Recent Developments in Archaeometry and Archaeological Methodology in South-Eastern Europe

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Edited by

Ina Miloglav

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PREFACE

The book *Recent Developments in Archaeometry and Archaeological Methodology in South-Eastern Europe* presents papers from the 3rd and 4th scientific conferences *Methodology and Archaeometry,* which were held during 2015 and 2016 at the Faculty of Humanities and Social Sciences of the University of Zagreb, Croatia. As the goal of the conference is to entice interdisciplinarity, critical thinking, new insights and approaches, as well as new theoretical frameworks in contemporary archaeological science, it has resulted in the ten scientific papers presented in this volume. The papers focus on various kinds of archaeological issue in the fields of archaeological methodology and archaeometry. From non-destructive methods which help us to better understand archaeological sites and landscapes and to preserve them, through different aspects of material analysis by using different analytical methods and techniques, to experimental archaeology which enables us to explain and reconstruct technological processes in the past. The various research and case studies in this volume bring together scientists from different disciplines (archaeologists, geologists, chemists, physicists) who give new insights and approaches, as well as new theoretical and methodological frameworks in contemporary archaeological science. Using different analytical techniques, approaches and tools, they encourage us to improve archaeological interpretation based on collected data and to give a more objective and comprehensive picture of past processes.

In order to create a volume of high scientific quality, each of the conference papers has been reviewed by two anonymous reviewers, to whom I am especially thankful for their comments, opinions and remarks. I also wish to thank all the authors who contributed to this book, as well as Croatian Archaeological Society for their support and Andy Tomlinson for proofreading of the manuscript. At the end special thanks goes to Cambridge Scholars Publishing for their interest in publishing the papers from the *Methodology and Archaeometry* conference and for their assistance during the process of editing this volume.

—Ina Miloglav

Palaeolithic Artefact Scatter Visibility in the Changing Landscapes of the Western Morava and Resava River Valleys (Serbia)

Irina Kajtez and Eric M. Heffter

Abstract

Palaeolithic research in Serbia since the second half of the 20th century has provided important yet relatively scant information. Although attention has been oriented mostly towards excavating caves, in recent years there have been attempts at discovering Palaeolithic open-air sites through pedestrian surveys on Pleistocene landforms. River terraces, in particular, have been the focus of these surveys. Here we discuss the results of two Palaeolithic surface survey campaigns focused on two river valleys with well-preserved terraces: the Western Morava and the Resava. While the survey of the Western Morava recovered high numbers of lithic artefacts, including many pieces indicative of occupation during the Middle Palaeolithic, vastly lower numbers of artefacts were discovered during the Resava survey, and most of this material dated to the Neolithic. We believe that the smaller number of artefacts collected from the Resava survey is the result of a lack of suitable raw material in the region for stone-tool manufacturing and more recent sediments covering the surfaces of the Pleistocene river terraces in the area.

Introduction

The Middle-to-Upper Palaeolithic Transition is an important time period in Europe and the Balkans in the context of human evolution. During this time, Anatomically Modern Humans (AMH) expanded into Europe, where they interbred with and replaced native Neanderthal populations (Benazzi et al. 2011). This modern human expansion is typically thought of as taking place via two routes: one that hugged the coast of southern Greece and Italy, and a northern route using the River Danube (Conard and Bolus 2003; Bar-Yosef and Belfer-Cohen 2013). The entry of modern humans into Europe is associated with various transitional stone-tool industries that combine elements of Middle Palaeolithic stone-tool technology with a shift to laminar technology (Bar-Yosef 2002; d'Errico et al. 2003). While the identity of the makers of these transitional industries is still controversial (see Higham et al. 2014; Pettitt and Zilhão 2015), it appears that some of these industries were made by modern humans (Bailey et al. 2009). The first unambiguous evidence of material manufactured by modern humans is the Aurignacian techno-complex, which displays a marked shift in lithic technology, including the widespread adoption of blades as blanks for tools and the use of bone-point technology. Other innovations include the manufacture of personal adornments and portable art, and an increase in transport distances for lithic raw material (summarized in Bar-Yosef 2002; d'Errico et al. 2003).

Despite being between these routes and less than 100 km from the earliest dated AMH skeletal remains in Europe in neighbouring Romania (Trinkaus et al. 2003a; 2003b), evidence of this transition in Serbia is relatively sparse. There could be several reasons for this, including a lack of settlement of the region by modern humans (Dogandžić et al. 2014; Kuhn et al. 2014), or the late survival of Neanderthals, which ESR dates of ~38,000 years ago from Mousterian layers at the cave of Pešturina may indicate (Blackwell et al. 2014). It is also possible that geological processes have deeply buried many Palaeolithic sites. Finally, the lack of sites may simply be the result of the Palaeolithic in Serbia being understudied relative to other areas in Europe (Darlas and Mihailović 2008). This last hypothesis may best explain the low numbers of Palaeolithic sites. In order to bring the Palaeolithic of Serbia into harmony with other regions, we must continue recent research efforts to increase the number of sites and localities found in the country. We believe the best way to do this is by surveying Pleistocene landforms for evidence of Palaeolithic artefact surface scatters.

History of Palaeolithic research in Serbia

While Gavela (1988) began researching the Palaeolithic of Serbia in the 1960s and 1970s, and the Aurignacian site of Vršac in the Banat region has been known since the 1890s (Radovanović 1986; Mihailović 1992; Chu et al. 2014; Chu et al. 2016), most Palaeolithic sites that we know of today have only been discovered since the 1990s (Darlas and Mihailović 2008). The most notable sites include the Velika and Mala Balanica caves near Niš (Mihailović 2009a; Roksandić et al. 2011; Rink et al. 2013; Dogandžić et al. 2014; Mihailović 2014; Mihailović and Bogićević 2016), Šalitrena Cave in Western Serbia (Mihailović 2013), and the cave sites of Orlovača and Bukovac, near Despotovac (Dogandžić et al. 2014) (Figs 1-1a,1b).

Figure 1-1a. Major Palaeolithic sites in Serbia and surrounding regions: Middle Palaeolithic sites: 1. Vindija, 2. Velika Pećina, 3. Krapina, 4. Zobište, 5. Lonđa, 6. Šalitrena Pećina, 7. Petrovaradin Fortress, 8. Hadži-Prodanova Pećina, 9. Velika and Mala Balanica, 10. Pešturina, 11. Kozarnika, 12. Temnata Dupka, 13. Bacho Kiro, 14. Mujina Pećina, 15. Crvena Stijena, 16. Bioče, 17. Mališina Stijena, 18. Golema Pešt, 19. Asprochaliko, 20. Klisoura, 21. Tabula Traiana. (Modified from Dogandžić et al. 2014)

Most surface surveys for Palaeolithic artefacts, raw material outcrops, quarries and open-air sites in Serbia have started only within the past decade (Fig. 1-2). One of the earliest surface surveys occurred at the raw-material source of Kremenac, near Niš (Fig. 1-2: 6) (Šarić 2013). The site represents a possible primary opal outcrop, though opal was not recovered in large amounts. While there are clearly Lower and Middle Palaeolithic artefacts at the site, there are some issues with this locality which impact the interpretation of artefacts collected from it. Until recently, Kremenac was used for military exercises and as an artillery range (Šarić 2013: 25-39), which may have created a large number of geofacts (Radinović and Jovanović 2016).

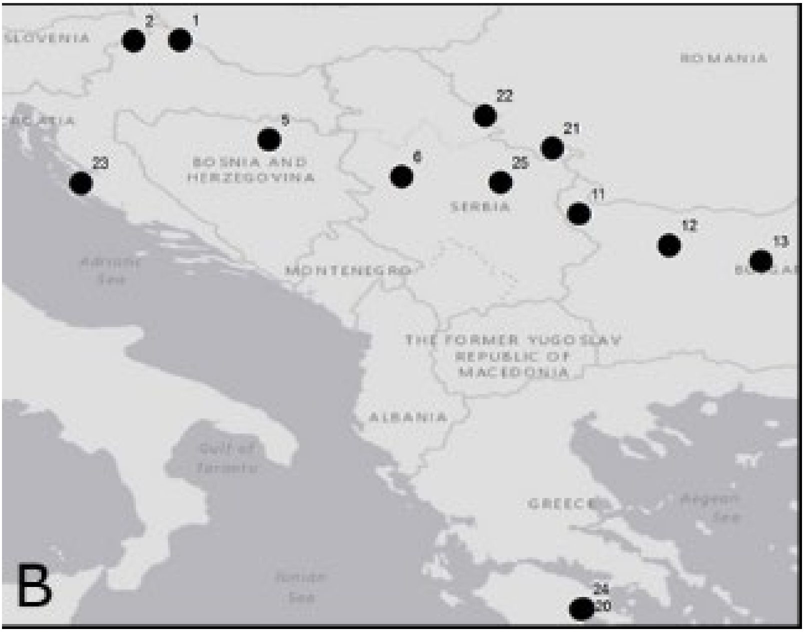

Figure 1-1b. Early Upper Palaeolithic sites: 1. Vindija, 2. Velika Pećina, 5. Lonđa, 6. Šalitrena Pećina, 11. Kozarnika, 12. Temnata Dupka, 13. Bacho Kiro, 20. Klisoura, 21. Tabula Traiana, 22. Crvenka-At, 23. Šandalja, 24. Franchthi Cave, 25. Orlovača and Bukovac caves. (Modified from Dogandžić et al. 2014)

Upper Palaeolithic scatters and open-air sites have also been found around the town of Vršac, in Vojvodina, and consist of several localities, namely Crvenka, At, At I, Balata Mesić and Kozluk (Fig. 1-2: 2) (Mihailović et al. 2011: 82-85). Research, both earlier (Radovanović 1986; Mihailović 1992) and more recent (Chu et al. 2014; 2016), has indicated the presence of Aurignacian artefacts at these localities. Also in Vojvodina is the Middle Palaeolithic site of Petrovaradin Fortress, near Novi Sad, which is located on the second Danube river terrace on the outskirts of the Fruška Gora mountain (Fig. 1-2: 1). The site is located inside a medieval fortress which is still used today as a public space. This has disturbed the original stratigraphy of the site to some extent. The artefacts were uncovered in loess and palaeosol sequences, some of which were dated using optically-

stimulated luminescence and malacological analysis to between Oxygen Isotope Stages (OIS) 4 and 6 (Mihailović 2009b).
Palaeolithic artefacts have also been found in the southern part of the country, especially near the Radan mountain (Fig. 1-2: 7). In 2014, University of Belgrade student Stefan Mladenović found Palaeolithic artefacts on his family's property near Radan. A brief survey conducted around the property, near the town of Slišane, indicated that the area is very rich in raw-material deposits suitable for knapping (Heffter 2014), and the quarry contains thousands of flakes and Middle Palaeolithic artefacts such as Levallois flakes and cores.

The most extensive surface surveys have occurred in the Western Morava river valley in central Serbia. The first Palaeolithic artefacts in the region[1] were found in 2008 by University of Belgrade student Marijana Stojanić in the back garden of her parents' house in Samaila, a village in the Western Morava valley (Fig. 1-2: 4) (Mihailović and Bogosavljević-Petrović 2009). During a survey campaign in 2008, 250 artefacts consisting of flakes and some Middle Palaeolithic tools were discovered in 6 fields adjacent to a cemetery and the Stojanić property. This area became known as the site of Vlaška Glava (Mihailović and Bogosavljević-Petrović 2009: Table 1-1).

Further investigations at Vlaška Glava occurred in 2010. The abovementioned fields were again surveyed, and two 2-by-2-metre trenches were opened beneath the cemetery where the majority of the artefacts were found in 2008. Unfortunately, these excavations revealed that there was no subsurface component to Vlaška Glava (Mihailović et al. 2014).

A more systematic survey occurred during 2011 that explored river terraces on the right bank of the Western Morava river between Kraljevo and Čačak. This survey found several Palaeolithic surface scatters: Kosovoska Kosa in the village of Zablaće, Vojnovića Brdo in the village of Ježevica, and Kremenac in the village of Viljuša (Fig. 1-2: 3) (Mihailović et al. 2014).

Another survey in 2012 explored fields on the left bank of the Western Morava between the villages of Miločaj and Sirča. A smaller number of artefacts were found, as well as petrified wood (Mihailović et al. 2014).

Surveying in the Western Morava continued in 2015 when Heffter conducted a two-week survey between Kraljevo and Čačak which mostly filled in the gaps from previous campaigns (Heffter and Mihailović 2016). Also in 2015, Mihailović and colleagues (2015) surveyed around the Goč

[1] The National Museum in Čačak had discovered Palaeolithic artefacts during an earlier surface survey, but detailed results remain unpublished (Mihailović et al. 2014).

mountain near Vrnjačka Banja, an area in the central part of the Western Morava valley, for raw-material sources (Fig. 1-2: 5). Preliminary results indicate that Middle Palaeolithic artefacts predominate in the Western Morava valley, while Lower Palaeolithic artefacts occur in smaller numbers, and Upper Palaeolithic material is virtually absent (Mihailović et al. 2014; Mihailović et al. 2015; Heffter and Mihailović 2016).

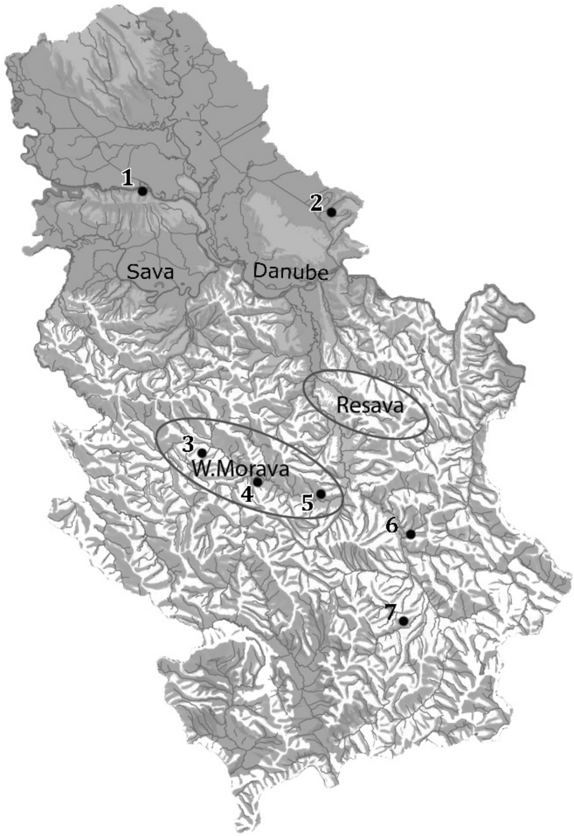

Figure 1-2. Palaeolithic open-air sites and lithic surface scatters in Serbia with survey areas circled: 1. Petrovaradin Fortress (MP), 2. Vršac-Crvenka and Vršac-At (UP/Aurignacian), 3. Western Morava open-air scatters (MP and some UP), 4. Samaila-Vlaška Glava (MP), 5. Vrnjačka Banja (RM source, some MP), 6. Kremenac (poss. LP/MP), 7. Radan mountain (MP).

Geological background

Even though Serbia covers a relatively small area, it is geologically very diverse. The country is divided into several tectonic zones of differing ages: the Dinarides, Vardar zone, Serbo-Macedonian massif, Carpatho-Balkanides, and the Pannonian basin in Vojvodina, which is the youngest of the formations and consists of marine and lacustrine sediments from the Pannonian Sea which overlay older tectonic formations (Jelenković et al. 2008).

Quaternary deposits cover a large amount of the country and consist primarily of loess deposits, river terraces and other fluvial accumulations. Loess deposits are distributed mainly in the Vojvodina region, although some researchers during the 1950s claimed that loess oases exist along the Great Morava valley. These claims were criticized during the 1970s by Rakić (1977) and others (such as Stevanović 1977), who argued that the loess oases represent thick silt deposits of fluvial origin which were created during periods of lower river velocities. River terraces are the most widely-distributed geomorphological landform of the Pleistocene. Terraces occur on lower elevations overlying Miocene lacustrine and marine deposits in many of the larger river valleys in the country, such as the Western Morava, Great Morava, Southern Morava, Danube and Sava (Krstić et al. 2012). The terraces are the result of erosional and accumulative processes, which are distinguished by shifts between gravels, sands and silt. Depending on the river, up to four terraces may be preserved.

Recent research on Pleistocene river terraces in Vojvodina has produced dates of these erosion-accumulation cycles from the malacological analysis (Nenadić and Bogićević 2014; Nenadić et al. 2015). However, geological literature concerning the terraces south of Vojvodina (the area where most surface surveys have occurred) is relatively sparse, so inconsistencies in classifying river terraces is a problem that we have encountered. The most complete publication on river terraces south of Vojvodina is from the seventies (Rakić 1977). Due to the age of the research, there are issues surrounding the results, one of them being the use of an Alpine glaciation model to approximate the age of the terraces, which is now an outdated system of determining terrace formation ages outside Alpine Europe. We have given here a table of proposed correlations for the Western Morava (from Kajtez 2015) with the approximate correspondence to Marine Isotope Stages (MIS), as a way to harmonize the assumptions of Rakić with modern dating conventions (Table 1-1) (Gaudenyi and Jovanović 2012). Some river terraces have also not been studied in enough detail to be placed in any general chronological framework (Marković et al. 1968; Brković et al. 1978).

Landform	Terrace	Relative Height (m)	Thickness (m)	Time Period/ Glaciation	MIS
High terraces		above 150	20-50	Miocene	
Middle terraces	t_4	90-110	10-15	Günz	16-14
	t_3	50-85	8-15	Mindel	13-7
Lower terraces	t_2	25-35	10-15	Riss	6-5
	t_1	10-15	5-15	Würm	4-2
Floodplain terraces	al	3-6	up to 6	Holocene	1

Table 1-1. Proposed correspondence of Western Morava terraces identified by Rakić (1977) with Marine Isotope Stages (MIS). (Modified from Kajtez 2015)

Geological setting of selected open-air sites in Serbia

There are several different geological contexts for open-air sites in Serbia. In Vojvodina, the main Quaternary geological landforms are loess and palaeosol sequences deposited during glacial and interglacial cycles. While these loess-palaeosol sequences are well-studied from a geological perspective (Marković et al. 2004a; Marković et al. 2004b; Marković et al. 2005; Nenadić et al. 2011), there are few Palaeolithic sites in loess. This probably results from a lack of surveying for open-air sites in the loess plateau (but see Chu et al. 2014), rather than indicating that the area was unpopulated during the Palaeolithic. There are also issues with the few sites we know about in the loess plateau region. For example, sites around Vršac are located in white sand which is probably redeposited, creating doubts as to how secure the context is (Chu et al. 2014). The only other Palaeolithic finds that come from loess and might indicate the presence of an open-air site come from Zemun, near Belgrade (Šarić 2009), though only preliminary data is available, because the finds do not come from a clear stratigraphic context.

The geological setting south of the Sava and Danube rivers is somewhat more diverse and tectonically active, and contains volcanogenic deposits. The quarry near the Radan mountain belongs to the Serbo-Macedonian geotectonic unit, which formed from Tertiary volcanic activity and is characterized by crystalline complexes and granitoids (Monthel et al. 2002: 41). The area is rich in faults, allowing water to circulate through the rocks and resulting in very pronounced hydrothermal alteration. The most frequent hydrothermal alteration process is silicification, which explains why the area is rich in opal, chalcedony and agate (Vukanović et al. 1965; Miladinović et al. 2010; Miladinović et al. 2016). The area around Vrnjačka Banja also has raw-material deposits in addition to Palaeolithic localities. During the abovementioned 2015 survey (Mihailović et al. 2015) several raw-material deposits of sedimentary-volcanogenic origin were detected, some of which contained opals and some siliceous material of hydrothermal origin.

Other sites occur on more recent fluvial and lacustrine landforms, typically Miocene to Holocene in an age which covers older formations. For example, Kremenac, near Niš, lies on the rim of a Miocene/Pliocene lake terrace. In the Western Morava valley, Palaeolithic localities such as Vlaška Glava and those around Vrnjačka Banja are typically found on Pleistocene river terraces and areas with Quaternary lake and river sediments (Marković et al. 1968). Sites and scatters are located mostly on higher river terraces (t_3 and t_4) which are usually in contact with Miocene and Pliocene lake deposits. According to Rakić (1977: 41), the third terrace is the highest and oldest fluvial terrace in the area of the Western Morava valley where Vlaška Glava is located (Mihailović and Bogosavljević-Petrović 2009).

Survey areas and methods

With the success of the Western Morava surveys, we decided to continue surface surveys for Palaeolithic artefact scatters in other river valleys. The Resava river valley was chosen because geological maps indicated that the area contained well-formed Pleistocene terraces, which stretch from Despotovac to Svilajnac. The Resava valley also contains the Orlovača and Bukovac caves near Despotovac, demonstrating that hominins inhabited the area. Both caves are multicomponent sites with Middle Palaeolithic, Aurignacian and Gravettian occupations (Dogandžić et al. 2014; Tamara Dogandžić personal communication 2017). Finally, if we found Palaeolithic artefacts during the River Resava survey, we could compare them to those from Orlovača and Bukovac to see if different site contexts (cave versus open-air) may have affected the composition of artefact assemblages, as it has been shown that assemblage composition differs between open-air and cave sites, even in the same area (Mackay et al. 2014).

During the last two weeks of October 2016, we surveyed river terraces in the Resava valley between Despotovac and Svilajnac, as well as river-terrace remnants and Pleistocene lake sediments to the east of Jagodina. We also surveyed possible lithic raw-material sources. We identified these possible raw-material sources by finding locations on topographic maps that contained the word *kremen*, which in Serbian means “flint”. It is possible to use this toponym to identify raw-material sources and quarries that were exploited during the Palaeolithic (Heffter 2014). At these quarry sites, stone tools were typically manufactured, leaving behind evidence of past occupations. We also documented river profiles near certain fields to understand the underlying stratigraphy of the area. The survey comprised walking ploughed agricultural fields with 3–4 surveyors spaced about 3 metres apart and collecting lithic materials that looked modified by hominins as well as flint raw-material, if present in the field, for future raw-material studies. Gathering all lithics in the field provided valuable information on artefact density and evidence for how geological processes may have disturbed artefact accumulations. We also collected samples of prehistoric pottery (but not modern and medieval pottery) if it was present in a field. Collecting pottery provided additional evidence for whether or not particular lithic-artefact surface scatters might belong to later periods (such as the Neolithic) when chronologically diagnostic stone tools were absent from a field. Each lithic artefact was piece-plotted using hand-held GPS units with 3-metre accuracy (Garmin eTrex 10) to see if we could identify potential artefact concentrations (see Fig. 1-3). Each surveyor had their own GPS unit. While these GPS units have 3 metres of positional error (and slightly more when recording elevation), other researchers documenting Palaeolithic surface scatters have found this level of precision sufficient for surveys (Škrdla et al. 2016). We also saved the GPS tracks for each field to see how our survey coverage was maintained. The elevation of each field was recorded, and each field was photographed. Lithic artefact density was calculated by dividing the number of lithic artefacts found in a field by its area, which we calculated using Google Earth.

The 2015 Western Morava survey had a slightly different design. While we walked over fields in the same manner and recorded the location and elevation of each field with a GPS unit with a similar level of accuracy, we did not piece individual plot artefacts or save tracks documenting exactly where we walked. Despite these differences in survey methods, this did not affect our ability to compare data between the two surveys, as during both we collected all the lithic material in a field, as well as raw-material and prehistoric pottery, and we were still able to calculate field density data in the same manner as with the Resava survey.

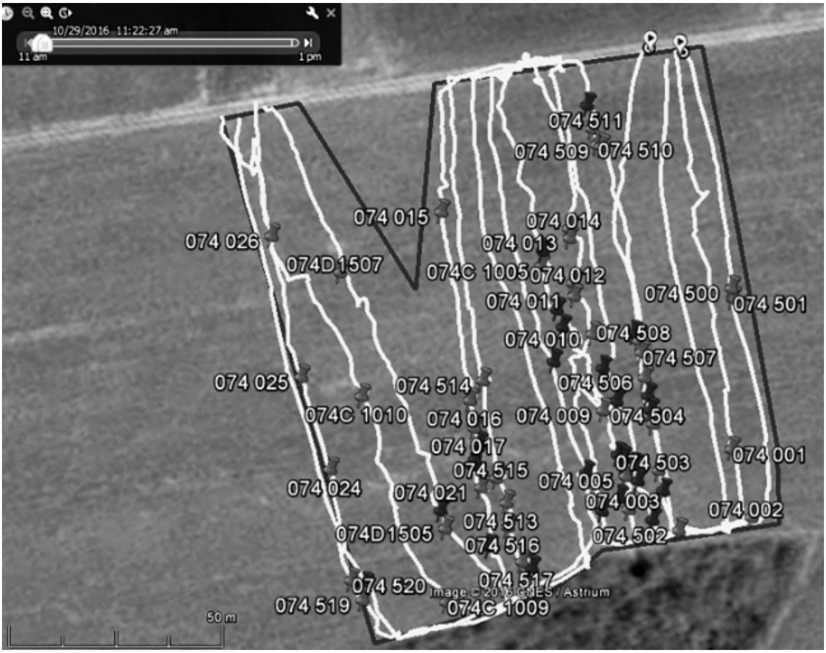

Figure 1-3. Example of artefact piece-plotting from surveyed field, village of Supska, near Jagodina. (Made by the authors)

Results

Summary statistics for artefacts found in the Western Morava and Resava river valleys are summarized in Table 1-2.

Our results show that lithic artefacts were far more numerous in the Western Morava survey area than in the Resava valley (Figs 1-4, 1-5). While we were able to find numerous diagnostic artefacts belonging mainly to the Middle Palaeolithic, such artefacts were virtually absent in the Resava valley and surrounding locations. Instead, we found mostly Neolithic artefacts, including a Neolithic stone-tool workshop in the village of Supska, near Jagodina (see Fig. 1-3). We also found that, because the fields surveyed were small in size, typically 1 hectare (ha) or less, piece-plotting artefacts did not help in identifying artefact concentrations (see Fig. 1-3).

	Western Morava	Resava Valley
Area surveyed (ha)	72.5	56.1
Number of fields surveyed	116	83
Total lithics	1021	134
Average density (Artefacts/ha)	14.08	2.4
Median artefact density	4	0
Maximum artefact density (artefacts/ha)	137	55
Percentage of fields with No artefacts	28%	67%
Predominant diagnostic tools	MP, some EUP and Neolithic	Neolithic

Table 1-2. Artefact statistics from the Western Morava and Resava river valleys.

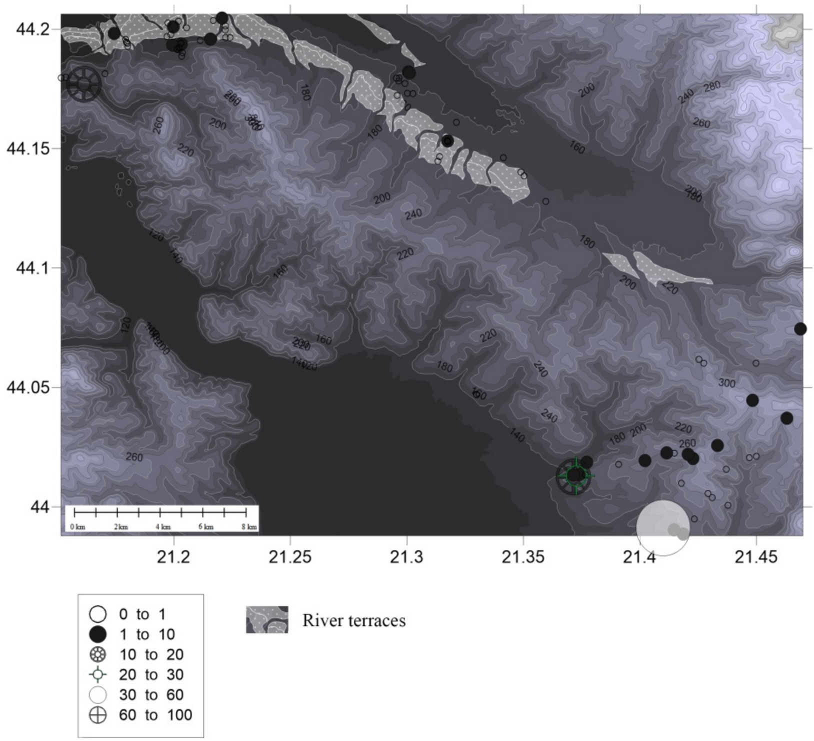

Figure 1-4. Field density data from the Resava survey.

The artefacts also looked different from a qualitative perspective. The artefacts from the Western Morava appeared older, with higher levels of water rolling and patina, while the artefacts from the Resava survey, with the exception of material from terrace remnants near Krušar, were unpatinated and devoid of post-depositional modification.

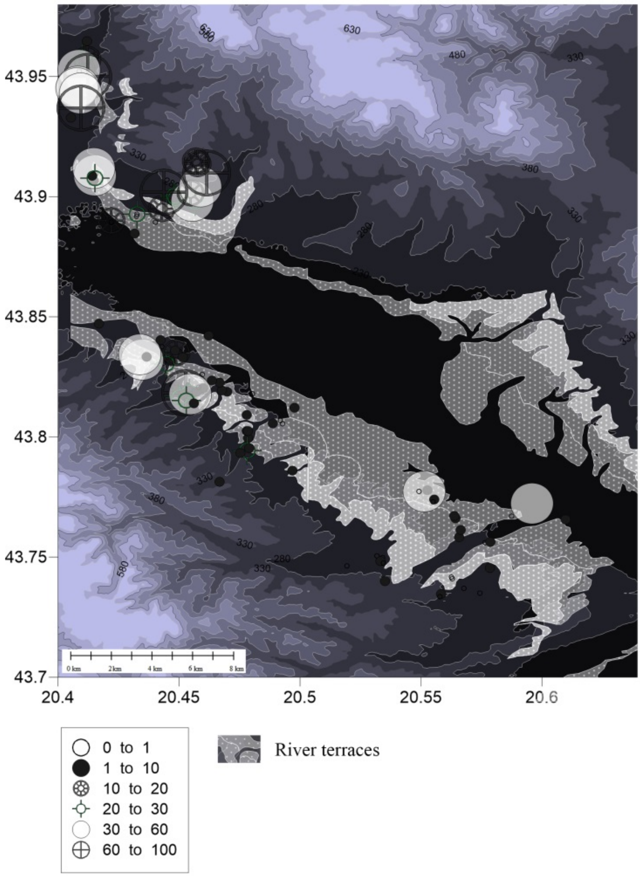

Figure 1-5. Field density data from the Western Morava survey.

Discussion

These results suggest that Palaeolithic occupations were more frequent in the Western Morava valley than in the Resava valley. Despite both the Western Morava and the Resava valleys having Pleistocene terraces, it seems that other factors may explain the differences in artefact densities and numbers of Palaeolithic finds, particularly raw-material availability. Table 1-3 shows the differences in raw-material availability between the Resava and Western Morava valleys. Fields and nearby rivers in the Western Morava typically contain high levels of flint raw-material. These flint sources are of good quality and large enough to manufacture stone tools. In contrast, flint raw-material is virtually absent from fields in the Resava valley. The only raw-material available is quartz, and most of it is of poor quality and typically too small to make stone tools effectively (Heffter and Mihailović 2017).

Category	**Western Morava**	**Resava**
Predominant raw-material	Flint	Quartz
Raw-material quality	Good	Poor
Raw-material amount	Numerous	Low
Level of stones in field	High	Low
Level of stones in nearby rivers	Moderate	Low to none
A degree of patinated artefacts	High	Low
A degree of water rolled artefacts	High	Low

Table 1-3. Differences between Western Morava and Resava.

The degree of patina may also indicate the level of visibility of surface artefacts. Typically, artefact patina is associated with older material and indicates that the material has spent a long time on the surface exposed to the elements. Presence of patina is typically used as a rule of thumb to identify undiagnostic lithic artefacts as belonging to the Palaeolithic (see Glauberman and Thorson 2012). With the exception of terrace remnants near Jagodina, we did not find many patinated artefacts on the Resava survey. The opposite is true in Western Morava, where many of the artefacts we collected had varying levels of patina and water rolling. This seems to indicate to us that part of the reason for the differences in artefact density between the Western Morava and the Resava is that the artefacts are much closer to the surface in the Western Morava, increasing the chance for us to discover them during the field survey.

Conclusion

While our survey in 2016 failed to find evidence of Palaeolithic artefacts in the Resava valley, we still learned many valuable lessons. The most important is that we cannot assume, just because an area has Pleistocene river terraces, that Palaeolithic artefacts will be found there. Other factors, including raw-material availability, need to be taken into account. All of this information can be used in the future to select better survey locations for Palaeolithic sites.

Acknowledgements

We would like to thank Dušan Mihailović and Steven Kuhn for their assistance in our research. The 2015 Western Morava survey was supported by a grant from the American Philosophical Society. The 2016 Resava survey was funded by a United States Fulbright Award. Finally, we would like to express our gratitude to the Department of Archaeology, Faculty of Humanities and Social Sciences, at the University of Zagreb, and the Croatian Archaeological Society for organizing and hosting the 2016 Methodology and Archaeometry conference.

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