production was focused on blade production and blades are understood as blanks. Most of the blades are made of erratic flint, only one piece was knapped from Olomučany chert. The width of the blades varies considerably from 8 to 23 mm, the mean value is 13.95 mm. But this variability is normal even in other Upper Paleolithic collections (e.g. Řevnice; Šída 2010). One third of the blanks were whole unbroken blades. Two third of were parts of the blades. The most numerous of them were medial pieces (49%), which are most suitable for tool production. Then there were basal pieces 31%, which are often considered as waste since they were often removed before modification of the blank to the tool. Less numerous were the terminal parts which form 20% of blade fragments. Most of the blanks were produced by direct organic percussion, only a few very small pieces may be knapped by soft hammerstone. Cortex is in low percentages present in 12% of the pieces, so it seems that they were knapped from well prepared cores.

According to the use-wear traces on the blanks, some of the blades were used unmodified, but most of them were intended to be modified to the shape of a tool. The composition of tools at this site is: 26% scrapers, 17% burins, 6% points, 3% combined tool (burin/scraper), 20% retouched blades, 20% retouched flakes and 9% hammerstones. Raw materials for their production were 83% erratic flint. Hammerstones were made of quartz, one retouched blade was made of Olomučany chert, and one burin was made of Stránská skála chert, all other tools were made of erratic flint. The metrics of the blades was described, and it corresponds well with those tools for which blanks were used as blades. Except for retouched blades and hammerstones, only 40% (10 tools) of the remaining 25 tools were made on blades, the rest of the collection were made on flakes. Burins and point were made on a blade (probably the unfinished Gravette, Fig. 4.6: 3); the scrapers were made on flakes. One broken projectile (Fig. 4.6: 5) is not very promising in terms of chronology, because it is only partially preserved. The majority of the tools is not diagnostic from the chronological point of view, however it fits well with what is known about the metrics and shapes of Gravettian collections in Bohemia (Šída 2009; 2010) and Moravia as well (e.g. Oliva 2009b). This homogeneity allows us to claim that the collection from Zářecká Lhota belongs to the Epigravettian. This is supported also by the points, which are the only chronologically sensitive pieces in the collection.

As a part of the analysis, we also recorded post-depositional modification of the artefacts, including patination, aeolisation, and burning. Patination was perhaps the most important of these as very general chronological indication within the assemblage. Patination was observed mostly on the erratic flint artefacts, and some level could be observed on 68% of all such pieces; 50% of the Stránská skála chert artefacts had patination, and 20% of the Olomučany chert artefacts. Due to this high level of patination, burning was not particularly visible, and the 9% of pieces that we observed, would be best interpreted as an under-representation, however, there did not appear to be a systematic pattern in terms of artefact types represented, indicating that this is likely post-depositional. The lack of aeolisation (wind erosion) and variability in patination indicate mixed depositional contexts which have likely been disturbed many times over by tillage.

Analysis of materials and wider context of the Upper Paleolithic of Eastern Bohemia

All the materials addressed in this analysis are from surface contexts, and it must be assumed that post-depositional processes at most (if not all) sites were significantly affected by agricultural activities which would have disturbed sediment deposits – deep tillage was particularly devastating to archaeological contexts in the socialist era. As a result, it is beyond the reach of this analysis to reconstruct original organisation of depositional, because movement of the artefacts within soil can be considerable (e.g. Kuna 1994; Vencl 1995). During recent survey activities, finding well stratified contexts with better preservation has been a top priority, but we have not been successful as of yet, and this is primarily due to the geomorphological context of the wider region. This is a typical situation beyond the study region in the wider context of Eastern Bohemia and the Czech Cretaceous Basin (e.g. Vencl 1978), which may well have been important landscapes for Upper Paleolithic communities but lack conducive preservation conditions beyond the scatters we have addressed in this paper.

The wider geographical context of the raw materials represented in surface collections is one area where our study can make a significant contribution to understanding the Upper Paleolithic of this poorly studied region. It is helpful to adopt a comparative perspective. During late hunter-gatherer periods (Late Paleolithic and Mesolithic) usage of material types was much more variable, with demonstrated eastward linkages to source locations in Moravia and Slovakia (Čuláková 2015). By the Mesolithic period, localized raw material sources became most very important. However, during the Upper Paleolithic, there is a very different pattern that is highly dominated by erratic flint. We assume that the nearest sources of erratic flint that were used to supply the assemblages we studied are from post-glacial deposits that are approximately 80 km northeast of the study region at a minimum (Přichystal 2013).

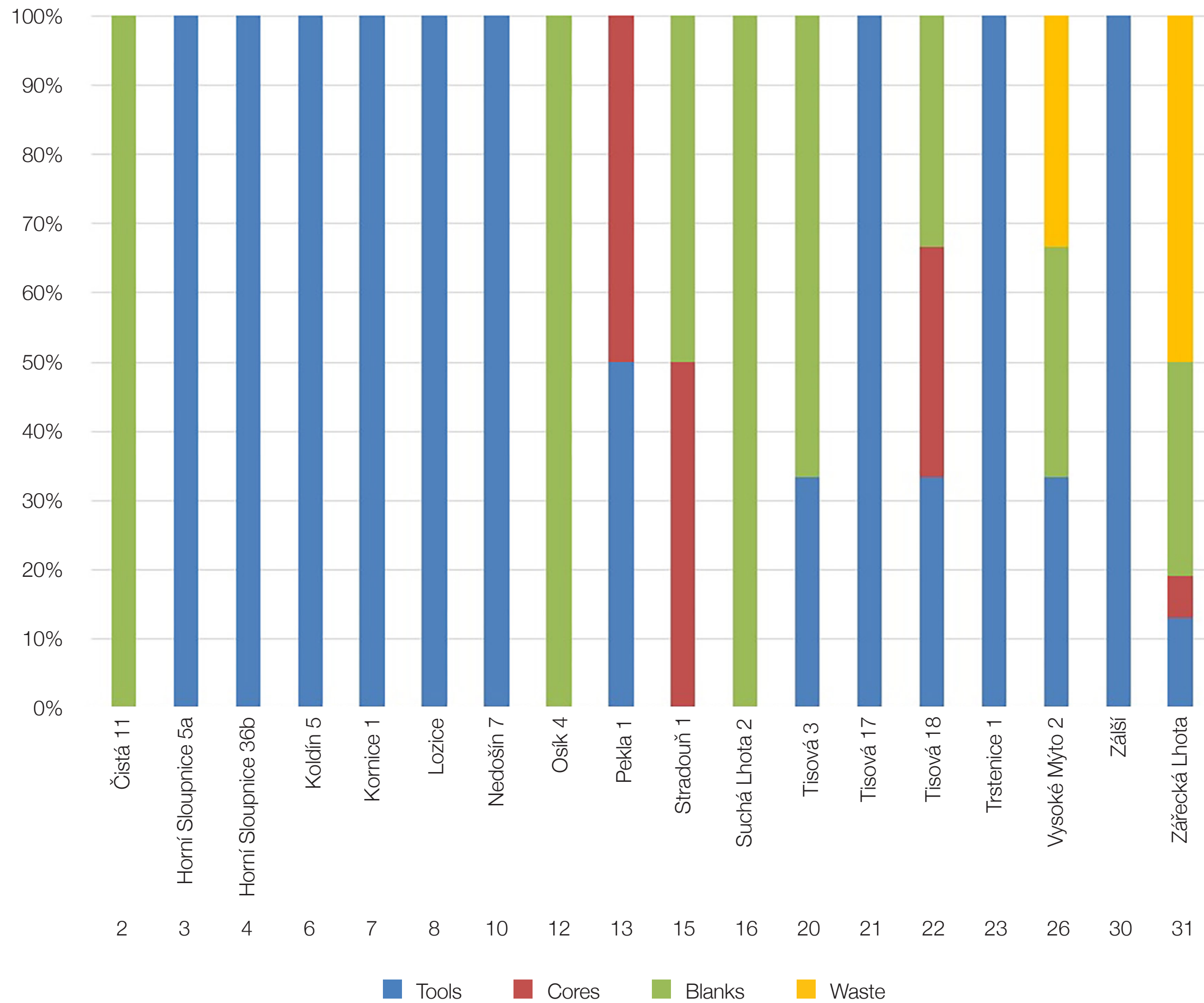

Fig. 4.9. Comparison of the production categories at sites which can be associated with Upper Paleolithic or (Epi)Gravettian. Author K. Kapustka.

A possible interpretation that could account for this pattern of non-local raw material is that the study area was predominantly secondary or seasonal in terms of how it was incorporated into Upper Paleolithic mobility and subsistence strategies. Indeed, short term occupations with little investment in locally available lithic material would account for the relatively small character of assemblages from this period, with the caveat that these must be understood as surface samples. The general observation does seem roughly in line with the character of assemblages from the wider Czech Cretaceous Basin; even the rare stratified contexts, such as Svobodné Dvory, appear to yield very small assemblages (Šída et al. 2006; Čechák 2019). It must be stressed, however, that we present this interpretation as a candidate explanation to be tested by further work. As it could be seen when looking at the composition of production categories, even the most numerous collection from Zářecká Lhota (Fig. 4.7, 4.8) is far from typical composition of a larger and representative collection. All the other presented collections are even further from what could be considered as normal composition of production categories (Fig. 4.9) and it is not comparable at all to what we would obtain as experimental collections. So further prospection within this region is necessary and the presented lithic collections should be considered as incomplete samples, but definitively document the presence of people during the Upper Paleolithic Period within this region.

Within region could be seen three chronological association of sites (Fig. 4.1), probably Gravettian sites – these are usually single finds from more numerous collections, where only tools and very selected finds were associated with the Upper Paleolithic Period. Thanks to the tools found at some of these sites we can claim presence of people during the Gravettian. This is the case of Horní Sloupnice 5 and 36 (point: Fig. 4.5: 12; scraper combined with burin: Fig. 4.6: 9), Kornice (Fig. 4.6: 1) and Zálší (Fig. 4.5: 11). Some sites could be associated with the Upper Paleolithic Period thanks to the shape and metrics of the blanks and cores. At the rest of the sites some pieces are present which evocate the possibility of Paleolithic occupation, but it is not very clear evidence for its certain presence. The samples through which the Upper Paleolithic of this region is being observed are subject to a variety of processes that could skew understandings of its importance within the environmental mobility of hunter-gatherer communities. Understanding seasonality and mobility will require further work, and we emphasize the importance of locating more stratified contexts.

Discussion

There are three points of discussion where the results of this analysis can have bearing on understanding the Upper Paleolithic in Eastern Bohemia:

1. The relevance of patination as a marker for chronological association within studied region
2. Raw material composition as an indication for chronological association
3. Composition of lithic artefact types as an indication of chronological association

Patination was discussed in this paper as a possible marker of the general age of assemblages that do not have stratified provenance. Patination is rightly a controversial measure that has varied perspectives on its value, and there are varied results of experiments with the patination of lithics (e.g. Balirán 2014, Borrazzo 2011). Its utility depends on many parameters that are regional and relative to the character of material or the specific research questions where it is deployed as having interpretive value. Interpretations that include patination have to be established with care and cannot be taken to give a direct age of a collection (Vencl 1996; Glauberman, Thorson 2012). In the specific context of Eastern Bohemia, we propose further discussion on the possibility of using patination to make very general differences between Mesolithic and Upper Paleolithic assemblages. Heavy patination in particular could be useful as a marker of Upper Paleolithic contexts as it appears to be rare in later periods, and on a regional scale this could be useful in comparing changing patterns in the distributions of sites.

Material choice and its relation to geographical position can be a potential marker of chronological position. Compared to the Late Paleolithic and Mesolithic, Upper Paleolithic collections, as we have discussed, tend to be dominated by erratic flint that has been transported (e.g. Šída et al. 2006; Čechák 2019). It is not until later periods that local sources of material, especially spongolite, come to dominate the composition of assemblages (Přichystal 2013; Čuláková 2015). Because many collections are surface scatters, they potentially include both Mesolithic and Paleolithic artefacts, and this distinction in patterns of material use maybe a useful line of consideration in assessing chronological representations of assemblages.

Most of the lithics from the sites discussed in this paper can be associated with the wide interval of the Upper Paleolithic, but more precise chronological associations are not possible. Some sites with retouched tools probably could be associated with the Epigravettian/Gravettian (?) (see Fig. 4.1; Tab. 4.1). The exception is Zářecká Lhota, due mostly to the size of the collection which makes it possible to discuss its chronology in more detailed way. Although the site was initially interpreted as reflecting a Magdalenian chronology (Čechák 2019), we interpret our analysis as indicating it has closer association with the Epigravettian based on the characteristic production processes, morphology of cores, and types of artefacts in this collection. The Epigravettian represents a long period and really variable cultural complex. According to our knowledge of its chronology in Central Europe (Svoboda, Novák 2004) and surrounding areas (Šída et al. 2021), the collection of Zářecká Lhota could be associated with Eppigravetian, according to lithic characteristics (short scrapers on flakes, core shapes). Single finds of diagnostic pieces might be Epigravettian too, but for these sites (Kornice, Horní Sloupnice, Zálší) we cannot exclude also association with older phases of Gravettian. There was a lack of diagnostic artefacts within the collection, but according to the identified production processes, morphology, and comparison with other collections we see this site as likely representing a Gravettian campsite (see: Šída et al. 2006; Šída 2009).

Conclusion

In terms of the Upper Paleolithic Period in Eastern Bohemia, a better understanding of hunter-gatherer lifeways requires interpretations built from a very small and scattered archaeological context. To make steps towards addressing this challenge, we have presented an overview and analysis of collections in the surroundings of the Rivers Loučná and Tichá Orlice. The most important collection we have examined is Zářecká Lhota which offers a rare glimpse into the Epigravettian. In our analysis and discussion, we raise discussion possibilities to build better chronological interpretations, built from multiple lines of evidence. Our analysis raises the likelihood that there are significant differences in how Upper Paleolithic and Mesolithic hunter-gatherers used the same landscape, as marked by preferences in raw material choice and transportation. There is hope to address the challenge set by Čechák (2019) by placing much needed attention on this area. However, full understandings of seasonality and settlement/mobility patterns require more work and would be bolstered by more structured survey and the identification of stratified contexts from the Upper Paleolithic.

05

Using charcoals to establish chronological inter-site relations in the Upper Paleolithic – the Gösing-Setzergraben data

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Introduction

The Austrian Middle Danube region with its numerous open-air sites ranges among the significant find zones of the Upper Paleolithic in Central Europe. In the course of construction works southwest of the municipality of Gösing am Wagram in 2014, the Quaternary Archaeology research group of the Austrian Archaeological Institute (Austrian Academy of Sciences) documented a pronounced Mid-Upper Paleolithic occupation horizon atop a sequence of at least three further archaeological layers, adding yet another site to this prominent archaeological landscape.

The new site named Gösing-Setzergraben is located at the southeastern extension of the Bohemian Massif about 8 km north of the present-day course of the Danube (Fig. 1.1: 4A; 5.1). The crystalline formations at Gösing am Wagram are partially covered by Early Neogene marine deposits of the Paratethys in the form of sands and clays (Steininger, Roetzel 1999), as well as Upper Miocene gravels and sands of the Hollabrunn-Mistelbach Formation (Nehyba, Roetzel 2004). The youngest deposits are composed of in parts several-metre-thick Quaternary loess sediments, which overlay the older formations over a large area that is today used extensively for viticulture. To the southeast, the terrain at Gösing am Wagram slopes continuously towards the alluvial plain of the Danube, the so-called Tullnerfeld. The modern surface is characterised by erosional gullies, some of which are several metres deep.

The first potential Upper Paleolithic finds in the form of Late Pleistocene faunal remains and charcoals were reported as early as the 19th century (Much 1871; Hörnes 1887). In addition to lithic surface finds (Bayer 1925–1931; Wallner 1930–1934; Wallner 1935–1938), stone artefacts of an

doi 10.47382/dvs_26-05

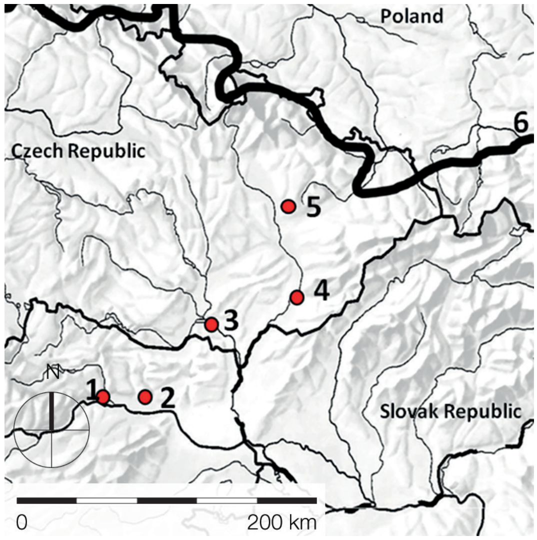

Fig. 5.1. Location of Gösing-Setzergraben and contemporaneous sites in the wider region.
1 – Krems-Wachtberg;
2– Gösing-Setzergraben;
3 – Dolní Věstonice and Pavlov;
4 – Jarošov and Boršice;
5 – Předmostí;
6 – maximum extent of Pleistocene glaciation.
Source: Österreichisches Archäologisches Institut / Österreichische Akademie der Wissenschaften.

Upper Paleolithic character, as well as find layers featuring charcoals and evident structures such as hearths, were primarily discovered during the construction and expansion of wine cellars (e.g. Wallner 1930–1934; Wallner 1959; Hölzl 1974). Due to the generally limited documentation data and lack of systematic examinations, a more precise chrono-cultural classification of these finds remains questionable. A first, more definite chronological context for the find zones around Gösing am Wagram was recorded in the course of surveys carried out by the Austrian Academy of Sciences in 1999–2000: a charcoal sample recovered from a cellar was dated to 27,370 +/- 230 BP (Neugebauer-Maresch 2010).

State of research

The site Gösing-Setzergraben

In August 2014, the site Gösing-Setzergraben was discovered during construction works. Several archaeological layers were hit in the course of the construction of a sewage pit. The greater part of the archaeological layers in the construction pit, which was about 2 m deep and 3 × 3 m wide, had already been removed before the mechanical excavation could be stopped. On-site investigations were therefore primarily limited to the documentation of the profiles. Only a small area in the northeast of the construction pit had remained untouched and was therefore systematically excavated and documented three-dimensionally.

A total of four distinct cultural layers (AH 1–4) were identified (Fig. 5.2). The find layers are embedded in a sequence of loess sediments and exhibit cryoturbation features such as patches of sediment displaced by solifluction and frost wedges, suggesting a significant impact from periglacial processes (Einwögerer 2016). The uppermost cultural layer AH 1 is the most distinct, showing the greatest anthropogenic impact. This several-centimetre-thick layer, dipping slightly from west-northwest to east-southeast, is characterised by substantial evidence of burning, such as charcoal and ashy inclusions, as well as patches of reddish-brown burnt sediment. In the northeastern corner of the construction pit, layer AH 1 includes the remains of an *in situ* preserved combustion feature (hearth 1). In contrast to AH 1, layers AH 2–4 are considerably less pronounced. Apart from a few small bone fragments and charcoal flecks, no other finds were recorded in the profiles and in the small systematically excavated corner. However, this does not exclude that one or more of these layers may have been

Fig. 5.2. Gösing-Setzergraben, northern profile. Photo by Österreichisches Archäologisches Institut / Österreichische Akademie der Wissenschaften.

more pronounced in the central area removed by the mechanical excavator. AH 2–4 show strongly deformed boundaries and wavy morphologies and are characterised by redox processes, probably caused by solifluction and possibly waterlogging. Like AH 1, layers AH 2–4 dip from west-northwest to east-southeast; however, they display a greater slope gradient.

The *in situ* preserved hearth 1, a feature in the sense of a *structure* évidente (Leroi-Gourhan, Brézillon 1972) is stratigraphically connected to AH 1. Hearth 1 is constructed in a shallow several-centimetre--deep pit dug into the loess sediment, and shows a multi-phased sequence consisting of layers of burnt sediment and at least one layer of horizontally arranged stone slabs, suggesting an intermediate re-arrangement and differential utilization. In its central area, the feature is more than 20 cm thick. The hearth's fill layers contain a high number of well-preserved large charcoals, fragments of burnt bones and lithics. The documented segment of the hearth represents only a small section of a larger combustion feature still preserved in the northeastern corner of the construction pit. The exact dimensions of the hearth therefore remain unclear. Based on the profiles, however, it can be estimated that the fireplace has a total diameter of more than one metre. Patches of burnt sediment in the northern and southern profiles suggest the presence of a potential second hearth in the immediate vicinity, and in the same stratigraphic context (AH 1). Due to the poor excavation context, it can also not be ruled out that additional structures, connected to either AH 1 or to one of the other archaeological layers, were destroyed and dug out in the central area of the construction pit.

Archaeological material

The vast majority of the find material was obtained by water screening the mechanically excavated sediments. Only a small part of the inventory was recovered during systematic excavation using single-find measuring. The assemblage includes more than 170 burnt stone slab fragments as well

Tab. 5.1. Overview of the technological composition of the lithic inventory of Gösing-Setzergraben.

	n	%		n	%
Blade/Bladelet	719	19.9	**Burin spall**	11	0.3
Flake	1,306	36.2	**Debris**	59	1.6
Preparation debitage	73	2.1	**Thermal debris**	1,434	39.7
Core	10	0.3	**Total**	3,612	100

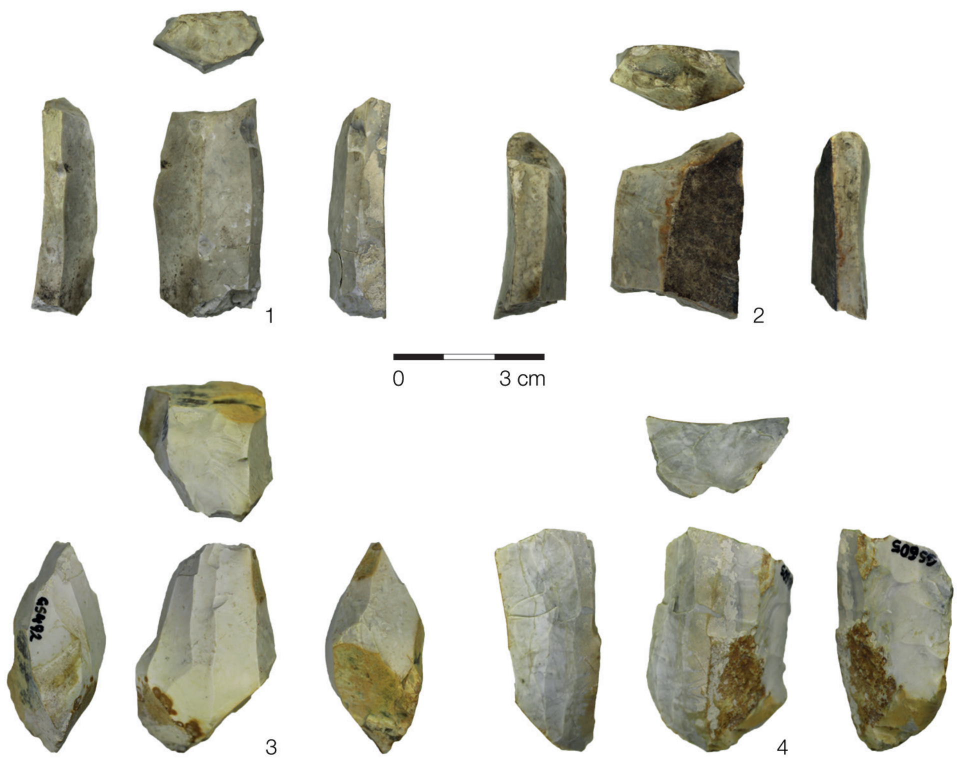

Fig. 5.3. Gösing-Setzergraben, cores. 1, 2 – Cores-on-flakes; primary 3, 4 – cores on raw volumes. Photo by Österreichisches Archäologisches Institut / Österreichische Akademie der Wissenschaften.

Tab. 5.2. Typological composition of the Gösing-Setzergraben assemblage.

	n	%		n	%
Truncation	6	8	**Notched piece**	1	1.3
Burin	3	4	**Microdenticulate**	12	16
Microgravette	2	2.7	**Borer**	1	1.3
Backed bladelet	18	24	**Microburin**	2	2.7
Retouched piece	30	40	**Total**	75	100

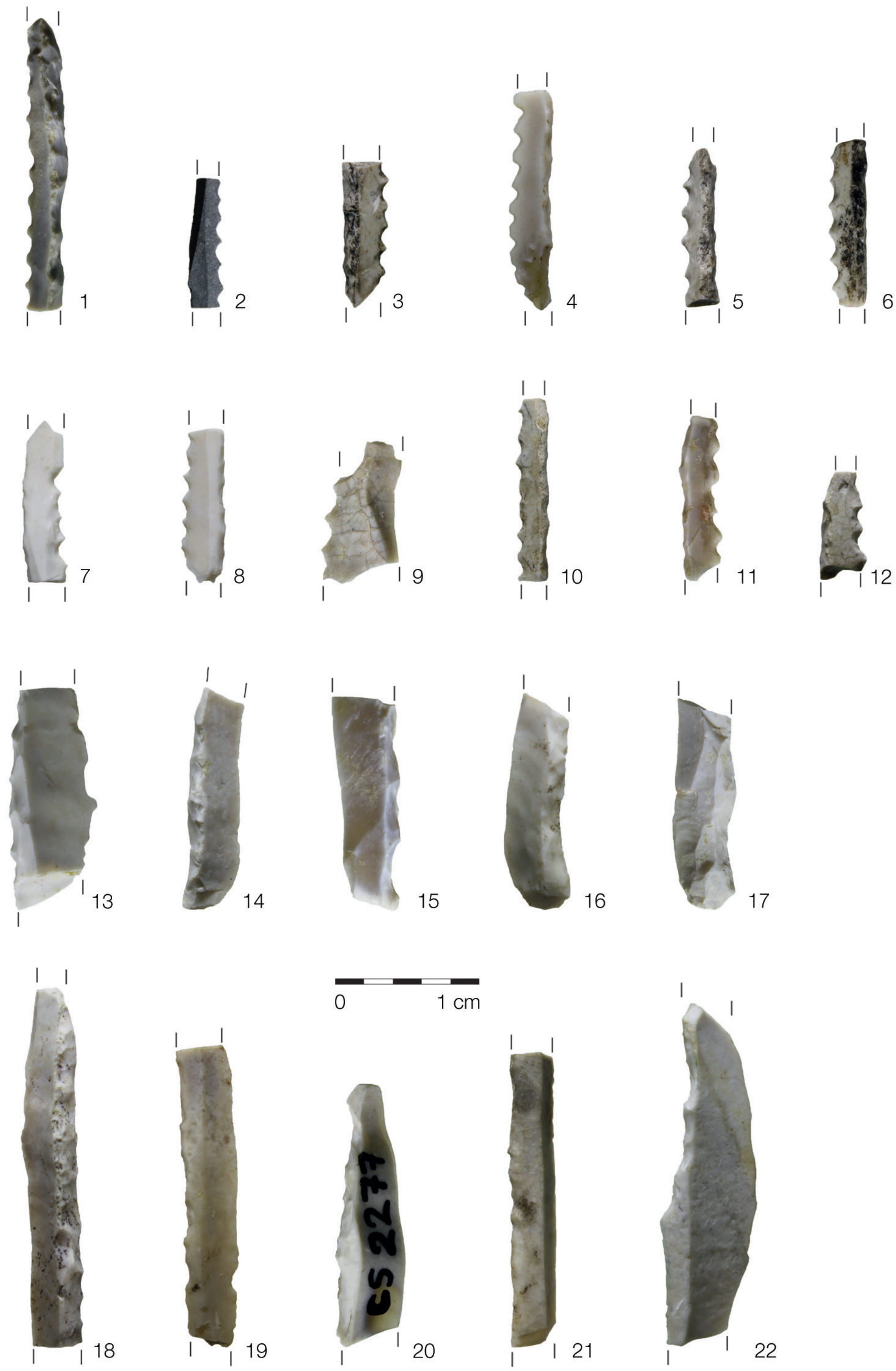

Fig. 5.4. Gösing-Setzergraben, lithic tools. 1–12 – Microdenticulates; 13–22 – backed bladelets. Photo by Österreichisches Archäologisches Institut / Österreichische Akademie der Wissenschaften.

as several quartz pebbles showing traces of heat exposure. In addition, colour materials such as red ochre, as well as four amorphous pellets of burnt sediment are present; however, without clear traces of shaping or fingerprints. Personal adornments are documented in the form of three Tertiary *serpulidae*. Large quantities of well-preserved charcoal include 37 individually recorded pieces and an assemblage of almost 0.5 kg retrieved by water screening.

Faunal remains are relatively sparse: In total, 91 bone fragments were recovered and analysed. The faunal spectrum includes species characteristic for a cold stage such as mammoth, reindeer, horse, bison, tundra hare, as well as carnivores such as wolverine, polar fox, and steppe polecat.

Most numerous among the categories of recovered find is the chipped stone assemblage which consists of 3,612 pieces. This number includes all finds ≥ 10 mm in size as well as smaller modified tools. The technological and typological analyses of the chipped lithic artefacts followed the data recording system developed by Auffermann et al. (1990), partially adapted to Mid-Upper Paleolithic assemblages. The inventory (Tab. 5.1) contains a low portion of nuclei, comprising primary cores and cores-on-flakes (Fig. 5.3). Based on a unipolar exploitation concept, primary core reduction aimed at the production of blades and bladelets on prepared raw volumes, and predominantly features single striking and reduction surfaces. A second reduction concept is documented by thick blanks that were laterally exploited as cores-on flakes to produce narrow blades and bladelets (Buchinger 2020). The combination of various concepts for blade production by primary cores on raw volumes and cores-on-flakes was also demonstrated for other Mid-Upper Paleolithic inventories in the region such as at Dolní Věstonice II (Novák 2016) and Milovice IV (Svoboda et al. 2011). The on-site reduction process is further illustrated by the presence of preparation debitage in the form of core tablets, crested blanks, and preparation flakes. The largest percentage of the inventory is composed of thermal debris, indicating a close spatial connection with one or more combustion features.

Among the modified tools (Tab. 5.2), laterally retouched pieces form the largest group. In addition, the inventory features a high proportion of backed implements in the form of backed bladelets and microdenticulates (Fig. 5.4; Buchinger 2020). While the standardised production of segments used as armatures can be distinctly attested, domestic tools occur to a significantly lesser extent. The tool distribution generally points to a homogeneous production concept specialised on few tool types. Whether this distribution can be attributed to a spatially delimited activity zone within an occupation floor or to a limited range of activities executed at the overall site cannot be determined at present given the excavation context of the material. In general, however, the assemblage appears consistent and gives the impression of technological homogeneity.

While backed bladelets and microgravettes can be considered typical Gravettian elements, microdenticulates allow for a more specific chrono-cultural assignment. As *fossiles directeurs* of the Pavlovian, the regional expression of the earlier Gravettian with its core zone in present-day Moravia, these armatures are characteristic elements of the lithic tool kits documented at inventories from Pavlov (Klíma 1959; Svoboda 1996; Verpoorte 2005), Dolní Věstonice (Klíma 1995; Novák 2016 Polanská 2016), Předmostí (Absolon, Klíma 1977), Jarošov-Podvršťa and Boršice (Škrdla 2005). In the Austrian Danube valley, this type was hitherto identified only at the site cluster Krems-Wachtberg (Einwögerer 2000; Thomas et al. 2016). Based on the typological analysis, Gösing-Setzergraben can thus be firmly assigned to the earlier Gravettian, and mapped as an additional Pavlovian site along the Danube.

Stereomicroscopic raw material analysis shows a clear predominance of imported raw materials in the form of erratic flint. With source areas more than 200 km away as the crow flies, this illustrates a supra-regional procurement strategy with high quality raw material. By contrast, local raw material from the adjacent catchment area occurs only in low numbers. About 40% of the artefacts are classified as cherts of undetermined provenance. While this group is presumably mostly composed of erratic flint from glacial deposits, the high degree of patina and heat exposure prevents a definite identification. For 12% of the most heavily burnt pieces, no information at all can be given on the material.

The pattern of a primarily import-based raw material economy in the earlier Gravettian represents a hitherto unprecedented novelty for the Austrian Middle Danube region. It stands in stark contrast to contemporaneous assemblages from this area, most notably from the nearby site cluster Krems-Wachtberg, where local material acquisition prevails (Einwögerer 2000; Thomas et al. 2016; Thomas 2023). The proportion of local raw materials also outweighs that of imported ones in the inventories from Aggsbach (Felgenhauer 1951) and Willendorf II AH 5, AH 6 and AH 8 (Moreau et al. 2016; Schmid et al. 2019). The extensive use of local raw materials in the earlier Gravettian can also be documented east of the Pavlovian core zone, in Slovakia (Kaminská 2016).

The assemblage Gösing-Setzergraben corresponds to the general provisioning pattern observed at Pavlovian sites, which is based on the long-distance transport of lithic raw materials (Svoboda 1996; 2004; 2007). It demonstrates that sites along the Danube were also connected to the Pavlovian raw material procurement network while at the same time showing that divergent supply strategies prevailed as a result of differences in economic organisation: the high proportion of erratic flint in Gösing-Setzergraben may reflect the site's function as a 'provisioning place' meaning that substantial quantities of raw materials have been amassed to serve foreseeable activities of the entire group, whereby the low proportion of imported lithics in the Krems-Wachtberg inventories can be explained to represent the toolkits of individuals (Kuhn 1992; 2004).

Chronological placement

The archaeological layers at Gösing-Setzergraben are embedded in a Loess-palaeosol-sequence showing baseline aeolian loess sedimentation interrupted by the formation of incipient gleyic soils and overprinted by periglacial processes. Two individually recorded charcoal samples from hearth 1 in AH 1 were radiocarbon-dated and provided ages of 26.8–26.5 ka BP (Tab. 5.3; Einwögerer 2016a). This confirms our observations on the stratigraphy and archaeological assessment, and corresponds to the ages obtained for the Pavlovian occupation layer AH 4.4 at Krems-Wachtberg 2005–2015 (Einwögerer et al. 2009; Händel 2017).

Tab. 5.3. Radiocarbon ages obtained for Gösing-Setzergraben. Ages calibrated with the Ox Cal online tool (version 4.4, accessed 13.03.2023) applying the IntCal20 calibration curve (Reimer et al. 2020).

La. No.	Field ID	AH	material	14C age BP	±	cal BP 1-sigma	cal BP 2-sigma
MAMS-22745	ID 237	1	charcoal	26,550	80	31,003 – 30,815	31,083 – 30,443
MAMS-22746	ID 186	1	charcoal	26,790	90	31,108 – 30,986	31,152 – 30,899

The charcoals – materials and methods

Since most of the excavated sediments had been removed by a mechanic excavator, the vast majority of the archaeological material was obtained by water screening. This also applies to the charcoals. This is why the charcoals were neither stratified nor related to an excavation level. However, the profiles (Fig. 5.2) and observations made and single find recording data produced for the small part of the excavation area investigated systematically, suggest that a greater part of the charcoals derive from AH 1. Charcoal, however, also occurs in the other three find layers, AH 2–4. It can therefore not be excluded that individual or clustered charcoals that were recovered and analysed derive from archaeological contexts other than AH 1.

For this study, we examined all the recovered charcoals. 37 specimens have been recorded individually during systematic excavation. Mainly, these derive from AH 1; only seven pieces were recorded in AH 2, and one in AH 3. Almost 0.5 kg was retrieved by water screening. The mesh size of the sieves used for water screening was 1.2 mm; the recovered fragments range from ca 1.2–20 mm in size. In the first step, pieces too small for further preparation were omitted. This removed the greater part of the charcoal fragments from further analyses. The remaining samples were inspected under a stereomicroscope, and pieces with a sufficient number of tree rings were selected for further processing.

The ring widths were eventually measured for the largest 33 pieces. To obtain the measurements, the pieces were cut in order to produce plain square sections rectangular to the stem axis of the former tree. This side was glued to an aluminium stub and connected by application of an electro-conductive varnish. Then, another square surface was produced by cutting and polishing. This surface was coated with a fine layer of gold. The samples were investigated with the help of a scanning electron microscope in order to be able to assess the extremely narrow rings.

For each sample, sets of overlapping microphotographs were taken along two radii. As many rings are rather fine and even ground surfaces are never completely plain, i.e. coplanar with the mounting stub, we used an electron microscope (JEOL JSM-6400) to combine high magnification with sufficient depth of focus to produce sharp photographs. After positioning the single photos in correct overlapping positions, the ring widths were measured with the help of the program OSM4 (On-Screen Measurement, developed by B. Knibbe; cf. Cichocki et al. 2014), which after calibration allows the measurement of the distances between graphic markers manually set on ring borders to an accuracy of 0.01 mm. Two sets of data were thus acquired per sample and compared to detect any potentially missing rings or measurement errors. After calculating the mean values, the data were ready for synchronization.

The first SYNCH operation was accomplished to compare the ring patterns of all samples of the site with a minimum number of 50 rings. This minimum is necessary as all synchronization operations are statistical calculations and thus require a representative sample size. With the help of the program PAST5 (Personal Analysis System for Tree-ring research, developed by B. Knibbe; cf. Cichocki et al. 2014) all the sets of data were synchronized which provided an overlap of a minimum of 30 rings. In a second operation, overlaps down to 25 rings were included, if they had a convincing similarity to the already synchronized samples.

In a final step, the obtained ring patterns were compared to the dataset obtained for the charcoals of the nearby Pavlovian site Krems-Wachtberg 2005–2015 (Cichocki et al. 2014) which shows clear parallels to Gösing-Setzergraben in terms of typo-technological characteristics, stratigraphy and chronological placement (Buchinger 2020; Einwögerer 2016a; 2016b).

Results

All the determinable charcoal samples recovered from Gösing-Setzergraben belong to the genus *Pinus*. The two species *Pinus sylvestris* and *Pinus mugo* (Fig. 5.5: 1) are not distinguishable by anatomic features (Schweingruber 1990), but *Pinus cembra* has specific ray features, which are, however, rarely preserved in charcoal and difficult to distinguish under the electron microscope. For Gösing-Setzergraben, the presence of *P. cembra* can be tentatively confirmed by thin-walled latewood tracheids (Fig. 5.5: 1). Species determination is also difficult due to the very narrow ring widths. Fig. 5.5: 3, for instance, shows narrow 'light rings' lacking thickened late wood cell walls as result of very low temperature during the growth season (Gindl 1999). Some rings show traumatic resin ducts most probably caused by very harsh climate conditions (Fig. 5.5: 4). From an ecological perspective, it should be considered that all three species of *Pinus* display similar resistance against drought and frost, and have similar frugal nutrition demands.

Synchronization operations produced four separate sequences, or synch patterns (Tab. 5.4). SYNCH 1 and 4 are based on the mean values of eight resp. twelve samples, and represent floating sequences of 117 resp. 177 rings. Twelve samples matched neither each other nor the two synch clusters, SYNCH 1 and 4. SYNCH 2 and 3 represent values of single samples. Both visual inspection and statistical values for SYNCH 1 and 2 are very convincing; for SYNCH 3 and 4 the match is not as perfect, but on a visual basis probably correct As no waney edges (= last rings grown before death of the tree) are present, all end-years are "data post quem".

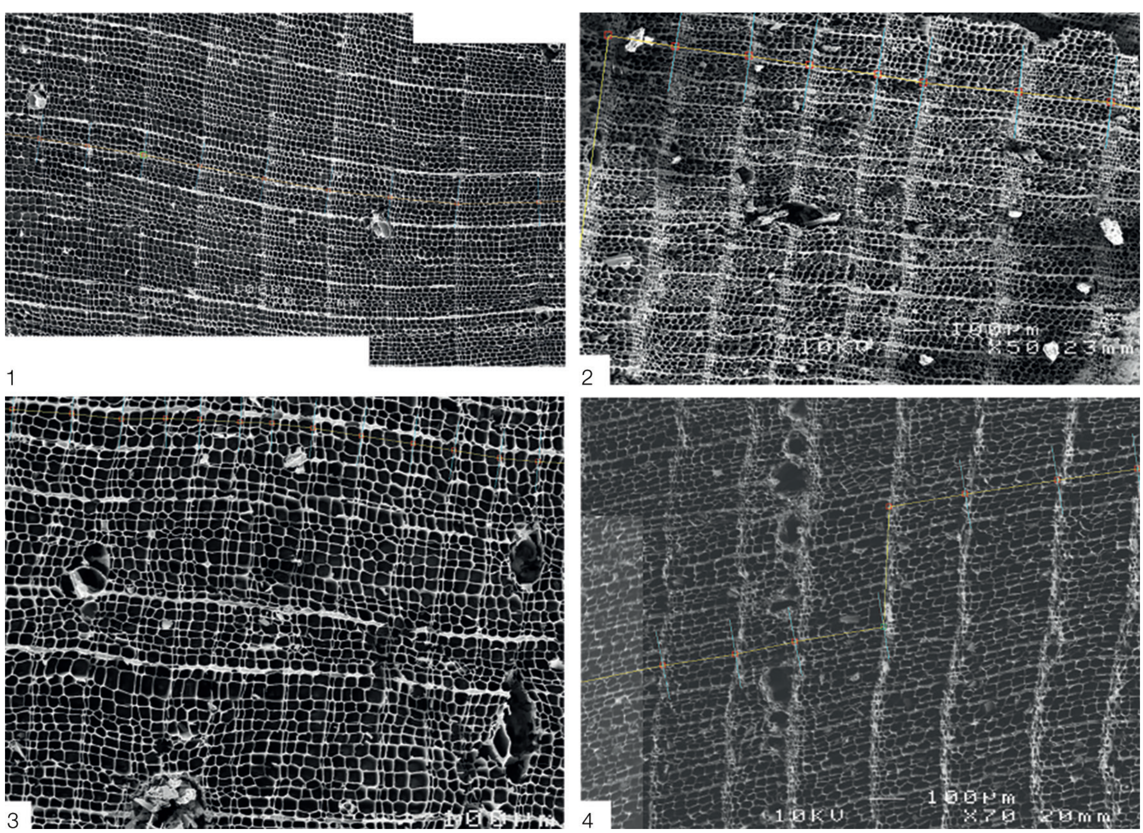

Fig. 5.5. Ring-width measurements of Gösing-Setzergraben (GS) samples performed with the program OSM4: 1 – Sample GS 165_30, *Pinus* cf. *sylvestris* or *mugho*; 2 – sample GS 165_12, cross section of *Pinus* cf. *cembra*; 3 – sample GS 165_14, very narrow 'light' rings; 4 – sample GS 165_1, tangential row of traumatic resin ducts. Photo by O. Cichocki.

Tab. 5.4. Statistical values of synchronization between samples and mean values of Gösing-Setzergraben and the floating mean data of Krems-Wachtberg (rel. end-year = temporal position in relation to the reference; TBP = t-test acc. Bailey-Pilcher; THO = t-test acc. Hollstein; CC = correlation coefficient; GL% = gleichläufigkeit in %; GL PTR% = gleichläufigkeit of pointer years in %; OLP = overlapping number of rings).

	rel. end-year	TBP	THO	CC	GL %	GL PTR %	OLP
SYNCH 1	116	4.66	5.99	0.30	62.80	73.20	117
SYNCH 2	268	9.56	10.20	0.77	84.80	96.80	56
SYNCH 3	423	3.24	3.76	0.39	70.60	72.30	80
SYNCH 4	659	3.46	3.88	0.06	63.60	63.30	177

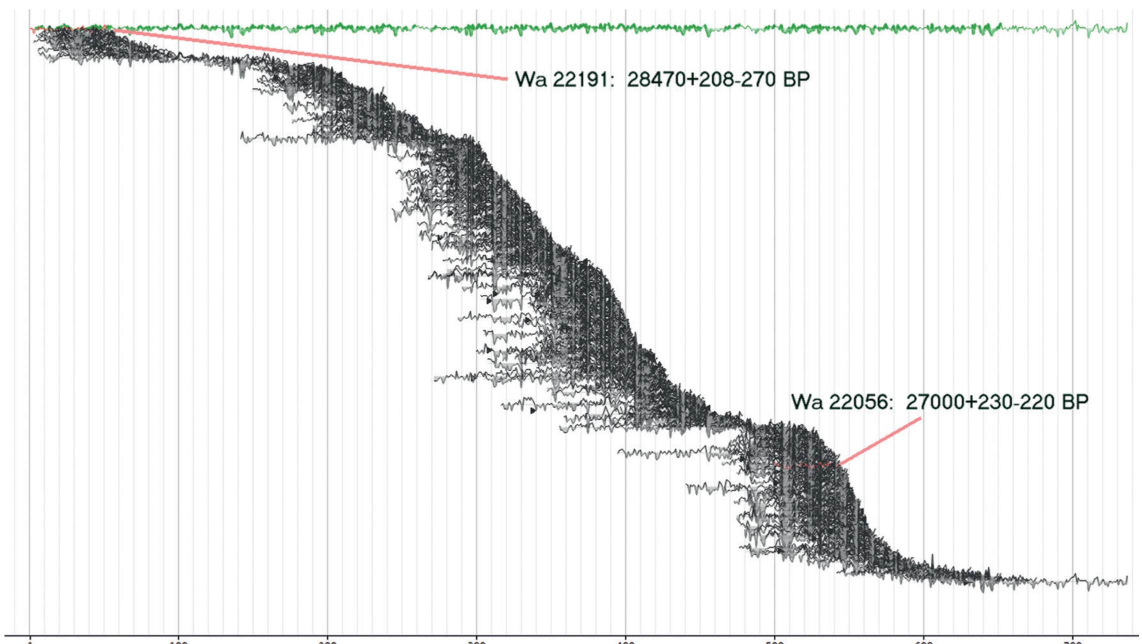

Fig. 5.6. Radiocarbon-dated floating sequence SYNCH2 of charcoal samples of *Pinus* sp. from Krems-Wachtberg. Author O. Cichocki.

Dendrochronological dating requires a standard. Usually, this is an absolutely dated set of ring widths produced as calculated mean of a large number of samples overlapping in time. As such a standard does not exist for the Upper Paleolithic timeframe, we used a floating sequence derived from charcoal samples recovered at the excavation of Krems-Wachtberg (Cichocki et al. 2014), for both comparison and relative synchronization. The new, hitherto unpublished composite Krems-Wachtberg floating sequence contains 737 rings as a mean of 645 samples and is absolutely dated by 14C to between 28,470 +280/-270 and 27,000 +230/-220 years BP (Fig. 5.6). The sequence was produced by the same method as the data from Gösing-Setzergraben and informs us about the relative temporal position of all 645 samples included in its calculated mean. Grey areas in the sequences mark pointer years showing a dramatic environmental impact on most of the samples included for the according sequence.

With the help of the floating Krems-Wachtberg sequence, it was possible to synchronize the shorter floating sequences and single measurements from Gösing-Setzergraben (Fig. 5.7). This strongly suggests contemporaneous occupation of the two sites.

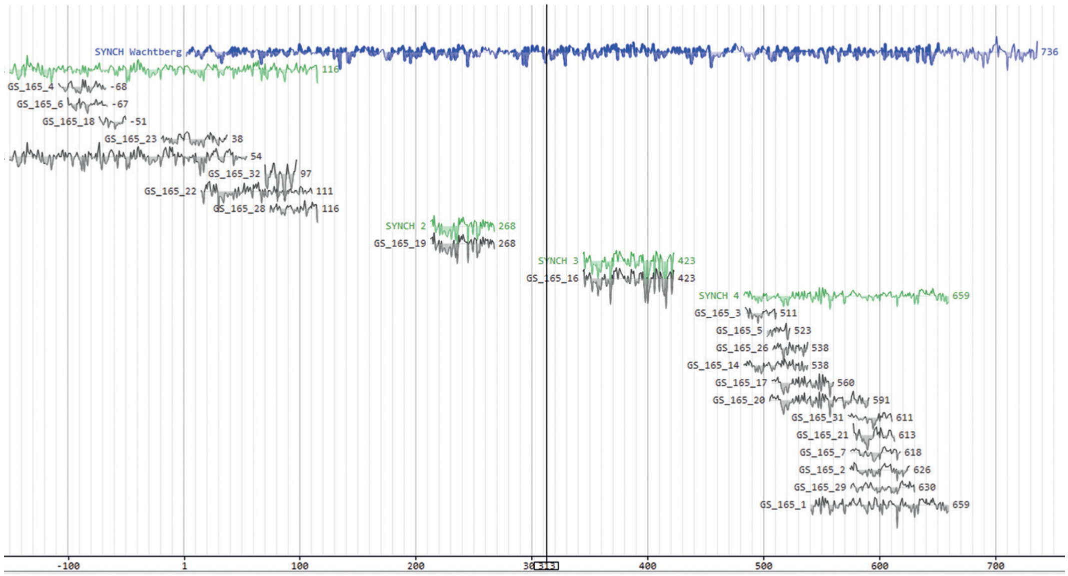

Fig. 5.7. Relative positions of the Gösing-Setzergraben floating sequences to the mean of floating sequence SYNCH2 of Krems-Wachtberg. Author O. Cichocki.

Discussion

The uneven representation of samples along the floating timeline produced from the Krems-Wachtberg charcoals (Fig. 5.6) presumably reflects the three Early Gravettian occupation phases (Fig. 5.8) established for the Krems-Wachtberg and Krems-Hundssteig sites located on the Wachtberg hill (Händel 2017). From a dendrochronological perspective, the end-years of these three phases would be located on a time line at ca 110+ and 480+ years, where the data density is lowest, and at 660 years, when not considering the one charcoal specimen extending the chronology to 737 years, the stratigraphic context of which is insecure. At Krems-Wachtberg, the point at 110+ years could thus represent the (relative) time of the occupation episode connected to the formation of AH 5, which belongs to occupation phase I, whereas the point at 660+ years would represent the Pavlovian (phase III) occupation connected to AH 4.4. Unlike at Krems-Hundssteig, the intermediate occupation phase II at the Krems-Wachtberg sites is only represented by material and radiocarbon data from palimpsest layer AH 4.11 but not by evident anthropogenic structures (Fig. 5.8).

It is remarkable that the Gösing-Setzergraben dataset suggests a very similar occupational pattern (Fig. 5.7). Here, the end-years of the two synch sequences based on multiple charcoal specimens are placed at 116 (SYNCH 1) and 659 years (SYNCH 4). The end-years are thus almost identical to the ones for AH 5 and AH 4.4 at Krems-Wachtberg. SYNCH 2 and 3 show no synchronicity with a specific occupational event at Krems-Wachtberg but fall into the long central part of the data sequence. The synch sequences at Gösing-Setzergraben are separated by ca 236, 155, and 155 years, which can be interpreted as reflecting four separate occupational episodes and/or events of burning, the latest of which, i.e. AH 1, is connected to a Pavlovian techno-complex. It should be noted that layers with charcoal and ash but without artefacts may also represent the remains of natural fires. Occurrences of such contexts have been observed in the vicinity of Gösing, at the Krems sites (Händel 2017 and references therein) and very pronounced in the Loisbach valley of Langenlois (Einwögerer, Händel 2023). For Krems-Wachtberg, high-resolution sediment analyses in conjunction with detailed stratigraphic observations and archaeological data demonstrated correlations between occupation, and/or pres-

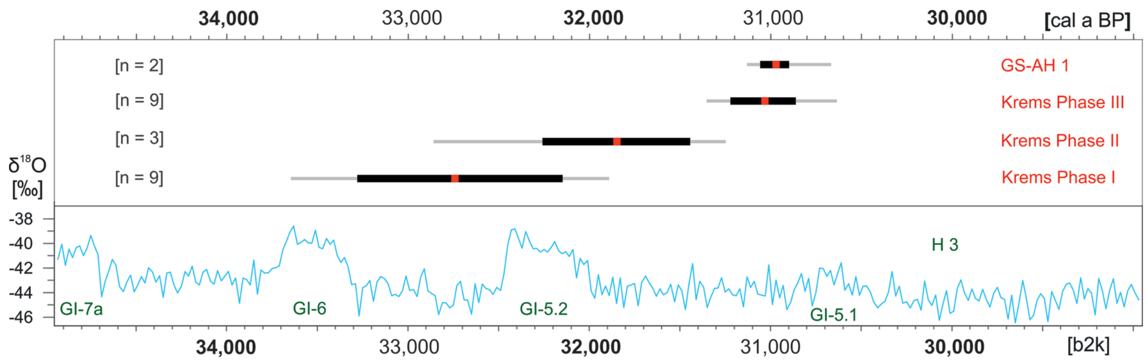

Fig. 5.8. Chronostratigraphic model of the Gravettian occupations at Gösing-Setzergraben (GS-AH 1) and at the Krems sites. The latter are grouped by occupation phases I to III as defined by Händel (2017). Ages calibrated with OxCal online tool (version 4.4, accessed 13.03.2023) applying the IntCal20 calibration curve (Reimer et al. 2020). Calibrated ages are plotted with 1– and 2– sigma error bars reflecting the average ranges for all individual ages. The curve shows the GICC05 timescale/20 yr d18O (Andersen et al. 2006); Greenland Interstadials (GI) follow the INTIMATE event stratigraphy (Rasmussen et al. 2014). Source: Österreichisches Archäologisches Institut / Österreichische Akademie der Wissenschaften.

ervation of the archaeological record, and environmental conditions (Händel et al. 2021). Due to the research history at Gösing-Setzergraben, such potential correlations cannot be tested with the available data; however, given the close proximity and a very similar occupational pattern, it could be argued that similar environmental conditions may have had comparable effects on occupation and/or preservation.

One of the major challenges in prehistory is the establishment of contemporaneity between different sites (cf. Lucas 2015 for discussion). Evidence for a contemporaneous occupation of Upper Paleolithic sites is very rare. Usually, it can only be established on the more general level of material culture and/or by chronometric, e.g. radiocarbon, measurements with their error margins. Both approaches can be successfully applied for the two sites, Gösing-Setzergraben and Krems-Wachtberg, based on lithic typo-technology, similarity of personal adornments (use of serpulides), construction and use of complex multi-phased hearths, as well as radiocarbon chronology (Einwögerer et al. 2009; Händel 2017). More precise determination of contemporaneity was hitherto only very rarely established by lithic refittings between sites (Cattin 1992; Scheer 1986). Other potential options to evidence contemporaneity *in sensu stricto* imply the use of unambiguous individual traits, such as genome (Teschler-Nicola et al. 2020), or fingerprints (e.g. Králík et al. 2002), but these remain to be demonstrated on an inter-site level.

Dendrochronology using floating tree ring sequences provides a novel option for Upper Paleolithic sites. Strictly speaking, synchronized ring sequences between sites evidence the use of firewood that grew at the same time. However, if it can be accepted that firewood that grew at the same time would also have been available at the same time, and therefore used, i.e. burnt, at the same time, a more precise level of contemporaneity can be supported than is possible by means of typo-technological assessment and radiometric measurements.

Given their contemporaneous occupation, an interpretation of the two sites, Gösing-Setzergraben and Krems-Wachtberg, in the regional Pavlovian site network based on the lithic raw material economies (see above) and thus differential but possibly interdependent site functions could argue that Gösing-Setzergraben was the target of a large move within the (seasonal?) mobility pattern from the erratic flint belt to the Danube, whereas Krems-Wachtberg was the target of a subsequent smaller move upstream along the Danube (cf. Fig. 5.1).

Acknowledgements

Fieldwork and water screening were financed by the National Heritage Agency of Austria (*Bundesdenkmalamt*). We are grateful to Kerstin Pasda who analysed the animal hard tissue remains, and Michael Brandl who determined the lithic raw materials. Last but not least, we thank Roswitha Thomas for graphical support.

06

The problem of cave settlement in the Tatra Mountains massif: A case study of Obłazkowa Cave

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Anna Kraszewska, Jakub Skłucki

Introductory remarks

The attempts made at the turn of the 20th century to identify the possibility of the existence of traces of Paleolithic man in the caves of the Polish Tatra Mountains (Grota Magury) ended in failure (Jura 1955; Buławka, Kerneder-Gubała 2020). To date, knowledge about prehistoric settlements in both the Slovak and Polish Tatras is close to zero. Until recently, we only knew of one cave archaeological site in the Tatras, but without traces dating back to the Stone Age. Pottery as well as bronze and iron items were found in Dúpnica Cave, located in the Sielnicka Valley in the Western Tatras in Slovakia. These date back to the Hallstatt Period and the Early Iron Age (Šimková 2006; 2014). A Celtic silver coin was also found (Soják, Struhár 2014). The cave was also inhabited in the Middle Ages and was used by the population as a shelter during World War II (Bella et al. 2007). At this point, we have to mention that there have been many spectacular discoveries from the Stone Age in caves in various mountain groups of Slovakia (cf. Soják 2006; Kaminská et al. 2014). This indirectly affects the archaeological potential of such sites in the Tatra Mountains.

According to field reconnaissance (Brunswig, Valde-Nowak 2018) and some analysis, Obłazkowa Cave in the group of Pawlikowski Caves in Kościeliska Valley was recognized as an object that meets the conditions for excavations in the Polish part of the Tatra Mountains (Fig. 1.1: 5; 6.1). The project undertaken "Stone Age man in the caves of the Tatra Mountains", the implementation of which is connected with the research of Obłazkowa Cave, aims to explain the settlement potential of this mountain group, which varied during the dynamic changes of the natural environment in the Pleistocene and the first half of the Holocene.

doi 10.47382/dvs_26-06

Fig. 6.1. General map of the northern slopes of Tatra Mountains. Red triangle – position of Obłazkowa Cave.

The cave

Fig. 6.2. Kościelisko, com. loco. Obłazkowa Cave. General view of the cave entrance in March 2022. Photo by P. Valde-Nowak.

Obłazkowa Cave is 120 m long. The entrance to it lies at an altitude of 1098 m a.s.l., about 130 m above the bottom of the Kościeliska Valley, in Raptawicka Turnia. Along with neighboring Mylna Cave, it is part of the Pawlikowski Caves system. Obłazkowa Cave was created by the Kościeliski Stream, which flowed through it in the past and hollowed it out (Filar 2015). The opening of the cave is quite spacious and measures ca 9 × 3 m (Fig. 6.2). The entrance chamber is relatively bright, but the path then turns into dark and narrow corridors.

Archaeological research in Obłazkowa Cave in 2022

Archaeological works in Obłazkowa Cave in the Tatra Mountains took place on 4–8 September 2022. The research was subject to the conditions set out in the Tatra National Park permit and the ministerial decision. The permit excluded the possibility of wet sieving of the sediments. Also, the number of samples taken, the spatial scope of the work and the number of participants were formulated very restrictively. This significantly limited the research possibilities. Despite this, their exploration was carried out in detail, with the use of small equipment (trowels). The material collected in this way was additionally sorted and reviewed on-site. It is worth mentioning that one of the conditions for starting work in the cave was careful backfilling of the trenches and bringing the examined places to the condition before the excavations had been undertaken.

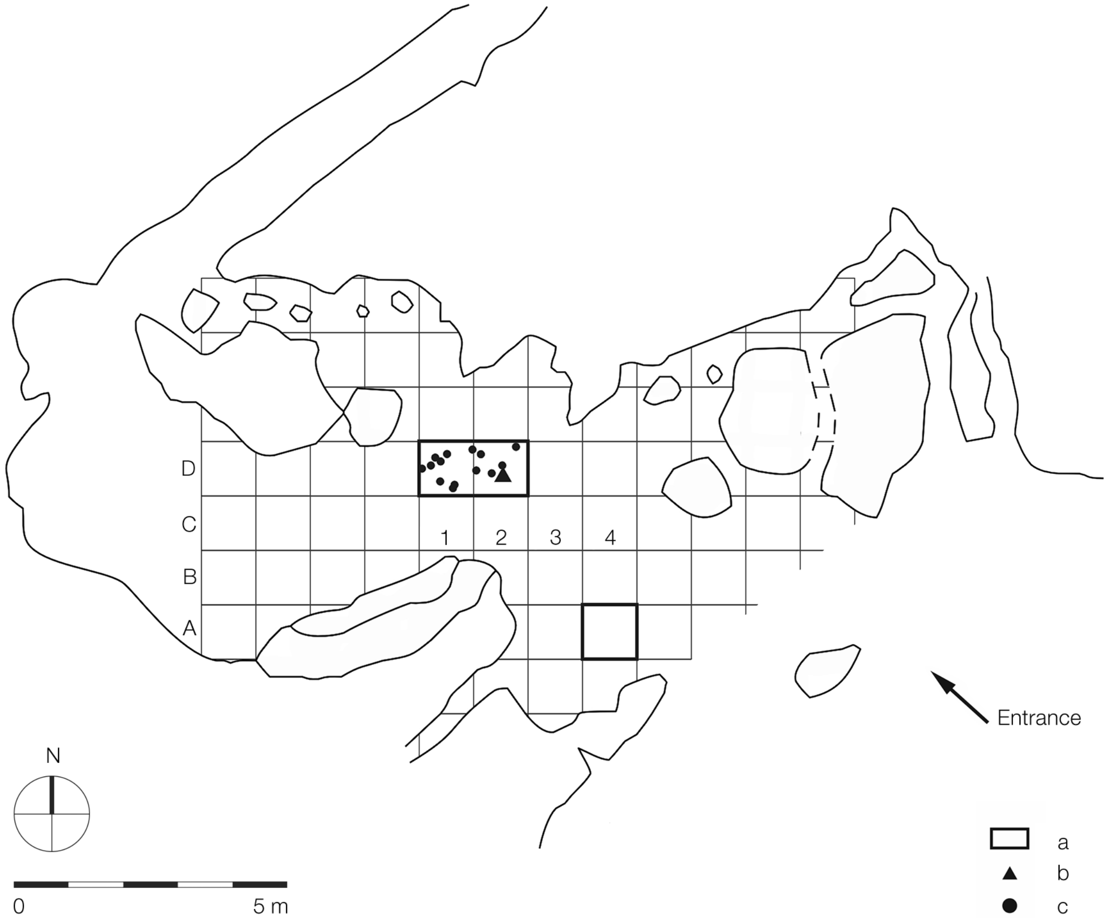

Fig. 6.3. Kościelisko, com. loco. Obłazkowa Cave. Plan of the cave with two trenches (a) and scattering of small bone fragments (c) and the place where a fragment of a glass vessel was found (b). Drawing by J. Skłucki.

Fig. 6.4. Kościelisko, com. loco. Obłazkowa Cave, trench No. 2, profil E. Photo by J. Skłucki.

After setting benchmarks using GPS bearings, setting a meter grid inside the cave and levelling, two small excavations were made, with a total area of 3 square meters: excavation 1 on the A4 meter at the entrance to the cave and excavation 2 on D1–D2 meters in the cave chamber (Fig. 6.3). The works were carried out using an arbitrary method, in layers 10 cm thick to a depth of about 1 meter. The stratigraphy of layers in both trenches is similar (approximate depths – Fig. 6.4):

- 0–25 cm grey layer 1 (treadboard)
- 25–60 cm yellow-fawn clay-silty layer with a small number of stones
- 60–90 cm light grey layer with a small number of stones; some of them were pebbles in the early stage of rolling, typical of water transport.

Fig. 6.5. Kościelisko, com. loco, trench No. 2. Glass vessel fragment. Photo by M. Kowal.

Below 90 cm, there was a dark brown-olive clay layer with fine gravel, which was quite moist and had an intense smell. From excavation II, from layer 1, a fragment of a glass vessel was obtained with an ornament of concentric cuts with a "rosette" thread (Fig. 6.5), from layer 2 – bear's tooth (Inv. No. 2/22), from layers 1–3 over a dozen small fragments of animal bones, undeterminable in terms of species, were excavated. All the bones were more or less polished in a manner typical of water transport.

Radiocarbon analysis

Two small animal bones were selected for dating. The dating was carried out in Laboratory C14 in Poznań (Tab. 6.1). The calibration was made with the OxCal v4.4.2 software (Bronk Ramsey 2021; atmospheric data from Reimer et al. (2020).

Tab. 6.1. Results of AMS dating of bone samples from the excavations in Obłazkowa Cave.
*may extend out of the range of the method.

Sample name	Lab. No.	BP Age	BCcal 68.3%	BCcal 95.4%	Remarks
Obłazkowa 11/22*	Poz-160803	40,000 ± 2,000	43,406 – 40,286	47,791 – 39,313	5%N 9.0%C, 4.6%coll
Obłazkowa 13/22	Poz-160804	30,900 ± 500	33,794 – 32,766	34,302 – 32,481	3.5%N 12.0%C, 10.6%coll

Main results

Trench 1 did not provide any faunal material or archaeological artefacts. In excavation 2, several small fragments of undetectable animal bones, a bear's tooth and one small (approx. 2.5 cm in diameter) fragment of the ornamented belly of a glass vessel from the turn of the 20th century were found.

The excavations were in the form of small surveys, in which the rocky bottom was not reached. Thus, it is difficult to comment on the thickness of the sediments of the Obłazkowa Cave fill in this place. A small fragment of a modern glass vessel, which is the only archaeological relic from the conducted research, is a surprisingly modest result in view of the high accuracy of the search. The lack of a larger amount of similar materials, and even contemporary rubbish, makes the hypothesis of the alleged re-modelling of the top part of the cave silt likely, possibly lowering its level, as evidenced by traces on the southern wall of the chamber, perhaps indicating the former level of the filled top (Fig. 6.6). However, there is no information about this process in the Tatra National Park archive or the Tatra Museum archive. The following supplement seems to be important in this situation. Information about the remodeling of silts of various caves in the Polish Tatras was provided to the author (PVN) in a telephone conversation on 12 April 2023 by a geologist specializing in the study of Tatra caves, and at the same time a speleologist, Prof. Zbigniew J. Wójcik from the Museum of the Earth of the Polish Academy of Sciences in Warsaw. He claims that in in the late 1940s after World War II the

Fig. 6.6. Kościelisko, com. loco, Obłazkowa Cave. General view of the interior of the chamber during excavations. Black arrows show the alleged trace of removed sediments visible on the wall. Photo by J. Skłucki.

Zwoliński brothers, after receiving a large state subsidy to make the Tatra caves available to visitors, undertook extensive earthworks in the caves, infringing on and practically destroying the sediments. These works were carried out without proper documentation. The mentioned above trace found on the wall of the entrance chamber of the Obłazkowa Cave, a few meters from excavation No. II, may indicate a mechanical loss of the roof part of the cave's sediments. It is known from sources that earthworks were carried out at the opening of Obłazkowa Cave, which were aimed at making a convenient path for tourists to Mylna Cave located next to Obłazkowa (Lewkowicz 2021, 244).

The perspective of research into the prehistory of the Polish Tatra Mountains.

The archaeological significance of the Tatra region will increase when we recall the occasional finding of Stone Age monuments from the Polish Tatras – e.g. a flint core from the Kondratowa Valley (Tunia 1979) and the Slovak Tatras – a copper axe from Veľká Studená Dolina (Large Cold Valley) (Novotná 1973), as well as multicultural discoveries of extremely intense *Neanderthal* and early *Homo sapiens* settlements at the foot of the Tatra Mountains (Valde-Nowak 1991; Valde-Nowak et al. eds. 2003). Another important clue, encouraging to look for traces of Paleolithic hunters activity in the Tatra Mountains, was the discovery of lithic artefacts: a blade and a fragment of the core in the village of Witów at the mouth of the Chochołowska Valley, near Siwa Polana, and thus on the very border of the Tatra National Park, at the foot of the Tatra massif. The author of this discovery recognized these traces as Late Paleolithic (Rydlewski 2006). A separate group of threads is connected with the still unexplained possibility of using local Tatra rocks to produce weapons and tools in the Stone Age, mainly radiolarites.

The process of intensive learning about the prehistory of the Carpathian mountainous areas outside of the Tatras is visible from the late 1970s to the present day (e.g. Pelisiak 2018), but it did not concern the high mountain formations such as the Tatra Mountains at all.

In this context, it should be pointed out that the number of sites from various phases of the Stone Age, discovered and successively researched in the Alps has been increasing over the years (Schäfer 1977; Leitner 1994; Hofmann 2005; Fontana et al. 2016; Hafner, Schörer 2017; Della Casa 2018; Bachnetzer et al. 2019). The complex of traces of settlement of Mesolithic hunters in the Alps is particularly noticeable there. Some of them are associated with hunting ibexes and chamois, others are associated with the exploitation of the local deposits of siliceous rocks, radiolarites (Kompatscher, Kompatscher 2005) and rock crystal (Leitner 2002; Della Casa 2005). These traces are located at an altitude of more than 2,000 meters above sea level (Reitmaier et al. 2016; Kompatscher et al. 2016). The long-lasting mystery of such an early settlement of the Tatra Mountains has recently begun to be clarified. Traces of the settlement of a group of late-glacial hunters of the Magdalenian culture were discovered in the Belianske Tatras, namely in Hučivá Cave in Slovakia, at an altitude of nearly

1,000 meters above sea level (Valde-Nowak, Soják 2018; Valde-Nowak et al. 2022). Last year, during the excavation works, a group of artefacts and relics of the hearth were excavated. The obtained radiocarbon date indicates the penultimate warm period of the last glaciation – Bölling interstadial 12,190 ± 60 years BP. These finds are accompanied by animal remains, which enriches the as-yet little information about the Pleistocene fauna in the Tatra Mountains (Horáček et al. 2015). The development of this research is extremely significant element, which will undoubtedly lead to further spectacular discoveries.

It must be said, however, that the results of the Obłazkowa Cave research described in the text are quite negative from the archaeological point of view. The puzzling lack of prehistoric remnants as well as the almost complete lack of modern materials and contemporary rubbish can be explained by the removal of sediments during the adaptation of the cave and its vicinity for tourism in the first years after World War II. Theoretically, another possibility may be considered. It is possible to hypothesize that cave openings in the northern part of the Tatra Massif were iced over during the Pleistocene and therefore unavailable. However, during longer warming periods, they should have been open. Therefore, the role of sediment remodeling during modern times seems definitely more likely.

Acknowledgement

This communication was created with the support of the research grant of the National Science Center: "*Stone Age man in the caves of the Tatra Mountains*"; project number: 2021/41/B/HS3/03217. We are grateful to Prof. Dr Adam Nadachowski for evaluating the bone material from the Obłazkowa Cave research. We would like to thank Dr. Dariusz Niemiec for the assessment of a fragment of a glass vessel. We thank Paweł Micyk, MA, Galty Company for facilitating the measurements in relation to the national geodetic grid. We would especially like to thank Professor Zbigniew J. Wójcik from the Museum of the Earth of the Polish Academy of Sciences for verbal information on the earthworks carried out by the Zwoliński brothers in the Tatra Mountains. We are indebted to Maria Król, MA, the head of the Scientific Research Department of the Tatra National Park for the consultation and support.

07

A new Middle Paleolithic assemblage from Gyöngyöstarján, Northern Hungary

Mónika Gutay, Zsolt Mester

Introduction

During her rich scientific career Ľubomíra Kaminská dealt with all periods and aspects of the Paleolithic (Kaminská et al. 2014). Moreover, she contributed considerably to the advancement of Central European Paleolithic research by her collaborations (e.g. Kaminská et al. eds. 2005; Kaminská et al. 2011; 2017; Budek et al. 2013; Neruda, Kaminská 2013; Chu et al. 2018; 2020). Concerning Middle Paleolithic industries with bifacial lithic tools, she demonstrated the presence of the Micoquian industry in Slovakia (Kaminská et al. 2014, 53–118) which constitutes a link between similar industries of Poland and Hungary. Here we present a new lithic assemblage of this lithic technology tradition from Northern Hungary.

The existence of a Middle Paleolithic industry with bifacial tools was recognized quite late in the research history of the Prehistoric archaeology of Hungary. No such industry was mentioned in the publications listing all known Paleolithic sites of the country until 1975 (Vértes 1965; Dobosi 1975). This situation was the result of two facts. The first one is that lithic assemblages containing bifacial leaf-shaped tools were attributed to the Upper Paleolithic Solutrean (Kadić 1934; Hillebrand 1935) and Szeletian (Vértes 1956; 1965, 128–163) or to the Mesolithic Eger culture with heavy tools (*Grobgerätiges Mesolithikum*) (Vértes 1951; 1965, 217–221; Dobosi 1975, 68–70). The Mesolithic age of this latter culture was based on the observation that the knapped stone industries, containing types of different periods, have been found on hilltops apparently in the Holocene soil without any ceramic remains. The revision of the assemblages and the new excavation at the eponymous site proved that it is a question of mixed materials (Dobosi 1995; Kozłowski et al. 2012). The second fact is that some new discoveries, made at the end of 1960s, had not been published yet (Gábori 1976, 78–81). Based on the stratigraphic

doi 10.47382/dvs_26-07

observation and paleontological association of the Remete-Felső Cave site, excavated in 1969–1970, V. Gábori-Csánk (1983) reconsidered the chronological position of the Transdanubian Szeletian assemblages and concluded a Middle Paleolithic age. As a consequence, she redefined this industry as Jankovichian (Gábori-Csánk 1993). Since, the relation of this industry to the Szeletian raised new questions (Mester 2017; 2018; Markó 2013; 2019). Apart from a short mention (Gábori 1976, 80–81), the material with bifacial leaf-shaped tools of Hont open-air site, excavated in 1969 by M. Gábori and V. Gábori-Csánk, remained unpublished for a long time. Gábori considered it as a Middle Paleolithic industry different from the Jankovichian. K. Zandler (2010) described the assemblage in detail and attributed it to the Moravian Szeletian.

From the 1980s onward, new field prospections and excavations accumulated evidence of a bifacial Middle Paleolithic phenomenon in the region of the North Hungarian Range (Fig. 7.1) (Dobosi 2005, 53–55, 59). Based on surface collections from the surroundings of Miskolc in the Bükk Mountains, Á. Ringer (1983) described a new Middle Paleolithic industry, characterized by bifacial tool production, named Bábonyian. Several assemblages of the former Eger culture, located in the regions of the Bükk and Tokaj mountains were linked to this Micoquian-like industry (Ringer 1983; Simán 1999; Kozłowski et al. 2009; 2012; Zandler, Béres 2014). Field surveys undertaken in the Cserhát Mountains discovered Middle Paleolithic assemblages containing bifacial tools of Micoquian character (Markó et al. 2002; Markó, Péntek 2003–2004; Markó 2007; Zandler et al. 2021). One of the most interesting features of these assemblages is the high ratio of a specific raw material originating from sources which are located approximately 100 km to the east in the Bükk Mountains (Markó 2009; Zandler et al. 2021). In the archaeological literature, this kind of rock is named vitreous quartz-porphyry (Vértes, Tóth 1963) or felsitic quartz porphyry (Simán 1986) or Szeletian felsitic porphyry (Markó et al. 2003), however revealed to be metarhyolite during geological reinvestigation of the Bükk Mountains (Pelikán ed. 2005). Its presence on Paleolithic sites was reported as far as in Szob in the region of the Börzsöny Mountains and in Moravany nad Váhom-Dlhá in Western Slovakia (Simán 1986; Markó et al. 2003; Nemergut et al. 2012).

Considering the connection between these members of the North Hungarian Range, it is surprising that hardly any Middle Paleolithic site was known in the region of the Mátra Mountains, located between them (Dobosi 2005). K. Simán (1986, 273; 1993, 249; 1996, 47) supposed that the way of circulation of the quartz-porphyry (metarhyolite) conducted from the Bükk Mountains through the

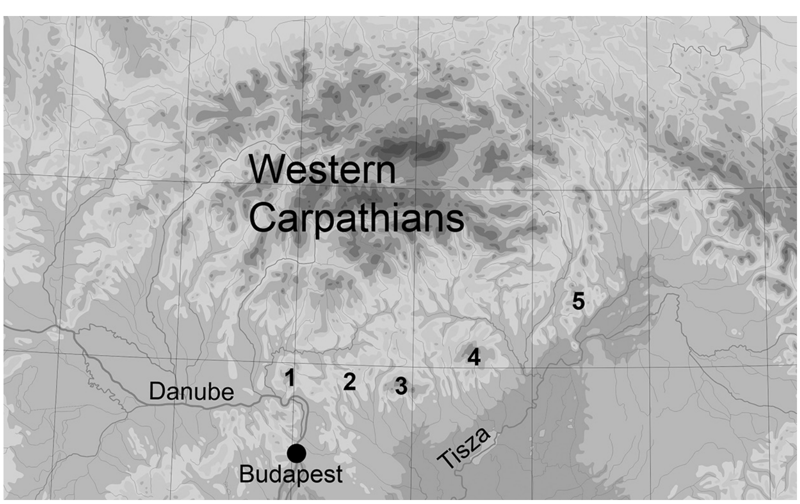

Fig. 7.1. Members of the North Hungarian Range:
1 – Börzsöny,
2 – Cserhát,
3 – Mátra,
4 – Bükk,
5 – Tokaj Mountains.

Mátra Mountains to the west. She cited six sites from the western and northern part of the mountains which yielded Paleolithic lithic assemblages. However, only two of them can be related to the Middle Paleolithic: the single bifacial tool of Parád-Marhád-tető (Biró 1984), the workshop material of Szurdokpüspöki-Derzsi, resembling the leaf point industry of the Eger region (Simán 1993).

Field prospections in the Mátra Mountains region

Because the southern foothills of the Bükk mountains, named Bükkalja, including the region of Eger, is rich in Paleolithic open-air sites (Zandler 2012), it was foreseeable that a similar situation would also be found on the southern foothills of the Mátra Mountains. Systematic field surveys have been started in the region in 2004 resulting in the discovery of many Upper Paleolithic open-air sites, mainly of Aurignacian and Gravettian/Epigravettian character (Gutay 2007; Gutay et al. 2019b). Some of them were excavated or tested (Gutay 2016a; 2016b; 2023; Gutay et al. 2016, 2019a). In 2011, four leaf points were found near Gyöngyöstarján and Gyöngyösoroszi villages on hillsides at 280–317 m a.s.l. (Gutay et al. 2012) (Fig. 1.1: 6; 7.2A). The associated lithic assemblages contained Upper Paleolithic blade cores, Aurignacian-like tools, as well as bifacial tools. The four leaf points were made from local limnosilicites of different colours. Their morphological and metrical characteristics do not allow clear cultural attribution. Considering their asymmetrical outline, plan-convex cross-section and raw material use, they probably belong to the Micoquian or Early Szeletian.

One of these leaf points (Fig. 7.2B: 2) was found in a vineyard on the southwestern slope of Mulató-hegy hill, identified as Gyöngyöstarján 10 site. The site is located 2.5 km northwest from the village Gyöngyöstarján at 270 m a.s.l. Successive field surveys were undertaken on the site in 2017, 2020 and 2021 for collecting more diagnostic lithic material. Knapped artefacts were found on a surface of 300 m × 180 m with two concentrations. These yielded dominantly artefacts of Middle Paleolithic character, including several bifacial tools. Archaeological investigation of one of the concentrations was carried out in August–September 2021 (Gutay, Kerékgyártó 2021). On a surface of 6 × 30 m, finds in the surface soil were recorded using hand tools and documented by a grid system. As a result, 2,710 artefacts were registered. Two test pits were dug for stratigraphic information yielding 284 lithic artefacts too. The sequence revealed to be less than 1 m because of the slope position. Sampling for sedimentology and OSL dating were made. The analyses are in progress.

The industry of Gyöngyöstarján 10 site

The lithic assemblage collected at the site contains a few retouched tools, many flakes and debitage products, including waste, as well as raw material block fragments. The site function is assumed to be the exploitation of the locally available raw material sources for tool manufacture. Here we concentrate on the diagnostic artefacts.

Raw material

The Mátra Mountains has a complicated tertiary volcanic structure and history which took place in the area of the Middle Parathetys (Pelikán 2010; Zelenka 2010), in the framework of the Neogene to Quaternary volcanism of the Carpathian-Pannonian Region, in strong connection to the geodynamic evolution of the area (Harangi 2001; Seghedi et al. 2005; Harangi, Lenkey 2007; Harangi, Lukács 2019). In the western part of the mountains, andesite and rhyolitic tuff can be found which were formed during the Carpathian and Badenian stages of the Early and Middle Miocene (from

Fig. 7.2. Bifacial leaf points found near the villages of Gyöngyöstarján and Gyöngyösoroszi.
A – Locations of the artefacts (after Gutay et al. 2012, Fig. 1); B – the four leaf points, the numbers correspond to the locations. Photo by M. Gutay.

Burdigalian to Serravallian) on the border of the sea. In collapsed craters, in connection with post-volcanic activity, thick diatomaceous earth had been deposited in a limnobrackish basin near Szurdokpüspöki and Gyöngyöspata villages (Szurdokpüspöki Formation). This diatomite layer complex can be subdivided into an upper part (yellowish-white) and a lower part (greyish). The diatomite layers alternate with limnoopalite layers, generally having a very varied and vivid colour. The middle-southern part of the mountains has a similar genetic history, where mainly pyroxene andesite with rhyolite intrusions from the Lower Badenian (Langhian) can be found. The hydrothermal activity resulted in a large body of supplementary andesitic rocks with jasper, chalcedony and quartzites with different colour variants from white, bluish-white to lilac and red, and geyser cones and terraces in the vicinity of Gyöngyöspata, Gyöngyöstarján, Gyöngyösoroszi, and Gyöngyössolymos villages (Gyöngyöspata Limnoquartzite Member of the Szurdokpüspöki Formation).

These geological processes produced potential raw materials of varied petrographic characteristics. Following A. Přichystal (2010; 2013) we name this group of siliceous rocks as limnosilicites. Occurrences of these rocks were sampled for the reference collection of the Institute of Archaeological Sciences of Eötvös Loránd University, Budapest (Mester et al. 2012; Mester, Faragó 2022) (Fig. 7.3). Raw materials in the studied assemblage can be identified with the local variants. The limnosilicites of dominantly brown colour with reddish, yellowish, and light grey patches or stripes can be linked to the diatomaceous formation to the west from Gyöngyöspata by their layered inner structure (Fig. 7.4: 1; 7.5: 5). Thin tufaceous layer inclusions can be often observed inside

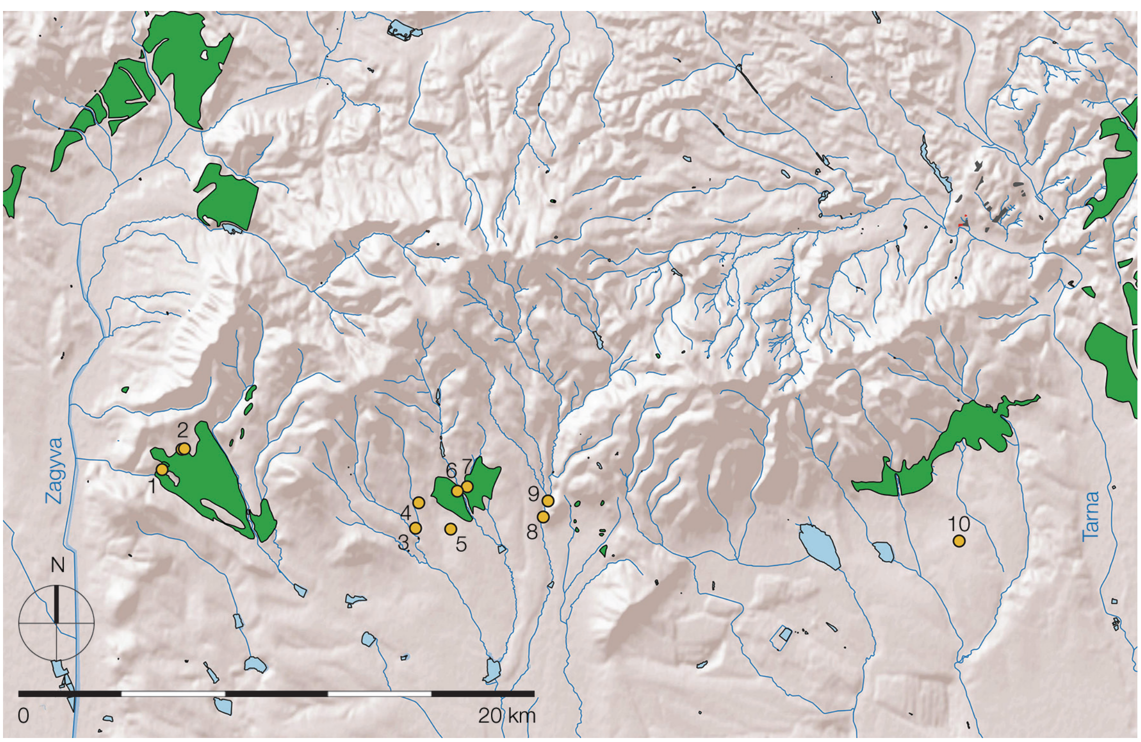

Fig. 7.3. Map of the Mátra Mountains with the geological formations containing siliceous rocks (green patches), according to the geological map of the Mining and Geological Survey of Hungary (Magyarország felszíni földtana), and the occurrences (yellow circles) already registered into the database of the Institute of Archaeological Sciences of Eötvös Loránd University, Budapest. 1 – Szurdokpüspöki-Diatoma-bánya; 2 – Gyögyöspata-Tilalmas-tető; 3 – Gyöngyöstarján-Füledugó-bánya; 4 – Gyöngyöstarján-Köves-tető; 5 – Gyöngyöstarján-Tűzköves-dűlő; 6 – Gyöngyösoroszi-Bánya-domb; 7 – Gyöngyösoroszi-Dögkút; 8 – Gyöngyössolymos-Lilakő-bánya; 9 – Gyöngyössolymos-Cserkő-bánya; 10 – Domoszló-Vécsi-part. After Mester, Faragó 2022, Fig. 3. The Gyöngyöstarján 10 archaeological site is located next to the occurrence No. 3.

Fig. 7.4. Diagnostic tools from the Gyöngyöstarján 10 site: *Keilmesser* (face A, face B). Photo by N. Faragó.

the blocks. This condition influenced the knapping of these raw material blocks. The limnosilicites of different shades of brown with yellowish or light grey patches can be linked to the formation next to Gyöngyöstarján and Gyöngyösoroszi (Fig. 7.4: 3, 7.5: 3, 7.6: 3). Finally, a homogenous limnosilicite of greenish- or yellowish-brown colour with opal-like shine can be linked to occurrences in the vicinity of the village of Gyöngyössolymos. To the best of our knowledge, there are only two variants of limnosilicite in the collection which are assumed to be non-local. One is a translucent yellowish or light brown limnosilicite like the variants known from the Tokaj Mountains (Fig. 7.7: 3). The other one is a bluish-grey limnosilicite with white patina (Fig. 7.5: 2).

Typology

The most important feature of the tool production at the site is the bifacial shaping method (Inizan et al. 1999, 44–49). Among 39 diagnostic tools, 22 (56.41%) are made by this method (Fig. 7.4–7.6). Four sidescrapers with bifacial retouch can also be added to this group of artefacts. The remaining tools represent different sidescraper categories (single, double, *déjeté*, transversal; Fig. 7.7), as well as one atypical endscraper and two notches. The underrepresented domestic tools suggest a site function linked to the knapping activity.

Although every bifacially shaped tools in the assemblage are not finished or broken pieces, the aimed tool-types can be recognized. From a diagnostic point of view, the three bifacially backed knives (*Keilmesser*) are the most important (Fig. 7.4). Their shaping was given up in the early phase of the production because of the problems caused by the layered structure of the raw material block. However, the structure of the pieces corresponds to the *Keilmesser* concept (Jöris 2006, 292–295). Apparently, the left side was chosen for the cutting edge. Their overall morphology evokes the Pradnik/Prondnik and Klausennische types (Bosinski 1967, 29, Taf. VI.5; Sobczyk 1994. Fig. 5; Jöris 2006, Fig. 6). There are two fragments of the base in the assemblage which should belong to *Keilmesser* or handaxe. They broke at a crack inside the block. The shape of the tool could not be estimated, but a certain asymmetry is visible, indicating rather a *Keilmesser*. Apart from these two ambiguous pieces, three artefacts can be

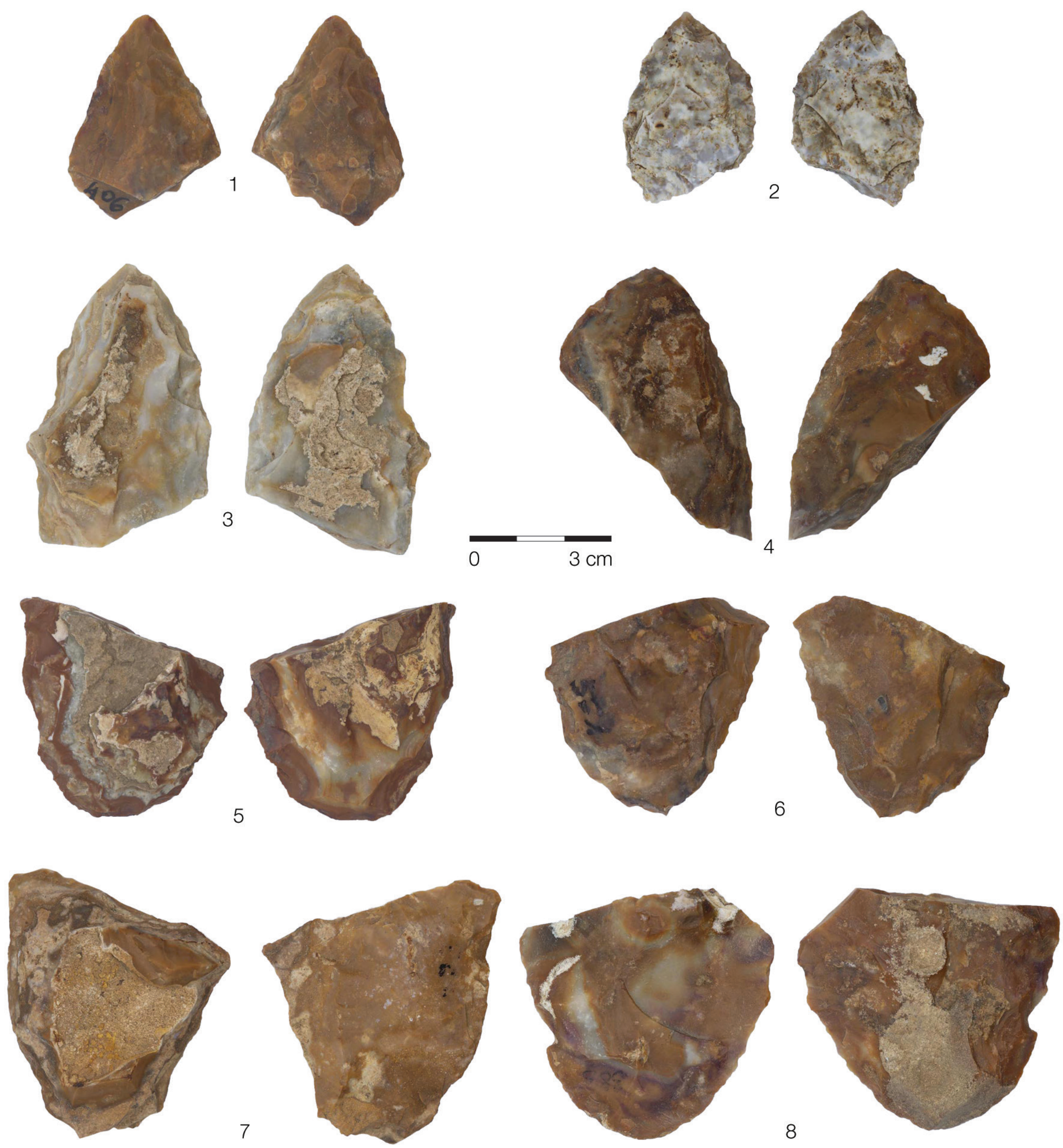

Fig. 7.5. Diagnostic tools from the Gyöngyöstarján 10 site: leaf points (face A, face B).
1–4 – Distal fragments; 5–8 – proximal fragments. Photo by N. Faragó.

classified as handaxes. Two of them are to be considered as preform. The third is a distal fragment which shows an asymmetry too according to the longitudinal axis (Fig. 7.6: 2). However, the shaping of the distal part testifies to an original intention of forming a more symmetric shape. It was blocked by the inhomogeneity of the raw material close to the right edge causing several hinged removals even before the break.

The most numerous category in the assemblage is that of the leaf points. Almost all are fragments: four proximal, five distal, and one lateral (Fig. 7.5). In most of the cases, the break was caused by the raw material in different phases of the production: during the overall shaping of the form (Fig. 7.5: 6, 8) or before finishing the tool (Fig. 7.5: 1, 4). An exception is the small leaf point made of probably non-local limnosilicite was broken by a strike (Fig. 7.5: 2). There are two pieces representing a preform phase of the shaping. One of them has been stopped by a series of hinged removals on the left side of the face B (Fig. 7.6: 1), while the other broke because of a transversal crack inside the block (Fig. 7.6: 3). Based on this assemblage, we are unable to reconstruct the types of leaf points made at the site. In comparison with the four entire leaf points found in the neighbourhood (Gutay et al. 2012) the assemblage of the site

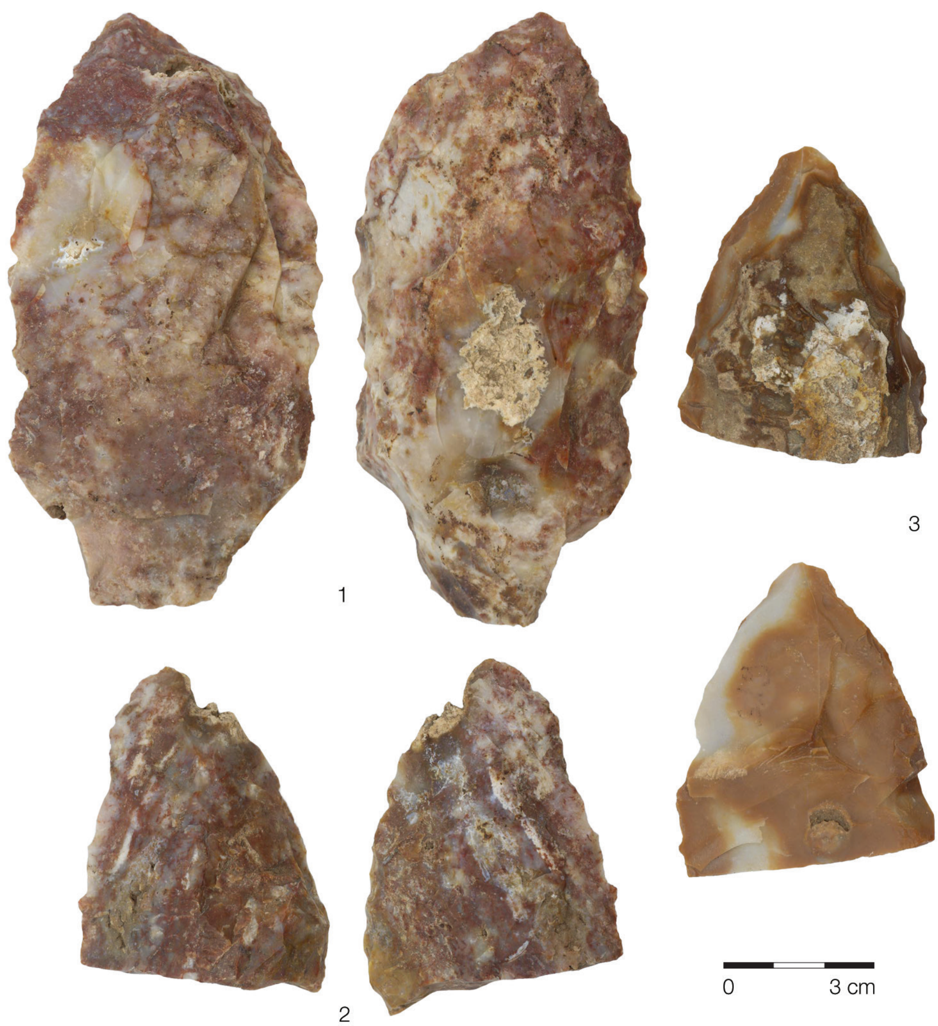

Fig. 7.6. Diagnostic tools from the Gyöngyöstarján 10 site: preforms of leaf points (1, 3) and handaxe (2) (face A, face B). Photo by N. Faragó.

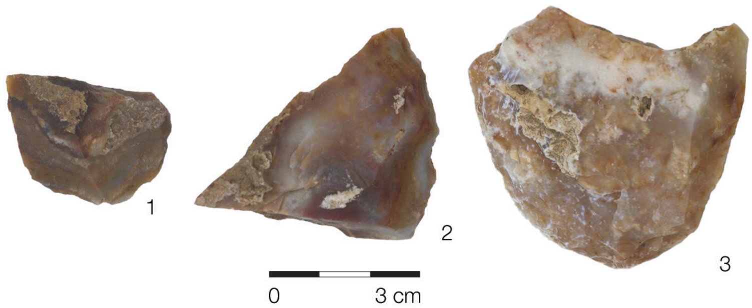

Fig. 7.7. Diagnostic tools from the Gyöngyöstarján 10 site: sidescrapers. 1 – Transversal; 2 – single convex; 3 – double. Photo by N. Faragó.

shows differences. Here we have exclusively rounded bases among the proximal fragments (Fig. 7.5), however almost all the entire points have a pointed base (Fig. 7.2B). The distal fragments in the assemblage demonstrate either highly pointed (Fig. 7.5: 1) or more rounded forms (Fig. 7.5: 3, 4).

The place of the industry in context of the Middle Paleolithic in Northern Hungary

Dated to the Middle Paleolithic, several cultural units are known in Northern Hungary (Dobosi 2005). The industry with microlithic tools attributed to the Taubachian (Ringer, Moncel 2002; Moncel 2003), the Typical and the Quina type Mousterian (Mester 1990; 1995; 2022; Mester, Moncel 2006; Mester, Patou-Mathis 2016; Daschek, Mester 2020), the Jankovichian (Gábori-Csánk 1983; 1993; Mester 2000; Markó 2013; 2019), the Bábonyian (Ringer 1983; Zandler, Béres 2014; Mester, Lamotte in press), as well as the Micoquian (Markó et al. 2002; Markó, Péntek 2003–2004; Markó 2007; Zandler et al. 2021). Although the industries of Tata and Diósgyőr-Tapolca Cave contain bifacially worked types (Vértes 1964, 154, 167; Dobosi 2004, 67, Fig. 3; Ringer, Moncel 2002, 182), bifacial tool production is not common in the Taubachian. There is only one bifacial tool in the assemblages of each Mousterian industries of the Subalyuk and Büdöspest Caves, but there are apparently intrusive pieces (Mester 1990, 112–113). The Jankovichian is characterized by bifacial leaf-shaped tools and is recorded on the territory of the North Hungarian Range too (Gábori-Csánk 1993; Mester 2000; Ringer, Mester 2000; Markó, Péntek 2003). However, it does not include a bifacially backed knife in the tool-kit because the artefacts attributed to *Bocksteinmesser* and *Volgogradmesser* (Gábori-Csánk 1993, 76) do not correspond to these typological categories (Mester 2008–2009, 83). Moreover, the leaf points of Gyöngyöstarján differ considerably from the tools of the Jankovichian. More similarities can be observed with the assemblages of Galgagyörk (Markó et al. 2002) and the Bábonyian (Ringer 1983). These are mainly bifacial asymmetric tools, the overall morphology of the leaf-shaped elements and the presence of *Keilmesser*. Based on these diagnostic pieces, the industry of Gyöngyöstarján 10 site is in relation to the circle of the Micoquian industry or *Keilmessergruppe* of Central and Eastern Europe (Bárta 1961a; Bosinski 1967; Gábori 1976; Valoch 1990; Kozłowski, Kozłowski 1996; Richter 1997, 2016; Marks, Chabai eds. 1998; Chabai, Monigal eds. 1999; Jöris 2004; Ruebens 2013; Kaminská et al. 2014; Kozłowski 2014; Demidenko 2015; Golovanova et al. 2017). As mentioned above, the *Keilmesser* at Gyöngyöstarján fit well into the concept of the Prondnik and Klausennische types regarding their structure (Jöris 2006, Fig. 6). Analogous forms were published from Klausennische (Bosinski 1967, Taf. 81.4–5) and Balver Höhle II Ia (Bosinski 1967, Taf. 101.1, 8) in Germany, from Ciemna Cave (Kozłowski, Kozłowski 1996, Pl. 12–13), Wylotne

Rockshelter (Kozłowski ed. 2006, Pl. 17, 49) and Zwoleń (Tomaszewski 2005, Fig. 7, 17, 19) in Poland, as well as from Zaskalnaya and Chokurcha (Chabai 2004, Fig. III-33, III-41, III-43) in the Crimea.

Owing to the lack of finished tools and formal tool-kit, the attribution of the Gyöngyöstarján lithic assemblage to one of the already known cultural units in Hungary is quite problematic. The presence of *Keilmesser* and leaf points link it either to the Bábonyian of the Bükk Mountains or the Micoquian of the Cserhát Mountains. On the contrary, besides limnosilicites, both cultural units intensively used quartz-porphyry (metarhyolite) from the Bükk Mountains (Ringer 1983; 2001; Markó 2007; 2009; Zandler et al. 2021) which is completely absent at the site of Gyöngyöstarján. The *Keilmesser*-like tool found on the opposite side of the Mátra Mountains, reported by K. T. Biró (1984, Fig. 2), was made of quartz-porphyry. The size of this tool is comparable to the *Keilmesser* of Gyöngyöstarján, however its shape looks different. By the overall characteristics of the lithic assemblage of the site, we currently suppose that the presented bifacial industry of the Mátraalja region represent another variant of the Micoquian not recognized in the North Hungarian Range until now.

Conclusion

The Gyöngyöstarján 10 site is located on the foothills of the Mátra Mountains , named Mátraalja, in a region from where Middle Paleolithic sites had not been reported until now. However, the neighbouring members of the North Hungarian Range, the Cserhát Mountains to the west and the Bükk Mountains to the east yielded a Middle Paleolithic archaeological record during field investigations undertaken in recent decades. The presence of Micoquian-like assemblages was documented on open-air sites in both regions. The contacts between these sites are evidenced by the intensive use of the quartz-porphyry (metarhyolite), a specific rock known exclusively in the geological context in the northeastern part of the Bükk Mountains.

Since 2004, systematic field surveys on the foothills of the Mátra Mountains have resulted in the discovery of a huge amount of Paleolithic surface collections, attributed mainly to Upper Paleolithic cultural units, including Aurignacian and Gravettian/Epigravettian. In 2011, four bifacial leaf points were found near the villages of Gyöngyöstarján and Gyöngyösoroszi. These artefacts are made of local limnosilicites, indicating the exploitation of local raw material sources by prehistoric human groups. Further systematic prospections at the location of one of these leaf points resulted in the collection of more than two thousand knapped stone artefacts.

The collection contains only broken and unfinished tools, flakes, debitage products and waste. The diagnostic elements of the assemblage, even in unfinished state, are bifacially backed knives (*Keilmesser*) and leaf points which let us to link the industry to the Micoquian or *Keilmessergruppe* of Central and Eastern Europe. The studied artefacts are made of limnosilicites from locally identified sources. The typological characteristics of this industry show differences either with the Micoquian of the Cserhát Mountains or with the Bábonyian of the Bükk Mountains. Further field surveys and analyses of the surface collections in the region are needed to clarify the problems of this industry and to complete the description of its characteristics.

Acknowledgements

We are grateful to Adrián Nemergut and Martin Novák for inviting us to contribute to this celebration of Ľubomíra Kaminská. Mónika Gutay is indebted to Gyula Kerékgyártó for his collaboration in field surveys since 2004 and to the volunteers participating in the excavation of the Gyöngyöstarján 10 site. Zsolt Mester thanks Norbert Faragó for his help in preparing the illustrations of this paper. The information concerning the raw material sources of the region were obtained in the frame of the "Lithic resource management dynamics from the Middle Paleolithic to the Middle Neolithic in Northern Hungary" project, financed by the the National Research, Development, and Innovation Fund (grant No. K 124334).

08

New Early Upper Paleolithic site in Banka-Štepnica 2 (Slovak Republic)

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Peter Šefčík, Peter Mandák

Introduction

In the village of Banka in southwestern Slovakia, we have recorded a considerably rich concentration of sites from the Upper Paleolithic. The situation is similar in the neighbouring villages of Moravany nad Váhom and Ratnovce. It is the best-known and most intensely investigated settlement area from this period in Slovakia (Ambrož et al. 1952; Bárta 1960; Hromada 2000; Kozlowski ed. 2000). Since 2020, the construction of stage 1 of the residential and relax complex of Beethovenova alej – Banka has been carried out in the village of Banka. It covers an area of 15 ha. It is located outside the built-up area of Banka, SE from the town of Piešťany (Fig. 1.1: 7; 8.1). It occupies a large hill with the sites of Štepnica and Vrchy on the left bank of the River Váh. In the past, the construction site was used primarily for agricultural purposes.

In 2021, a layer with finds of chipped lithic industry was identified at the relevant construction, the site of Štepnica 2. It is located at an altitude of approx. 247 m a.s.l., on the ridge continuing southeastwards, up to the hilltop with an altitude of 271 m a.s.l. The layer was discovered 400–450 cm below the current terrain, at the bottom of the construction pit for a water tank (Fig. 8.2). The area surface was located 247.64 m a.s.l. The private company of Archaeological Agency, Ltd. partly excavated the layer in the form of a trench, 5 × 3 m, with maximum depth of 70 cm, using heavy machinery and trimming the profiles conducted by the excavation executor (P. Mandák). The trench was situated next to the profile of the excavation, its axis oriented in the NW–SE direction. The other excavated area (3 × 1 m) was oriented in the NW–SE direction with its longer axis, parallel with the first trench, 25 cm SE from it. The trench was divided into three sectors (sectors 1–3) of 1 × 1 m, from the NW; each sector was further divided into four squares (A–D) of 50 × 50 cm, starting from the N corner of the sector,

doi 10.47382/dvs_26-08

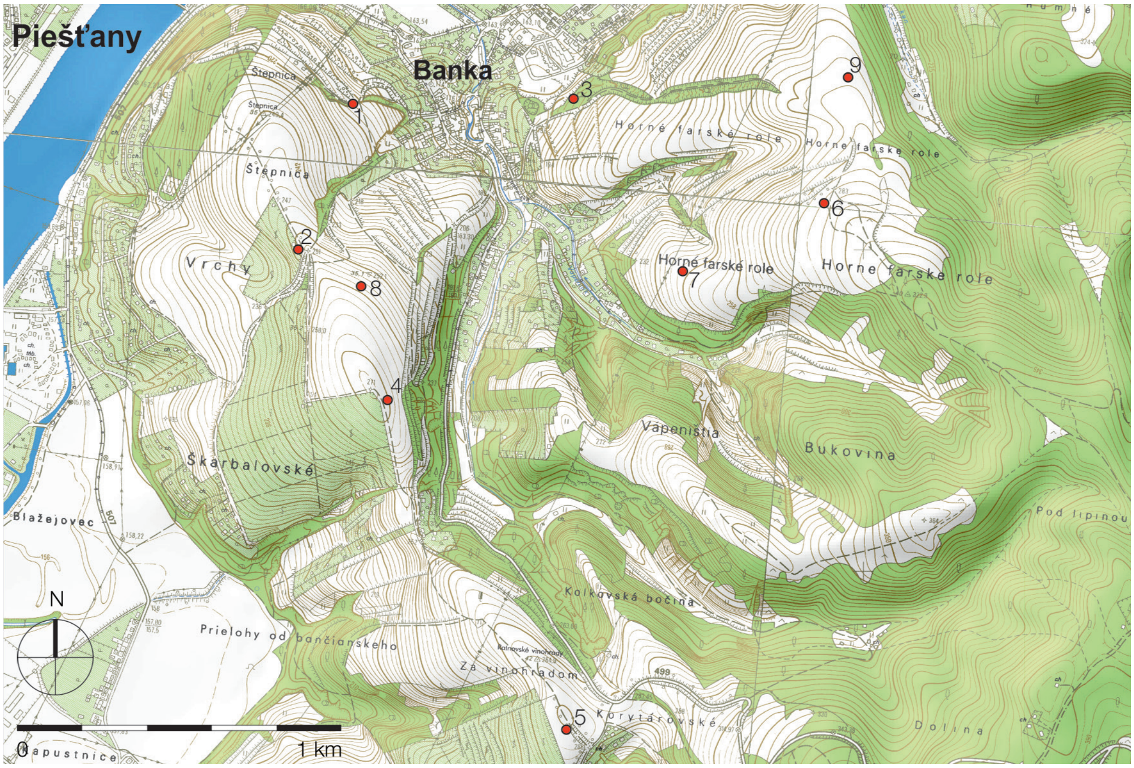

Fig. 8.1. Location of sites in Banka. 1 – Štepnica 1; 2 – Štepnica 2; 3 – Brickyard; 4 – Škarbalová; 5 – Vila Bakchus; 6 – Chrasť; 7 – Kňazovica; 8 – Hanzlovská; 9 – Kopanice. Graphic by A. Nemergut.

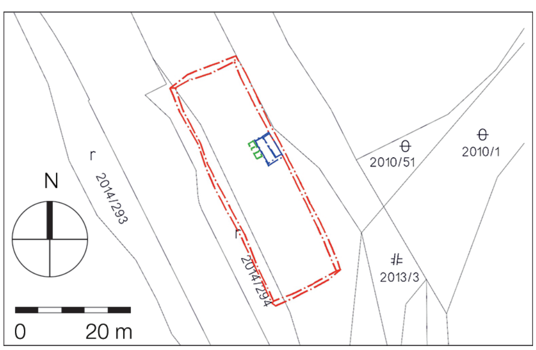

Fig. 8.2. Banka-Štepnica 2 site plan. Red – construction pit for a water tank; blue – excavated area by the Archaeological Agency, Ltd. Company; green – excavated area by the PAMARCH, Ltd. Company; IA SAS; SGIDŠ. Graphic by O. Žaár.

continuing clockwise. The excavation was not carried out by the private company performing the rescue excavation at the construction since its beginning; it was carried out by the authors of the article (O. Žaár – PAMARCH, Ltd.; A. Nemergut – Institute of Archaeology of SAS (IA SAS); and M. Moravcová – State Geological Institute of Dionýz Štúr [SGIDŠ]). The excavation was carried out in 5 cm thick mechanical layers (layers 1–20). For each layer, a 3–5 litre sample of soil was taken for soil sieving analysis by wet method. The wet-wash preparation method involved agitating the sample in a water suspension. The agitation was done by hand using a wet wash sieve underwater running from a faucet. Sieves with a mesh size of 0.5 mm, 1 mm and 0.5 cm were used for sieving. Due to the short time, only sectors 1 and 3 were fully investigated. The area in both trenches was lowered to the original surface of the structure by approx. 400 cm. It is just a rough estimation (the maximum depth of the excavation for the water tank or the height of the NE profile of the excavation). The exact depth is unknown, since the excavation was located on the hill, on the edge of the slope. However, according to the hill edge relief, the original depth was approx. 350–450 cm. After that, the authors of the article (M. Moravcová, P. Šefčík) carried out a geological-paleontological field investigation of the loess profile in the overburden of the studied "cultural layer" with finds of chipped lithic industry.

The presented article deals with stratigraphy, find context, chipped lithic industry, its cultural classification and dating of the settlement of the studied site from the excavation in question.

History of research

The very first Paleolithic finds from Banka come from the currently closed brickyard, where two lithic artefacts were rescued by M. Greisiger in 1901. It is also one of the few sites providing investigations not only with finds but also with information on stratigraphy. In the course of the excavation by F. Prošek, the brickyard profile had nine layers in total. Unique finds were first detected only in the lowest layer 9 (Prošek, Ložek 1954a, 306); they were classified to the Mousterian by F. Prošek (1950, 179). Finds from later excavations were classified also to later periods, the Gravettian and Neolithic (Bárta 1960, 194). Most of the sites in Banka are known only from surface collections. They were identified mainly thanks to the prospections by L. Zotz and V. Vlk (1939), later by F. Prošek (1953) and J. Bárta (1960). Their chronological classification is often difficult due to possibly mixed finds from multiphase settlement. Leaf points occur in the assemblages exceptionally (e.g. Banka-Škrabalová – Prošek 1953, Tab. V: 12; Banka-Vila Bakchus – Prošek 1953, Tab. XI: 13). They classified settlement at the sites to the Szeletian. Most assemblages are classified to the Gravettian, primarily on the basis of shouldered points (Banka-Chrasť – Kozłowski 2008, Fig. 4: 1; 5: 1, 2; Banka-Kňazovica – Kozłowski 2008, Fig. 3: 1), Kostienki knives (Banka-Hanzlovská – Čerman 2004; Banka-Kňazovica – Žemla 2001, Tab. 39: 3; Banka-Kopanice – Sobczyk 2000, Pl. 17: 10, 11; 18: 1–6) as well as backed pieces. Important information comes from the international excavation at the Kopanice site in 1997. Three cultural horizons were defined. Two of them belong to the Late Gravettian culture – the developed horizon of shouldered points and final horizon of shouldered points. The third layer is dated to the Epigravettian (Alexandrowicz et al. 2000). The last excavation in Banka was executed at the construction in question in 2020. The Archaeological Agency, Ltd. company carrying out a rescue excavation investigated the concentration of chipped lithic industry at the site of Štepnica 1. It was identified in the layer just below the topsoil. It is most probably an assemblage from the Upper Paleolithic and it might be classified to the Gravettian culture. Approx. 2,000 pieces of chipped lithic industry were found. The finds have not been processed in detail yet (personal information).

Stratigraphy

The length of the loess profile was 30 m and its height was 4.5 m. The site of geological-paleontological research and sample taking was approx. 4 m far from the archaeological trench (Fig. 8.3).

Geological description of the loess profile based on the macroscopic features (from the overburden to the subsoil. For evaluating and classifying the colour of the soil, Munsell Soil Color Charts were used [Munsell Color 1992], Fig. 8.3):

- 0–20 cm – A horizon of recent soil. Colour 2.5Y 4/6
- 20–90 cm – B horizon of recent soil, dense roots, soil edaphon. Colour 2.5Y 5/4

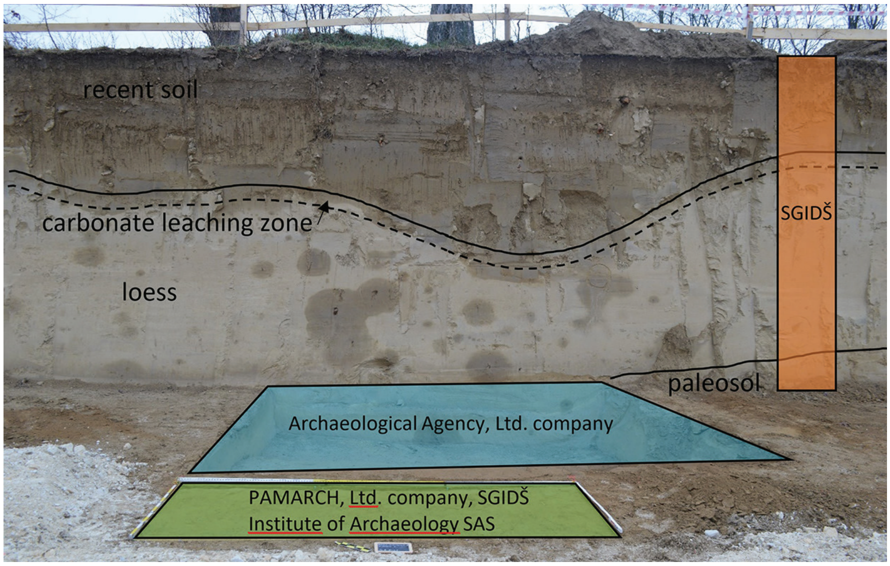

Fig. 8.3. Banka-Štepnica 2. Scheme of the geological situation at the investigated site. Red – profile studied by SGIDŠ; blue – archaeological excavation by the Archaeological Agency, Ltd. Company; green – archaeological excavation by the PAMARCH, Ltd. Company; IA SAS; SGIDŠ. Photo and graphic by M. Moravcová.

- 90–150 cm – C horizon of recent soil, dense roots, presence of thin white carbonate pseudomycelia. Rare semi-rounded calcium carbonate concretions max. size 3 cm. Colour 2.5Y 4/4.
- 150–160 cm – lower part of C horizon of recent soil, dense roots. Colour 2.5Y 5/4.
- 160–170 cm – transitory horizon between loess (middle-grained silt) and overburdened C horizon of recent soil. Gradual wavy transition. Colour 2.5Y 7/4.
- 170–230 cm – compact loess (middle-grained silt), presence of thin white pseudomycelia of carbonates and Fe oxyhydroxides (colour 10YR 5/8) with diameter of max. 2 mm intensifies towards the overburden. Roots of recent trees are present. Colour 2.5Y 7/4.
- 230–430 cm – compact loess (middle-grained silt) with rare thin white carbonate pseudomycelia, roots of recent trees are present. Fe oxyhydroxides of organogenic origin are present in the root system, fine charcoals in the form of numerous smears. Colour 2.5Y 7/3, 2.5Y 7/4, 2.5Y 6/4.
- 430–450 cm – gradual transition of the subsoil to loess (middle-grained silt), edaphon and roots are not present. Rare archaeological finds. Colour 2.5Y 6/6.
- 450 cm and lower – fossil soil with archaeological finds, rich in charcoals (30–50%).

Samples for further geological-paleontological investigation were taken from the trimmed loess profile (depth 0–450 cm). 3 samples were taken from each 10 cm for the following analyses:

A geochemistry, texture analysis, Ph, carbon content (45 samples, approx. 1 kg each)
B malacofauna, charcoals, inorganic component (45 samples, approx. 2 kg each)
C comparative deposit sample (45 samples, approx. 200 g each).

Four calcium carbonate concretions were taken from the upper part of the profile. Two special samples were taken in metal tubes to identify their age by the OSL method. Along with the samples for OSL dating, two parallel samples of sediments (each of approx. 5 kg) were taken for a complex geochemical analysis. One sample of sediment (approx. 5 kg) was taken for a complex geochemical analysis from the bottom part of the profile – the "cultural layer".

Geological description of the fossil soil containing archaeological finds located under the loess profile based on the macroscopic features (Fig. 8.4):

- 450–543 cm – it is a relatively homogeneous profile, powder clay granularity, fine polyhedral to fine lumpy structure. Colour when wet 10YR 5/6. The root system of recent plans – 3–5 mm thick – and fine roots of 1 mm reach 543 cm deep. Therefore, when taking samples for radiocarbon dating, it is necessary to avoid secondary influence (contamination) and, thus, incorrect dating.
- Features characterizing changes in the intensity of loess sedimentation, pedogenesis and subsequent biogeochemical processes can be identified as follows:
- 450–473 cm deep, there are black organomineral formations (1–1.5 mm) with visible iron rims (iron oxyhydroxides of biogenic origin, it is the result of decomposition of organic matter – plants, roots, etc.)
- 473–518 cm deep, these features disappear. Loess in this zone does not show signs of intense biogenic activity and bears no traces of enrichment by iron oxyhydroxides. It is probably caused by the loess sedimentation prevailing over pedogenesis, or the previous biogenic activity was covered with loess sedimentation and further creation of loess.
- 518–543 cm deep, the loess character is changed, but with properties identical to those 450–473 cm deep.

In the entire thickness of the fossil soil containing archaeological finds, carbonate micronodules or smears, dominant in its middle part, are rarely found. The above-described micro and macro features can be documented in the attached photos of the profile (Fig. 8.3). Details could be only found by means of a mineralogical and geochemical analysis. The fossil soil is situated on a considerably oblique slope falling towards the River Váh. As a result of the sloping hill, layers are being wedged. With regard to this location on a slope, we can assume erosion and solifluction.

Fig. 8.4. Banka-Štepnica 2. Trench PAMARCH, Ltd.; IA SAS; SGIDŠ, sector 3,1 m deep.
A – SW profile; B – NE profile with the spot where a geological sample was taken. Photo by A. Nemergut.

Lithic industry

The finds from this site can be divided into two assemblages. The first assemblage contains the material from the excavation by the Archaeological Agency, Ltd. company. This assemblage consists of 70 artefacts (Tab. 8.1). Sixty-six of them come from the archaeological trench, one from the excavation profile next to the trench and three come from the collection on the heap of earth excavated from the trench. Other than flakes, their fragments, chips (51 examples), blades and bladelets (10 examples), the discovered artefacts included one example of each of the following – a retouched blade, retouched flake, sidescraper, endscraper, notch, splintered piece as well as two fragments of unidentified tools. The assemblage is complemented with a core fragment. The second assemblage presents the excavation by the PAMARCH, Ltd. company, IA SAS and the SGIDŠ. This trench contained 252 finds – 169 examples of chipped lithic industry, 73 charcoals, 5 stones, three lumps of pigment and two shells (Tab. 8.1).

The assemblage of the chipped industry from the trench by the Archaeological Agency, Ltd. company

The assemblage contains 70 pieces of chipped lithic industry (Tab. 8.1). In the raw material composition, radiolarite in various colour varieties prevails (58 artefacts). One artefact was made from quartzite and 11 examples were made from an unidentifiable raw material of grey-white colour, which is more brittle, eroded and resembles chalk. It is possibly a peripheral part of cortex of radiolarite or a similar quartzite or chert. The material does not bear traces of burning.

Tab 8.1. Banka-Štepnica 2. Lithic industry. Graphic by O. Žaár.

	Archaeological Agency, Ltd.	PAMARCH, Ltd. / IA SAS / SGIDŠ	Total
Flakes	51	136	**187**
Blades	10	22	**32**
Retouched tools	8	6	**14**
Cores	1	5	**6**
Unworked stones	0	5	**5**
Total	70	174	**244**

Tab 8.2. Banka-Štepnica 2. Retouched tools. Graphic by O. Žaár.

Retouched tools	Archaeological Agency, Ltd.	PAMARCH, Ltd. / IA SAS / SGIDŠ	Total
Retouched blade	1	0	**1**
Retouched flake	1	2	**3**
Bifacial thinnig flake	0	2	**2**
Endscraper	0	1	**1**
Endscraper on flake	1	0	**1**
Indistinct endscraper	0	1	**1**
Splintered piece	1	0	**1**
Sidescraper	1	0	**1**
Fragment of tool	2	0	**2**
Notch	1	0	**1**
Total	8	6	**14**

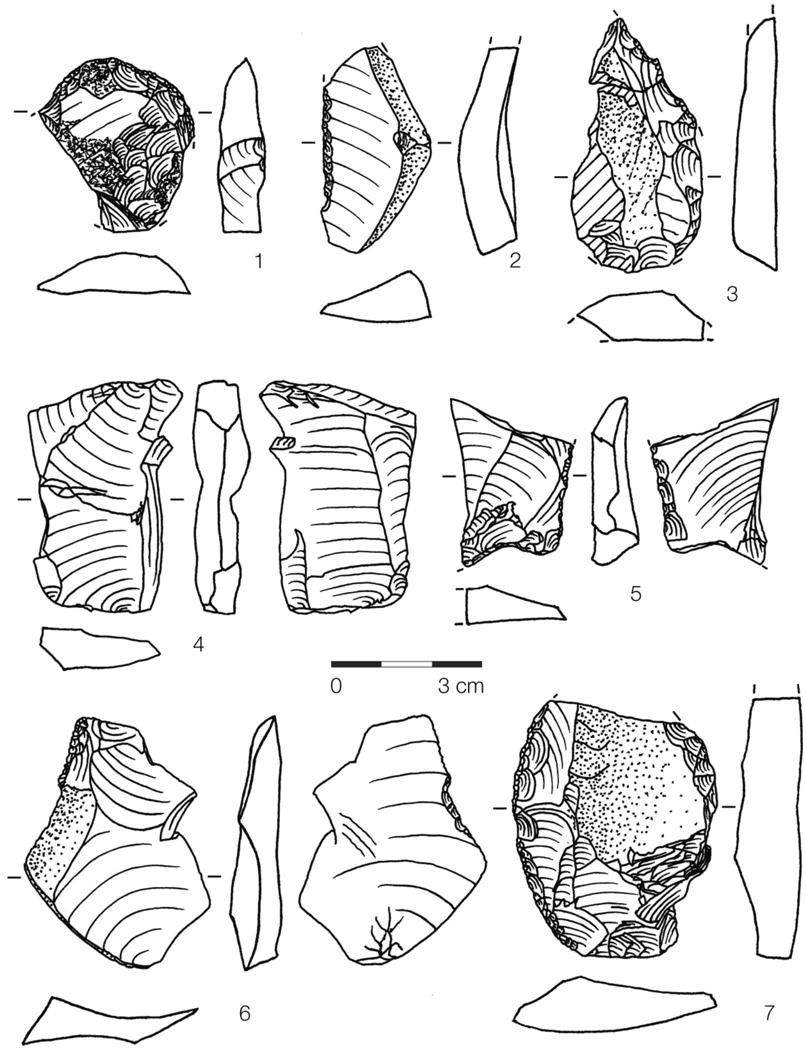

Fig. 8.5. Banka-Štepnica 2. Finds from the trench by the Archaeological Agency, Ltd. company. 1 – Endscraper on a flake; 2 – retouched blade; 3 – fragment of a tool; 4 – splintered piece; 5 – retouched flake; 6 – notch; 7 – sidescraper.
1, 2, 4–7 – radiolarite; 3 – unidentified raw material. Drawing by O. Žaár.

The assemblage consists mainly of flakes (25 examples), fragments of flakes (8 examples) and chips (8 examples), together with blades (9 examples) and a bladelet. Retouched tools are represented by a retouched blade, a retouched flake, a sidescraper, an endscraper, a notch, a splintered piece and two fragments of unidentified tools (Tab. 8.2). The assemblage is complemented with a core fragment.

In the assemblage of 35 flakes, the size varies between 14 and 59 mm of length, 12 to 47 mm of width and 3–18 mm of thickness. The dorsal sides of the flakes were covered with cortex on up to 25% of the surface on seven examples, up to 50% on 6 examples, two flakes had 75% of their surface covered and one was completely covered. The remaining 19 flakes did not have cortex. The most common types of negatives on the dorsal side of the flakes were crosswise (26 examples), followed by opposing (4 examples) and parallel (2 examples) types. No negatives were observable on the three examples. Butts were mostly represented by facetted (9 examples) and plain (6 examples) types. They were followed by dihedral butts (4 examples) prepared by a single negative (3 artefacts), cortical (2 examples) and there was one punctiform/linear butt. Eight butts were unidentifiable. Bulb was mostly conical

(15 examples), less frequently in the shape of micro-negatives (10 examples) and visible (5 examples) or invisible (5 examples). The point of percussion was visible on 27 artefacts; it was invisible on 8 artefacts. Ten flakes were more or less of the blade character and one flake was burned.

The group of fragments of flakes and chips consisted of 16 artefacts. Their sizes varied from 9–44 mm of length, 5–40 mm of width and 2–20 mm of thickness. Four artefacts were covered with cortex on up to 25% of their surface, one had 50% covered and the remaining 11 artefacts did not have cortex. The negatives on the dorsal sides were most frequently crosswise (9 examples), two examples had parallel negatives and one was from a core edge. On four artefacts, negatives were not observable. Butts were not observable on 11 examples; other examples had a plain butt, with cortex, a facetted, a punctiform/linear and a dihedral butt. Bulb was invisible on 11 examples, on three it had the shape of micro-negatives, one was conical and one visible. The point of percussion was invisible on 11 examples and visible on five. Five artefacts bear visible traces of fire.

A smaller group contained blades and fragments of blades (9 examples) and one fragment of a bladelet. Only five blades were complete. The length of the complete blades was 26–75 mm, they were 17–37 mm wide and 6–14 mm thick. The remaining examples consisted of two proximal-mesial parts, two mesial parts and one mesial-distal fragment. As for the cortex on the blades, there was lateral (3 examples), lateral-distal (2 examples) and distal (1 example) cortex. On other blades, cortex was absent. Negatives on the dorsal side were most frequently from a double-platform core (5 examples), less frequently from a single-platform core (4 examples) and unobservable on one example. Facetted butt was the most frequent type (3 examples). There was also a cortical, plain, punctiform, with a lip and dihedral butt – one example of each. There were no butts on the remaining three blades. In five examples, bulb had the shape of a micro-negative, two negatives were conical and three were invisible. The point of percussion was visible on five examples and invisible on three. The edges on the blades were mostly irregular (5 examples), two blades had divergent edges and convergent and parallel edges were represented by one example each. In one case, the shape of the edges was impossible to define. The transverse cross-section of the blades was triangular in 5 examples, trapezoidal in 4 and irregular in 1. The longitudinal profile was straight in four examples. There were also three convex and three twisted examples.

The group of retouched tools (8 examples; Tab. 8.2) is represented by a brown radiolarite endscraper on a flake with partial retouch (Fig. 8.5: 1), a grey radiolarite bilateral sidescraper (Fig. 8.5: 7), a splintered piece from grey-green radiolarite (Fig. 8.5: 4), a shallow ventral notch on a blade flake from grey-green radiolarite (Fig. 8.5: 6), a fragment of a retouched left-side blade from yellow radiolarite (Fig. 8.5: 5) and a fragment of a tool from an unidentified raw material composed of two recently broken pieces (Fig. 8.5: 3).

The assemblage is complemented by one fragment of a core from brown radiolarite with the original surface preserved on one side.

The assemblage of the chipped industry from the trench by PAMARCH, Ltd. – IA SAS – SGIDŠ

The collection of finds of chipped lithic industry consists of 169 artefacts (Tab. 8.1). Among the raw materials used, radiolarite of various qualities and colour shades absolutely prevails (156 examples). In fewer cases, it is probably radiolarite (9 examples) and in four artefacts, the raw material was unidentifiable. The most common colour variety of radiolarite is brown (96 examples), followed by grey-green (40 examples) and yellow (10 examples). Other varieties were found only in minimum numbers. Two artefacts were burnt and two were probably burnt. Four artefacts had the whole dorsal side covered with cortex – they are so-called cortical flakes and one blade. Along with other production waste, they document that besides processing and production of the industry at the site, whole unprocessed nodules of raw material were imported to the site.

The assemblage consists mainly of flakes, blade flakes and small flakes (86 examples in total), followed by fragments of flakes and chips (50 examples in total). Twenty-two blades and bladelets were found. However, they are mainly artefacts with irregular edges, more probably from core modification; some of them might be classified as blade flakes, not typical blades with parallel edges. Six examples of retouched tools were found and the assemblage is complemented with five cores and their fragments.

Among the raw materials in the group of flakes (86 examples), radiolarite prevailed (85 examples). In one case, it was impossible to identify the raw material. Sizes varied from 3–68 mm for length, 5–86 mm for width and 1–28 mm for thickness. Dorsal sides of the flakes were covered with cortex – up to 25% of the surface in 14 examples, up to 50% in 10 examples, up to 75% in four flakes and in two examples were completely covered with cortex. The most common type of negatives on the dorsal sides of the flakes were transversal (32 examples), followed by parallel (16 examples), from the core edge (4 examples), from opposing directions (3 examples) and the dorsal side was completely covered with cortex in 2 examples. Negatives were unobservable in 29 examples. Butts were most frequently represented by two types – linear or punctiform (30 examples) and plain (23 examples). They were followed by facetted (8 examples), dihedral (6 examples) and cortex (3 examples) butts. In 16 specimens, butts were unidentifiable. Bulb was most frequently conical (42 examples), less frequently in the form of micro-negatives (20 examples), invisible (14 examples) and visible (10 examples). The point of percussion was visible in 59 artefacts and invisible in 27 examples. Fourteen flakes had a more or less blade-like character.

The assemblage of fragments of flakes and chips is represented by 50 artefacts. Radiolarite prevails among raw materials (47 examples) over silicite (1 example) and two fragments of unidentified raw material. Dimensions of the artefacts were 5–48 mm in length, 4–50 mm of width and 1–23 mm of thickness. The surface of four artefacts was covered with cortex to as much as 25%, one up to 50%, two up to 75%, one was completely covered with cortex and the remaining 42 examples had no cortex. The negatives on the dorsal sides were most often transverse (11 examples); parallel negatives (3 examples) and negatives from core edges (3 examples) were less frequent. One fragment had secondary negatives from a core edge and one fragment was completely covered with cortex. In the remaining 31 examples, negatives were unobservable. Butts were unobservable on 41 examples, other examples had mainly plain (4 examples) and punctiform and lip butts (3 examples). Bulb was invisible in 42 examples, forms of micronegatives and conical were detected in four examples each and in two examples, it was visible. The point of percussion was invisible in 45 examples and visible in five examples. Two fragments were burnt by fire and two were probably burnt.

The assemblage of blades and bladelets consists of 22 artefacts – 14 blades and 8 bladelets. Radiolarite was the exclusive raw material used for their production. Fourteen examples were complete. The length of the complete blades was 16–52 mm, their width was 7–25 mm and their thickness varied from 3 to 8 mm. The remaining examples consisted of a proximal part of a blade, two proximal-mesial parts, one mesial part, two mesial-distal parts and two distal fragments. The cortex on the blades was lateral-distal (3 examples), lateral (1 example) and one artefact was completely covered with cortex. Other blades did not have preserved cortex. Negatives on the dorsal sides mostly came

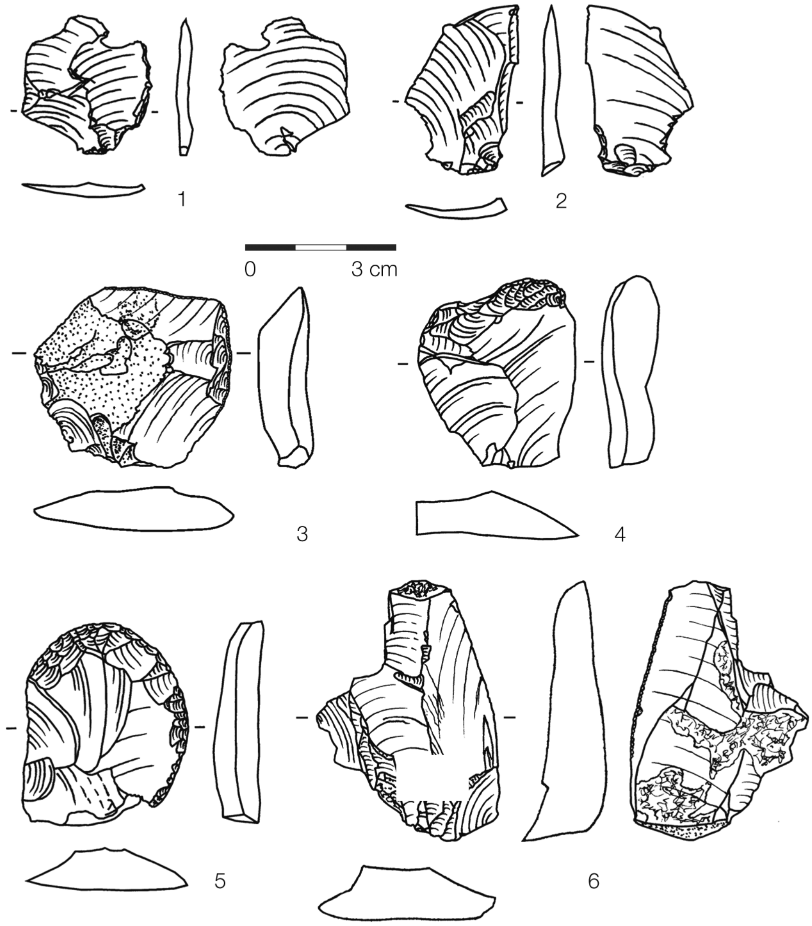

Fig. 8.6. Banka-Štepnica 2/2021. Finds from the trench. 1, 2 – Bifacial thinning flakes (BTF); 3, 6 – retouched flake; 4 – indistinct endscraper; 5 – endscraper. 1–4, 6 – radiolarite; 5 – unidentified raw material. Drawing by O. Žaár.

from double-platform cores (7 examples), fewer came from single-platform cores (5 examples), one was secondary from a core edge, one blade was completely covered with cortex and on 8 blades, negatives were unobservable. The most frequent type of butt was punctiform (8 examples), followed by plain (5 examples), facetted and dihedral (2 examples each). On the remaining five blades, butts were absent. Bulb was often found in the form of micro-negatives (7 examples) or it was conical (7 examples), less visible (3 examples). In five examples, it was unobservable. The point of percussion was visible in 17 examples and in five artefacts, the bottom part of the blade was absent. The shape of blade edges was mostly irregular (10 examples), followed by relatively parallel (5 examples), convergent (4 examples) and divergent (3 examples) edges. The transverse cross-section of blades was triangular in 14 examples, trapezoidal in seven and facetted in one example. The longitudinal profile was straight in 9 examples, convex in seven and twisted in six examples.

The assemblage of retouched tools contains six artefacts (Tab. 8.2) and two bifacial thinning flakes. The most remarkable finds include an endscraper from an unidentified grey-white raw material (Fig. 8.6: 5) and an indistinct endscraper made from brown radiolarite (Fig. 8.6: 4). There were also two retouched flakes from brown radiolarite with miniature utility retouch (Fig. 8.6: 3, 6). With regard to their importance, two bifacial thinning flakes (BTF) were included documenting bifacial artefacts at the site (Fig. 8.6: 1, 2).

The assemblage is complemented with five cores and their fragments. Two cores were prismatic (Fig. 8.7: 1), two block-shaped (Fig. 8.7: 3) and one totally reduced flat core on a flake from grey-green radiolarite (Fig. 8.7: 2). Three cores were completely reduced, one was in the process of reduction and one is a core fragment. All cores were multi-platform examples with changed orientation. On one core, a natural striking surface is documented.

Five stones were found together with chipped industry in the layer with finds (Tab. 8.1). They are small stones, pebbles, and amorphous fragments with a maximum size of 2.9 cm. Two of them were from quartz, one was granite and in two examples, the raw material was not identified.

The distribution of finds in sectors was relatively even (Fig. 8.8), despite the fact that sectors A and B show higher numbers, compared to sectors C and D. A layer inclined to NW–W is visible in the side view of the trench. With regard to the location and documents on the position of artefacts (on the side, perpendicular, etc.), it is obvious that the layer not in its intact position. It was affected by solif-

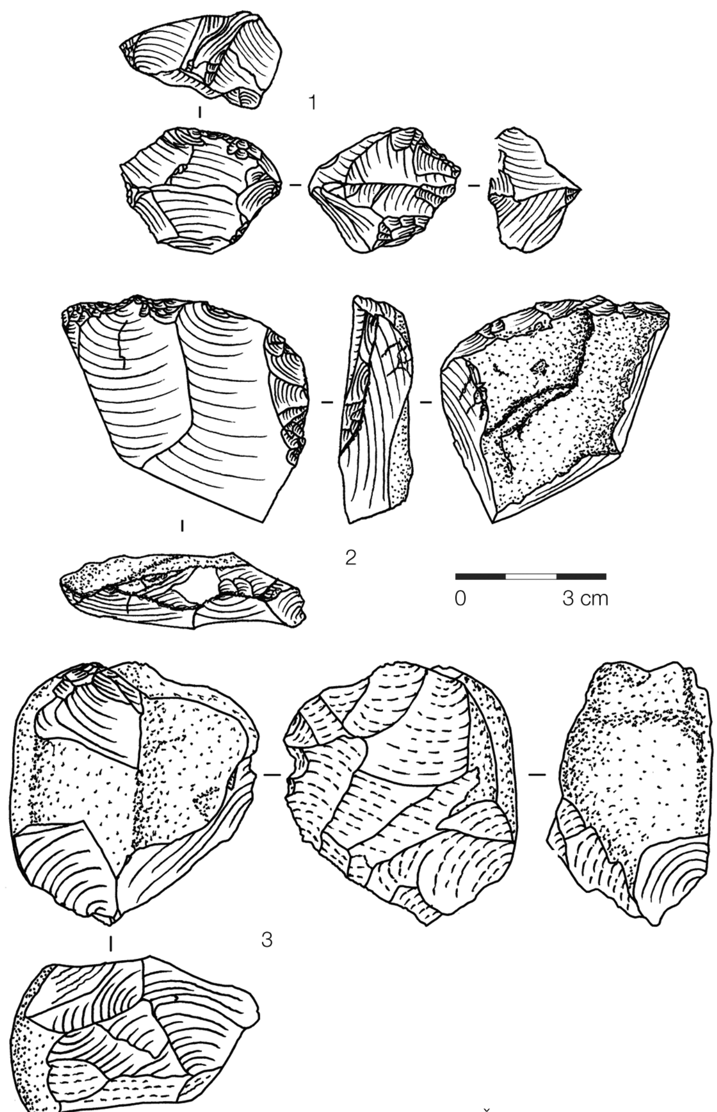

Fig. 8.7. Banka-Štepnica 2/2021. Finds from the trench.
1–3 – Cores. Radiolarite. Drawing by O. Žaár.

luction and slid down the slope from a higher altitude, although it is located just below the hilltop. This means that the slide was minor. Artefacts signalling a "cultural horizon" were discovered from mechanical level 1 to level 17. Most finds were between levels 5 and 15, with the highest density of approx. in levels 7–14. Levels 18 and 19 did not contain findings. Together with one finding in level 16 and two finds in level 17, the bottom of the "cultural level" was assumed there. Nevertheless, sectors 1 and 3 were inspected down to level 20, where a single artefact was found in sector 3C. It is unknown whether it is a signal of postdepositional vertical shift (fall), the continuation of the layer or another part affected by solifluction or a new layer, since there was no scope within the project for investigation of the deeper layers.

Radiocarbon dating

Three samples of charcoals were used for radiocarbon dating in the laboratory in Poznan (Poznan Radiocarbon Laboratory, Poznan, Poland) (Tab. 8.3). Sample No. 193 from mechanical level 10 was sent first in 2021, without specification. By the end of 2022, another two samples from levels 2 and 15 were sent; they were identified by M. Hajnalová as *Picea/Larix* indicating a colder climate (Tab. 8.3). Stratigraphically, all three samples were arranged ascendingly from the top to the bottom of the trench (Fig. 8.9). The sample from level 10 shows the largest spread. For the dating of the site, the datum from the lowest level 15 is the most interesting (33,200 ± 600 uncal. BP) and the oldest. It seems to be the key datum for the definite chronological and cultural classification of the site settlement. It is only 400 years younger than the datum from the site of Moravany nad Váhom-Dlhá (33,600 ± 300 uncal. BP; Kaminská et al. 2011, 44). Based on the dated charcoals, it is possible to chronologically classify the creation of the loess profile containing archaeological finds to the younger part of Middle Pleniglacial, which corresponds with MIS 3 (~60–30 ka BP) (Fig. 8.9). Sedimentation and evolution of this profile was subject to climatic oscillations of stadial and inter-stadial character. We suppose that pedogenetic processes took place in the period of Greenland interstadials GI-8 and GI-7. In the period of Greenland stadials GS-9 (= Heinrich event H-4), GS-8 to GS-7, sedimentation of loesses prevailed over pedogenesis. Above the fossil soil containing archaeological finds, there is loess deposited in the last glacial period (MIS 2). Unfortunately, the period of completion of this loess sedimentation is not documented by dating.

Discussion

With regard to its position and finding contexts, the site is important for the study of the Early Upper Paleolithic. It is the first open site from this period in this territory which can provide complex evidence on paleoclimate and stratigraphy in relation to Paleolithic settlement. With regard to the depth of finds, we can suppose minimum disturbance with modern interferences. Although it is a "cultural layer" affected by solifluction and containing typologically less distinct chipped industry, the high number of well-preserved charcoals provides precious material for the study of flora as well as for absolute dating.

Unfortunately, the extent of the archaeological excavation was very limited. It has been reflected also in the size of the obtained assemblage of the lithic industry. It lacks typical "fossile directeur" which could allow definite cultural classification. Stratigraphy in relation to absolute data is also problematic. The later absolute data possibly associated with the Aurignacian come from the upper levels. However, finds (e.g. carenoid endscrapers, blades, and bladelets) possibly associated with it

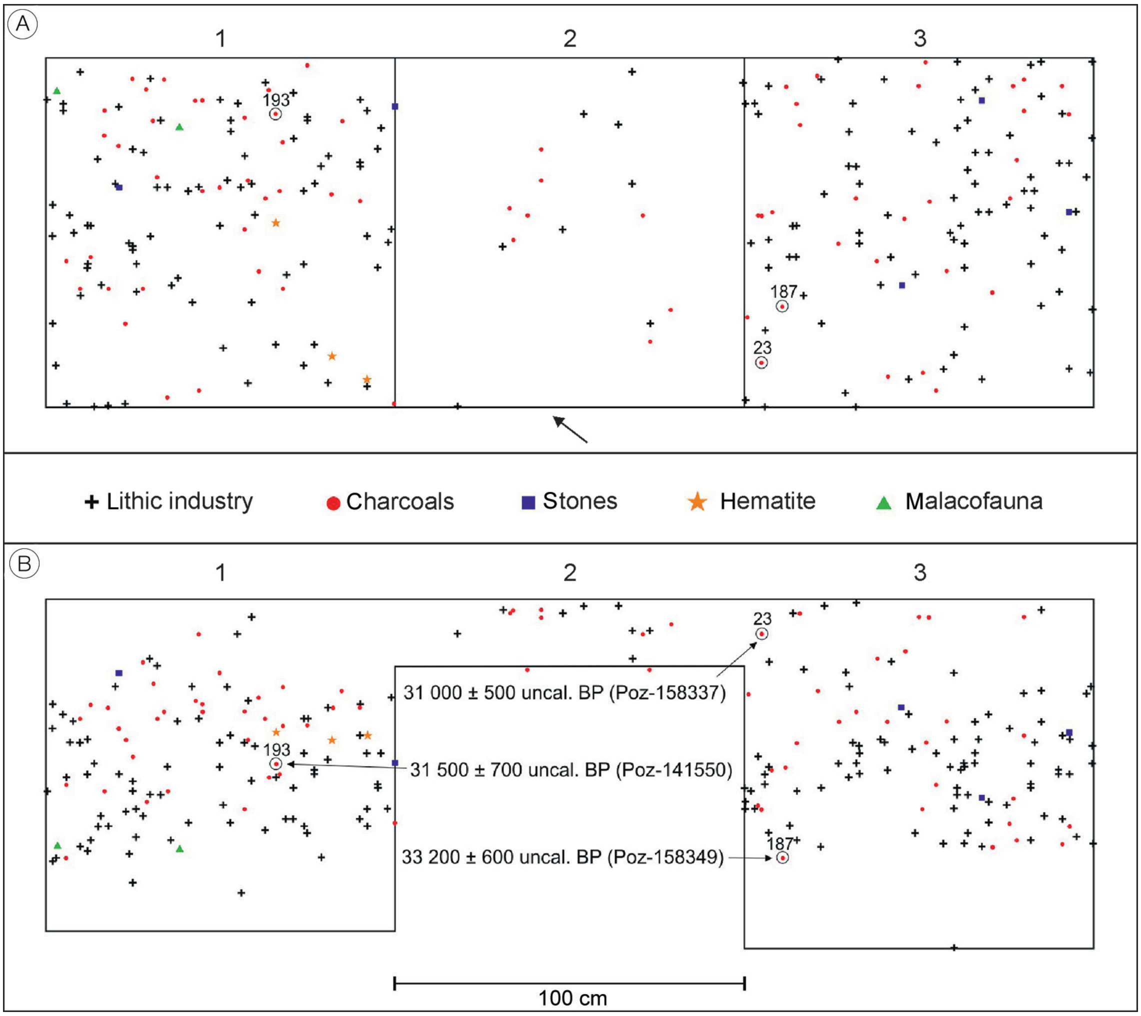

Fig. 8.8. Banka-Štepnica 2. Horizontal and vertical distribution of artefacts in trench by PAMARCH, Ltd. company, IA SAS, SGIDŠ with indicated types of finds and position of charcoals dated by the radiocarbon method. A – Ground plan; B – cross-section. Graphic by O. Žaár, A. Nemergut.

are absent in the lithic industry. The various absolute age of levels is most probably associated with the late redeposition of probably one layer. An intact deposition is also disproved by the great vertical dispersion of finds as well as the vertical incline of artefacts. Nevertheless, the lithic industry from upper as well as lower levels shows signs of homogeneity (radiolarite absolutely dominates the raw material range and most finds are flakes). BTF are an important discovery in the assemblage. They indirectly confirm the presence of bifacial tools, probably leaf points. The earliest radiocarbon datum corresponds with it; it is almost identical with the datum from the nearby Szeletian site of Moravany nad Váhom-Dlhá (Fig. 8.9). It is known with its numerous leaf points, including many BTF, which represent waste from leaf point production (Nemergut 2010, 191–192). The absolute prevalence of the local radiolarite is identical at the sites of Banka-Štepnica 2 and Moravany nad Váhom-Dlhá (Nemergut et al. 2012, table I). In Banka, the sites of Škrabalová and Vila Bakchus, we have recorded two other sites where leaf points – also from radiolarite – were discovered in the course of a surface collection. These are most probably Szeletian sites. In the past, J. Bárta documented an important find context in the region, in the cave of Čertova pec near Radošina, which he also classified to the Szeletian. He did so based on the age of the hearth, which is 38,320 ± 2480 uncal. BP (Bárta 1965, 112).

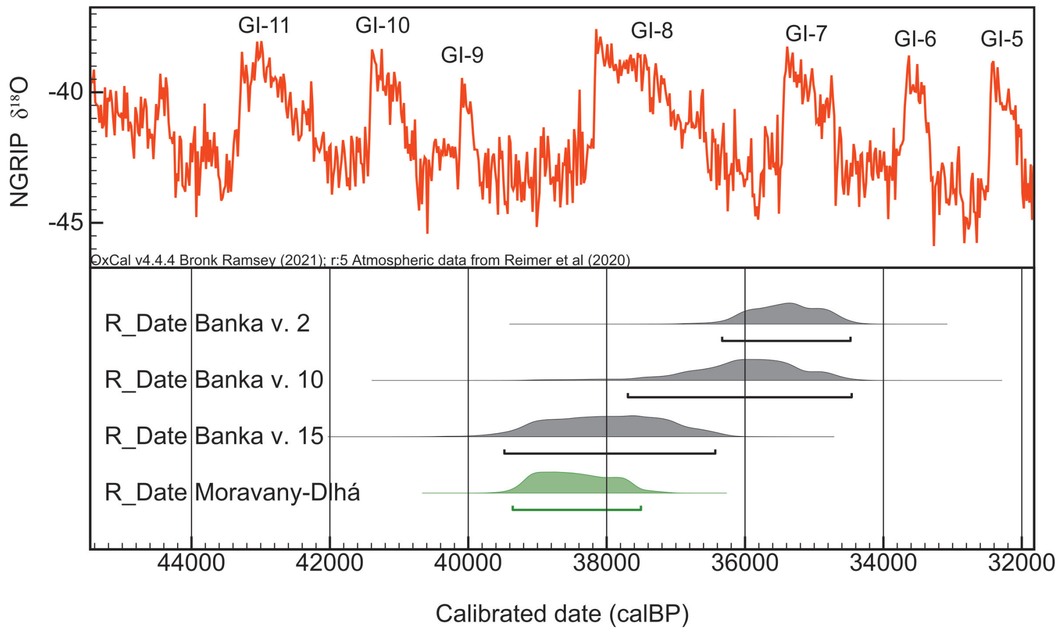

Fig. 8.9. Radiocarbon calibrated dates from Banka-Štepnica 2 (grey) and Moravany nad Váhom-Dlhá (green) sites using the atmospheric calibration curve Intcal20 (Reimer et al. 2020). Graphic by A. Nemergut.

Tab 8.3. Banka-Štepnica 2. Results of radiocarbon dates. Graphic by O. Žaár, A. Nemergut.

Lab. No.	sector	Sample No.	Level	Depth (cm)	Taxon	Date uncal BP	Sigma
Poz-158337	3D	23	2	-10	Picea/Larix	31000	500
Poz-141550	1B	193	10	-47	–	31500	700
Poz-158349	3D	187	15	-74	Picea/Larix	33200	600

Therefore, the new datum from Banka is the third obtained age from Western Slovakia, most probably belonging to the Szeletian. As for other stratified finds from Western Slovakia, such as Vlčkovce (Bárta 1962) or Trenčianske Teplice (Kaminská 2015), absolute data are lacking. Other finds come from surface collections and their affiliation to the Szeletian is assumed based on the presence of leaf points. Points of the Moravany-Dlhá type have a specific status. The largest collection of them outside the eponymous site was discovered in Veľký Kolačín (Kaminská et al. 2008, Fig. 38). They occur in smaller numbers at other sites in the region of Považie (Kaminská et al. 2011). The find from the site of Dolné Srnie-Na kopaniciach oproti háju 2, where one complete point from brown radiolarite was found by surface collecting in the course of an archaeological excavation, is one of the latest finds of leaf points of the Moravany-Dlhá type. The important data for comparison come from Moravia and Hungary, where the radiocarbon dating yielded earlier dates. Regardless of the problematic context of the Szeleta cave industry and the dating (Lengyel, Mester 2008), the recently obtained AMS data come in between 44–41 ka cal BP (Hauck et al. 2016, 283). The absolute data from Moravian sites of Vedrovice V, Moravský Krumlov IV (Neruda, Nerudová 2013, 10) and Želešice (Škrdla et al. 2014, Fig. 9) come within the range of 47–40 ka cal. BP.

Taking samples from the loess profile and their preservation for further analysis was part of the investigation. Studying the loess profile from the aspect of climatic development is extremely important for the microregion of Banka – Moravany nad Váhom – Ratnovce in the Interpleniglacial period (MIS 3) to the Upper Pleniglacial period (MIS 2) and the Holocene. The Middle Pleniglacial (MPG; MIS 3; ~60–30 ka) is characterized by frequent and abrupt climatic changes of high amplitude, represented by repetitive fluctuations in climate systems. This is revealed in high-resolution deep sea and ice core oxygen isotope records (Johnsen, Dansgaard 1992; Dansgaard, Gundestrup 1993; Huber et al. 2006; Hošek et al. 2017). Its beginning is characterized by sudden warming interrupted by short very cold events. Mild warming lasted until approx. 40 000 BP and then the climate gradually cooled until approx. 37 000 BP. In some areas, the climate conditions allowed the evolution of birch-pine taiga and limited expansion of some more demanding deciduous woods. In the dry loess territory of Central Europe, the steppe character of the landscape with specific grass communities and a mosaic of thin boreal forests continued in the Middle Pleniglacial period (Broecker et al. 1985; Frenzel 1987; Haesaerts, Teyssandier 2003; Ložek 2011; Moravcová et al. 2011; Feurdean et al. 2014; Nigst 2014; 2019; Hošek et al. 2017; Andrews, Voelker 2018; Pötter et al. 2023). More demanding woods (spruce, ash-elm riparian forests, etc.) were probably limited to river floodplains (Jankovská, Pokorný 2008; Komar et al. 2009) also documented at the excavated site of Banka-Štepnica 2 (Žaár et al. 2023, 91). The loess complexes of Považie (Moravany nad Váhom, Banka) as well as cave sediments of the Čertova pec cave, the periphery of the southern spur of the White Carpathians (Nové Mesto nad Váhom-Mnešice) and Trnavská pahorkatina hills (Vlčkovce) are among the most important sites in Western Slovakia documenting paleoclimatic and paleoenvironmental evolution of the Middle Pleniglacial period. The loess complexes in Moravany nad Váhom (Hlboký jarok and Veľký jarok sites) and Banka near Piešťany were studied mainly from the sedimentary-petrographical, stratigraphical, zoogeographical, ecological, malacozoological and archaeological points of view. Their investigation was dealt with by V. Ambrož et al. (1952), J. Bárta (1970), J. Hromada (2000), J. K. Kozłowski (2000), B. Hromadová et al. (2021). The main Pleistocene loess complex is situated on the northern wall of the so-called Hlboký jarok site. The loess cover shows three layers of loess separated by two layers of fossil soils. The uppermost loess represents the dry and cold steppe stage of the latest Vistulian stadial. Below, there is loess with relic soil representing the more humid tundra stage of the latest Vistulian stadial. Another loess is classified in the final steppe stage of the second Vistulian stadial with the transition to the previous interstadial. Below this loess, there is a horizon of fossil soils of chernozem character and it represents the well-developed first Vistulian interstadial. Subsoil loesses and loess soils belong to the first Vistulian stadial. Below them, there are soils probably originating in the Eemian interglacial. Trias rocks come up in their subsoil. The loess profile at Veľký jarok site in Moravany nad Váhom is chronologically from the period of the Middle Pleniglacial (MIS 3 period). Accumulation of the bottom loess layer of this profile started before 61,300 ± 3 300 (GdTL-3207) BP. The upper part of the loess was deposited around 42,500 ± 2 100 (GdTL-3208) BP and later. Based on $\delta^{18}O$ values from malacofauna shells, it was discovered that paleotemperature was much lower in the period of the loess deposition process than the average temperature today. This conclusion is supported by malacofauna analysis characterizing this open landscape – a loess steppe in the beginning of sedimentation of the studied loess (around 61 000 BP). The landscape gradually changed into the open landscape with few forests near a water environment (approx. 42 000 BP). The character of the site is reflected in its location on the border between the Považský Inovec mountains' foothills and the River Váh floodplain. The meandering River Váh has always had a great influence on the microclimatic evolution of the studied profile and its surroundings (Šefčík et al. 2019).

Conclusion

Based on the obtained data, the settlement at the site of Banka-Štepnica 2 can be dated to the Early Upper Paleolithic. The lithic industry most probably belongs to the Szeletian. It is suggested by the flake character of the industry, almost 100% share of the local raw material – radiolarite as well as radiocarbon dating, which sets the site to the very end of the Szeletian culture period and suggests its longer existence in our territory. Although leaf points typical of this culture have not been discovered, the presence of BTF is clear evidence of bifacial artefacts at the site. Further analyses of samples from the loess profile along with the "cultural layer" in terms of geology-paleontology will allow us to understand the changing climate conditions in the studied microregion and associate it with other archaeological and geological researches in the area. It was announced shortly after this article had been submitted for printing that the project of construction of a water tank has been changed and the area will not be built up completely. Thus, based on an agreement with the site owner, a new excavation season has been opened, in which excavation of a larger area is expected. It is obvious from the finds so far that the site continues northwards and westwards, where the area is currently available for research. The typological range of tools has been complemented with an endscraper, a retouched flake, and a broken distal part of an unifacially retouched radiolarite point.

Acknowledgment

This article was supported by the Slovak Research and Development Agency under Contract No. APVV-20-0521 and project VEGA 2/0033/23. We would like to thank M. Hajnalová and J. Miháliyová for charcoal analysis.

09

Stone structure D: Fourth paved feature at Mohelno-Plevovce

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Introduction

A salvage excavation was conducted in difficult conditions to recover a fourth stone structure –labeled KSD (abbreviation "KS" is "kamenná struktura" in Czech and means "stone structure" in English) in Mohelno-Plevovce during 2020–2021.

The Mohelno water reservoir (Fig. 1.1: 8; 9.1) is part of the Dalešice waterworks and serves as an equalization basin for the Dalešice Pumped-Storage Hydroelectric Power Station as well as a source of process water for the Dukovany Nuclear Power Station. The power station functions as an energy accumulator; it generates electricity during peak periods and consumes it during off-peak periods of surplus (source: ČEZ, a. s.).

The operation of the power station causes periodic water level fluctuations (Fig. 9.2) in the water reservoir levels by up to 12.4 m between the min. level 290.8 m a.s.l. and max. level 303.2 m a.s.l. (source: Povodí Moravy, s. p.). The fluctuating water levels cause erosion of the Quaternary sediments deposited on the slopes along the shores of the reservoir and this process repeatedly disturbs intact archaeological contexts. For this reason, the site has been under permanent archaeological supervision (including surface surveys, test pitting and subsequent excavations) since 2011 when the archaeological potential of this site was recognized. Unfortunately, the site was not supervised systematically in earlier times (a local forestry worker who reported isolated artefacts, pottery, and "pavement" – Lysák 2005 and pers. comm.), i.e. from 1978 (when the reservoir was filled with water) till 2011. The recent archaeological works have resulted in the discovery of five paved structures (KSA, KSB, KSD, KSE, and KSF; e.g. Škrdla et al. 2016; 2018; Bartík et al. 2020; Augustinová et al. 2023),

doi 10.47382/dvs_26-09

two intact scatterings of Late Glacial Epigravettian artefacts (Škrdla et al. 2015, obr. 2: A), Middle Neolithic (Moravian Painted Ware Culture) sunken features (Bartík et al. 2019), and isolated finds indicating Mesolithic/Late Paleolithic (no stratified context and unpublished), Eneolithic (Škrdla et al. 2012), as well as Early and Late Medieval (Procházka et al. 2019) activities at the site.

As the Dalešice waterworks forms an integral part of the Czech power grid network, and the functioning of the Czech Republic electric grid has priority over archaeological excavations, the salvage archaeological works are only possible when the area is not flooded, i.e. only during short time windows during by maintenance breaks (cf. Škrdla et al. 2018). A short visit of the site is often possible in the early morning (ca 6am), when maximum volumes of water from the lower (VD Mohelno) reservoir are pumped into the upper reservoir, and the water level in VD Mohelno is at its minimum. Sunrise occurs later in the day during wintertime and filling of the upper reservoir cannot be completed each day. In addition, the water-logging of sediments just after reduced water levels make movement over the terrain difficult. The above-mentioned factors make all visits, surveys, and excavation complicated with uncertain results.

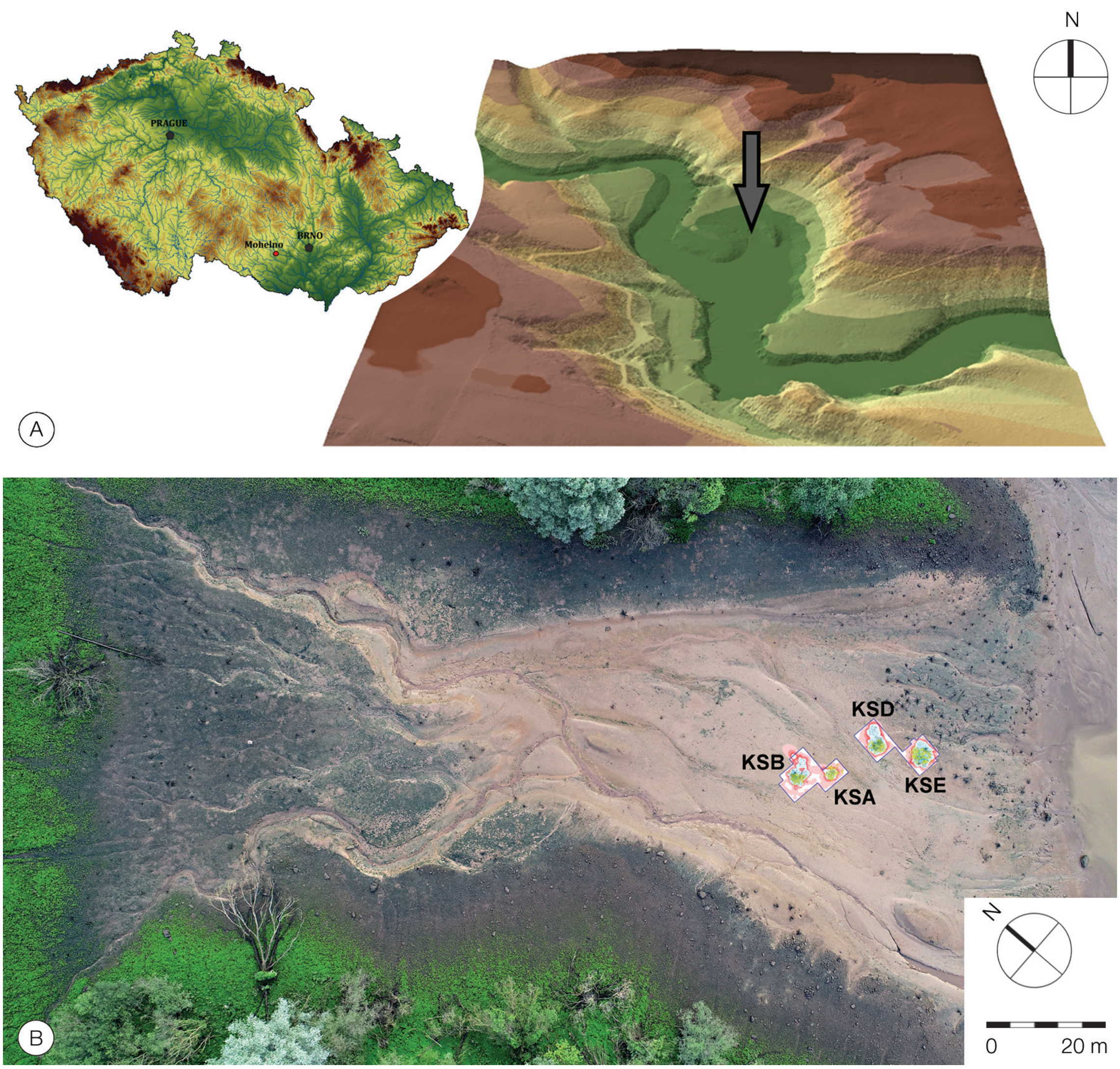


Fig. 9.1. Location of the site (A) and drone image showing individual excavated features (B).

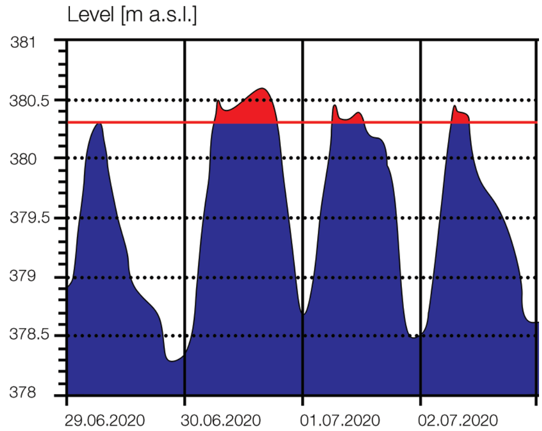


Fig. 9.2. Excavation of KSD. Time windows for excavations. Graphics by K. Augustinová based on the data from Povodí Moravy.

Excavation methodology

Stone structures KSD and KSE in Mohelno-Plevovce were discovered in early 2019. While KSE was excavated in 2019, KSD was excavated during 2020–21. Both structures were excavated over several subsequent excavation campaigns permitted by the time constraints of the short maintenance breaks throughout 2019–2021. The excavation area is almost always under the water surface so opportunities for archaeological excavations are very limited. While KSA and KSB were excavated during longer maintenance breaks that lasted for several days, opportunities for excavation of KSD and KSE were more limited. The excavation was realized during a series of short breaks over three consecutive days. This unusual set of circumstances required a tailored excavation methodology. The field work must be swift, but precise at the same time – we propose to name this technique 'salvage-systematic' excavation. Digging is generally possible for only several hours during the early morning immediately after the area drains, and until the area floods again towards the middle part of the day. The excavated sediments are water-logged and not easy to dig, store, and transport for wet sieving (Fig. 9.3A). The excavation continues until the trenches flood. The following day, water in the trench must be bucketed out (Fig. 9.3B) before the excavation resumes and rising water (from sediment) complicates digging. Before transport to the wet-sieving station, the excavated sediments are placed in buckets (10 l each) and individual sectors (0.5 × 0.5 m) and layers (the 1st layer is sediment above the stones and from gaps between individual stones, the second layer is sediment below the stones) are labelled. Some of the sediments are wet-sieved during the excavation on the edge of the water reservoir in the area of the fluctuating water level, and some of the sediment is transported ca 250 m out of reach of the fluctuating water level to be wet-sieved later. The shape of the stone structure has been reconstructed from photographs using photogrammetry (Fig. 9.3C, 4). No stratigraphic observations, or identification of possible pits or post holes below the pavement, or artefact bearing horizon are possible in these excavation conditions.

The KSD excavation itself was initiated by the removal of a protective "sarcophagus" (Bartík et al. 2020, Fig. 9.3: H) made from local sediment in 2019 to protect the structure from erosion until it can be excavated (Bartík et al. 2020, Fig. 9.3: H). KSD (4 × 3.5 m with additional 0.75 m^2 protrusion, i.e. 14.75 m^2 in total) was excavated using the methodology described above over three days in summer 2020 and two subsequent one day campaigns. In addition, several short-term wet sieving campaigns were realized in order to sieve ca 1/5 sediment buckets that were transported away from the site to be wet sieved later. In total, 460 man-hours were spent on the excavation of KSD – like the 560 man-hours spent on the slightly larger (20 m^2) KSE excavation in 2019. In contrast to the excavation of KSE

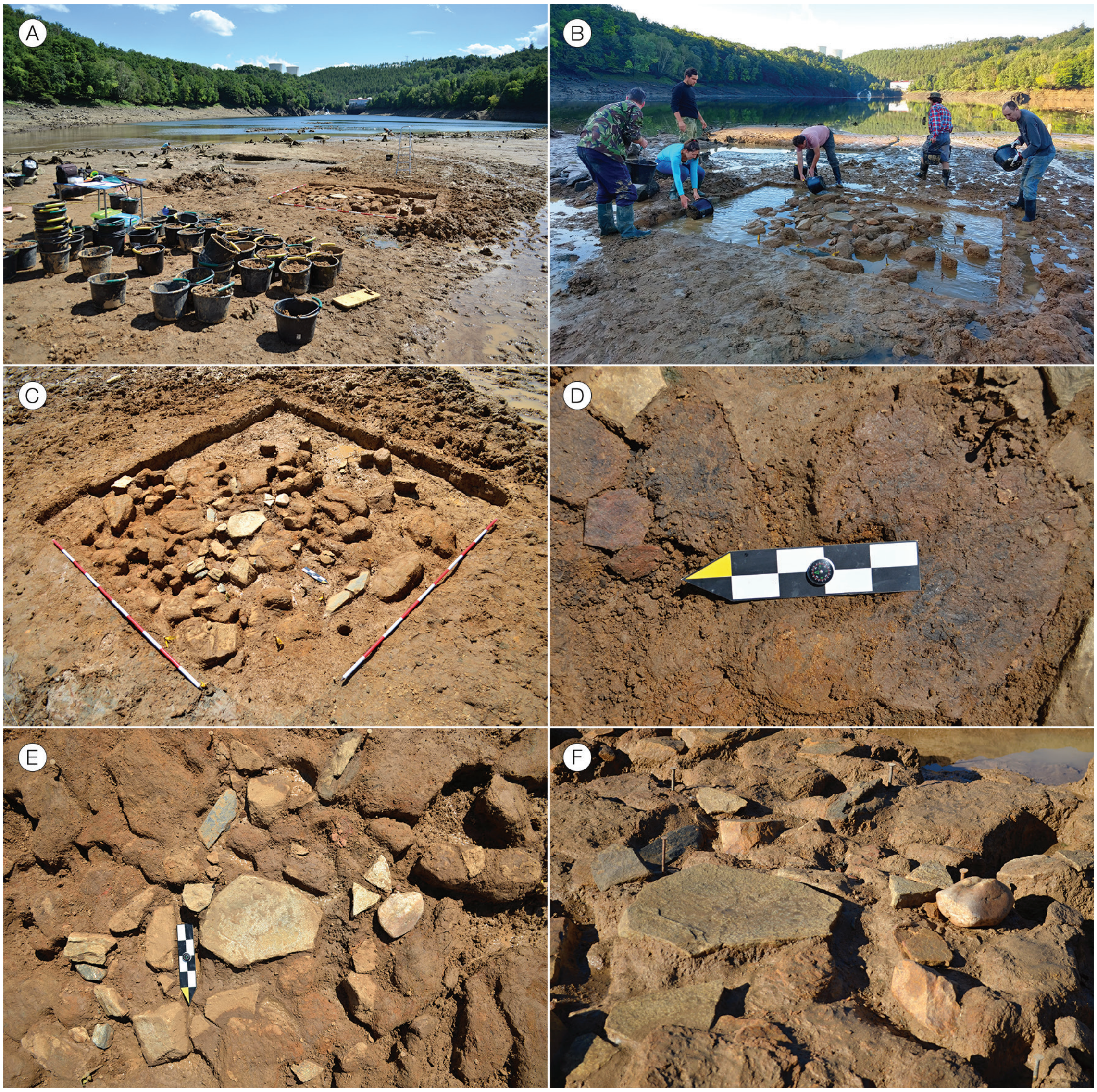


Fig. 9.3. Excavation of KSD. Photo by P. Škrdla and J. Bartík.

in 2019, the maintenance break on first day of the excavation lasted the entire day followed by relatively long breaks on the second and third days, which allowed enough time to clean and document almost the entire KSD structure (see Fig. 9.2 and compare with Bartík et al. 2020, Fig. 9.1).

The excavated material was cleaned in the laboratory and the larger artefacts with field recorded coordinates were labeled with 2D recording numbers. The artefacts obtained from wet sieving (small finds) were deposited in bags separately for individual sub-squares (0.5 × 0.5 m) and levels (upper – above pavement, lower – below pavement). Ochre and osteological material were stored in the same way, labelled by sub-square and level. Finally, all data including 2D recorded artefacts, sieved artefacts, heavy duty implements, ochre, osteological material were stored in a database and added to data from previous excavations at the site.

Charcoal pieces were extracted by water flotation using a mesh size of 0.25 mm. All visible charcoal fragments (> 0.5 mm) were analysed and identified using reflected light microscopy (Nikon Eclipse 80i) with 200–500× magnification and a reference collection. The additional standard identification keys were also utilized (Schweingruber 1978).

In Czech Radiocarbon Laboratory, the charcoal sample was leached repeatedly in 0.5M HCl, water, 0.1M NaOH and 0.05M HCl based on published procedures (Gupta, Polach 1985; Jull et al. 2006; Brock et al. 2010). Subsequently, the samples were dried at 60°C to reach constant weight.

After the pretreatment, the dry sample together with a small amount of Cu O was torch sealed under a dynamic vacuum into a quartz glass tube and combusted at 900°C for at least 12 hours. The resulting carbon dioxide was then purified and transferred into the graphitization reactor. The batch method of graphitization with pure Zn as a sole reduction agent was derived from similar routines described by Rinyu et al. (2015) and by Orsovszki and Rinyu (2015). Following the graphitization step, the sample was sealed in vacuum and sent for AMS measurements to the radiocarbon laboratory in Debrecen with international code "DeA" (Molnár et al. 2013a, 2013b).

The measurement was carried out with the EnvironMICADAS compact tandem accelerator (Kromer et al. 2013; Molnár et al. 2013b). Graphitized samples of oxalic acid NIST HOX II SRM 4990-C were used for calibration (Schneider et al. 1995). Graphitized samples of fossil phthalic acid anhydride were then used for correction of background contributions.

Results

A preliminary analysis of spatial distribution (Krigging method in Surfer software pack) of lithic finds identified two areas where the finds overlap the pavement boundary – a southern fold and a northeastern fold (Rychtaříková et al. 2021, Fig. 9.9). For this reason, but also due to the short duration of the planned maintenance breaks, emphasis was placed on completing the KSD area, rather than initiating excavation of KSF during 2021. The excavation of KSD was conducted during a short break in August that was followed by a series of short early morning visits when 2–4 sub-squares were usually excavated and wet-sieved. An estimated total of 170 man-hours were spent on excavation and wet-sieving during 2021. A post -Paleolithic intrusion extended into the northern part of KSD. The excavated sunken feature was tentatively interpreted as a natural spring paved with stones and a drainage channel. As it lacked any archaeological material apart from redeposited artefacts from the KSD feature, its age is unknown.

In conclusion, a series of fieldwork campaigns in 2020 and 2021 resulted in the excavation of an area of 6.0 × 4.5 m, which is equivalent to 27m². Approximately 630 man-hours were spent in the field. The artefact cluster was followed to the area where artefact density dropped off to only isolated artefacts within a sub-square, or an empty sub-square.

Planography and spatial distribution

KSD, like KSB and KSE, is composed of two parts – the paved area and a northeastern unpaved prolongation (a fold). The paved area has a shape of an irregular circle (an irregular pavement hexagon) with a diameter of 3.0 m. The unpaved fold is 2.5 m long and ca 2.0 m wide. The artefact density within the paved area is higher (Fig. 9.5). An important situation was uncovered when a large central stone was removed (at coordinates: [1700, 400]) – a lens including tiny charcoal pieces and decomposed horse teeth (Fig. 9.3D). The charcoal was subjected to anthracological analysis and AMS dating.

Fig. 9.4. Rectified photo of KSD. Photo by J. Bartík.

Artefacts

The excavated artefacts are divided into two groups: (i.) larger items are recorded with X, Y coordinates and depth information (above pavement or below). There are 576 items in this group. (ii.) Most small finds are placed in this category with the majority being waste products found during wet sieving. They number 4,615 items. Sub-square and depth information is recorded for each.

The raw material, technology, and typology were also recorded for each artefact in both groups. Fourteen macroscopically identifiable microliths were recognized, however, there may be more present and a more detailed analysis requiring special magnifying equipment will be conducted later.

Raw materials

Tab. 9.1 lists artefact counts and total weight for each raw material. Inventoried artefacts are listed separately to see if the data for this group is representative of the whole collection and whether it can be used for comparison between individual stone structures.

Rock crystal followed by quartz (petrographic distinction between these two categories is unclear) are the dominant raw materials. The nearest outcrop of both raw materials is currently known within a quartz/rock crystal vein located ca 400 m southeast of the site, however, more such outcrops probably exist in the nearby surroundings. Some of the rock crystal artefacts have well developed crystal surfaces and in combination with the presence of smoky quartz, an origin from more distant outcrops (ca 40 km to the north) located within the River Oslava catchment area is expected (cf. Valoch 2004; Vokáč 2004). In addition, several artefacts possess abraded (chemically corroded and mechanically abraded) crystal surfaces resulting from colluvial deposition. Several rock crystal and quartz artefacts show pebble cortex indicating raw material origin in fluvial sediments (probably nearby gravel terraces, so-called Moldavite-bearing deposits, Vokáč 2004). Also, the Krumlovský les-type chert was available in these local gravels (Vokáč 2004). The weathering product of serpentine of Plasma-type (8.1%) is known from several serpentine outcrops in the area (Vokáč 2004). Nearest currently known outcrops (utilized during the Neolithic) are

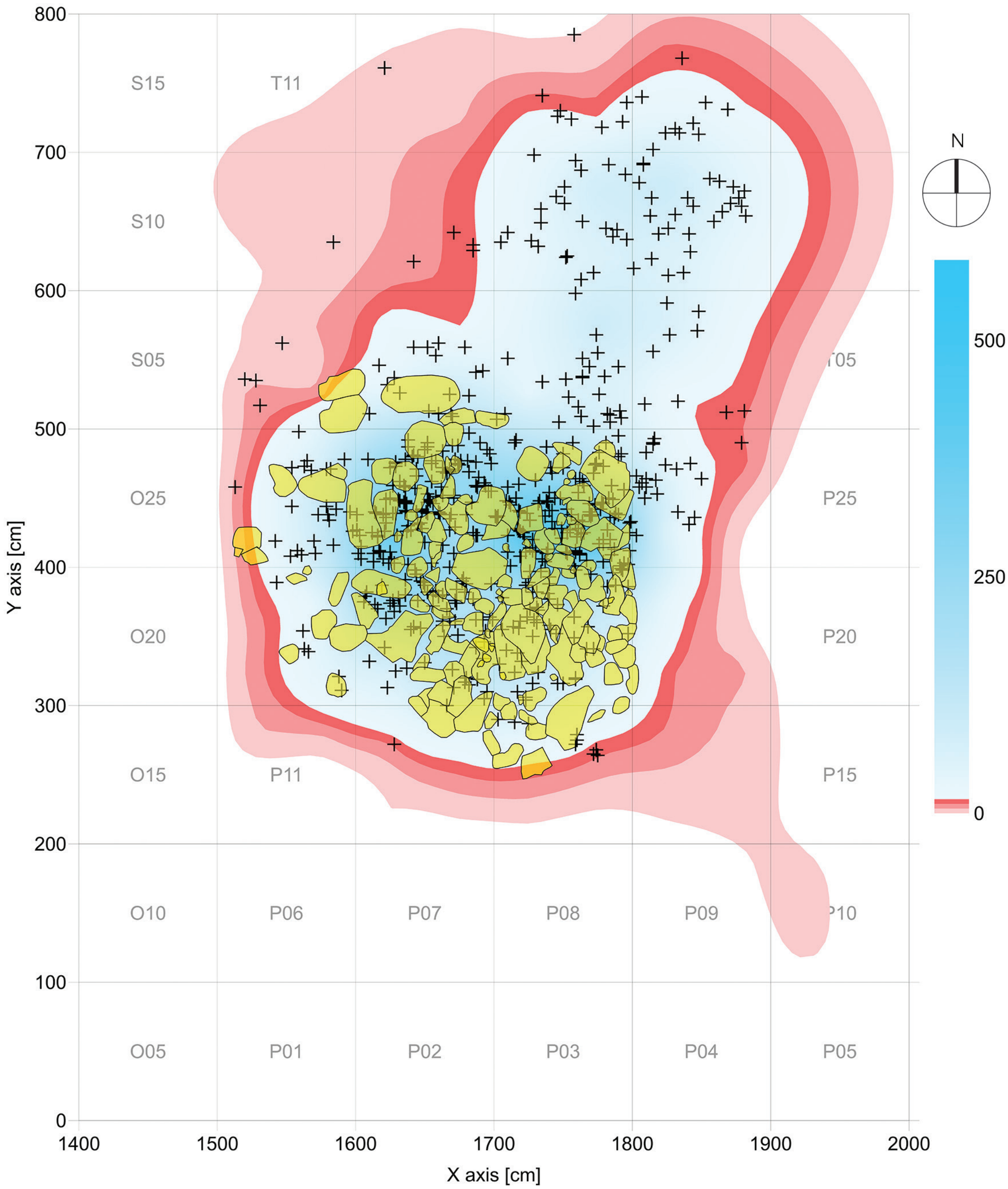


Fig. 9.5. Spatial distribution of finds. Graphics T. Rychtaříková and P. Škrdla.

at Dukovany, ca 2 km (Nad studánkou field) and 6 km (Vinohrádky field) to the southeast. The weathering product may also originate from these outcrops. Erratic flint was imported from glacial-fluvial outcrops located at least 150 km to the northeast. Red radiolarite with primary cortex was probably imported from the well-known source in the White Carpathians (ca 140 km to the east), however, closer Austrian outcrops (e.g. Wien-Mauer, ca 100 km to the south, or Danube gravels with the nearest locations slightly closer (Přichystal 2013), cannot be excluded. The collection also contains one artefact made from a greyish-black radiolarite with brownish weathering surface of as-yet unknown origin.

Tab 9.1. Data for individual raw materials

	Raw materials	Inventoried artefacts only				Small finds			
		No. of items		Weight [g]		No. of items		Weight [g]	
Local	Quartz	170	29.5	4891.08	64.6	1246	27	279.7	39.28
	Rock crystal	277	48.1	1917.57	25.3	2489	53.9	340.24	47.78
	Plasma	48	8.3	578.66	7.6	259	5.6	31.78	4.46
	Smoky quartz	13	2.2	34.39	0.45	30	0.7	19.97	2.80
	KL chert	5	0.9	36.5	0.5	14	0.3	5.34	0.75
Imported	Erratic flint	58	10.1	95.76	1.3	510	11.1	30.22	4.24
	Red radiolarite	4	0.7	13	0.2	64	1.4	4.82	0.68
	Black radiolarite	1	0.2	4.12	0.05	3	0.1	0.08	0.01
	TOTAL	**576**	**100.0**	**7,571.08**	**100.0**	**4,615**	**100.0**	**712.15**	**100.0**

A new question asked for the KSD lithic material was artefact numbers and weight per raw material. Raw materials imported from greater distances including erratic flint and radiolarite follow the expected pattern predicting more economical use – their proportion is greater in numbers than weight, suggesting the raw material was reduced to complete exhaustion. While local quartz artefacts show higher weight values, other local raw materials (including rock crystal, smoky quartz, and plasma) show different patterns. While the number of items and weight proportions for plasma and Krumlovský les-type chert are similar, the proportion of artefact numbers is twice that of the weight proportion for rock crystal and smoky quartz (perhaps the influence of higher cleavage resulting in more tiny chips?).

The data presented above are consistent with economizing of imported rocks compared to local rocks. The differences in local rocks are probably related to raw material quality. The raw material data form a separate analysis of inventoried items differing from data obtained from the whole collection in single percents only and point to the separate analysis of inventoried items as a good base for inter-stone structures analysis.

Technology

The technological spectra for inventoried artefacts and small finds were analysed separately and then summarized (Tab. 9.2). Small chips and shatter dominate. Apart from these two categories, the KSD lithic assemblage is characterized by prevailing flakes, supplemented by splintered pieces / bipolar anvil cores (Fig. 9.6: 33–55; 7: 1), cores (Fig. 9.7: 2–4), and microcores. This technological composition is like the previously analysed KSA, KSB, and KSE. A small part of the assemblage metrically corresponds to complete and broken blades and microblades. The rest of the collection consists of burin spalls, unidentified fragments, and unmodified raw material pieces. In the raw material, quartz and rock crystal are often present as small fragments whereas plasma has more burin spalls and bladelets. Burin spalls, blades and bladelets are more frequent for erratic flint.

Total (including small finds)			
No. of items		Weight [g]	
1416	27.3	5170.78	62.4
2766	53.3	2257.81	27.25
307	5.9	610.44	7.4
43	0.8	54.36	0.7
19	0.4	41.84	0.5
568	10.9	125.98	1.5
68	1.3	17.82	0.2
4	0.1	4.2	0.05
5,191	**100.0**	**8,283.23**	**100.0**

Tab 9.2. Technological categories

Category	Inventoried only	Small finds	Total collection
Raw material	15	2	**17**
Core	37	-	**37**
Microcore	6	2	**8**
Bipolar anvil core	37	-	**37**
Flake	406	84	**490**
Flake, partially ret.	2	1	**3**
Blade	7	2	**9**
Broken blade	7	1	**8**
Bladelet	16	48	**64**
Broken bladelet	-	7	**7**
Bladelet, partially ret.	1	-	**1**
Chip	-	3,973	**3,973**
Fragments	17	-	**17**
Shatter	-	474	**474**
Burin spall	7	21	**28**
Tool	18	-	**18**
TOTAL	**576**	**4,615**	**5,191**

Typology

There are 16 tools (3.2% of assemblage, counted without microlithic tools, but not all have been identified yet), that include burins (5 items), endscrapers (7 items), a borer (Fig. 9.6: 19), a combined tool (a truncation with a notch, Fig. 9.6: 20), and four retouched flakes (Fig. 9.6: 8, 9). The burins include a multiple burin (Fig. 9.6: 32), a burin on a truncation (Fig. 9.6: 22), a burin on a retouched point (Fig. 9.6: 23), a transversal burin (Fig. 9.6: 21), and a burin on a broken bladelet (Fig. 9.6: 31). The endscrapers include two atypical carinated endscraper/cores (Fig. 9.6: 11, 12), two endscrapers on a short flake (Fig. 9.6: 15, 16), an endscraper on a blade (Fig. 9.6: 13), an endscraper on a broken blade (Fig. 9.6: 17), and an endscraper combined with a notch (Fig. 9.6: 14). The last five items are thin in cross section. An atypical carinated endscraper/core (Fig. 9.6: 24) was found during surface preparation before excavation (not included in the inventoried artefacts list). In addition, two flakes (Fig. 9.6: 18) and a bladelet (Fig. 9.6: 3) are partially retouched.

Considering raw material preferences, erratic flint was preferred for tool production (11 of 18 items, 61.11 %, i.e. almost 2/3; without microliths).

A collection of 14 tiny microliths including characteristic Sagaidak-Muralovka-types retouched into a point were identified macroscopically (Fig. 9.8). Their length ranges between 5–15.6 mm and width between 2.3–8.5 mm.

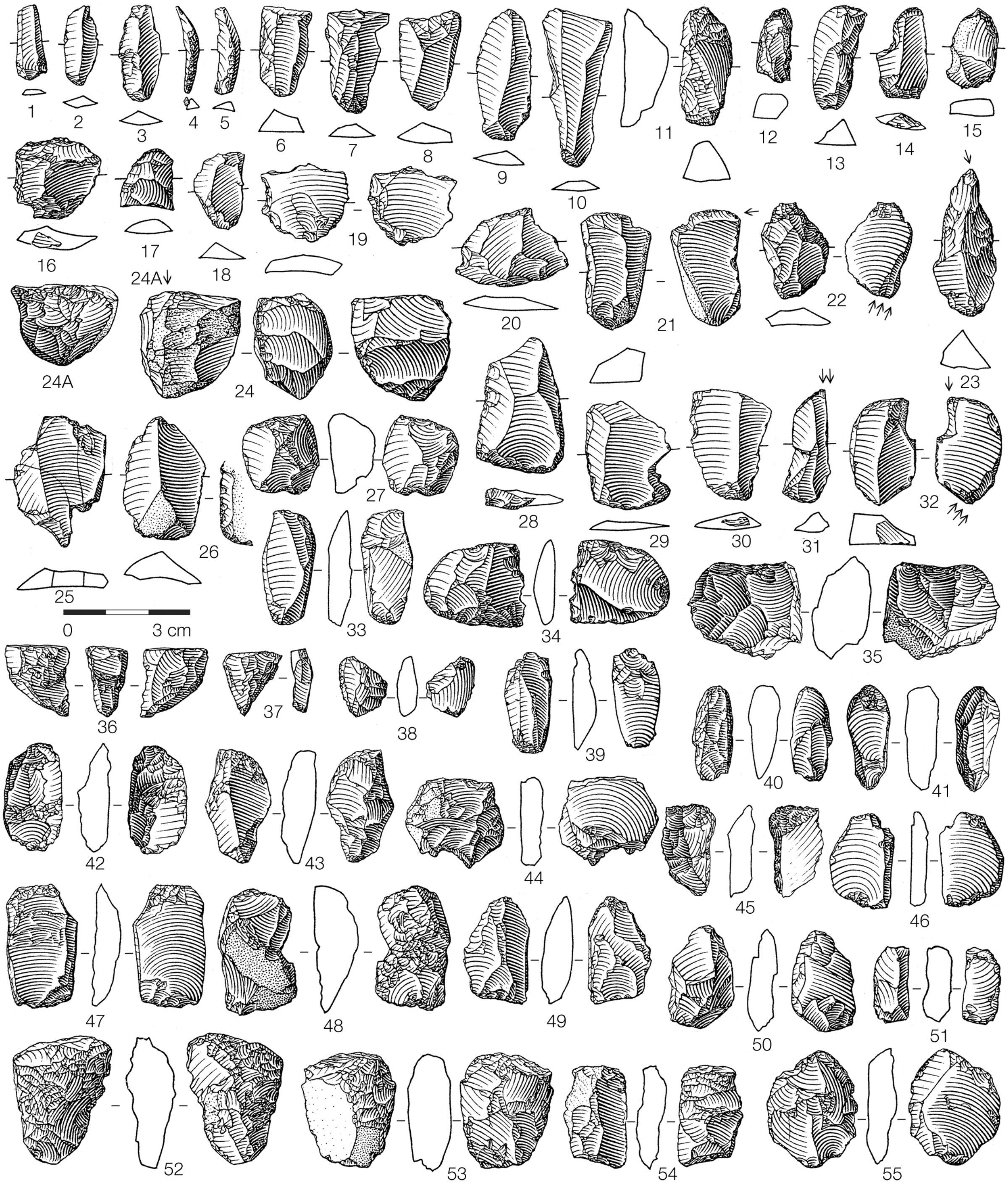


Fig. 9.6. Selected artefacts. Raw materials: 1, 4, 5, 9, 10, 13–16, 19, 20, 25–34 – Erratic flint, 2, 3, 6–8, 11, 12, 17, 18, 22, 23, 36–55 – rock crystal, 21, 35 – radiolarite, 24 – plasma.
Drawing by J. Brenner.

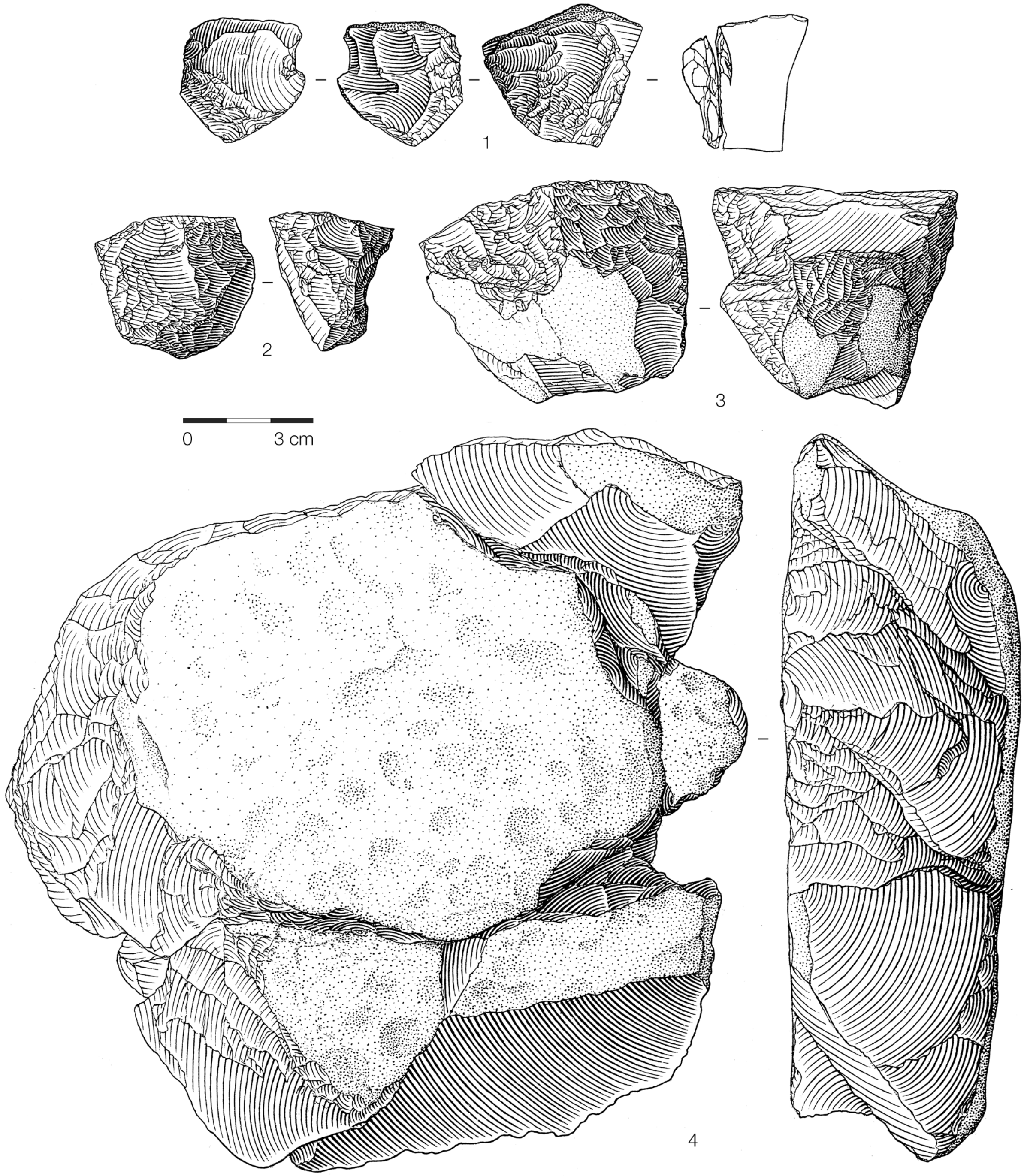


Fig. 9.7. Selected artefacts. Raw materials: 1 – Plasma, 2 – rock crystal, 3, 4 – quartz.
Drawing by J. Brenner.

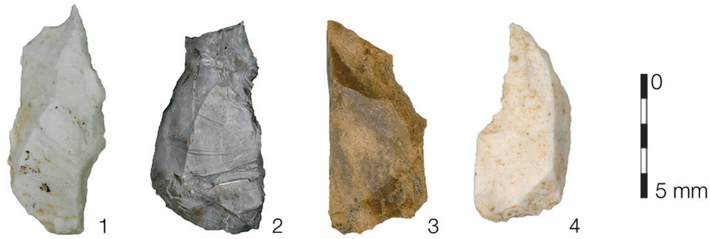


Fig. 9.8. Selected microliths.
Raw materials: 1, 4 – Erratic flint,
2 – rock crystal, 3 – plasma.
Photo by K. Augustinová and J. Bartík.

Heavy-duty stone industry

Stone structure D (hereafter KSD) yielded 235 pieces interpreted as heavy duty implements. These artefacts are characterized by traces of pounding, grinding, or polishing. These artefacts were identified among the floor stones (however, some of them were located stratigraphically higher, seemingly above the pavement – Fig. 9.3E, F), where orthogneiss predominates. Despite the weathered surface of the orthogneiss, it cannot be conclusively determined whether it was used as part of the floor, or as a functional artefact. Use of pavement stones for a wide range of other activities has already been noted at a similarly dated site in Grubgraben (Montet-White, Williams 1994). In KSD, fragments of slabs with working surfaces made of granulite and amphibolite, as well as fragments with negatives and clearly visible bulbs, were observed and analysed.

Artefacts in this group generally include tools made from rough raw materials, or large artefacts with traces of knapping. The industry can be distinguished based on the raw material (granulite, amphibolite, orthogneiss, quartz, etc.) used, the shape of the artefact (boulder, slab fragment, fragment, etc.), and the traces of work on the surface (pounding, grinding, smoothing, polishing, etc.).

Orthogneiss is the most frequently used raw material in the heavy-duty industry at KSD, followed by granulite, amphibolite, quartz, and quartz sandstone. The type of raw material used is related to the object function. There is a correlation between individual raw material and artefact function – while the granulite and amphibolite (probably also orthogneiss) slabs were utilized as pounding and grinding pads, the quartz pebbles were utilized as hammerstones. There are pads and slabs made of granulite, amphibolite, and probably also orthogneiss (despite considerable weathering on the surface, however, it was not possible to analyse them in greater detail), while hammers and polishing tools are made of quartz, or quartz sandstone.

It can be assumed that this industry was part of the site furniture (material left at site for future use) according to L. Binford (1979). The refitting method was used to assemble 26 puzzles consisting of two to five pieces. Despite the large number of relatively large fragments of granulite plates, it was not possible to refit them, suggesting that they were broken elsewhere and then brought to the KSD area (a similar situation is also evident at KSE; cf. Bartík et al. 2020, 53).

In the future, a separate study will be devoted to the detailed processing and description of the use-wear traces on individual artefacts. Associations between technological properties of the raw material, morphological attributes and use-wear traces can be observed on the artefact (cf. Svoboda 1997b; Svoboda et al. 1999, 19). Overall, the analysis of the material from KSD provides insight into the technology and raw materials used in heavy-duty industry during the time in question.

Ochre

A series of 639 tiny pellets of hematite were recovered during wet sieving. Their weight is 68.7 g and mean weight of an individual pellet is 0.11g. Their maximum dimension does not exceed 10 mm. The nearest known outcrop of similar material sourced from a weathered outcrop of serpentinite is near Dukovany, close to the plasma outcrop in the Vinohrádky field. This outcrop was exploited for Fe-ores in the more recent past (Dufek 1991).

Osteology

Preservation of osteological material was very poor. The bones and teeth were strongly weathered and disintegrated into many fragments during the wet sieving process. Only 7 horse molars were recognized. The rest of the osteological collection consists of over 210 small tooth fragments and 32 small bone fragments. Not enough diagnostic details are present for taxonomic identification, or a more detailed description.

Anthracology

Charcoal analysis identified 41 charcoal fragments. *Juniperus* sp. is most common (34 charcoal fragments, percentage proportion 82.9%) followed by *Pinus* sp. (five charcoal fragments, percentage proportion 12.2%) and *Betula* sp. (2 charcoal fragments, percentage proportion 4.9%). The charcoal fragments were very small.

Radiocarbon dating

An age estimate of 19341 ± 58 BP (DeA 20_598) was obtained which is like previous dates from this site (Tab. 9.3) and fits well within a time-range of similar industries from neighbouring countries (Škrdla et al. 2021).

Tab 9.3. Radiocarbon dating for individual stone structures, calibrated using CalPal software (Weninger, Jöris 2008) on the IntCal20 curve (Reimer et al. 2020).

Lab. No.	Structure	Material	14-C age BP	calBP
DeA 20_598	KSD	Juniper charcoal	19,341 ± 58	21,440 ± 242
Poz-76195	KSA	Juniper charcoal	18,970 ± 110	20,885 ± 150
Poz-76196	KSB	Juniper charcoal	19,100 ± 110	21,103 ± 103

Discussion

KSD stone structure is the fourth feature of similar shape, dimension, and associated material culture excavated at Mohelno-Plevovce. The features documented to date are distributed in an arc-shaped pattern and roughly equidistant from each other. The area in the centre of this arc was eroded away before our salvage excavations begun.

The shape of KSD is like other features – the maximum dimension (diameter) of the paved area differs only by tens of centimetres from the other stone structures (KSA: 3.0 × 3.3; KSB: 3.0 × 3.0; KSE: 2.8 × 3.6 m). The northwestern fold was also documented in KSB and KSE (it was not expected and went unnoticed (if it was present) in KSA and the area is now destroyed so it cannot be revisited to test for the presence of this fold). In comparing artefact numbers, KSD yielded a slightly smaller number of items than KSE, ca twice more than KSB, and significantly more artefacts than KSA.

The general composition of the lithic industry is similar at all the excavated stone structures with several minor but notable differences. While the KSA is characterized by greater proportion of erratic flint, the raw materials spectra of KSB, KSD, and KSD are all similar and local raw materials prevail. In contrast to other stone structures, KSD exhibits a greater proportion of blades, bladelets and elongated chips. The endscraper / burin ratio is similar in all the assemblages.

The data available to date allows for a preliminary discussion about site function, season of occupation, contemporaneity / non-contemporaneity of features, and mobility patterns.

The lithic material analysis suggests the following activities:

- raw material exploitation – indicates substantial knowledge of the surrounding landscape and knowledge of various local outcrops;
- adaptation to knapping of different kinds of rock (including low-quality rocks), production of blanks and tools;
- transporting large and heavy stones for several hundred meters for pavement construction – indication of longer term rather than short term occupation.
- presence of northeastern protrusion of the lithic cluster outside the paved area – an area shaded by the hypothetical hut during late morning, noon, and afternoon when the sun was highest in the sky and sunlight was most intense;
- production of microliths indicate curation of hunting equipment (retooling) and, indirectly, hunting;
- antler working and hide scraping (Rios-Garaizar et al. 2019) – also indicate domestic activities.
- plaques, anvils and hammerstones, often broken and heavily damaged – indicate powdering and hammering;
- red ochre acquisition and use;
- large structured hearths inside features are missing.

As for seasonality studies, the absence of combustion features inside the paved areas and the acquisition of rocks from local outcrops excludes winter occupation when the heating of shelters is necessary and the ground is frozen. The absence of osteological material makes seasonality attribution difficult, but it is likely to have taken place between spring and fall.

Five similar stone structures located at similar distances from each other have been documented so far. Two hypotheses can be generated about their contemporaneity:

1st Sequential visit hypothesis (not contemporaneous): the features are a result of repeated seasonal visits of a small band (Škrdla et al. 2018; Rios-Garaizar et al. 2019; Demidenko et al. 2021) who came with distant raw materials (KSA) and soon adapted to utilization of local raw materials on following visits.

2nd Village (communal) hypothesis (contemporaneous): the features were occupied at the same time (a single visit, or repeated visits) by a large group consisting of several units which is known from Paleo-Innuits (cf. Coulson, Andersen 2020) and present day Siberian nomadic tribes (Golonev et al. 2018).

Although the attempt to refit lithic artefacts between KSA and KSB (Yu.D.) was not successful, we favour the first hypothesis (cf. Coulson, Andersen 2020), but it is too early to reach a conclusion and more work needs to be done in the future.

The presence of distant raw materials and extended raw material networks indicate high mobility. The nearest outcrops of erratic flint are located 150–200 km east-northeast of Mohelno and outcrops of Bakony radiolarite are located ca 250 km to the south-southeast. When all three points (Mohelno, erratic flint outcrops and Bakony are connected by lines, the resulting triangle has a circumference of 760 km (i.e. closest connection routes) and covers an area of 25,000 km^2. Such lithic exploitation system could be labelled as a circulating/residential logistical mobility pattern (Marks, Friedel 1977; Demidenko et al. 2021).

The anthracological analysis recorded only restricted species composition (*Juniperus, Pinus, Betula*). The presence of these stress tolerant species suggests the presence of an open landscape with relatively unfavourable climatic and environmental conditions. Based on our results we can suggest a large-scale distribution of steppe vegetation and only sporadic occurrences of trees in microclimatically suitable small patches.

Conclusion

The salvage excavation of stone structure KSD was completed (an area of 27 m^2) during subsequent campaigns in 2020 and 2021. Preliminary analysis of all excavated material was completed. Characteristics of the lithic industry and spatial patterning of artefacts and pavement are like previously excavated stone structures at the site (KSA, KSB, KSE). More detailed analyses of the KSD material will follow.

The structure consists of a paved area and an adjoining northeastern fold – this shape is like some of the other documented stone structures.

In a similar vein to the previously excavated structures, the raw material spectrum consists of prevailing local raw materials including rock crystal, quartz, plasma, smoky quartz, and Krumlovský les-type chert, supplemented by imported erratic flint and radiolarite. The technological spectrum is characterized by abundant splintered artefacts that were used as bipolar anvil cores for microlithic blanks (Fig. 9.6, 9.7). The prevailing tool types are endscrapers (however, some of the pieces were used as cores for carenoidal blanks) and burins. Fourteen microlithic tools were identified (Sagaidak-Muralovka-type microliths), however, their number may increase when the collection of small finds is systematically studied under magnification.

Knapped stone artefacts were supplemented with heavy-duty implements made on coarser rocks including quartz, granulite, and amphibolite.

Salvage excavation will continue in order to connect the individual trenches, i.e. in the areas between individual structures. This will aid a detailed study of spatial distribution and testing hypotheses concerning contemporaneity / non- contemporaneity of the individual structures.

Acknowledgments

The research itself was conducted with institutional support RVO: 68081758 – Czech Academy of Sciences, Institute of Archaeology, Brno. Radiocarbon dating (Ivo Světlík) was implemented with the support of RAMSES: OP RDE, MEYS, Reg. No. CZ.02.1.01/0.0/0.0/16_019/0000728.

10

Stone artefacts from Hradisko near Kroměříž (Central Moravia, Czech Republic)

Ondřej Mlejnek, Petr Gadas, Jaroslav Peška

Introduction

Hradisko near Kroměříž, a former independent municipality, today a rural suburb of the city of Kroměříž, is about 4 km northwest of the city centre (Fig. 10.1). The dominant feature of Hradisko is the late Baroque parish church of All Saints, behind which the remains of a prehistoric fortification, which are currently only partially visible, have been since time immemorial (Fig. 10.2). These are the remains of a rampart dated to the Bronze Age, which have been inscribed in the List of Cultural Monuments of the Czech Republic under number 46267/7-6099 (Podborský 1993, 274; Wikipedia). The GPS coordinates of the locality are: 49.3217819N, 17.3471872E.

The hillfort is in an elevated position west of the northwestern part of the village on a field sloped slightly to the north and northeast with an altitude of approximately 210 to 220 m a.s.l. and with a top height of 222.4 m a.s.l. located at the southeastern part of the hillfort in the part called "Všech svatých" (All Saints). The rest of the site's area is in the fields called "Pod Hroby" (Under Graves; southern part) and "Vinohrádky" (Little Vineyards; northern part). The area of the hillfort is delimited in the northwest by a narrow ravine opening into the flat floodplain of the original course of the Stream Haná, which flows into the Morava River as the crow flies about 1.3 km from the highest point of the hillfort. The northeastern border of the hillfort area is formed by a steep slope falling into the above-mentioned river floodplain by approximately twenty meters in height. The southeastern border of the originally fortified area is formed by a steep ravine falling to the northeast into the Morava River floodplain. On the southwestern and partly also on the western side, the area of the fort was delimited by a rampart with a moat, which no longer exists today.

doi 10.47382/dvs_26-10

Fig. 10.1. Map of the Hradisko near Kroměříž site with a marked line of the former hillfort fortification. Source: www.mapy.cz. Modified by O. Mlejnek.

Fig. 10.2. Hradisko near Kroměříž. View from the area of the prehistoric hillfort towards the village with the dominant feature of the All-Saints Church. Photo by O. Mlejnek.

The bedrock of the hillfort area consists mainly of Quaternary loess and loess soils, passing especially on the northeastern slopes into diluvial sandy-loamy to clayey-sandy sediments or mixed diluvial-fluvial deposits of Quaternary age in neighbouring ravines and floodplain fluvial sediments in alluvial plains of the rivers Morava and Haná (CGS).

Remains of the original fortification with a wooden front wall and earthen infill were still clearly visible in the form of ramparts in the field west of the village at the end of the 19th century. The area of the hillfort was 14 ha. From the 1880s, the local archaeological finds attracted the attention of amateur researchers, which was amplified by the discovery of a hoard of bronze objects in 1905. However, the first professional archaeological excavation was not carried out here until 1949–1956 by Václav Spurný from the State Archaeological Institute in Prague. One of the outcomes of the research was the dating of the peak of the population of the hillfort to the period from the end of the Early Bronze Age to the beginning of the Urnfield Period. Part of the cremation burial site from the beginning of the Urnfield Period was also explored. The last excavation, caused by the construction of the cycle path, took place here in 2008. As a result of this excavation, it was possible to confirm the dating of the wall, which apparently disappeared during a military clash, as evidenced by the skeletal remains of human bodies found thrown into the ditch (Parma et al. 2020; 2023).

Apart of rare finds of Paleolithic (probably Aurignacian) patinated chipped industry, the oldest evidence of human habitation in the locality are the remains of a settlement of the Lengyel culture (Moravian Painted Ware culture) from the end of the Neolithic. The findings consist mainly of ceramics (including typical female figurines), but also polished and chipped stone industry and animal bones. In the following Eneolithic period, a burial ground of the Corded Ware culture was established between the rampart and today's road. The Eneolithic graves were apparently originally covered by mound embankments, which were later ploughed up. During the Early Bronze Age, a prehistoric central settlement was founded here, which was apparently already fenced off in some way. However, the massive outer wall with a moat, three hoards of numerous bronze objects, found in 1905, 1989 and 2012, and an extensive cremation burial site are later, dated to the end of the Middle Bronze Age and especially to the beginning of the Urnfield Period (Spurný 1954b). After the destruction of the fortification around 1200 BC, the site was used only sporadically, namely at the beginning of the La Tène culture (Spurný 1954a) and in the Early Medieval Period (8th century AD), when there were several agricultural estates around the former hillfort (Parma et al. 2020; 2023).

In between 2020 and 2022, the project "Hradisko near Kroměříž – a fortress from the Bronze Age" was conducted (cf. Parma et al. 2023). It was a grant project within the Regional Cooperation of Regions and Institutes of the Czech Academy of Sciences. It was implemented by the Museum of Kroměříž in cooperation with the Institute of Archaeology of the Czech Academy of Sciences in Prague, Palacký University in Olomouc, the Institute for Archaeological Heritage in Brno, and the Archaeological Centre in Olomouc. The main goal of the project was the complex analysis of archaeological finds coming from the excavation of Václav Spurný, which took place from 1949 to 1956 on the "Vinohrádky" and "Pod Hroby" fields, which are deposited in the Museum of the Kroměříž Region in Kroměříž. Another goal was the conservation and documentation of the hoard of bronze objects weighing 40 kg, found at the site in 2012, and its storage in the collections of the Museum of the Kroměříž Region. Finally, as part of the project, the documentation of the excavation lead by Václav Spurný was digitized. One of the project outputs is also this article, in which the stone artefacts found in Hradisko near Kroměříž within the framework of the archaeological excavation in 1946–1956 are described in detail.

For contemporary archaeologists, the context, i.e. the exact circumstances of the find, is often more important and interesting than the artefact itself. Due to the fact that more than seventy years have passed since the time of the archaeological excavation of Hradisko near Kroměříž under the guidance of Václav Spurný, in the case of many artefacts it was quite difficult to find where exactly they came from, and unfortunately in the case of several finds we were unable to find out at all. Nevertheless, we tried to provide a brief description of the stone finds from the individual periods, into which we dated them based on the typological dating of other finds (especially ceramics) from the same contexts and on the basis of the raw material used and the typology of stone artefacts. Stone artefacts are usually classified according to the method of production as chipped, polished, and other stone industry. In the text below, we follow this division.

Methods

The production technology and typology of stone chipped industry was analysed using traditional statistical methods (see e.g. de Sonneville-Bordes, Perrot 1953; Klíma 1956b; Inizan et al. 1995; Andrefsky 2005), taking into account the specifics of Neolithic (Mateiciucová 2008) and later (Kaňáková Hladíková 2013) chipped industry. Polished and other stone industries were archaeologically determined to the level of basic tool types according to the available manuals (e.g. Salaš 1981; Sklenař, Hartl 1989; Vokáč 2008; Bartík 2013; Řídký et al. 2014). Stone raw materials were determined by studying them under a stereoscope in immersion liquid (Přichystal 2013, 43). In the case of a unique stone shoe-adze made of eclogite, scanning electron microscopy (SEM) was used to confirm the presumed raw material, which involved the determination of the chemical composition of the analysed rock by energy dispersive analysis (EDX). The analyses were performed without surface treatment of the artefact in low vacuum mode on a JEOL 6490 LV instrument at the Department of Electron Microscopy and Microanalysis, Institute of Geological Sciences, Masaryk University in Brno. Chemical analyses were carried out mainly on the garnets and pyroxenes contained in this rock.

Results

Chipped stone artefacts

The analysed assemblage of chipped stone artefacts (Fig. 10.3, 10.4)) consisted of 146 items, which are described in detail in Tab. 10.1. The earliest artefacts from Hradisko near Kroměříž can be dated back to the Early Upper Paleolithic. These are isolated chipped tools covered with white patina, specifically, two distinctly retouched endscrapers made with the highest probability of erratic flint, a fragment of an erratic flint flake and two flakes made of the Troubky-Zdislavice type chert. Given the nature of these finds and the raw material used, it is likely that they were made by hunters of the Aurignacian culture (about 40–30 thousand years ago). Sites of this culture are relatively numerous in the Kroměříž region (Oliva 1987; Pěluchová Vitošová 2009). Whether a small Paleolithic settlement was also located in the Hradisko area, or whether these artefacts were brought to the site in the later prehistoric period, is uncertain. However, the second possibility is more likely, which is also supported by the discovery of a patinated flake made of the Troubky-Zdislavice type chert, popular in the Aurignacian, with a notch, which was retouched in the distal part of the flake in the later prehistoric periods. The steep ventral retouch disturbs the white patinated surface of the flint and reveals the original brownish-grey colour of the raw material used.

The majority of the chipped artefacts found at Hradisko near Kroměříž can be assigned to the Lengyel culture (Moravian Painted Ware culture), which dates back to the Late Neolithic and Early Eneolithic (approximately 5th millennium BC). The assemblage consists of 100 artefacts in total, which allowed their analysis in more detail. The artefacts were chipped using technology typical of the Neolithic period. Mainly imported raw materials of northern origin, such as silicites of the Cracow-Częstochowa Jurassic (SCCJ, 63 pieces) from Lesser Poland, erratic flint originating from glacial moraines in Silesia (12 pieces), and chocolate flint from the Svatokrzyskie Mountains region in central Poland (6 pieces) were used for the Neolithic chipped stone industry. These raw materials probably arrived at the site already in the form of semi-finished products (blades and flakes), as there were no cores present in the collection. Among the Moravian raw materials, chert of the Olomučany type with outcrops in the central part of the Moravian Karst (5 pieces including 4 cores, this could be an admixture of the Neolithic Linear Pottery culture, during which the use of this raw material

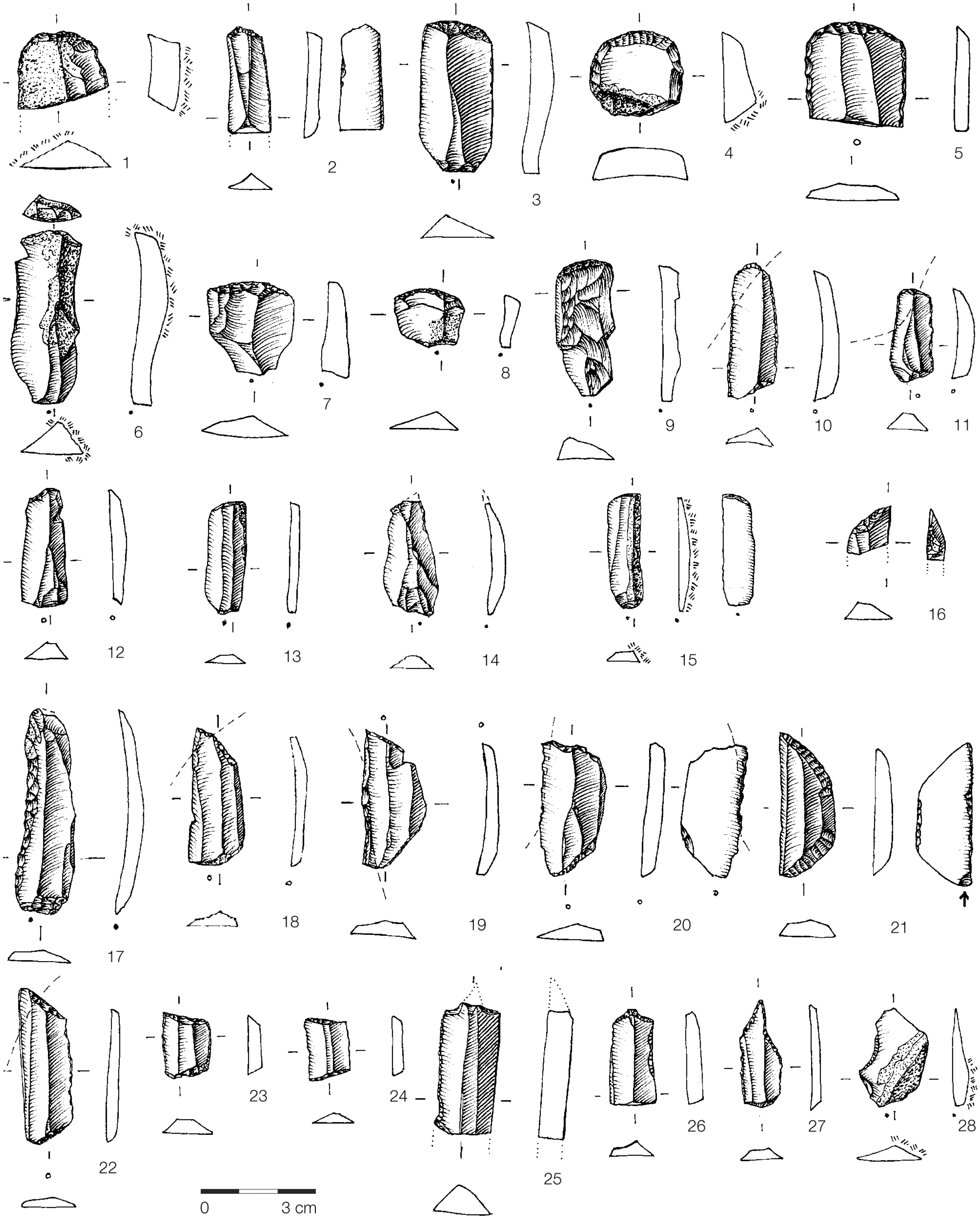


Fig. 10.3. Hradisko near Kroměříž. Selected chipped stone artefacts dated to the Lengyel culture (Moravian Painted Ware culture). 1–9 – Endscrapers; 10, 11 – endscrapers with obliquely truncated opposite end of the blade; 12–16 – truncated and backed blades; 17 – laterally retouched blade; 18–24 – trapezes; 25 – perforator reutilized to truncated blade; 26, 27 – perforators; 28 – notch. 1, 3, 6–12, 14–17, 19–27 – Silicites of the Cracow-Częstochowa Jurassic; 4, 18 – erratic flint; 2, 5, 13, 28 – chocolate flint. Drawings by L. Dvořáková. Arranged by O. Mlejnek.

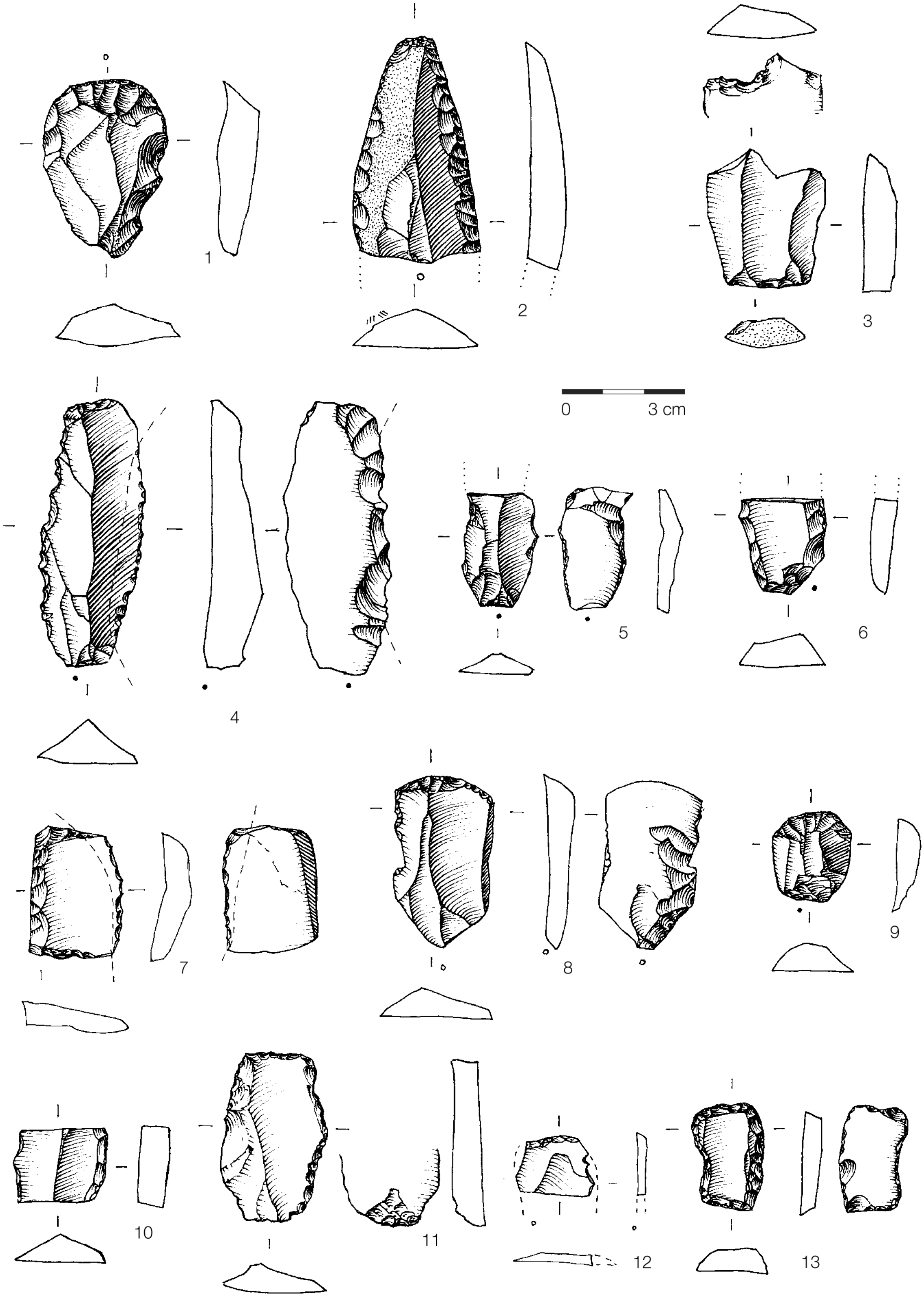


Fig. 10.4. Hradisko near Kroměříž. Selected chipped stone artefacts. 1–3 – Aurignacian; 4 – Eneolithic; 5–7 – Věteřov culture; 8–12 – Lusatian Urnfield culture; 13 – Early Modern Period. 1, 8, 9 – Endscrapers; 3 – Paleolithic flake with a Postpaleolithic notch; 2, 4–7, 10, 11 – laterally retouched blades and their fragments; 12 – transversally truncated blade; 13 – riffle flint. 12 – Silicites of the Cracow-Częstochowa Jurassic; 1, 2, 4, 5, 9, 11, 13 – erratic flint; 8 – chocolate flint; 6, 7, 10 – Krumlovský les type chert, variety 1; 3 – Troubky-Zdislavice type chert. Drawings by L. Dvořáková. Arranged by O. Mlejnek.

culminated), as well as chert of the Boršice type from the Lower Moravian Valley (3 pieces) and one piece each of the Krumlovský les type chert – variety 1 (KL1), spongolite, and Moravian Jurassic chert (MJC) appeared. In the case of the limestone fragment, it is probably not even an artefact and the Želešice type metabasite fragment certainly comes from the manufacture or sharpening of polished stone tools. In a case of five burnt artefacts the raw material could not be determined (Fig. 10.5).

The artefacts were produced by knapping from prismatic to conical-shaped single-platform cores using a soft percussor (bone, antler, or soft stone). Blades (36 pieces) and bladelets (18 pieces) significantly predominate among the detached pieces over the flakes (30 pieces). The final blades were also probably already produced by pressure flaking. The target blanks were regular blades with an average width of approximately 14 mm, which were usually further broken into segments and often retouched to formal tools (e.g. endscrapers, trapezes, truncated sickle blades etc.). These were further inserted into handles made of organic materials (wood, bone, antler). The retouch was most often aimed to create a tough rounded edge of an endscraper that could be used for scraping fur. Also, a backing technique, which created an edge suitable for insertion into the handle using natural glue (resin, glue, bitumen), was frequently used.

In the collection of retouched tools from Hradisko near Kroměříž, endscrapers and trapezes predominate, while burins are completely absent. In the set of ten endscrapers, five endscrapers on retouched blades, two endscrapers on a broken blade, two endscrapers on a flake and one round endscraper are present. The other two endscrapers were found in combination with an obliquely truncated opposite end of a blade with sickle-gloss. Other numerous groups of tools are truncated and backed blades. Specifically, there are three obliquely convex backed blades, two obliquely straight-backed blades, one blade with transverse straight truncation (probably a reutilized perforator), and a blade with transverse convex truncation. The trapezes are represented by six specimens. While the four long trapezes, interpreted as sickle blades, bear a distinctive sickle-gloss in one corner, produced by the abrasive action of silica from the cut-off stems of cultivated cereals, the sickle-gloss is completely absent in the case of the two short trapezes. It is therefore more likely that these were used as arrowheads. The set of retouched tools is completed by three laterally dorsally retouched blades (two with left-sided retouch and one with bilateral retouch), two perforators (one with an elongated tip in the axis of the blade and the other with a short thick tip), and one notch on the blade. Five locally retouched artefacts were recognized in the assemblage (four locally retouched blades and one flake). In addition, some blades bear macroscopic signs of use-wear. The microscopic use-wear analysis was not carried out on the assemblage, but it can be assumed that the tools found were used in the processing of hides (scrapers), cutting various types of natural materials (retouched and truncated blades), harvesting grain (long trapezes used as sickle blades), making holes (perforators), or as projectiles (short trapezes, perhaps used as arrowheads).

The period from the Early Eneolithic to the beginning of the Bronze Age is less represented at the site. In terms of the chipped stone artefacts, we can assign to this period a massive blade with a bilateral lateral and transverse dorsal retouch and with a right-sided flat ventral retouch, which is made of erratic flint and bears a distinctive sickle-gloss on the right edge. The blade could have been set in a handle of wood or bone and used, for example, as a knife to cut plant material.

A total of 18 chipped stone artefacts come from the contexts dated to the end of the Early Bronze Age (Věteřov culture, 16th century BC), of which, however, a rectangular rifle flint is definitely a modern admixture. During this period, stone tools were gradually being replaced by metal tools, which were

Tab 10.1. Summary table with a description of the stone chipped artefact from Hradisko near Kroměříž. SCCJ: silicites of the Cracow-Częstochowa Jurassic, MJC: Moravian Jurassic cherts, Olomučany: Olomučany type chert, KL1: Krumlovský les type chert, variety 1, KL2: Krumlovský les type chert, variety 2. Dimensions in millimetres, weight in grams.

Inv. No.	Former Inv. No.	Context dating	Raw material	Support type
130	4788	Undated	Troubky-Zdislavice	Flake
132	4790	Undated	Other	Fragment
131	4789	Undated	KL1	Flake
18	769	Undated	Erratic flint	Flake
210	1091	Undated	Erratic flint	Flake
175	7161	Undated	MJC	Flake
3	702	Undated	Erratic flint	Flake
148	11177	Undated	Erratic flint	Flake
40	1027	Undated	Greywacke	Flake
41	1033	Undated	Erratic flint	Raw material
13	754	Undated	Erratic flint	Blade
204	1722	Undated	Erratic flint	Blade
63	754	Lengyel culture	SCCJ	Flake
61	754	Lengyel culture	SCCJ	Blade
60	754	Lengyel culture	SCCJ	Blade
62	754	Lengyel culture	SCCJ	Blade
59	754	Lengyel culture	Undeterminable	Flake
58	754	Lengyel culture	SCCJ	Blade
57	754	Lengyel culture	SCCJ	Blade
64	754	Lengyel culture	SCCJ	Blade
65	754	Lengyel culture	SCCJ	Blade
67	754	Lengyel culture	SCCJ	Blade
56	754	Lengyel culture	Erratic flint	Flake
70	754	Lengyel culture	Erratic flint	Flake
49	754	Lengyel culture	SCCJ	Blade
71	754	Lengyel culture	SCCJ	Flake
72	754	Lengyel culture	SCCJ	Blade
73	754	Lengyel culture	Undeterminable	Blade
74	754	Lengyel culture	Chocolade flint	Blade
75	754	Lengyel culture	SCCJ	Blade
76	54	Lengyel culture	Erratic flint	Blade
69	754	Lengyel culture	SCCJ	Flake
43	754	Lengyel culture	SCCJ	Blade

Artefact description	Fig. No.	Lenght	Width	Height	Weight
Paleolithic flake with a ventral notch retouched in the Neolitic in a distal part	10.4: 3	34.8	29.5	9	10.2
Fragment of a closer undeterminable brown chert		31.9	34.7	12.5	12.5
Complete flake		30	39.2	7	8.24
Proximal fragment of a flake with a ventral indistinct retouch		25.6	29	5.2	4.47
Locally retouched elongated flake with indistinct marginal gloss		51.6	33	10.7	10.4
Complete flake		22.4	18.1	6.6	2.75
Fan-shaped patinated Paleolithic endscraper on a mesial flake fragment	10.4: 1	43.6	31.5	8.55	13.4
Complete flake		17	14	4.4	1.09
Distal fragment of a large pointed flake. debris from a grinding slab fabrication?		96	42	15.5	59.1
Raw material fragment locally covered by sinter		49.6	31.8	12	19.8
Flat endscraper on a mesial fragment of a strongly retouched Paleolithic blade	10.4: 2	57.2	30.7	9.6	17.5
Blade with saw-tooth lateral and flat ventral retouch. Eneolithic? knife. gloss	10.4: 4	67.6	25.5	12.8	19.2
Complete flake		20	13.7	3	0.67
Proximal blade fragment with marginal lateral ventral retouch		31.5	11.6	2.37	1.4
Perforator with an elongated tip in axis of a proximal bladelet fragment	10.3: 27	27.6	11.6	2.7	1.04
Dorsally retouched short trapeze	10.3: 24	16.3	11.9	2.75	0.64
Mesial flake fragment		15	22.7	3.4	1.48
Proximal fragment of a cortical bladelet with a ventral oblique truncation	10.3: 15	30.1	9.3	3	1
Proximal fragment of a blade with a lateral use-wear		37.3	8.7	2.9	1.16
Mesial fragment of a locally retouched blade		16.1	12.6	3.7	0.95
Flat end scaraper on a proximal fragment of a crested blade	10.3: 9	35.8	16	5	3.68
Perforator with a thick short tip on a mesial fragment of a blade	10.3: 26	25.2	11.8	3.9	1.53
Round endscraper on a mesial fragment of a flake	10.3: 4	23.6	24.8	9.8	6.98
Complete elongated flake		19	13	5	1.44
Mesial fragment of a blade with unilateral use-wear		22.2	14.9	4.7	2.18
Mesial fragment of a flake		18.9	23.5	4.7	1.65
Distal fragment of a flake		16.2	8.3	4.8	0.55
Left-side marginally retouched mesial fragment of a blade		26.4	19.3	5.8	2.84
Proximal fragment of a bladelet with a convex truncation	10.3: 13	29.5	11	2.4	1.02
Distal fragment of a pointed bladelet		14.2	6.8	2.9	0.27
Mesial fragment of a cortical blade with a local marginal lateral retouch		32	17.7	4.8	3.48
Complete flake		14.6	12.9	3.6	0.54
Flat endscraper on a proximal blade fragment	10.3: 3	40	19.6	5	4.9

2	912	Lengyel culture	Chocolade flint	Blade	
84	754	Lengyel culture	SCCJ	Blade	
85	754	Lengyel culture	SCCJ	Fragment	
86	754	Lengyel culture	SCCJ	Core	
87	754	Lengyel culture	Želesice metabasite	Fragment	
88	754	Lengyel culture	Limestone	Fragment	
14	912	Lengyel culture	Chocolade flint	Flake	
15	912	Lengyel culture	Chocolade flint	Blade	
16	912	Lengyel culture	SCCJ	Flake	
17	912	Lengyel culture	SCCJ	Blade	
51	754	Lengyel culture	Olomučany	Core	
42	754	Lengyel culture	SCCJ	Blade	
55	754	Lengyel culture	SCCJ	Blade	
44	754	Lengyel culture	SCCJ	Flake	
45	754	Lengyel culture	SCCJ	Blade	
46	754	Lengyel culture	Undeterminable	Flake	
47	754	Lengyel culture	SCCJ	Flake	
48	754	Lengyel culture	SCCJ	Blade	
68	754	Lengyel culture	SCCJ	Flake	
50	754	Lengyel culture	Erratic flint	Blade	
77	754	Lengyel culture	Undeterminable	Fragment	
52	754	Lengyel culture	Chocolade flint	Blade	
53	754	Lengyel culture	Erratic flint	Blade	
54	754	Lengyel culture	Erratic flint	Flake	
19	913	Lengyel culture	SCCJ	Blade	
178	1918	Lengyel culture	SCCJ	Blade	
163	1911	Lengyel culture	SCCJ	Blade	
164	164	Lengyel culture	SCCJ	Blade	
165	1913	Lengyel culture	SCCJ	Blade	
166	1914	Lengyel culture	SCCJ	Blade	
167	1915	Lengyel culture	SCCJ	Flake	
168	11149	Lengyel culture	SCCJ	Flake	
169	11150	Lengyel culture	SCCJ	Blade	
170	11151	Lengyel culture	SCCJ	Flake	
171	11152	Lengyel culture	SCCJ	Flake	
78	754	Lengyel culture	SCCJ	Blade	
173	11154	Lengyel culture	SCCJ	Flake	

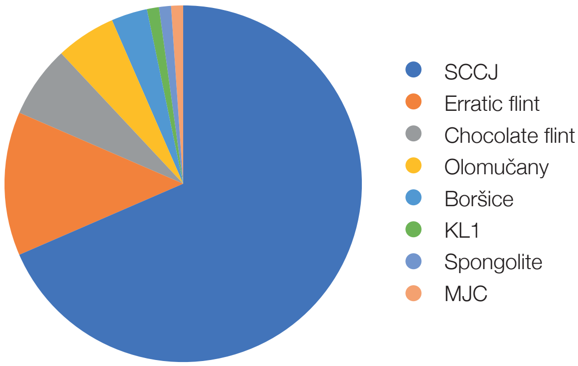
Mesial fragment of a blade with use-wear traces		26.6	12	3.34	1.46
Flat endscraper retouched on a base of an alternatelly retouched blade		34	17	5.9	3.08
Core-shaped fragment		22.8	13	10.8	2.86
Irregular core		34.3	19.6	13.3	6.33
Fragment of Želešice type metabasite probably from a ground tool fabrication		21.6	8.36	2.77	0.72
Doubtful artefact, limestone fragment		15.2	15	10	2.09
Complete flake with use-wear traces		36.8	38.7	13.4	10.8
Flat endscraper on mesial fragment of a wide retouched blade	10.3: 5	26.4	26.8	4	4.12
Proximal fragment of a flake from a core reparation		13.3	18.7	4.5	0.91
Long trapeze with alternate retouch, sickle-blade with corner gloss	10.3: 21	37.3	15.2	4.7	3.06
Exploited conical single-platform core		24.7	29.1	20	15.9
Flat endscraper on a mesial fragment of a cortical retouched blade	10.3: 1	19.4	25	7.7	4.33
Short trapeze with dorsal retouch	10.3: 23	17.2	12.9	3.6	1.01
Complete cortical flake		33	24	5.2	5.37
Long trapeze on a blade with dorsal retouch. sickle-blade with corner gloss	10.3: 22	41.3	13.8	2.6	1.96
Proximal fragment of a burnt flake		15	19.8	3.9	1.22
Proximal fragment of a flake with a local vetral retouch		23.2	25	6	3.59
Base of a blade with bilateral dorsal marginal retouch		24	20.9	7.34	3.95
Complete flake		12.8	18.3	2.5	0.63
Mesial fragment of a blade		18.3	12.2	2.8	0.63
Tiny burnt fragment		11.5	5	2.3	0.14
Flat endscraper on alternately retouched fragment of a bladelet	10.3: 2	27.9	11.5	3.86	1.63
Proximal fragment of a blade		25.1	15	3.4	1.69
Notch retouched on a flake	10.3: 28	24.3	21	3.9	1.29
Proximal fragment of a cortical bladelet		37.1	9.8	2.83	1.1
Flat endscraper with obliquely truncated opposite end of a bilaterally retouched blade, corner gloss	10.3: 11	24.6	12.3	4.5	1.51
Flat endscraper on a locally left-sided retouched blade	10.3: 6	46.2	18.3	8.3	6.75
Flat endscraper on a lat. retouched blade and obliquely truncated blade, corner gloss	10.3: 10	36.1	14.5	4	2.31
Proximal fragment of a blade with use-wear traces and oblique truncation	10.3: 14	30	14.6	3.4	1.63
Proximal fragment of a blade with lateral use-wear traces		26.5	14.7	3.1	1.23
Pointed flake with a broken tip		29	18	4.9	2.1
Mesial fragment of a flake		14.7	26.5	5	3
Proximal fragment of a blade		30.6	22.6	3.6	2.81
Complete flake		26.8	15.7	5.4	1.82
Proximal fragment of a flake		20	26	6.3	3.5
Proximal fragment of a bladelet		28.9	8.6	2.1	0.73
Base of a flake with bilateral dorsal marginal retouch		19.1	29.8	5.7	2.37

162	1910	Lengyel culture	Undeterminable	Blade	
174	11155	Lengyel culture	SCCJ	Flake	
172	11153	Lengyel culture	SCCJ	Flake	
179	1919	Lengyel culture	SCCJ	Blade	
193	1712	Lengyel culture	SCCJ	Blade	
194	1713	Lengyel culture	SCCJ	Blade	
195	1714	Lengyel culture	SCCJ	Blade	
196	1715	Lengyel culture	SCCJ	Blade	
197	1716	Lengyel culture	SCCJ	Blade	
198	1717	Lengyel culture	SCCJ	Blade	
199	1718	Lengyel culture	Erratic flint	Flake	
200	1719	Lengyel culture	MJC	Fragment	
201	1720	Lengyel culture	KL1	Fragment	
202	1721	Lengyel culture	Erratic flint	Flake	
66	754	Lengyel culture	SCCJ	Blade	
152	1875	Lengyel culture	SCCJ	Blade	
80	754	Lengyel culture	SCCJ	Blade	
79	754	Lengyel culture	SCCJ	Flake	
83	754	Lengyel culture	Chocolade flint	Flake	
81	754	Lengyel culture	SCCJ	Blade	
151	1874	Lengyel culture	SCCJ	Blade	
82	754	Lengyel culture	Troubky-Zdislavice	Flake	
161	1909	Lengyel culture	Erratic flint	Blade	
153	1876	Lengyel culture	SCCJ	Blade	
154	1877	Lengyel culture	SCCJ	Flake	
155	1878	Lengyel culture	SCCJ	Flake	
156	1879	Lengyel culture	Erratic flint	Fragment	
157	1905	Lengyel culture	SCCJ	Blade	
158	1906	Lengyel culture	SCCJ	Blade	
159	1907	Lengyel culture	SCCJ	Flake	
160	1908	Lengyel culture	SCCJ	Blade	
128	7753	Lengyel culture?	Boršice	Fragment	
122	7747	Lengyel culture?	Spongolit	Flake	
121	7746	Lengyel culture?	Olomučany	Core	
123	7748	Lengyel culture?	Olomučany	Core	
124	7749	Lengyel culture?	SCCJ	Flake	
144	7714	Lengyel culture?	Erratic flint	Blade	
176	7837	Lengyel culture?	Olomučany	Core	
127	7752	Lengyel culture?	Olomučany	Fragment	

	Mesial fragment of a burnt blade		15.8	17	3.6	1.1
	Complete flake		15.5	17	3.9	1.06
	Complete flake with a dorsal abrasion		21.5	17.5	6.4	2.44
	Mesial fragment of obliquely truncated laterally retouched blade		15	13.7	3.6	0.73
	Long trapeze with marginal lateral retouch. sickle blade with marginal gloss	10.3: 20	32.3	17.2	3.8	3.26
	Pointed blade		35	16.2	2.5	1.37
	Proximal fragment of a blade with local lateral ventral retouch (use-wear)		32.5	10.5	3.4	1.26
	Laterally retouched thick blade with straight truncation, reutilized perforer	10.3: 25	34.6	16.3	8	5.72
	Crested blade		37	17.8	4.4	2.92
	Proximal fragment of a blade		21.3	14.4	4.3	1.46
	Complete flake		20	27	2.8	1.51
	Closer undeterminable burnt fragment		23.3	15.9	12.7	3.75
	Closer undeterminable fragment		23.4	15	10.4	2.61
	Complete flake		16.4	26.4	7.2	3.42
	Proximal fragment of a blade with bilateral use-wear		18	15	2.4	0.89
	Distal fragment of a bent blade		43.3	13.5	4	3
	Mesial fragment of a blade		11.5	15.2	6.6	1.38
	Pointed elongated flake		23.2	13.2	7.3	2.13
	Distal fragment of a pointed burnt flake		31	14.5	6	2.51
	Obliquely convexly truncated mesial fragment of a blade with marginal left-sided retouch	10.3: 12	30.4	12.4	4	1.55
	Laterally left-sided retouched bent blade	10.3: 17	54	15	4.2	3.8
	Complete flake		15.1	22.7	4.3	0.93
	Proximal fragment of a blade		18.1	19.1	8.9	2.63
	Proximal fragment of a slightly bent bladelet		41	10.3	3	1.44
	Flat endscraper on an elongated flake	10.3: 7	25.3	23.7	7.4	3.56
	Flat endscraper an a flake containing petrosilex	10.3: 8	15.8	18	4.2	1.31
	Closer undeterminable fragment (possibly of a core)		31.8	19.8	10.4	6.7
	Mesial fragment of a bladelet		27	8.1	2.4	0.69
	Proximal fragment of a bladelet with indistinct corner gloss		26.3	11.4	3.1	0.9
	Complete flake with dorsal abrasion		18.5	17.8	6.5	2.07
	Convexly obliquely backed point on a mesial fragment of a blade	10.3: 16	10	11.5	4.5	0.64
	Closer undeterminable fragment		43.4	25.6	10	9.81
	Pointed flake		35.2	27	10.5	7.86
	Exploited semiconical single-platform core for a fabrication of bladelets		33.5	36.8	25.5	26.1
	Single-platform prismatic core for a fabrication of blades (pressure flaking?)		41	33	33.5	28.2
	Complete flake		14.3	23	6.4	1.67
	Atypical long trapeze with gloss. sickle-blade	10.3: 18	36.8	14.8	3.5	2.31
	Single-platform semiconical precore prepared for a fabrication of flakes		30.5	26.8	22.7	10.9
	Closer undeterminable fragment		44.4	29.4	11	12.4

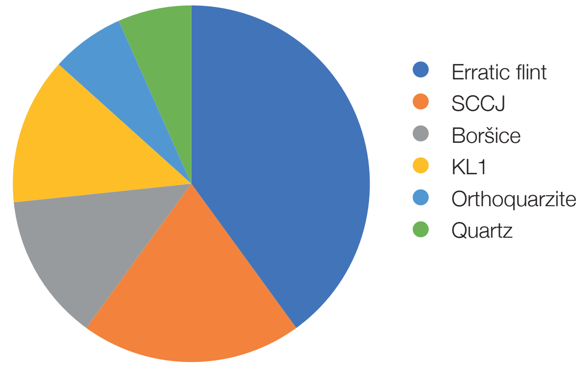
126	7751	Lengyel culture?	Boršice	Fragment	
125	7750	Lengyel culture?	Erratic flint	Blade	
129	7754	Lengyel culture?	Boršice	Fragment	
10	1088	Věteřov culture	Erratic flint	Blade	
9	1088	Věteřov culture	Erratic flint	Blade	
5	4596	Věteřov culture	Erratic flint	Core	
192	9994	Věteřov culture	Quartz	Flake	
6	4597	Věteřov culture	Undeterminable	Flake	
206	885	Věteřov culture	Undeterminable	Blade	
207	882	Věteřov culture	sluňák	Flake	
208	884	Věteřov culture	Erratic flint	Blade	
205	644	Věteřov culture	Erratic flint	Core	
141	196	Věteřov culture	SCCJ	Flake	
138	242	Věteřov culture	Boršice	Flake	
139	196	Věteřov culture	SCCJ	Blade	
140	196	Věteřov culture	SCCJ	Flake	
11	4595	Věteřov culture	KL1	Flake	
142	196	Věteřov culture	Erratic flint	Flake	
143	196	Věteřov culture	Erratic flint	Flake	
20	5228	Věteřov culture	KL1	Blade	
209	883	Věteřov culture	Boršice	Blade	
145	7009	Lusatian culture	SCCJ	Blade	
4	1	Lusatian culture	SCCJ	Blade	
7	1273	Lusatian culture	MJC	Flake	
8	1274	Lusatian culture	SCCJ	Flake	
146	10624	Lusatian culture	KL1	Blade	
149	7036	Lusatian culture	KL2	Fragment	
150	6888	Lusatian culture	Erratic flint	Blade	
137	322	Lusatian culture	Erratic flint	Flake	
191	720	Lusatian culture	SCCJ	Blade	
133	4622	Lusatian culture?	Erratic flint	Raw material	
147	3513	Lusatian culture?	Chocolade flint	Blade	
177	9089	Lusatian culture?	Boršice	Flake	
136	4624	Lusatian culture?	Erratic flint	Flake	
134	4625	Lusatian culture?	SCCJ	Fragment	
12	945	Lusatian culture?	Erratic flint	Flake	
135	4623	Lusatian culture?	Radiolarite	Blade	

	Closer undeterminable fragment		25.5	22.8	10.8	7.28
	Crested bladelet		33.8	8.2	5	1.71
	Closer undeterminable fragment. pseudoartefact?		41.8	29	9.5	8.81
	Recrangular riffle flint. Early Modern admission	10.4: 13	27	18.6	5.9	4.62
	Proximal fragment of a blade with bilateral ventral irregular retouch and dorsal abrasion	10.4: 5	30.5	18.4	5.4	3.77
	Splintered piece on a core fragment		26.4	19.5	8.7	5.13
	Distal fragment of a flake		30.1	23.5	8	6.02
	Mesial fragment of a burnt flake		27.2	24.3	14.6	7.96
	Mesial fragment of a burnt blade (Boršice type chert?) with local marginal retouch		17.9	19	4.6	1.87
	Distal fragment of a flake with indistinct local retouch		29.7	36	6.5	7.93
	Indistinct transversal burin on a proximal fragment of a crested blade with dorsal abrasion		24.4	25	6.7	5.16
	Tested fragment of a nodule		38.8	55.3	26.3	60.7
	Complete elongated flake		28	17.8	5	3.02
	Mesial fragment of a massive flake. perhaps a flint for making fire		19.6	20.8	9.4	3.32
	Bilaterally iregulary alternately retouched mesial fragment of a blade		49	12.1	3.8	3.31
	Complete flake		28	36.8	8.6	6.21
	Mesial fragment of a blade with saw-tooth retouch. sickle-blade with gloss	10.4: 7	33	24.6	7.8	7.69
	Complete flake		37.4	29.4	5.4	5.78
	Distinctly retouched mesial fragment of a flake containing petrosilex		30.5	29.6	12.9	8.02
	Base of a bilaterally dorsaly retouched sickle-blade with gloss. thinned base	10.4: 6	25.3	22.9	8.6	6.05
	Proximal fragment of a massive blade with alternate sidescraper-like retouch		76	31.6	13.4	30.6
	Long trapeze. sickle blade. probably Lengyel admission	10.3: 19	36.7	17.8	4.2	2.64
	Proximal fragment of a blade with local alternate retouch		23.5	12.2	3.2	1.3
	Fragment of a flake with knapped off base and ventral retouch		38.9	23.7	10.2	9.49
	Complete elongated flake with ventral marginal bilateral retouch		40	27.5	7.2	6.56
	Mesial fragment of a blade with partial bilateral retouch	10.4: 10	19.7	24.5	6.4	4.33
	Closer undeterminable fragment		23	18.5	19.5	10.5
	Truncated blade with lateral saw-tooth retouch. reduced base of a blade	10.4: 11	42.4	25.7	8.8	11.3
	Retouched mesial fragment of a massive flake. probably a flint for making fire		26.9	37.7	13.8	14.3
	Convexly trumcated mesial fragment of a blade	10.4: 12	14.9	19.9	2.17	1.06
	Conical flint nodule		37.4	34.5	32.3	39.3
	Flat endscraper an alternatelly retouched blade, a base is ventrally retouched	10.4: 8	42.7	25.1	6.8	7.31
	Complete flake		32.8	24.1	7.3	4.86
	Splintered piece on both ends of a flake fragment		28	33.8	10.5	9.4
	Fragment (of a core?)		30.5	14	11	4.14
	Short flat endscraper on a proximal fragment of a flake with dorsal abrasion	10.4: 9	23.2	19.8	6.58	3.36
	Indistinct flat endscraper on a mesial fragment of a blade		30.8	14.8	5.4	2.53



Raw materials of the Lengyel chipped stone industry

Fig. 10.5. Graph of the representation of specific stone raw materials used for manufacturing the chipped stone industry of the Lengyel culture from Hradisko near Kroměříž. SCCJ: silicites of the Cracow-Częstochowa Jurassic, MJC: Moravian Jurassic cherts, KL1: Krumlovský les type chert, variety 1.

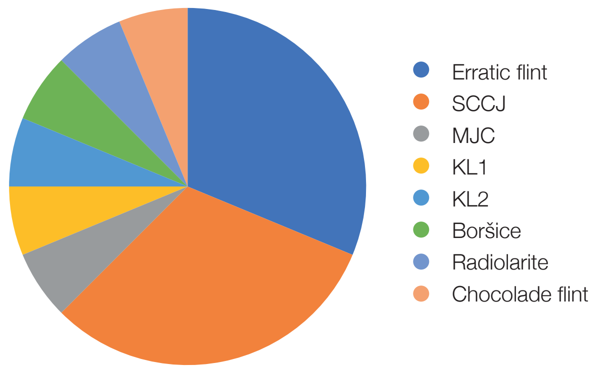


Raw materials of the Věteřov chipped stone industry

Fig. 10.6. Graph of the representation of specific stone raw materials used for manufacturing the chipped stone industry of the Věteřov culture from Hradisko near Kroměříž. SCCJ: silicites of the Cracow-Częstochowa Jurassic, KL1: Krumlovský les type chert, variety 1.

not yet in abundance, so that stone chipped tools were still widely used (Kaňáková Hladíková 2013). Among the raw materials used, erratic flint (6 pieces) predominated, followed by silicites of the Cracow-Cęnstochowa Jurassic (3 pieces), chert of the Boršice type (2 pieces), and Krumlovský les type chert – variety 1 (KL1, 2 pieces). One piece each of orthoquartzite from the Drahany Highlands and quartz was also present in the collection. In the case of one burnt blade fragment, it was not possible to determine the raw material used (Fig. 10.6). This small lithic assemblage consists of two core pieces (a splintered piece on a core fragment and a fragment of tested flint nodule), nine flakes, and five blades. The dimensions of the artefacts are larger compared to the Neolithic (the average width of the blades is 22 mm) and the number of blades is decreasing in favour of the flakes. Retouch is less regular than in the Neolithic, with steep, invasive, sawtooth, and flat retouch taking the place of the backed retouch. There are nine formal tools in the set. Endscrapers, backed blades and truncated blades are absent. One burin is present in the assemblage. It is an indistinct transverse burin on a broken crested blade. There are four laterally retouched blades present in the assemblage. These are a basal fragment of a bilaterally retouched sickle blade with a thinned base, a proximal fragment of an irregularly ventrally marginally retouched blade, a mesial fragment of a bilaterally alternately retouched blade, and an alternately retouched fragment of a massive blade. Of the other tools, there is one distinctly retouched fragment of a flake, the splintered piece with sickle-gloss mentioned above, a sickle-blade segment with a sawtooth retouch and distinct gloss and a slightly burnt steeply retouched core-shaped fragment of a flake, probably originally used as a flint for making fire. Finally, one locally steeply retouched burnt fragment of a flake completes the toolkit. The above-described tools were probably used as sickle segments for cutting off ears of grain, as well as for slicing and cutting (retouched blades), engraving (burin), or as a flint for lighting fires.

During the Younger and Late Bronze Age (Lusatian Urnfield culture), the stone chipped industry had long passed its heyday, yet it still appears in smaller quantities. A total of 16 artefacts have been dated to this period in the analysed collection, but it is likely that in some cases they may be an admixture from earlier periods. Among the raw materials, erratic flint and silicites of the



Raw materials of the Lusatian chipped stone industry

Fig. 10.7. Graph of the representation of specific stone raw materials used for manufacturing the chipped stone industry of the Lusatian Urnfield culture from Hradisko near Kroměříž. SCCJ: silicites of the Cracow-Częstochowa Jurassic, MJC: Moravian Jurassic cherts, KL1: Krumlovský les type chert, variety 1, KL2: Krumlovský les type chert, variety 2.

Cracow-Cęnstochowa Jurassic are equally represented by five pieces, while one artefact each was also produced from Moravian Jurassic chert (MJC), Krumlovský les type chert, variety 1 and 2 (KL1 and KL2), Boršice type chert, radiolarite and chocolate flint from the Svatokrzyskie Mountains region in central Poland (Fig. 10.7). Chipped stone artefacts dated to the Urnfield period include one fragment of raw material (flint nodule), two closer unidentified fragments, seven blades, and six flakes. There are eleven formal tools in the assemblage. Specifically, there are three flat end-scrapers (one each on a blade, a retouched blade, and a flake) and two transversally retouched blades – one of them has a lateral sawtooth retouch. Burins are missing from the set and the laterally retouched blades are represented by a bilaterally retouched blade fragment. Two retouched flakes are present in the collection. In the first case it is a steeply ventrally retouched flake with a chipped off base and in the second case it is a ventrally bilaterally marginally retouched flake fragment. The long trapeze with a gloss made of silicite of the Cracow-Częstochowa Jurassic, obviously serving as a sickle blade, is probably a Lengyel intrusion. The toolkit is completed by a double-sided splintered piece on a flake and a retouched fragment of a massive core-shaped flake that may have served as a flint for making fire.

Polished stone artefacts

In the case of the polished artefacts (Tab. 10.2; Fig. 10.8: 1–8), most of the seventeen tools are probably related to the settlement of the Lengyel culture, although it is not possible to exclude either the admixture of an older Linear pottery culture (two fragments of small shoe-adzes, the presence of the amphibole-rich metabasite from the Jizerské hory Mountains) or the Eneolithic dating of some artefacts found in the Věteřov cultural layer. Rather, however, these are Lengyel intrusions. The spectrum of raw materials used to produce polished stone tools is quite varied. The most abundantly represented by seven finds is the Želesice type metabasite, formerly known as green slate, a raw material typical of the Moravian Lengyel assemblages (Moravian Painted Ware culture). Two pieces each of serpentinite and amphibolite were documented. One artefact each was then produced from greywacke, amphibole-rich metabasite from the Jizerské hory Mountains (Přichystal 2013, 192–195; Šída et al. 2014), andesite, muscovite quartzite, microdiorite, and eclogite (Fig. 10.9). In the case of eclogite, from which the shoe-adze

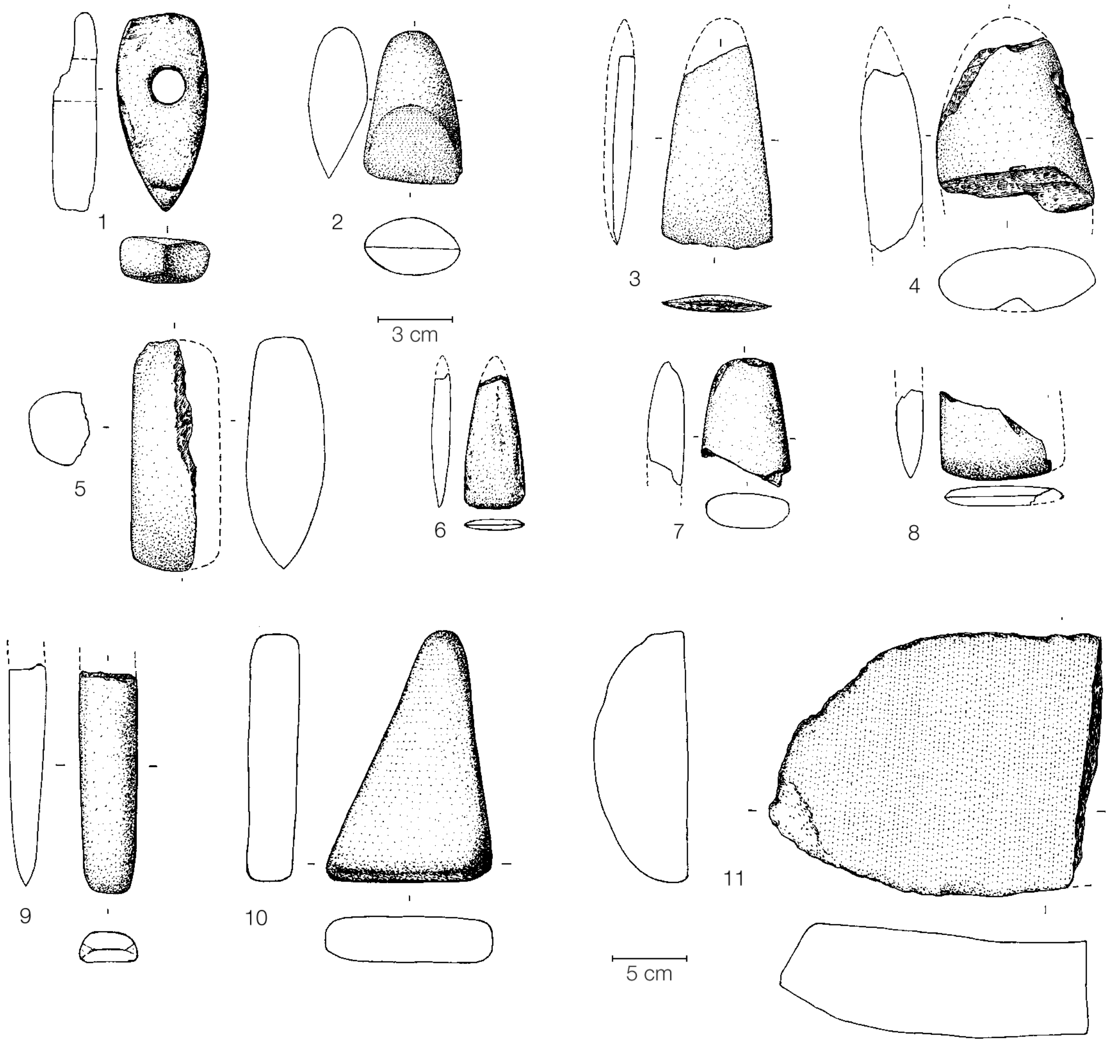
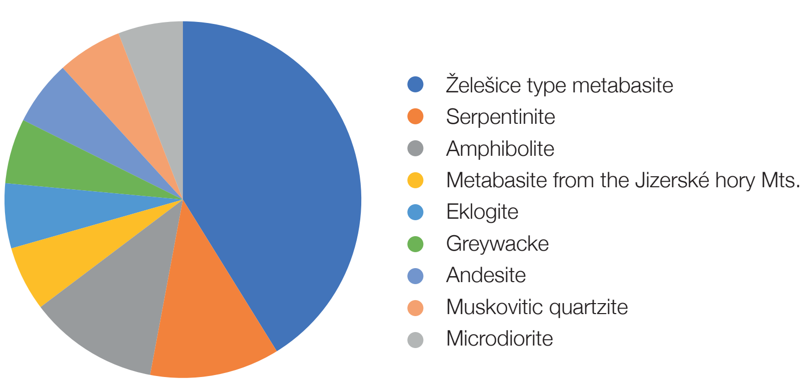


Fig. 10.8. Hradisko near Kroměříž. Selected polished stone artefacts dated to the Lengyel culture (1–8) and other stone artefacts dated to the Věteřov culture (11) and Lusatian Urnfield culture (9, 10). 1 – Shaft-hole hammer-axe; 3, 6–8 – flat axes and their fragments; 2 – cleaver-axe; 4 – fragment of a base of a massive axe; 5 – broken shoe-adze; 9 – fragment of a whetstone; 10 – triangular stone pad; 11 – fragment of a grinding slab. 1–4, 6–8 – Želešice type metabasite; 2 – andesite; 3 – serpentinite; 5 – eclogite; 9 – gneiss; 10, 11 – greywacke. Drawings by L. Dvořáková. Arranged by O. Mlejnek.



Raw materials of the Lengyel polished stone industry

Fig. 10.9. Graph of representation of specific stone raw materials used for manufacturing the polished stone industry of the Lengyel culture from Hradisko near Kroměříž.

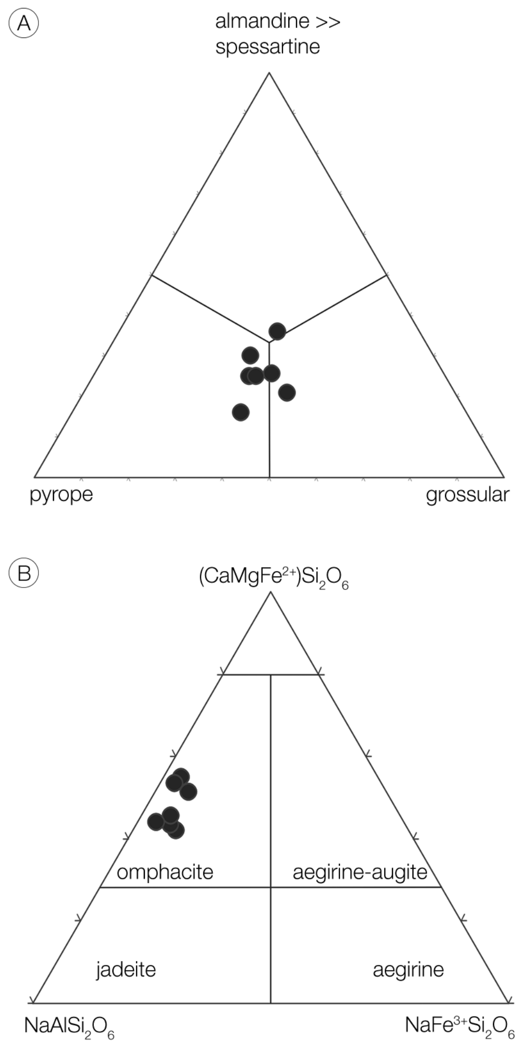


Fig. 10.10. The chemical composition of the a) garnets and b) pyroxenes based on SEM-WDX analyses. Chart by P. Gadas.

fragment was made, it is only the second polished stone artefact made from this raw material in Moravia after the axe from the settlement of the Lengyel culture in Plaveč near Znojmo (Přichystal 2013, 209, 335). The identification of this raw material was confirmed by electron microanalysis (SEM-EDX). Based on the petrography and the chemical composition of garnets, pyroxenes (cf. Fig. 10.10), and biotite, which correspond to Fe-Ca rich pyrope, especially *omphacite,* and Mg-rich phlogopite respectively, we believe that this relatively rare raw material may originate from occurrences in the area between the Hrotovice and Biskupice-Pulkov in Western Moravia, where eclogite outcroppings are found, usually locally associated with serpentinites (e.g. Itami et al. 2022).

As far as the types of polished stone tools are concerned, flat axes and their fragments are represented by six specimens, in the case of four other axe fragments it was not possible to determine their type more precisely. There is one cleaver-axe with a polished edge and one semi-finished axe in the assemblage. Two fragments of shoe-adzes are present, and three hammer-axes and their fragments were found at the site. In terms of function, Neolithic and Early Eneolithic polished artefacts were mainly woodworking tools. However, other functions of these tools cannot be excluded. For example, in the case of the hammer-axes, their use as weapons is considered, or they could have been also conceived as prestigious artefacts and symbols of power. However, the hammer-axes found at Hradisko near Kroměříž are quite small, so this function is not very likely.

Other stone artefacts

Stone artefacts that do not bear the characteristics of either chipped or polished stone industry are classified among the so-called other stone industry (Tab. 10.3; Fig. 10.8: 9–11). These include, for example, grinding slabs, rubbing stones, whetstones, stone pads and plates, abraders, percussors, stone wristguards, etc. The other stone industry from Hradisko could again be roughly divided into the three periods most represented at the site. Unfortunately, eight artefacts (two fragments of grinding slabs, two fragments of rubbing stones, two stone pads, a fragment of a whetstone and a more closely unidentified piece of a coarse tool) could not be dated to any particular period.

Only two fragments of grinding slabs made of greywacke can be dated back to the period of the Lengyel culture, while more numerous findings of the Věteřov culture are dated to the end of the Early Bronze Age. There are a total of twenty pieces of other stone industry dated to this period. Again, these are dominated by grinding slabs. A total of eight of their fragments are made mainly of greywacke, fine sandstone, psammite (weathered crust), and puddingstone. Three fragments can be

Tab 10.2. Summary table with a description of the stone polished artefacts from Hradisko near Kroměříž. Dimensions in millimetres, weight in grams.

Inv. No.	Former Inv. No.	Tool type	Tool description
21	769	Flat axe	Fragment of a small flat axe
22	6775	Hammer-axe	Tiny damaged hammer-axe. base is knapped off
23	4714	Flat axe	Edge fragment of a flat axe
24	6638	Cleaver-axe	Cleaver-axe with a polished edge
26	6112	Shoe-adze	Damaged shoe-adze
97	283	Flat axe	Fragment of a flat axe (edge)
98	283	Semifinished tool	Semifinished ground tool. probably an axe
103	474	Hammer-axe	Fragment of a hammer-axe (edge)
118	1872	Flat axe	Fragment of a longitudinally broken flat axe
119	1873	Axe?	Ground tool fragment. probably an axe
120	555	Shoe-adze	Fragment of a tiny shoe-adze
181	1112	Flat axe	Tiny flat axe with a broken-off base
182	1111	Flat axe	Flat axe. fragment of a base
187	660	Massive axe	Base of a massive axe
188	660	Flat axe	Distal fragment of a flat axe (edge)
189	660	Flat axe	Base of a small flat axe
190	9992	Hammer-axe	Fragment of a ground tool (hammer-axe?)

Tab 10.3. Summary table with a description of the other stone artefacts from Hradisko near Kroměříž. Dimensions in millimetres, weight in grams.

Inv. No.	Former Inv. No.	Context dating	Raw material
100	759	Lengyel culture	Greywacke
117	10718	Lengyel culture?	Gneiss
90	191	Věteřov culture	Greywacke – puddingstone
91	191	Věteřov culture	Siltstone – mudrock
92	191	Věteřov culture	Sandstone. Burnt?
93	191	Věteřov culture	Psamite – weathered crust
94	191	Věteřov culture	Sandstone
95	191	Věteřov culture	Vein quartz
96	191	Věteřov culture	Sandstone with biotite
112	159	Věteřov culture	Limonitized Sandstone
113	1286	Věteřov culture	Greywacke

Raw material	Lenght	Width	Height	Weight	Fig. No.
Želešice type metabasite	39	23.9	9.3	17.68	
Želešice type metabasite	79	36.5	18	72.87	10.8: 1
Metabasite from the Jizerské hory Mts.	31.7	49.1	12.5	29.14	
Andesite	60	40.6	24.6	80.33	10.8: 2
Eklogite	92.9	31.2	27	143.15	10.8: 5
Amphibolite	55	54	17	88.8	
Amphibolite	114	54	23	265	
Greywacke	31	20.5	20.8	24.9	
Serpentinite	82.5	44.7	6.5	44.06	10.8: 3
Serpentinite	54	55	10	34.6	
Muskovitic quartzite	45	26.5	15.5	26	
Želešice type metabasite	51.8	36.3	15.1	36.4	10.8: 6
Želešice type metabasite	195	165	63	3608	10.8: 7
Želešice type metabasite	71	64.5	25.5	171.7	10.8: 4
Želešice type metabasite	35.7	44.7	11.2	21.8	10.8: 8
Želešice type metabasite	27.1	30	9.8	11.34	
Mikrodiorite	47.6	31.8	36.5	38.13	

Tool type	Tool description	Lenght	Width	Height	Weight
Grinding slab	Middle part of a grinding slab	132	114	29	760
Whetstone	Whetstone fragment. Fig. 10.8: 9	71.5	19.8	11.5	31.66
Grinding slab	Grinding slab fragment	121	165	37	1310
Stone pad	Stone pad fragment	124	106	16	345
Grinding slab	Grinding slab fragment?	97	60	40	280
Grinding slab	Grinding slab fragment?	58	90	28	173
Percussor	Percussor fragment?	50	50	31	93
Rubbing stone	Rubbing stone for a grinding slab?	70	43	45.5	205
Coarse stone tool	Fragment of a closer undeterminable tool	92	70	21	157
Stone pad	Stone pad fragment	50	50.7	9.5	30.17
Stone pad	Fragment of a stone pad with one sharp edge	60	47	9.3	39

114	1286	Věteřov culture	Arkosic sandstone
115	1286	Věteřov culture	Drahany type orthoquartzite
116	1286	Věteřov culture	Greywacke – puddingstone
104	237	Věteřov culture	Tertiary Sandstone
183	A6	Věteřov culture?	Greywacke
184	A2	Věteřov culture?	Puddingstone
185	763	Věteřov culture?	Greywacke
29	464	Lusatian culture	Weathered Sandstone
30	11230	Lusatian culture	Arkosic Sandstone
36	5000	Lusatian culture	Sandstone
99	225	Lusatian culture	Greywacke – Sandstone
105	416	Lusatian culture	Limestone
106	432	Lusatian culture	Greywacke
111	385	Lusatian culture	Greywacke
180	1823	Lusatian culture	Quartz
109	282	Iron Age	Arkosic Sandstone
110	282	Iron Age	Arkosic Sandstone
107	141	Medieval Period	Muskovitic siltstone
108	133	Medieval Period	Arkosic Sandstone
25	5227	Undated	Tertiary Sandstone
27	459B	Undated	Quartzite
28	674	Undated	Silty Sandstone
31	4767	Undated	Greywacke – Sandstone
32	753	Undated	Greywacke (Culmian?)
33	?	Undated	Greywacke (Culmian?)
34	4764	Undated	Greywacke (Culmian?)
35	4765	Undated	Sandstone – puddingstone
37	1026	Undated	Greywacke (Culmian?)
38	5981	Undated	Greywacke (Culmian?)
39	4594	Undated	Greywacke (Culmian?)
89	733	Undated	Arkose
101	1882	Undated	Greywacke
102	312	Undated	Sandstone
186	643	Undated	Arkosic Sandstone

Stone pad	Mesial fragment of a stone pad (wristguard?)	27.6	35.5	8	13.4
Rubbing stone	Fragment of a rubbing stone for a grinding slab?	69	60.5	27.5	155.2
Coarse stone tool	Fragment of a closer undeterminable tool	106.5	48.2	17.8	84.4
Stone pad	Stone pad fragment	75.5	67	12.2	106
Grinding slab	Grinding slab fragment. Fig. 10.8: 11	195	165	63	3608
Grinding slab	Grinding slab fragment	285	203	90	8535
Grinding slab	Grinding slab fragment	270	170	65	5744
Stone pad	Stone pad fragment?	52	66	16.8	62.12
Grinding slab	Grinding slab fragment?	96	71	44	305
Grinding slab	Grinding slab fragment	102	86	38.4	460
Whetstone	Whetstone fragment	57	31	15.5	47.8
Whetstone?	Whetstone fragment. traces of iron?	73.8	49.6	14.2	76.1
Stone pad	Triangular stone pad. Fig. 10.8: 10	82.2	54.5	15.2	98.15
Whetstone?	Pointed fragment of a whetstone?	45.5	18	12.8	13
Raw material	Percussor fragment? Probably not an artefact at all	37.2	25	18.7	18.54
Whetstone	Whetstone fragment	68	35.7	21.6	98.7
Whetstone	Almost complete whetstone with a broken tip	99	26.4	21	116.7
Whetstone	Whetstone fragment	60	44.5	21	55.7
Whetstone	Whetstone fragment?	43.4	16	12	8.9
Whetstone	Whetstone. proximal fragment	44	36.6	16.6	31.65
Rubbing stone	Rubbing stone for a grinding slab	65.2	62.4	41.4	305
Stone pad	Flat stone pad	112	61.2	12.8	161
Grinding slab	Grinding slab fragment	300	220	60	4880
Grinding slab	Grinding slab fragment	200	155	50	3433
Grinding slab	Grinding slab fragment	230	130	52	2145
Grinding slab	Grinding slab fragment	190	145	39	1510
Rubbing stone	Fragment of a rubbing stone for a grinding slab	100	78	54	470
Rubbing stone	Fragment of a rubbing stone for a grinding slab	70.8	24.8	32.9	74.78
Rubbing stone	Fragment of a rubbing stone for a grinding slab?	60.3	48	23.4	56.06
Whetstone	Whetstone fragment	88.4	30.3	10.4	49
Grinding slab	Grinding slab fragment	180	145	56	1975
Stone pad	Stone pad fragment?	93	64	21	187
Coarse stone tool	Uncertain artefact	78	56	45	200
Percussor?	Pebble. probably not an artefact at all	81.8	32.3	15.7	64.3

classified as rubbing stones, for which quartzite, coarse-grained sandstone and vein quartz were used. There are three pieces each of stone pads and fragments of whetstones made of siltstone and sandstone. Two sandstone pebbles could be interpreted as percussors, and in the case of one piece of coarse sandstone industry, the function of the stone tool fragment has not been further established.

As far as the contexts dated to the Younger and Late Bronze Age (Lusatian Urnfield culture) are concerned, a total of fourteen artefacts of other stone industry were included. The most common were fragments of six whetstones, made of greywacke, sandstone, gneiss, and limestone. In addition, there were two fragments of sandstone grinding slabs and one fragment of a rubbing stone made of orthoquartzite from the Drahany Highlands. The assemblage was completed by three fragments of stone pads made of sandstone and greywacke, a fragment of a stone pad made of arkosic sandstone, and a single piece of larger artefact of unknown function made of greywacke-puddingstone.

As far as the function of these artefacts is concerned, grinding slabs with rubbing stones were used from the beginning of the Neolithic to the Early Iron Age for grinding grain. Stone pads and plates could have been used, for example, for crushing and grinding various natural materials (e.g. dyes) or as pads for cutting and slicing food. The first stone whetstones appear with the advent of metal tools and were used to sharpen them. Percussors used to produce chipped stone artefacts appear in the archaeological record from the Paleolithic onwards. Other stone industry only changed a little over time and therefore it is not very chronologically sensitive. It is usually made from materials of local origin or from the neighbouring area. Therefore, it was not so valued by prehistoric people, and it was usually left in place when the settlement was abandoned.

Conclusion

The results of the analysis of stone artefacts coming from the excavation of the prehistoric site of Hradisko near Kroměříž, which took place from 1949 to 1956 under the direction of Václav Spurný from the State Institute of Archaeology in Prague, were published in this article. A total of 208 artefacts were analysed, including 146 pieces of chipped stone industry, 17 pieces of polished stone industry and 45 pieces of other stone industry. Based on the type of the finds and especially of the archaeological dating of the contexts in which the artefacts were found, the stone tools were dated to the Early Upper Paleolithic (probably Aurignacian), the Lengyel culture (specifically Moravian Painted Ware culture) and the Bronze Age (the Věteřov culture and the Lusatian phase of the Lusatian Urnfield culture). Isolated artefacts can probably also be assigned to the Eneolithic Period (retouched blade with sickle-gloss) and the Early Modern Period (rifle flint). Mostly these are standard finds that do not deviate in any way from the typical assemblages of stone artefacts found in the wider area at similarly dated sites. Of interest is the presence of Upper Paleolithic artefacts in the assemblage, which may be related to the Paleolithic settlement of Hradisko near Kroměříž, but they may also have been brought and used by the inhabitants of this site in later prehistoric periods. Also worthy of special mention is the discovery of a Neolithic shoe-adze made of a rather unusual raw material – eclogite.

Acknowledgement

The analysis of stone artefacts from Hradisko near Kroměříž and this chapter are part of the outputs of the project "Hradisko near Kroměříž – Bronze Age Hillfort". This project was financially supported by the Regional Cooperation of Regions and Institutes of the Czech Academy of Sciences.

11

An unique Levallois core from Letky / Libčice nad Vltavou (Prague-West District, Central Bohemia, Czech Republic): The technological analysis and the revision of the context

Petr Neruda, Jan Eigner, Petr Šída

Introduction

An important part of the Paleolithic research focused on the lithic industry is the technological classification of all stone artefacts found at the excavated site. The correct reading of traces represented mostly by scars is the only way how to describe the technological complexity of a distinct lithic industry (Tixier 2012), identify specific processes related to it, e.g. ramification (e.g. Bourguignon et al. 2004; Rios-Garaizar et al. 2015), and in many cases, avoid mistakes related to the typological classification of specific artefacts. The process of knapping itself excludes the production of morphologically and metrically identical items compared to, e.g. the production of bronze artefacts. Moreover, not all pieces were produced by an experienced knapper and many pieces are related to the process of learning. Therefore, we must work rather with the variability of a specific form of each artefact type then and we must take into account that a grey zone can exist between any two types.

Such an approach has been applied within the Upper Paleolithic tool types that are defined using their specific features but the morpho-metrical variability is also taken into account (e.g. Demars, Laurent 1989). In this context, the Middle Paleolithic stone artefact variability could be considered limited because the technology and tool types look relatively simple and monotonous. Nevertheless, each of Middle Paleolithic technological concepts requires a specific sequence of technological steps and each of them can be affected by the skills of the knapper, raw material features, recycling processes etc. Even methods that are technologically very strict, e.g. the Levallois method, can contain pieces that deviated from "standards" and resemble products of different methods or even concepts. The typical example is distinguishing Levallois recurrent centripetal cores from discoidal

doi 10.47382/dvs_26-11

cores although both methods are well-defined in their typical variants (Peresani 2003). Moreover, artefacts typologically classified as, e.g. Levallois points can be produced by different methods, non-Levallois included (Boëda 1995).

Although the definition of individual forms of artefacts or methods based on typical examples is important, analysis of so-called "atypical" artefacts that deviated from an applied mental template is also desirable, especially for the reasons stated above. In this contribution, we presented one specific core made on a quartz pebble originating from a loess quarry at Letky / Libčice nad Vltavou cadastres, which was originally described as an atypical core (Fridrich 1982). We propose an alternative classification and relate this piece to the Levallois concept, more precisely to the Levallois method for the preferential flake. However, the find has not been stratified, the analysis of other collected pieces and the original and published field notes allow for its approximate chronological classification.

Geographical settings

Pleistocene finds, localised to Letky (today the southern part of Libčice nad Vltavou Town) and described in this contribution, were found in the Brothers Fischers' Brickyard that is situated on both sides of Letecká Street in one meander of the left bank of the Vltava River, north of Prague in the Czech Republic (Fig. 1.1: 10; 11.1). The findings fall under both cadastres and therefore, we use the new designation as Letky / Libčice nad Vltavou (hereinafter Letky/Libčice).

The brickyard consisted of a factory part built on the eastern side of Letecká Street (Fig. 11.1B, 11.2) and a loess quarry on the left where loess sediments reach a depth of about 20–25 m. The southern border is defined by the communication from Letky to Tursko, the western border does not surpass the elevation of 240 m. The former northern part is hidden in the area of U Krytu and Tržní Streets.

History

The first archaeological and anthropological finds were uncovered during the opening of the brickyard in 1893 (for the history of the site see Fridrich 1982). Between 1899–1906 the quarrying of the loess was situated in the southern part of the former brickyard (Fig. 11.1B). One hearth was found there; nevertheless, the lack of both archaeological and paleontological finds does not enable us to relate this structure to the Pleistocene. Therefore, the probable first Pleistocene find was represented by a well-preserved upper part of a rhino skull from 1921 (Vacek 1925). Twenty years later (the closest snapshot in time showing the state of the brickyard in Fig. 11.2: right), bones and charcoals were recognised in fossil soil. František Prošek who visited the site in January 1942 only mentioned this structure without details (Prošek 1946), but it was documented by Ivan Borkovský in 1942 (Borkovský 1942). He describes two hearths at a depth of 550 cm merged by the cultural layer with the bones belonging also to the rhino (Fridrich 1982). Nevertheless, F. Prošek recorded a hollow in the brickyard wall filled with reddish soil in 1942 and two similar hollows in 1944 (Prošek 1946). One of them should contain the most famous find – a massive flake made from a quartzite (Tab. 11.1, Find 1). The stratigraphic situation at the site was documented also by J. Böhm in 1945 (1945). He confirmed the general structure of Prošek's profile and mentioned the presence of lithic artefacts ("flints") that should originate from Prošek's layers 9–14, which means above the flake from 1944 (Tab. 11.1, Find 1).

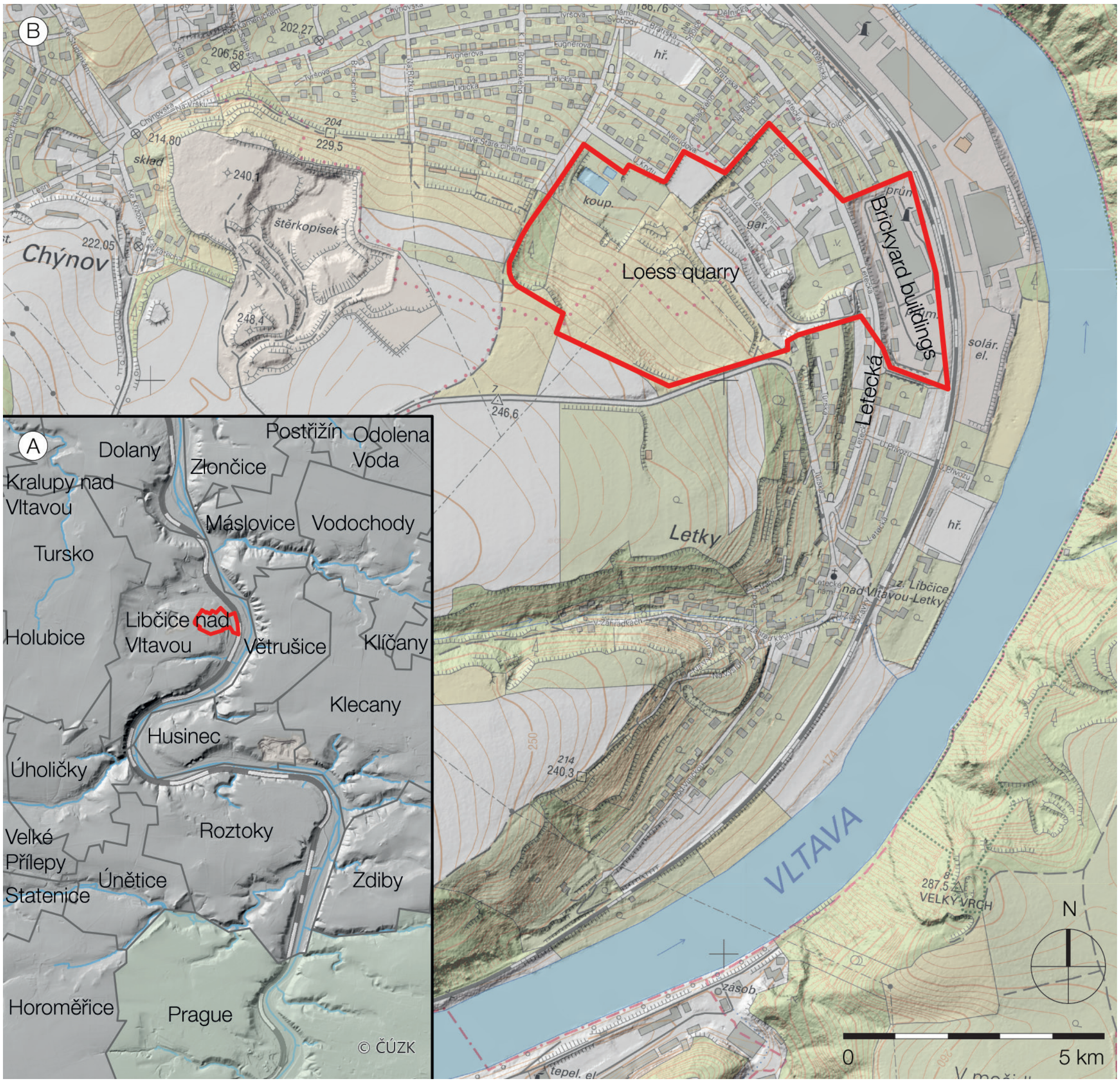


Fig. 11.1. Position of the site within the map of the region of the River Vltava, north of Prague (A) and cadastres Letky and Libčice nad Vltavou (B). The pink dotted line indicates the border of individual cadastres, and the solid red line is the probable extension of the Brothers Fischer's brickyard. Map source: © ČÚZK; graphic by P. Neruda.

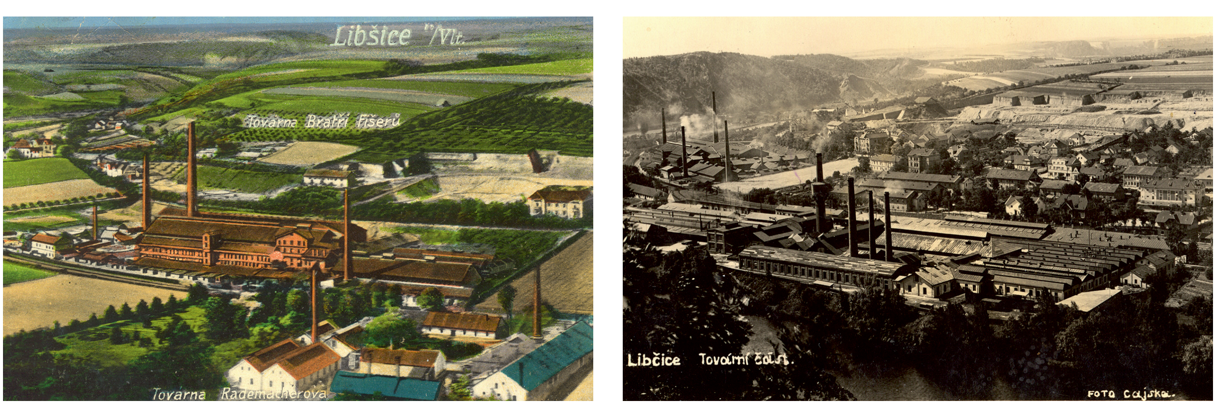


Fig. 11.2. The Brothers Fischer's brickyard and the factory about the 20s (left) and 30s of the 20th century (right) from the east. The extension of the brickyard to the west is visible. Source: archive of fabriky.cz.

Tab. 11.1. A list of finds from Letky / Libčice nad Vltavou. In italics – direct inscriptions on artefacts, asterisks indicate the source of the information. * – elevation of finds to the terrace is questionable because post-depositional movement form loess sediments cannot be ruled out. Source of information: (1) Prošek 1946; (2) Fridrich 1982; (3) Prošek, Ložek 1954b; (4) Kukla 1961; (5) Valoch 1996; (6) Vávra 1994, 20. 11.; (7) Vávra 1994, 30. 12.

Find No. Fig.	Description of finds	Collector and year	Original description of stratigraphic position	Dating
1 Fig. 11.3: 1	A massive flake from an Ordovic quartzite pebble, 135 × 200 × 62 mm[1] (139.5 × 217 × 62.2 mm)[2]	F. Prošek 1944	The upper part of the third fossil soil[1]	Mindel/Riss[3] PK IV[2, 4, 5] MIS 7 (current interpretation)
2	A small flake from quartz pebble, 75 × 72 × 22 mm[3]	1946	The bottom of the loess quarry	Unknown
3 Fig. 11.3: 2	A quartz pebble knapped on one face – cf. chopper, 97 × 79.2 × 53,3 mm (95 × 77 × 53 mm)[2]; (92 × 75 × 52 mm)[3]	1947	The bottom of the loess quarry, sandy crust on the surface corresponding with the upper part of the lower soil Mindel/Riss[3], e.g. PKIV[2]	Unclear, perhaps PK IV (MIS 7)
4 Fig. 11.4	A Levallois core on a quartz pebble, 78.6 × 59.5 × 41 mm (75 × 53 × 35 mm)[2]	1954–1982	A note "*Not stratified*" on the surface, same sandy incrustation as Find 3	Unclear, perhaps PK IV (MIS 7)
5 Fig. 11.3: 3	A fragment from the bipolar splitting of a quartz pebble, 40 × 33 × 22.5 mm (40 × 33.5 × 22.5 mm)[2]	1954–1982	A note "*Not stratified*" on the surface, a rest of a grey-brown crust on the pebble cortex	Unclear
6 Fig. 11.3: 4	A fragment from the bipolar splitting of a quartz pebble, 40 × 21.3 × 10.5 mm (21.5 × 40 × 12.5 mm)[2]	1954–1982		Unknown
7 Fig. 11.3: 6	An atypical flake from a quartz pebble, 35.5 × 33.5 × 11 mm[2]	1954–1982		Unknown
8 Fig. 11.3: 5	A flake with a plain platform (cortex from a quartz pebble), 37 × 37 × 9.5 mm	1954–1982, probably F. Prošek	R-W (Saale-Warthe Interglacial), the second fossil soil[1] R-W (Saale-Weichsel Interglacial, probably the first fossil soil[3]	MIS 7 MIS 5e
9 Fig. 11.5: 1	A coarse-grain quartzite pebble with two scars – cf. a chopper, the natural origin cannot be excluded; 119 × 97 × 56 mm (115 × 90 × 55 mm)[6]	M. Vávra until 20. 11. 1994, Find 2[6]	*The terrace under the exploited loess, above a conveyor*[6], altitude approx. 210 m a.s.l.*	
10 Fig. 11.5: 2	A pebble of Ordovician (?) quartzite with scars – cf. chopping tool, the natural origin cannot be excluded; ground side of one extremity probably anthropic as same as scratches – cf. a hammerstone, 78 × 99 × 46 mm (95 × 80 × 45 mm)[6]	M. Vávra 20. 11. 1994, Find 4[6]	*The terrace under the exploited loess, above a conveyor*[6], altitude approx. 210 m a.s.l.*	Unclear, the post-Paleolithic age cannot be ruled out
11 Fig. 11.5: 6	A chopper, a quartz pebble, 56.4 × 40.8 × 20 mm (56 × 41 × 20 mm)[6]	M. Vávra 20. 11. 1994, Find 5[6]	*The terrace under the exploited loess, above a conveyor*[6], altitude approx. 210 m a.s.l.*	Unclear
12 Fig. 11.5: 3	A half of a quartzite pebble, bipolar splitting, 99 × 68.8 × 43 mm	V. Stárka 1993, according to Vávra 20. 11. 1994, Find 1[6]	*The terrace under the exploited loess, above a conveyor*[6], altitude approx. 210 m a.s.l.*	Unclear

13	A rectangular core with approx. 8 flakes from both sides. Eolithic weathering and a carbonate crust, quartzite, 130 × 110 × 60 mm(6)	M. Vávra 20. 11. 1994	*The terrace under the exploited loess, above a conveyor*(6), altitude approx. 210 m a.s.l.*	Unclear
14	A core with two large scars side by side. Eolithic weathering and a carbonate crust, quartzite, 160 × 125 × 75 mm(7)	M. Vávra 30. 12. 1994, Find 6(7)	*The terrace under the exploited loess, above a conveyor*(7), altitude approx. 210 m a.s.l.*	Unclear
15 Fig. 11.5: 4	A bloc with rounded edges (fluvial abrasion) and one scar, probably intentional, an Ordovician quartzite, 52 × 64 × 100 mm	1967	*The upper floor of the loess quarry*	Unknown
16 Fig. 11.5: 5	A core on envil (bipolar splitting, two scars) – chopper (one scar), An Ordovician quartzite pebble 59 × 98 × 88 mm	1968	*A loess part of the quarry*	Unknown

Other finds are mentioned in the synthesis of the Paleolithic occupation in former Czechoslovakia focused on the stratigraphy of finds (Prošek, Ložek 1954b). Prošek described two other finds – a small flake from a quartz pebble (Tab. 11.1, Find 2) and a quartz pebble with unifacial knapping traces (cf. a chopper; Tab. 11.1, Find 3). Find 3 is kept in the National Museum in Prague along with five other finds (Tab. 11.1, Finds 4–8) denominated as Prošek's collection, which is located in Letky/Libčice without indicating the year of the find. We suppose that pieces originated from the Brothers Fischers's brickyard because at that time, only this loess quarry was opened and Find 4 has the same crust as Find 3. All these pieces (Finds 3–8) were described and visualised by J. Fridrich (1982). Find 4 – a core is the piece being examined in this contribution.

Prošek incorporated the site into the wider chronostratigraphic context in 1954 (Prošek, Ložek 1954b) and updated it in 1957 (Prošek, Ložek 1957). It must be stressed that Prošek surprisingly related the fossil soil with the flake (Find 1) to different river terraces – to IIIb in (Prošek, Ložek 1954b) and IIb in (Prošek, Ložek 1957). Both chronostratigraphic interpretations were based on Záruba's system of the Vltava's river terraces from 1942. This system was not updated until 1977 (Záruba et al. 1977).

Among other significant activities, it is necessary to mention the research from 1961, which was reported by V. Ložek (1961). It was situated in the southwestern corner of the loess quarry and focused on the stratigraphical relation between a massive horizon with fireplaces in the western wall and a red-brown fossil soil in the southern one. They uncovered pedo-complexes, which they marked as PK IV and V with Lower Paleolithic artefacts (according to the former classification). We have no detail information about them and therefore, they are not included into the Tab. 11.1. The micromorphological analyses of sediment carried out by L. Smolíková were important for the chronostratigraphic classification of the fossil soils and Find 1 (Smolíková 1968).

Other archaeological finds from Letky Brickyard were collected by M. Vávra in collaboration with V. Stárka in the 1990s. They found several lithic artefacts at the bottom of the quarry on the surface of a terrace (Tab. 11.1, Finds 9–14). Information about their position is based on Vávra's field notebook stored at National Museum in Prague.

The collection is complited by two artefacts from 1967 and 1968 that are situated to the brickyard but the finder is unknown (Tab. 11.1, Finds 15, 16).

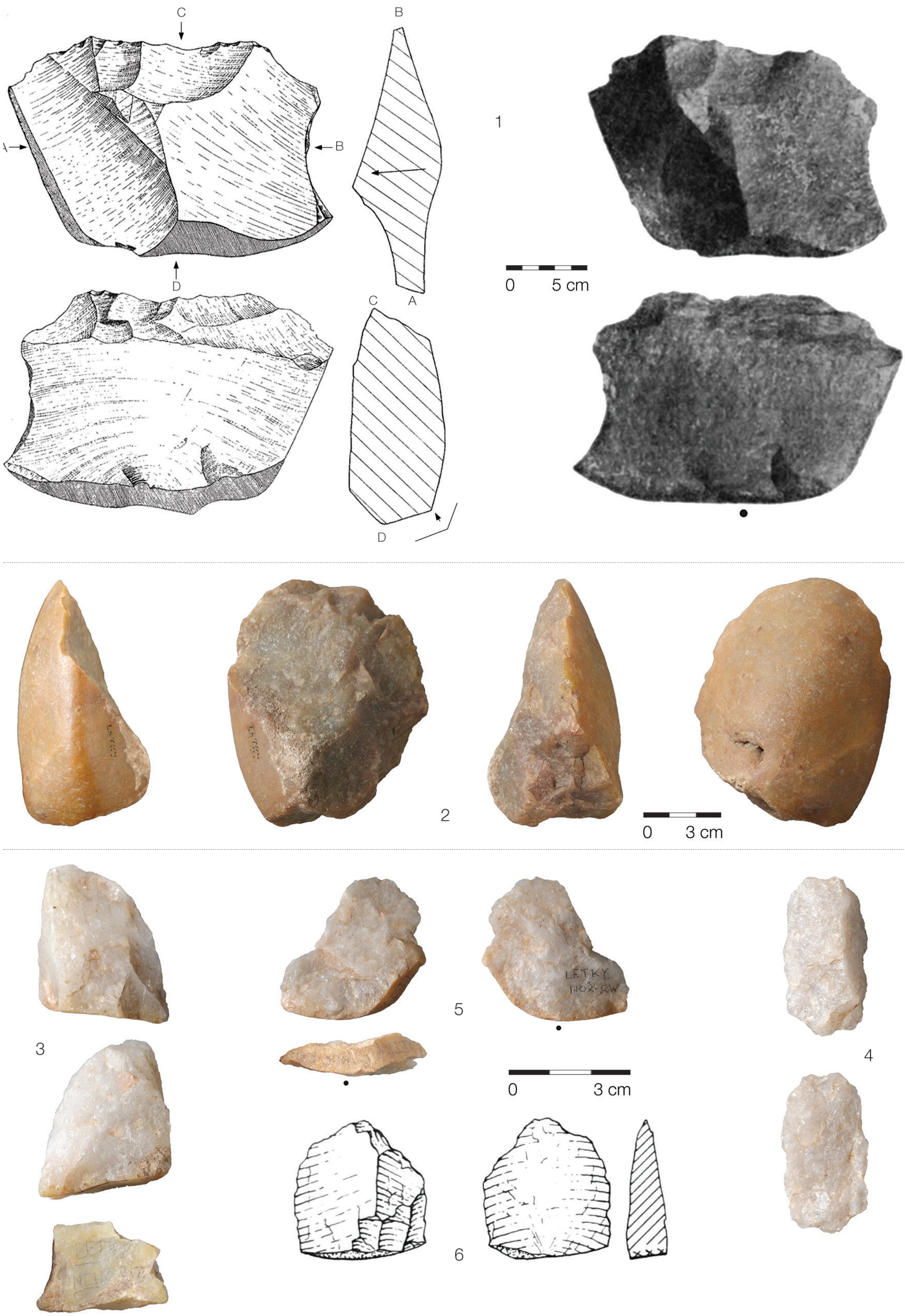


Fig. 11.3. Letky / Libčice nad Vltavou, F. Prošek's finds. 1 – Find 1; 2 – Find 3; 3 – Find 4; 4 – Find 5; 5 – Find 6; 6 – Find 7. Photos: 1 – after Prošek 1947, 133; 2–5 – P. Neruda; drawings: 1 – after Prošek 1946, obr. 3; 6 – after Fridrich 1982, Tab. 97: 4 (for the numbering of the finds, see Tab. 11.1).

Materials and methods

An available archaeological collection from Letky/Libčice is limited rather to isolated pieces of lithic knapped industry collected in different years by several collectors. We summarise all known pieces from both published and non-published materials (Tab. 11.1) and numbered them in the order in which they were found or published. Pieces stored in the National Museum in Prague were photographically documented and an original description was modified.

The case study is related to Find 4 (Tab. 11.1). The analysis of this piece is based on the technological description of the find with a special focus on the determination of individual parts of the core (a surface of the exploitation, a striking platform etc.). These features were compared to criteria for the Levallois concept proposed by E. Boëda (1995). Due to the inner structure of the quartz used for the core, the scar pattern analysis (cf., e.g. Kot 2016; Kot, Richter 2012) was applied only in a limited way because it was difficult to determine the order of individual removals.

The correlation of the core and other finds with the nowadays chronostratigraphy is based on Prošek's profile (Prošek 1946) because both finds with preserved information about the stratigraphical position were found by him. We also took into account the report of J. Böhm (1945) who related his observation to Prošek's main profile.

Prošek interpreted stratigraphical sequence from Letky/Libčice several times (Prošek 1946; Prošek, Ložek 1954b, 1957). His system was based on the Záruba's Vltava Terraces system from 1942 (Záruba 1942). To transform the chronostratigraphy from the 50s of 20th century to more modern chronostratigraphy we accepted micromorphological analyses of L. Smolíková (1969), interpretation of J. Kukla (1961) and the new Vltava Terrace system (Záruba et al. 1977).

If we offer any correlations of former systems with current ones, then we use the system of Marine Isotope Stages (MIS) to minimise the problem related to the progress of the terminology of Pleistocene stages. Nevertheless, we realize that the correlations are indicative only. Without controlled sampling of the entire profile and absolute data, some phases of the Pleistocene may be missing in the published chronostratigraphic sequences and could affect our interpretation.

Results

Technological description of the find

The piece under analysis (Find 4) is the core made from the part of a quartz pebble (Fig. 11.4A). The upper face of the core (A – the surface of the exploitation) is represented mostly by river pebble cortex and one scar recorded the extraction of one short preferential flake from the prepared striking platform in the direction approximately on the longitudinal axis of the core. Several scars are visible on the left side. Nevertheless, these scars are not the result of the knapping. The traces on the edge are fresh and the scar morphology shows an effect of pressure related to the loess quarrying or trampling by heavy mechanization.

The opposite face (B – the surface of the striking platform) of the core consists of a flat surface (the core back) and a facetted striking platform. The back of the core is represented by two scars (Fig. 11.4B – fr1, fr2) indicating the use of bipolar fracturing of the pebble's original volume. The shape of the core's periphery was modified by several flakes, knapped from Surface A (Fig. 11.4B – dark blue). The striking platform was created by the extraction of several flakes from two points in the divergent direction. The striking platform for these flakes was a natural plain river pebble cortex, not the surface produced by the bipolar splitting. The extracted flakes created two notches that define (pick up) the future point of impact that is faceted, although the raw material is relatively coarse-grained. The distance between the striking point and the hinge (the term according to Boëda 1995) is 6.3 mm.

The division of both Faces A and B is not regular if we compare it to Boëda's criteria (Fig. 11.4B). If we rotate the core so that the surface of the preferential flake (scar) is parallel to the horizontal plane, we see that the cross-section through the core is asymmetric. It is not clear whether this is a mistake of the knapper or, on the contrary, a knapper tried to adapt the shape of the blank.

Stratigraphy

Due to rather unsystematic research in the Letky/Libčice brickyard, we have only limited stratigraphical descriptions of the site. All of them are impossible to localise exactly within the map of the region or even the brickyard. Nevertheless, the stratigraphical sequence at this site has been exceptional and has played an important role in the chronostratigraphy of loess sequences in the Czech Republic.

The first stratigraphical description of Fischer's brickyard was published by F. Prošek (1946). He distinguished 17 layers, emphasizing the presence of three fossil chernozem-type soils that were supposed to represent interglacials (Fig. 11.6). The first degraded chernozem (Layer 6) was correlated to the Warthe-Weichsel Interglacial (e.g. Eemian, Mis 5e according to the present system), the second one (Layer 11) should represent Saale-Warthe Interglacial (MIS 7 sensu lato) and the third soil that contained the massive flake (Find 1) in the upper part represented according to Prošek an interglacial before the Saalian (Prošek 1946) or Mindel-Riss Interglacial (Prošek, Ložek 1954b). In our present system (Cohen, Gibbard 2019) such an interpretation could correspond to the early phase of the Saalian (MIS 9). The dating of the sequence was based on the pedostratigraphy and especially on the presence of two terraces of the River Vltava. Prošek mentioned the older terrace IIIa and younger IIIb. Layer 11 (and probably Layers 12 and 13) laid on the Terrace IIIb and Layer 15 (and 16) were recorded between Teraces IIIb and IIIa. Therefore, Layers 15 and 16 should be older than Terrace IIIb which should represent our present MIS 8 and younger than Terrace IIIa (MIS in the sense of Záruba's terrace system, 1942).

Notes and the cross-section of J. Böhm (1945) partly confirm Prošek's interpretation and only indicate the stratigraphic sequence was partly different in distinct spots of the loess quarry.

Discussion

The core was created from a part of the quartz pebble that was fractured using bipolar splitting perpendicular to the longitudinal axis of a pebble (Fig. 11.4B). For a distinct but unclear reason, the knapper directly created the striking platform extracting several flakes from two points in divergent directions. The main goal was to define (pick up) the future point of impact. The striking platform itself was finished by faceting in the same direction. Despite the relatively coarse-grained nature of the raw material, the knapper produced a well-defined surface. Surprisingly, the surface of the exploitation was not prepared as is usual for the Levallois method. The knapper used the natural convexity of Surface A and directly tried to extract a preferential flake from the prepared striking platform.

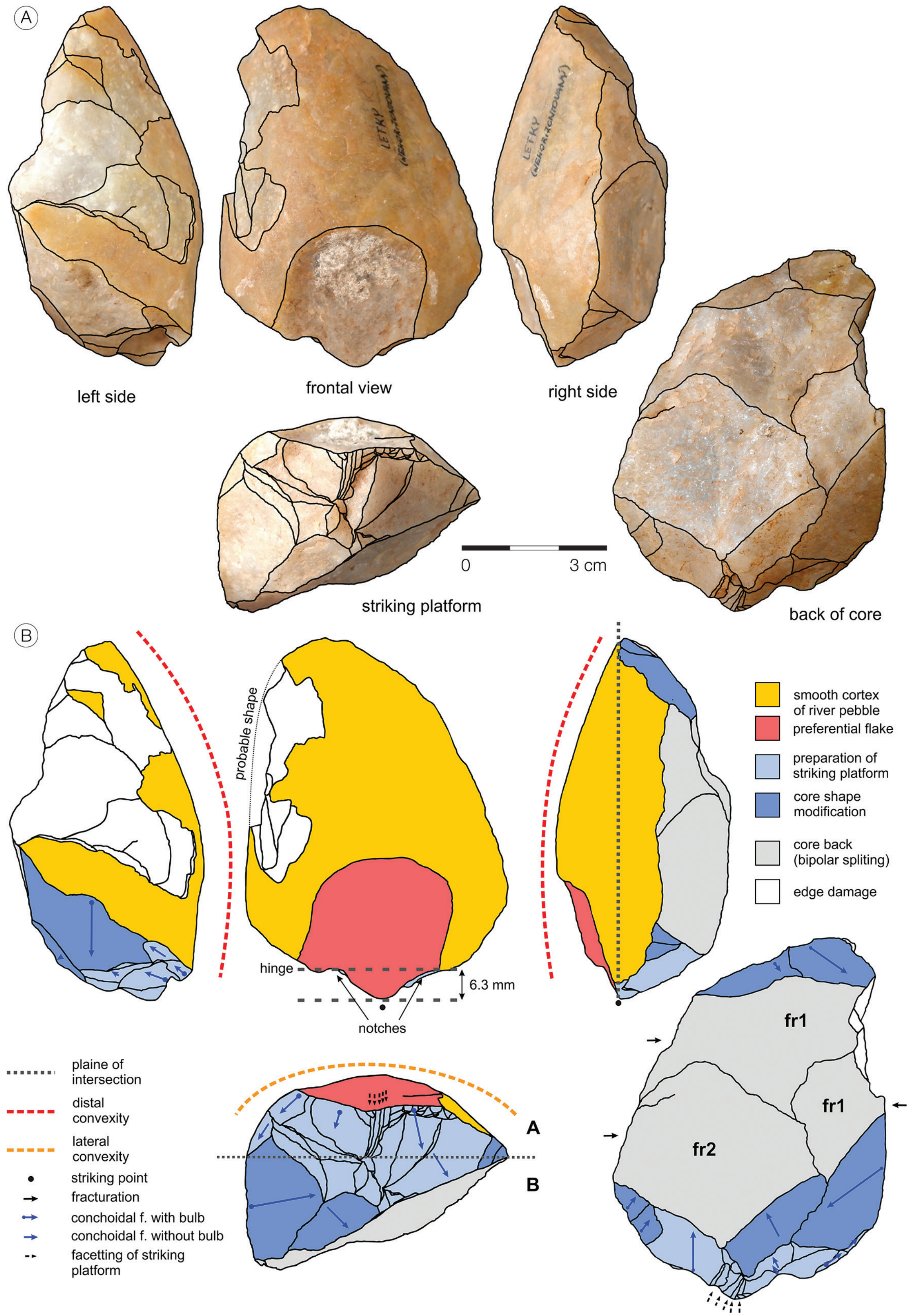
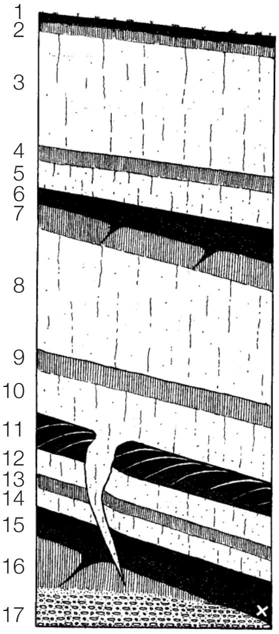


Fig. 11.4. Letky / Libčice nad Vltavou. Find 4 – a Levallois core. Images and model by P. Neruda.

Fig. 11.5. Letky / Libčice nad Vltavou, lithic artefacts from the the 1960s and 1990s. 1 – Find 9; 2 – Find 10; 3 – Find 12; 4 – Find 15; 5 – Find 16; 6 – Find 1. Photo by P. Neruda (1–3, 6) and J. Souček (4–5).



1. 15–20 cm, topsoil (disturbed by ploughing of Holocene chernozem)
2. 15 cm, decalcified rusty soil (degradational B-horizon of overlaying chernozem)
3. 75–100 cm, brown-yellow calcified loess
4. 20 cm, rusty decalcified loess-soil (interstadial brown soil)
5. 50–20 cm, light yellow calcified loess
6. 10–40 cm, I. fossil chernozem, secondary weakly calcified
7. 40 cm, decalcified reddish soil (degradational B-horizon), intersected by small ice wedges filled with chernozem
8. 200–150 cm, yellow calcified loess
9. 30 cm, light brown decalcified soil (interstadial brown soil).
10. 75–100 cm, grey-yellow calcified loess with rusty bottom
11. 30 cm, II. fossil chernozem secondary calcified, intersected with narrow fractures (5 mm) filled with carbonate, fractures are mowed downhill with solifluction, the soil is intersected by an ice wedge 40 cm wide and 150 cm deep, which is filled by greyish loess
12. 20–40 cm, greyish calcified loess
13. 15–20 cm, dark loess-soil secondary calcified (interstadial brown soil)
14. 40–15 cm, greyish calcified loess
15. 30–75 cm, III. fossil chernozem, upper part secondary calcified
16. 100–75 cm, rusty decalcified soil (degradational B-horizon), intersected by ice wedges filled with humous material of chernozem
17. 100-? sands and gravels of Vltava river terrace IIIa

Fig. 11.6. Letky / Libčice nad Vltavou. A stratigraphic sequence according to Prošek 1946, 132–133, obr. 2; terminology corresponds to the year when it was made. The white cross indicates the position of Find 1 (see Tab. 11.1).

It can be argued the morphology of the core is not appropriate to the Levallois method. Probably the most significant problem is related to the surface of the exploitation, which is not artificially created by extracting flakes defining both longitudinal and lateral convexities. Moreover, the knapper had to know the core could not be rejuvenated for the next extraction of a second flake.

The solution is not simple. We work with the static object in a distinct stage of exploitation. We cannot rule out that the core was proceeded by a knapper with a lower level of experience, that it may demonstrate the process of teaching-learning etc. The realisation of a reduction concept could be affected by the quality of the accessible raw materials. The presented piece is an isolated example with the Levallois feature. There are no other by- and end-products undoubtedly related to the core under analysis at the site. Therefore, it is difficult to study the dynamic aspect of the core reduction and we must focus on distinct morphological features.

Probably the most promising way of interpretation is the confrontation of the piece with a definition of the Levallois method. This definition has been discussed many times (cf., e.g. Boëda 1988; 1995; Usik 2006; Usik et al. 2013; Van Peer 1992; 1995). All definition approaches differ in details, but it is obvious that the core must fulfil some morphological parameters for extraction of predetermined flakes of the Levallois type, especially in the case of preferential cores. We consider that criteria defined by E. Boëda (1995) are mandatory for the extraction of Levallois products and can be applied even to examples presented by Van Peer (1992) or V. Usik (2006; Usik et al. 2013).

We compared described core to Boëda's six criteria (Boëda 1995). The core fulfils all the defined criteria (Tab. 11.2), although for specific criteria, it is not obvious without explanation. Probably the most problematic point is the division of the core into two surfaces (A and B) according to the plane of intersection (Criterium 1). If we rotate the core to obtain the final flake scar parallel to the plane of intersection then the core is asymmetrical in cross-section. Nevertheless, both Surfaces A and B are hierarchised and cannot be reversed (Criterium 2). Criterium 3 is also fulfilled because the core has both convexities, however not prepared but natural. Criterium 1 affects the rule that the fractured plane of the predetermined flake must be parallel to the plane of intersection (Criterium 4). In our case, it looks both planes are not parallel but it could reflect a knapper's error or incorrect orientation of the core. Criteria 5 and 6 are fully established.

Based on the comparison of the core and Boëda's criteria we understand the core as a Levallois preferential core and we refuse the classification published by J. Fridrich (1982) who considered it as an atypical core with the surface of the exploitation on the flat part of the piece (our Surface B). Concerning both concepts applied on the core (bipolar fracturing and Levallois method), we think the Levallois method is more significant due to the systematic way of flake extraction, contrary to the random results of bipolar fracturing.

On the other hand, the coexistence of both concepts is interesting and extends our interpretative possibilities. It seems bipolar fracturing was the first technological step that prepared the material for the following procedure – the Levallois production. It means two concepts were applied in one piece and it opens four hypotheses about knapping strategies.

First, the coexistence of bipolar fracturing and the Levallois method is a random process that was used only for this core to solve any technological considerations. The knapper divided the pebble first and then he prepared the piece of pebble to the form of the Levallois core for a preferential flake. He extracted the flake and the core was abandoned. The second possibility is related to the target application of both concepts as the target strategy. It means the fracturing of pebbles and their transformation to Levallois (only) cores was a standard process of lithic blank production. We cannot exclude the third hypothesis that archaic humans used two or more methods for flake production (the Levallois and, e.g. discoid) and they applied them according to the shape or dimension of a fractured pebble. In

Tab 11.2. Comparison of Boëda's definition of the Levallois method and the core from Letky / Libčice nad Vltavou.

Criteria of the Levallois concept	Find 4 relations to Boëda's criteria	Comments
1) Intersection of two asymmetrical convex secant surfaces	Yes with reservation	The intersection is vaguely defined or the plane of the preferential flake was intentionally turned within the plane of the intersection
2) Hierarchically related surfaces. A – surface of debitage (in the text the surface of the exploitation; cf. Van Peer 1995 upper (core) surface and Usik et al. 2013 working surface), B – surface of striking platform (cf. Van Peer 1995 striking platform face – under the surface)	Yes with reservation	Visible in the area of the striking point, especially. The exact division is affected by Criterium 1
3) Lateral and distal convexities	Yes	This criterium is fulfilled by natural convexities of the pebble cortex
4) Fracture plane of predetermined blank parallel to core plane	Yes with reservation	The deviation of the fracture plane from the core plane is related to Criterium 1
5) Axes of percussion are perpendicular to the hinge	Yes	In the area of the hinge, the direction is slightly oblique within the longitudinal axis of the pebble fragment
6) Direct hard hammer percussion; striking point takes place a few millimetres from hinge	Yes	Striking point 6.3 mm from the hinge, facetted

such a case, we noted the strategy of ramifications. Contrary to this, the Levallois core can represent evidence of recycling. In this case, the fractured pebble represents waste and the coexistence of the Levalois method and bipolar fracturing is random. Nevertheless, it is obvious that all the explanations are only hypothetical without the complete assemblage.

It is interesting to discuss the question if the core from Letky/Libčice is unique or if the use of natural convexity of the pebble as the surface of the exploitation is only the logical adaptation to a specific raw material – the quartz. Our possibilities to study analogical collections are rather limited. The presence of the Levallois method during the Middle Paleolithic is less abundant in the Czech Republic as compared to, e.g. Germany. Levallois methods were used for the blank production of blanks from the chert of Bečov-type but in this case, the raw material is usually possible to obtain in the form of irregular blocks and the core shape must be prepared. We also noted Levallois production in Moravian sites (Oliva 2006) but many of them are isolated artefacts mostly from surface sites and in several cases, they do not fulfil the criteria for the Levallois method. Taking into account stratified finds, the presence of this phenomenon is not abundant. Two collections with several pieces are dated to MIS 6 – Layer 14 in Kůlna Cave (Neruda 2011; Valoch 1988) and Layer 3 in Moravský Krumlov IV (Neruda 2009). In these assemblages, we have no Levallois cores on river pebbles.

Using of this kind of raw material is known from the both lower and upper Middle Paleolithic layers at the Předmostí II – Hradisko open-air site (Moncel, Svoboda 1998; Svoboda et al. 1996) that are dated to the Last Interglacial and contain Levallois pieces (the collection of the Institute of Archaeology of the Czech Academy of Sciences in Brno). Besides several flakes (e.g. ID 12/89, 60/90 and 192/90), two pieces can be related to the Levallois cores (Fig. 11.7). The first is the Levallois core for the preferential flake (ID 83/90 – the upper Middle Paleolithic layer) of circular shape (an orthoquartzite) and the second is the core in the shaping stage made of a quartz pebble (ID 225/92 – the lower Middle Paleolithic layer). In both cases, the surface of the exploitation is prepared and the natural convexities of pebbles were used as surfaces of the striking platform. Such treatment seems to be the logical way because it provides better control of both surfaces – the surface of the exploitation and the surface of the striking platform. From this point of view, the core from Letky/Libčice is rather unique, but the limited number of analogical Levallois pieces on pebbles does not support it significantly.

Probably the most complicated problem, related to finds from the Letky/Libčice brickyard, is the chronological correlation of individual pieces of evidence of human activities. We can divide them into three groups – combustion zones and charcoal accumulations, bone accumulations and lithic artefacts.

However, we have to be very careful in accepting individual evidence, especially when it comes to the presence of charcoal deposits and layers of red "burnt" clay that should be burnt according to Prošek. None of the structures was unambiguous. Concerning charcoal accumulations, we cannot exclude natural fire and within red "burnt" layers the question is more complicated because F. Prošek mentioned the presence of such layers above the charcoal horizons (Prošek, Ložek 1954b). In total, Prošek did talk about four fireplaces (Prošek, Ložek 1954b) and two oval depressions that contained the charcoal layer and also a red "burnt" layer above them. He believed that they represented the remains of settlement objects. Nevertheless, K. Žebera (1952) expressed doubts about their artificial origin and thought that they could be a result of a pedogenetic process, similar to "orsteins" (hardpan). The difficulty of clearly classifying such situations as fires is also shown by the modern analysis of the so-called fire from Schöningen 13/II (Stahlschmidt et al. 2015). Natural origin can also explain the presence of animal bones in sediments, especially

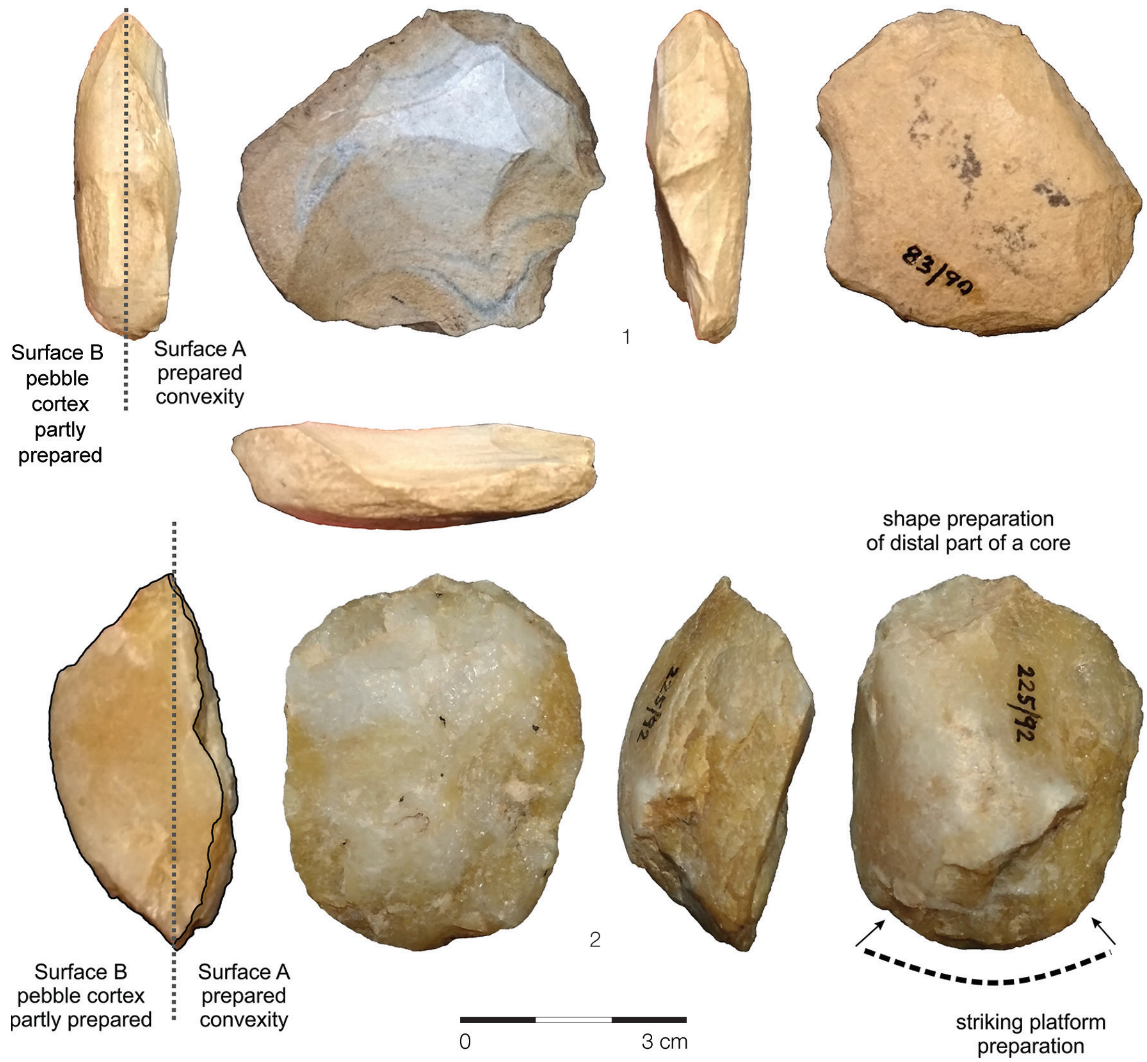


Fig. 11.7. Předmostí II. Example of Levallois cores. 1 – For the preferential flake, exploited; 2 – for the preferential flake (?), prepared. Collection of the Institute of Archaeology of the Czech Academy of Sciences, Brno. Photo and graphic by P. Neruda.

if they are not in obvious connection with other anthropic structures, they should be found in layers with charcoals and according to Böhm also with lithic flakes (Report 73/45, Archive of the Institute of Archaeology of the Czech Academy of Sciences, Prague). Such an observation cannot be verified and often relied only on information from brickyard workers.

Only stone artefacts are therefore conclusive. The lower dating of the presence of an archaic human at Letky/Libčice is proven by the flake from 1942 (Find 1), but its original dating has to be revisited. As we mentioned above, F. Prošek correlated it with the late phase of the Mindel/Riss Interglacial (Prošek, Ložek 1954b). A similar chronological position was published by J. Kukla, however, he correlated the find with Pedocomplex IV (Bodenkompolex – BK) of the new pedostratigraphic division of the Pleistocene of former Czechoslovakia published in the 1960s (Smolíková 1969). Today, such stratigraphic position is associated with Intrasaale Interglacial sensu lato (MIS 7).

A significant shift was brought about by the updating of the system of Vltava's river terraces, which designates the original terraces IIIa and IIIb as Va and Vb and correlates them with the older phase of the Saale Glacial, i.e. MIS 8 (Záruba et al. 1977). This would support the classification of both the soil and Find 1 itself to MIS 7. From today's point of view, this "short" chronology seems more likely, but without absolute dating, for example, through the OSL method, and without a modern revision of the profile in the brickyard, it will not be easy to solve this problem.

From older reports (e.g. Böhm 1945) it follows that there were stone artefacts younger than Find 1 at Letky/Libčice. In any case, the exact stratigraphic position is not recorded. Concerning this, Find 8 appears to be the most reliable. The flake with the natural cortex rest of the striking platform bears the inscription "R–W", which indicates that it came from any interglacial soil above Prošek's Layer 15. Comparing Prošek's tables we see he used the abbreviation R–W for Saale-Warthe Interglacial (Prošek 1946) and later for the Saale/Weichsel (Riss/Würm) Interglacial (Prošek, Ložek 1954b). We can presume he mentioned Saale/Weichsel and therefore, it is probable the find belonged to Layer 6 or Layer 7 (according to the division in Prošek 1946). In such case, the correlation with PK III (MIS 5e) or with some Weichselian interstadials (MIS 5c or 5a) is probable. This find is part of Prošek's small collection stored in the National Museum in Prague and therefore, we can assume that all finds could belong to the same horizon, the Levallois core included. On the other hand, the Levallois Core (Tab. 11.1, Find 4) has the same sandy crust on the surface as Find 3. This crust should correspond with the upper part of the lower fossil soil correlated with Mindel-Riss (Prošek, Ložek 1954b) or PK IV (Fridrich 1982). If we take into account the available data, then it seems that the findings prove the stay of members of the Neanderthal lineage in the Letky/Libčice area in the warm periods of MIS 7 and MIS 5.

Conclusion

Despite all the imperfections in the documentation of the finds from Letky/Libčice and the limited number of artefacts, we can gain interesting insights from this old material regarding the technological skills of archaic humans. Although quartz is not a suitable raw material for the production of stone tools due to its internal structure, under certain circumstances it could have been processed with such a strict procedure as represented by the Levallois concept.

We re-evaluated the original classification of the core (Find 4) and technologically described the features that allow us to include this piece in the group of Levallois cores for the preferential flake. A river pebble was chosen as the raw material, which was first broken by bipolar fracturing, and half of it was further processed into a core. The main difference with the analogous Levallois cores on boulders is that the surface of the boulder served directly as a mining surface, and not, as is usual, as a striking surface.

Analysis of the available information on the stratigraphic position of the finds from Letky/Libčice enables us to correlate finds with the chronostratigraphic system of the Pleistocene. It seems likely that the finds come from two or more horizons, mostly fossil soils representing interglacials in the MIS 7–MIS 5 time span.

Acknowledgement

We would like to thank Martin Novák from the Institute of Archaeology of the Czech Academy of Sciences, Brno for access to the material from the excavation of Předmostí II – Hradisko. Our thanks also go to ing. Martin Vonka, PhD., who provided us with images of the Libčice brickyard from the archive www.fabriky.cz. This paper was financially supported by the Ministry of Culture of the Czech Republic through institutional financing of the long-term conceptual development of the research institution (the Moravian Museum, ref. MK000094862, and the National Museum DKRVO 2019–2023/IIe, 00023272).

12

A new plain bone point find from prehistoric context in Kaderníkova 1 Cave (Tisovec, Slovakia)

Bibiána Hromadová, Marián Soják, Martin Sabol, Dušan Hutka

Introduction

Points from hard organic raw materials represent typical artefacts from prehistoric sites all over Europe. One of the few exceptions is the territory of Slovakia where only sporadic bone and antler points come from various periods of Paleolithic and even more rarely from later periods. Indeed, Mesolithic projectiles are only represented by an old double find from Medvedia Cave near Košická Belá – Ružín (Bárta 1990). The accidental find of a point from hard organic raw material during a speleological expedition in the Tisovec region is therefore unique on a national scale. This interesting find emphasises the need for a detailed examination of mountain and karst areas in Slovakia.

Epipaleolithic and Mesolithic periods are represented in Slovakia mostly by finds of fine chipped stone industry (e.g. Kaminská et al. 2014). The Epipaleolithic is represented predominantly by characteristic finds of the arch-backed pieces technocomplex in Eastern Slovakia and of the Świderian and the Ahrensburgian in the Spiš region (Kaminská et al. 2014, 317). The Mesolithic occupation of the mountainous regions and Eastern Slovakia is very poorly known. Limited information about the local Mesolithic settlement comes mostly from individual finds or specific archaeological situations such as Medvedia Cave near Ružín (Bárta 1990). But more numerous assemblages and larger sites are virtually missing. A larger site has been partially excavated in Košice-Barca (Eastern Slovak Lowland) and was provisionally classified as the Tardenoisian (Kaminská et al. 2014, 320). Mesolithic finds from the Spiš region seems mostly connected with overlaps of the Janisławice and Penkovka cultures (Valde-Nowak, Soják 2010). Thus, the find from Kaderníkova 1 Cave provides new information about this part of Slovakia in the late Pleistocene and the early Holocene.

doi 10.47382/dvs_26-12

The most complete faunal remains and the plain-bone point from Kaderníkova 1 Cave have been studied through morphometric and basic typo-technological analyses. The analysis includes a description of the circumstances of the discovery and the site in general. The aim of the preliminary analysis of the bone artefact is to discuss its chrono-cultural classification and the possibilities of the penetration of Mesolithic and Epipaleolithic traditions from the regions north of Slovakia.

Geomorphological conditions and circumstances of the find

Several smaller caves were discovered in the boundary area between karst and non-karst rocks during a speleology field survey southwest of Tisovec (Rimavská Sobota District), in the region of Gemer and in the Spiš-Gemer Karst – Muránska planina. Pekná, Veľká Puklina, Kaderníkova, Janka and Troch Kamarátov Caves were gradually discovered. One of the caves, called Kaderníkova, was discovered in a rocky terrain in an indistinctive rock crevice, with an entrance at an altitude of 649 m above sea level (Fig. 1.1: 11). The cave is situated west of Tisovec in Kuklička Valley, in the crags of so-called Panská Rock, above the right bank of the Stream Rejkovský (Fig. 12.1). From the perspective of the karst phenomenon, the cave is located on the boundary between the Jaslište Valley karst and the non-karst rocks of Tisovská Poľana. Two small erosion apertures were originally visible in the rock wall, indicating that there was a cave in the massif. On 26 June 2019, speleologists D. Čipka and D. Hutka dug out an exploratory probe about 1 m deep near the rock wall in the direction of a narrow fissure. They discovered that the fissure widened as they dug deeper. Further deepening of the probe widened the fissure enough to make it possible to crawl into the massif. The vertical fissure with the dimensions of 1 × 0.5 m slightly descended for three metres, ending with several larger fallen rocks that had to be overcome and later removed (Fig. 12.2, 12.3). The entrance fissure ended in a small, 4 × 1.3 m cave formed on a vertical fissure, with two narrow chimneys leading into it from the surface as well. The space was less than a metre high; a man could only stand in the area of the chimneys. The cave was undecorated, only containing modest sinter flows, especially in the chimneys. The bottom was covered by sharp-edged stones and deposited leaves. At the end of the smallish cave, the space bifurcated into two parallel short projections. As the cave, denoted as Kaderníkova 1, might have continued inside the massif in the direction of the projections, an assumption that later proved true, an exploratory probe started to be dug in the left, more distinctive part. The second cavity, named Kaderníkova 2 Cave, is apparently devoid of any finds.

Fig. 12.1. Kuklička Valley with the Stream Rejkovský; D. Hutka points to Panská Rock, in which Kaderníkova 1 Cave and its continuation, Kaderníkova 2 Cave are situated. Photo by M. Soják.

The floor of the small Kaderníkova 1 Cave was comprised of sharp-edged rocks, gravel, soil, and plant roots, with several small animal bones, teeth and later also several teeth of a young bear found scattered among the rocks. As the expected result was not achieved, the speleological work was interrupted for some time. During an inspection of the cave on 21 November 2020 (D. Hutka, L. Vlček), speleologist L. Vlček noticed a fragment of a sintered deer antler. Later, during a further deepening of the probe, D. Hutka, M. Ryček, Š. Zachar, A. Havel and J. Riegl discovered a second antler fragment along with several larger animal bones in a depth of c. 20 cm on 26 September 2021.

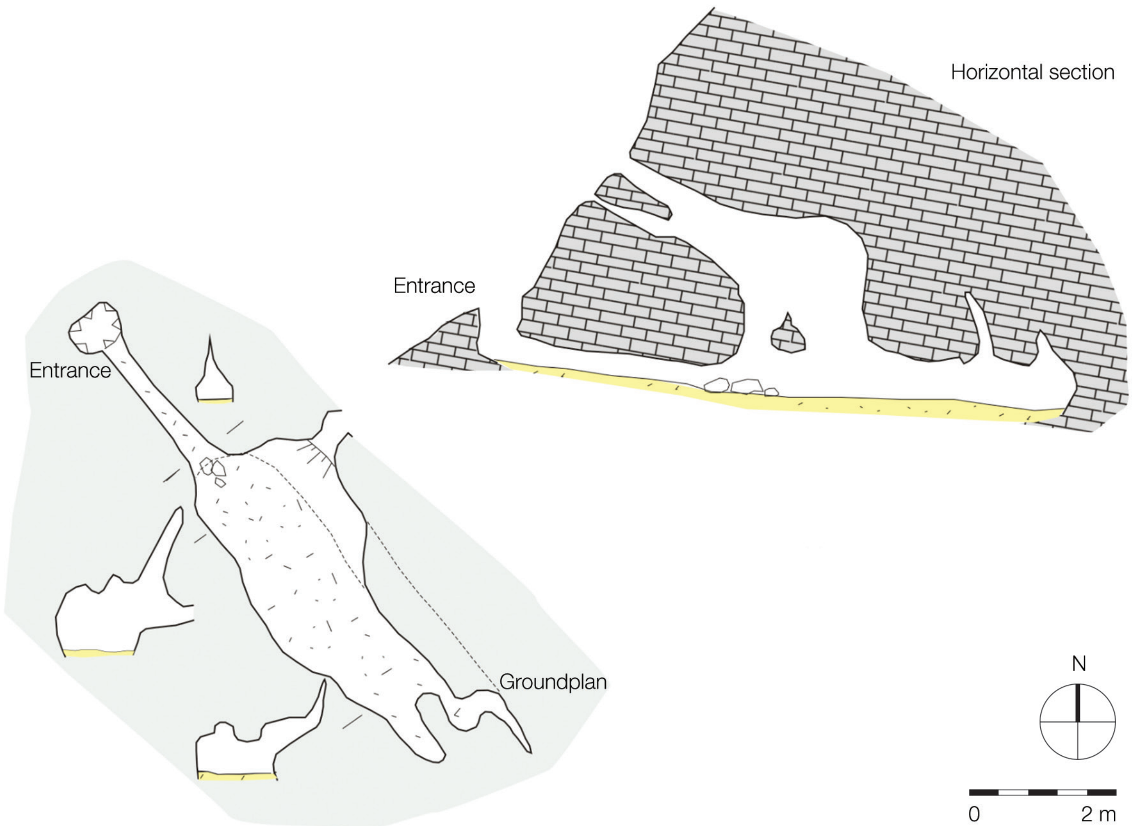


Fig. 12.2. Tisovec – Kaderníkova 1 Cave map. Localisation and drawing by D. Hutka; digitisation by F. Mihál'.

Several more animal bones and teeth were gathered during further digging (D. Hutka, D. Čipka, L. C. Luberda, J. Krajči, A. Krajči, S. Chovan). During a deepening of the probe on 9 November 2021, D. Hutka discovered a thin long bone in a depth of 130 cm with clear traces of working recognisable after cleaning.

The bone artefact and the faunal remains reached a co-author of the present study, archaeologist M. Soják, who examined the cave floor together with the speleologists a few times after that. No traces of human occupation have been detected during the latest examination of the cave. Presumably, the bone artefact finds found their way to the cave rather accidentally.

Morphometric analysis of animal finds

Significant mammal remains without intentional traces were subjected to basic morphometric analysis.

1. Second upper left bear molar (M2 sin.; Fig. 12.4: 1)
The tooth is rather large, ca 42 mm long, ca 22 mm wide in the anterior part and ca 17 mm wide in the posterior part. The crown of a light-brown to brown colour is slightly damaged on the surface, unworn, probably with as yet undeveloped roots, apparently not erupted yet, formed in the jaw (age phase II–III, juvenile individual, after Stiner [1998]).

The paracone is a massive cusp, the largest of the cusps on the crown, with a smooth medial wall and with 3–4 secondary cusps on the base (so-called "paracone jutty", morphotype B after Rabeder [1999], also further). The parastyle is not developed as a cusp; instead, there is a short crest-shaped structure on the mesial end of the protocone ridge (the anterior edge of the crown is comprised of multiple smaller secondary cusps), connected to the anterior ridge of the paracone, which turns in the anterolingual direction (similarity to morphotype B3). The metacone is distinctive, smaller than the paracone, from which it is divided by a distinct groove (within the so-called mesostyle complex, the posterior ridge of the paracone is not in contact with the anterior ridge of the metacone, morphotype 0); two ridges diverging from the top are situated on the inner side of the cusp. The metaloph is not developed; instead,

Fig. 12.3. Tisovec – Kaderníkova 1 Cave. 1 – Speleologist D. Hutka in the entrance; 2–3 interior; 4 – rear part, where the cave continues with Kaderníkova 2 Cave. Photo by M. Soják.

Fig. 12.4. Tisovec – Kaderníkova 1 Cave. 1 – Bear tooth analysed by C14; 2, 3 – deer antlers, the first of them analysed by C14. Photo by M. Soják; drawing by Z. Nagyová.

there are four unordered secondary cusps in its place (morphotype A). The metastyle is not developed (morphotype 0), and the edge of the crown is 'split' in this place. The crest-shaped protocone is lower, divided into two larger parts with a crest-shaped double cusp in the posterior portion, separating it from the hypocone; several minor ridges lining the base of the protocone are situated on the inner side near the base (morphotype 1). The hypocone is distinct, almost as large as the metacone, higher than the protocone, with three ridges on the base of the inner side. The posthypocone is as distinct as the hypocone, equally high but shorter. The posteroloph, if developed, has only the shape of two parallel transverse incomplete 'ridges', both formed by four secondary cusps – the anterior one, running from the posterior edge of the hypocone, is shorter than the posterior one, which runs from the anterior end of the posthypocone (similarity to morphotype 2). The talonid basin contains cusps; the secondary cusps are not ordered (morphotype B). The distal cingulum, or more precisely the distal edge of the tooth is comprised of 6–7 smaller cusps divided by grooves (morphotype B). The distinctly developed lingual cingulum contains cusps and reaches under the posthypocone (morphotype (2,5) 3).

In conclusion, it is possible to write that the analysed tooth shows a developed morphology like the M2 morphology of cave bears (*Ursus* ex gr. *spelaeus*) at first glance; it is close to it also with its size, unusually large for a brown bear. The absence of the metastyle might represent a diagnostic feature, accompanied from the morphology perspective by a predominance of more basal or central forms of morphotypes of the individual morphological elements. Since this is an isolated find, however, and its redeposition cannot be ruled out, it can only be determined as *Ursus* sp. based on the description above. Based on the dating, however, (see below) its classification as brown bear (*Ursus arctos* ssp.) is more likely. Another find of a formed crown of a bear canine, with the root part still undeveloped (juvenile individual), also comes from the site.

2. Antler fragment No. 1 (Fig. 12.4: 2)
The light brown antler fragment consists of the pedicle, the rosette, and basal parts of the orbital and supraorbital point. In view of its size and shape, the fragment is supposed to belong to a larger cervid (Cervidae), probably to a red deer (*Cervus elaphus*); due to the preservation of the find, however, it has only been determined as *Cervus* sp. The find shows distinctive traces of the activity of a taphonomic agent – probably, the traces of gnawing by a larger rodent (?).

3. Antler fragment No. 2 (Fig. 12.4: 3)
The grey-coloured antler fragment consists of the pedicle, the rosette, and basal parts of the orbital and supraorbital point. In view of its size and shape, the fragment is also supposed to belong to a larger cervid (Cervidae), probably to a red deer (*Cervus elaphus*); due to the preservation of the find, however, it has also been only determined as *Cervus* sp.

For both antler finds, the assignation to another larger cervid genus (*Rangifer*, *Dama*) is less likely. The assignation to large genera (*Alces*, *Megaloceros*) is ruled out from the morphological viewpoint.

Analysis of the bone point

In addition to faunal remains, a pointed complete artefact was also found in Kaderníkova 1 Cave. The primary objective of the analysis was to determine taphonomic alterations and intentional modifications to categorise the artefact typologically and to discuss the interest of this find for Slovak Prehistory.

The artefact was preliminarily analysed using a magnifying glass; photographic documentation was made using Canon EOS 70D camera with EF–S 60mm macro-objective in Helicon Focus 7.0 program. The identification and classification of the object included classical morpho-typological analysis and analysis of some traces of fabrication. At first glance, it was clear that the object was a complete point from a hard organic raw material. The taphonomic aspects of the artefact were analysed (e.g. after Behrensmayer 1978; Fernández-Jalvo, Andrews 2016 etc.). Shape and design of bevel and macromorphological traces helped to specify the "type" of the artefact and some details of its manufacturing and use. A precise diagnostic of traces of fabrication could not be performed due to the lack of equipment; it will be the subject of a further analysis.

Characterisation of the material
The object is made from a mammalian long bone. This is evidenced by a dense cancellous bone structure with the rest of the medullary cavity, which is preserved in almost the full length of the artefact and is typical of bone tissue. The absence of identifiable parts does not enable a closer deter-

mination of the type of the bone or of the animal species (in this case a ZoomS analysis should be performed, see e.g. Pfeifer 2022). Points of a similar type from eastern European sites are usually made from metatarsal or metacarpal cervidae bones (e.g. Zhilin, Savchenko 2012). The compact bone from which the pointed object was made is at least 7–8.5 mm thick, and the point length is almost 180 mm long. In the medial part there are distinctive remains of the medullary cavity gradually going over to spongy bone tissue in the proximal and distant parts. This means that almost the whole length of the diaphysis of a more massive bone was used to make the artefact, which might correspond to cervidae metapodia. Without histology analysis, however, this is still an assumption rather than a definitive conclusion.

Taphonomy

The point was found in excellent condition, with minimum damage from taphonomic agents. The colour of the point is light yellow, with traces of white sediment in sponge bone. The surface of the point is very smooth, which complicated the overall analysis of the traces. Almost no taphonomic alterations are observable at the point, except for minor mechanical damage likely caused by post-depositional processes. The point seems to be strongly mineralised; generally, it corresponds to the other bone points finds from other Slovak caves (e.g. Medvedia Cave; Allard et al. in press). From the perspective of taphonomy (the colour, preservation, and general aspects of the surface) of the point differs from other faunal remains found in the cave.

Description of the artefact (Fig. 12.5: 1)

The object is 178 mm long; its thickness varies from 2 to 8.5 mm. The section of the point is circular, reaching ca 8 mm in the centre.

The distal part of the point, the apex, is approximately 2 mm wide and has planoconvex section. Minor crescent-shaped damage is visible on the rounded end, accompanied by a slight flattening of the surface. It is a breakage caused by a slight pressure on the sharp point and its subsequent crushing. The edges of the breakage are rounded and smoothed, like the rest of the point. The damage is minor and not deep, affecting only a few millimetres of the surface. Breakage diagnostics is generally a complicated process, with many factors and pitfalls. The origin of this type of damage is often connected not only with hunting but also with an impact on a hard surface; in this case, a relatively mild one (Pétillon 2006; Pétillon et al. 2016).

The distal and mesial parts of the point are both strongly polished, almost to a gloss. The surface shows no considerable deformations. The shaping techniques have not been precisely identifiable yet due to final surface modifications.

The proximal part of the point is worked into a wedge-shaped morphology with flattened biconvex section along the sides. This is the most massive part of the object, with the width of the section reaching 8.5 mm. Several groups of various alterations can be identified on the surface.

- Group 1: macromorphological adjustments of the shape of the base. The base of the point is worked into a slightly pointed wedge-shaped form. In order to reach such a shape, the object was flattened on the edges into a sharp convergent end and then shaped into the final form by a series of short cuts. The shaping was done by cutting, as evidenced by a series of elongated and flattened removal scars. Very fine parallel glossy striation occurs on the surface of the removal scars. The edges of the removal scars are strong and regularly smoothed, probably due to further use.

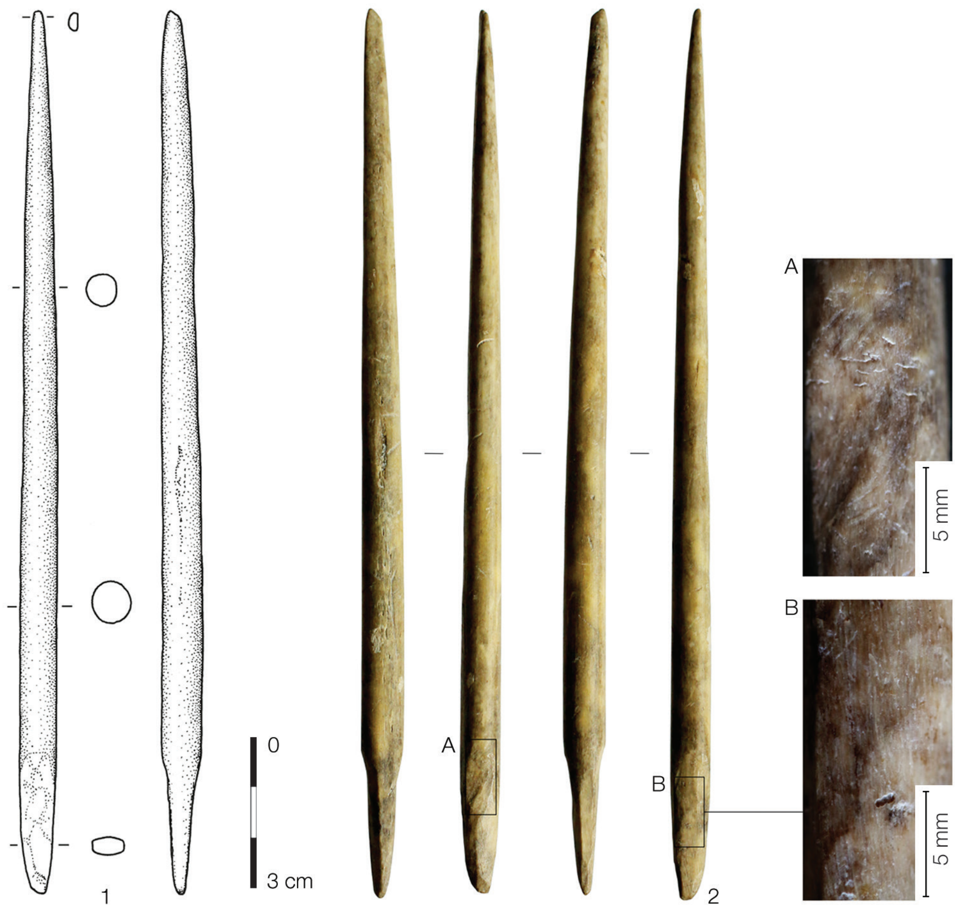


Fig. 12.5. Tisovec – Kaderníkova 1 Cave. Plain bone point with a double-bevelled base and its details. Photo by M. Soják; drawing by Z. Nagyová; picture by B. Hromadová.

- Group 2: traces of shaping. The surface of the point body in the areas above the base is slightly wavy with fine strongly smoothed step-marks (Fig. 12.5: 2, B) accompanied by transversely and parallelly arranged marks (small linear traces oriented transversely to the main axis of the object). These alterations occur within a range of two centimetres from the wedge-shaped end at the most. Similar traces usually represent bounces after working with a stone tool during the scraping or the longitudinal levelling of the surface using a bladelet. They are better preserved than the rest of the artefact's surface. This might be caused by the fact that this part of the point was hidden in the shaft or, more precisely, under the place where the point was fastened to the shaft. Due to limited possibilities of analysis, it is impossible to reconstruct the precise manner of fastening to the shaft. Given the length of the wedge-shaped base, the point was presumably fixed in the shaft at a length of at least 4.5 cm from the end. The interpretation might be specified by prospective residues or microstriations on the surface of the object; however, none are visible with small magnification.

- Group 3: additional alterations of the surface. A group of deeper and wider linear marks of various orientations and an unspecified origin was identified in the area of the transition from the wedge-shaped base to the body of the point (Fig. 12.5: 2, A). They overlap traces of Group 1 (caused by surface shaping) and are therefore later. No other traces are situated in superposition. The later origin of this group of traces has not been explained yet.

Classification of the point

The traditional classification element of the point is the shape of its base. The flattened conical to wedge-shaped form of the base represents a specific, double-bevelled form. This morphology occurs globally for several types of points from the late Paleolithic to the Neolithic. The second typological element is usually the body of the point and the form of the distal end. This object is a plain point with round section.

This type of point is one of the basic forms known as Type 1 (*tanged points* group) in Mesolithic point classification after J. G. D. Clark (Clark 1936). This category of points is rather variable, comprising points of lengths ranging from 10 cm to more than 30 cm (Clark 1936, 117). The base can be flattened in various ways or even angular. Morphologically very similar points may also have triangular section. Generally, however, points with triangular section and a wedge-shaped base are categorised as Clark's Type 13 (1936).

Discussion

Chronocultural distribution

Plain points with a double-bevelled base of various size have a broad chronological occurrence; they are typical of many Late Paleolithic and Neolithic cultures in Central, Eastern and Northern Europe as well as the Baltic countries (e.g. Zhilin 2011; Gummerson, Molin 2019; Pfeifer 2022 etc.). It is perhaps one of the most common forms of point for European Late Prehistory. The main problem with the identification of the point from Kaderníkova 1 Cave is its preliminary chronological classification without the use of direct dating methods. In the absence of a clear archaeological context and possibility of direct dating of the artefact, typological classification of the object based on analogies in the neighbouring countries is the only possible way to propose a chrono-cultural attribution.

The closest analogies come from Polish sites (Fig. 12.6). Polish scholars made their own detailed classification; within points with round section, they singled out the "Nowe Juchy" type, which also includes points with a specific double-bevelled base (Galiński 1986; 2013; Orłowska, 2021). According to Galiński, a series of points of the "Nowe Juchy" type occurs throughout northern and central Poland; they are usually dated to a period between Allerød and Younger Dryas (Galiński 2013, 110). Recently two similar points from Witów and Kosierzewo sites were directly dated using the AMS method and categorised in the Arch Backed Pieces technocomplex (Orłowska, Osipowicz 2022, 6, 13, Tab. 2, 3) generically belonging to the Federmesser group. The results of the dating are interesting, as they put the age of an antler point from Witów as far as the Allerød period (11,170 ± 60 uncal. BP, 13,177–12,921 cal. BP; after Orłowska, Osipowicz 2022), i.e. the very end of the Paleolithic. Other directly dated plain points from Polish sites have a typical triangular section and they do not correspond to the type of the artefact from Kaderníkova 1 Cave (Orłowska, Osipowicz 2022).

Similar points are also known from Eastern Europe, where long points with round section and a wedge-shaped base flattened along the sides have been identified on a territory spanning from the Baltic countries to the forest zone of Russia. Clark's Type 1 is morphologically very variable there as well; according to M. G. Zhilin, this type of point incorporates multiple variations and minor technological modifications on the base (Zhilin 2011, 116, 142). For example, they occur at Ivanovskoe VII/4, Pulli, Sūļagals, Zviejnieki 2 (lower layer), Stanovoe 4/4, 3, Kunda, Veretie 1,

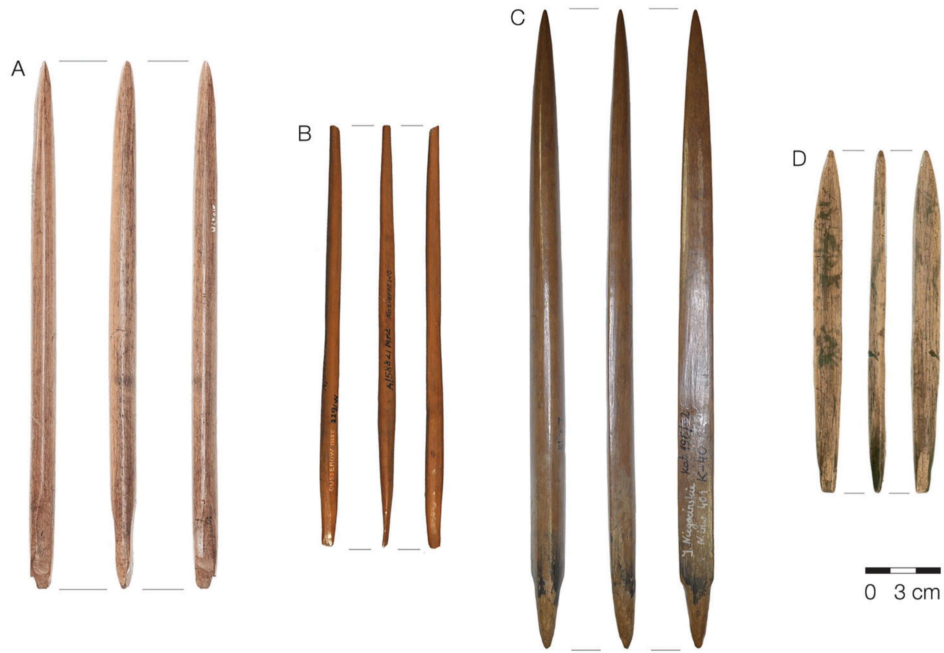


Fig. 12.6. Osseous points from the sites Witów (A), Kosierzewo (B), Lake Niegocin (C) and Lisi Ogon (D). After Orłowska, Osipowicz 2022, Fig. 2.

Nizhnoe Veretie, Zamostie 2 and many other sites up to the Urals (Zhilin 2011; Zhilin, Savchenko 2012). In Russia's forest zone, they persisted from the Preboreal to the Neolithic (Zhilin 2011, 146) due to the alleged continuation of Mesolithic traditions in Neolithic cultures in this region.

Returning to Kaderníkova 1 cave, it should be emphasized that this is the first and, to date, only point of this type found in Slovakia. Unlike in Eastern Europe, this type of point does not exist in the Neolithic Period in Slovakia and neighbouring countries. While the Kadernikova point cannot be attributed with certainty to any precise culture, the artefacts can nonetheless most probably be traced back to the final periods of Prehistory, probably the Mesolithic and perhaps (as in the case of the Witów point) the Epipaleolithic.

Epipaleolithic finds in Slovakia are limited to sporadic stone industries and the find of this unique bone point is without local analogies. Therefore, a wider context needs to considered. Incursions of Epipaleolithic human groups from Poland into Eastern Slovakia (Kaminská et al. 2014, 317) could explain the appearance of this single bone point with a double-bevelled base, as it belongs to the classic types of the technocomplex "arch-backed pieces".

If the artefact of Kaderníkova does indeed belong to the Holocene, it would represent the third Mesolithic point recognized in Slovakia. Two slotted bone points found in Medvedia Cave near Ružín (Bárta 1990) have recently been compared to artefacts of the Kunda, Kukrek and Grebenyky cultures thanks to C14 dating and detailed microlith analysis (Allard et al., in press). From a typological point of view, the slotted bone points from Medvedia Cave could come from Eastern Europe or the Eastern Baltic, i.e. from the southwestern limit of their currently known distribution area. Considering their frequency and occurrences, plain points with a double-bevelled base rarely occur in the same context as slotted points. For the present, the two types of points represent unique finds that are linked by similar archaeological circumstances – the discovery in an accidental context in a small cave without clear and rich archaeological context. The points from Ružín were found together with the remains of several brown bear individuals, and one has probably been fractured consecutively to its use against one of them (Bárta, 1990, Allard et al. in press). The point from Kaderníkova 1 Cave does not exhibit any typical break that could be linked to an impact on an animal body (despite that fact it still has to be considered as a possibility, see e.g. Pétillon et al. 2016); instead, it shows damage characteristic of a light impact into a hard barrier, corresponding to a greater number of hunting activities. It should be noted that the point shows no critical damage that would prevent it from being reused, which would seem to support the hypothesis of accidental loss. At present, it is impossible to determine from the traces whether they are the resulted of a missed shot on a cave wall or hard stony ground for instance, that would have led to the loss of the weapon.

We have shown above that the point was accompanied by the finds of multiple animal bones. The Poznań Radiocarbon Laboratory provided absolute data concerning samples No. 1 (*Ursus* sp. tooth) and No. 2. (*Cervus* sp. antler fragment No. 1). The pointed artefact was not analysed using absolute dating methods due to its gracility and the possibility of damage when taking an adequately large sample. The authors of the study left the decision concerning its direct dating to further research. The bear tooth was dated to the Neolithic, 4430 ± 35 uncal BP (3123–2922 cal. BC), the deer antler was dated the Early Middle Ages, 1195 ± 30 uncal BP (771–895 cal. AD). The dating conclusions are confirmed also by the different states of preservation of the objects and the colour and character of the taphonomical alterations. These observations enable the presumption that the artefact and unmodified animal bone remains were not deposited in the place at the same time. Unlike in Ružín (Medvedia Cave), the hunting of brown bears or deer is not proved. However, it does not mean that other, undated small animal bone fragments from Kaderníkova 1 Cave may not be contemporary with the bone point. The small spaces of the cave with a narrow entrance area may hypothetically indicate that a hunted animal, may be a brown bear, was targeted by the hunter's projectile and fled to the cave. Thus, we do not assume that Kaderníkova 1 Cave was really occupied in the Mesolithic, the Epipaleolithic or in later periods (Eneolithic, Early Middle Ages).

Function of the point and some technological observations

The term 'point' is a very generic term used to describe the artefact but what does this designation mean? Similar types of points usually correspond to hand weapons (thrusting spears) or points of spears thrown at a short distance (e.g. Verhart 2000). In order to preserve the ballistic properties, a detailed consideration of the object's weight and shape and of its fastening to the shaft was necessary when manufacturing the point. The bevelled base with smoothened places and microstriations along the whole circumference of the point from Kaderníkova Cave demonstrate that the point was thrust into the shaft and further fastened in various possible ways. The method of fastening to the shaft required the shaft itself to be rather wide, more than 1 cm, and therefore likely unsuitable for the production of an arrow for a simple Mesolithic bow. Plain points with various types of bases were often found with residues of the substances suggesting that the whole composite implement was fixed by glue. Conifer resin was also found on points from Medvedia Cave in Slovakia (Ambros et al. 1990; Bárta 1990). Part of a shaft was preserved along with a point at Krzyż Wielkopolski site in Poland (Kabaczińskí et al. 2023) but no wooden artefacts from the Early Holocene are known in Slovakia.

Despite the limited information provided by our preliminary analysis, some important technological and ballistic parameters of plain points with a double-bevelled base can be discussed. These points are efficient weapons that are rather easy to maintain. Their simple design indicates that they could be produced in a standardised manner using a wider range of known Mesolithic techniques (David 2006; Zhilin 2011). The double-bevel fixing system allows the tip to be replaced directly in the field if necessary, while the long length enabled to repair several times the point in case of damage after a missed shot. This means that the hunter who used the point was probably able to repair the weapon him or herself immediately in the field, and also carried the necessary tools to do so. These light and transportable weapons were intended, under the optimal conditions, for hunts that were not preceded by long-term planning and preparations (e.g. tracking animals, hunts with unpredictable results) (Bleed 1986).

Conclusion

The region of Tisovec and Muránska planina offers very limited archaeological material from the Late Pleistocene and Early Holocene period. This is why each individual find can potentially add more information to the discussion about the overlaps of groups and technocomplexes into the mountainous regions of the Carpathians.

The bone point from Kaderníkova 1 Cave near Tisovec shows closest analogies with Polish sites from the Epipaleolithic and Mesolithic periods. The cave itself does not have archaeological layers preserved in the explored section. Taphonomic condition and dating of the faunal remains found in the cave, not prove any direct link with the point and they likely belong to later periods (even if between relation of the point with some smaller undetermined bone fragments cannot be completely ruled out). The deposition of the finds in the cave rather indicates an accidental single event, maybe during a hunting episode. Due to the absence of more distinctive sites and assemblages from the given period in the karst area of Eastern Slovakia, it is, for now, impossible to attribute confidently the point to some specific cultural groups of the Late Epipaleolithic or Mesolithic of Eastern Slovakia. The interest of this exceptional artefact alone has not been exhausted, however; a direct dating of the point could be carried out in the future, as well as more detailed morpho-technological or traceological analyses with a precise determination of the material used to make it.

Acknowledgment

This work was supported by the Slovak Research and Development Agency under Contract No. APVV-20-0521 and by grant projects of VEGA No. 2/0033/23.

13

Gravettian female figurine – anthropogenically modified eolith from Trenčianske Bohuslavice in Slovakia

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Introduction

The question of the eoliths arose immediately with the emergence of the science of prehistory. Most often these are unworked concretions of flintstone the shapes of which resemble that of an animal, a human figure, or a human head. Some of them were found in the same stratum as flintstones worked into tools, although the former should be assessed with caution as they never show distinct traces of human interventions. On the other hand, a collection of unusually shaped stones has been clearly proven to be worked by men of comparatively early prehistoric epochs (Leroi-Gourhan 1967).

Trenčianske Bohuslavice site – Pod Tureckom location (Nové Mesto nad Váhom District, Fig. 1.1: 12; 13.1) is one of the most important Gravettian sites in the Trenčín region, as well as in Slovakia (e.g. Vlačiky et al. 2013; Kaminská et al. 2014; Wilczyński et al. 2020). It is located on the right side of the River Váh, in the valley of the Stream Bošáčka (210 m a.s.l.). Archaeological research was mainly carried out by Juraj Bárta (e.g. 1986c; 1988), and later by Ondrej Žaár (2007), Martin Vlačiky et al. (2013) and Jaroslav Wilczyński et al. (2020).

The research led by J. Bárta was carried out in Trenčianske Bohuslavice in 1981–1986 and revealed three locations of abundant Gravettian finds (Bárta 1986c; 1988; Fig. 13.2). For example, over 9,000 pieces of stone artefacts chipped from various raw materials were discovered, as well as a number of paleontological and paleobotanical finds. During a later detailed analysis of the stone industry, Ondrej Žaár (2007) discovered an interesting and unique object. It dates from the 1985 survey season and is a limestone concretion – a calcareous nodule precipitated in loess and resembling a female figure

doi 10.47382/dvs_26-13

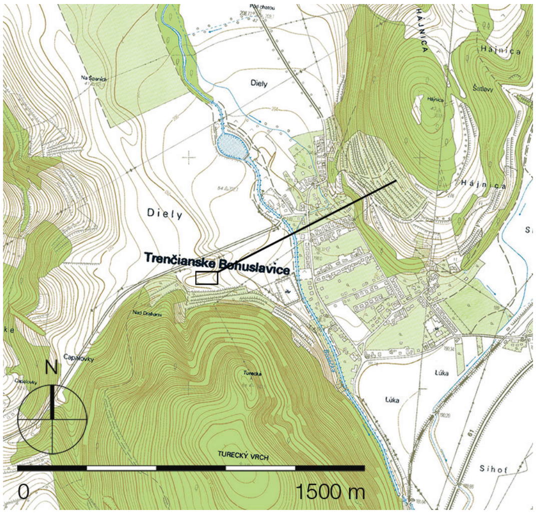


Fig. 13.1. Site location Trenčianske Bohuslavice site – Pod Tureckom location (Nové Mesto nad Váhom Distric) marked on the base map. Graphics by R. Čambal.

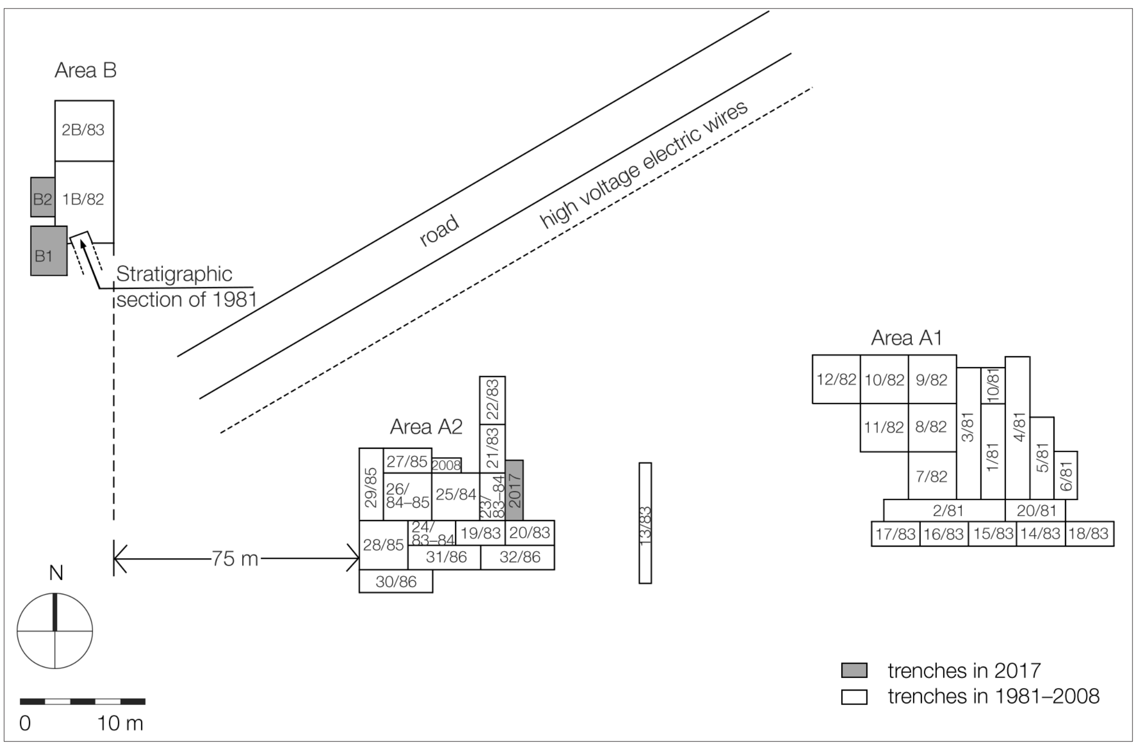


Fig. 13.2. Plan of archaeological research in Trenčianske Bohuslavice – Pod Tureckom. Location of archaeological excavations at sites A1, A2 and B. After Wilczyński et al. 2020.

with a child. There are visible traces of artefactual manufacture on the limestone. The nodule appears to have been (anthropogenically) modified using the engraving process which accentuated the feminine markings and in addition, it has been coloured with red pigment. The result is a small sculpture of a woman (Fig. 13.3). Juraj Bárta did not mention this object in his short references to individual survey seasons (Bárta 1986a; 1986c) and in the report on the finds (Bárta 1986b).

The calcareous nodule – a sculpture – was examined both macroscopically and microscopically and its colouration was identified with the help of Raman spectroscopy.

Material

The limestone being examined originates from the probe 26/85 in area A2, at a depth of 165 cm (Fig. 13.2, 13.4) and formed part of the middle Gravettian layer of finds (Žaár 2007). The radiocarbon method dates the current middle (main) layer of the Trenčianske Bohuslavice site to a period between 25,650 and 22,500 BP (Bárta 1988; Verpoorte 2002; Žaár 2007; Vlačiky et al. 2013; Wilczyński et al. 2020). The calcareous nodule was found in a bag with 22 pieces of limestone that were not coloured by any pigments. It was covered with a layer of clay from which it had to be dissected (Žaár 2007).

Fig. 13.3. Anthropogenically modified limestone core – a female figurine, height 3 cm, area A, probe 26/85, depth 165 cm, age 25, 650–22,500 BP (Gravettian). Photo by B. Gábriková.

Fig. 13.4. Archaeological layers on the eastern wall of the probe in area A2 from 2017. Layer A2-1 age 22,370 ± 150 BP (Pos-97252); layer A2-2 age 23,850 ± 230 BP (Pos-101182); layer A2-3 age 25,560 ± 290 BP (Pos-101180); black points – stone finds, grey points – bone finds. After Wilczyński et al. 2020.

Methodology

Macroscopic and microscopic research

The macroscopic examination was carried out with the aid of a preparation microscope – binocular magnifying glass Nikon C-PS model with the highest magnification of 60×. For microscopic evaluation, a Keyence VHX-5000 and Keyence VHX-7000 digital microscopes with the highest magnification of 300× were used. The microscopes were used to examine the artefactual interventions on the figurine and the characteristics of the angle of the presumed anthropogenically created groove.

Analysis of red pigment

The red colouration was examined by Raman spectroscopy. This analysis has been widely used in the non-destructive examination of the mineralogical composition of archaeological artefacts. Its purpose is to precisely determine the mineralogical composition of ceramic finishes (pigments, glazes) and paintings (pigments) or for identifying precious stones.

The Raman spectra taken from the surface of the figurine were obtained using a Thermo Scientific DXR3xi Raman Imaging microscope at the Slovak National Museum-Natural History Museum in Bratislava. Several lasers were used during the study, mainly a 785 nm laser, a 10× objective, a 25 μm confocal pinhole, and an EMCCD detector. Approximately 80 spectra were acquired from the studied mineral phases at a laser power of 0,3–3 mW between 0.03 and 3 s (80 scans per cycle). The processing of spectra (including fitting by Voigt functions) was carried out using the Thermo Fisher Scientific OMNIC v. 9.11 software package. The spectra thus obtained were compared with the RRUFF database (www.rruff.info).

Results

Macroscopic and microscopic research

The analysed item sized 30.4 × 13.4 × 11.4 mm is of light yellowish-beige colour with clearly visible traces of red discolouration which does not completely cover the item (Fig. 13.3). Even at low magnification using a magnifying glass, grains of minerals such as quartz, feldspars and micas can be

Fig. 13.5. Material composition of the figurine (calcareous nodule): matrix of light yellow colour – a mixture of carbonate and clay minerals, grains of quartz, feldspar and mica are visible in the matrix; digital microscope Keyence VHX-5000, magnification 200×. Photo by R. Ošťádal.

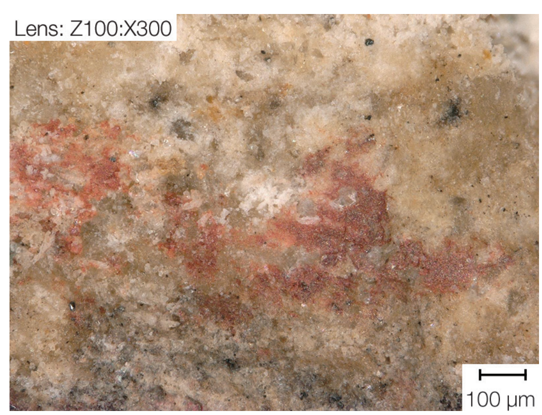


Fig. 13.6. Red dye on the figurine surface; Keyence VHX-5000 digital microscope, magnification 300×. Photo by R. Ošťádal.

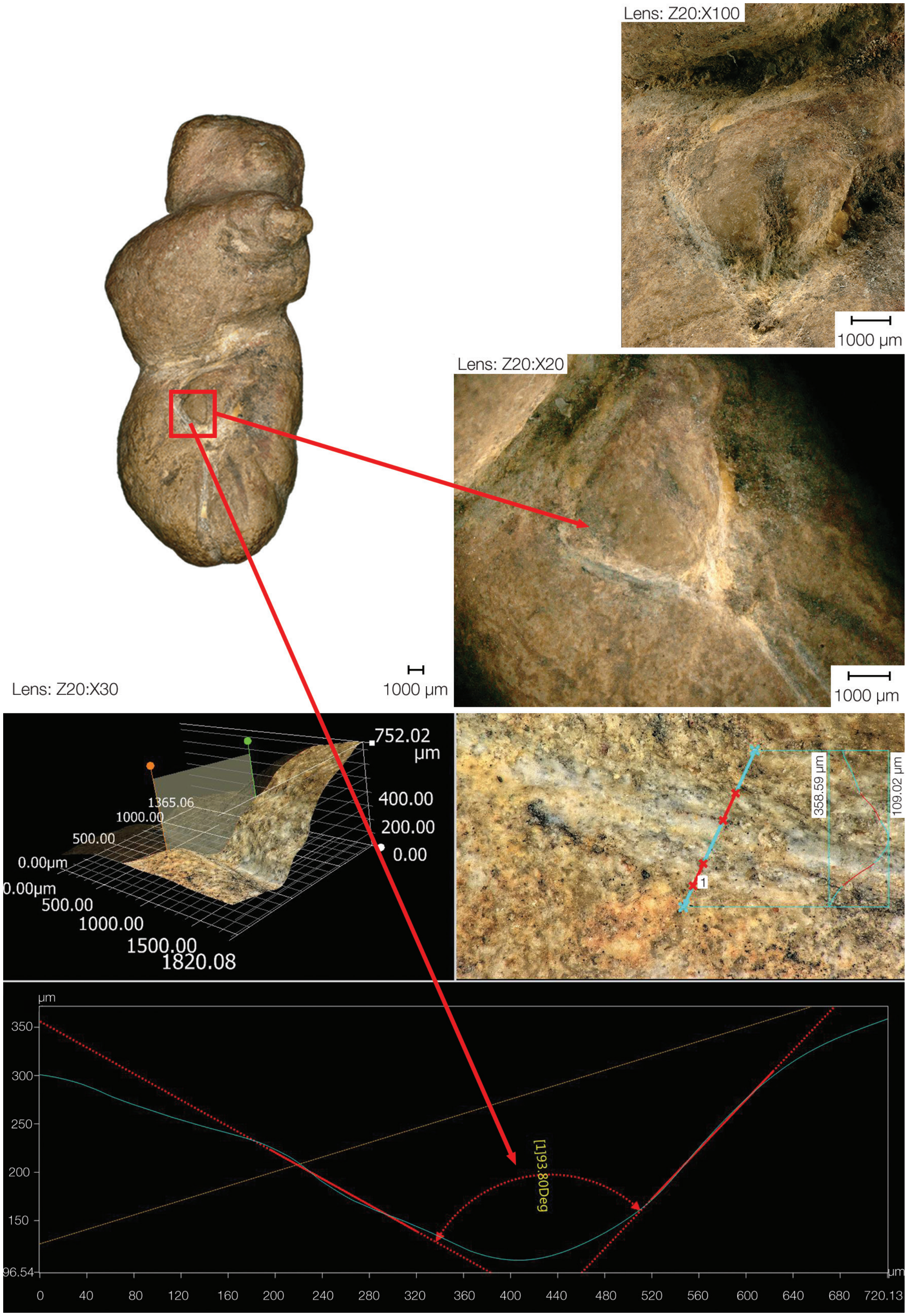


Fig. 13.7. Anthropogenic interventions using a sharp object on the natural calcareous nodule – figurine of a woman: the area of the waist, womb and lower limbs, Keyence VHX-5000 digital microscope, various magnifications (30–200×). Photo by R. Ošťádal.

Fig. 13.8. Secondary precipitated carbonate (calcium carbonate) in the area of anthropogenic intervention, which highlights the separation of the lower limbs, Keyence VHX-7000 digital microscope, magnification 50× and 150×. Photo by B. Gábriková.

Fig. 13.9. Other anthropogenic interventions on the figurine body. On the left side are visible intersecting grooves, which may have been created during cleaning or during an attempt to finish the artwork. Photo by F. Engel.

observed (Fig. 13.5). The light-yellow matrix probably consists of a mixture of carbonate and clay minerals. Macroscopic examination shows that the sculpture consists of calcareous concretion from loess sediments. The identified red layer appears homogeneous (Fig. 13.3, 13.6).

The anterior part of the calcareous nodule seems to consist of three parts separated by natural constrictions: the upper smallest one resembles a head, below is the thoracic part, and the third one represents the lower limbs and the womb. The posterior part seems to consist of upper limbs immediately connecting to the constriction separating the head. In the frontal view, the nodule resembles a female figure holding a baby.

Even in routine examination and especially under a magnifying glass, it is artificial (anthropogenic) accentuation – created by a hard (possibly stone) tool (Fig. 13.7) – visible in the womb area. Similar traces can be found in the area of the lower limbs. This is confirmed by fine grooves which are parallel to each other. In addition, the magnified view shows secondary precipitated carbonate (calcium carbonate) in the man-made grooves; which was formed later, over a longer period, after the working of the natural material (Fig. 13.8).

The examination with the Keyence microscope has shown that the cross-sectional angle of the best visible groove in the right (image left) side of the womb area (Fig. 13.7) is of a rounded shape measuring 93.8° and the shoulder of one side is more concave than the shoulder of the other side. According to an experiment by d'Errico and Nowell (2000), who compared the cross-sectional appearance of tuff fragments of a groove created by a spear point with and without retouch, the angles created by spear point without retouches are significantly smaller (n = 23, min. = 39, max. = 67, average = 53.5, range = 28, SD = 7.56, SD error = 1.58). Their walls are mostly straight and their base is narrower. The angles of the grooves created by spear points with retouch (n = 17, min. = 59,7, max. = 91, average = 76.8, range = 31.3, SD = 8.35, SD error = 2.03) usually consist of one straight wall and one convex, concave, or irregular wall with a rounded base.

Using these criteria, the appearance of the cross-section angle of the groove on the nodule from Trenčianske Bohuslavice corresponds to the technique of creation by a tool with retouch. The magnified view of the lower right side of the statuette shows visible, extremely thin intersecting grooves, which may have been created during cleaning or during an attempt to finish the artwork (Fig. 13.9).

Analysis of the red pigment

Using Raman spectroscopy, the mineralogical composition of the red layer was found to only consist of hematite (Fig. 10). The spectrum of the sample agreed well with those in the RRUFF database and there is also good agreement in the reported spectra of hematite (de Faria, Lopes 2007; de Faria et al. 1997; Chernyshova et al. 2007) with bands at 227, 293, 412 and 612 cm^{-1} (this work). Due to the luminescence background and eventually, to the cut off profile in the lowest frequency region, the 227 cm^{-1} Raman band may not be always present, and, in the end, it may be measured as a weak feature (Zoppi et al. 2005).

Hematite, α-Fe_2O_3, is the most common and thermodynamically stable iron oxide in nature, and active areas of research are being undertaken to better understand electronic, magnetic properties, and the Raman spectrum of this compound. Crystallographically, hematite α-Fe_2O_3 is isostructuralwith corundum α-Al_2O_3 and crystallizes in the trigonal $D^6{}_{3d}$ space group, with two Fe_2O_3 units, 10 atoms per rhombohedral unit cell. The Raman active phonons can be further classified as five internal modes (2A1g + 3Eg), which involve motion within a single $Fe(O)_6$ octahedral unit, whereas

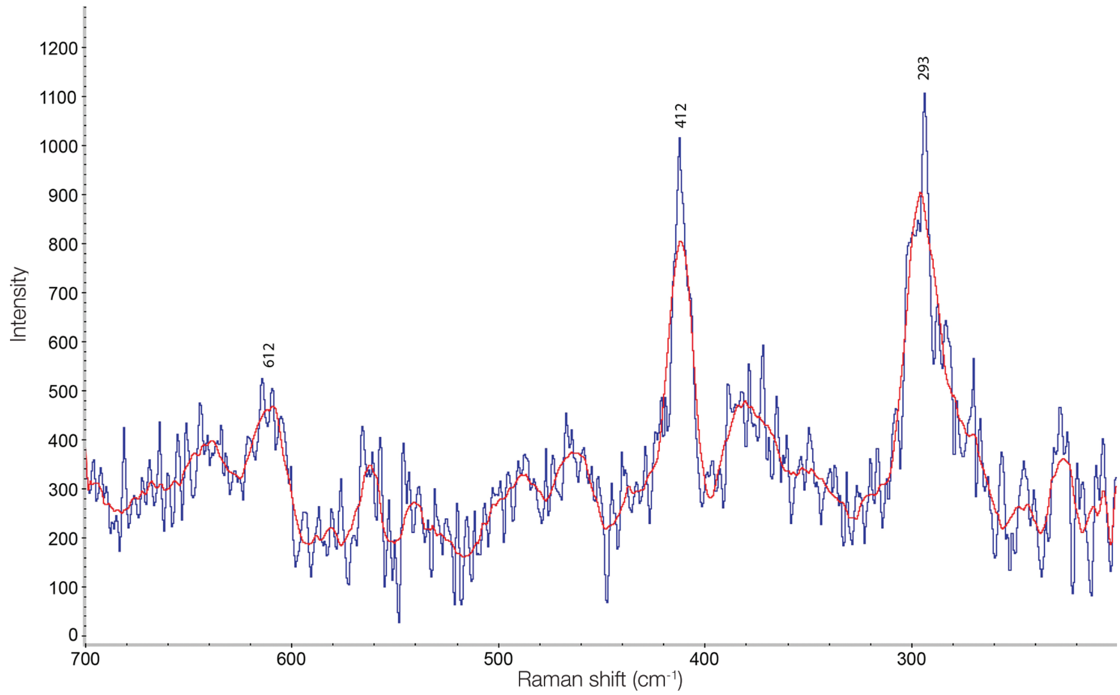


Fig. 13.10. Raman spectrum of the red layer with identified hematite from the surface of the figurine (raw spectrum in blue colour, smoothed spectrum in red colour). Graphics by B. Lalinská-Voleková.

2Eg phonons are external modes, involving rotations and translations of entire Fe_2O_3 units. The above-predicted phonon modes occur at 225 cm^{-1}($A_{1}g$), 245 cm^{-1} (Eg), 294 cm^{-1} (Eg), 298 cm^{-1} (Eg), 412 cm^{-1} (Eg), 500 cm^{-1} ($A_{1}g$), and 610 cm^{-1} (Eg). The Eg mode at 294 cm^{-1} has been attributed to one of the two external Eg phonons; however, the other external mode has not yet been resolved and hence assigned (Marshall et al. 2020).

Discussion

The collection of natural materials that are unusual in shape, colour or appearance and their working by man in different periods of time is a known phenomenon. The imagery, like our own, was not missing among people living many, perhaps hundreds of, thousands of years ago (Leroi-Gourhan 1967; Klíma 1990). In the opinion of some, evidence of symbolic, creative, and aesthetic thinking dates all the way back to the Lower Paleolithic (Dart 1974; Bednarik 1998; 2013). The following examples do not appear to be arranged chronologically or thematically. Additionally, there is still some uncertainty about some of them. However, they all represent evidence of the same characteristic – the imagination of humans throughout even distant periods.

One of the earliest examples is the discovery and deliberate transfer (manuport) of a reddish-brown jaspilite pebble into Makapansgat Cave in South Africa. The stone (8.3 × 7 × 3.8 cm; 260 g) represents a random natural creation in the form of a human head (Fig. 13.11: A). It is thought to have been spotted by australopithecines (or early hominini) about 3,000,000 years ago, appropriated, and purposefully transported from its original site to the cave as far 32 km away (Dart 1974; Bednarik 1998; 2013; Lorblanchet 1999).

Among the ancient artefacts is the so-called Venus stone from Tan-Tan, which was discovered in 1999 in Morocco in the sediments of a river terrace on the northern bank of the River Draa near the town of Tan-Tan (Bednarik 2003a; 2003b). The limestone stone resembling a small golem is of a more flattened shape (6 × 2.6 × 1.2 cm; 10 g) and appears to have been deliberately worked into the form of a human, where an almost neckless head; the trunk and lower limbs are visibly separated by grooves on both sides with only a hint of hands. The statuette was found 15 m below the surface in a layer of gravel and sand sediments near stone tools which were typical for the Middle Paleolithic (Acheulean) and is estimated to be 400,000 years old. According to Bednarik (2003a; 2003b), natural forces created the basic shape, and man completed the creation of the statuette. Tool traces, as well as stains that could have been caused by ochre dye, were found on it.

Another case was the Berekhat Ram sculpture (Goren-Inbar 1986; d'Errico, Nowell 2000; Fig. 13.11: B). This is a piece of basalt tuff with clusters of scoriae which resembles a crude human figure (35 × 25 × 21 mm; 10.33 g). It comes from the Middle Paleolithic archaeological site of Berekhat Ram in the Golan Heights region of Israel. The figurine was found along with Acheulean tools in an archaeological layer from approximately 250,000–280,000 years BP. Experimental comparison of various grooves on the figurine with artificially (analogous tools) and naturally created grooves on similar material and using an electron microscope made it possible to prove that some grooves were man-made. However, the basic appearance was shaped by nature.

At the site of Bečov I on Písečný Vrch (Sand Hill) near the city of Most (Czech Republic), J. Fridrich (1976) discovered the remains of a human dwelling dating to the beginning of the Middle Paleolithic, which was originally attached to a rock overhang. Remains of a wooden structure and a centrally located fireplace were found here. Around the fireplace lay numerous stone tools and spear points made of local quartzite of high quality, as well as remains of dyes and palettes for smearing the dyes. Two human-modified objects were found among these (Fridrich 1976). Of which, it is mostly object No. 1 (6.85 × 5.56 × 4.5 cm) of granular sandstone which bears obvious anthropogenic traces with what is a very distant representation of a human head with neck and shoulders (Fridrich 1976; 1982). On the right upper part, there are regularly spaced oval-shaped pits with a diameter of 2.5–5 mm and a length of 5–10 mm. They form an irregular circle with an outer diameter of about 25 mm. Some pits were originally covered with sinter. The age of the object is estimated to be about 200,000–250,000 years old.

Another interesting and much younger Mousterian sculpture comes from the Neanderthal encampment at Roche-Cotard (Langeais, Indre-et-Loire, France) (Marquet, Lorblachet 2000). It is a flintstone (105.5 × 93 × 40.5 mm) aged 32,100 years, which comes from the river sediments in front of a cave on the bank of the River Loire. The object was chipped off to form a human or animal face (Fig. 13.11: C). The eyes were formed by using a bone which was transversely threaded through a natural hole under the upper surface approximately in the stone's centre.

At the well-known Czech Pavlovian (Gravettian) site of Předmostí (part of Přerov), K. J. Maška (1913) found five fully preserved mammoth metapodia with traces of anthropogenic interventions (fragments of others and some less worked ones are also mentioned) during research from 1883 to 1913. They look like highly stylized schematic statuettes of seated pregnant women (Maška 1913; Klíma 1990; Valoch 1975; 1993; Lorblanchet 1999; Fig. 13.11: E). The round joint heads of the metapodia were sometimes even more artificially rounded to represent the heads, the constricted portion of which was even further accentuated by man – using a deep notch – into the form of a neck. Maška (1913) originally assumed that this was a natural abrasion, but the discovery of other almost identically worked statuettes convinced him that they were of anthropogenic origin. In some cases, preserved sinter remnants were found in the neck notch. The opposite broader part of the bone evokes gravidity, which might have inspired the prehistoric people to complete the figurines. Their height ranges from 120 to 140 mm.

A similar find is also mentioned by Škrdla et al. (2008b) in the Spytihněv-Duchonce site (near Uherské Hradiště). This was a complete *os metacarpus* III (the metacarpal bone) of a woolly mammoth, although its surface was heavily eroded so a detailed examination of the workmanship was not possible. The figurines may also have served as weights (Svoboda 2006).

The broken head of a mammoth femur bone, on the upper part of which a sketch of a human face is depicted consisting of deep incisions, was also found at the Předmostí site (Klíma 1990; Fig. 13.11: F).

On Slovak territory a known and now classic, so-called Paleolithic idol was also found on the Tokaj hill near Cejkov (Bánesz 1961; Bárta 1965; Kaminská 2009). It is a human-modified pebble (Fig. 13.11: D). It is a slightly heart-shaped item with one rounded side against which a wedge was ground. The remains of red dye were found on its surface and in general the object resembles a schematic female womb (vulva) and, according to Bánesz (1961), there are analogous items in Kostienky. Similar Gravettian finds were also discovered in Willendorf, Austria, of which one was found in layer 8 and three in layer 9 (Valoch 1993).

There are more recent examples of anthropogenic modifications of natural material shapes. One of many examples is a limestone slab modified by retouches to the profile of a female figure (10 cm high) from Peterfels near Engen (Albrecht 2009) or a stone pendant modified into what distantly resembles a sculpture of an animal (8 cm) from Isturitz in the Pyrenees (Leroi-Gourhan 1995 et al.) of the Middle Magdalenian.

At Ölknitz (Saale Valley, south of Jena) suggestively shaped pebbles collected from the river are more or less modified to reproduce the silhouette female form in three dimensions (Feustel 1970; Cook 2013). Two similar pebbles were found in Courbet Cave (Aveyron Valley) where they stood out as distinctive and deliberately collected in the mass of limestone pieces (Cook 2013).

An example of a naturally flat round black slate stone (88 × 23 × 6 mm) being used as a schematic sculpture of a woman comes from Hrabůvka – Býčí Skála Cave (Moravian Karst, Magdalenian period) (Oliva 2009a; 2015). Its profile features a distinct curve representing the buttocks and it is decorated with repeating engravings of the "V" motif. A similar example can also be a modified black slate stone (54 × 14 × 5 mm) from the Mokrá site, from Pekárna Cave (Oliva 2015).

The hornstone nodules from a much younger period were found to be deliberately added to the graves at the burial site of the Eneolithic Tiszapolgár culture in Veľké Raškovce (Trebišov District). According to some opinions, these have been modified by human intervention into schematic forms of women or various animals (Vizdal 1977).

Statuettes of women (or Venus) are a well-known ancient symbol of Paleolithic art (Mellars 2009). The oldest ones date back to the Aurignacian (Conard 2009). Some are created with meticulous perfection; others are stylized and many are almost functionalistically schematic using the shapes of the natural material. Some 160 items were found in various sites in Western France and all the way across Europe to as far as Siberia (Cook 2013). The smallest items are less than five centimetres in size and the largest one (found in Savignano, Italy) measures more than 22 cm.

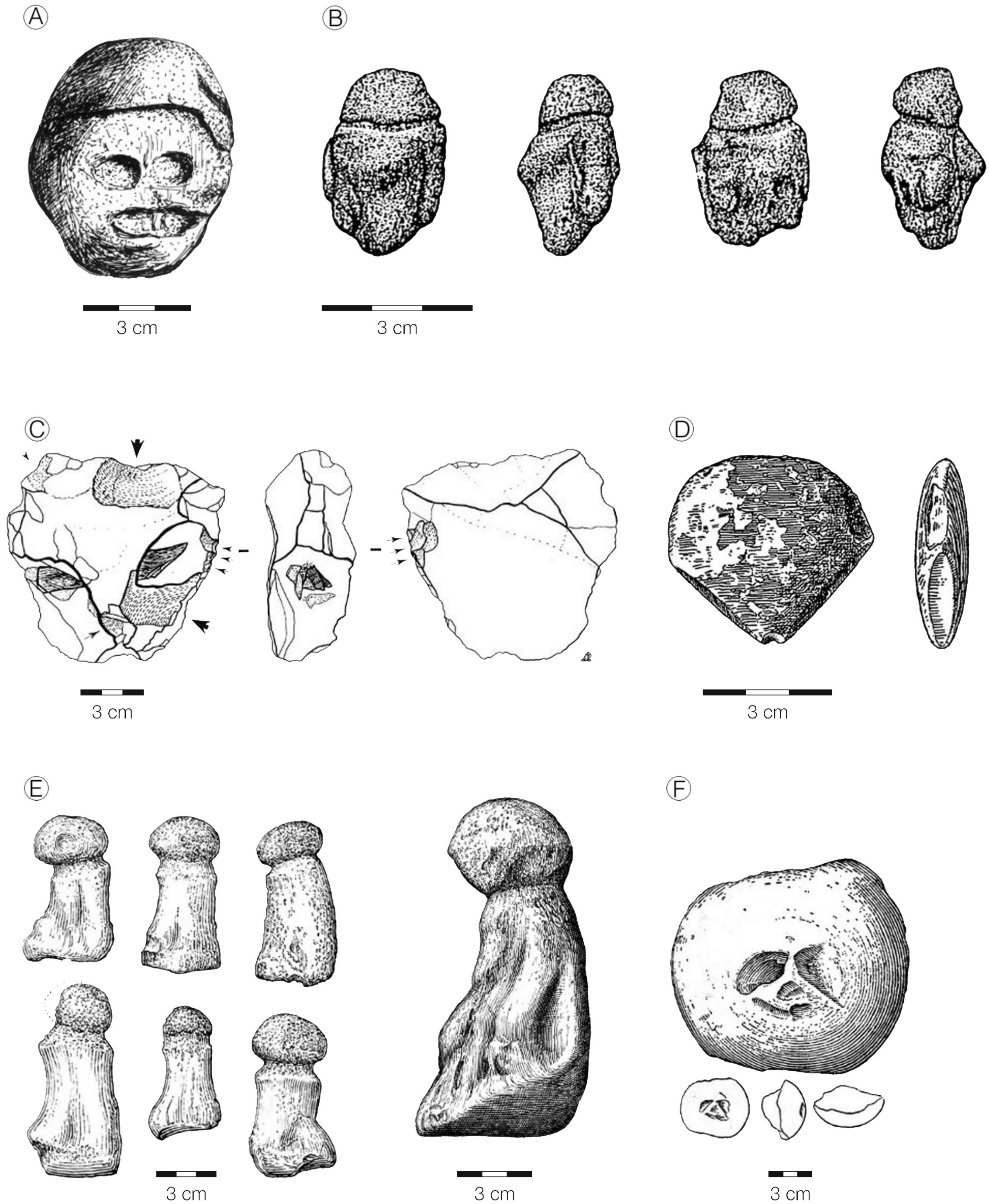


Fig. 13.11. Findings of stylized human or animal faces and figurines. A – Natural jaspilite stone resembling a head, Makapansgat Cave (Southern Africa), found and relocated by australopithecines, age three million years, pen drawing (according to Lorblanchet 1999, drawing by I. Poplavskyj); B – sculpture from Berekhat Ram, age ca 250,000–280,000 years BP (after Goren-Inbar 1986); C – sculpture – face/mask of flintstone and bone, Roche-Cotard (Langeas, Indre-et-Loire, France), age 32,100 years, Mousterian (after Marquet, Lorblanchet 2000); D – modified pebble, Cejkov, (after Bánesz 1961); E – mammoth metapodia figurines, Předmostí, Pavlovian/Gravettian (after Klíma 1990); F – sketch of a human face, broken off the head of a mammoth femur, Pavlovian/Gravettian, Předmostí (after Klíma 1990).

The role of female sculptures is not yet fully known but ethnological analogies may be the key to understanding (Sázelová 2008; Stannard, Langley 2021). It is certainly related to human ideas about the nature of life. The Venuses could be part of a cult using magical rituals with the aim to provide fertility and, most importantly, the survival or growth of a human group. They could be symbolic objects, representing talismans – spells which protected women, children, home, family, and community... or they could also be portraits (Huyghe 1967; Marshack 1991; Svoboda 1997a; 2008; Soffer et al. 2000; Cohen 2003; Floss 2006; Oliva 2009a; Conard 2009; Conard, Kind 2017). This may also be the reason for the working and use of our calcareous nodule.

Since prehistoric times, the red colour has had many different meanings in different cultures and again, with the help of analogies, it is possible to surmise why it was also found on the surface of a simple schematic figurine from Trenčianske Bohuslavice. Red is one of the most important colours for men across the entire spectrum. It is the warm colour of blood, signifying the return of life (rebirth), the symbolism of creation, it is related to fire, the colour of martyrdom, of love, but also of the struggle for life, of the devil and hell, of violence and aggression (Leroi-Gourhan 1967; Biedermann 1992; Antl-Weiser 2011; Neugebauer-Maresch 2011).

Conclusion

The macroscopic, microscopic, and spectroscopic aspects of the surface intervention traces on the presented Gravettian calcareous nodule of Trenčianske Bohuslavice prove that this is a deliberate schematic anthropogenic modification with the intention to represent a woman. In order to complete the figurine, man used the natural shape of the original raw material (an eolith) to serve them in the same way as other statuettes of women of a similar period.

14

Anthropomorphic statuette of the Lengyel culture from Dlhá

Zdeněk Farkaš

Introduction

In the winter of 2020/2021, the Archaeological Museum-Slovak National Museum in Bratislava carried out the rescue archaeological excavation in the cadastre of the village of Dlhá (Trnava district) in Western Slovakia. It was due to the construction of a water pipeline between Borová and Dlhá (Fig. 1.1: 13; 14.1). The excavation in the Dlhá cadastre cut through two distinct elevations that slope down to the now regulated Podhájsky (Bosniansky) stream (Fig. 14.2A). At the Brezina site, on a gentle southeast-facing slope flanked by the Podhájsky and Kozárovský stream (Fig. 14.2B), on a small indistinct plateau, approximately between the contour lines 188 and 190 m a.s.l., two distinct ground intrusions, in one case with a segmented bottom and fill, were captured in both excavation profiles. The third appeared only as a shallow bowl-like pit in the northern wall of the trench for the pipeline (Fig. 14.3, 14.4).

The Dlhá site lies in the gently undulate terrain of the Sub-Little-Carpathian Hills, part of the Trnava Tableland, at the confluence of several small watercourses. From the south, its cadastre is protected by a distinct terrace divided into several parts. Their elevation above the village, with 185 m a.s.l. in the centre, is from 32, 39 to 52 m. Towards the northwest, at a distance of about 3.5 km from the centre of the village, there is a continuous belt of the Little Carpathians.

According to the geological map of the Slovak Republic (SGIDŠ), fluvial sediments from the Holocene period, mainly lithofacies characterised by undivided alluvial clays or sandy to gravelly clays of valley and mountain stream valleys, are found in the Podhájsky stream basin. At the Brezina site, higher above the stream inundation, the subsoil consists of Holocene proluvial sediments and

doi 10.47382/dvs_26-14

clay or sandy gravels with rock fragments, with a cover of loess and diluvial outwash in the lower middle alluvial cones. At the crest of the hill, behind the former Agricultural Cooperative site, there are proluvial sediments, clay, and sandy gravels with rock fragments to residues in the lower alluvial cones. The subsoil, in places resembling clay secondary overlain by outwash, is covered by modal cultivated brown earths (PP). They were 0.4 to 0.5 m deep, corresponding to the topsoil layer removed from the area prior to the excavation of the trench for the water pipeline.

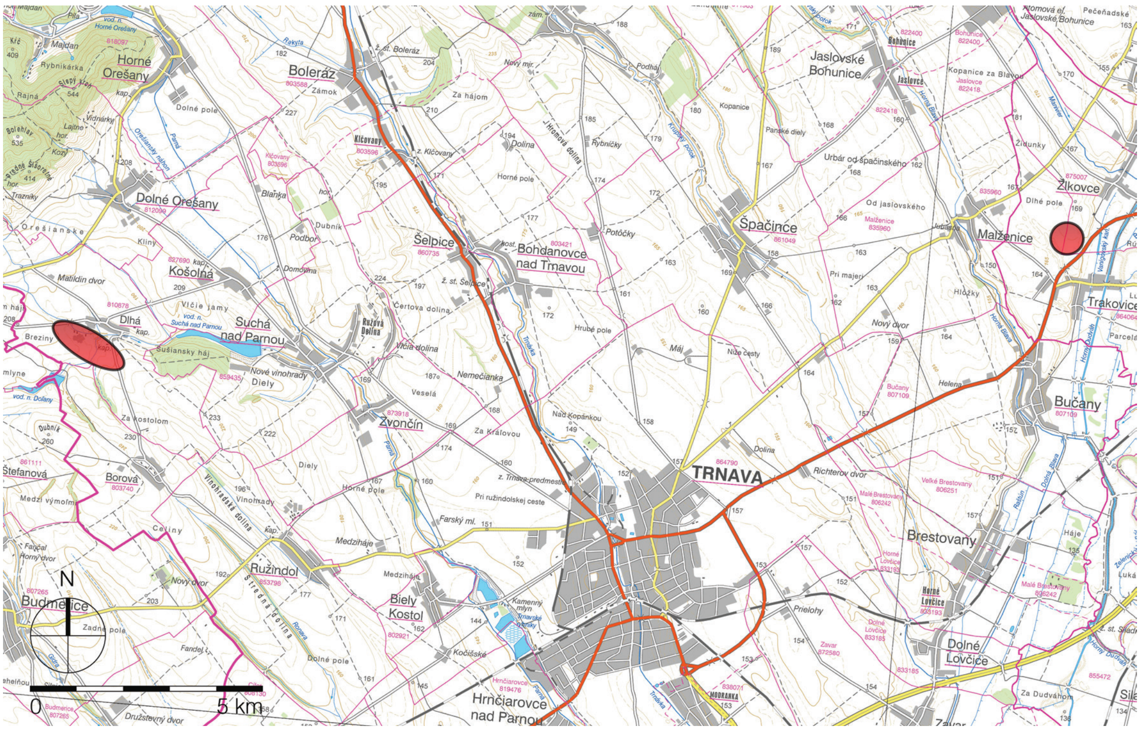


Fig. 14.1. Map with the new finds of anthropomorphic statuette of the Lengyel culture near Trnava. 1 – Dlhá, site Breziny, 2 – Žlkovce, site Vaniga. Source: zbgis.skgeodesy.sk.

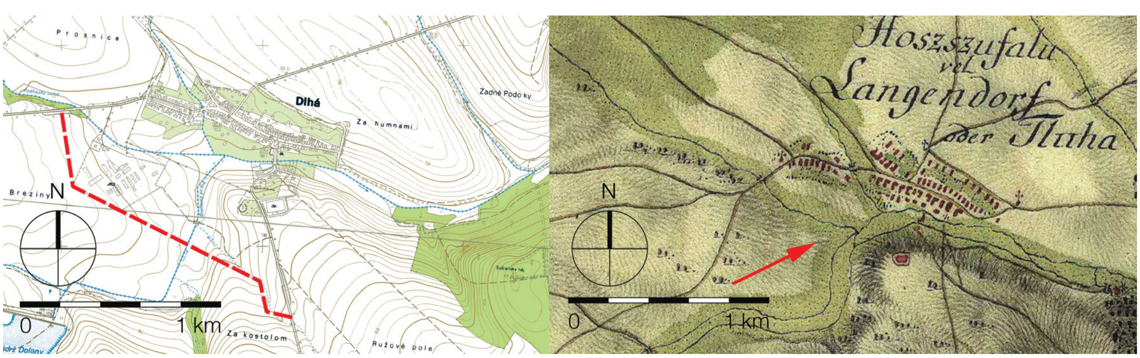


Fig. 14.2. A – Dlhá (district of Trnava), site Brezina with the place of the excavation (red line – water pipeline) and the location of the Neolithic settlement from the Lengyel period (source: zbgis.skgeodesy.sk). B – Location of the Neolithic site on a gentle slope promontory originally bounded by small watercourses on three sides on a map from the 1st military mapping. Source: geoportal.stage.geocloud.sk.

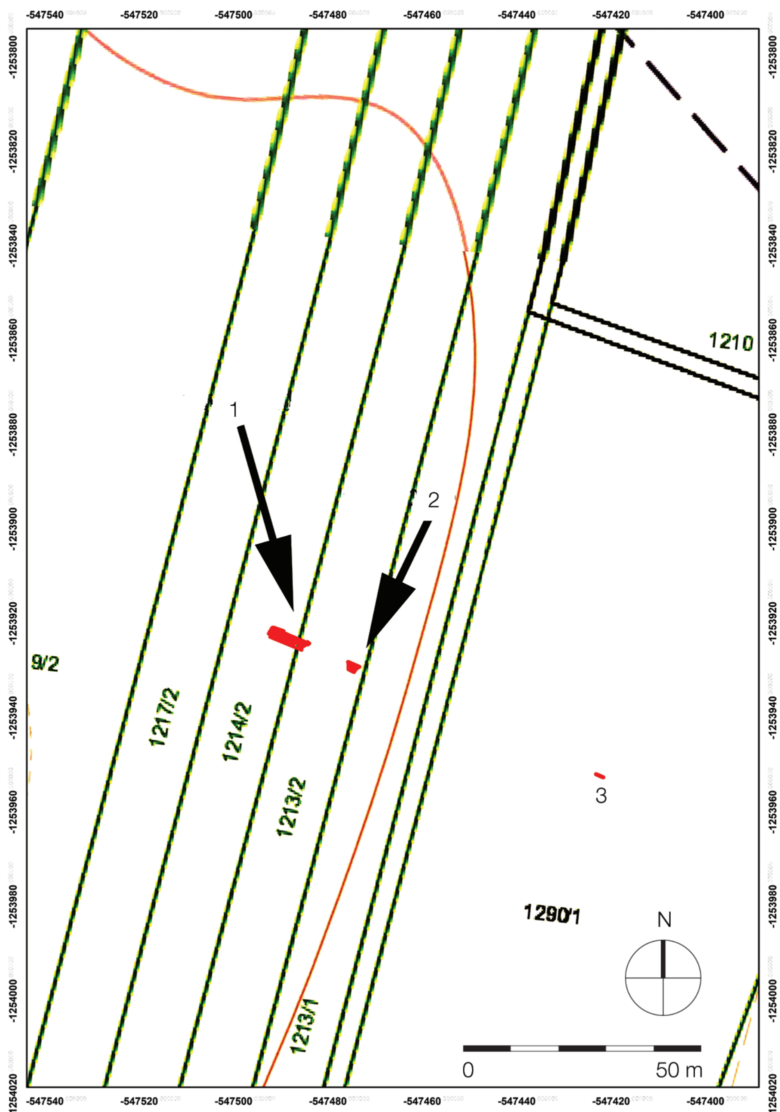


Fig. 14.3. Dlhá (district of Trnava), site Breziny. Features 1 to 3/2020 on the cadastral map. According to J. Bartík's survey.

Description

Feature 1/2020

The edges of feature 1/2020 were clearly distinct from the light clay and gravel subsoil and its walls arced down to an irregularly undulated base which, particularly in the southern part, extended below the bottom of the trench. The fill was mostly dark clay soil, which extended up to the upper level of the denuded area and consisted of varying shades from light grey-brown at the uneven base and edges to brown-black and almost black in the middle of the fill. In horizontal bands, it was mixed with fragments of daub burnt orange and, in places, crumbling charcoal. The dimensions of the intrusion were 8.7 m in the northern profile and 8.95 m in the southern profile. At the location of the object, the depth of excavation for the pipeline ranged from 1.1 to 1.2 m, extending to a depth of approx. 1.5 to 1.6 m from the original surface (Fig. 14.4A).

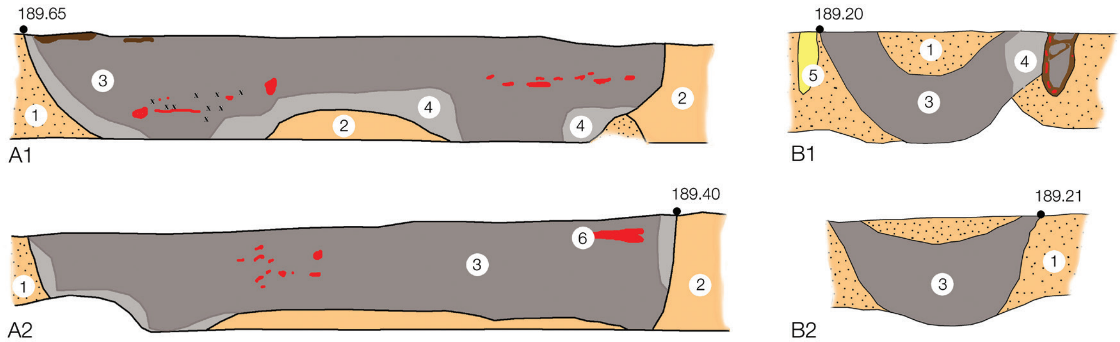


Fig. 14.4. Dlhá (district of Trnava), site Breziny. A1 – Feature 1/2020, northern profile in the excavation for the water pipeline; A2 – Feature 1/2020, southern profile; B1 – Feature 2/2020, northern profile in the excavation for the water pipeline; B2 – Feature 2/2020, southern profile. 1 – light clay-gravel subsoil; 2 – light clay loam subsoil; 3 – brow-black clay soil with gravel admixture; 4 – lighter brown-black soil; 5 – light loess clay; 6 – red-burnt soil and fragments of daub; x – charcoal from burnt wood. Author Z. Farkaš.

The nature of rescue research, which had to be adapted to the site conditions, and the largely waterlogged terrain, prevented the uncovering of the whole object and only allowed samples to be taken. The sampling consisted of collecting archaeological material from the fill excavated by the earthmoving machinery and partially extending the excavations laterally to allow for the handling of the pipeline and the free passage of various mechanisms. Nevertheless, the object section produced 1,606 fragments of pottery from earlier Lengyel culture (hereinafter LgK), dominated by fragments of vessels with the "medium fragment thickness". They were mainly bowls with a wide mouth, sometimes on a hollow foot, pots and pot-shaped vessels such as buckets or vases, etc. Thin-walled pottery was also relatively frequent. Fragments of thin-walled cups with a biconical body with a sharp edge on the bulge and a high, outwardly curved neck were predominant in percentage; there were fewer small thin-walled bowls. Geometric patterns made of light grey-white, red, and yellow clay were preserved on the surface of primarily thin-walled pottery. In addition to the smaller fragments, fifteen larger pieces of daub were discovered in the object, with a few exhibiting impressions indicating wicker construction. The small finds included three clay fragments of anthropomorphic statuette, a cubic jar, 5 fragments of spoons or ladles with hollow handles, a miniature footed vessel, a circular weight, or spindle whorl, and 4 fragments of ambiguously identifiable clay objects. Of the sharp stone tools, a fragment of a flat axe and a reused fragment of an axe-hammer with the remains of the original drilled hole were preserved. Both objects were made from Little Carpathian amphibolite schist. In addition, smaller flat pieces of schistose rock were also found, perhaps the raw material used for the of sharp stone tools. Stone chipped tools included 26 silexes, mostly semi-finished products (blades and blade chips) and waste. A blade scraper was documented. A spherical crusher made of quartzite pebble was also found, and a fragment of axe-hammer and a crushing stone, a "runner" from the Little Carpathian granite, also had a secondary use for this purpose. Fifty-eight animal bones were also recovered from the fill. Of these, however, only a smoothed tip (the awl) may be classified as a work tool.

Description of small clay finds

1. The right foot of the standing anthropomorphic statuette broke away from the body at the point where it begins to extend to the prominent backward-arched bottom. The toes of the straight foot are broken off, the outer ankle and knee, almost at the level of the beginning of the bottom, are represented by small nipple-like protrusions. Below the bottom hemisphere, slightly above the knee, there was a conical hole across the originally joined but separately modelled lower limbs

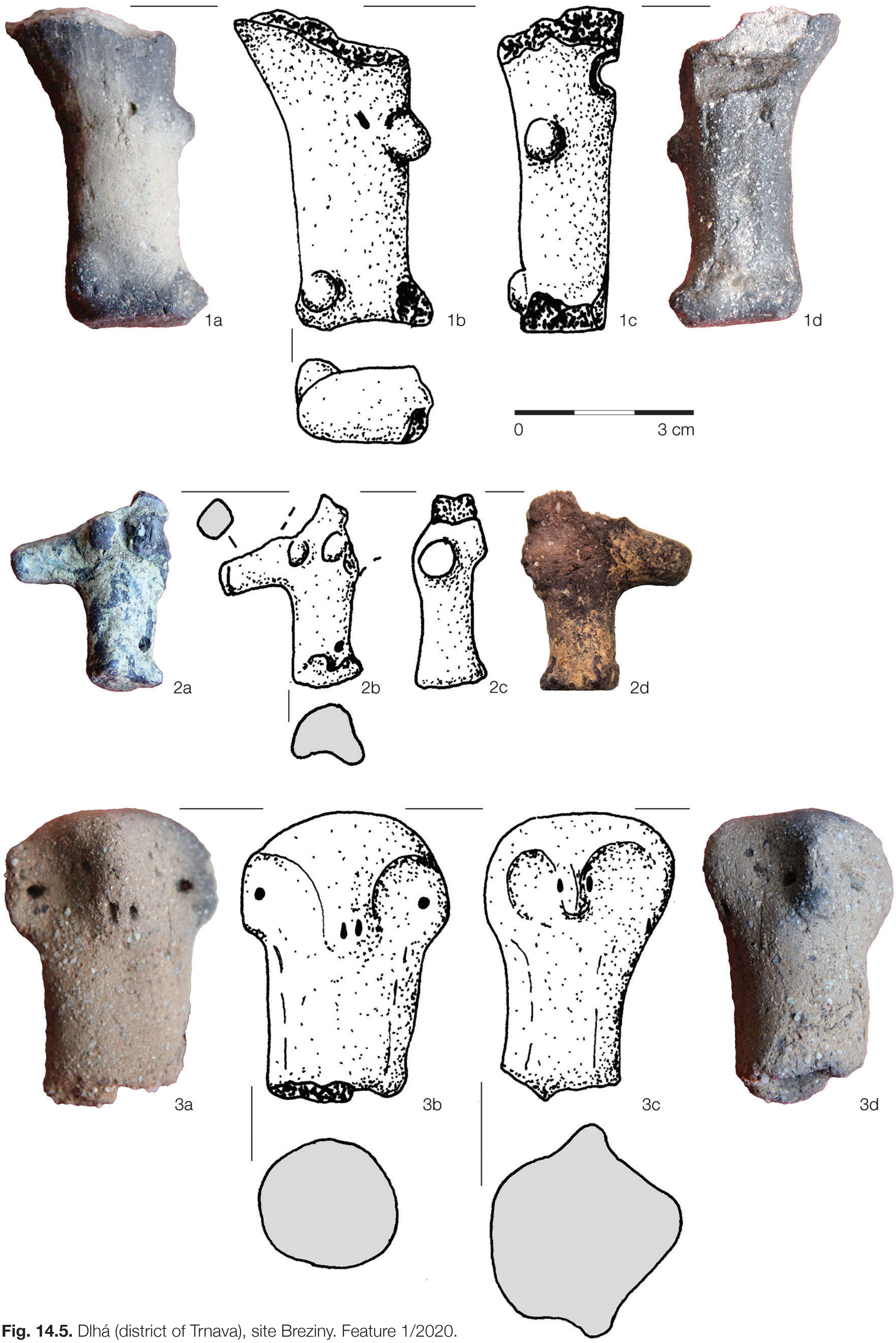


Fig. 14.5. Dlhá (district of Trnava), site Breziny. Feature 1/2020.
Fragments of anthropomorphic statuette. Photo and drawing by Z. Farkaš.

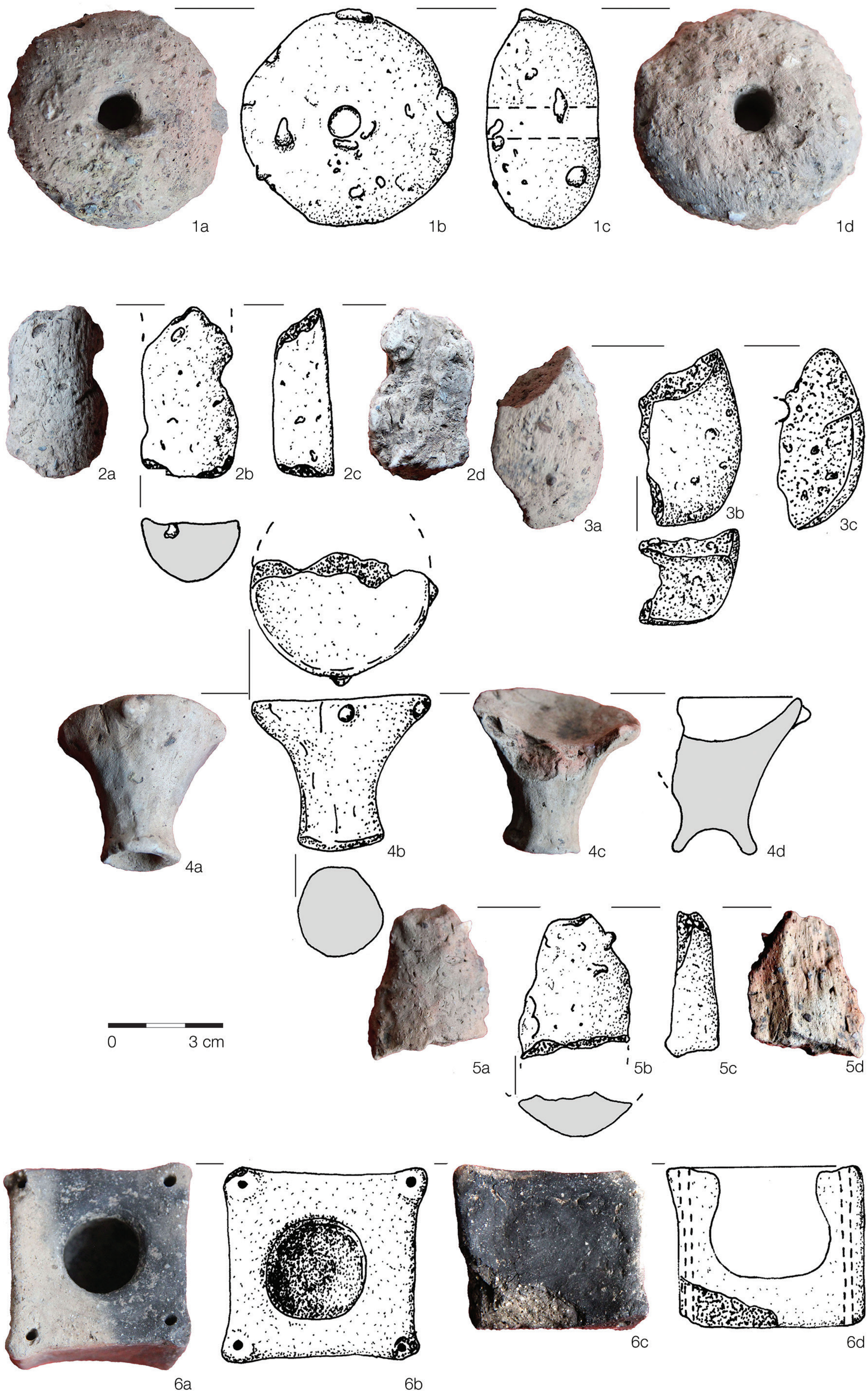


Fig. 14.6. Dlhá (district of Trnava), site Breziny. Feature 1/2020. 1 – Spindle whorl (weight?); 2, 3, 5 – fragments of clay cylindrical objects (parts of statuettes?); 4 – miniature vessel; 6 – cubic vessel. Photo and drawing by Z. Farkaš.

of the statuette. The statuette was made of washed clay with a small admixture of fine-grained sand and was fired hard. The surface, except for the inner side of the foot, originally attached to the left lower limb, was smoothed and uneven firing with partial access to air coloured it in ochre to black shades. The fracture at the point of transition to the torso of the statuette is light, grey-ochre, black on the foot. Size: length of limb: 5.3 cm, length of foot: 2.3 cm, width of foot: 1.5 cm, section of foot 1.8 × 1.7 cm, section at the fracture 3 × 2.3 cm, diameter of hole 0.5 to 0.8 cm (Fig. 14.5: 1).

2. Small anthropomorphic statuette with spread upper limbs without palms and fingers and with two small protrusions in the line of their upper edge formed by breasts. The body, consisting of a cylinder, continues directly into unseparated legs marked only by a pair of small protrusions. They are represented by flat feet, which are rotated approximately 13° to the left of the frontal line of the figure. The earthmoving mechanism destroyed the head and left arm of the statuette and also partially damaged the back at the shoulder blades and the left breast. The right arm is separated from the back by a small groove running from the back of the unpreserved head to the armpit. The statuette was made of washed clay with an admixture of fine-grained sand and was fired hard. The surface of the brown paint was smoothed and is now largely covered by an ochre-yellow layer of dye that was originally compact. The fracture of the statuette is brown, with lighter shades in the centre of the statuette. Size: preserved height: 2.9 cm, diameter of body and joined lower limbs: 1 cm, length of feet: 1 cm, length of preserved hand: 1.5 cm (Fig. 14.5: 2).

3. Head of a large anthropomorphic statuette of spherical shape which continues directly into a long cylindrical neck. The prominent hooked (Armenian or Semitic) nose and the pair of large protruding flat ears with pierced holes were made by pressing a lump of pottery. The nostrils are represented by a pair of punctures at the base of the nose. No other facial details, such as indications of hairstyle, eyes, or mouth, could be identified on the head. The statuette was made of washed clay with a large admixture of fine-grained sand, the surface was smoothed where possible and fired hard. The surface is mostly light ochre with a black spot on the left ear. The fracture is grey and shades to ochre near the surface. Size: height: 4.9 cm, diameter of the head: 3.3 cm, section of the neck 2.2 × 2.5 cm, length of the nose 1.8 cm, diameter of the holes in the ears 0.2 cm (Fig. 14.5: 3).

4. A large and heavy spindle whorl or smaller disc-shaped weight with a distinct central hole but without traces of suspension. It was made of muddy, stream clay with a large admixture of sand to fine gravel with pebbles up to 1 cm long. It was fired hard and the surface, roughened with fine gravel, is mostly ochre to ochre-red, with a grey-black core showing through in places. Size: diameter: 5.6 cm, thickness: 2.9 cm, hole diameter: 1 cm (Fig. 14.6: 1).

5. Fragment of a longitudinally split clay cylinder, about half of its original diameter and with broken ends. It was made of washed clay with an admixture of fine sand and organic material. The object was fired hard, and the surface and fracture are ochre with a light grey undertone. Size: length: 4.4 cm, width: 2.6, thickness: 1.5 cm (Fig. 14.6: 2).

6. A lump of fired clay with three round side and original fractures, resembling the left half of the bottom of an anthropomorphic statuette (?). A rounded groove runs across the body of the object at the point of fracture, which could be the remnant of a transverse hole with circular cross-section. It was made of washed clay with a large admixture of fine-grained sand

and perhaps organic material. As a result, the original surface of light ochre colour is rough. The fracture has similar colour, with pronounced red hues in one place, which might indicate at least partial secondary firing. Size: 4.3 × 2.8 cm, max. thickness 2.3 cm (Fig. 14.6: 3).

7. Miniature, wide-open flat bowl on a full, flared foot with a concave stabilising depression at the base. Approximately two fifths of the bowl, on whose rim two nipple-shaped protrusions are preserved, were broken off. It was made of fine washed clay. The ochre surface, which is partly tinged with light brick-red where the vessel is open, was smoothed before perfect firing. The fracture is brick-red and shades to ochre near the surface. Size: height: 4.4 cm, diameter of mouth: 4.8 cm, diameter of foot base: 2.3 cm, depth of base curve: 0.6 cm (Fig. 14.6: 4).

8. Fragment of a longitudinally split cylinder, about one third of its diameter, with both ends broken off. It was made of washed clay fired hard with an admixture of organic material and sand. The surface and the fracture are dull brick-red. Size: length: 3.4 cm, width: 1.6 to 2.8 cm, thickness: 1.2 cm (Fig. 14.6: 5).

9. Cubic vessel with slightly concave folded side walls, which accentuate the upper and side vertical edges. The base is flat, damaged in three corners. Approximately in the centre of the upper part there is a circular hole into a pear-shaped cistern with a rounded base and a slightly widened mouth. Vertical edges at the corners of the cube reinforced by folding, there are four small holes from the base to the dorsum for suspension of the vessel using a thread. The object was made of washed clay with a small admixture of fine-grained sand and was fired hard after the surface was smoothed. The surface is mostly grey to brown grey with a larger light ochre patch; the fracture is a relatively light grey-brown. Size: height: 4.1 cm, upper part: 5 × 5.3 cm, base: 4.8 × 4.8 cm, vessel hole diameter: 2.1 × 2.2 cm, vessel depth: 3 cm, maximum internal vessel diameter: 3.1 cm, suspension hole diameter: 0.25 to 0.3 cm (Fig. 14.6: 6).

Results

The LgK settlement in Dlhá, in the valley of the Podhájsky (Bosniacky) stream, which flows into the River Parná near the village of Suchá nad Parnou, lies on the gently undulated foothills of the Little Carpathians. The foothills have a dense network of small watercourses flowing into smaller rivers, in this case Parná and Gidra, which drain the central part of the eastern side of the Pezinok Carpathians (Fig. 14.1). Relatively continuous settlement from the Neolithic period is documented near Dlhá at a distance of 3–4 km in Častá and Štefanová (Schmidt a kol. 2003, 90–96) and continues to the southeast through the cadastre of Budmerice to Cífer. To the south of the area of interest, at a distance of about 3.6 km, there is a site from an earlier phase of Lengyel culture (LgK) near the village of Borová (Němejcová-Pavúková 1997, 11–15). At a distance of 3 to 5 km to the east, relatively large settlements are known in the cadastre of the villages of Košolná and Suchá nad Parnou (Kraskovská 1955, 101–103; Farkaš 2009, 193). Roundels were documented at three of the settlements or in their vicinity, of which only the one near the village of Borová has been explored (Němejcová-Pavúková 1997, 11–64; Kuzma 2005, 197; 2007, 16, Fig 11; Tirpák 2007, 46). Circular ditches from the border of the cadastres of Štefanová and Budmerice (Kuzma 2007, Fig. 10: 58; Farkaš 2008, 33, Fig. 15) or Suchá nad Parnou (Farkaš 2009, 193, Fig. 1) are so far known only from the orthophotomaps of Slovakia. Another roundel in the Gidra basin, consisting of four concentric rings, was captured by aerial photography only in the cadastre of the town of Cífer (Kuzma 2005, 189–191, Fig. 3: 5, 6; 2007, 16, Fig 8: 3; Tirpák 2007, 44), and an interesting circular fortification consisting of five ditches and several palisades has recently been published from Bíňovce located northeast of Dlhá (Milo et al. 2015, 324, Fig. 1). Here, a settlement from the earlier LgK stage is documented on the left bank of the Trnávka River, and archaeological research during remediation works at the local dam (the Boleráz reservoir) identified a light sterile layer of outwash clay about 15 cm thick, which separated immovable finds from the LgK I to the turn of LgK I/ II (Farkaš, Prášek 1998, 60).

Of course, the settlements were not all contemporaneous. The earliest finds appear to be from two cultural pits at Budmerice, where fragments of an anthropomorphic statuette were found alongside fragments of vessels painted after firing with strips and targets of red clay (Novotný 1986, 207–212, Abb. 2). According to the painted decoration and pottery shapes, these finds are closer to the pottery of the Sé-Wölbling group than to the Lužianky group. In addition to similar painted decoration, this group is also characterised by slender, full feet of bowls (Novotný 1962, 51, Fig. 16: 11, 13, 18), which are absent in Budmerice. However, they were found in the collection material from an unknown location in the cadastre of the neighbouring village of Štefanová (Farkaš 2008, 29). The available finds make it impossible to decide whether these are two regional temporally-close groups or whether they are separated by a chronological gap.

The chronologically earlier finds, close to the Lužianky or Sé-Wölbling groups, include some of the finds from the vicinity of the roundel near the village of Borová (Němejcová-Pavúková 1997, 100–102, Abb. 37), although other finds are clearly from later periods of LgK, including its final Ludanice stage (see also Čižmář a kol. 2004).

Based on the colour patterns, mostly consisting of narrower geometric stripes made by applying red, yellow and grey-white to white clay to the surface of the vessels after they were fired. In one case the motif of red dots on a continuous yellow layer was preserved. The tectonics of the vessels and the nature of the protrusions (hemispherical, vertically elongated with or without a horizontal hole, often located directly on the rim, indented, button-shaped, small studs on the cups, etc.), their location on a distinct edge or at the rim, and according to the discovery of arched ears under the rim, etc., the group can be classified as the Ib phase of the Moravian or Austro-Moravian painted pottery culture (hereinafter MPPC/MOG) in Moravia and Lower Austria (Vildomec 1928–1929, 23–26; Podborský 1970, 260–263; 1985, 13–15; Podborský a kol. 1993, 114–117; Kazdová et al. 1994, 136–139; Neugebauer-Maresch 1995, 66; Doneus 2001, 88, 102, Abb. 110). Based on preliminary conclusions, analogies of pottery from Dlhá can be seen, for example, in the published material from Jaroměřice nad Rokytnou in Moravia (Koštuřík 1979). The only difference is the sporadic occurrence of engraved decoration (only 1 fragment to date). The close cultural links of southwestern Slovakia, especially the wider area of the Bratislava Gate, to the Southern Moravian, but especially Lower Austrian cultural area are, however, evident in various periods of prehistory and early history. In many periods the border between different communities was not the River Morava or the Little Carpathians, but the area around the River Dudváh, possibly the River Váh. This trend is further evident in the early Neolithic stages of LgK, where distinct regions can be identified based on variations in their spiritual and material culture (Kalicz 1975–1976, 52–53, Abb. 1; 1985, 96; Fiuntak 2021, 6; Pavúk 2021, 50). Apart from the presence of distinctive pottery and decorative patterns, these regions differ from each other in other aspects such as the presence of anthropomorphic or zoomorphic statuettes and the evidence of funerary rites. A notable change took place during the early Eneolithic period, when the cultural inclination of the entire area, including Záhorie and the Myjava Hills, shifted towards the developments in the northwestern part of the Carpathian Basin, as exemplified by the Ludanice group. Considerable western influences can be traced in its content.

As per the current state of knowledge, a distinct characteristic of the western region in the earlier LgK stage is the abundance of fragmentary anthropomorphic statuettes, with the highest representation found in the sub-Little-Carpathian region of Slovakia. The chronologically significant finds from feature 1/2020 in Dlhá include the right foot of a standing anthropomorphic statuette. This find is notable for its originally clay-coated joined but separately modelled feet, featuring a distinctive foot, knee, and outer ankle. Of particular significance is the partially-preserved circular hole that was originally positioned between the statuette's thighs, located at the lower edge of the original and exaggerated bottom (Fig. 14.5: 1). The foot thus probably represents statuettes of the Maloměřice type (Podborský 1983, 30, 36–47, Fig. 9; 1985, 70, 98–99) or the IIb type (Fiuntak 2021, 133). The transverse holes are characteristic of the Ib phase of MPPC and also appear in the finds from Jaroměřice nad Rokytnou (Koštuřík 1979, 36–38, Tab. 15: 15, 22: 9, 11, 17, 19; Podborský 1985, 98; Doneus 2001, 122; Podborský, Čižmář 2008, 155).

The rare separate miniature anthropomorphic statuettes that are not attached to other pottery (Podborský 1983, Fig. 31; 1985, 103) include a statuette damaged by an earthmoving machine with a preserved height of 2.9 cm. It was found in the profile of feature 1/2020, alongside the remains of an open bowl placed on its side, featuring a hollow ring foot. Unfortunately, the find situation does not allow a conclusion whether the statuette was placed into the fill of the bowl intentionally or accidentally. In any case, it was in an almost undisturbed state before it was damaged by the earthmoving machine.

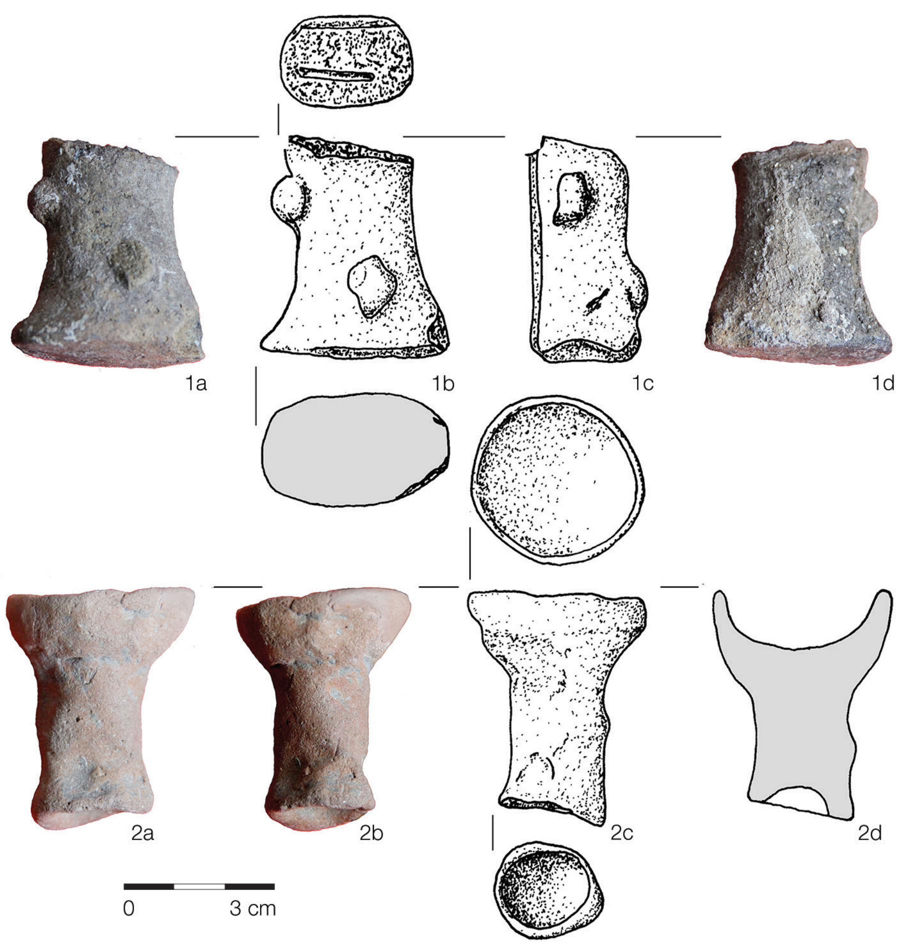


Fig. 14.7. Žlkovce (district of Trnava), site Vaniga. Finds from surface collection.
1 – Foot of an anthropomorphic statuette, 2 – miniature vessel. Photo and drawing by Z. Farkaš.

The statuette's arms are outstretched horizontally, without the representation of palms and fingers. This particular feature makes it a Střelice type statuette (type IIa1 according to Fiuntak 2021, 133). The process of its moulding (Fig. 14.7: 2) had to be adapted to its small size. The statuette was crafted from a single piece of clay, with the outstretched arms sweeping slightly downward (one arm is currently missing). The body seamlessly transitions into the undivided legs, and a pair of feet is represented. As a secondary addition, perhaps before firing, small breasts were attached to the body, resembling the shape of small oval protrusions on thin-walled cups and small bowls. The surface of the statuette was originally coated with a continuous layer of ochre-yellow clay, parts of which fell off over time (Fig. 14.5: 2). As noted by V. Podborský (1985, 92), around 10% of MPPC statuettes in Moravia exhibit remnants of painted surfaces, with traces of red being more prevalent compared to yellow, black and white dyes. However, the percentage of coloured clay that remains on the surface of statuettes is higher in the MPPC Ia phase (Podborský 1983, 61). Their quantity varies depending on the site, which may also be due to different soil conditions. Austrian researchers suggest that yellow clay was used to represent the colour of the skin (Neugebauer-Maresch, Neugebauer eds. 1982, 18). A continuous yellow paint was preserved on fragments of anthropomorphic statuettes from Těšetice-Kyjovice, Střelice-Bukovina and Hluboké Mašůvky (Podborský, Čižmář 2008, 185, 187, 207, 222).

The head of an anthropomorphic statuette from Feature 1/2020 is also a relatively chronologically-sensitive find. It is characterised by a long neck with a circular cross-section, a flat top of the head, and a face pressed with the fingers to create an arched nose, sunken cheeks, and a pair of large protruding ears (Fig. 14.5: 3) pierced with small holes. Indications of hairstyle, mouth and eyes are absent, unless the holes in the ears also represent the pupils of the eyes. All of the above features, sometimes regarded as attempts at a portrait (Podborský 1983, 41, 67, Fig. 32; 1985, 73, 95), are characteristic of the MPPC Ib phase. Although each statuette is a separate work of art, a similar modelled face was found at the Vaniga site near Žlkovice, which, however, is dated to LgK phase II in Slovakia (Pavúk 1998, Fig. 11: 4). However, the overall morphology of the head from Dlhá is more reminiscent of the character Sid from the animated film Ice Age than of a real person. The piercing of the ears of anthropomorphic statuettes in Neolithic LgK stages is not frequent, but it has been documented (e.g. Podborský 1983, Tab. I: 4, II: 1, 2; Podborský, Čižmář 2008, 230). It is not yet certain whether the holes were used to thread various ornaments through earlobes, as documented for Neolithic and Eneolithic cultures in the Balkans.

Three small objects in a fragmented state found in feature1/2020 at Dlhá could be potentially linked to the statuette. In one case (Fig. 14.6: 3) a lump of clay resembles a steatopygia-deformed bottom half without traces of attached limbs. In two cases (Fig. 14.6: 2, 5), parts of cylindrical objects were preserved that may or may not have come from the limbs of an unidentifiable statuette.

In comparison to other cultures, the presence of spindle whorls and clay loom weights is not as prominent in the material content of LgK (Podborský 1970, 257). Only three pieces have been documented from the otherwise abundant and diverse collection material discovered around the nearby Štefanová (Schmidt a kol. 2003, 91). However, they are unlikely to have chronological significance. The disc-shaped object with a large central hole (Fig. 14.6: 1) could be both a weight and a spindle whorl. Ethnological observation and practice suggest that the quality of yarn was influenced by the weight of the spindle whorl. The heavier the spindle whorl, the stronger the yarn (Anderson Strand 2015, 48) and the weight also seemed to depend on the raw material being processed. According to R. J. Forbes (1956, 152), strong linen fibre had to be spun on a spindle with a relatively heavy spindle whorl, while slightly lighter types were more suitable for wool processing. If the loaf-shaped object was a spindle whorl, it may have been used for spinning vegetable rather than animal fibres.

The interesting finds include a miniature model of a wide-open bowl with protrusions below the rim and a high cylindrical foot (Fig. 14.6: 4). Similar surface finds were found in the nearby Štefanová (Schmidt a kol. 2003, 95) and in Žlkovce (Vaniga site) (Fig. 14.7: 2). Miniature vessels of various shapes have been documented from the entire LgK. Although their purpose is often attributed to cult or ritual practices, they may have had more mundane uses, such as toys, models, pottery experiments by children, etc.

Cubic vessels, usually with a central cylindrical or pear-shaped cistern and four, presumably hinged, holes in the corners, are present in the material content of the Lengyel culture. These vessels were found in Slovakia as well as in Hungary, Austria and Moravia (e.g. Podborský 1970, 257 et seq.; Farkaš 1984, 13 et seq.; Zalai-Gaál 1993, 19 et seq.; Bánffy 1997; Pavúk 1997, 66–68; Beljak Pažinová 2016, 298–299). One of them was also found in feature 1/2020 in Dlhá (Fig. 14.6: 6).

The oldest cubic vessels appeared at the beginning of the Lengyel culture in Slovakia in the contents of Pit No. 2 at Budmerice (Novotný 1986, 208, Abb. 1:6). According to the available finds, their occurrence culminates in MPPC/MOG Ib phase (Doneus 2001, 122; Pavúk 2021, 42) and subsides during the IIa phase (Pavúk 1997, 72 et seq.), although in some places they persist in a modified form up to the period of the late Lengyel culture, corresponding to MPPC IIb phase or LgK IIIa to IIIb in Hungary (Bánffy 1997, 19 et seq.). They are usually thought to be pendant lamps, receptacles for dyes or aromatic substances or small altars; however, the general opinion is that they had a cult role (Zalai-Gaál 1993; Bánffy 1997; Pavúk 1997; Podborský 2006, 168; Beljak Pažinová 2016, 298–299).

The decorative elements of the cubic vessels of the C1 I variant of Zalai-Gaál (1993), such as the corners of a cuboid from Střelice reinforced with rollers (Podborský 1970, Fig. 8: 2), could indicate that they were modelled after larger objects crafted from less durable materials, such as wood.

Conclusion

The recently discovered LgK site at Dlhá (district of Trnava), located in the Sub-Little-Carpathian Hills on the Trnava Tableland, reveals evidence of an active settlement by LgK people, which remains relatively unexplored. The finds from feature 1 and 2/2020 can be classified as the MPPC Ib phase, which roughly coincides with the finds from Jaroměřice nad Rokytnou (Koštuřík 1979). These finds, together with settlements in Brno-Komín, Střelice-Sklep I, Brno-Žebětín, etc., are dated to the early MPPC Ib phase (Kazdová et al. 1994, 139), which, according to older assumptions, was not as long as the MPPC Ia phase (300 to 400 years), but its time span of approximately two centuries (Podborský a kol. 1993, 114, 117) indicates that it was not a short or transitional horizon. However, recent data obtained by 14C AMS analyses reduced the original assumptions to only 93 years for the MPPC Ib phase (Stadler et al. 2006, 53, Tab. 4, 5). Nevertheless, the MPPC Ib phase, which would thus take longer than MPPC Ia, could last for up to 3 human generations (Zalai-Gaál, Osztás, Somogyi 2014, 330). In southwestern Slovakia, the finds from the elevated settlement on the slopes of Devínska Kobyla in Bratislava can be attributed to this period (Farkaš 1984, 5 et seq.). A large settlement near Dlhá on the southern slope between the village of Košolná and the Suchá water reservoir can be dated to this period due to the characteristic and relatively abundant material obtained, unfortunately, mostly by surface collection (Kraskovská 1955, 101 et seq.; Farkaš 2009, 191; Pažinová 2012, 122). Some known settlements in the basin of the Gidra, Parná and Trnávka rivers and other streams starting on the eastern side of the Little Carpathians may have existed in this period. The large area of some of these settlements, documented by surface collection, may indicate their longer temporal development, perhaps not always continuous. A similar phenomenon may be found at the well-known settlement in the cadastre of the village Žlkovce, studied extensively by J. Pavúk (e.g. 1991, 350–354; 1998, 169–178; Pavúk, Karlovský 2004, 213, 229). Given its distinct, white-painted pottery, this settlement is dated to the LgK II – Pečeňady period, close to the MPPC IIa phase in Moravia. However, elements close to the MPPC Ib phase have also been identified in the collection material from the immediate surroundings of the former Vaniga farm. In addition to pottery, these elements include a fragment of an anthropomorphic statuette with traces of secondary connection of lower limbs and remains of a transverse hole (Fig. 14.7: 1).

1. The left foot of standing anthropomorphic statuette with oval cross-section with small protrusions representing the outer ankle and knee. The foot is straight, oval, bilaterally expanded with no toes marked. On the inner side there is a scar from the original attachment to the separately modelled right lower limb of the statuette. Near the fracture, just above the knee but still below the unpreserved bottom connection, there is a remain of the backward-sloping hole that originally passed between the joined feet. It was made of perfectly fired washed clay with an admixture of fine-grained sand. The light-brown surface with a small black spot on the foot is quite rough, without smoothing. The fracture is black. Size: height: 4.5 cm, sole of the foot: 4 × 2.3 cm, diameter of foot at the fracture: 2.8 × 2 cm, diameter of the hole at least 0.5 cm (Fig. 14.7: 1).

2. A miniature, carelessly modelled goblet-shaped bowl on a high, 180° laterally inclined full foot with an extension at the base. For static reasons, it has a shallow depression at the base with a potter's fingernail impression, which was probably intended to evoke the hollow foot of real-sized models. No traces of any protrusions were preserved on the bowl. The surface is levelled and smoothed but not flat and there are clear impressions of the potter's fingers. It was made of finely washed clay, fired to a light brownish-red shade. Size: height: 4 cm, bow rim diameter: 3.2 cm, foot lower edge diameter: 2 × 2.2 cm, foot diameter: 1.6 × 1.9 cm, foot depression depth: 0.5 cm (Fig. 14.7: 2).

The important explored and, above all, partially evaluated LgK sites on the Trnava Tableland include a settlement with a roundel in the cadastre of the village of Bučany (Bujna, Romsauer 1986, 27–35), which was dated by N. Beljak Pažinová to LgK IB1 and IB2 according to the J. Pavúk chronology (1981, 265–272, see also Čižmář a kol. 2004). However, the sharp fractures of cup bulges and oval protrusions in the late phase of the settlement, which move towards the edges of pottery indicate the gradual onset of elements characteristic of the MPPC Ib phase (Pažinová 2010, 235; 2012, Fig. 4).

The finds from features 1 and 2/2020 from Dlhá show again the close relations of Western Slovakia, especially the Bratislava Gate area and the Sub-Little-Carpathians region with the Lower Austrian and Southern Moravian cultural area in the Early Neolithic. They are also reflected in the existence of a fully-fledged later developmental phase of the earlier LgK stage, corresponding to the MPPC Ib phase, with a distinctly longer temporal development. Its origins could be sought in the material of later features from Bučany (Pažinová 2010, 235). It is therefore necessary to consider the validity of the continuity of the LgK IB (according to the classification of J. Pavúk 1981, 265–272, see also Čižmář a kol. 2004, mostly corresponding to the MPPC Ib-c phase) and the LgK II for this area of Western Slovakia. In our opinion, this MPPC Ib phase (called transitional or horizon Santovka, Pavúk 1981, 272–274; 2021, 40–58), probably lasted only a short period of time. The finds from Santovka, situated at the eastern border of the LgK distribution, are characterised by yellow and white paste surface painting, engraved double lines and, above all, numerous cubic vessels, often incorporated into zoomorphic statuettes (Pavúk 1994; 1997, 66–70, Fig. 3; 2021, 40, 42), which were documented at other

LgK sites north of the River Ipeľ (e.g. Beljak Pažinová, Beljak 2014, 59, Fig. 56, 58). Although these finds correspond to the features of the MPPC Ib phase, they are so specific that they probably represent a local, time-limited group, which clearly precedes the start the of LgK II stage according to J. Pavúk (1981, 274–279) and the MPPC IIa phase, which is characterised by white paste dye. However, the present state of research does not allow a determination of its duration. The Lengyel culture is a complex of several local groups (Fiuntak 2021, 6), often with differences in material and spiritual culture (Zalai-Gaál 2007, 157; Pažinová 2010, 235), especially in its earlier stage I. These differences, in addition to the large territory of the Lengyel culture, were probably also conditioned by the partly different cultural substrate on which it emerged at the turn of the Middle and Early Neolithic and its gradual spread. In Austria, its expansion into a new environment may thus also have been reflected in the temporal shifts of the individual subphases in the otherwise relatively homogeneous western group represented by the MPPC and MOG (Doneus 2001, 88, Abb. 110). Difficulties in the detailed dating of individual sites may also be caused by the long temporal development of some settlements, spanning tens to several hundred years (Osztás et al. 2013, 280, Tab. 8).

15

Lithic raw material sources and their exploitations during the Paleolithic in Transcarpathia (Ukraine): A newly proposed approach analysis

Yuri E. Demidenko, Béla Rácz

Introduction

Nowadays it is hard to find a scientific publication on Paleolithic research where a lithic artefact assemblage is not analysed through a raw material type study with, at least, a figure showing the main and supportive lithic types used for on-site and possibly off-site artefact production and use. At the same time, such lithic raw material type studies significantly vary. Their approaches usually differ in the specific scientific aims for the planned studies of artefact assemblage(s). The present article presents a new regional approach analysis for the Paleolithic record in Transcarpathia, Ukraine. On the one hand, Transcarpathia features a rather rich Paleolithic record for a small region in Europe with a total area only of ca 12,800 km² (see the region's basic characteristics below) where good industrial–geochronological data sets are already established for the period from the Lower Paleolithic up to the Early Upper Paleolithic (Gladilin 1989; Haesaerts, Kulakovska 2006; Usik 2008; Kulakovska, Usik 2011). On the other hand, it is possible to state that lithic raw material studies in the Paleolithic of Transcarpathia are still in their initial stage. Therefore, a new approach for such research is suggested and will be applied and shown for the first time here. At the same time, all the previously known and processed lithic raw material data for the Paleolithic investigations in the region will also be discussed.

Transcarpathia: geographical setting and history of paleolithic research

Transcarpathia is the westernmost part of Ukraine, the only region of the country located in Central Europe. Moreover, the most accepted geographical centre of the European Continent has been recognized since 1887 as lying near the town Rakhiv, namely in Transcarpathia. By geomorphological

doi 10.47382/dvs_26-15

data, Transcarpathia belongs to the Carpathian Basin of Eastern Central Europe occupying its northeastern corner and characterized by mostly southwestern slopes and foothills of the Eastern Carpathian Mountains. More precisely, it is a transitional zone between the Pannonian – Middle Danube Plain and the Eastern Carpathian Mountain Main Range. From a strict geological point of view, Transcarpathia is mostly a chain of intermountain basins of a piedmont deflection and a ridge of various volcanic formations with the most distinguished among them being the Vihorlat–Gutin Volcanic Range and Berehove Volcanic Shallow Mountain Area. These formations naturally caused the presence of varied and numerous lithic types of volcanic *sensu lato* origin at Transcarpathian Paleolithic sites.

The geographical location of Transcarpathia in Central Europe had also led to its political affiliation to several countries during the period of last 1000 years. It was mostly part of Hungary, a part of the Upper River Tisza region, from the early 10th century when Hungarian tribes settled in the Carpathian Basin. After the collapse of the Austro-Hungarian Empire, it was belonged to Czechoslovakia as "Subcarpathian Ruthenia" in 1920–1939. During the Second World War Transcarpathia was again a part of Hungary. And only in 1944 did the region become a part of Ukraine, then in the Soviet Union and since 1991 as a newly independent country. Such a political history of Transcarpathia has objectively led to not only a long-lasting "multi-cultural" character of many aspects of life for the region's people but also to scientific investigations, including Stone Age archaeology, by archaeologists from different countries where Transcarpathian archaeological context was to some extent always considered within a different country at any given time period. Such a "multi-state" feature of Paleolithic research in the region makes it truly unique in Europe.

The beginning of the Paleolithic research in Transcarpathia certainly should be connected to archaeological surveys and find collection by a local Hungarian lawyer, district attorney and amateur archaeologist Tivadar Lehoczky (1830–1915), "*the true founder of Subcarpathian Ruthenia Prehistory*" (Skutil 1938, 128). Although he did not recognize the Paleolithic character of lithic artefacts from two loci, collected by him at Pavlova hora near the town Mukachevo and found by a Ruthenian worker A. Monda near the town Berehove, he kept these finds in his museum in Mukachevo. The Upper Paleolithic affinity of artefacts from Pavlova hora and near Berehove was later properly recognized by a Czech professional Paleolithic archaeologist Jozef Skutil (1904–1965). In a course of his Stone Age surveys and observations in the first half of the 1930s of "Paleolithic *terra incognita*" in the east of Czechoslovakia, after an intensive and successful research in Slovakia, the core region for his investigations then, he additionally visited Subcarpathian Ruthenia in 1935. Studies of the artefacts at the Lehoczkys Museum in Mukachevo allowed Skutil to recognize and describe Upper Paleolithic features and namely Aurignacian ones, according to Paleolithic archaeology standards at that time, for lithic artefacts from the above-noted two loci (Skutil 1938, 126–135, Tab. XV–XVI). He also personally visited the two loci and areas around them, pointing out a good potential for the region's Paleolithic studies, although he did not conduct any proper archaeological excavations in Transcarpathia then. Moreover, one of the loci happened to be a real site. In a company with a local Hungarian geologist from Berehove, V. Jantský, Skutil was brought by Monda to a rhyolite quarry at Mala hora loci near Berehove where the Ruthenian worker had found the lithic artefacts for Lehoczky. Skutil and Jantský not only found several dozen lithic pieces there but also recognized an *in situ* Upper Paleolithic layer in the quarry's Pleistocene sediments. Thus, 1935 can be recognized as a year when real scientific recognition of Paleolithic sites and namely Upper Paleolithic sites presence in Transcarpathia was established. From this date we can also count the long-lasting history for Paleolithic research in Transcarpathia.

Since that time, a number of professional and amateur archaeologists have significantly contributed to our knowledge of the Transcarpathian Stone Age. From our point of view, the main achievements were by the following people and their associates. First, it is impossible not to mention Transcarpathian Ruthenian P. P. Sova (1894–1984) who should be regarded as the actual discoverer of the first unquestionable Middle Paleolithic lithic artefacts at three surface find loci, Zamkova hora, Horyany and Radvanka, within Uzhhorod City territory after the end of World War II in the 1940s and 1950s (Sova 1964). Moreover, according to our current opinion using the data published by Sova, the Uzhhorod loci are industrially related to the Middle Paleolithic Charentian tradition mostly based upon primary and secondary treatment of local siliceous sandstone and to a lesser extent of siliceous argillite. Since that time a few more surface find spots with similar artefacts have been found in the vicinity of Uzhhorod but no one *in situ* site yet, although the already known findings are still considered by us as one of Middle Paleolithic loci concentration within Transcarpathia. Second, the 1967 and 1968 field work of V. F. Petrun (1922–2005), at that time Kruvyi Rig and then Odesa (Ukraine) and one of the leading founders of "archaeological petrography studies" in the entire Soviet Union, led to a discovery of a distinct obsidian outcrop in the vicinity of the village Rokosovo in Transcarpathia where he also found a series of "Mousterian artefacts" recognized by him (Petrun 1972). But with any possible reservations on some other people's research, it is needed to state that it was V. N. Gladilin (1935–2015) who played a crucial role for the Paleolithic investigations in Transcarpathia during the last third of 20th century (Demidenko 2017). Already knowing about the Skutil's, Sova's and Petrun's discoveries in the region, Gladilin organized in Kyiv a specialized "Transcarpathian Paleolithic Expedition" for a search of Lower and Middle Paleolithic sites in Transcarpathia in 1969. The expedition, from 1982 a "Permanent Functioning Paleolithic Expedition", worked until 1991 and its scientific results until now constitute a core dataset on the Transcarpathian Paleolithic record. In addition to new discoveries of more surface find loci throughout Transcarpathia and at Berehove's shallow mountain area and at Rokosovo's mountain area with excavations of an *in situ* Upper Paleolithic site at Mala hora known then as the Berehove I Aurignacian site, Gladilin had his main archaeological discovery find in 1974 Korolevo, which was investigated annually under his direction from then to the collapse of the Soviet Union in 1991. Korolevo is in fact a huge Paleolithic site complex occupying total areas with lithic artefact occurrence for more than 100,000 m² where more than 1500 m² were excavated at three hilly peaks at various River Tisza terraces (Gladilin 1989, 95; Gladilin, Sitliviy 1990, 27). Taking into account all the initially published data (e.g. Gladilin 1989; Gladilin, Sitliviy 1990; Kulakovska 1989) and then their later revised versions (e.g. Haesaerts, Kulakovska 2006; Kulakovska, Usik 2011; 2015), Korolevo industrial–geochronological sequence spans a time frame from ca 950 000 ky BP to ca 40 000 BP with Lower Paleolithic and Early Upper Paleolithic at the frame's extreme edges having, however, the most numerous and representative archaeological horizons with finds related to the MP. Over the last 25 years, periodic but systematic Paleolithic field investigations in Transcarpathia have continued under the direction of L. Kulakovska and V. Usik with both important re-evaluations and re-excavations of the already known sites and discoveries of a few new *in situ* Middle and Upper Paleolithic sites providing basically some more variability data for the already known lithic industries in the region.

As a result of the realized Paleolithic studies in Transcarpathia over the last ca 50 years, three main site clusters are still recognized in the region, Korolevo, Rokosovo and Berehove (Fig. 1.1: 14A, 14B). Almost all other known *in situ* and surface sites can be still considered as more or less "satellite-loci" to one of the three site clusters with a single exception for Sova's Middle Paleolithic surface find spots in Uzhhorod which certainly deserves some special research in the future. Further, all the known Paleolithic data can be used for studies of various research subjects, including lithic raw material topic.

Main lithic raw material types used at paleolithic sites in transcarpathia

Several basic lithic raw material types most often used at Transcarpathian Paleolithic sites have been recognized in a course of the various Paleolithic investigations in the 1960s–1990s. These were Korolevo andesite, Rokosovo obsidian, Berehove flint and/or chert, while quartzite and slate were of unidentifiable origin then (e.g. Gladilin 1989, 95; Gladilin, Sitliviy 1990, 36; Kulakovska 1989, 15, 72, 79–80; Gladilin, Demidenko 1989, 146, 164; Tkachenko 2003, 19). Thus, each of the three recognized main site clusters corresponds to its own local raw material type. This fact alone had to drive the sites' investigators to some in-depth special studies regarding the interconnection of sites and lithic outcrops/sources, but in spite of some claims, these studies have not really been done and a series of questions remain to be answered on the subject.

First, it had to check the already applied terminology to the Transcarpathian sites' lithic raw materials. This was because other than obsidian, the lithic raw material was determined not through proper petrographic studies but by Gladilin using only "his naked archaeological eye" recognition method. One of us (B. R.) finally performed the needed petrography study. Initially, it was conducted during Ph D research (Rácz 2013a; 2013b) and since then the study has continued (e.g. Rácz et al. 2016; Demidenko et al. 2020). The petrography research has led to the following terminology and description results. The Korolevo "andesite" turned out to be a "hyalodacite (glassy dacite)". The Rokosovo "obsidian", after its pioneering recognition by Petrun in the late 1960s and early

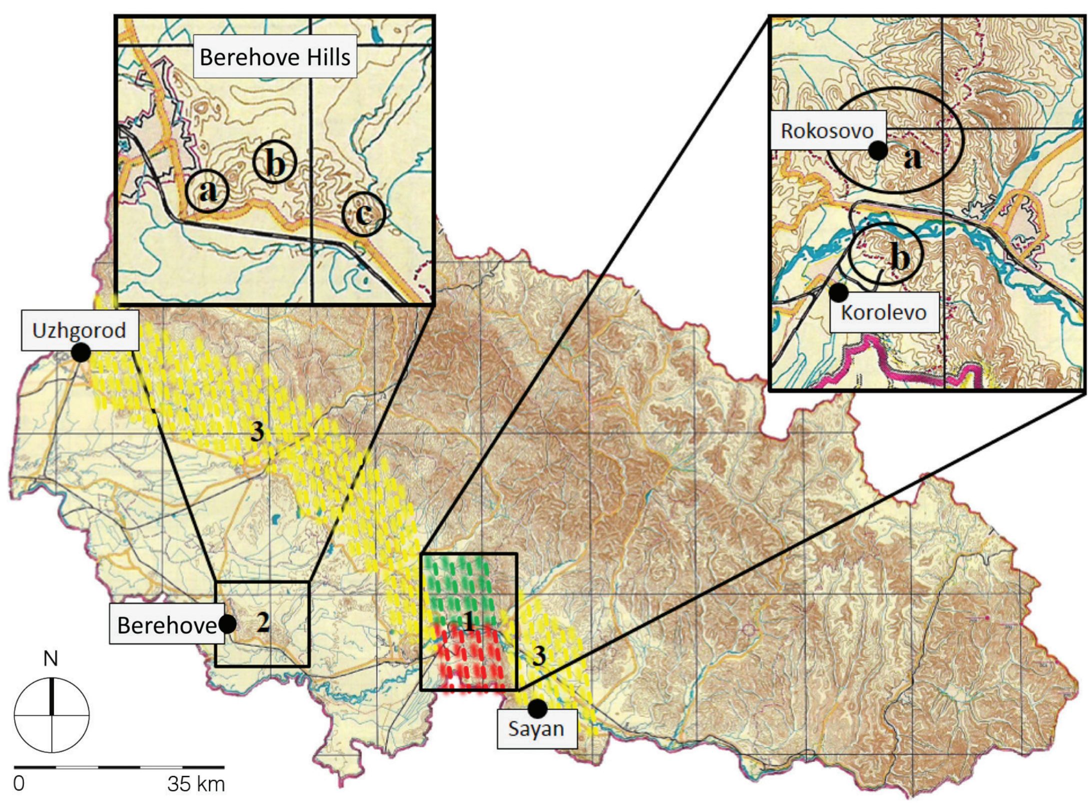


Fig. 15.1. Transcarpathia (Ukraine) and its lithic raw material regions. 1 – Volcanic; 2 – metasomatical; 3 – sedimentary. Modified after Rácz et al. 2016, 221, Fig. 16.

1970s was then internationally acknowledged and "coined" "Carpathian 3 type obsidian" (Rosania et al. 2008; see also Rácz 2013a; 2013b; 2018) following the long ago established "Carpathian 1 and 2 types obsidians" in Eastern Slovakia and Northeastern Hungary (e.g. Přichystal 2009). The Berehove "flint" and/or "chert" are in fact again of volcanic origin due to the fact that the Berehove Shallow Mountain Area was created as a result of Late Tertiary volcanism. Thus, it can be said that the Berehove lithic raw materials are like the above-noted Transcarpathian volcanism actions "created" hyalodacite and obsidian. However, the Berehove volcanic origin acidic rocks had undergone metasomatical alteration, which is why homogeneous glassy lava rock was transformed by post-volcanic activity, changing the glass into opal. As a result, various sorts of metasomatically transformed (siliceous, opalised) "tuffs, tuffites and rhyolites" – siliceous rhyolite tuff varieties (type I and II), siliceous tuffite (type I and II), siliceous and opalised rhyolite (type I and II) were petrographically identified. Two other most known lithic raw material types for Paleolithic sites in Transcarpathia, "quartzite" and "slate", are of non-volcanic but of sedimentary origin "siliceous sandstone" and "siliceous argillite". They do not have localized primary outcrops/sources, like the three above-characterized lithic raw material types. It is believed that these rocks are "*potentially originating from the Flysch-belt of the Carpathians, from the Cretaceous Sipotian or the Oligocene Menilite Formation*" from where "*rivers of south-south-western flow orientation could transport the pebbles in the immediate vicinity of the archaeological sites*" in Transcarpathia (e.g. Rácz et al. 2016, 220). Accordingly, siliceous sandstones and siliceous argillites are known from many secondary sources in view of the alluvial load of various regional rivers in Transcarpathia.

In sum, recent lithic raw material type studies based on petrography approach have revealed three basic raw material regions in Transcarpathia: volcanic, metasomatic, and sedimentary (Fig. 15.1). One region is also subdivided into separate sub-regions: Korolevo and Rokosovo sub-regions for the volcanic region. In contrast to the two strictly localized volcanic and metasomatic regions, the sedimentary region is characterized by a seeming continuous and wide belt going almost throughout the entire Transcarpathia from northwest down to southeast with some intermittent areas covered by thick Eopleistocene and Pleistocene sediments that were making the areas unavailable for Prehistoric hunter-gatherers.

Finally, it has to be mentioned that some other lithic raw materials also occur at Paleolithic loci in the region (e.g. Rácz et al. 2016, 223, Tab. 1) but none of them was used as any important source for lithic treatment processes since they never approached even 5% of all artefacts at any given lithic assemblage.

Lithic raw material regions in transcarpathia and their exploitation dururing the paleolithic

Now it is proposed to study the significance of each raw material region and sub-region for the known Paleolithic loci inside and outside the given region/sub-region. Here it must be kept in mind that a meaning of a lithic raw material region/outcrop/source is mainly connected to a use of its objects outside (*sic*!) its primary and/or secondary area distribution. In this case, it is also often possible to evaluate in what way a region's/outcrop's/source's objects were used within and outside its area. Indeed, having three raw material regions and four basic lithic raw material types there (hyalodacite; obsidian; tuff, tuffite and rhyolite; siliceous sandstone and siliceous argillite) the Transcarpathian Paleolithic record could be a good "polygon" for such an analysis of raw materials.

Korolevo volcanic hyalodacite raw material sub-region

The hyalodacite primary outcrop (Fig. 15.1) is known in the area of the so-called Khust Gate between the towns of Vinohradiv and Khust, within the Korolevo open-air quarry at the edge of village Veryatsya. The area is characterized by black glassy various sized natural blocks (even up to 1 m in diameter) with aphyric or microporphyrous texture abundantly occurring along the contact zone of the dacite subvolcanic body in the quarry. The outcrop's formation can be related to Late Tertiary Volcanism, assigned structurally to the Kutchava volcanic complex that forms an Intra-Carpathian Volcanic Arch, extending approximately 500 km from the Visegrád Mountains (Danube Bend) to the Hargita Mountains in Eastern Transylvania following the internal arch of the Carpathian Mountains.

The Korolevo site complex (more than 100,000 m² for the total areas with lithic artefact presence) discovered by Gladilin in 1974 within the open-air quarry is known for topographically three peaks separated by Pleistocene ravines at part of the 100–120 m high Kopanska Terrace on the left bank of the River Tisza: the "Beyvar" and "Gostryi Verkh" peaks (Korolevo I site) and the 20 m high terrace leaned toward the "Vinnychki" peak (Korolevo II site). As was mentioned above, the Korolevo site complex is a series of no less than 10 *in situ* find complexes from Lower Paleolithic to Early Upper Paleolithic investigated within Quaternary sediments up to 12 m thick. Regarding the on-site lithic treatment processes, all Paleolithic human groups frequently visiting the area were of course very mainly using hyalodacite blocks. The blocks were easily available almost at any particular loci at Korolevo due to still known (and also discovered during excavations) Pleistocene ravines eroding thick Quaternary sediments down to natural deposits of the hyalodacite objects within Tertiary sediments and also within the terraces' alluvial deposits. The blocks and their naturally damaged fragments were initially treated in the two following ways: 1) straight core flaking processes with cores sometimes approaching even 30–50 cm in length; 2) first, removing large-sized and thick flakes from a block and, second, using the detached flakes as blanks for core reduction then. It is no wonder then that the resulting lithic assemblages from very different Paleolithic epochs and periods are of quite large-size with no so-called "microlithic industry". Hyalodacite always approaches more than 80% of all artefacts within any assemblage. It is well seen using the extreme assemblages at two opposite edges of the Korolevo industrial–geochronological sequence where we still get about the same results: the lowermost Lower Paleolithic horizon VII at Korolevo I (MIS 23–25, ca 950 kyr BP) – 90.9% hyalodacite, 6.1% siliceous sandstone, 3.0% quartz (re-calculated from Kulakovska, Usik 2015, 13) and Early Upper Paleolithic horizon Ia at Korolevo I (MIS 3, ca 40 kyr BP) – 97.1% hyalodacite and 2.9% taken together as some pieces of flint, siliceous sandstone, siliceous argillite, radiolarite, sandstone, or quartz (Gladilin, Demidenko 1989, 164).

Such permanent on-site exploitation of hyalodacite might lead one to suggest that the Korolevo hyalodacite outcrop had always served as a very appropriate workshop area for Paleolithic hunter-gatherers in permanently realized intensive core reduction processes with then some definite "export" of many produced pieces (e.g. pre-cores, cores, Levallois debitage pieces, bifacial and some other specific tools) to other sites in Transcarpathia. The reality, however, shows a different picture. First, none of the excavated *in situ* Paleolithic horizons can be interpreted as a pure workshop. All of them are sites-workshops combining features of both a workshop and a living site. Second, taking all the known Lower Paleolithic to Early Upper Paleolithic sites and surface find sites in Transcarpathia, no such lithic assemblage in the region even accounts for a small series (for example, not even 1%) of artefacts made of Korolevo hyalodacite. Five different site examples well illustrate "no export" of hyalodacite outside the Korolevo area at all.

First, it is worth mentioning *in situ* Middle Paleolithic site of Ruban that is situated ca 2 km to southeast from Korolevo. The site was discovered by V. I. Usik in 2005 and then excavated by L. Kulakovska, V. Usik and O. Votyakova in 2006–2008 with recovery of ca 900 lithic artefacts mostly produced of local siliceous sandstone. Later, in 2016–2017, some geological studies were conducted at the Ruban site by N. P. Gerasimenko in association with the above-named archaeologists. The site and its materials, as well as three more sites in both Korolevo and Rokosovo volcanic sub-regions were the scientific subject for Ph D research recently conducted by Votyakova on the Middle Paleolithic Charentian tradition in Transcarpathia, geochronologically connected to a short time of MIS 5a–4, ca 74–64 kyr BP (Votyakova 2021). The Charentian etalon-like site and its lithic artefacts in Transcarpathia are Korolevo I, horizon II where the basic raw material for artefacts was, of course, local hyalodacite. Thus, it can be assumed that some kind of connection – interconnection had to exist between the closely located Korolevo I and Ruban Charentian sites. The raw material data (Votyakova 2021, 204, Tab. 33) demonstrate an unexpected pattern, however. While Korolevo I/II lithic assemblage with 3,943 items in addition to the dominant pieces of hyalodacite (85.3%) is also characterized by a good series of pieces of siliceous sandstone (10.99%), Ruban 896 lithic artefacts feature even a great prevalence of siliceous sandstone (97.21%) and the presence of not a single piece made of hyalodacite.

Second, continuing with the Middle Paleolithic Charentian industrial subject, it is also important to mention again Sova's three surface loci in the Uzhhorod area (ca 80 km in a straight line from Korolevo) where again not a single clearly identifiable Middle Paleolithic lithic piece was manufactured of hyalodacite. Other lithic raw materials, the sedimentary ones, were either exclusively or mainly used at these loci where two rock types "*in considerable number occur in the River Uzh valley in view of the pebbles and boulders*" (Sova 1964, 183). Here it is additionally worth mentioning Sova's permanent notions (Sova 1964, 181–182, 184) that each of the three Uzhhorod Middle Paleolithic loci is located at different hills and their terraces having at their bases "*andesite rock deposits*" (Yu. D. and B. R – hyalodacite in our geological terminology), with the best given such example for the Zamkova hora loci where "*andesite deposits in a view of large-sized stony boulders*" are mentioned. However, Sova did not write about even a single artefact produced of andesite/hyalodacite.

Third, the Rokosovo volcanic obsidian raw material sub-region is situated about opposite on a straight line of ca 5–7 km from the Korolevo hyalodacite sub-region but on the right bank of the River Tisza. In total, there are about 20 surface loci in the vicinity of the villages Rokosovo and Malyi Rakovets with a variety of lithic artefacts of various techno-complexes and industries from Lower Paleolithic up to Late Middle Paleolithic (e.g. Gladilin, Sitliviy 1990, 65–74). Gladilin and Sitliviy published raw material data on Rokosovo Lower and Early Middle Paleolithic assemblages with a two-fold approach where they first calculated the most abundant obsidian and andesite/hyalodacite pieces and then considered the non-volcanic raw materials separately. For the first set of pieces, andesite/hyalodacite items had a share of ca 1–3.7% among all taken together with volcanic rocks. However, paying attention to a situation that "*a numerically considerable group is composed of pieces on non-volcanic rocks – quartz, quartzite, flint, slate*" (Gladilin, Sitliviy 1990, 66), it appears at best the presence of a few andesite/hyalodacite artefacts for each Rokosovo loci. Recently, finds of Malyi Rakovets IV Middle Paleolithic Charentian were analysed from partly *in situ* excavations by V. I. Sitliviy in 1989–1991 and S. N. Ryzhov in 1995, 1997, 2003, 2004, 2006 (Votyakova 2021, 110–130, Tab. 33). As usual for all Rokosovo and Malyi Rakovets loci, obsidian absolutely dominates among the Charentian artefacts – 94.69%, while andesite/hyalodacite is known for only 0.41% pieces, although siliceous sandstone has a higher representation, 3.45%.

Fourth, Berehove metasomatic tuffs, tuffites and rhyolites raw material region can be mentioned here. The straight distance between Korolevo and Berehove is ca 40 km and, like the case with Rokosovo, Berehove hills and terraces are easily seen from the Korolevo Hills. The Berehove Shallow Mountain Area features a number and functionally variable Proto-Aurignacian Berehove and Muzhievo surface loci in the vicinity of the single *in situ* site of Berehove I (Demidenko et al. 2020). Hyalodacite was not recognized among artefacts coming from the surface find spots. In addition to still very prevailing pieces on local tuffs, tuffites and rhyolites, the Berehove I site also features the presence of some artefacts on several other raw materials (Usik 2008, 59–60). Andesite/hyalodacite items were also mentioned there but with no specification of their specific types and precise quantity, although it is known there are very few of them (see also Tkachenko 2003, 19).

Finally, there is one more Early Upper Paleolithic example coming from Sokirnitsa 1–A *in situ* site located ca 30 km directly northwest from the Korolevo area at the right bank of the River Tisza, ca 7 km southeast from the town Khust. The site was discovered in 2000 by V. I. Usik and then excavated by him during the following years in the early 2000s (e.g. Usik et al. 2004; 2006). The site's Early Upper Paleolithic level 3 represents different typological facies of the same technologically industry to which Korolevo I, horizon Ia finds had previously been assigned (Usik et al. 2004, 102) where 97.1% of 5,803 artefacts were manufactured of hyalodacite. The majority of level 3's more than 2 000 lithic artefacts are said to have been produced of quartzite/siliceous sandstone (ca 62%) and slate/siliceous argillite (24%), while the occurrence of andesite/hyalodacite was claimed to be represented by just 0.4% of artefacts. There is no information for all artefact types on andesite/hyalodacite but from our point of view it is worth mentioning two published tools (a retouched blade and a burin) of this volcanic rock (Usik et al. 2004, 1–2, Fig. 6).

In sum, all the above-discussed five examples of sites and surface loci in Transcarpathia show no real "export" of any kind of hyalodacite objects in terms of either natural blocks or serial artefacts. They are only at best represented by a few "curiosity items" (Rokosovo – Malyi Rakovets loci; Berehove I site) or tool examples from a hunter-gatherer's "travelling pocket" (Sokirnitsa 1-A site).

Rokosovo volcanic obsidian raw material sub-region

The particular volcanic sub-region (Fig. 15.1) is connected to the upper reaches of Silskiy stream that is to the north of the village Rokosovo and to the south of Malyi Rakovets where the Upper Tertiary Sinyak Formation comprises obsidian blocks and bombs in an agglomerate type tuff of acidic composition. The area forms the central part of the Vinohradiv Mountains in the Vihorlat–Gutin volcanic range. The size of the blocks and bombs currently available varies between a few cm to several dozen cm. The obsidian natural pieces can be easily collected in substantial quantities on the eroded Tertiary surface and the stream valleys even today.

As was already mentioned during discussions on possible "export" of hyalodacite pieces to other sites and loci, the Rokosovo – Malyi Rakovets loci are like the Korolevo site complex lithic assemblages being characterized by a very dominance of its local lithic raw material, obsidian, from which no less than 90% of artefacts were always made. However, "export abilities" of the Rokosovo Carpathian 3 obsidian were never explored. The sites and loci already used for hyalodacite "export" are also proposed to be viewed for the obsidian.

The Middle Paleolithic Charentian *in situ* origin assemblages show either the entire absence (Ruban site) or very minor occurrence (Korolevo I/II) of obsidian items (Votyakova 2021, 204, Tab. 33). The latter presence case at Korolevo I/II is also very indicative with the obsidian pieces' share in only 0.15% (6 pieces in our re-calculation among all the assemblage's 3,943 artefacts), being the least represented raw material type in comparison to other supplementary to hyalodacite raw materials (siliceous sandstone – 10.99%; radiolarite – 1.6%; sandstone – 1.49%; siliceous argillite – 0.25%; quartz – 0.22%). Regarding the Middle Paleolithic Charentian surface finds in the Uzhhorod area, Sova mentioned obsidian presence only for Radvanka loci (Sova 1964, 184). Here, however, the obsidian information should be taken with a caution, keeping in mind the following two possible reasons for its presence there: 1) some obsidian pieces might in fact represent a later period admixture, e.g. Neolithic, Chalcolithic, Bronze Age, for the loci's surface finds; 2) it could be Slovakian and/or Hungarian Carpathian 1 and 2 obsidians. Accordingly, the Uzhhorod area Charentian finds do not show any convincing data for the Rokosovo obsidian presence.

Looking at the entire Korolevo site complex archaeological sequence, there were always mentions of finding a few obsidian pieces (probably never reaching even 1%) among dominant hyalodacite artefacts for some archaeological horizons (e.g. Gladilin, Sitliviy 1990, 36–37, 39, 41, 49, 55; Kulakovska 1989, 16, Tab. 1). And again, the recovered obsidian pieces were not representing any specific cores and/or, for example, "curated" tools.

Turning to the Berehove Shallow Mountain Area with its metasomatic tuffs, tuffites, rhyolites and Proto-Aurignacian site and surface loci surrounding it, the presence of a few obsidian artefacts at many of the Proto-Aurignacian archaeological spots was often mentioned. However, it is not possible yet to associate the obsidian artefacts found with, namely Rokosovo Carpathian 3 type of obsidian and/or Proto-Aurignacian human visitor's leftovers at the Berehove and Muzhievo site and several loci. First, Berehove I *in situ* site's very few obsidians present were ever really explored on their particular belonging to the three types of obsidian known, while a Slovakian and/or Hungarian "obsidian case" cannot be excluded at all. The additional problem is the real difficulty to associate these small-sized obsidian pieces from Berehove I with the Rokosovo area using just a "naked eye" recognition method with a petrography analysis not yet performed. Second, from our point of view, a few obsidian artefacts at Berehove and Muzhievo surface find spots are most likely of Eastern Slovakian origin and they have to be connected to Neolithic, Chalcolithic and/or Bronze Age settlements and not with the Proto-Aurignacian Upper Paleolithic visits.

Here it is important to bear in mind the frequent use of Slovakian Carpathian 1 type obsidian at Eastern Slovakian and Northeastern Hungarian sites during the Neolithic – Bronze Age. At the same time, that obsidian type was very rarely used during the entire Aurignacian techno-complex and Early Upper Paleolithic as a whole (e.g. Bánesz 1991; Kaminská 2018b). In this respect it is also notable to recall the find in the late 1980s by Demidenko and Usik of an as-yet unpublished single Neolithic-looking obsidian elongated pyramidal blade core at a terrace between the Korolevo site complex and the Ruban site. At that time, we did not know what obsidian type was used for the core. However, early in 1990, we recognized many examples of the same blade cores at L. Bánesz's office at The Institute of Archaeology of the Slovak Academy of Sciences in Nitra. Those seen then were Slovak Carpathian 1 type obsidian blade cores from the Middle Neolithic Bükk culture, a branch of Linear Pottery culture in Eastern Slovakia and Northeastern Hungary, Kašov-Čepegov I site (Bánesz 1991; also see Allard et al. 2017, 1–11, Fig. 4, 6; Kaminská 2018b, 207, 208, Fig. 11, 12). The particular Neolithic culture is characterized by a wide exploitation, network exchange and even trade of C1 type obsidian pieces within various areas of the northeastern part of the Carpathian Basin (see Kaczanowska, Kozłowski 2002; 2008). Accordingly, it can now be said the Bükk culture's obsidian core found between Korolevo and Ruban in Transcarpathia certainly marks further to the east Carpathian 1 type obsidian pieces distribution during the Neolithic Period. On the other hand, there is no yet data on Carpathian 3 obsidian pieces distribution even within Transcarpathia in the Paleolithic.

Berehove–Muzhievo metasomatic tuff, tuffite, rhyolite raw material region

The Berehove Shallow Mountain Area (Fig. 15.1) is worth noting here by an abundant occurrence of metasomatically transformed tuffs, tuffites, and rhyolites. The rocks in a view of various-sized angulated natural objects can virtually be found almost at any place within the area now, aside from a few areas with Pleistocene sediments "hiding" the rocks like is the case with the Berehove I *in situ* site. The local tuffs, tuffites and rhyolites with a good flaking quality were probably the main reason why Proto-Aurignacian hunter-gatherers systematically visited so-called "Berehove Hills". At first sight, the particular metasomatic raw material sub-regions look like the above-described Korolevo and Rokosovo volcanic raw material sub-regions where various epochs and periods of Paleolithic humans came on a regular basis. On the other hand, in contrast to the Korolevo and Rokosovo cases with evidence of human visits of different Paleolithic epochs and periods, the the Berehove–Muzhievo case is only characteristic for its Proto-Aurignacian human traces and not even one more convincing Paleolithic example. Indeed, it is a striking example for the raw material source exploitation in the Paleolithic when people bearing only a single Early Upper Paleolithic industrial tradition, Proto-Aurignacian, used the Berehove–Muzhievo outcrops. Only after the Paleolithic, in the time of Neolithic through Bronze Age, did some Prehistory human groups settle at the Berehove Shallow Mountain Area and using mainly in an ad hoc and very supportive way the local rocks in addition to "imported" non-local rocks, like Slovak obsidians and Dniester flints. Looking at "export data" for the Berehove–Muzhievo rocks during the Paleolithic, there is not much objective data on it, although some Aurignacian finds from several surface loci within a radius of ca 15 km from the town of Berehove, e.g. Dobrosillya, Bigan, Didova Hora, Zastavne, Shalanki (Smirnov 1975; Tkachenko 2003, 23–26) were "*mainly made from flint of the Berehove type*" (Tkachenko 2003, 23). However, till now the above-mentioned loci are poorly investigated and their Aurignacian-looking lithic finds cannot be industrially connected yet with the Berehove–Muzhievo Proto-Aurignacian site cluster.

Thus, at best the Berehove–Muzhievo raw material region's rocks were only used locally and exclusively by Aurignacian human groups, probably not just Proto-Aurignacians due, for example, to the presence of some very narrow nosed / shouldered endscraper-cores at Zastavne (Demidenko 2003, 164–165), while the rocks' use was not extending to even other areas in Transcarpathia.

Not narrowly localized siliceous sandstone and siliceous argillite of the sedimentary region

These two lithic raw material types occur in a view of pebbles throughout its region extending from northwestern to southeastern "corners" in Transcarpathia as a ca 15 km wide strip underlying the Eastern Carpathians from where several rivers were "driving" the rocks to the southwest (Fig. 15.1). As a result of the rocks' secondary origin in many areas of Transcarpathia, they are deposited in both the present-day and the former alluvial beds of several rivers. When such alluvial beds are not heavily covered by Eopleistocene and Pleistocene sediments, pebbles of the particular sandstone and argillite could have been easily found by humans during various Paleolithic epochs.

Nowadays three Paleolithic sites and/or loci clusters in Transcarpathia are known by a prevalence of artefacts manufactured of these two rocks. Here, however, it is necessary to mention that of the two rocks namely siliceous sandstone always dominates among artefacts, while siliceous argillite had a subordinate role for artefact production.

Ruban *in situ* Middle Paleolithic Charentian site is characterized by 97.21% of artefacts produced on siliceous sandstone with additionally 1.56% siliceous argillite pieces found (Votyakova 2021, 204, Tab. 33). The site's Middle Paleolithic humans established the site at a terrace's slope underlined by a sandy-clayey alluvium containing numerous present pebbles of the sandstone and argillite (Votyakova 2021, 98, 101). Accordingly, the site's human inhabitants were literally sitting on used lithic raw materials with good flaking qualities. Keeping in mind only 2 km distance from the Ruban site to the Korolevo site complex where Korolevo I, horizon II contains artefacts belonging to the same Middle Paleolithic Charentian industry, we can even propose that the Ruban site, aside from being a site-workshop itself, also probably served partially as a workshop for Korolevo I/ II humans. The suggestion is further supported by the fact that Korolevo I/ II assemblage features the lowest occurrence of hyalodacite artefacts (85.3%) among all the other Korolevo site complex Paleolithic assemblages and, at the same time, the presence of a considerable portion of pieces made of siliceous sandstone (10.99%), not forgetting also a few items of siliceous argillite (0.25%) (see again Votyakova 2021, 204, Tab. 33). Ruban's "export" for Korolevo I/ II can even be objectively checked with some refit attempts for the present siliceous sandstone pieces in the two discussed assemblages. Anyway, the Ruban Middle Paleolithic site demonstrates a good example in Transcarpathia of a site organized right at an easily available alluvium bed with many siliceous sandstone pebbles and some siliceous argillite pebbles.

Three surface loci with similar Middle Paleolithic Charentian in the Uzhhorod area also demonstrate a dominance of siliceous sandstone and/or black siliceous argillite artefacts (Sova 1964) that is connected to the numerous presences of the two rock types' pebbles in the nearby River Uzh valley alluvium. Due to an understandable limited data for not numerous and random finds from the surface find spots, it is not possible to gain deeper understanding of what Middle Paleolithic humans were actually doing at these loci.

The Early Upper Paleolithic site of Sokirnitsa 1-A *in situ* site is not only notable for the dominance of siliceous sandstone (ca 62%) and siliceous argillite (24%) for its level 3 lithic artefacts but also for its location quite far away from the nearest source of the two rock types' sources, "*at River Rika, 20 km*" (Usik et al. 2006, 217). With the absence of fauna remains at the site, that is a usual taphonomy situation with Paleolithic open-air sites in Transcarpathia due to Pleistocene sediment chemical content peculiarities, there is still no other way for us to interpret the Sokirnitsa 1-A site and its level 3 than it representing a sort of special task Early Upper Paleolithic occupation when its humans were mostly manufacturing their lithic artefacts from distant raw materials. This example is also valuable for us in a sense that siliceous sandstone and argillite were used not only at their open sources but far away from these sources, too.

Looking at the three above-listed examples on the use by various Middle Paleolithic and Early Upper Paleolithic human groups of siliceous sandstone and siliceous argillite in Transcarpathia and adding to them about all other the known Paleolithic sites and their lithic assemblages, it is now possible to state that the two rocks were in fact the most valuable lithic raw material types in the region during the Paleolithic. Indeed, taking all the already above-discussed sites and/or surface loci situated at the strictly localized volcanic and/or metasomatic raw material regions in Transcarpathia with abundant and easily available local rock objects, visiting the raw material regions various Paleolithic human groups also used some other non-local rock types and always the most numerous among them were artefacts of siliceous sandstone with siliceous argillite pieces being present as well.

Moreover, taking again a look at the map of Transcarpathia with all the discussed lithic raw material regions (Fig. 15.1), a ca 15 km wide strip of sedimentary raw material region containing siliceous sandstone and siliceous argillite goes right to the northwestern and southwestern borders of both Transcarpathia and Ukraine as a whole. It might mean the sedimentary raw material region extension beyond Transcarpathia with distribution into Slovakia and Romania, too. There are no detailed objective geological data on such a sedimentary region's "foreign extension" yet (but see below for the respective data on Eastern Slovakia), which is why some archaeological data definitely can play a role here, at least indicating the presence of some artefacts of siliceous sandstone and siliceous argillite. The published Paleolithic records on Northwestern Romania, the Satu Mare and Maramures regions of Transylvania have not yet been explored by us. The published and unpublished data on Eastern Slovakian Paleolithic have, however, already been partially studied by us and the study's beginning has already revealed the inclusion of Tibava site in the east of Slovakia and its lithic finds into Berehove–Muzhievo Proto-Aurignacian site cluster (Demidenko et al. 2020, 215, Fig. 12, 13). The Tibava artefact assemblage corresponds well industrially to the Berehove–Muzhievo Proto-Aurignacian techno-typological characteristics (see Demidenko et al. 2020, 210–215). Finally, when one of us (Yu. D.) personally studied Tibava lithics in Nitra (Slovakia) in October of 2019, in addition to industrial observations, it was also recognized that a number of pieces of siliceous sandstone and some artefacts of siliceous argillite and the two rock types exactly looked like their Transcarpathian analogies. Unfortunately, it has not been possible to study the Tibava raw materials in detail since that time but there is still some Slovak published data on the site's subject. The Tibava site field investigator in the late 1950s, L. Bánesz (1960), noted that the most numerous group of the excavated in 1956 artefacts in 37% share for the entire lithic assemblage was manufactured on "*Quarzit*" (Quartzite). Recently, Ľ. Kaminská et al. (2014, 170) significantly clarified Bánesz's raw material data for Tibava. She corrected the "*Quarzit*" (Quartzite) with "*prekremenený pieskovec*" (siliceous sandstone), although she also used one more term for the same rock type, "*cherts/claystones*" for taken together "*Aurignacian sites in the East Slovak Lowland*" (Kaminská 2013, 102). She proposed two possible hypotheses from where Tibava site Upper Paleolithic humans were getting their siliceous sandstone natural objects. First, she pointed out "*siliceous sandstone could originate from Flysch sandstone formation situated in Vihorlat Mountains between villages of Ruská Bystrá and Beňatinac. 15–20 km to the north of Tibava (Žec 1997, 50)*" (Kaminská et al. 2014, 170; see also location of "*brown cherts / silicified claystones*" in Kaminská 2013, 105, Fig. 1), that is in the Snina District right at the border with Transcarpathia, Ukraine, and its Uzhhorod area. Second, she used the published data of one of us (B. R.) on the presence of siliceous sandstone at the foothills of the Vihorlat–Gutin Mountain Range for suggesting that the discussed rock type pieces were either naturally transported into the Eastern Slovak territory by the River Latoritsa or directly brought by human groups from Transcarpathia (Kaminská et al. 2014, 170). In any case, Kaminská's data on Eastern Slovakia definitely show us the importance of the Transcarpathian sedimentary raw material region on an interregional scale. Siliceous argillite pieces were not noted for Tibava artefact assemblage either by Bánesz or by Kaminská but it is clearly present there that it is one more example that the two rock types, siliceous sandstone and siliceous argillite, always go "hand in glove" both geologically and archaeologically. And these rocks are the only Transcarpathian rocks known so far beyond our Ukrainian region.

Conclusion

The realization in the present article of a new approach for studying lithic raw material regions and sources known for Paleolithic use in Transcarpathia has brought us to the newly appearing situation that was not understood before. Four lithic raw material regions and sources can be grouped into two clusters. On the one hand, the first cluster and its three strictly localized volcanic and/or metasomatic raw material regions (Korolevo with hyalodacite; Rokosovo with obsidian; Berehove–Muzhievo with tuffs, tuffites, and rhyolites) with local rock objects that are numerous, easily available and have high flaking qualities demonstrate an almost exclusive use of these regions' rocks at sites situated in these regions with, at the same time, no rocks' use outside the regions. Accordingly, it appears that Paleolithic humans of various epochs and industry types were coming to the three raw material regions to exploit their rocks only there and not outside of the regions. Aside from singular "curiosity items" and at best a few tools, no artefacts of the three regions' rocks are known at other sites in Transcarpathia, not even mentioning territories outside of Transcarpathia. Moreover, one of the regions, Berehove–Muzhievo with metasomatically transformed rocks, was even more restricted by its exploitation in the Paleolithic being in fact systematically occupied by only Proto-Aurignacian humans and was possibly sometimes visited by other Aurignacian humans of the Early Upper Paleolithic period. Thus, in contrast to some other similar strictly localized lithic raw material regions and sources in Europe that are the well-known by both "on-the region/source" and "off-the region/source" exploitations in the Paleolithic where the latter so-called "export abilities" were always of a great importance for Paleolithic humans in various epochs and industry types, e.g. Bergerac region in Southwestern France (Demars 1994; Fernandes et al. 2012); south of the Paris Basin in Central France (Delvigne et al. 2017); Carpathian 1 and 2 types of obsidians in Eastern Slovakia and Northeastern Hungary (Přichystal 2009; Kaminská 2018b). On the other hand, the second cluster and its single, not narrowly localized but widely dispersed, sedimentary region with siliceous sandstone and siliceous argillite appears to be equally important for both sites at and beyond the region's "diving" outcrops at river alluvium beds in the Paleolithic. It indicates that siliceous sandstone and siliceous argillite were the most valuable and important rock types for lithic treatment processes in the Transcarpathian Paleolithic. Furthermore, the sedimentary region with siliceous sandstone and siliceous argillite goes outside the borders of Ukrainian Transcarpathia, at least in northwestern direction to northeastern corner of modern-day Eastern Slovakia where our recent data witnessed the industrial belonging of Tibava site artefacts to the Berehove–Muzhievo Proto-Aurignacian cluster and the presence of many siliceous sandstone and some siliceous argillite pieces in the Slovak assemblage.

As one of the main results of the conducted study, it seems to be the "dethroned" status now of the importance of the three strictly localized raw material regions with their about "disposable on-the region/source" lithic exploitation during the Paleolithic and instead, sees the significance of a not narrowly localized but widely dispersed sedimentary region and its rock types throughout about all the Transcarpathian areas and sites. Moreover, the conclusion also allows us to propose a hypothesis that sites with prevailing siliceous sandstone and argillite could represent a sort of base camps in the region's Paleolithic. Sites in the Korolevo and Rokosovo regions could be of a specific short-termed site-workshop character. The Berehove–Muzhievo site and loci cluster was likely a local Proto-Aurignacian centre with some additional sites at neighbouring regions, like Tibava in Eastern Slovakia. In light of siliceous sandstone and siliceous argillite piece importance in the Transcarpathian Paleolithic, sites like Tibava which mainly used these rock types for artefact production could have played a more central regional role.

16

The fly in the soup – problems in provenancing long distance items

Katalin T. Biró

Introduction

Provenance studies are built on the principle that resources (raw materials used by human population) are unevenly distributed, both geographically and socially, and (prehistoric) communities made special efforts – quarrying, exploitation, transport, and trade – to get what they wanted and what they preferred (Kaminská 2001; 2013). The individual sources can be characterised, in the ideal case, adequately enough to distinguish them in the archaeological heritage – in a non-destructive manner (or to an acceptable /permissible extent). These conditions are met mainly in the case of lithic raw materials because

- they "fossilize" well and with minor (chemical, physical) alteration only
- in the course of the technological process transforming raw material to tool, no significant chemical alteration takes place
- due to regional differences in geology and formation of the rock, individual "fingerprints" can be formed that will be effectively used in characterisation studies.

The relation of the site and the source (Archaeological Locality (AL) and Geological Locality (GL)) was treated in details by the author formerly (Biró 2004b). The current paper, in the first version presented at the conference "Stories written in Stone" in Iaşi, Romania, 20–24 August 2013 (Biró 2013) deals with special difficulties in source identification within the archaeological material on examples of the Central Danube Basin (i.e. Carpathian Basin).

doi 10.47382/dvs_26-16

Classical distribution studies

There are two possible aspects to study the distribution of raw materials in archaeological context: by site, i.e. analysing the varieties of raw materials used at a specific archaeological site for the purpose of determining the contacts and movements of the community, and, by raw material – i.e. following one specific, conspicuous raw material from the source area and its distribution on archaeological sites around the sources and beyond.

The first approach is concerned with the '*Action radius*' of the population (e.g. Bodrogkeresztúr, in Dobosi ed. 2000; Biró et al. 2000a; 2000b; Fig. 16.1) and/or its system of contacts. In the case of Paleolithic societies, we can assume that community members covered the area of the sources personally while in the case of more recent settlements we can think of an effective supply system operating in several steps from source to site, i.e. raw material distribution network (De Grooth 1988).

The other possible approach is to follow the individual raw materials on several sites and in several periods. The results can be presented on a classical dot-map. A good example for this approach is the case of obsidian, very easy to recognise even for untrained eye among the stone tools. It is not by chance that the first such "dot map" was constructed on obsidian – without further distinctions – by F. Rómer in 1876 (1878). The map has been reproduced in recent studies as well (Biró 2005, 47, Fig. 1., large version in the Appendix). On the same map, Rómer plotted the distribution of "silex" artefacts without specific features and reference to sources, reflecting not actual "distribution" data but much rather the scope for the collection of data in those times. Through the advance of petroarchaeological (archaeometri-

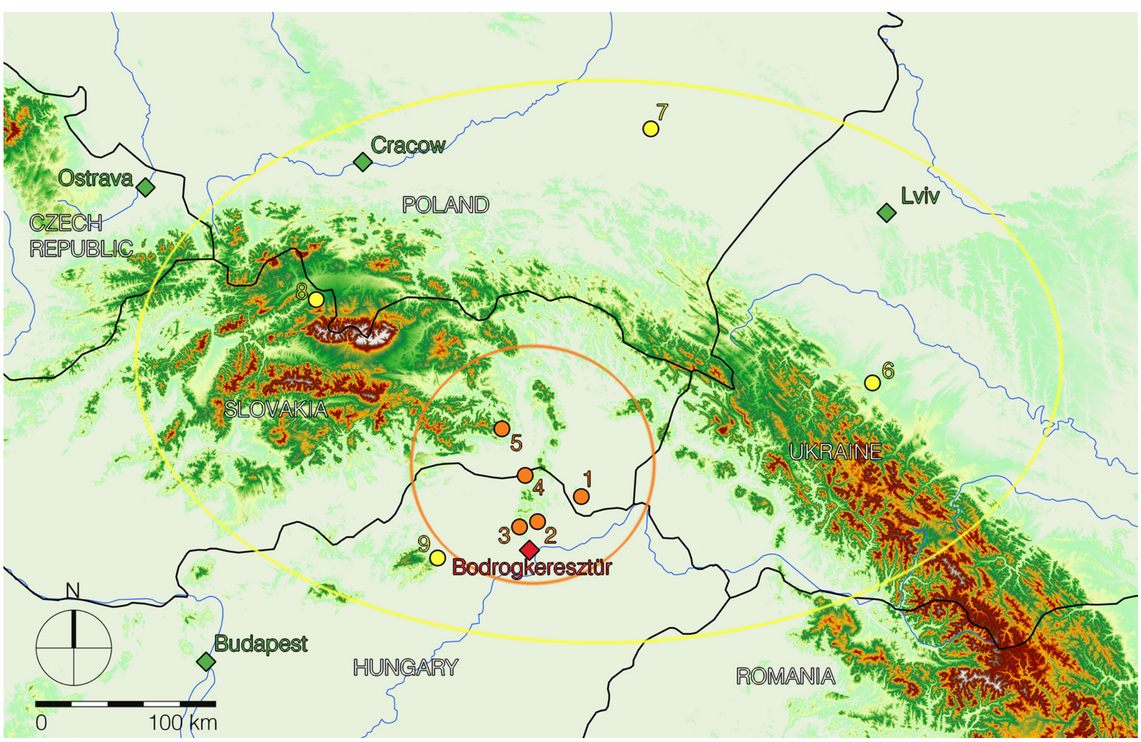


Fig. 16.1. Action radius for Bodrogkeresztúr-Henye Upper Paleolithic site. Site location (in red), provenances tested by PIXE-PIGE: mesolocal contact zone (in orange): 1 – Carpathian I (Slovakian) obsidian (Viničky); 2 – Carpathian II (Hungarian) obsidian (Mád, Tolcsva); 3 – "stone marrow"; 4 – limnic silicites; 5 – Carpathian radiolarite. Long distance contacts of the site (not analysed by instrumental techniques) (in yellow): 6 – Prut-Dniestr (Volhynian) flint; 7 – Swieciechów flint; 8 – erratic flint; 9 – Szeletian felsitic porphyry. Author K. T. Biró.

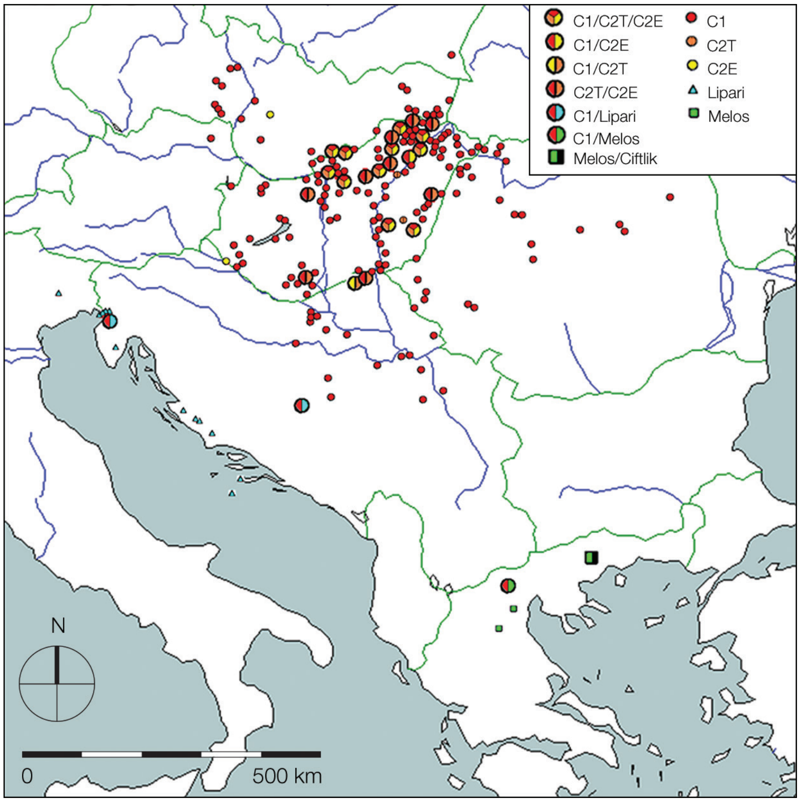


Fig. 16.2. Distribution area of Carpathian obsidians according to analytical studies and proven interactions between sources supplied from several sources. Author K. T. Biró.

cal) research, source characterisation has become more specific, embracing variants and competitive raw materials as well, including several factors for possibly interpretation, on age and raw material type (Kaminská 2019; Biró 2014a, 52, Fig. 6.; 2018; Biró in press, Fig. 15; Fig. 16.2).

At the same time, quantities and ratios have become important. Distribution models were created, on the strength of distance from the source (e.g. Down-the line trade model (Renfrew 1969) or 3D distribution models in space, quantities / percentages plotted on the geographical coordinates (isoscale distribution models /by Surfer/ Zimmermann, Mattheußer 1989; Biró 1998a; 1998b).

Where then is the "fly in the soup"? The main factor is source identification itself, its reliability and relevance. Do we really know all the sources? Are they actually the same sources as in the time of the ancestors? Are our tools adequate and enough to identify them in archaeological context? We try, we have good methodology, but we must always be aware of possible "bugs" in argumentation and knowledge.

Comparative collection of possible raw materials

Our prehistoric ancestors had a profound knowledge on their environment, including accessible resources – edible and non-edible. Their mere existence depended on it. Their wealth of knowledge included regional geology / geography (probably under different labels) and available raw materials of suitable quality. Therefore, the assortment of raw material varieties used at the individual sites helps in the proper identification of the sources as well. Wherever a good quality local source emerged in the neighbouring territories we can bet on it having been used on the site.

This argumentation has led to the construction of regional comparative raw material collections, built on current knowledge and the distribution of applicable raw materials, i.e. a collection-and-database approach (Biró 2005). It was realised that a special collection of potential raw materials, even more, a network of such collections may help in macroscopic characterisation as well as provide a basis for analytical studies (Biró 1992; 2014b). This is why we founded the Lithotheque of the Hungarian National Museum (Biró, Dobosi 1991; Biró et al. 2000c) with great aid from our colleagues all over the world; that is currently an element of a network of comparative raw material collections (Biró 2014b).

Raw material distribution by distance

We can classify raw materials actually used by prehistoric populations according to a number of factors, i.e. the (hypothetical) distance of the site (AL) from the source (GL):

L – Local: within 1-day walking distance
R – Regional: within normal activity radius of the community or within observable cultural entities; typically, 30–200 km
LD – Long distance: transgressing community boundaries, typically > 200 km
ELD – Extra long distance: > 500 km for exceptionally high-quality raw materials

There is a marked difference in the quantity, size, type, and the raw material ratios within the lithic industry components in function of distance from the source. At the quarry site itself, tons and thousands of more or less suitable pieces in different – mainly initial – stages of elaboration can be identified, some of them actually worked on but quite often simply dislocated by human activity, i.e. exploitation. The raw material composition is almost 100% local – it may contain e.g. mining tools brought to the site (Lech 1981). The choice of raw material varieties will naturally reflect the character of the source, from top quality to fractured / inferior quality pieces; often they can be made into expedient tools, just like practising. Typical tool forms and traces of use are rarely present. Such forms can be observed at the exploitation site for Szentgál radiolarite (Biró 1986; Biró, Regenye 1995). Around the source, probably at more convenient locations we can find small "chipping sites", with lots of flakes and a few spoilt tools, made of the same raw material but selected to some extent by quality. For this specific case, we could also observe a system of settlements surrounding the source(s) with intensive workshop activity but otherwise "normal" settlement material and features (Biró, Regenye 1991; Biró 1994a; Regenye 1994; 2011). The number and density of lithic finds is much larger than average habitation sites, the raw material composition is dominated by the near-by source raw material varieties with definite qualitative selection.

In areas lying more distant from the raw material sources – perhaps having no direct access to the sources – we can observe a mixed raw material distribution, with focus on ready-made tools with traces of use, even re-use (Biró 1994b). Quantities are moderate, intensity values much lower (e.g. Regenye, Biró 2012). Dominance of "regional" raw materials can be observed: accessible but already intentionally selected on the basis of physical qualities like homogeneity and colour. There is a marked difference in size and techno-typological composition: more used tools, more re-working and fewer raw material pieces in the initial stages of workmanship, fewer full cores and primary (decortication) flakes.

“Long distance” materials appear in the picture in special cases.

One of such instances can be the “long distance” movement of the whole community. Such movement was anticipated for the Late Middle Paleolithic / Early Upper Paleolithic context in the Sólyomkút (Vidróczky) cave, for Swieciechów flint in one of the classical (macroscopic) provenance characterisation studies (Vértes 1960; Mester 2000b). A similar “migration related” movement can be supposed for the Upper Paleolithic site Esztergom-Gyurgyalag with a very high percentage of Prut flint (Dobosi, Kövecses-Varga 1991, 248). In this case, macroscopic characterisation studies were complemented with neutron activation analysis on two pieces of artefacts from the site and eight pieces of comparative samples from the Lithotheca collection (Varga 1991, 267). The very high percentage (over 90%) of extra-Carpathian flint can be only explained by the presence of a new community, “fresh” in the Carpathian Basin (Dobosi 1997). A similar, “migration-related” case can be the appearance of Balkan platform flint in the lithic evidence of the Körös culture site Endrőd 39 with a depot find of 101 lithic artefacts (Kaczanowska et al. 1981; Biagi, Starnini 2013).

This takes us to another possible occurrence of LD and ELD finds, i.e. special context like depot finds (“hoards”) and funerary sites of high prestige and offerings (Siklósi 2004).

The most famous Neolithic and Copper Age lithic depot finds in the Carpathian Basin both comprise ELD materials of exceptional quality and dimensions. (Nyírlugos (Hillebrand 1928; Kasztovszky et al. 2014) and Kálló (Patay 1960; Kasztovszky et al. 2005). A similar but less spectacular core find was recently recovered from the depository of the Nyíregyháza Museum (Biró et al. 2021; Fig. 16.3). These depot finds were located along potential commercial routes and probably represented hidden but unclaimed commercial caches. Votive finds can be supposed in the case of Szécsény-Ültetés where a large obsidian core (“Nyírlugos style”) was found together with a large Triton snail horn in a votive pit (Soós 1986). A similar possible votive find came to light from Hejőkürt (preventive rescue excavation in the place of LIDL) with large burnt obsidian raw material and a copper axe (Biró 2019, funerary context not excluded).

The most frequent occurrence of LD/ELD lithic finds is the funerary context. Already J. Hillebrand had noticed flint knives from Trans-Carpathian (Volhynian) flint in Copper Age graves (Hillebrand 1929). This practice was a regular characteristic of Early and Middle Copper Age burial sites (Bognár-Kutzián 1963; 1972). A more recent beautiful example is the “princely” grave in the Lengyel culture Alsónyék cemetery (Zalai-Gaál et al. 2011).

The last context of occurrence for LD/ELD goods is a central place of distribution within a smaller geographical region. Such “Distribution centres” were observed in Late Neolithic context, e.g. Chapman 1981a; 1981b or Biró 1998b.

Identifying ELD materials:

The characterisation / provenancing of LD and ELD materials is a key problem for source identification studies. For the best quality raw materials, the potential distribution area is very large, therefore very large territories should be involved in the analysis of the archaeological material. It should be noted that high quality raw materials close to the sources typically dominate the tool kit, but at the fringes of the distribution area they can be fairly scarce and easily mistaken for other raw materials of similar physical qualities.

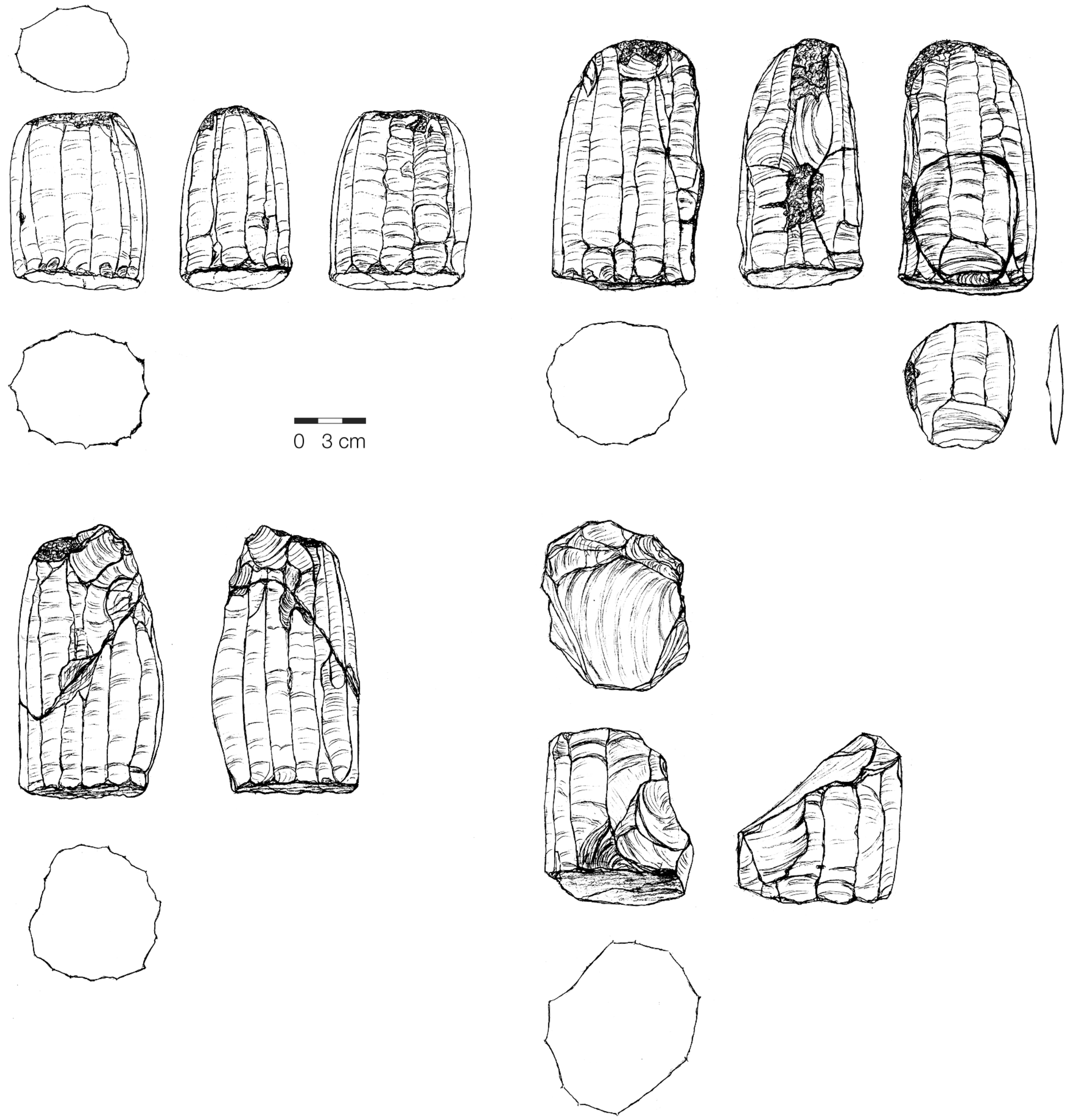


Fig. 16.3. Obsidian cores from Besenyőd. After Biró et al. 2021, drawing by J. Antoni.

We do not necessarily know the sources adequately, they might have been exploited, eroded, or covered by recent sediments. It is more probable that macroscopically similar items appear over large areas in the archaeological material. The similarity may be rooted in similar conditions / time of origin (e.g. radiolarite or flint deposited over large areas), also in the technical /aesthetic preferences of prehistoric communities. As there are large distances involved, only very few, very valuable pieces will travel – but they can come from various, culturally different directions. The investigations are made even more difficult by the selection of optimal methods: when investigating choice items of long-distance trade, we should concentrate on non-destructive, non-invasive methods that will be less sensitive to small differences between the sources. Making an over-confident or not adequately supported conclusion on the place of origin for our finds will have lasting effects on historical interpretation as well: once erroneously published, it is never fully cleared from the technical literature.

The basic method for analysing large assemblages is still macroscopic study, coupled with analytical studies on selected pieces as well as possible comparative raw material samples. It is of primary importance to fully document individual pieces so that they can be always checked and re-examined at need, doubt, or, when a new methodology becomes available.

A successful example of provenancing ELD lithic material is the study of greenstone trade, especially jadeitite. An early example of perceiving jadeitite trade is represented by the work of Štelcl et al. 1973 from Moravia.

After successful efforts at locating the sources and distribution in Western Europe and the western part of Central Europe (Pétrequin et al. eds. 2012) the studies were extended over Central Europe (Přichystal, Trnka 2001). The first sign of jadeitite trade expanding to east, at least as far as the Carpathian Basin was the site Golianovo (Hovorka 2010; Pétrequin et al. 2011) and the princely grave at Alsónyék (Zalai-Gaál et al. 2011). They encouraged systematical research in this region launched under the name of project JADE 2 (2013–2015) – results in Pétrequin et al. eds. 2017, for the eastern part of Central Europe (Biró et al. 2017). The source identification for the pieces was partly macroscopic (complemented with spectroradiometry), the Hungarian pieces were also analysed by, strictly non-destructive, methods of physical and chemical investigation to study chemical and mineral composition (Szakmány et al. 2011; 2013; Bendő et al. 2014; 2019).

LD / ELD and the problem cases

The success of detecting the source of origin for LD and ELD archaeological material depend on the unique character of the source and proper methodology for characterisation and distinguishing from potential concurrent sources and material. The scarcity and excellence of LD (especially, ELD) materials is a big help, but our possibilities in correctly identifying the actual source is always geographically / geologically determined – the same as for the one-time population for obtaining the high-quality resource.

In this paper, our concern is the Central Danube Basin (Carpathian Basin) with focus on present-day Hungary, in the experiences of the author. We can practically distinguish two basic directions, in and out, i.e.

FROM present-day Hungary
and
TO present-day Hungary (Fig. 16.4)

FROM:

Obsidian (+**C1, C2T, C2E**) (Fig. 16.4: 1–3)
This is the classical ELD raw material known from the Carpathian Basin, currently named after O. Williams (Williams, Nandris 1977; Williams-Thorpe et al. 1984) as Carpathian 1-2-3 type, respectively. The best quality and widest distribution obsidian is the Carpathian 1 variant (C1) from the environs of Viničky, Cejkov and Brehov, SE Slovakia. The sources for Carpathian 2T and Carpathian 2E types are in the central and southern part of the Tokaj Mts. in NE Hungary. The identification of the sources is stable on geochemical as well as geochronological grounds (Biró 2014a). They can be

differentiated on the basis of macroscopical qualities as well. Problem cases include pieces found on the fringes of the distribution area (Biró 2018; in press). Some obsidian pieces, however, come from unidentified sources (Biró 1986, 263; Starnini et al. 2021; Markó et al. in prep.). Recently we have had problems, especially in surface collected material, by artificial glass / slag products (Biró 2004a) and modern, "tourist" export from popular resort places (Biró in press). Therefore, the authentic context is gaining greater and greater importance.

Szeletian felsitic metarhyolite, formerly quartz porphyry (Fig. 16.4: 4)
This special material is a glassy volcanic rock from the Triassic period, known under various names (summarised in Markó et al. 2003, 297). It has a great significance for archaeometry and petroarchaeology of the Paleolithic period being the first lithic raw material identified by large scale analytical facilities (Vértes, Tóth 1963). The rock resembles certain grey silicites, especially hornstone, macroscopically, but by both mineral composition (XRD) and chemical composition (PGAA) it can be reliably identified. Distribution and characterisation studies were made by (destructive) petrographical thin section (L. Baranyai in Dobosi 1978) and XRD (Vértes, Tóth 1963) as well as non-destructive chemical analysis (PGAA, Kasztovszky et al. 2008). This raw material was used almost exclusively in the Paleolithic Period, when its distribution surpassed 200 kms. In more recent periods, the known few examples from Neolithic context were probably re-use of Paleolithic pieces (Biró 2014c, 212, 224, 228).

Fig. 16.4. LD / ELD lithic raw materials identified from the Central Danube Basin.
1 – C1 obsidian; 2 – C2T obsidian; 3 – C2 E obsidian; 4 – Szeletian felsitic porphyry;
5 – Szentgál radiolarite; 6 – Tevel flint; 7 – Swieciechów flint; 8 – jurassic Kraków flint;
9 – chocolate flint; 10 – Volhynian flint; 11 – Prut flint; 12 – Balkan ("Banat") flint;
13 – Lessini flint; 14 – contact metabasite; 15 – jadeitite; 16 – rock crystal. Author K. T. Biró.

Radiolarite (esp. Szentgál radiolarite) (Fig. 16.4: 5)
Most of Transdanubia was basically supplied with radiolarite as raw material for prehistoric chipped stone artefacts (Biró 1998a; 1998b). Radiolarite is a deep-sea rock composed mainly from the skeletal elements of the single-celled organism *Radiolaria*. In the Mesozoic Period, it was widely formed in the Tethys Ocean. It can be found from the Iberian Peninsula to the Himalayas. Phenotypes can be differentiated among the known variants by their specific colour; the red to reddish brown "Szentgál" type was especially popular (known under the name "Szentgál flint", Lipp 1876). This version was recognised among LD components along the upper reaches of the River Danube (Přichystal 1985; Gronenborn 1994; Mateiciucová 2010) Microfaunistical composition can be studied from special preparata (Dosztály 1986; Ozsvárt 2009); however, they will not characterise the sources unambiguously. The same can be said about chemical analysis; radiolarite will be fairly well differentiated from other siliceous rocks but the regional varieties will not be clearly distinguished (Biró et al. 2002). Recently a lot of effort was devoted to study of the colour, texture and surface using microscopic methods (Brandl 2010; Szilágyi et al. 2020), but we are still far from a perfect solution: macroscopic phenotypes still characterise the lithic assemblage better than instrumental analyses.

Grey flint: Tevel flint (Fig. 16.4: 6)
Flint in the strict sense means young shallow water marine sedimented siliceous rocks (see also below) In Hungary, such rocks crop out only at Western Transdanubia, at Nagytevel, Tevel Hill. The rock is of Upper Cretaceous (Senonian) age with characteristic but scarce microfauna (Bihari 1981; Bence et al. 1990) According to knappers' opinion, this is probably the best quality chipped stone raw material occurring in the territory of Hungary. The source is rather small, it was exploited and used mainly in the Middle and Late Neolithic period (Biró et al. 2010). The known distribution area of Tevel flint is mainly regional, on the border of LD materials. As grey flint (and chert) is fairly common among the chipped stone raw materials, it is difficult to separate in archaeological context from other raw materials, e.g. Moravian, Bavarian and probably Slovenian cherts and flints. It was analysed chemically by NAA and PGAA (Varga 1991; Kasztovszky et al. 2005; 2008).

TO:

Flint (Fig. 16.4: 7–13)
Most of the long-distance "imports" in the central regions of the Carpathian Basin are comprised by flint from territories outside the Carpathian Basin. The first of them described was the dark grey spotted Polish "*Swieciechów flint*", located in the North Hungarian Paleolithic material (Vértes 1960). This was followed by several phenotypes of "flint", some of them meeting the strictest criteria = shallow water marine siliceous rock, from relatively young geological periods such as the Cretaceous/Neogene (on terminological questions in general, see Vol. 2010/3 of Archeometriai Műhely, "Siliceous rocks and their nomenclature – an interface of mineralogy, petrography and archeology", Lectures on IMA Congress, Budapest, esp. Götze 2010). Looking at flint from present-day Hungary, the most important is the direction of contact indicated: from North (*Jurassic Kraków flint, Chocholate flint, Erratic (Baltic) flint*, northeast (*Prut and/or Volhynian flint*) or from south-southeast (*Banat / Balkan flint*) or southwest (*Lessini flint*). Most of these rock types are high quality and visually (macroscopically) distinguished. So far, they have been spotted in the chipped stone industries from various periods (Biró 1998a; 2002a). Sometimes the high quality "imported" flint is replaced by local raw materials, i.e. hydrothermal or limnic silicites (Biró 1989; 1998a) or heat-treated chert (Biró 2002b).

We know that some flint varieties were used in large numbers for polished stone tools, often the great "flint mines" supplied the raw material for such axes, adzes; in Hungary, however, we have not been able to locate flint axes yet.

Polished stone tool raw materials (Fig. 16.4: 14, 15)
It is obvious by now that the largest networks of Neolithic trade were connected to the raw materials of polished stone tools. As a first effort to detect this trade in Central Europe, we have to mention the project initiated by D. Hovorka "Raw materials of the Neolithic / Aeneolithic polished stone artefacts" in the framework of IGCP 442 (http://www.ace.hu/igcp442/; International Geoscience Programme (IGCP) serves as a knowledge hub of UNESCO to facilitate international scientific cooperation in the geosciences). Though the closing monograph planned was not published, quite a lot of the partial results have become accessible through the project publications (Hovorka 2004). One of the long-lasting results of IGCP 442 was the involvement of the eastern part of Central Europe in the network of the JADE project (Hovorka 2010; Pétrequin et al. 2011) and consequently, extending knowledge on the trade of *jadeitite* and related rocks (Pétrequin et al. eds. 2017; Biró et al. 2017). Moreover, it gave due attention to the trade of *contact metabasite* from the sources in Moravia and Bohemia, i.e. the Czech Republic (Přichystal 2009; 2013).

Currently, we are involved in a national project to map and analyse polished stone tool raw materials used at archaeological sites (Kasztovszky 2021) that will hopefully bring a great deal of new information regarding prehistoric trade networks.

Rock crystal
Rock crystal (crystalline quartz) is obviously among the "high prestige value" items in prehistoric chipped stone industries; compared to siliceous rocks, however, it is difficult to shape into standard tool form. The theoretical possibility of source (source region) identification was raised by István Gatter; together with Viola Dobosi, they have performed the collection, mapping and analysis of the known rock crystal finds from the Hungarian Paleolithic (Dobosi, Gatter 1996). In their opinion, these artefacts probably originated from the Eastern Alps (Fig. 16.4: 16). It is interesting that rock crystal finds typically occur along the Danube and towards the Tokaj Mts., i.e. along the "obsidian route". More recent finds made of rock crystal have been summarized by A. Péntek (Péntek 2019).

Conclusions

The study of high-quality raw materials, spread over very large areas can be especially interesting for the research of prehistoric contacts, either movement of people / ideas or exchange and networking. The high-quality and large (sufficient) amount of available raw materials will result in a large distribution pattern over wide geographical areas. At the fringes of the distribution areas, however, the proper identification of the raw material in question and its provenance will be more difficult. At the same time, we have to be selective in our methodology, preferring non-destructive or minimally invasive techniques that may or may not be enough for exactly identifying the source.

The "movement" of high quality lithic raw materials (transport, exchange, trade) has exceeded the limits of the current scope of our regional research. Therefore, these connections can only be revealed by broad international collaboration, the exchange of samples, ideas, and results.

Non-invasive analysis and proper documentation is imperative; the role of a stable archaeological context is also essential.

Acknowledgement

The authors of this study gratefully acknowledge the support of NKFIH (OTKA) project K-131814 (Large facility analytical studies of polished and ground stone artefacts for the reconstruction of Prehistoric trans-regional trade routes in the Carpathian Basin and its surroundings), lead by Zsolt Kasztovszky, for setting the framework for the analytical studies.

17

Late Pleistocene mammal fauna from the travertine quarry in Santovka – Malinovec (Southern Slovakia)

Martin Sabol, Csaba Tóth, Martin Vlačiky

Introduction

The village of Santovka (Levice District, Nitra County; 48°9'22'' N, 18°46'1'' E) is located in the central area of the Santovka Uplands (Santovská pahorkatina) within the geomorphological unit of the Ipeľ Uplands (Ipeľská pahorkatina) in the northeastern part of the Danube Uplands (Podunajská pahorkatina) (Kočický, Ivanič 2011), in the valley of Creek Búr, approximately 15 kilometers southeast of the town of Levice. The village consists of two parts – Santovka itself and the local part of Malinovec, until 1948 called Maďarovce. Both parts were joined in 1964. The village is known for its thermal mineral springs, the result of whose activity are travertine as well as foam and calcareous sinters located mainly near the Creek Búr and forming the so-called Santovka group of freshwater limestones (Halouzka 1977). These lie on a geological underlier formed by Neogene sediments, andesite tuffites and lens of underlying limestones, with a cover of Quaternary loess, fine sandy loess and loess clays. The formation of solid travertines near Santovka was classified by Halouzka (1977) on the basis of their character and position in the hilly relief to the period of the Middle (Cromerian to Elsterian) to Late (Eemian) Pleistocene. The best-preserved travertine mound (Fig. 1.1: 15; 17.1), declared a natural monument, is situated approximately in the central part of the village at an altitude of 143 m a.s.l. (WGS84: 48.156900° N, 18.767189° E). It is approximately 5 m high and approximately 40 m wide, with a small crater at the top. The main travertine mound, originally situated at an altitude of 140 to 160 m (WGS84: 48.154597° N, 18.768197° E), was destroyed by exploitation lasting more than half a century (Bátora 2013). Research of a settlement from the Early Bronze Age is currently being carried out in its preserved part (Bátora, Tóth 2010).

doi 10.47382/dvs_26-17

The location near the thermal springs already attracted people in the Paleolithic, as evidenced by the findings of chipped stone tools and the occurrence of charcoal. The interrupted continuity of the settlement is complemented by finds from the Neolithic (Culture with Western Linear Pottery and the Lengyel-Baden Culture), from the Early Bronze Age (Maďarovce Culture) and the Middle Ages (Bátora 2013; Kaminská et al 2014).

Fig. 17.1. Santovka – Malinovec site with a view of central travertine mound. Photo by J. Madarás.

The fossil record of Pleistocene vertebrate fauna, especially mammals, is also associated with Paleolithic settlement on the site. Récsey (1894) was the first to mention the finds of mammoth remains (?*Mammuthus primigenius*) on the territory of Santovka. These from there (the Maďarovce site) were also mentioned in his work by J. Eisner in 1934 (ex Skutil 1938). Three years later, even a "skeleton" of a mammoth was found here in a quarry at a depth of approximately 10 meters, from which only a fragmented skull, vertebrae and half of a femur were mentioned. Unfortunately, the skull could not be saved (Anonymous 1937). Pávai-Vajna (1948) mentions that, in addition to the malacofauna (*Cepaea hortensis*, *Vallonia* sp., *Succinea* sp,. *Limnaea* sp., *Helix* sp., *Pupilla* sp., and *Condrula tridens*), also fossils of a woolly rhinoceros (*Coelodonta antiquitatis*; determined by M. Mottl), the remains of a fireplace, processed bones, and a flint fragment from the overlying loess (with clay gravel) of the Santovska travertines. The author also noticed that fissures in the travertine are filled with a thick layer of "soot", which could indicate the existence of larger spaces in the travertine mound, used by humans as a temporary shelter. It is assumed that the entrance to this space (abri?) could be located in the preserved southern part of the travertine mound (currently situated on the property of Mr. J. Lauko; J. Bátora, oral information), where a relatively large imprint of a proboscidean tusk (not preserved) was also found after the former blasting. The taxonomic interpretation of this tusk is very various. Pávai-Vajna (1948) assigned it to a mammoth, Mostecký (1961) only to an unspecified proboscidean, and Bobula (2017) to an undetermined species of the family Elaphantidae. According to the overall shape and inconspicuous curvature, this tusk most likely belongs to a straight-tusked elephant (cf. *Palaeoloxodon antiquus*) (Fig. 17.2).

In 1954, J. Bárta discovered a new Paleolithic settlement in the loose sinters above the travertine quarry in the Malinovec part on the left bank of the Creek Búr. In addition to the Gravettian industry, there were also traces of an older settlement on the site, supported not only by finds of older industry, but also by quartz fragments embedded in compact travertine (Bárta 1961b; 1972). However, a detailed research of the Paleolithic settlement has not yet been conducted here. At the beginning of the 1960s, the Santovka – Malinovec site was visited twice by the staff of the geological-paleontological department of the National Museum in Prague (hereinafter NMP) (Mostecký 1961; Bobula 2017).

Fossil finds were collected from the Pleistocene fissure fills of the then-active travertine quarry. Among these, the remains of a woolly rhinoceros, a steppe bison (*Bison priscus*), a cave lion (*Panthera spelaea*), a red deer (*Cervus elaphus*) and probably also a reindeer (*Rangifer* sp.) were identified (Mostecký 1961). Unspecified fossil finds of mammoths and woolly rhinoceroses from the site were also reported by Bárta (1965). Fossil remains, that were found during mining, were housed in nearby museums, but to this day they are only registered in the Tekov Museum in Levice (Ďurišová 1996).

Since 2006, the archaeological research of the eponymous settlement of the Maďarovce Culture from the Early Bronze Age has been carried out in Santovka under the leadership of prof. J. Bátora from the Archaeological Institute of the Slovak Academy of Sciences. During excavations on the travertine mound north of the local swimming pool, above the archaeological research, the bones of Pleistocene animals were also found in the loam with an admixture of travertine debris. These fossils were assigned to the woolly mammoth, bovid (probably *Bison* sp.), arctic reindeer (*Rangifer tarandus*) and to an unspecified larger mammal. Other, better preserved bones from a mammoth and horse (*Equus* sp.), a fragment of an antler (probably from a reindeer), and a fragment of a pubic bone of a medium-sized mammal were found in the loess profile next to the area of the local nursery school. When uncovering the finds, Paleolithic stone chipped industry and charcoals were also found in the layer together with them. During a more detailed survey of the profile, another layer with artefacts was found in its overburden (Vlačiky et al. 2009). From the lower layer with bones and artefacts, malacofaunal finds were also found, which were identified by J. Kovanda (personal written communication, 2010). The collected samples contained the remains of the species *Columella columella*, *Vallonia tenuilabris*, *V. costata*, *Vertigo parcedentata*, *Pupilla loessica*, *P. muscorum*, *P.* (cf.) *sterrii*, *P. triplicata*, and *Helicopsis striata*. The identified assemblage consists of steppe species from the very cold part of the younger part of the Last Glacial Period, probably from the period of the existence of the Gravettian culture on the territory. In addition to the findings of typical steppe species (*C. columella*, *P. loessica*, and *V. tenuilabris*), M. Horsák (ex Bobula 2017) mentions from the abovementioned profile of the loess cavity also species with greater demands for humidity (*Pupilla alpicola* and *Vertigo pseudosubstriata*).

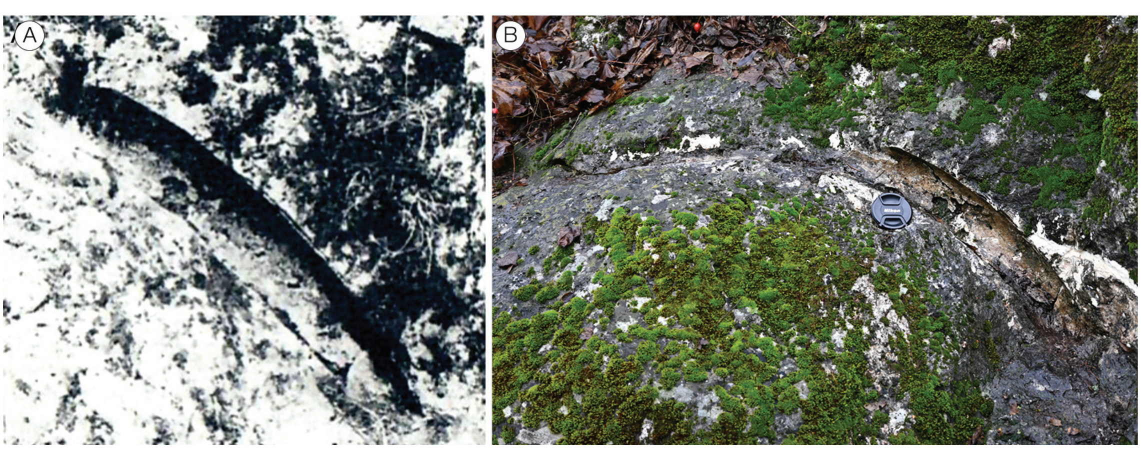


Fig. 17.2. The proboscidean tusk imprint from southern side of the travertine quarry Santovka – Malinovec. A – original photo by J. Novák (ex Mostecký 1961), B – the current state of the find. Photo by K. Csicsay.

The last published output on the Pleistocene fauna from the site is a monographic work by Ďurišová (2022) focused on proboscidean finds stored in the paleontological collections of the Slovak National Museum – Natural History Museum (hereinafter SNM-PM). From Santovka – Malinovec, she mentions the discovery of a fragment of the left upper molar (M3 sin.; Z 1114) of a mammoth without a species determination (*Mammuthus* sp.).

Material and methods

The subject of the revision research is the fossil material, originating from the collections of the NMP employees, where it is still stored. Fossil remains were collected and verified by F. Kotlaba and V. Bartoš in May 1961, partially also by V. Mostecký in June 1961 (although one of the museum cards shows the date 20/06/1960). The location is usually stated on the labels as "*Malinovce* (*dř. Maďarovce*) (*1961*), *okres Šáhy*" [Malinovce (earlier Maďarovce) (1961), Šáhy district] or "*okres Levice*, *travertínový lom u lázní*" [Levice district, travertine quarry near the spa] or "*travertínový lom Santovka u Levíc*" [Santovka travertine quarry near Levice]. Part of the finds was also excavated from the "*sute* (*se žlutou hlínou*) *vlevo nad travertínovými bloky*" [debris (with yellow clay) on the left above the travertine blocks] (e.g. NMP 1004/61). Rarely, the location is also mentioned as "*Malinovce, o. Levice, Osmiletá střed. škola Domadice*" [Malinovce, Levice district, Eight-Year High School Domadice] (e.g. NMP 1043/61 [K433]) (Tab. 17.1).

The findings stem from the Pleistocene sediments of a quarry, established in a travertine mound near the mineral spring Santovka (Mostecký 1961). The fossiliferous deposits fill the travertine fissures, covered by Holocene subsurface soil horizons with animal remains related to the settlement of the Maďarovce Culture (Mostecký 1961; Šedivá 2022). In the place of discovery, the Upper Pleistocene layer was formed by yellowish clay (probably redeposited loess) with abundant travertine debris. Bluish-gray clay was situated underneath this layer and sediments in its underlying were already covered with debris from mining. The revised animal remains stem from the Upper Pleistocene layer, less than two meters below the surface level of the large travertine blocks (Mostecký 1961) (Fig. 17.3).

Tab. 17.1. The list of large mammal taxa from the travertine site of Santovka – Malinovec in comparison with the data of F. Kotlaba and V. Bartoš (in May 1961), V. Mostecký (in June 1961) and Vlačiky et al. (2009).

Taxon	**May 1961**	**June 1961**	**2009**
Panthera spelaea		*Panthera spelaea*	
Cervus sp.		*Cervus* cf. *elaphus*	
Rangifer cf. *tarandus*	*Rangifer* sp.?	cf. *Rangifer* sp.	*Rangifer tarandus*
Bison priscus / Bos primigenius	*Bison* sp. – *Bison priscus*	*Bison priscus*	*Bison* sp.
Equus sp.			*Equus* sp.
Coelodonta antiquitatis	*Rhinoceros* sp. – *R. antiquitatis*	*Tichorhinus antiquitatis*	
Mammuthus primigenius			*Mammuthus primigenius*
Mammalia indet.	Mammalia indet.		Mammalia indet.

The Pleistocene findings found during the last research on the Maďarovce Culture settlement (Vlačiky et al. 2009) and stored in the SNM–PM in Bratislava, are not the subject of this revision study (Fig. 17.4). The fossil assemblage consists of *Mammuthus primigenius* (scapula fragment, rib fragment, pelvis fragment, and the proximal part of left tibia), *Bison* sp. (distal part of the metacarpal bone), *Rangifer tarandus* (fragmented second cervical vertebra, left ulna and radius, and probably also an antler fragment), and *Equus* sp. (left calcaneus, left third tarsal bone, and the proximal part of left metatarsal bone). The fossil record is complemented by the findings of a fragmented pubic bone of a medium-sized mammal and the patella of a large mammal (Tab. 17.1).

For the purposes of taxonomic determination (Mc Kenna, Bell 1997), the revised dental and osteological remains were studied by traditional biometric (Musil 2001; Gonzáles 2003) and morphological analyses (Pales, Lambert 1971a; 1971b; Schmidt 1972; Bärmann, Rössner 2011), also using comparative material. Odontological and osteological parameters were measured by the standard method using the engineering vernier calipers Powerfix (with a reach of up to 150 mm) and Somet (with a maximum range of up to 420 mm). The measurements were taken to the nearest 0.1 mm, 0.3 mm standard deviation, 0.1 mm dispersion, and 4.2% random error.

Systematic part

Classis: Mammalia Linnaeus, 1758
Order: Carnivora Bowdich, 1821
Family: Felidae Fischer [de Waldheim], 1817
Genus: *Panthera* Oken, 1816

Panthera spelaea (Goldfuss 1810)

Material: *femur* dext. (NMP 1003/61) and *calcaneus* dext. (NMP unnumbered); MNI = 1 (Fig. 17.5, Tab. 17.2).

Description: The right femur belonged to an adult animal. The light-yellow bone is damaged mainly in its proximal portion and on the condyles of the distal epiphysis (*condylus lateralis et medialis*); in some places it is covered with a grey travertine crust as well as dendrites on the caudal

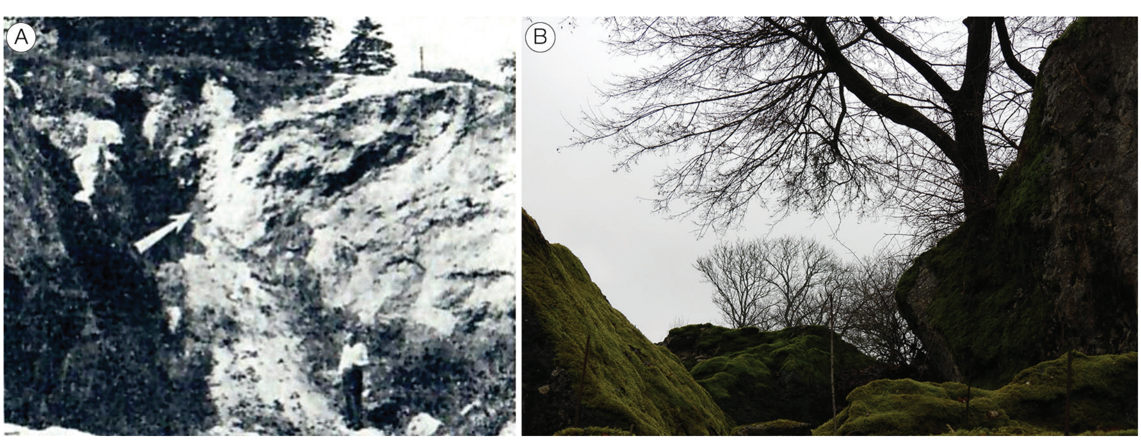


Fig. 17.3. The finding place of revised mammal fossil record from the travertine quarry in the Malinovec local part near the Santovka spring. A – original photo by J. Novák (ex Mostecký 1961) with the indication of finding place by white arrow; B – the current state of the site. Photo by K. Csicsay.

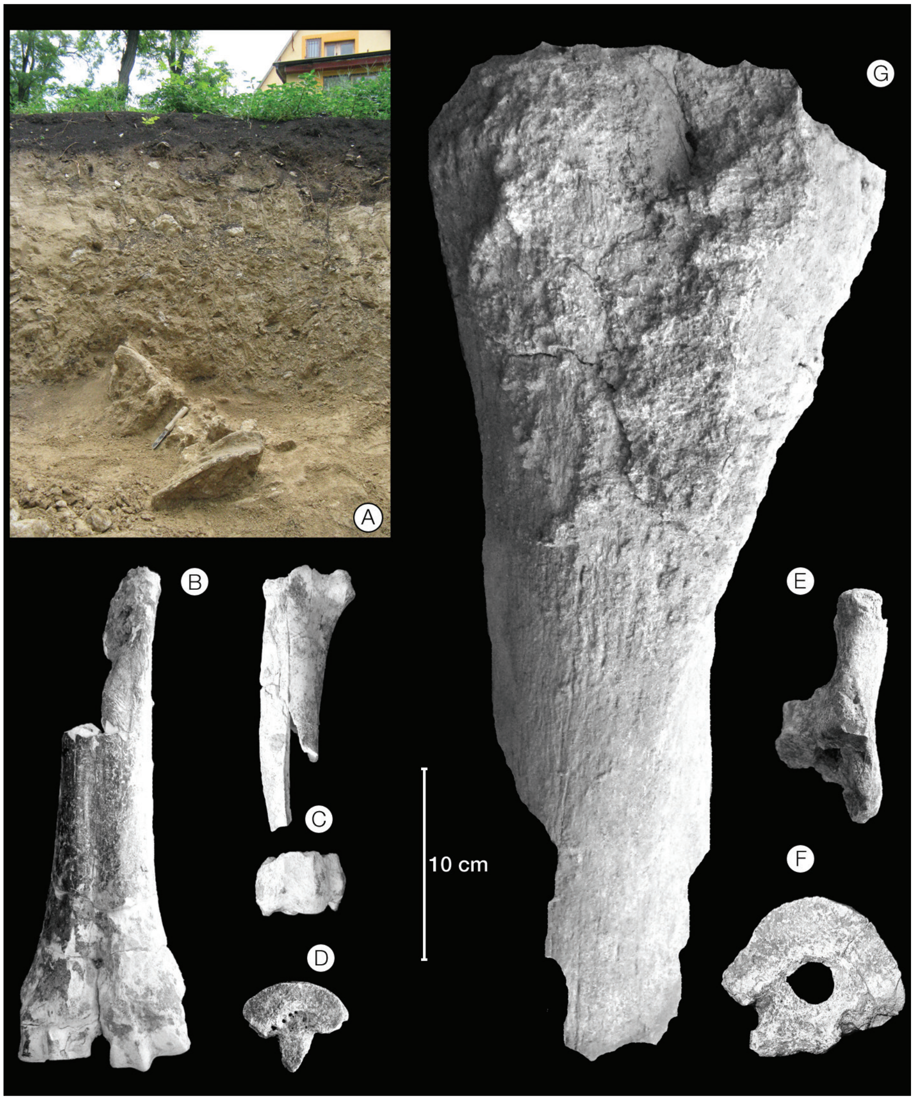


Fig. 17.4. The finding place and mammal fossils found during the last archaeological research of the site, mentioned by Vlačiky et al. (2009). A – the profile at the finding place; B – *Bison* sp., distal part of metacarpal bone in anterior view; C – *Rangifer tarandus,* fragmented left radius in lateral view; D–F – *Equus* sp., left third tarsal bone in dorsal view (D), left calcaneus in anterior view (E), and proximal part of left metatarsal bone in dorsal view (F); G – *Mammuthus primigenius*, proximal part of left tibia in anterior view. Photos by M. Vlačiky.

side. Among the anatomical features, the prominent ridge in the dorsal portion of the diaphysis on the edge between the caudal and lateral sides (or on the lateral side of the bone respectively) is interesting. The bone shows no pathological phenomena or traces of organic taphonomic agents (Fig. 17.5: A, B).

The unnumbered, yellow-grey right calcaneus also belonged to an adult animal (Fig. 17.5: C–F). It is damaged in the area of the head (*tuber calcanei*), at the base of the plantar (caudal) side, as well as on the surface with rare dendrites. Two short "notches" are present on the bone in the upper part of its medial side below the head, accompanied by a "chop" on the dorsal side in the space close to the notches (Fig. 17.5: G, H). Individual articular astragalar facets (*facies articulares talares*) are separated from each other. The bone shows no pathological phenomena and no other traces of other taphonomic agents.

Taxonomic and paleoenvironmental remarks: In terms of size, the dimensions of both lion bones (Tab. 17.2) correspond well to the biometric range established for cave lions. The right femur with an estimated length of approximately 380 mm (Mostecký 1961, 59) and with a diaphyseal transverse dimension of 35.9 mm belonged to a smaller individual, possibly a lioness (Fig. 17.6). Also, the calcaneus corresponds in size to the calcaneal bones of smaller individuals of the species, and its dimensions resemble an isolated find from the Medvedia jaskyňa (Bear Cave) in the Western Tatras Mts. (MJ-ZT/P16; Sabol et al. 2018) (Tab. 17.2). Also, it has not been ruled out

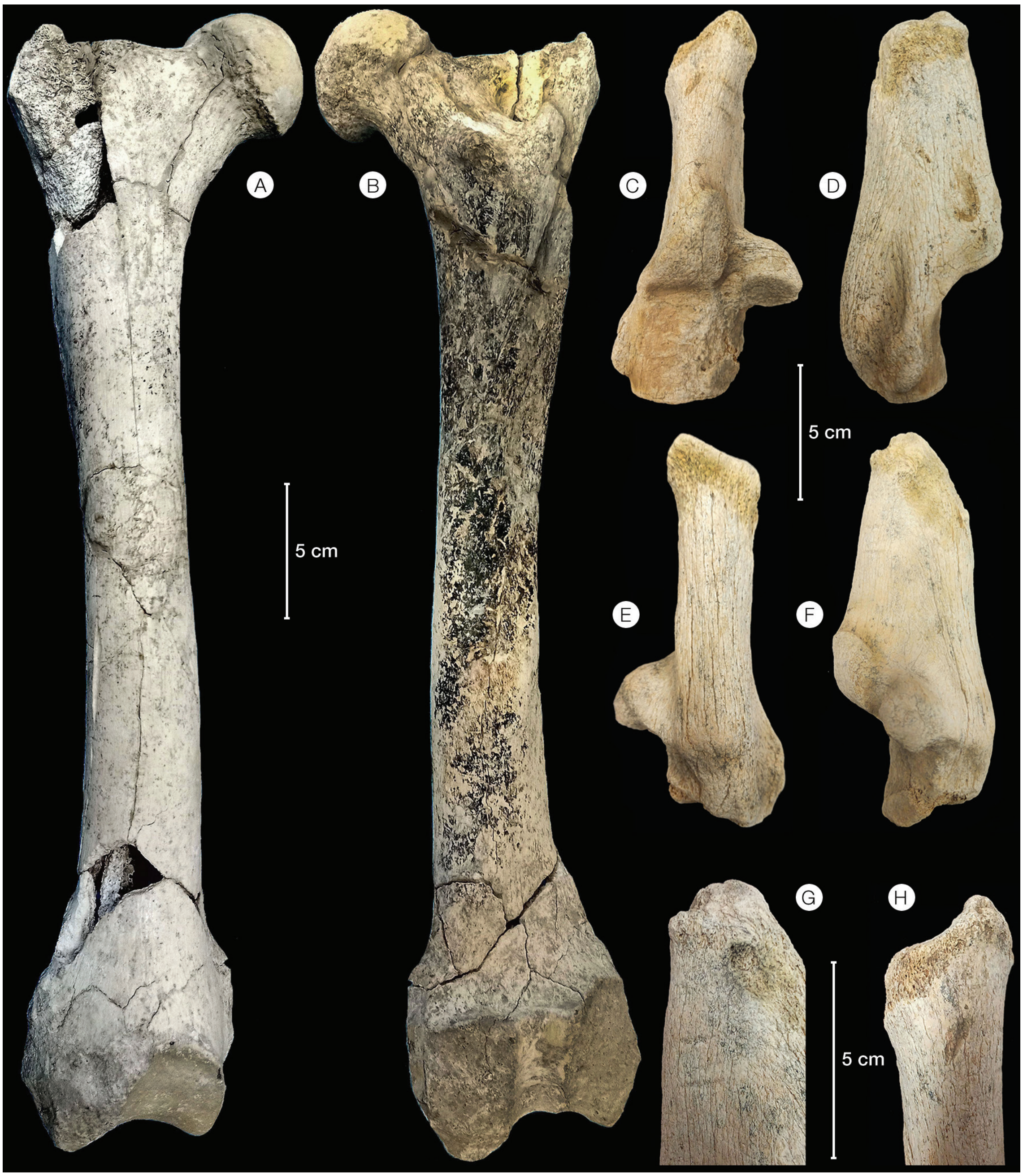


Fig. 17.5. Fossil remains of *Panthera spelaea* (Goldfuss 1810) from Santovka – Malinovec. A, B – right femur (NMP 1003/61) in lateral (A) and medial (B) views; C–H – right calcaneus (NMP unnumbered) in anterior (C), lateral (D), posterior (E) and medial (F) views, with detail views on taphonomic phenomena in dorsal bone portion (G and H).

that it belonged to the same individual as the right femur. Overall, the calcaneal bones of Late Pleistocene Eurasian lions are smaller than those of Middle Pleistocene lions (Sabol 2014), but are proportionately more robust.

Typical cave lions (*Panthera spelaea spelaea*) were widespread in Europe mainly during the Late Pleistocene (Sabol et al. 2022b) and their last appearance is reported from the western part of the continent with a date of 11.2 kya (Argant 2010). European Late Pleistocene lions inhabited diverse environmental conditions ranging from open lowlands to open woodlands and penetrated also into the mountainous boreal forest (Musil 1986; Sabol et al. 2018). Although their fossils are known mostly from cave deposits, lion remains are occasionally found also in open air sites (Diedrich 2007), such as Paleolithic settlements or travertine localities (e.g. Musil 1996; Čeklovský et al. 2016; Sabol et al. 2017).

Order: Artiodactyla Owen, 1848
Family: Cervidae Goldfuss, 1820
Genus: *Cervus* Linnaeus, 1758

Cervus sp.

Material: metapodial fragment (NMP 1003/61); MNI = 1.

Description: It is probably a find that Mostecký (1961) mentions as "*zlomek dorsální části levého metatarsu, který pravděpodobně náleží jelenu* (Cervus elaphus *L.*)" [a fragment of the dorsal portion of the left metatarsus, which probably belongs to a deer].

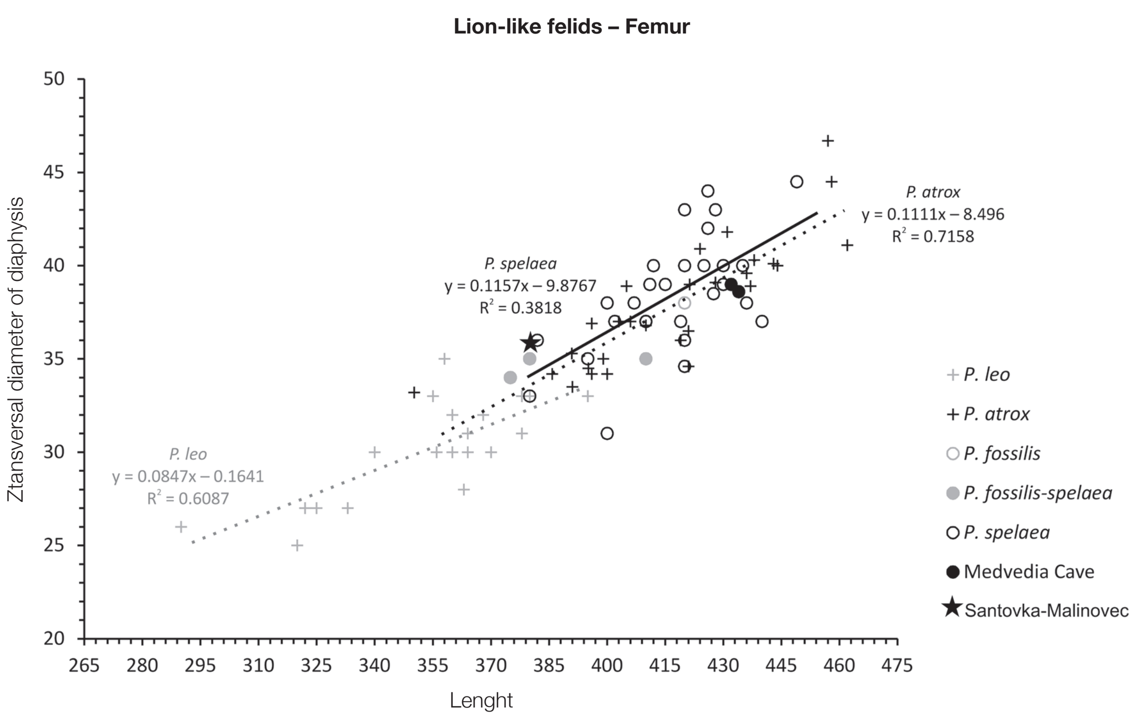


Fig. 17.6. A scatter diagram for the measurements of lion-like felid femora including the measurements of the cave lion specimen from Santovka – Malinovec. According to Sabol et al. 2018 and references therein.

Tab. 17.2. The dimensions of the cave lion femur and calcaneus found in Santovka – Malinovec.

***Panthera spelaea*, Santovka – Malinovec**	**Femur dext.** 1003/61	**Calcaneus dext.** unnumbered
Maximum length	(380.0)	123.5
Intertrochlear distance	80.1	-
Length of the neck	54.7	-
Maximum transversal diameter	-	55.8
Maximum transversal diameter of the proximal epiphysis	100.3	-
Transversal diameter of the head	45.7	-
Minimum transversal diameter of the diaphysis	35.9	-
Lower diameter of the distal articular surface	41.9	-
Maximum anteroposterior diameter	-	51.9
Distance between epicondyles	23.0	-
Height of the tuberosity	-	64.4

Taxonomic and paleoenvironmental remarks: The find stems, like most of the finds determined by Mostecký (1961), from debris with yellow loam. Its attribution in the species *Cervus elaphus*, although probable, is questionable especially from the viewpoint of the fragmentary nature of its preservation. Indeed, Croitor (2020) also mentions the species *C. canadensis* (wapiti) from the Pleistocene of Europe, currently occurring only in Eastern Asia and the western part of Northern America. The difference between the two species is not only in size, but primarily in the surface morphology of their antlers (Croitor 2020).

The red deer prefers open woodlands to dense broad-leafed forests in warmer and ecologically more productive ecosystems (Drucker et al. 2011), although it can be found in most environments with warm climate (Musil 1986). Though known in the fossil record from both the glacials and interglacials (e.g. Sabol et al. 2017), the Quaternary distribution of *Cervus elaphus* in Western Carpathians is mainly related to warmer periods and forested landscapes.

Genus: *Rangifer* H. Smith in Griffith et al. 1827b

Rangifer cf. *tarandus* (Linnaeus, 1758)

Material: antler fragment (NMP P 115/1959), proximal (NMP 1004/61) and medial phalanges (NMP P 115/1959 [k 502]). MNI = 1–2 (Fig. 17.7: A–C; Tab. 17.3).

Description: The grey-white antler fragment shows dendrites on its surface and was probably also gnawed (?), or it could also serve as a hammer (Fig. 17.7: A).

The yellow proximal phalanx of an adult animal is undamaged, partially covered with travertine, showing no pathological phenomena or traces of taphonomic agents (Fig. 17.7: C).

The medial phalanx, colored from yellow, grey, brown to black, undamaged and without pathologies or traces of taphonomic agents, probably belonged to another adult individual (Fig. 17.7: B).

Fig. 17.7. Fossil remains of artiodactyls from Santovka – Malinovec. A–C – *Rangifer* cf. *tarandus* (Linnaeus 1758) – antler fragment (NMP P 115/1959, A), medial (NMP P 115/1959 [k 502], B) and proximal (NMP 1004/61, C) phalanges in lateral view; D, E, L: – *Bison priscus* (Bojanus 1827 et/seu *Bos primigenius* (Bojanus 1827) – p3 sin. (NMP unnumbered) in occlusal view (D), right ulna (NMP P 115/59 [k 502]) in lateral view (E), and proximal phalanx (NMP P 115/1959) in lateral view (L); F–K – *Bison priscus* (Bojanus 1827) – two right tibae (NMP P 115/1959, NMP 998/61 [14/5]) in anterior (F, H) and inferior (G, I) views, right metatarsus (NMP 1003/61 [k 233]) in superior (J) and posterior (K) views. Photo by M. Sabol.

Taxonomic and paleoenvironmental remarks: The finds, which due to the different places of discovery on the site probably stem from different individuals, are classified in the genus *Rangifer* based on morphological features. However, their species determination is open, although reindeer finds from the Late Pleistocene of Europe are generally assigned to the species *R. tarandus*. However, three species of reindeer are known from Europe today, originally considered only subspecies of the nominal species (Lupták 2003): tundra (mountain) reindeer (*R. tarandus*), forest reindeer (*R. fennicus*) and Svalbard reindeer (*R. platyrhynchus*). Except for the last-mentioned species, which is an insular endemic one (Mattioli 2011), the remaining two are known from continental Europe. While the forest reindeer currently mostly inhabits the forest habitats of Karelia to Siberia (Mattioli 2011), the tundra reindeer is known from the tundra of Fennoscandia through Siberia to Kamchatka (Forman et al. 2000; Mattioli 2011; Rozhkov et al. 2020). Although this taxonomic division is based on recent morphotypes, the presence of tundra reindeer and forest reindeer in Central Europe during the Late Pleistocene is not completely excluded. However, due to the lack of data for distinguishing both species of reindeer in the fossil record, the finds from the site under study are determined as *R.* cf. *tarandus*.

Family: Bovidae Gray, 1821
Genus: *Bison* C. H. Smith in Griffith et al. 1827a et/seu *Bos* Linnaeus, 1758

Bison priscus (Bojanus, 1825) et/seu *Bos primigenius* (Bojanus, 1825)

Material: p3 sin. (NMP unnumbered), fragmented *scapula* dext. (NMP P 115/1959 [k 502]), fragmented *ulna* dext. (NMP P 115/59 [k 502]), 2 *tibia* dext. (NMP P 115/1959, NMP 998/61 [14/5]), Mt dext. (NMP 1003/61 [k 233]), and proximal phalanx (NMP P 115/1959); MNI = 2 (Fig. 17.7: D–L, Tab. 17.3).

Description: Damaged white crown of p3 sin. with dark dentin belonged to a senile individual. It is partially covered with gray-brown cementum, which also fills the remains of the trigonid and talonid valleys. From the morphological elements, the paraconid, protoconid, metaconid, hypoconid, and entoconid can be distinguished on the tooth. All these elements are incorporated into one worn surface, also including the paralophid/protolophid, metalophid, hypolophid and posterolophid. Yellow roots are broken off (Fig. 17.7: D). The dimensions of the tooth fragment are as follows: the maximum crown length is 26.8 mm, the maximum crown width is 19.5 mm, and the maximum crown height is 27.8 mm.

The fragment of the right scapula of an adult individual consists only of a partly preserved high ridge (*spina scapulae*). This brownish-yellow bone is damaged, with Mn dendrites and partially covered with travertine.

Only the proximal portion with the trochlear notch is preserved from the right ulna of an adult individual. The brownish-yellow to brown fragment is covered with isolated Mn dendrites and sediment. The diaphysis is broken off (an flacking fracture) and the bone shows also bite marks at the place where the olecranon was present (probably bitten off by a middle to large carnivore). The ulna is also damaged on the caudal edge (bitten?) and the lower articular process of the trochlea on the lateral side is broken off. No futher traces of other taphonomic factors are detected and the fragment does also not show any pathological phenomena (Fig. 17.7: E).

Both right tibiae belonged to adults (Fig. 17.7: F–I). They are preserved without the proximal portions. The bones are colored gray-brown to reddish-brown (P 115/1959) or yellow-brown to brown

(998/61 [14/5]) and damaged on the surface, covered with relatively extensive Mn dendrites (mainly on the caudal side of P 115/1959) and with rare sediment remains. In their proximal portion, the bones show an inverted V-shaped fracture, as well as an irregular perpendicular one in the case of P 115/1959 without the presence of spongiosis, which does not exclude also the possible activity of human agents (?).

The gray-brown to brown right metatarsal bone of an adult individual is damaged in the proximal portion of its diaphysis and in the region of the lateral epicondyle of the distal epiphysis, which was probably gnawed. There are rare Mn dendrites on the bone surface, and a piece of travertine is preserved in the space between the epicondyles. In addition, there are five transverse lines in the central portion of the diaphysis, resembling "imprints" of material that could have been wrapped around the bone (?) (Fig. 17.7: J, K).

The proximal phalanx also belonged to an adult individual. The black bone is damaged at the base of the proximal portion and in the area of the distal epiphysis (Fig. 17.7: L).

Taxonomic and paleoenvironmental remarks: The study of Pleistocene large bovids is often hampered by the difficulty of telling the difference between these, especially in postcranial elements. The finding of p3, fragmented scapula and ulna, as well as the proximal phalanx can be assigned either to a steppe bison (*Bison priscus*) or to an aurochs (*Bos primigenius*), whereas the morphological characteristics of both tibiae along with the metatarsal bone allow their attribution to the bison. Both tibiae from the site have articular facets for malleolus divided by a prominent notch and their anterior facet for malleolus is raised and circular. According to Gee (1993) and Sala et al. (2010), these characters distinguish the genus *Bison* from the genus *Bos*. Also, the right metatarsal bone shows typical characters of *Bison* at the proximal articular head, such as a ridge between the cubonavicular and 2nd/3rd tarsal facets, prominent medial tubercle, and more rounded facet for 1st tarsal, including also a characteristic morphology of the lateral side between diaphysis and distal epiphysis (Gee 1993; Sala et al 2010). Based on that, all these three Pleistocene finds have been assigned to the species *Bison priscus*.

The steppe bison is a typical member of the Late Pleistocene open environment communities (steppes and forest-steppes), able to live both in arctic conditions and in warm climates (Musil 1986). On the other hand, aurochs lived rather in forested areas although it could inhabit also a forest-steppe to steppe landscape and even penetrate the Alpine zone in the mountains (Musil 1986). The occurrence of both these species at the site is, not excluded if paleoecological conditions in the near vicinity of the Santovka travertine heap(-s) during the Last Glacial Period are taken into account.

Order: Perissodactyla Owen, 1848
Family: Equidae Gray, 1821
Genus: *Equus* Linnaeus, 1758

Equus sp.

Material: M3 sin. (NMP unnumbered), p3 dext. (NMP unnumbered), and Mt sin. (NMP unnumbered); MNI = 1 (Fig. 17.8, Tab. 17.3, 17.4).

Description: The left M3 (Fig. 17.8: A) belonged to an adult individual, probably no older than 5 years (worn stage II; according to Nejedlý, Sláma 1962). The crown covered with orange cement has white to yellow-white enamel and brown-yellow dentine. The tooth narrows posteriorly. The paracone is

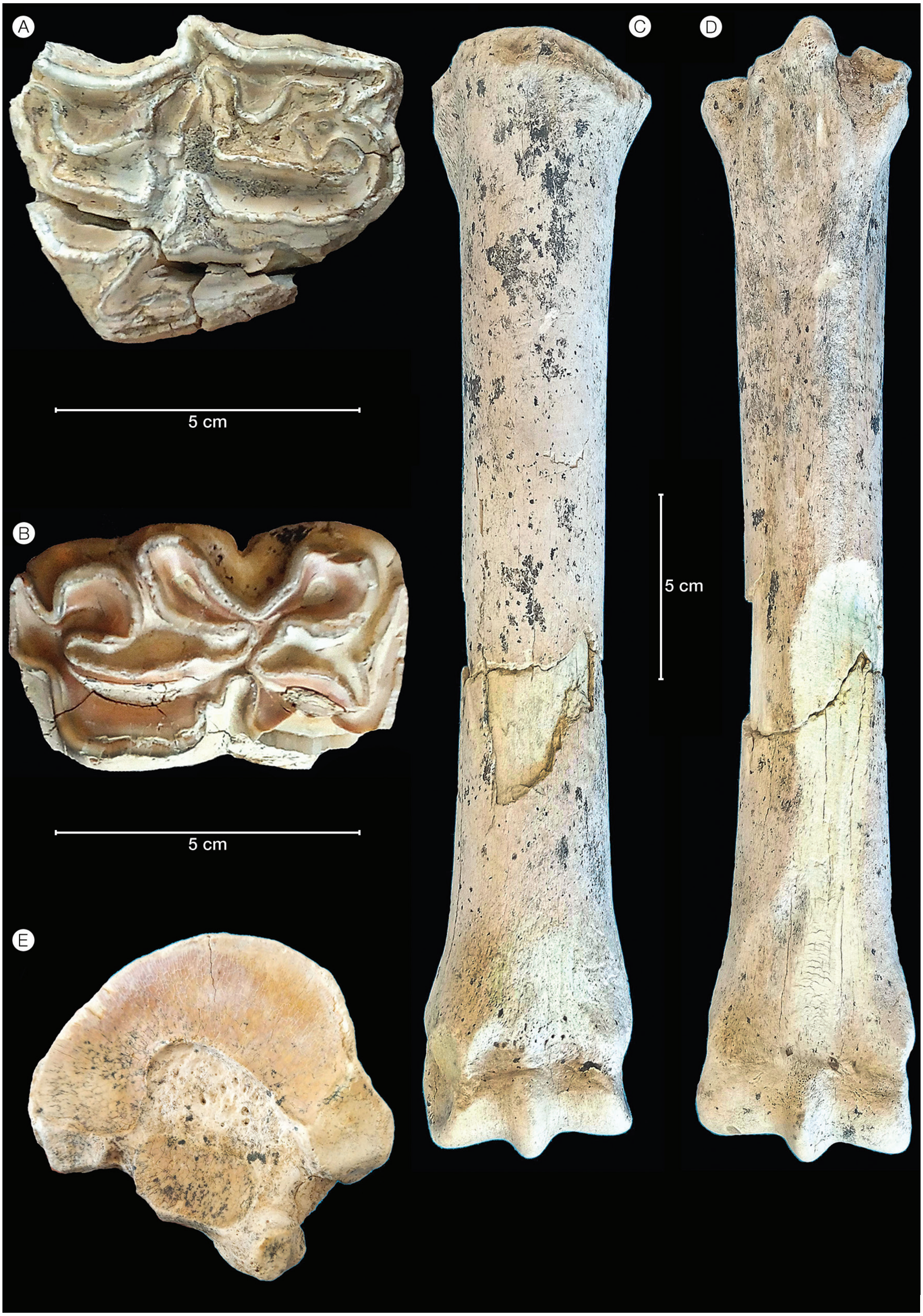


Fig. 17.8. Fossil remains of *Equus* sp. from Santovka – Malinovec. A – M3 sin. (NMP unnumbered) in occlusal view; B – p3 dext. (NMP unnumbered) in occlusal view; C–E – Mt sin. (NMP unnumbered) in anterior (C), posterior (D), and dorsal (E) views. Photo by M. Sabol.

Tab. 17.3. The dimensions of the ungulate postcranial elements found in Santovka – Malinovec.

Ungulata, Santovka – Malinovec
Maximum length
Anteroposterior diameter of the head
Height of trochlea
Maximum transversal diameter of the upper epiphysis/extremity
Maximm anteroposterior diameter of the upper epiphysis/extremity
Maximum transversal diameter of the lower epiphysis/extremity
Maximum anteroposterior diameter of the lower epiphysis/extremity
Height of the lower epiphysis
Heigth of the median ridge
Minimum transversal diameter of the body
Minimum anteroposterior diameter of the body
Transversal diameter at level of the deltoid tubercle
Lower transversal diameter of the trochlea
Maximum vertical diameter of the trochlea
Anteroposterior diameter of the lower articular surface
Transversal diameter of the lower articular surface
Transversal diameter of the intermal articular surface
Anteroposterior diameter of the internal median ridge
Distance between two median ridges in the upper part

Ungulata, Santovka – Malinovec
Maximum length
Anteroposterior diameter of the head
Height of trochlea
Maximum transversal diameter of the upper epiphysis/extremity
Maximm anteroposterior diameter of the upper epiphysis/extremity
Maximum transversal diameter of the lower epiphysis/extremity
Maximum anteroposterior diameter of the lower epiphysis/extremity
Height of the lower epiphysis
Heigth of the median ridge
Minimum transversal diameter of the body
Minimum anteroposterior diameter of the body
Transversal diameter at level of the deltoid tubercle

Ragifer cf. *tarandus*		*Bison priscus*			Bovidae indet.	
Phalanges		Tibia dext.		Mt dext.	Ulna dext.	Phalanx
1004/61	P 115/59	P 115/59	998/61	1003/61	P 115/59	P 115/59
54.7	41.4	-	-	293.6	-	89.4
-	-	-	-	-	49.6	-
9.4	17.0	-	-	-	-	-
21.5	20.7	-	-	68.2	-	
23.0	23.0	-	-	63.2	-	46.0
18.5	17.8	101.4	93.2	-	-	38.2
13.7	20.3	73.8	70.6	47.3	-	-
-	-	-	-	42.5	-	-
-	-	-	-	33.9	-	-
15.8	14.1	66.2	61.4		37.4	35.5
11.5	13.6	45.0		37.9		23.7
-	-	-	-	-	23.6	-
-	-	-	-	-	35.0	-
-	-	-	-	-	-	-
-	-	65.6	59.6	-	-	-
-	-	68.0	67.8	-	-	-
-	-	-	-	34.9	-	-
-	-	-	-	45.8	-	-
-	-	-	-	38.1	-	-

Equus sp.	*Coelodonta antiquitatis*					
Mt sin.	Humerus sin.	Ulna dext.	Mc IV sin.	Tibia dext.	Phalanges	
unnumb.	998/61	1003/61	unnumb.	P 115/59	P 115/59	1003/61
272.4	-	-	-	-	47.3	51.0
-	-	-	-	-	-	-
-	-	-	-	-	17.2	13.2
54.8	-	-	57.3	-	59.2	53.1
45.5	-	-	52.5	-	32.1	38.4
52.3	-	-	-	105.8	58.1	48.5
38.2	-	-	-	92.0	28.7	28.3
35.3	-	-	-	-	-	-
25.5	-	-	-	-	-	-
36.0	74.2		39.9	72.4	48.6	47.5
29.7	82.2	48.8	25.6	58.2	24.7	21.5
-	-	-	-	-	-	-

Lower transversal diameter of the trochlea
Maximum vertical diameter of the trochlea
Anteroposterior diameter of the lower articular surface
Transversal diameter of the lower articular surface
Transversal diameter of the intermal articular surface
Anteroposterior diameter of the internal median ridge
Distance between two median ridges in the upper part

slightly larger than the metacone. The parastyle is broken, the metastyle is rather only indicated, and the mesostyle is distinct, undivided, perhaps smaller than the parastyle (?). The crown anterior margin is formed by a damaged protoloph, which connected the parastyle to the protocone. The protoloph expands posterolingually, with a distinct pli protoloph running posteriorly approximately from its central portion. The damaged protocone is long, oval, occupying almost 2/3 of the crown lingual margin, with a weak fold on the lateral margin and slightly wavy in the posterior portion on the medial margin. The pli caballin is absent (!), or it is only very faintly indicated respectively, while the pli protocone is prominent. The slightly deepened metaloph passes transversely through the crown central part from the mesostyle; first it is narrowing, then widening, and finally turning posterolingually and passing into the hypocone. The pli hypostyle is absent, and the hypocone is connected to the metastyle by a posteroloph that borders the crown posterior margin. Distinct folds are developed on the posteroloph in its central part on the medial and lateral margins; the larger one (on the medial margin) is weakly bifurcated and surrounds a small isthmus. The prefosseta is more distinct than the postfosseta, which has an overall irregular shape. The pli prefosseta is only indicated, while the pli postfosseta is conspicuous. The roots are broken at the base.

The worn crown of the right p3 (worn stage II; according to Nejedlý, Sláma 1962) of an adult individual (Fig. 17.8: B) is covered with orange cement. The tooth is rectangular in shape. The crown anterior portion is formed by a distinct paraconid (parastylid?), running along the entire width of the crown anterior portion and posteriorly passing into the damaged protoconid on the buccal side. The paraconid is separated from the metaconid by a pronounced preflexid, passing into the prefossete (*fossa lunata* ant.) with a narrowed anterior arm and posteriorly with a widened posterior arm. The protoconid connects posteriorly through the isthmus to the damaged hypoconid, which is the largest crown element. Behind the ectoflexid (= *vallis externa*), a small pli caballin(-id) (der Sporn) is situated between the protoconid and hypoconid. The ectoflexid extends only to the base of the isthmus. The hypoconid posterior portion passes together with the posterior portion of the almost round entoconid into a closed posterior structure (hypoconulid/talonid), narrowing posterolingually and forming the lingual half of the posterior margin. The entoconid is the smallest of the lingual elements. The metastylid is about the same size as the metaconid, separated from the entoconid by a narrow postflexid, which passes into the postfossette (*fossa lunata* post.), branching into a larger anterior and smaller posterior arms, with a slight undulation on its buccal margin. The lingual fold (lingualflexid) is deep and wide, of the caballine type. The metaconid is, along with the metastylid, the largest element on the crown lingual side and both form a double loop. The metaconid connects to the connection between the protoconid and the hypoconid through a narrow straight and short isthmus. The lateral margins of the lingual elements are slightly convex, while those of the paraconid, protoconid and hypoconid are straight. The two roots are separated and broken off in the basal portion.

-	-	-	-	-	-	-
-	95.0	-	-	-	-	-
-	-	-	-	61.5	-	-
-	-	-	-	88.8	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

Tab. 17.4. The dimensions of the *Equus* sp. teeth from Santovka – Malinovec.

***Equus* sp., Santovka – Malinovec**	**M3 sin. unnumb.**
Maximum tooth length	31.0
Maximum tooth width	25.5
Parastyle length	-
Mesostyle length	3.7
Protocone length	16.1
Length of the protocone anterior portion	3.7
Length of the protocone posterior portion	11.0
Width of the isthmus	2.8
Maximum width of the protocone posterior portion	5.8
Distance between the hypocone and the protocone posterior portion	2.0
Pli caballin length	-
Maximum length of the pre-fossette	14.2
Maximum length of the post-fossette	12.3
Number of the pre-fossette plis	2
Number of the post-fossette plis	3
Protocone index (PI)	51.95

***Equus* sp., Santovka – Malinovec**	**P3 dext. unnumb.**
Maximum tooth length	31.4
Maximum tooth width	21.3
Metaconide – metastylide length	18.6
Maximum length of the pre-fossette	10.4
Maximum length of the post-fossette	14.6
Talonide length	3.3
Length of the ectoflexid (vallis externa)	2.5
Inner width (depth) of the ectoflexid (vallis externa)	6.9
Width of the isthmus	1.5
Number of fossa lunata plis	3

The brown-yellow left metatarsal bone of an adult individual (Fig. 17.8: C–E) is preserved completely (glued together from two parts), but it is damaged on the diaphyseal surface. The bone is covered with Mn dendrites, but shows no futher traces of other taphonomic agents or pathological phenomena.

Taxonomic and paleoenvironmental remarks: The equid fossil record from Santovka – Malinovec is very scanty, consisting only of two teeth and metatarsal bone. In such case, it is difficult to exactly determine a species only based on morphological criteria. The teeth fits with their dimensions (Tab. 17.4) into the variation range for *Equus germanicus* (or *E. ferus germanicus*, see van Asperen et al. 2012, 10 or Boulbes, van Asperen 2019, 11–12), but also *E. taubachensis* Freudenberg 1911 (Fig. 17.9). However, from the morphological point of view, the teeth show rather a simplification than more complicated characteristics (such as known in *E. germanicus* or *E. taubachensis*), accompanied by poor or no pli-caballin development. On the other hand, it can also be considered to be an aberrant condition (?). Also, the calculated protocone indices of the investigated M3 (Tab. 17.4) fit well into the determined variation ranges for Late Pleistocene caballoid horses (see Sabol et al. 2022a, Tab. 1). The lingual flexid of the lower molar is deep and wide, resembling rather an angular V than typical U-shaped or V-shaped valley, thus differing from the morphology of stenonoid and hemionoid horses.

The main dimensions of the metatarsal bone tend to fall rather into the upper variation ranges of *E. germanicus* than into the lower variation ranges of *E. taubachensis* (Fig. 17.10). Unfortunately, the data available for comparative analysis are too scanty to enable more exact taxonomic determination.

From the size and morphology of the limited amount of equid remains from Santovka – Malinovec, it is obvious that these belong rather to caballoid horses than to other representatives of the Equidae family and allow for a certain consideration of their assignment into the Late Pleistocene *E. germanicus* or *E. taubachensis* (?).

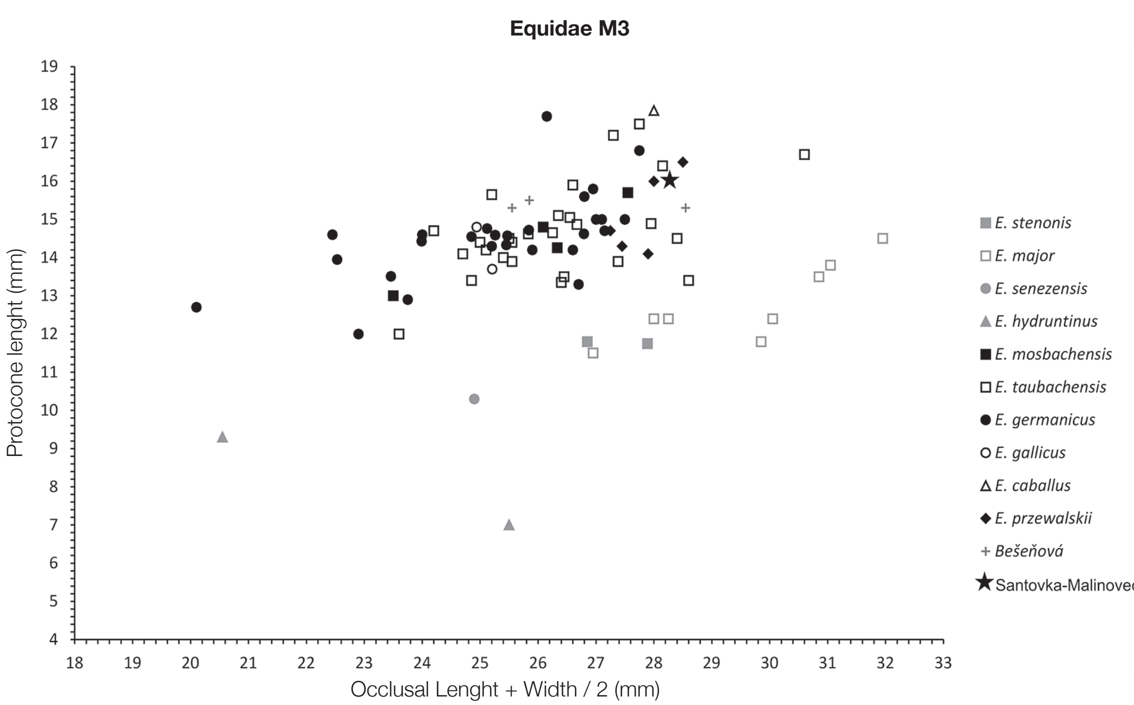
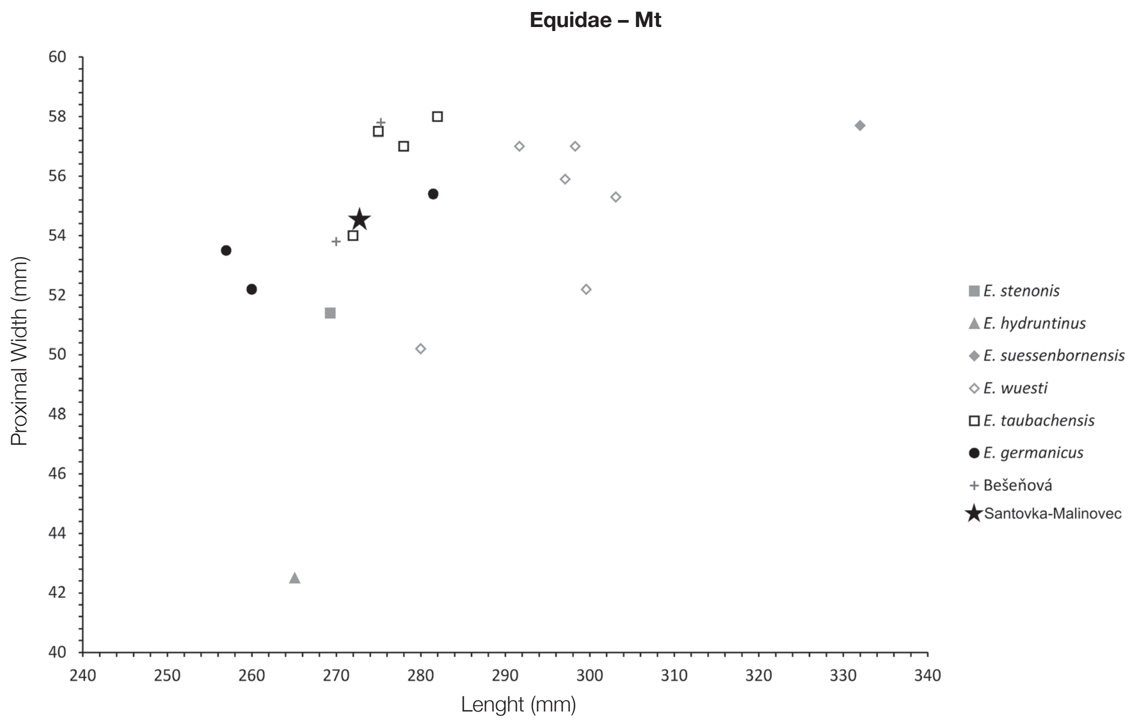


Fig. 17.9. The scatter diagram for the measurements of equid M3 including the measurements of the horse specimen from Santovka – Malinovec. According to Sabol et al. 2022a and references therein.



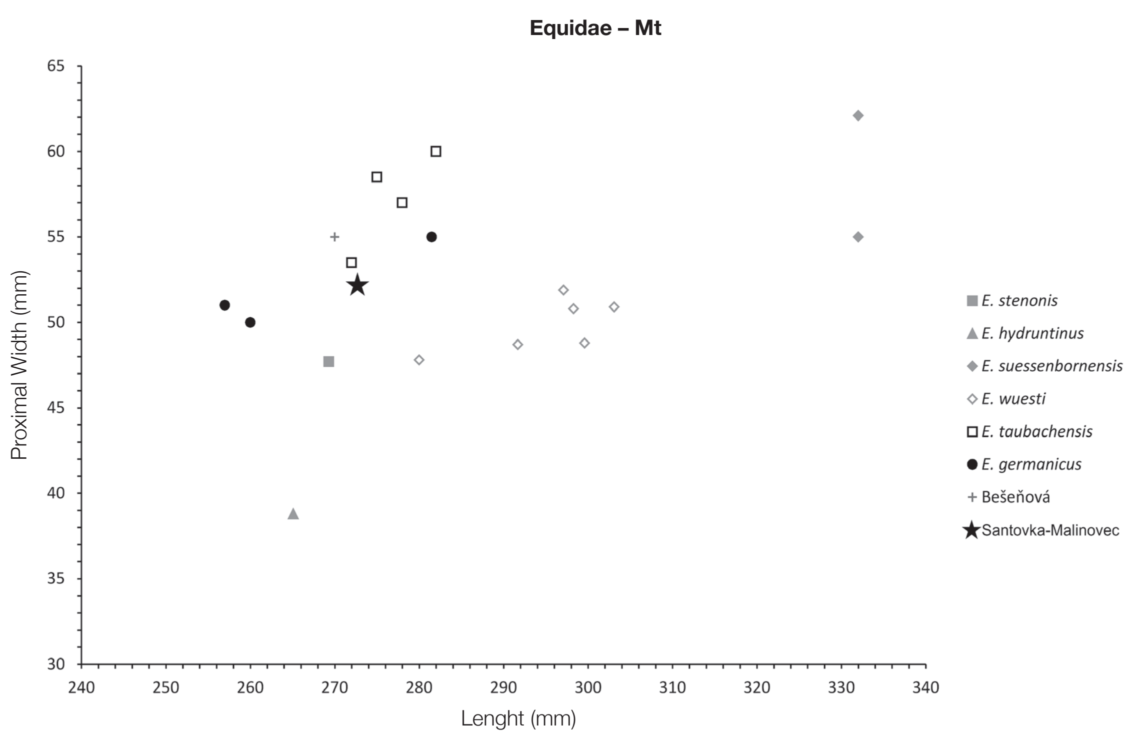


Fig. 17.10. The scatter diagrams for the measurements of equid Mt including the measurements of the horse metatarsus from Santovka – Malinovec. According to Sabol et al. 2022a and references therein.

Late Pleistocene horses are typical steppe animals, partly occurring also in the forest-steppe or, in rare cases, even in semi-arid environments (Musil 1986). The caballoid horses were usually of larger body size than stenonoid horses, from which they clearly differed by dental morphology and metrics (van Asperen et al. 2012). Furthermore, less harsh climatic conditions during warmer periods or suitable areas with thermal springs and more temperate climate (such as the territory of the site under study) could enable them to grow to even larger body size and slender proportions. This phenomenon was observed in many contemporaneous equid forms from the Late Pleistocene *ferus*-group (Eisenmann 1991; Spassov, Iliev 1997; van Asperen 2010; van Asperen et al. 2012), what enabled to define them as different ecotypes (ecomorphs) adapted to various climatic regions (van Asperen et al. 2012; Saarinen et al. 2016; Boulbes, van Asperen 2019).

Family: Rhinocerotidae Gray, 1821
Genus: *Coelodonta* Bronn, 1831

Coelodonta antiquitatis (Blumenbach, 1799)

Material: upper left cheek tooth (NMP 1043/61 [K433]), m^2? sin. (NMP 1003/61), lower molar fragment (NMP 1003/61), fragmented *scapula* (NMP P 115/59 [k 502]), *humerus* sin. (NMP 998/61 [233]), fragmented *ulna* dext. (NMP 1003/61), fragmented Mc IV sin. (NMP unnumbered), *tibia* dext. (NMP P 115/59 [k 502]), and 2 proximal phalanges (NMP P 115/1959 [k 502], NMP 1003/61); MNI = 1 (Fig. 17.11; Tab. 17.3, 17.5).

Description: The damaged upper left cheek tooth is P4 or M1 (an unspecified upper premolar according to Mostecký [1961]) (Fig. 17.11: A). The white, rounded, almost square crown is worn. The paracone and metacone are connected by an ectoloph with a distinct fold on the buccal side (mesostyle?). The parastyle and metastyle are broken off together with the protocone. The damaged protoloph was probably long. The metaloph was probably shorter than the protoloph, more obliquely oriented to the protoloph and passing postero-lingually into the broken hypocone. The central fossette is oval and bordered on all sides; its anterior border is formed by the "crista" and lingually the "crochet". The medisine (lingual valley) is closed on all sides. The postfossette is larger than the middle fossette, well bounded from all sides, ovally elongated and slightly bent posterobuccally. The cingulum is distinctly developed only on the anterior side. The buccal roots are completely broken off, while the bent lingual root is broken off at the base.

The crown of the damaged left m^2? is worn (Fig. 17.11: B). The crown anterior part is broken off along with the metaconid. Only the posterior portion of the paralophid has been preserved. The short protolophid is straight, transversely connecting the protoconid with the broken metaconid. The hypolophid and posterolophid form a wide arch. The trigonid valley was probably U-shaped, while the talonid valley is more open, larger and deeper.

Tab. 17.5. The dimensions of the *Coelodonta antiquitatis* teeth from Santovka – Malinovec.

***Coelodonta antiquitatis*, Santovka – Malinovec**	**P4/M1 sin.** 1043/61	**m2? sin.** 1003/61	**m1-2 frag.** 1003/61
Maximum crown length	45,3	-	-
Maximum crown width	45.7	22.7	-
Maximum crown width at the base	-	32.6	-
Maximum crown height	37.0	39.3	27.14

Another lower tooth is a fragment of the first or second lower molar, possibly belonging to the same adult individual as the above-described m^2 (Fig. 17.11: C). The tooth was probably already worn. Only a short straight protolophid is preserved from the crown elements. The trigonid valley is U-shaped, the talonid valley is more open and larger. Four roots are fused transversely (lingual with buccal ones) and damaged on the surface.

The scapula fragment of an adult individual consists more or less only of the area of the articular head (acronion), with Mn dendrites and remains of sintered sediment. The missing parts of the scapula were rather broken off than bitten off.

The proximal portion of the adult left humerus is absent due to possible human or predator (scavenger) activity. The light yellow bone is covered with Mn dendrites on the cranial side and has a damaged distal epiphysis that was probably gnawed. On the caudal side of the diaphysis, there are probably traces of various, more detailed unspecified biotic agents, represented by short, close to each other located "notches" (Fig. 17.11: D, E) and a distinct "cut" or "notch" (Fig. 17.11: D, F).

The right ulna of an adult individual consists of a diaphyseal fragment with a portion of trochlea, covered by Mn dendrites (Fig. 17.11: G). The bone proximal portion (the olecranon and parts above it) is recently broken, while the distal portion shows an ancient columnar fracture, apparently caused by hyena activity. Traces of other taphonic agents are not present and the fragment also does not show any pathological phenomena.

The left fourth metacarpal consists only of the proximal portion, while the distal one is probably bitten off, but the surface of the bone is almost intact (Fig. 17.11: H, I).

The adult right tibia also has a bitten-off proximal portion, showing bite marks (the fracture is irregular perpendicular). The spongiosis is eaten off, which is a clear indication of hyena activity. The distal portion of the bone is also damaged (Fig. 17.11: J, K).

Both adult proximal phalanges are preserved whole, almost complete and undamaged (or slightly damaged resp.), with Mn dendrites on the surface (Fig. 17.11: L, M).

Taxonomic and paleoenvironmental remarks: All described rhino fossil remains from the site under study are attributed to woolly rhino (*Coelodonta antiquitatis*) based on their morphological and metric characteristics (Fig. 17.11; Tab. 17.3). Although the teeth found are damaged, their attribution to the species is supported by finding and geological circumstances at the site. The same applies also to bones, when, for example, the humerus and tibia fall within the metric range for *Stephanorhinus kirchbergensis*, but mainly for *Coelodonta antiquitatis* (Fig. 17.12).

The fossil remains of woolly rhinoceros, as a typical member of the *Mammuthus-Coelodonta* Faunal Complex from the Eurasian Late Pleistocene (Kahlke 2014), occur mainly in MIS 3 and MIS 2 deposits of Europe. It lived predominantly along river valleys in so-called mammoth steppe – an open grassy and bush landscape with dry to arid climates (Boeskorov 2001), although its environmental requirements did not have to be exclusively linked only to that habitat (Puzachenko et al. 2021). During more favourable climate phases, the species could also penetrate to higher elevations and occur sporadically in more open forest areas or in the landscape of a park character in which open areas interchanged with minor patches of forests (Musil 1986). The species became extinct in Europe at about 14 ka (Stefaniak et al. 2023).

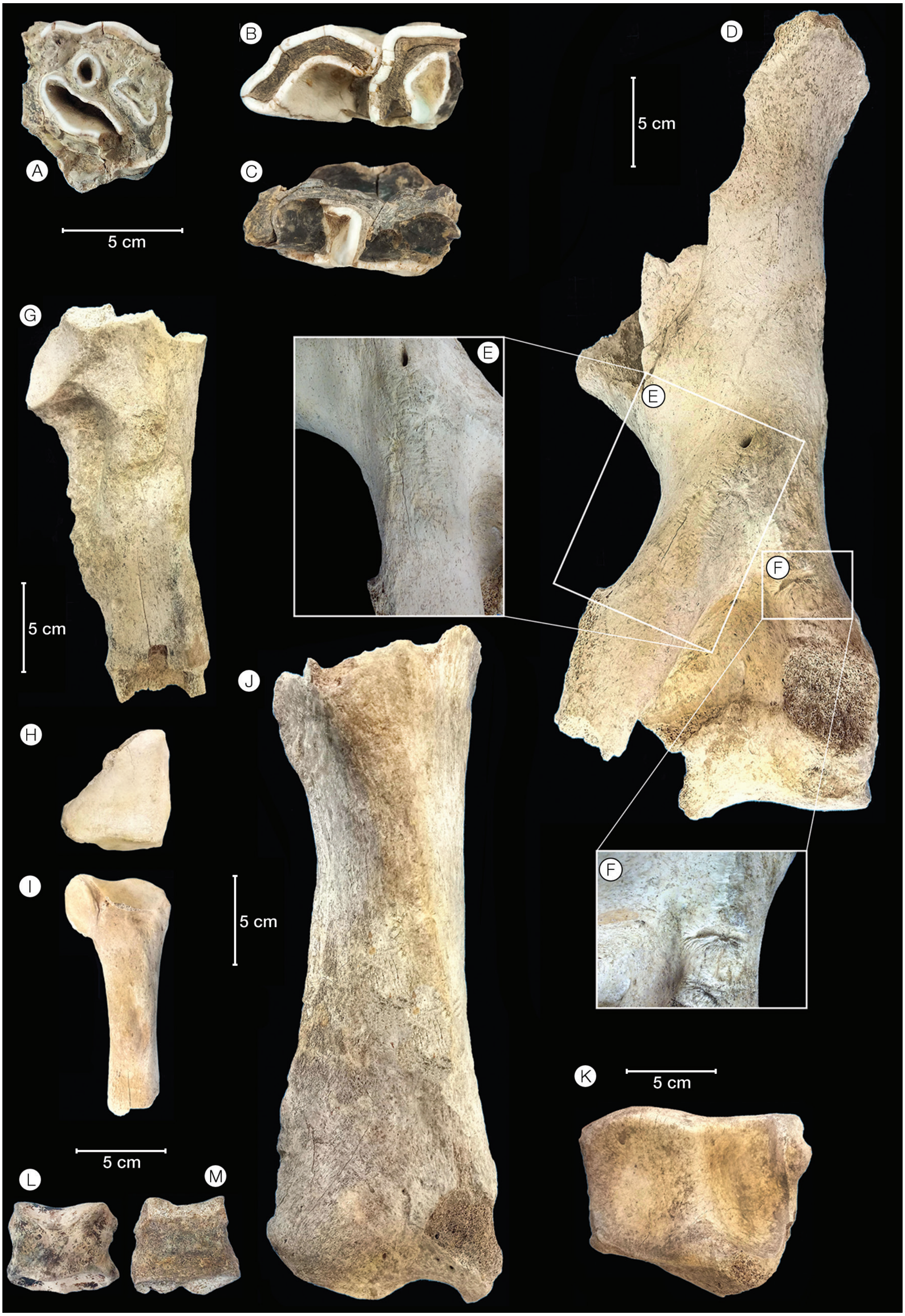
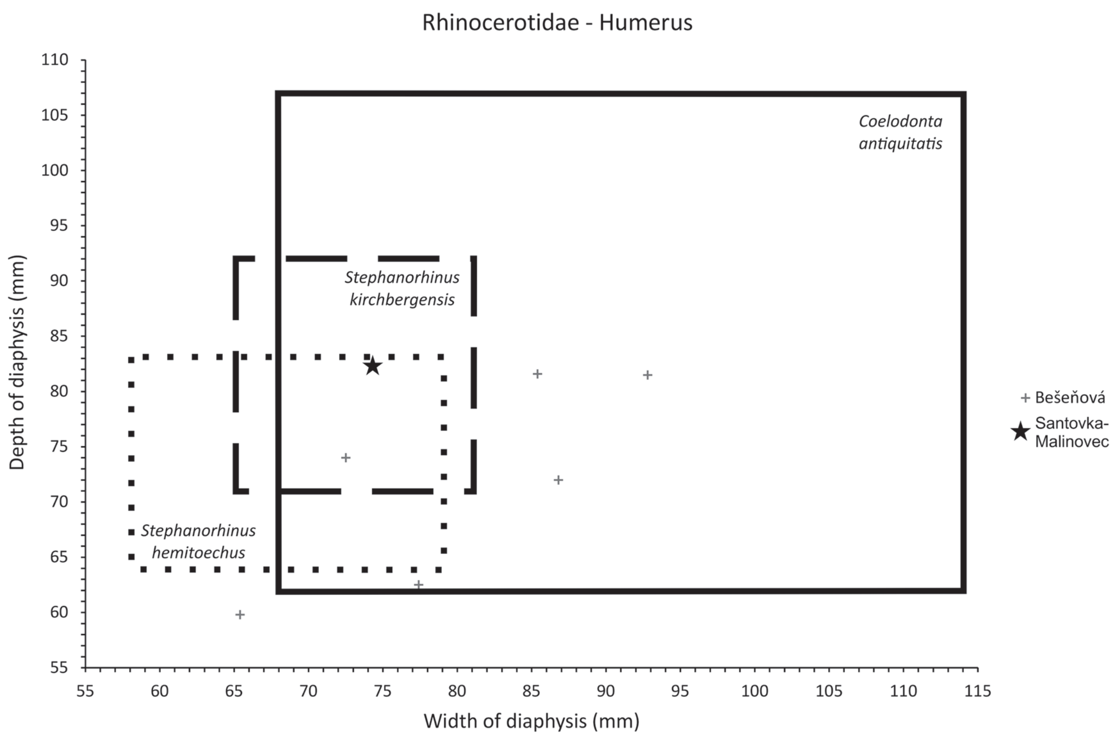


Fig. 17.11. Fossil remains of woolly rhino from Santovka – Malinovec. A – upper left cheek tooth (NMP 1043/61 [K433]) in occlusal view; B – m2? sin. (NMP 1003/61) in occlusal view; C – lower molar fragment (NMP 1003/61) in occlusal views; D–F – left humerus (NMP 998/61 [233]) in caudal view (D) with detail views on the phenomena described in the text (E, F); G – fragmented right ulna (NMP 1003/61) in lateral view; H–I – fragmented left Mc IV (NMP unnumbered) in proximal (H) and dorsal (I) views; J–K – right tibia (NMP P 115/59 [k 502]) in anterior (J) and lower articular (K) views; L–M – 2 proximal phalanges (NMP P 115/1959 [k 502], NMP 1003/61) in dorsal view. Photos by M. Sabol.



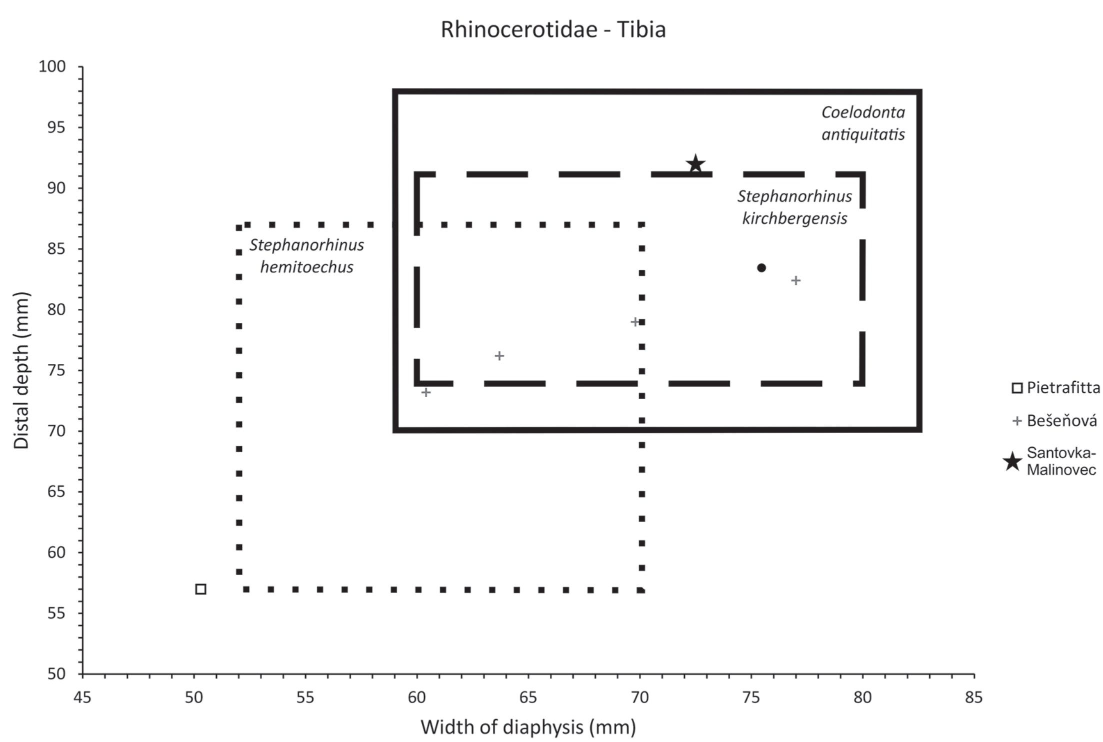


Fig. 17.12. The scatter diagrams for the limb bones of various rhino species from the Pleistocene including measurements of the rhino finds from Santovka – Malinovec. According to Sabol et al. 2022a and references therein.

Mammalia gen. et spec. indet.

Several undetermined bone fragments are also known from the site, which are classified only in the taxon Mammalia gen. et spec. indet. This includes two size-groups. The first group (medium-sized mammals) with the number NMP P 115/1959 consists of a flat bone fragment, a pelvis fragment (?), a humerus fragment, a radius fragment (?), an ulna fragment (?), and 6–7 fragments of long bones that were gnawed by carnivores and probably also broken by man. The second group (large-sized mammals) with the number NMP 1003/61 consists of five long bone fragments, two fragments of ulnae (?), and 15 fragments of different bones.

Discussion and Conclusion

Various taphonomic phenomena found on fossil mammal remains from Santovka – Malinovec testify not only to the activity of predators/scavengers but possible also of humans. Their presence here is documented by the record of the Gravettian stone tools as well as artefacts, probably of earlier Paleolithic Culture (Bárta 1961b; 1972). However, the Gravettian industry is mentioned from unconsolidated sinter above the solid travertine, while quartz artefacts, indicating an earlier settlement at the site, were also found in the compact travertine. From this point of view, it is interesting that none of analysed mammal finds stem from the compact travertine. It could thus indicate their probable connection with the bearers of the Gravettian Culture.

The Gravettian replaced the Aurignacian by about 33,000 BP (Pike et al. 2012; Jacobi et al. 2015) and had mostly disappeared by about 22,000 BP, close to the Last Glacial Maximum, although some elements persisted until about 17,000 BP (Pesesse 2013). The overall revised composition of the herbivorous assemblage from the site (woolly rhino, horse, bovids, deer, and reindeer) very good corresponds with the main prey of the Gravettian hunters. The postcranial mammoth remains from the upper loess layer (Vlačiky et al. 2009 and unpublished material) most probably also belong to this assemblage. On the other hand, some fossil finds, such as the mammoth incomplete M3 mentioned from the site by Ďurišová (2022), were probably also collected from the travertine strata and can be associated with Bárta's earlier Paleolithic culture (Bárta 1961b; 1972). The mammoth molar in question shows more archaic lamellar frequency < 7.5 and could stem from an archaic form of *Mammuthus primigenius*, typical rather for the early Late Pleistocene (Vörös 1980; Baryshnikov 2003), or early Weichselian respectively. On the other hand, the enamel thickness (max. 2.4 mm) indicates *M. intermedius* described from late Middle to early Late Pleistocene localities from Russia and Ukraine (Baigusheva, Titov 2021; Ridush et al. 2021). In contrast, the abovementioned tusk imprint of the straight-tusked elephant (?) in the hard compact travertine is probably of the Eemian age. Such proboscidean assemblage is known in Slovakia so far only from the Neanderthal site of Gánovce (Sabol et al. 2017). Based on that, the Santovka travertines are also a prospective Paleolithic site that would deserve systematic interdisciplinary research in the future.

The determined assemblage under study is probably uniform, since all finds stem from the Last Glacial layer of yellowish clay (probably floated loess) with abundant travertine debris. Its uniformity is more or less confirmed by the degree of fossilization and could be dated to the final phase of MIS 3, or to MIS 3 – MIS 2 transition (?) based on their assumed connection with the Gravettian artefacts.

From environmental point of view, the mammalian fauna found form a community of an open landscape (lion, mammoth, woolly rhino, horse, steppe bison, and reindeer) with a smaller representation of forest elements (deer and aurochs?). However, the latter exemplars could also have been introduced at the site by predators or prehistoric hunters. A certain role in the accumulation of animal remains at the site could be played by the thermal mineral springs themselves, forming the Santovka travertine mounds. They surely attracted wildlife from the wider area by creating more favourable climatic conditions in their surroundings, especially during the winter months or colder seasons. This could explain the presence of faunal elements of both open and forested land in the fossil record as well as prehistoric man whose activity has also been recorded at the site. In any case, the presence of relatively warm springs (with a current temperature from 12.5 to 27 oC) also played an important role for the formation of a more suitable paleoenvironment.

Acknowledgements:

We would like to thank Ján Wagner from the National Museum in Prague for the oportunity to review the finds from the site. Our thanks goes also to Juraj Lauko and Ladislav Lauko – the mayor of the village of Santovka for the kind opportunity to observe the tusk imprint, Anna Ďurišová for access to the fossil material of mammals deposited in the paleontological collection of the Slovak National Museum – Museum of Natural History in Bratislava, as well as to Ján Madarás and Kristian Csicsay for providing photographs.

The authors gratefully acknowledge the helpful comments and suggestions of anonymous reviewers for improvement of the manuscript. Their gratitude goes also to the editor Adrián Nemergut and Martin Novák for handling the manuscript.

Funding sources

This work was supported by the Scientific Agency of the Ministry of Education of the Slovak Republic (grant number VEGA 2/0033/23 [M.S.] and VEGA 2/0066/24 [Cs.T.]) and the Slovak Research and Development Agency (grant number APVV-20-0079 [M.S.]).

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Paleoecology and the migration of animals from Gravettian sites in the Middle Danube

Miriam Nývltová Fišáková

Introduction

Seasonal or perennial occupancy of the prominent Central European Gravettian localities is one of the hottest Paleolithic research topics, where zooarchaeological, paleontological, and geochemical methods may be employed. The application of these methods could also reveal data about paleoecology and migration of hunted animals, thus gaining further details for wider geoarchaeological interpretations. The probable domestication of reindeer during the Gravettian is also related to these questions. The possible domestication could be indicated by the fact that the reindeer did not migrate during this period.

Material

The material for this study derives from Gravettian localities in the Middle Danube region and adjoining areas of Central Europe. The following Gravettian sites in Austria were studied: Krems-Hundssteig (e.g. Fladerer, Salcher-Jedrasiak 2008a; 2008b; Neugebauer-Maresch 2008; Fladerer et al. 2010; historical samples and 2000–2002 excavation) and Krems-Wachtberg (e.g. Fladerer 2001; Einwögerer et al. 2006; Fladerer et al. 2010; excavations in 1930 and 2005–2008, the material is administrated by the Prehistoric Commission, Austrian Academy of Sciences). From Slovakia the localities studied were Trenčianske Bohuslavice- Pod Tureckom (Bárta 1988; Vlačiky 2013; material from the Faculty of Natural Sciences, Comenius University in Bratislava) and Moravany nad Váhom-Lopata II (Kozłowski 1998; material deposited at the Slovak National Museum in Bratislava). The following localities from Moravia were studied: Dolní Věstonice II-Western Slope (Svoboda et al. 1991 –

doi 10.47382/dvs_26-18

research 1987), Dolní Věstonice IIb (Svoboda et al. 2006 – research 2005), Jarošov II-Podvršťa (Škrdla 2005 – research in 1996-2000), Přerov-Předmostí (Nývltová Fišáková 2001; Svoboda 2001; Svoboda et al. 2007 – research in 1992 and 2006), Spytihněv (Škrdla et al. 2007b – research 2006), and Boršice (Škrdla et al. 2007a; 2008). From Poland only one locality was studied, namely Kraków-Spadzista (Kozłowski 1969; 1971; Kozłowski et al., 1972; 1974), which is archived at the Institute of Systematics and Evolution of Animals of the Polish Academy of Science in Kraków.

The main layer at Wachtberg from the excavation in 1930 is dated from 27,700 to 27,100 C-14 dating BP (Einwögerer 2000; Fladerer 2001, Fladerer, Salcher 2004; Fladerer, Salcher-Jedrasiak 2008a; 2008b) and the actual dates of the main layer GH26 range from 28,300 ± 270 (VERA-3932) to 26,520 ± 210/-200 ^{14}C BP (VERA-3819; Einwögerer et al. 2009). The Hundssteig main layer is dated between 28,000 and 27,200 ^{14}C BP (Neugebauer-Maresch, 2008). The radiocarbon data of Trenčianske Bohuslavice place the site into the Willendorf-Kostenkian phase of the Gravettian (Verpoorte 2002; Vlačiky 2009; Vlačiky et al. 2013). Radiocarbon dates from this research range from around 25,500 to 22,500 ^{14}C BP (Verpoorte 2002; Žaár 2007; Vlačiky et al. 2013). The material studied from Moravany Nad Váhom-Lopata II was acquired during excavations carried out by a Slovak-Polish team in 1993-1996, led by J. K. Kozlowski (Kozłowski 1998). Radiocarbon dates from this research range from around 24,100 to 21,400 ^{14}C BP (Vlačiky 2009). The studied teeth from Dolní Věstonice II-Western Slope 1988 (year of research 1987) come from rescue excavations carried out in 1986. The radiocarbon data of the bottom layer from Přerov-Předmostí site range from 26,879 ± 250 to 26,780 ± 140 ^{14}C BP (Svoboda et al. 2007). The radiocarbon data from the locality Jarošov-Podvršťa range from 27,200 ± 200 to 25,110 ± 240 ^{14}C BP (Škrdla 2005). All radiocarbon dates of the Kraków-Spadzista Street (B) site are clustered around 24,000-23,000 ^{14}C BP (Kozlowski et al. 1974; Wojtal, Sobczyk 2005; Wojtal 2007)

Methodology

The ratios of strontium isotopes were analysed in the laboratories of the Czech Geological Survey in Prague and the ratios of carbon and nitrogen isotopes in the Czech Geological Survey in Prague and the geochemical laboratories of the University of Georgia in the USA and Bergen Geoanalytical Facility of the University of Bergen, Norway.

Strontium isotope ratio

Due to its chemical proximity to calcium, strontium can easily replace a lighter element in Enamel, dentine, or bone. Strontium enters the body through food, where its isotopic ^{87}Sr /^{86}Sr ratio reflects the ratio in the local soil. Tooth Enamel carries an isotope record from childhood. Dentine and bone reflect an isotope record from adulthood or recent years of the subject's life. Isotopes pass through the food chain (from soil to plants, then to herbivores and carnivores) in an unfractionated manner, and the isotopic composition of the organism reflects the soil and subsoil where the individual lived (Gosz et al. 1983; Gosz, Moore 1989; Miller et al. 1993). By comparing the isotope record in the Enamel and the bone or Enamel of different teeth (e.g. first versus third molars, we can reconstruct movement for different life periods of an individual in a geologically variable environment (Lenihan et al. eds. 1967; Price et al. 1985). Strontium occurs in rocks in 4 isotopes – ^{84}Sr, ^{86}Sr, ^{87}Sr and ^{88}Sr. The ^{87}Sr isotope is formed by the radioactive decay of ^{87}Rb and slowly accumulates over geological time. This isotope is expressed as a ratio to the stable isotope (^{87}Sr / ^{86}Sr). In rocks that are old (> 100 million years) and contain high values of rubidium, the isotope ratio ^{87}Sr / ^{86}Sr is higher. This is characteristic for areas with old granite rocks, gneisses, and old sedimentary rocks. For rocks that are geologically younger (<100 million years) and have a low rubidium content, the isotope ratio $^{87}Sr / ^{86}Sr$ is lower. Such rocks include, for example, young volcanic rocks. These values are transmitted by weathering of rocks into the soil, through plants into fauna and humans. The variance of this ratio appears to be very small, and typically low values may be 0.704, while values of 0.720 are considered high.

This difference is very easy to measure (Montgomery et al. 2007). Domestic pigs, rodents, or snails that live in the area throughout the year and throughout their lives are most commonly used as a basis for subsoil signaling (Price et al. 2002; Hoppe et al. 2003; Bentley et al. 2002; Nývltová Fišáková 2008; Nývltová Fišáková et al. 2009). Strontium in bone binds to PO_4-, instead of calcium (Ca^{2+}). The ratio of Zn and Sr can be used to determine the nutrition of an animal or human. There is more strontium and less zinc in herbivores. In carnivores, the ratio is reversed (Smrčka, 2005). As the geological subsoil is not the same everywhere and the rocks have different ages in different places, the ratio of the unstable isotope ^{87}Sr and the stable ^{86}Sr in the bones and teeth of animals can identify areas in which the individual lived at different times of its life and thus determine its migration (Grupe et al. 1997; Price et al. 1998; Price et al. 2001; 2004; Schweissing, Grupe 2003; Bentley et al. 2003; 2004; Smrčka 2005). To capture possible migrations throughout an individual's life, samples are taken from the Enamel of the first permanent molar (mineralized already in the prenatal stage and not affected by diagenetic processes) and from dentine or bone (rebuilt every 7 to 10 years – Trickett et al. 2003; Richards et al. 2008). Recent shells of the snail (*Helix pomatia*) were taken to determine the values of $^{87}Sr / ^{86}Sr$ in subsoil. The teeth of domestic pigs (*Sus domestica*) were used as another comparison sample.

In the mentioned laboratory the following methodology according to Price, Manzanilla and Middleton (2000) was used to determine the observed ratio. The Enamel, dentin and snail shells were sonicated for 15 minutes in distilled water to remove impurities. The samples were cut with a dental drill. The obtained material was again purified by ultrasound in distilled water with 5% acetic acid. Acetic acid serves to gently remove the surface layer, as this layer can be contaminated with environmental contaminants. The samples were then dried in a laminar box. The dried material was burned for a total of 8 hours at 825 °C. The obtained ash was dissolved in concentrated HNO_3. The obtained concentrate was dried again and then dissolved in 6 mol of HCl and dried again. This was followed by redissolution in concentrated HNO_3 and drying again. The evaporation was dissolved in 2 mol HNO_3. The separations were performed in ion exchange chromatographic columns. The value of the strontium isotope ratio $^{87}Sr / ^{86}Sr$ was determined on a mass spectrometer with solid-state ionization MAT 262 from Finnigan, in a dynamic mode double-stranded arrangement. Thermal fractionation was corrected by normalization to the expected strontium ratio $^{88}Sr / ^{86}Sr = 8.375209$. Reproducibility was checked by measuring the strontium isotope ratio $^{87}Sr / ^{86}Sr$ of the NBS 987 standard, which has a long-term average of 0.710248 with a standard deviation of 0.000013 (23 replicates).

Carbon ($^{13}C / ^{12}C$) and nitrogen ($^{15}N / ^{14}N$) isotope ratio

The ratio of ^{13}C and ^{12}C isotopes provides information about the composition of a particular individual's diet. We distinguish between the so-called C4 and C3 plants, depending on the proportion in which they incorporate ^{13}C and ^{12}C carbon isotopes into complex sugars during photosynthesis. In C3 plants, the carbon isotope content ^{13}C –22 to –30‰ of the PDB standard, these are Central European trees, including fruit trees, or rice. For C4 plants it is -9 to -16‰ of the PDB standard, C4 plants are some cereals (corn, millet) and grasses (Ambrose et al. 1997; Schoeninger et al. 1983;

DeNiro, Epstein 1981; Smrčka 2005; Smrčka et al. 2005; Nývltová Fišáková et al. 2009; Richard et al. 2008 Stafford et al. 1988; Tauber 1981).

Animal or human nutrition can also be inferred from the ratio of ^{15}N and ^{14}N nitrogen isotopes stored in bones or teeth. In plants, the ratio of N isotopes depends on its origin, whether it is nitrogen from soil nitrates or nitrogen taken up by symbiotic bacteria. Differences in the ratio of N isotopes can also be found between herbivores and carnivores in connection with their nutrition. Meat has the most ^{15}N isotope (Schoeninger et al. 1983; Ambrose, Norr 1993; Smrčka 2005; Smrčka et al. 2008, while legumes have the most nitrogen isotopes (^{15}N). The ^{15}N content also depends on geographical location and climate, there is more ^{15}N isotope in warm areas because there is higher bacterial production and bacteria prefer the ^{15}N isotope (Bocherens, Drucker 2003; Hedge, Rejnard, 2007; Smrčka 2005; Nývltová Fišáková et al. 2009).

Wooly mammoth (*Mammuthus primigenius*), reindeer (*Rangifer tarandus*), and horse (*Equus* sp.) teeth were used for analysis, and polar hare (*Lepus timidus*) teeth and snail shells were used for comparison from the localities Dolní Věstonice, Pavlov, Přerov-Předmostí, Willendorf, Krems-Wachteberg, Krems-Hundsteig, Jarošov, Boršice, Trenčianske Bohuslavice, Moravany nad Váhom-Lopata II, Petřkovice, and Krakow-Spadzista.

Results and discussion

The results of isotopic analyses of carbon and nitrogen isotope ratios are shown in Tab. 18.1 and Fig. 18.1 and 18.2. All samples met the criteria for good collagen preservation (DeNiro 1985; DeNiro, Epstein 1981; van Klinken 1999). The C/N ratio ranged from 2.9 to 4.5.

Based on the analyses of carbon and nitrogen isotopes in herbivores, it can be said that most of the animals lived in the steppe to tundra environment, only two individuals of reindeer lived in the light forest environment. On the basis of nitrogen isotopes, it can be concluded that most of the studied animals lived in an environment with little precipitation, which corresponds to the cold steppe to tundra. Paleolithic animal bones showed the floral change close to the OIS 3-2 transition, when was the expansion of grass initiated, i.e. to the extension of tundra. These results are in agreement with those of Richards and Hedges (2003) and Pryor (2006). Analyzes of the ratio of strontium isotopes (^{87}Sr / ^{86}Sr) from woolly mammoth, reindeer, woolly rhinoceros, polar fox and hare, and horse are shown in Tab. 18.2 and Fig. 18.3.

Looking at the data in Fig. 18.3, we can see that most of the reindeer and some mammoths did not migrate anywhere with respect to the subsoil, they stayed in the loess region of Southern Moravia and Lower Austria.

Rodent and hare teeth were used to detect the biosignal from the subsoil, because strontium contamination from soil carbonates is possible in the snail shells (Bentley et al. 2004). The data from rodents show a wider range of the signal from the subsoil (0.708116–0.719344) than the data from snail shells made earlier (Vašínová Galiová et al. 2013) – 0.70891–0.70979. However, it turns out that compared to the analyses of Pryor et al. (2016) the reindeer did not migrate much, staying relatively close to the analysed sites (Fig. 18.4). Finally, this is stated by Pryor et al. (2016) that they stayed in the wider vicinity of Pavlov Hill. The subsoil of the investigated sites is similar, the Tertiary rocks of the Carpathian Foreland lie beneath the loess. Loess is influenced by the rocks from which it was blown,

Tab. 18.1. Results of carbon and nitrogen isotope analyses from Gravettian sites from Southern Moravia and the Slovak Republic.

Code	Druh	δ13C	δ15N	C/N
Boršice 2006	*Rangifer tarandus*	-19.53	4.57	3.5
Boršice 2006	*Mammuthus primigenius*	-19.18	6.14	3.5
Boršice 2006	*Mammuthus primigenius*	-22.47	9.8	3.5
Pavlov VI	*Mammuthus primigenius*	-21.70	10.37	3.5
Pavlov VI	*Mammuthus primigenius*	-19.73	9.45	3.5
Pavlov VI	*Mammuthus primigenius*	-19.49	10.05	3.5
DV 1987	*Equus* sp.	-19.33	4.86	3.2
DV 1987, nad cihelnou (abov the brickworks)	*Equus* sp.	-21.03	4.98	3.4
DV II 1987	*Equus* sp.	-20.54	6.54	3.2
Moravany nad Váhom-Lopata II	*Rangifer tarandus*	-20.4	6.4	3.4
Moravany nad Váhom-Lopata II	*Rangifer tarandus*	-20.5	4.81	3.8
Boršice	*Rangifer tarandus*	-20.9	8.6	3.1
Boršice	*Mammuthus primigenius*	-20.2	6.9	2.9
Boršice	*Mammuthus primigenius*	-21.6	7.9	3.0
Dolní Věstonice II, 1987	*Mammuthus primigenius*	-20.4	7.3	2.9
Dolní Věstonice II, 1987, pole (field) II	*Rangifer tarandus*	-20.2	4.3	2.9
Dolní Věstonice II, 1987	*Equus* sp.	-19.0	6.0	2.9
Dolní Věstonice II, 1987	*Equus* sp.	-21.2	6.1	2.9
Boršice	*Rangifer tarandus*	-20.7	4.9	3.2
Boršice	*Rangifer tarandus*	-20.7	6.9	3.1
Boršice	*Rangifer tarandus*	-19.3	5.7	3.0
Boršice	*Rangifer tarandus*	-24.0	5.1	3.0
Moravany nad Váhom-Lopata II	*Rangifer tarandus*	-20.4	6.5	4.6
Moravany nad Váhom-Lopata II	*Rangifer tarandus*	-20.0	6.4	3.0
Moravany nad Váhom-Lopata II	*Rangifer tarandus*	-19.8	4.8	2.7
Moravany nad Váhom-Lopata II	*Rangifer tarandus*	-22.7	5.4	4.0
Trenčianske Bohuslavice-Pod Tureckom	*Rangifer tarandus*	-19.5	5.1	3.0
Trenčianske Bohuslavice-Pod Tureckom	*Rangifer tarandus*	-20.4	5.8	2.9
Trenčianske Bohuslavice-Pod Tureckom	*Rangifer tarandus*	-20.3	5.3	2.9
Trenčianske Bohuslavice-Pod Tureckom	*Rangifer tarandus*	-20.7	6.9	2.9
Boršice	*Rangifer tarandus*	-20.7	9.9	3.2
Boršice	*Rangifer tarandus*	-20.7	6.9	3.1

Tab.18.2. Ratio of strontium isotopes from Pavlov, Dolní Věstonice II, Krems-Wachtberg, Krems-Hunsteig, Stilfried, Jarošov, Přerov-Předmostí, Boršice, Ostrava-Petřkovice, Moravany nad Váhom-Lopata II, Trenčianske Bohuslavice. Krakow-Spadzista.

Lab No.	Locality	Anatomy/species	$^{87/86}Sr$	2S error
jk 5218	1 Př	Enamel, mammoth	0.719810	0.000004
jk 5219	2 Př	Dentine, mammoth	0.719371	0.000004
jk 5220	3 Pr	Enamel, mammoth	0.720095	0.000003
jk 5227	10 Petř	Enamel, mammoth	0.730717	0.000004
jk 5228	20 Petř	Dentine, mammoth	0.731168	0.000004
jk 5229	30 Petř	Enamel, mammoth	0.727742	0.000004
jk 5230	40 Petř	Dentine, mammoth	0.723860	0.000004
jk 5231	50 Petř	Dentine, mammoth	0.723633	0.000004
jk 5519	1. DV IISZ2	Enamel, reindeer	0.709728	0.000009
jk 5520	2. DV IISK3	Dentine, reindeer	0.709480	0.000009
jk 5521	3. DV IISZ4	Enamel, reindeer	0.709551	0.000009
jk 5522	4. DV IISK9	Dentine, reindeer	0.709685	0.000008
jk 5523	5. DV IISK5	Enamel, reindeer	0.709507	0.000008
jk 5524	6. DV IISZ8	Dentine, reindeer	0.709600	0.000007
jk 5525	7. PR K17	Enamel, reindeer	0.709944	0.000008
jk 5526	8. KW Z 38	Dentine, reindeer	0.710423	0.000008
jk 5527	9. KW K39	Enamel, reindeer	0.710306	0.000008
jk 5528	10. KH Z40	Dentine, reindeer	0.710202	0.000009
jk 5529	11. KH K41	Enamel, reindeer	0.710355	0.000008
jk 5530	12. SF Z43	Dentine, mammoth	0.710512	0.000009
jk 5531	13. KW K44	Enamel, reindeer	0.710276	0.000009
jk 5532	14. SF K45	Dentine, mammoth	0.710471	0.000008
jk 5533	15. Kr Sk	Enamel, mammoth	0.711074	0.000009
jk 5534	16. Kr SM2	Dentine, mammoth	0.710856	0.000009
jk 5535	17. Kr Sk3	Enamel, mammoth	0.711134	0.000008
jk 5536	18. Kr SM4	Dentine, mammoth	0.710900	0.000009
jk 5537	19. Kr Sk5	Enamel, mammoth	0.711254	0.000008
jk 5538	20. Kr SM6	Dentine, mammoth	0.711256	0.000009
jk 5539	21. Kr Sk7	Enamel, mammoth	0.710954	0.000009
jk 5540	24. Kr SM10	Dentine, mammoth	0.711031	0.000009
jk 5541	25. Kr Sk11	Enamel, mammoth	0.711244	0.000009
jk 5542	26. Kr SM12	Dentine, mammoth	0.711286	0.000009
jk 5543	27. Ja13	Enamel, reindeer	0.709996	0.000009
jk 5544	28. Ja 16 A,B	Enamel, mammoth	0.710242	0.000009
jk 5545	29. Ja 29 A,B	Enamel, horse	0.709882	0.000009
jk 5546	31. Ja 24 A,B	Enamel, mammoth	0.710334	0.000008

jk 5547	32. PR Z7	Tusk, mammoth	0.710017	0.000009
jk 5548	33. PR Z1	Enamel, mammoth	0.709789	0.000008
jk 5549	34. Pr 48 A,B	Dentine, mammoth	0.710061	0.000008
jk 5550	35. Pa 57 A,B	Tusk, mammoth	0.709998	0.000008
jk 5551	36. Pa 59 A,B	Enamel, reindeer	0.709858	0.000008
jk 5552	37. Pa 79 A,B	Tusk mammoth	0.709909	0.000009
jk 5553	38. Přb A	Enamel, reindeer	0.708116	0.000009
jk 5555	40. G/ S 37	Enamel, reindeer	0.709455	0.000009
jk 5556	41. K-W 34	Enamel, reindeer	0.709865	0.000009
jk 5559	44. Pa 32	Enamel, reindeer	0.709723	0.000009
jk 5284	DV II	Enamel, rodent	0.709794	0.000007
jk 5285	DV II	Enamel, rodent	0.708914	0.000008
jk 5286	DV II	Enamel, rodent	0.711172	0.000008
jk 5287	DV II	Enamel, reindeer	0.711033	0.000008
jk 5288	DV II	Water vole	0.709726	0.000007
jk 5289	DV II	Enamel, bear	0.713604	0.000008
jk 5290	DV II	Enamel, rhinoceros	0.709822	0.000008
jk 5291	DV II	Enamel, mammoth	0.712886	0.000007
jk 5292	DV II	Dentine, mammoth	0.713143	0.000008
jk 5293	DV II	Enamel, rodent	0.718588	0.000008
2137	DV1	Enamel, rodent	0.718109	0.000016
2138	DV2	Enamel, rodent	0.719344	0.00001
2139	DV3	Enamel, reindeer	0.709439	0.000016
2140	DV4	Dentine, reindeer	0.710207	0.000014
2141	DV5	Enamel, horse	0.709932	0.000013
2142	B9	Enamel, polar hare	0.709421	0.000009
2143	B3	Enamel, reindeer	0.709661	0.000018
2144	B6	Dentine, reindeer	0.709786	0.000009
2145	B7	Enamel, reindeer	0.709741	0.000013
2146	B1	Enamel, rodent	0.719748	0.000017
2147	MV4	Enamel, rodent	0.719426	0.000011
2148	MV10	Enamel, reindeer	0.709676	0.00001
2149	MV5	Enamel, reindeer	0.709685	0.000011
2150	MV7	Dentine, reindeer	0.710043	0.000014
2151	MV6	Enamel, reindeer	0.709853	0.000017
2152	TB10	Dentine, reindeer	0.709731	0.000015
2153	TB1	Enamel, reindeer	0.70987	0.000019
2154	TB11	Dentine, reindeer	0.709518	0.00002
2155	TB12	Enamel, reindeer	0.709577	0.000018
2156	TB13	Dentine, reindeer	0.709464	0.000015

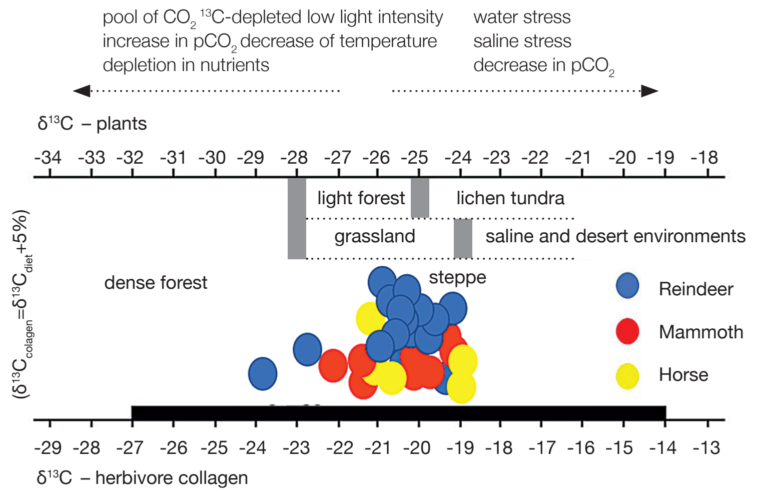

Fig. 18.1. δ^{13}C values obtained from horse, mammoth, and reindeer from Gravettian sites. The obtained values show that the individuals lived and moved in different types of environments. Environmental data was taken from Bocherens (2003), Nelson et al. (1986), Bocherens et al. (1994; 1996; 2000), Rodiére et al. (1996).

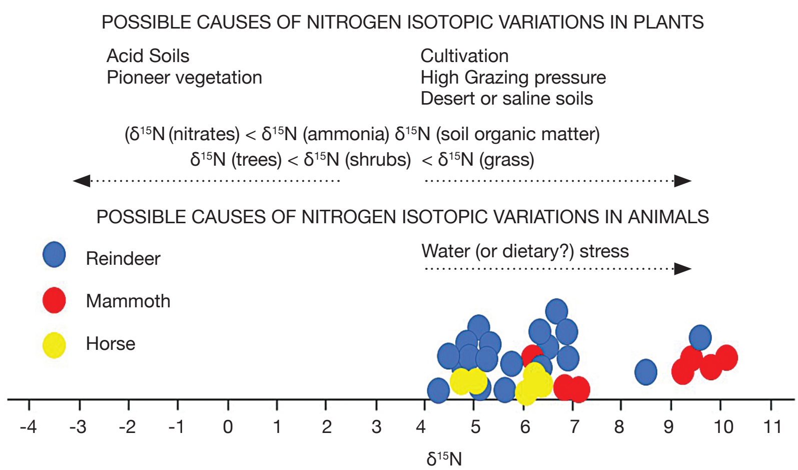

Fig. 18.2. δ^{15}N values obtained from horse, mammoth, and reindeer from Gravettian sites. The obtained values show that the individuals moved during the year in different environments. The environmental data was taken from the Bocherens (2003), Nelson et al. (1986), Bocherens et al. (1994; 1996; 2000), Rodiére et al. (1996).

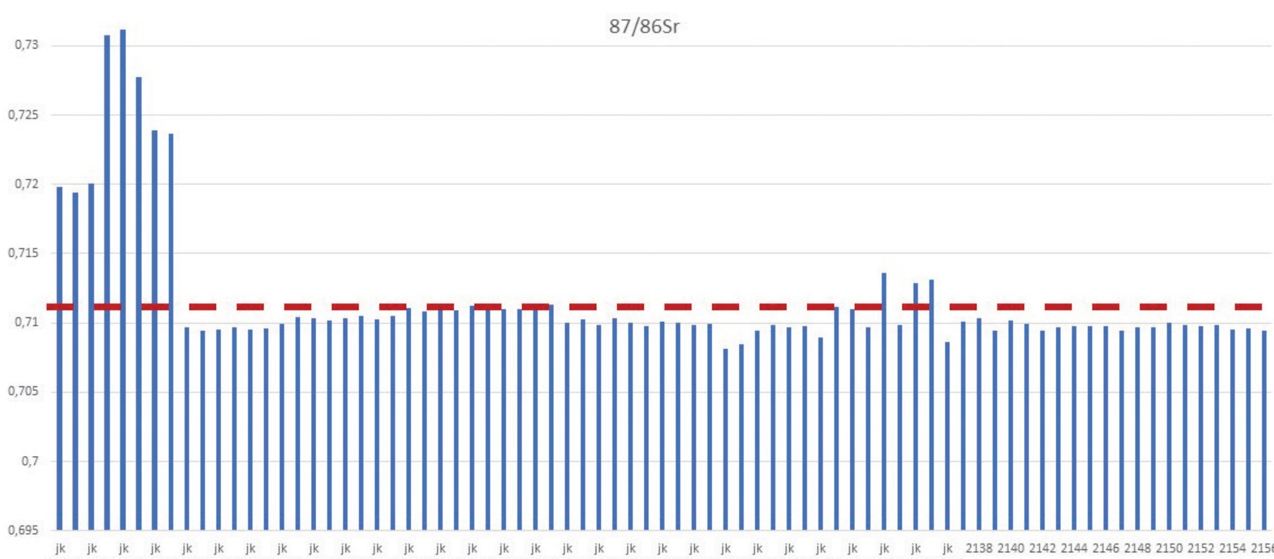

Fig. 18.3. Plotted strontium isotope ratio. The red dashed line shows the range of values at the loess areas. Those values that are below the dashed line are local, and that are above the dashed line are migrants. Author M. Nývltová Fišáková.

Fig. 18.4. Pavlov VI. A concentration of mammoth bones. The sample was taken from a transversely lying tusk. Photo by M. Nývltová Fišáková.

Fig. 18.5. The upper premolar of a woolly rhinoceros from Dolní Věstonice II. Photo by M. Nývltová Fišáková.

and its signal varies regionally (Lisa, Uher, 2006). We therefore see that the reindeer moved in a very small space, and it does not correspond to the traditional large migrations known from recent times (Joly et al. 2021) rather, it corresponds to the herding known among reindeer herders from Siberia, e.g. at Thunz (Novikova, Funk 2012) or see the website reindeerherding.org.

The exceptions are the mammoths from Ostrava-Petřkovice, the woolly rhinoceros (*Coelodonta antiquitatis* – Fig. 18.5) and the brown bear (*Ursus arctos*) from Dolní Věstonice. In addition, the hunting season and multi-element analysis of this individual bear were determined, which showed seasonal migration as well as a diet rich in plants (Sr/Ba ratio) – Nývltová Fišáková et al. (2009); Galiová et al. (2010).

Fig. 18.6. The distal part of the metapodium and the phalanges of the reindeer. Photo by M. Nývltová Fišáková.

It shows that during the Gravettian period in Moravia the climate was so favourable that some mammoths and reindeers did not migrate (Fig. 18.6–18.11). The mammoth migration was documented only in the Přerov-Předmostí and Ostrava-Petřkovice localities. This can be explained by the fact that these mammoths come from the younger phase of the Gravettian, the so-called Willendorf-Kostenkien, when it cooled down (MNI2 stage). This dependence is not present in reindeers. One of the options for reindeers is their eventual domestication. Reindeers is one of the animals domesticated relatively early. Due to isotope analyses of isolated human bones from Dolní Věstonice (Pryor 2006), it appears that the population was more dependent on reindeer than on other animals. Given the early domestication of the dog (Germonpré et al. 2009), this possibility is likely. However, further analysis is needed to verify these conclusions.

Conclusion

On the basis of carbon and nitrogen isotopic analyses, it was shown that the herbivores lived in the steppe to forest-steppe landscape. The environment was poor in precipitation. Based on the strontium isotopes, it turned out that only a part of the animals migrated, mostly the mammoths, mainly from the Přerov-Předmostí and Ostrava-Petřkovice areas. This can be explained by the fact that these mammoths come from the younger phase of the Gravettian, the so-called Willendorf-Kostenkien, when it cooled down (MNI2 stage). The rest of the mammoths ranged in Southern Moravia, Northeastern Austria, and Slovakia. Which indicates that in the Subdanubian area mammoths did not migrate much and lived in small groups. Reindeers migrated even less, which could mean that the Gravettian hunters were more herders and grazed the reindeer, as we know it from Siberia, for example near Thunz. For this conclusion it is necessary to conduct further analyses. However, it appears that the study area was rich in resources during the Gravettian period and supported a large number of faunae.

Fig. 18.7. The landscape of Altai showing the type of landscape like the Central Europe lanscape during Gravettian period. Rich vegetation around the river, with Siberian larch (*Larix sibirica*), pine limba (*Pinus cembra*), willow (*Salix sibirika*) and gooseberry (*Potentilla anserina*). Photo by M. Nývltová Fišáková.

Fig. 18.8. Forest-steppe with Siberian larch (*Larix sibirica*) in Altai.
Photo by M. Nývltová Fišáková.

Fig. 18.9. Wooded northern slopes with Siberian larch (*Larix sibirica*) in Altai.
Photo by M. Nývltová Fišáková.

Fig. 18.10. A forest of Siberian larch (*Larix sibirica*) in Altai.
Photo by M. Nývltová Fišáková.

Fig. 18.11. Siberian larch forest (*Larix sibirica*) transitioning to forest-steppe.
Photo by M. Nývltová Fišáková.

19

What do some findings of fauna indicate: Notes on the survival of mammoths and woolly rhinos at the end of the Last Glacial Maximum

Zdeňka Nerudová

Introduction

Not only in recent years, but also through earlier research, we have obtained interesting information about the late Paleolithic settlements, where, in addition to the stone chipped industry, the remains of Pleistocene fauna were often discovered. If we leave aside the cave environment, which has been the focus of archaeological research since its inception, and of which numerous localities are known, open-air localities are also gradually being discovered. These finds, although at first quite rare, were somewhat unusual: in terms of stratigraphic placement, the nature of the finds, or, for example, the presence of representatives of certain types of megafaunas. In this paper, I would like to focus on the phenomenon of the survival of representatives of the megafauna (Martin 1984), specifically the woolly mammoth and the woolly rhinoceros, based on known findings of the bones of these animals from archaeological (cultural) contexts. I would like to summarize the faunistic finds of mammoth and rhinoceros from the end of the LGM on our territory and point out some interesting aspects that result from these finds and comment on them in a somewhat broader context. From an archaeological point of view, these osteological finds can be associated with Epigravettian and Magdalenian. Since many of these osteological findings have been directly dated, the occurrence of mammoth or rhino bones in Epigravettian and Magdalenian cannot be attributed to the mere collection of randomly found cadavers. Given the stratigraphic deposits of the Epigravettian and Magdalenian industries, it is not surprising that the bones of these two species of fauna are found in cave environments rather than in open-air localities. At the same time, however, due to the demands of both mammoth and rhino on the ecosystem, the caves represent an environment completely unsuitable for these species. The main focus of this contribution is put on the mammoth or rhino bones, tusks, and teeth. For simplicity, I only write bones, but I mean generally any kind of hard animal tissues.

doi 10.47382/dvs_26-19

Fauna, environment, dating

Mammoths and rhinoceros are probably the most typical members inhabiting the so-called mammoth steppe, a cold, dry, and grassy biome, as defined by Guthrie (Guthrie 1968; 1982; 2001). These two representatives of megafauna are often considered to be iconic animals of the Ice Age. Although the extent of their habitat did not completely overlap, the rhinoceros and the mammoth had almost the same requirements for the environment, which was an open steppe or park landscape, with adaptation to cold climatic conditions (Musil 2014, 131). Despite the term mammoth steppe, the mammoth steppe represented a biome with a great diversity of species including large mammals with specific nutritional conditions, focused on sufficient water sources and energetically suitable food (Guthrie 2001).

Towards the end of the last glacial period, probably due to climate changes, some representatives of the large Pleistocene fauna die out, while other (smaller) species migrate to other (more suitable) areas. Numerous works confirm that the extinction of some species at the end of the Pleistocene is not a simple causal phenomenon, but a long complex process with multiple factors. The definition of extinction states that: "When the fossil bones of a given species fail to appear above a certain stratigraphic horizon in a region, we assume that this species died out, at least in that region. However, as the old proverb says, 'absence of evidence is not evidence of absence.' The discovery of any younger fossils will, of course, mean that the extinction date has to be revised" (Elias, Schreve 2007). It can only be noted that such revisions occur with basically every new archaeological or paleontological find.

Several professional contributions are devoted to the causes and, in particular, to the question of when certain species of fauna die out in the Late Pleistocene. Discussions devoted to the causes of extinction (caused by climate changes, human activity, or the coincidence of both factors) are relatively rich (for example, Musil 1993, 2014; Elias, Schreve 2007; Markova et al. 2010b; Leshchinskiy 2012; MacDonald et al. 2012,) and are not the point of this paper. A great deal of literature is also dedicated to the time of the extinction of individual species, while the absolute dates are refined and condensed, or the extinction limit of the studied species is moved closer to our present day, such as for the woolly mammoth (Stuart et al. 2004; Markova et al. 2010a, 2013; Nadachowski et al. 2011; Stuart, Lister 2012).

Some authors state that in the period of the end of the LGM (15–18 ky BP), due to warming, mammoths or woolly rhinoceroses should not be represented in the hunting fauna. They claim that, for example, the bones of the woolly rhinoceros (hunted game) are not found in European Paleolithic sites from the end of the Last Glacial period, or are completely absent (Musil 2003), while they are supposed to be rare already in the Gravettian. In Siberia after the LGM around 20 ka BP, the share of wholly rhino should be only 11% (Lorenzen et al. 2011; Stuart, Lister 2012). Published data indicate that the mammoth became extinct in Europe sometime around the end of the last glaciation, perhaps 12.8 ka (Stuart 1991; 1999). Northern populations decline in the Younger Dryas (~12.9–11.5 ka), except Wrangel Island and Beringia, where the last individuals definitively die out around 4 thousand ka (MacDonald et al. 2012). The definitive extinction of the woolly rhinoceros is supposed to occur around 14 ka (Stefaniak et al. in press), the youngest age of the find is 13.9 ka (Stuart, Lister 2012). Although a Holocene date of 9510 ± 260 BP (IPAE-93) BP (IPAE-93) (Kosintsev 1995; 2007) was previously obtained at the Lobvinsy Cave site in the Middle Urals, this date was not accepted as it is an extreme outlier which could not be tested by further dating (Stuart, Lister 2012). At the same time, at the end of the LGM, there should be a fundamental change in the species composition of the fauna and the quantitative representation of species. Examples are the gates of the

Kammern-Grubgraben and Ságvár localities (Musil 2014, 141). The above-mentioned locality, due to the turbulent history of research (Neugebauer-Maresch et al. 2016), is not an ideal example in the given discussion, Ságvár seems to be a station oriented towards reindeer hunting, although the discovery of mammoth bones is also described from there (Vörös 1982). Musil further states that the Magdalenian [regarding the hunting fauna] shows similarities with the preceding Epigravettian and at the same time points out that the glacial fauna, if they are young finds [in terms of their dating], are always found in caves (Musil 2014, 142).

The above-cited reasoning does not correspond to the archaeological data, which have been multiplying especially in recent years. The disproportion between the faunal findings, often originating from the context of Paleolithic artefacts, and the radiometric dating of some of these faunal findings was unfortunately not accepted by the aforementioned author, especially when it was obvious based on many years of "autopsy" that the species in question simply could not occur at that time. Small localities with rare evidence of animal bone finds were overlooked because their negligible number could not compete with large, long-term investigated localities with dozens or hundreds of faunal finds.

A relatively extensive comparative study devoted to the Epigravettian chronology in Central Europe in the context of the dominant types of stone tools and faunal remains was recently published (Lengyel et al. 2021). From it, I cite data concerning the finds of mammoth and rhinoceros bones and expand them with the context of the finds from Moravia (Tab. 19. 1).

Although not all of the cited finds come from a clear stratigraphic context, it is clear that finds of mammoth and rhinoceros bones are relatively common not only in the Epigravettian but also in the Magdalenian. Even if we exclude finds that do not chronologically fall within the time frame monitored here, and further then finds that have been unequivocally proven to be unrelated to late Paleolithic settlement (for example Šošůvské caves, Výpustek, Vratíkov), the overview of their occurrence in Moravia will remain quite numerous. If we were to mention the findings from the wider area, then we must mention that the bones of the woolly rhinoceros come from Hostim, or the Na Průchodě Cave, from Western Europe the rhinoceros was further documented in Grappin, Rigny, Müzingen, Kesslerloch, Napoleonskopf, Burghöhle Dietfurt, Kuhstalhöhle, Spitzbubenhöhle, Vogelherd, Roche-al-Rue, Gönnersdorf, Wildweiberlei, Wildscheuer, Herdloch Ranis, Oelknitz, Lausnitz, Schafgraben, and Kamegg (Maier 2015). Woolly mammoth bones were also recorded at the Magdalenian sites of Croze-sur-Suran, Grappin, Farincourt, Rigny, Freudenthalh, Kesslerloch, Petersfels, Napolenskopf, Höhle Fels, Schelk, Brilenhöhle, Kastelhanghöhle, Coléoptère, GD, Verlaine, Gönnersdorf, Feldhofhöhle, Wildscheuer, Aschenstein, Teufelsbrücke, Oelknitz, Kniegrotte, Lausnitz or Schafgraben (Maier 2015). Mammoth or rhinoceros bones have also been documented in the late Magdalenian in Poland (Połtowicz-Bobak 2012).

In the past, several extensive dating projects have been carried out, focusing on the woolly mammoth and woolly rhinoceros in the wider area of Central Europe. For example, in the case of woolly mammoth finds in Poland, it turned out that after a certain break, bounded by roughly 24 cal. ka BP up to 18 cal. ka BP, when the mammoth disappears from the records, its return occurs between approximately 18 and 15 cal. ka BP (Nadachowski et al. 2011; Stefaniak et al. in press). According to the definition, "extirpation" (i.e. local extinction) occurred in these species, which is not synonymous with extinction (Elias, Schreve 2007).

Considering the research of available resources and the ecological demands of both species, I would like to point out several problems. Musil states that both the mammoth and the rhinoceros needed

Tab. 19.1. Findings of woolly mammoth (M) and rhinoceros (Cl) dated to the end of the LGM from an arc haeological context. If it is significant, and if the information is available, the number of MNI in the locality is also given.* indicates a problematic find (i.e. old find, uncertain stratigraphy or context, uncertain dating, etc.)

Site	Datation	Specie	Note	Source
Bratčice	Epigravettian	M (>1)	Date from the mamoth: OxA-33454: 14,395 ± 70	Nerudová et al. 2019
Brno-Štýřice II I	Epigravettian	M (>1), Cl	Date from the mamoth bone OxA-28114: 14,870 ± 90	Roblíčková et al. 2015
Jaroslavice	Epigravettian	M, CL	GrA-7574: 19,340 ± 100 BP	Wurmbrand 1878
Horákov "Macocha"	Epigravettian	M		Škrdla, Kos 1999
Kamenná (Brno-Štýřice)	Epigravettian	M	Date from the mammoth bone *OxA-24105: 14,235 ± 60 BP	Nerudová 2010
Nemocnice Milosrdných bratří (Hospital)	Epigravettian	M	*GdA-459: 15,650 ± 70 BP	Škrdla et al. 2005
Opava – Předměstí I (Lundwall´s Brickyard)	Epigravettian	M		Bayer, Stumpf 1929
Oslavany – elektrárna (power station)	Epigravettian	M, Cl		Oliva 2007
Stadice	Epigravettian	M	GrN-15862: 14,280 ± 120 BP Date from mammoth bone – OxA-42443: 14,121 ± 83 BP	Vencl, Fridrich 2007; Oliva 2023
Stránská skála IV	Epigravettian	Cl	GrN-13954: 18,220 ± 120	Svoboda 1991
Stránská skála IV	Epigravettian		GrN-14351: 17,740 ± 90	Svoboda 1991
Stránská skála IV	Epigravettian		Poz-101463: 18,670 ± 110	Svoboda et al. 2020
Třebíč 1 – Ptáčov	Epigravettian	M		Vokáč 2003
Velké Pavlovice	Epigravettian	M	Date from the mammoth bone *GrN-16139: 14,460 ± 230 BP	Svoboda, Fišáková 1999
Vídeňská 11	Epigravettian	M, Cl (>1)	Date from the rhino bone: Poz-137944: 15,560 ± 80 BP	Nerudová et al. 2022
Vídeňská 15	Epigravettian?	M	Association with Epigravettian according to stratigraphy	Nerudová et al. 2022
Vojtova	Epigravettian?	M or Cl	Association with Epigravettian according to stratigraphy	Nerudová et al. 2022
Zlín-Louky	Epigravettian	M		Klíma 1956a
Moravany nad Váhom-Podkovica (all excavations)	Epigravettian	M (>1)	The data range from 22,682 ± 400 to 17,160 ± 690 uncal BP	Hromadová et al. 2021
Moravany nad Váhom-Žakovská	Epigravettian	M		Hromada, Kozłowski 1995; Kubiak 1995; Lengyel et al. 2021
Krakow-Spadzista, Trench E, 1986	Epigravettian	M	Stratum C2, AMS from mammoth teeth 7,350 ± 35 BP	Wiśniewski et al. 2017; Wojtal et al. 2015
Krakow-Spadzista, Trench F, 1989	Epigravettian	M, Cl		Wiśniewski et al. 2017; Wojtal et al. 2015
Krakow-Spadzista Trench E1, 2012	Epigravettian	M (2 MNI)		Wiśniewski et al. 2017; Wojtal et al. 2015

Langmannersdorf	Epigravettian	M (17 MNI), Cl	C-14 dating directly from the mammoth bone; 19,340 ± 100 up to 20,590 ± 110 uncal BP	Verpoorte 2004; Lengyel et al. 2021
Estergom-Gyurgyalag	Epigravettian	M (1 MNI)	C-14 dating directly from the mammoth bone; 15,120 ± 80 up to 16,160 ± 200 uncal BP	Lengyel et al. 2021
Budapest-Csillaghegy	Epigravettian	M (1 MNI)	15,940 ± 150 uncal BP, the youngest date 13,460 ± 70 uncal BP; date from the mammoth tooth	Lengyel et al. 2021
Balcarova skála Cave*	Magdalenian	M, Cl		Knies 1900
Barová Cave	Magdalenian	M, Cl		Horáček et al. 2002; Seitl et al. 1986
Býčí skála Cave*	Magdalenian	M, Cl		Musil 2002
Čertova díra Cave	Magdalenian	Cl	In Layer 2	Musil 2002
Hlavicova Cave	Magdalenian	M, Cl	Retrospectively reconstructed according to the data	Skutil 1955
Jeskyňka č. 10 u Křtin (Vinckova) Cave	Magdalenian	Cl		Valoch 1950
Jeskyně č. 16 (“Pod Vintokami”, V Hložku)* Cave	Magdalenian?	M, Cl	Numerous perhaps splintered bones	Skutil 1949
Jezevčí díra Cave	Magdalenian	M		Skutil 1941
Kolíbky Cave	Magdalenian	M		Skutil 1941
Křížova Cave	Magdalenian	M, Cl	Rather basis of Magdalenian layer	Musil 2002
Kůlna Cave	Magdalenian	M, Cl	In layers 5 and 6.	Musil 2002
Liščí Cave*	Magdalenian	M, Cl	Basis of Magdalenian layer or older	Musil 2002
Michalka Cave*	Magdalenian	M	Basis of Magdalenian layer or older	Musil 2002
Nová Drátenická Cave	Magdalenian	Cl		Klíma 1949
Pekárna Cave	Magdalenian	M, Cl		Musil 2002
Sklep Cave*	Magdalenian?	Cl	The association with the Magdalenian is not certain	Musil 1954
Šipka Cave	Magdalenian	M, Cl		Musil 2002
V Hložku Cave	Magdalenian	M, Cl	102 pcs of rhino bones, 8 pcs of mammoth bones	Skutil 1949
Zkamenělý zámek (Javoříčko)	Magdalenian	M, Cl		Skutil 1941
Žitného Cave	Magdalenian	Cl	Date from the rhino bone: 11,425 cal BP	Musil 2014
Desczowa	Late Magdalenian	M, Cl		Cyrek et al. 2000
Dzierżysław 35	Late Magdalenian	M	C-14 dating directly from the bones	Ginter et al. 2002
Maszycka	Magdalenian	Cl		Lasota-Moskalewska 1995
Wilczyce	Late Magdalenian	Cl	Often butchered!	Irish et al. 2008
Zawalona	Magdalenian	Cl		Alexandrowicz et al. 1992

a cool, open, and grassy landscape, but at the same time states that the youngest bone finds known in our country come from the caves of the Moravian Karst (Musil 2014). This is a completely different ecosystem, which, moreover, does not represent the places where animals live, but the preferences of people (hunters) or other animals.

The fact that R. Musil mentions finds mainly in caves and not from open-air locations is due, on the one hand, to the fact that he did not carry out careful research of the finds and then especially to the fact that the cave environment was, after all, more suitable for the preservation of animal bones than the late glacial secondary sediments in open air. Animal bones or dentition are not preserved at many of the Magdalenian open-air sites (Kobylanka, Borky, Loštice, Hošťálkovice), and also at many Epigravettian stations (Kašov, Nitra III). Many localities do not have suitable depositional conditions, animal bones are fragmented, incohesive, corroded, and/or undeterminable: Święte 9, Targowisko, Sowin, Kašov, Nitra III (Wiśniewski et al. 2012; Kaminská 2014; Kaminská, Nemergut 2014; Łanczont et al. 2021). If the soil conditions allowed preservation, the entire spectrum of the glacial mammoth fauna can be found (Brno-Štýřice III). In this context, it is appropriate to recall that "absence of evidence is not evidence of absence" mentioned in the introduction.

The depiction of mammoths and rhinoceroses in the Magdalenian – among other animals – is usually interpreted as depicting something that people probably did not already know from autopsy, even though these depictions are perfect and faithful. Some authors even deny the possibility of hunting them. Stuart and Lister 2012 write: "Although figured in Palaeolithic art, there appears to be no compelling evidence that woolly rhinoceros – a large, formidable and dangerous animal – was hunted by humans, although presumably, this might have happened occasionally. The rare occurrence of their remains in caves and open-air sites could well represent material collected after death" (Stuart, Lister 2012, 12). Without discussing the question of hunting here, there is a contradiction between the facts, because their finds, at least on a regional scale, are not rare. Moreover, many of the youngest bone finds come from a clear archaeological context (Bratčice, Stadice, Brno-Štýřice III, Kamenná, Vídeňská, Moravany-Podkovica; see Tab. 19. 1). Therefore, I contend that the argument of merely collecting the bones of dead animals is not tenable. Even if we take into account the statistical variation of the dating, then if such young cadavers were collected, the particular Paleolithic settlement would have to be quite a bit younger than we think, or the cadavers would have to be quite fresh, given that many absolute dates come from animal bones.

Conclusion

Osteological finds from Central and Western Europe indicate a long survival of the mammoth and the rhinoceros, in some cases until the beginning of the Holocene.

Their sporadic presence on late Paleolithic sites may not be due to their extirpation or extinction, but rather to depositional conditions in late-Pleistocene sediments that are soiled by Holocene sediment. The most eloquent evidence is the skull of a mammoth from Brno-Štýřice III, the upper part of which was covered with Holocene sediment!

The main hunting fauna in the Magdalenian were horses and reindeer, while in the Epigravettian it was probably still mammoths. Especially in the early and late stages of the Epigravettian, mammoths dominate the fauna, as reported by Lengyel (Lengyel et al. 2021, 177, Tab. 11). Therefore, there was no need for competition between Magdalenian and Epigravettian in terms of subsistence.

Given the long survival of both mammoths and rhinoceroses, there is no reason to believe that the Magdalenians could not have known them from autopsy. Assuming that the reasoning about different subsistence strategies in the Magdalenian and Epigravettian is true, then if the Magdalenians themselves did not actively hunt these animals, they may have obtained them (e.g. by exchange) from the Epigravettians.

Regardless of the meaning, the material used, or the style of execution, I tend to believe that realistic depictions of animals are mostly always based on autopsies. How else to explain that, for example, in the Wadi Buzna rock art gallery, the wild animals shown correspond to the desert climate and the time of creation of the rock carvings (Jelínek 1994); in Mathrndush (Fezzan) the progressing domestication of some animals is recorded (Jelínek 1984). A small engraving of a mammoth cub with its mother was found at the Petite grotte de Bize locality in the younger Solutréen, proving the ethology of these animals (Sacchi 2017). Realistic representations of the woolly mammoth with many details are dated to the middle and late Magdalenian (Rouffignac, Font-de-Gaume, Les Combarelles, Bernifal). Finally, why else would the regions of occurrence of the fauna overlap with the localities where it was depicted (Braun, Palombo 2012)?

Acknowledgement

I would like to thank my colleagues Adrián Nemergut and Martin Novák for inviting me to participate in the book dedicated to the 70th anniversary of Ľubomíra Kaminská and for their insistence that I definitely write something. I have known associate professor Ľubomíra Kaminská and have met her occasionally for more than 30 years! I met her for the very first time in 1990 or 1991, when we fresh students in the 1st and 2nd year at Masaryk University, Faculty of Arts, as part of our student excursion to eastern Slovakia, had a lecture on the Paleolithic in Slovakia.

This chapter appears through the institutional support of long-term conceptual development of research institutions provided by the Ministry of Culture (ref. MK000094862).

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"...instead of conclusion". Commemoration of the Ľubomíra Kaminská life anniversary

Adrián Nemergut, Martin Novák

"It is a joy to be able to regard ones' mentors and tutors as kind friends. The same joy is the chance to wish a kind friend a distinguished life jubilee. Happy birthday Ľuba, and many more stones..."
Ivana Fridrichová-Sýkorová

With the year of this monograph's publication, we are commemorating the important life anniversary of our colleague, mentor and friend, a prominent Slovak archaeologist, university teacher and long-time researcher at the Institute of Archaeology of the Slovak Academy of Sciences, doc. PhDr. Ľubomíra Kaminská, DrSc. The presented monograph is therefore also a small gift for this jubilee.

Ľubomíra Kaminská was born on 1 April 1954 in Úbrež in the Sobrance District. Her academic and scientific journey began in 1973, when, after graduating from the Secondary General Education School in Sobrance, she was accepted for university studies at the Archaeological Seminar of the Faculty of Arts of Comenius University in Bratislava. She successfully completed her studies in 1978 by defending her diploma thesis "Keramika zdobená brázdeným vpichom typu Bajč-Retz" [*"Furchenstich"* pottery of the Bajč-Retz type]. She started her career in professional archaeology the same year, when she joined the District Museum of Local History in Trebišov. Already a year later, in 1979, she was admitted to the Institute of Archaeology of the Slovak Academy of Sciences, to the Department of Research of Eastern Slovakia in Košice. Here, alongside Ladislav Bánesz, she gradually developed into a leading figure in Slovak archaeology specialising in the Paleolithic period. Košice became her home and the Eastern Slovak department of the Institute of Archaeology of the Slovak Academy of Sciences her permanent place of work, where she continues her research with unceasing energy and enthusiasm, since 2019 as its head.

doi 10.47382/dvs_26-20

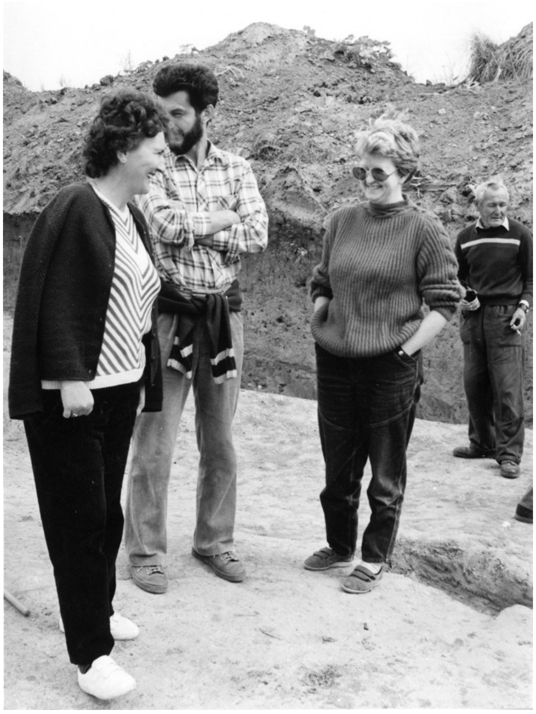

Fig. 20.1. Ľubomíra Kaminská, together with Mária Lamiová-Schmiedlová and Ivan Smatana, on a visit to the archaeological excavation of the multicultural site of Nižná Myšľa-Alamenev (Slovakia) in 1986. Photo by A. Marková.

During her professional career, she did not stop in her own scientific education. Already in 1980, she received the title of PhDr. at the Faculty of Arts of Jan Evangelista Purkyně University in Brno (today's Masaryk University). The subject of the defended rigorous thesis "Príspevok k štúdiu sakrálnych stavieb, cintorínov a pohrebísk v 11.–13. storočí na juhovýchodnom Slovensku" [A contribution to the study of sacral buildings, cemeteries and burial grounds in the 11th–13th centuries in Southeastern Slovakia] was a treatment of her first archaeological research, which she conducted while working in the museum in Trebišov, where she examined an early medieval cemetery and a Romanesque sacral building (Kaminská 1982). In 1989, she was awarded the scientific rank of CSc. (Candidate of Sciences) in the field of archaeology, which she defended with the candidate thesis "Význam surovinovej základne pre mladopaleolitickú spoločnosť vo východokarpatskom priestore" [The importance of the raw material base for the Upper Paleolithic society in the Eastern

Fig. 20.2. Visiting the Korolevo II Paleolithic site (Ukraine) during the international archaeological conference's excursion in 1990. From up left: J. Bárta, A. Ringer, V. Usyk, L. Seitl, K. Valoch, M. Oliva, Yu. Demidenko, K. Sobczyk, I. Kovanda, M. Gladkyh, V. Sitlivy, J. Fridrich, Yu. Kukharchuk, L. Zykina, Ľ. Kaminská, V. Gladilin, L. Gladilinova. Photo by S. Ryzhov.

Carpathian area] at the Institute of Archaeology of the Slovak Academy of Sciences in Nitra. This work, published in abbreviated form in 1991 in the journal *Slovenská archeológia* (Kaminská 1991), contributed significantly to the knowledge of the use of raw material sources for the chipped stone industry in the Upper Paleolithic in Slovakia and adjacent areas. In 2008, she habilitated as an Associate Professor in the field of archaeology at the Faculty of Arts of Comenius University in Bratislava with her monograph "Hôrka-Ondrej. Osídlenie spišských travertínov v staršej dobe kamennej" [Hôrka-Ondrej. Settlement of the Spiš travertines in the Old Stone Age] (Kaminská 2005). With this habilitation thesis, she summarised the results of her long-term research at the eponymous site and significantly expanded the knowledge of the Middle Paleolithic settlement of Slovakia. The highest scientific rank of DrSc. was awarded to her by the Slovak Academy of Sciences in 2016 based on the doctoral thesis "Staré Slovensko 2. Paleolit a mezolit" [Old Slovakia 2. Paleolithic and Mesolithic] (Kaminská et al. 2014).

As part of advancing her scientific career, she also developed her education through foreign internships and scholarships, which significantly helped her to expand her scientific horizons and familiarise herself with the latest trends in Paleolithic and Mesolithic research. In 1990, she completed study stays at the Institute of Human Palaeontology in Paris and at the Institute of Archaeology of the Russian Academy of Sciences in St. Petersburg. She received the prestigious DAAD (Deutscher Akademischer Austauschdienst) German scholarship twice, in 1992 and 1999, which she completed at the University of Erlangen–Nuremberg at the Institute of Prehistoric Archaeology. She completed other study stays abroad in Austria at the Department of Prehistoric and Protohistoric Archaeology at the University of Vienna (1993, 1995, 1996 – SAIA scholarship, 2007), in Poland at the Institute of Archaeology of the Jagiellonian University in Krakow (1998, 2000, 2004, 2008) and at the Institute of Archaeology and Ethnology of the Polish Academy of Sciences in Poznań (2003) and also in the Czech Republic at the Institutes of Archaeology of the Czech Academy of Sciences in Prague (2004) and Brno (2005). Thanks to these study stays, she acquired valuable professional knowledge and experience, which she further utilized in her work, and at the same time, she created a wide network of scientific and friendly contacts, which she has maintained to this day.

Fig. 20.3. Ľubomíra Kaminská explaining the stratigraphy at the Hôrka-Ondrej Middle Paleolithic site (Slovakia) during an archaeological excursion in 1996. Photo by A. Marková

In addition to scientific research, Ľubomíra Kaminská is also actively involved in teaching activities, through which she contributes to the education of the next generation of archaeologists and historians. In 2004, she began lecturing at the Faculty of Theology in Košice of the Catholic University in Ružomberok, where she worked until 2009. From 2006 to 2011, she led lectures and seminars on the Paleolithic for students of archaeology and classical archaeology at the Faculty of Arts of Comenius University in Bratislava. Since 2009, she has been working as an associate professor at the Department

Fig. 20.4. Ľubomíra Kaminská with Jiří Svoboda, Krzysztof Sobczyk and Janus K. Kozłowski during the excavation at the Middle/Upper Paleolithic site of the Dzeravá Skala Cave (Slovakia) in 2002. Photo archive of Ľ. Kaminská.

of History of the Faculty of Arts of Pavol Jozef Šafárik University in Košice. In 2018, she wrote, not only for its students but all those interested in the subject, the first university textbook dedicated to the prehistory and early historical period in Slovakia (Kaminská 2018a).

With her energetic approach, resolution, and ambitions, Ľubomíra Kaminská naturally oriented herself towards researching such complex periods as the Paleolithic and Mesolithic from the beginning of her professional career. After arriving at the Institute of Archaeology of the Slovak Academy of Sciences, she gradually took over the research baton from Ladislav Bánesz and Juraj Bárta and developed into a leading figure in Slovak Paleolithic archaeology. That is also why her field activities were focused primarily on the research of Upper and Middle Paleolithic sites, of the most important ones, e.g. Hrčeľ (1982, 1983, 1985), Háj – Slaninová jaskyňa (1986), Hôrka-Ondrej (1987–1992, 1995), Nemšová (1996, 1997), Banka (1997), Nižný Hrabovec (1998, 2000), Cejkov (2001), the Dzeravá Skala Cave near Plavecký Mikuláš (2002), Trenčianska Turná (2007), Trenčianske Teplice (2009), and Seňa (2016). Nevertheless, she also contributed to expanding knowledge of chronologically later periods. In particular, it is necessary to mention the research of the Neolithic settlement at the sites of Červený rak, Galgovec and Barca in Košice (1980, 2000, 2005, 2012), or the larger multicultural sites of Ižkovce (1994) and Čičarovce (1998). She has published the results of her research in the form of numerous contributions in scientific journals and collective volumes (her rich bibliography cites over 200 publication outputs) and has also presented them at various international conferences. She placed great emphasis on the interdisciplinary approach while intensively collaborating not only with archaeologists and natural scientists from Slovakia, the Czech Republic, Poland, and Hungary but also from France, Spain, Great Britain, Australia, the USA and Canada. She treated her most important research projects in monographs – Čičarovce-Veľká Moľva (Kaminská 2010), Hôrka-Ondrej (Kaminská 2005), Hrčeľ-Pivničky (1995), and the Dzeravá Skala Cave (Kaminská et al. eds. 2005).

During her scientific career, she managed to publish not only the results of her field activities, but also to treat archaeological material and evaluate finding situations from the research work of her predecessors, e.g. in cooperation with P. Neruda monographically treated and reevaluated the Middle Paleolithic travertine sites in Bojnice (Neruda, Kaminská 2013), in cooperation with J. K. Kozłowski, they collectively evaluated J. Bárta's research at the Nitra I-Čermáň site, which they put into the context of the Late Gravettian of Central Europe (Kaminská, Kozłowski 2011), or in cooperation with A. Nemergut processed J. Bárta's previously only partially published research from 1964 at the Epigravettian site of Nitra III (Kaminská, Nemergut 2014).

From her theoretical works, it is necessary to mention an overview of the development of Gravettian on both sides of the Carpathians (Kaminská, Kozłowski 2002) or a reevaluation of Szeletian finds from Slovakia (Kaminská et al. 2011). Her collective work "Staré Slovensko 2. Paleolit a mezolit" [Old Slovakia 2: Paleolithic and Mesolithic] (Kaminská et al. 2014) is extremely important and beneficial on an international scale, because it is an essential and valuable source of information not only for the professional, but also for the lay public. The comprehensive monograph is a long-awaited publication for which the Paleolithic community has been waiting for almost 50 years, since the last (and at the same time the very first) monographic synthesis of the Paleolithic and Mesolithic in Slovakia was published (Bárta 1965). Here, in accordance with the modern and interdisciplinary research trend, the author has summarized comprehensively and in meticulous detail the previous knowledge about Paleolithic and Mesolithic settlements on the territory of Slovakia in the broader context of Central European development.

Since 1995, Ľubomíra Kaminská has been actively involved in domestic grant projects awarded by the VEGA grant agency. Initially, she worked as a co-investigator, and since 2001, she has become the principal investigator of five projects researching the issue of the Stone Age in Slovakia. Her research work was not limited only to domestic initiatives. As a co-investigator, she also participated in several international projects that received support from renowned foundations such as the Wenner-Gren Foundation, The Leakey Foundation, the Visegrad Fund, or the Czech Science Foundation.

Ľubomíra Kaminská also shares her scientific outlook and experience as a member of the editorial board of domestic and foreign scientific journals or expert commissions. Since 1991, she has been a member of the editorial boards of the journals *Východoslovenský pravek* and *Slovenská archeológia* (both published by the Institute of Archaeology of the Slovak Academy of Sciences in Nitra). Between 2000 and 2020, she also served on the editorial board of the *Praehistoria* journal, published by the University of Miskolc in Hungary. Since 2021, she has also been a member of the Slovak Commission for Scientific Ranks of the Ministry of Education, Science, Research and Sports of the Slovak Republic. The international impact of Ľubomíra Kaminská is also proven by her membership in the international professional organization "Union international des Sciences Préhistoriques et Protohistoriques, Commission 8: Le Paléolithique Supérieur de'Eurasie" (UISPP) affiliated to UNESCO, where she has represented Slovakia since 1998.

During her 45-year scientific career, Ľubomíra Kaminská has built a reputation as an extremely hardworking and active researcher with an undeniable contribution to the research of the earliest human history. That is also why, in her case, it is not surprising that she is still interested in further research endeavours and new challenges, whether it is field excavation, analysis of the finding material or publishing in renowned international journals, which her peers often resign themselves to. Moreover, she is often able to motivate even younger colleagues in this regard. In the same way, this book is, in a sense, the result of her tireless scientific curiosity, passion for knowledge, and, above all, her ability to connect researchers from different corners of the world in fruitful direct collaboration. It is precisely in such an atmosphere of mutual sharing of scientific knowledge and collaborative work that our scientific community is able to assemble individual small and often inconspicuous fragments of archaeological research into a complex, vivid picture of the earliest human history. We believe that this monograph is proof of that, and that the work of Ľubomíra Kaminská will continue to inspire archaeologists of all generations and be a model for all who strive for a deeper understanding of our past.

Fig. 20.5. Visiting the Miriama rockshelter Mesolithic site (Slovakia) in 2022. From left: M. Horvát, M. Ďurišová, M. Orvošová, G. Lešinský, A. Nemergut, Ľ. Kaminská, J. Psotka. Photo by M. Soják.

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doc. PhDr. Ľubomíra Kaminská, DrSc.

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Institute of Archaeology
Czech Acad Sci, Brno

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of Sciences

ISBN 978-80-7524-080-4