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# CHRONOLOGY AND SUCCESSION OF PALAEOLITHIC TECHNOCOMPLEXES IN SERBIA[1]

**Abstract:** During the last two decades, the state of Palaeolithic research in the Central Balkans has improved considerably. More than a hundred caves suitable for Palaeolithic settlement have been identified South of the Sava and Danube rivers, while dozens of Palaeolithic open-air sites have been documented in the regions of Šumadija and Pomoravlje. Test pit excavations have been carried out in numerous caves, and systematic excavations have been undertaken in the Balanica Cave Complex in Sićevo and in the cave site of Šalitrena Pećina near Mionica. Most of the investigated sites have been dated using various techniques (i.e., $^{14}$C, ESR, OSL, and TL). Thanks to this research, we now have an extraordinary opportunity to look at the chronology and succession of Palaeolithic technocomplexes in the Central Balkans. The dating results show that the territory of Serbia had been inhabited for more than 400,000 years, while the identification and periodization of Palaeolithic technocomplexes provided initial insights into the cultural and demographic changes that marked the earliest prehistory in this part of Europe.

**Key words:** Palaeolithic, dating, technocomplex, Balkans, lithic artifacts, Mousterian, Aurignacian, Gravettian

## INTRODUCTION

Compared to Western Europe, the Palaeolithic of Southeastern Europe has been poorly and unevenly researched. Throughout the 20th century, Palaeolithic research in

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the Balkan Peninsula was mainly focused on the areas where the most significant discoveries were documented previously: the Slovenian Karst, Hrvatsko Zagorje, Posavina, the Lower Danube, and the coastal belt of the Adriatic-Ionian and Aegean zones. However, many parts of the Balkans remain unexplored, particularly the territory of the Central Balkans where only a few Palaeolithic sites were known until recently.

The Central Balkans includes the Great, South, and West Morava Valleys, the eastern branches of the Dinaric Alps in the west, and the western parts of the Carpatho-Balkanides in the east. The central part of this area cuts through the Moravian-Vardar corridor, which represents the main natural communication connecting Southwest Asia with Central and Western Europe. The lack of research in this region significantly hindered the overall understanding of cultural changes and demographic trends in the Pleistocene of Central and Southeastern Europe.

During the past twenty years, a large number of Palaeolithic sites from the Middle and Late Pleistocene have been explored in Serbia. Although several preliminary reports on this research have been published, no synthesis of earlier and more recent research has been offered so far. For this reason, we will present preliminary conclusions about the chronology and periodization of Palaeolithic technocomplexes in the Central Balkans and try to point out some of the key questions imposed by recent research.

## RESEARCH HISTORY

The beginning of Palaeolithic research on the territory of today's Serbia was marked by the field surveys and excavations of caves in the Svrljiški Timok river basin and the Sićevo Gorge (southeastern Serbia) undertaken by Jovan Cvijić and Đoko Jovanović (Јовановић 1891; Јовановић 1892; Цвијић 1981) and the book „Stone Age" published in 1893 by Jovan Žujović (Жујовић 1893). However, the initial interest in the Palaeolithic was short-lived – lasting only until the mid-1890$^{s}$ – and, until the middle of the 20$^{th}$ century, archaeology in Serbia became more oriented towards later prehistoric and historic periods.

Palaeolithic research in Serbia was restarted in the 1950s when Branko Gavela excavated Jerinina Cave near Kragujevac and Risovača Cave near Aranđelovac in Central Serbia (Гавела 1988). This was followed by another hiatus in research, which lasted until the 1980s when Ivana Radovanović and Zvonimir Kaluđerović started field surveys and excavations of Palaeolithic sites. During that and the following decade, several sites were excavated, including Crvenka-At near Vršac, Šalitrena Pećina, Smolućka Cave near Tutin, and Pećurski Kamen near Sokobanja (Radovanović 1986; Kaluđerović 1991; Mihailović 2014a). At the beginning of the 1990s, Dragoslav Srejović – who had by then conducted excavations of several Palaeolithic sites in Montenegro – began the excavations of Baranica Cave near Knjaževac (Михаиловић, Ђуричић и Калуђеровић 1997). After that, research was interrupted again due to unstable social and political circumstances.

The beginning of Palaeolithic research in 21st-century Serbia is marked by protective research (excavations). In 2002, the Faculty of Philosophy (University of

Belgrade) took part in a field survey conducted along the line of the Niš–Dimitrovgrad motorway. Numerous caves were registered, and a single Palaeolithic site (Velika Balanica) was confirmed in the village of Sićevo near Niš in southern Serbia (Михаиловић 2009). In the following two years, the Faculty of Philosophy and the National Museum in Belgrade carried out protective excavations of Hadži Prodanova Pećina near Ivanjica in Western Serbia (Михаиловић и Михаиловић 2006). Moreover, in cooperation with the City Museum of Novi Sad, the Faculty of Philosophy also undertook excavations of Palaeolithic strata at Petrovaradin Fortress in Novi Sad (Mihailović 2009).

A turning point in the research came in 2004 when numerous Palaeolithic materials were excavated both in Balanica and Šalitrena Pećina. It soon became evident that these two sites covered a large part of the Palaeolithic sequence – from 0.5 Ma (million years ago, i.e., the age of hominin remains from Mala Balanica; see Rink et al. 2013) to 28 ka (thousand years ago, i.e., the age of the Gravettian of Šalitrena Pećina; Mihailović 2008). From then until 2010, research was mainly focused on the Balanica Cave Complex (i.e., Mala and Velika Balanica Caves), Pešturina Cave, and Šalitrena Pećina, while the excavations of Tabula Traiana Cave in the Danube Gorges had only just began (Borić et al. 2012).

Several international projects focused on the research of cave sites in eastern Serbia have been launched since 2011, and systematic surveys of open-air Palaeolithic sites in the West Morava river valley have also been started. Dozens of Palaeolithic sites have been documented, many of which were later test-pit excavated (Mihailović 2014b). Research has had a distinctly interdisciplinary character – in the initial stages, they were focused on radiometric dating and geoarchaeological investigations, but later they included bioarchaeological studies, with palaeogenetic analyses. Although not all analyses have been completed yet, we are now able to provide preliminary information on the chronology and succession of Palaeolithic technocomplexes in the territory covered by the research.

## LOWER PALAEOLITHIC

### *Chronology of the sites*

In the last ten years, several sites that can be attributed to the Lower Palaeolithic have been discovered on the territory of Serbia (Fig. 1). Probably the oldest among them is the open-air site Petrovac 1, which is located on the slopes of Radan Mountain near the town of Kuršumlija in southern Serbia, on the rim of a Miocene caldera, where primary deposits of opal and chalcedony occur (Miladinović 2012). Thousands of Palaeolithic artifacts were found during the field survey, while test pit excavations demonstrated that the Petrovac 1 site contains at least three geological layers, with the lower two definitely associated with the Lower Palaeolithic (Михаиловић и др. 2021). The chronology of the site is currently unknown. The results of optically stimulated luminescence (OSL) dating were inconclusive, while palaeomagnetic measurements indicated that the deepest layers were formed dur-

ing a normal polarity (M. Sier, personal communication). Cosmogenic nuclide dating of the site is planned.

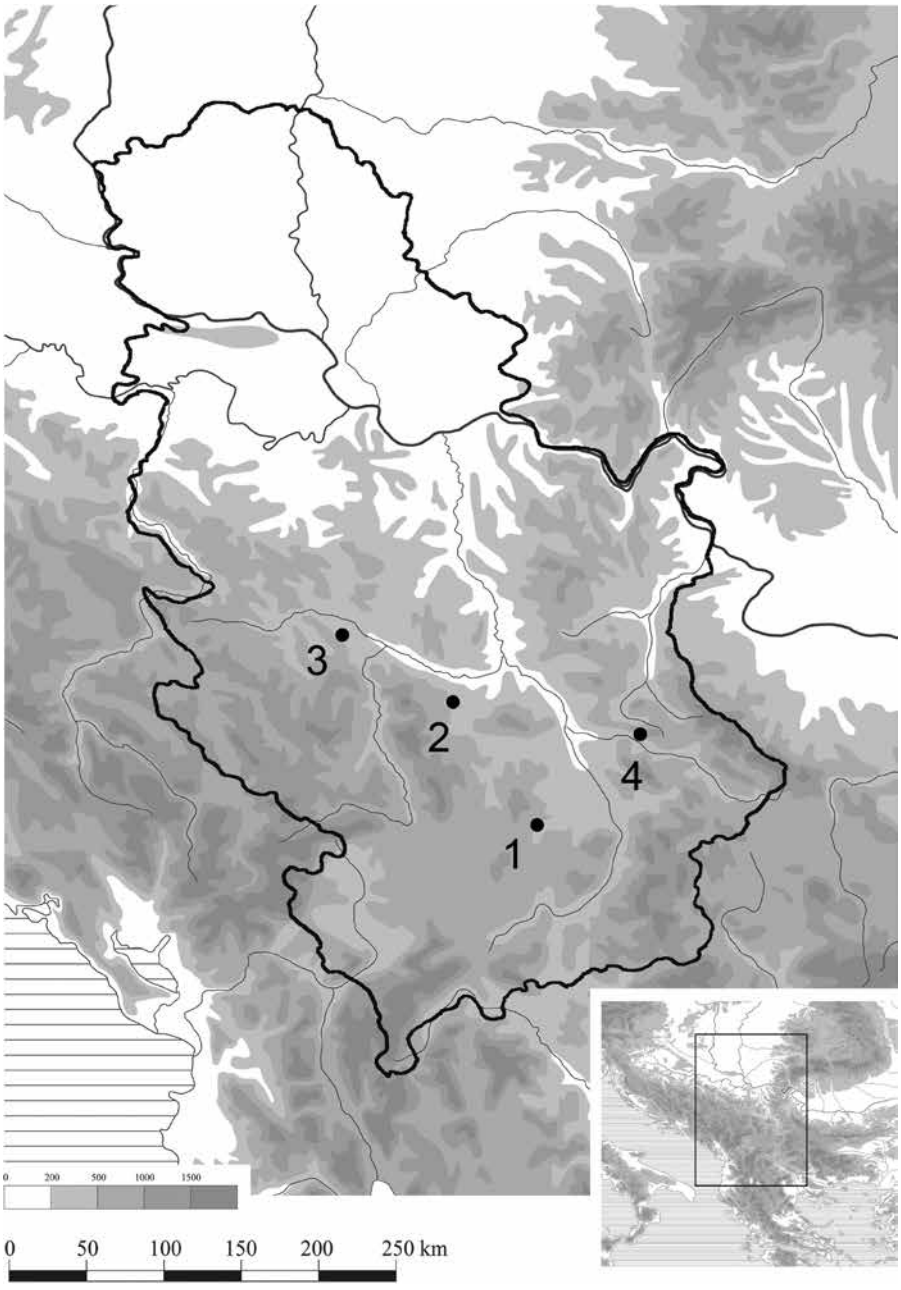


Fig. 1 Lower Palaeolithic sites in Serbia: Petrovac I (1), Gvozdenac (2), Kosovska Kosa (3), Mala Balanica (4)

Сл. 1 Доњопалеолитска налазишта у Србији: Петровац I (1), Гвозденац (2), Косовска коса (3), Мала Баланица (4)

Mala Balanica in Sićevo (southeastern Serbia) remains the oldest confirmed Lower Palaeolithic site in Serbia to date. Layer 3 of Mala Balanica yielded a partial hominin hemi-mandible (BH-1), which was originally assigned to *Homo* sp. (Roksandic et al. 2011), then to *Homo heidelbergensis* s.l. (Skinner et al. 2016), and more recently tentatively attributed to *Homo bodoensis* (Roksandic et al. 2022a). Several chipped stone artifacts – including a pair of quartzite cortical flakes and a notched tool made on a thick quartzite flake – were recently found in Layer 3. A minimum age of between 397 and 525 ka was obtained for Layer 3, via a combination of several techniques: electron spin resonance (ESR), uranium series isotopic analysis, and infrared/postinfrared luminescence (Rink et al. 2013).

Two more sites in Serbia could be tentatively assigned to the Lower Palaeolithic. More than 200 lithic artifacts – dominated by irregular flakes and denticulated tools, with tools made on pebbles (i.e., choppers) also present – were gathered from the surface of the Kosovska Kosa site in Zablaće near Čačak (central Serbia). Irregular and preferential cores and tools on massive flakes were found at the Gvozdenac site near Trstenik (Михаиловић и др. 2015; Mihailović and Bogićević 2016). The chronologies of these two sites have not been established yet. It should be noted that the Lower Palaeolithic was also reported at Kremenac near Niš (Kaluđerović 1996; Šarić 2013), but the material from this site includes a large number of geofacts and has not been analysed in detail. However, the possibility that Kremenac is indeed a Lower Palaeolithic site cannot be completely ruled out, since we recently noted a layer of clay containing several non-diagnostic flaked artifacts at the bottom of the profile of the test pit originally excavated by Z. Kaluđerović.

### *Technocomplexes*

Based on a preliminary insight into the Petrovac 1 artifact assemblage, we are inclined to conclude that the findings from Layer 3 of this site belong to the so-called pebble core and flake industries (Fig. 2), i.e. Mode I according to Clark's classification (Clark 1969). These are the oldest lithic industries which are associated with ancient hominins and were produced from about 3 Ma in Africa (Plummer et al. 2023) to 400–600 ka in Europe (Barsky 2009). In Southeastern Europe, these industries have been confirmed in Šandalja I in Croatia (Malez 1979) and Kozarnika Cave in northwestern Bulgaria (Sirakov et al. 2010), as well as in the open-air sites of Dealul Guran in southeastern Romania (Iovita et al. 2012) and Marathousa 1 in the Peloponnese, Greece (Tourloukis et al. 2018).

Several finds from Layer 3 of Mala Balanica probably belong to the so-called small-tool assemblages, which were widespread in Central and Eastern Europe in the Chibanian (Middle Pleistocene), and often dominated by quartz artifacts, and denticulated and notched tools (Doronichev 2016). It is not entirely clear whether the assemblages from the West Morava river valley – with denticulated tools, irregular scrapers and sidescrapers, as well as artifacts of somewhat larger dimensions – can be attributed to this type of lithic industry. Larger tools were found in Layer 2 of the Petrovac 1 site on Radan Mt., where Lower Palaeolithic artifacts also predominate. Unfortunately, the stratigraphic integrity of Layer 2 has not yet been reliably verified.

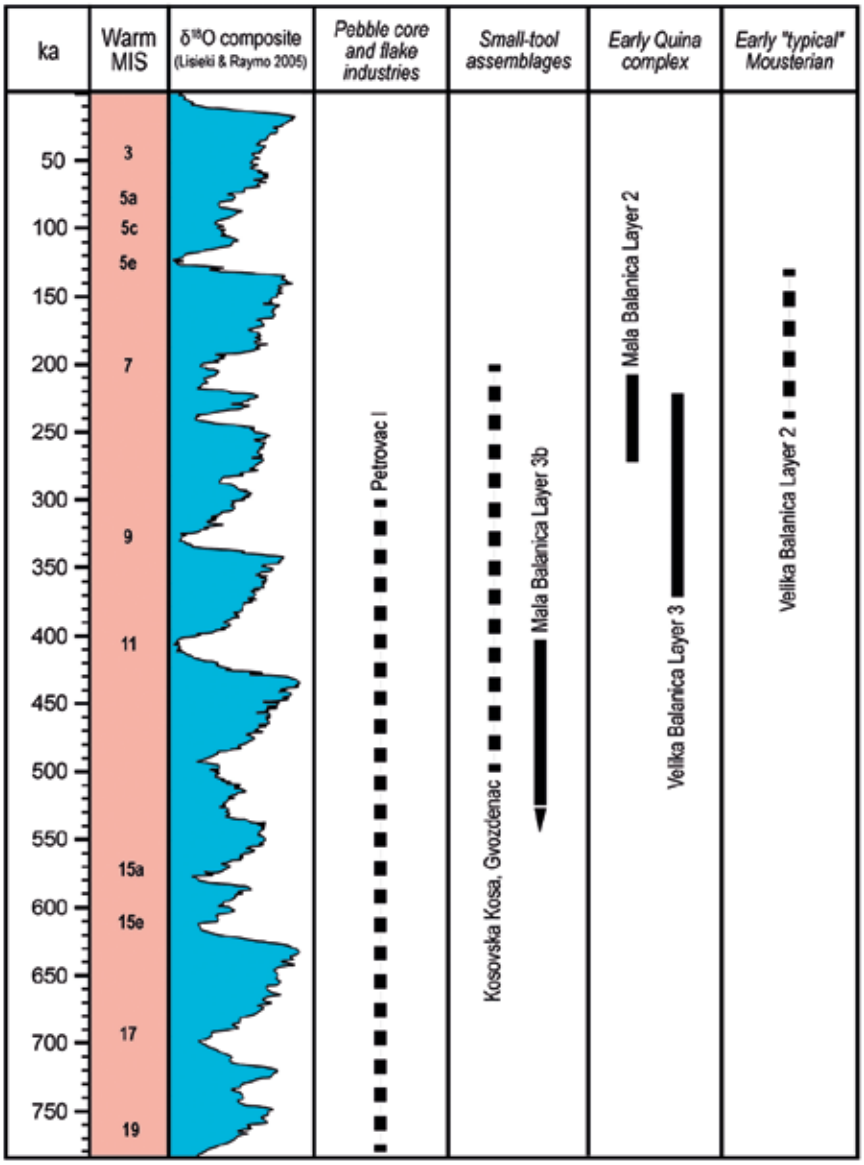


Fig. 2 Chronology of Lower and Early Middle Palaeolithic sites in Serbia
Сл. 2 Хронологија налазишта из доњег и раног средњег палеолита у Србији

## MIDDLE PALAEOLITHIC

### *Chronology of the sites*

Velika and Mala Balanica Caves represent the oldest Middle Palaeolithic sites not only in Serbia but also in the whole of Southeastern Europe. Layer 3 of Velika Balanica, containing early Neanderthal fossils and numerous artifacts and remains of fauna, was dated via thermoluminescence (TL) of burnt flint to around 290 ka

(Mihailović et al. 2022a; Roksandic et al. 2022b). Although Layer 2 at the same site has not yet been reliably dated, it was probably deposited at the end of the marine isotope stage (MIS) 7 or during MIS 6 (Anne Skinner, personal communication). Findings from Layer 2 of Mala Balanica, which technologically correspond to artifacts from Layer 3 of Velika Balanica, were dated by the ESR to around 240 ka (Mihailović et al. 2022a).

Pešturina Cave in the village of Jelašnica near Niš represents the best-dated Middle Palaeolithic site in Serbia. The lower layer of this site (4b), which contained important Neanderthal fossils (Radović et al. 2019; Lindal et al. 2020; Fellows Yates et al. 2021), artifacts, and numerous remains of Pleistocene fauna, was dated via several ESR dates to an average age of 111 ka (Mihailović et al. 2022b). The upper layer (3), containing Middle Palaeolithic material, was dated using various techniques (ESR, OSL and $^{14}$C), which resulted in inconsistent dates ranging from 72 to 38 ka (Blackwell et al. 2014; Alex et al. 2019).

The Middle Palaeolithic layers at Petrovaradin Fortress were dated using the OSL method; the lowermost layer (2b) was dated to about 90 ka, while Layer 2a (which contained the majority of archaeological material) was estimated to be 38–45 ka (Marković et al. 2021). Numerous knapped artifacts have been found at the site, while faunal remains have not been preserved (Mihailović 2009).

The lower layers of Hadži Prodanova Pećina were dated via ESR to MIS 3 (Anne Skinner, personal communication), while the upper layers were radiocarbon dated to more than 39 ka cal BP (Alex et al. 2019). The cave of Šalitrena Pećina presents a similar case: the lower layers were dated to MIS 5b-4 by ESR (Daković et al. 2019), and the upper ones by the $^{14}$C method to 42–39 ka cal BP (Marín-Arroyo and Mihailović 2017). The Middle Palaeolithic layer in Tabula Traiana Cave has been radiometrically dated to between 52.3 and 46.7 ka cal BP (Borić et al. 2021).

In addition to the ones already mentioned, some additional sites were also dated (Figs. 3, 4). However, there are no firm dates for most of them, while for some the material is too scarce to attempt a cultural affiliation. The Middle Palaeolithic layer of Smolućka Cave was dated to more than 42 ka (Alex 2016), while for Risovača – for the layer above the layer with artifacts – the age of 36,400 ± 6,000 and 31,100 ± 2,800 $^{14}$C BP was estimated (Димитријевић 1997). The dates obtained for Risovača do not contradict the cultural data (similar industries in Central Europe are dated to before 44–40 ka cal BP; see Hauck et al. 2016) but they also do not allow us to reliably determine the age of the layer with archaeological finds.

### *Technocomplexes*

Taken as a whole, almost all Middle Palaeolithic technocomplexes in the Central Balkans can be classified as Quina and non-Quina Mousterian, depending on the frequency of Quina elements such as Quina cores, naturally backed flakes, and Quina retouched sidescrapers. The artifacts from Layer 3 in Velika and Layer 2 in Mala Balanica belong to the Early Quina complex and were already published in detail by Mihailović et al. (2022a). We will only mention that the artifact assemblages from these two sites differ only in that the Quina aspect is more apparent in the style of

execution in Mala Balanica and in the technology of knapping in Velika Balanica. In this phase, there are no Levallois artifacts in both assemblages of Velika or Mala Balanica.

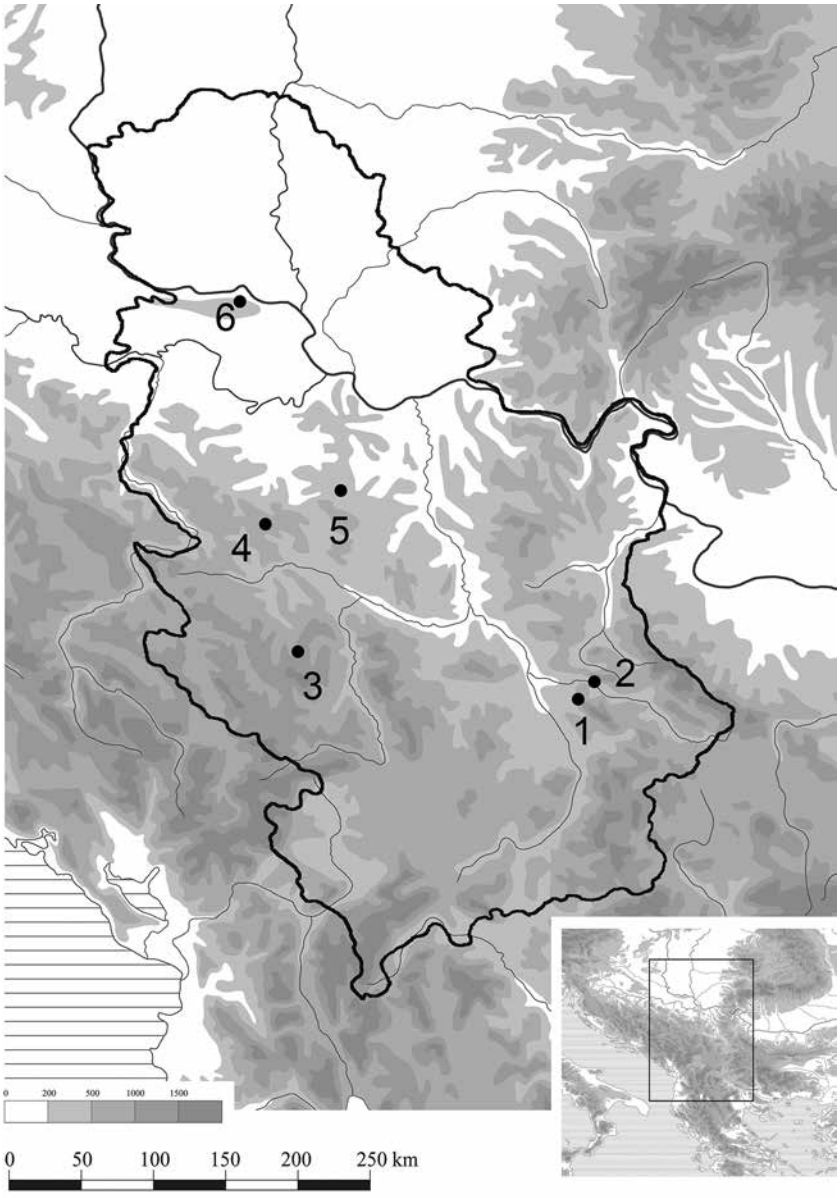


Fig. 3 Middle Palaeolithic sites in Serbia: Pešturina Cave (1), Velika and Mala Balanica (2), Hadži Prodanova Pećina (3), Šalitrena Pećina (4), Risovača (5), Petrovaradin Fortress (6)

Сл. 3 Средњопалеолитска налазишта у Србији: Пештурина (1), Велика и Мала Баланица (2), Хаџи Проданова пећина (3), Шалитрена пећина (4), Рисовача (5), Петроварадинска тврђава (6)

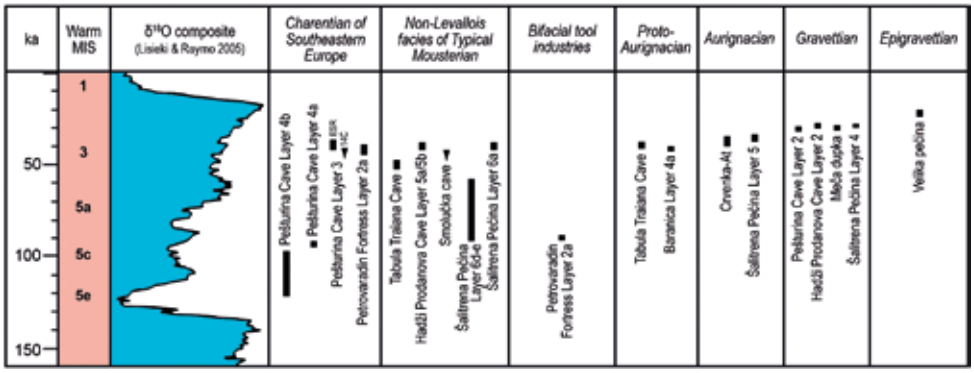


Fig. 4 Chronology of Late Middle and Upper Palaeolithic sites in Serbia
Сл. 4 Хронологија налазишта из касног средњег и горњег палеолита у Србији

In later industries, Levallois products are always associated with Quina artifacts. Artifacts from the lower Layer 4 of Pešturina Cave are attributed to the Quina Mousterian, i.e. the so-called Charentian of Southeastern Europe, and Quina elements are more present in the knapping technology than in the repertoire of tools (Mihailović et al. 2022b). A similar situation can be seen within the assemblage from Layer 3, which was originally attributed to the Denticulate Mousterian (Михаиловић и Милошевић 2012). After a larger sample of material had been collected, the assemblage from Layer 3 was also attributed to the Quina Mousterian.

The assemblage from the upper layer of Petrovaradin Fortress can also be attributed to Charentoid industries (Mihailović 2009), with Quina elements being more pronounced in the sidescrapers, and only barely noticeable in technology. Quina elements are even less pronounced in the lower layer, and considering the presence of bifacial backed tools, these artifacts might be better associated with the early Micoquian and Bábonyien of the Carpathian Basin (Ringer 2001).

Apart from the quartz Quina industries, numerous sites dominated by artifacts knapped via the discoid and Levallois methods are also present in the Central Balkans. Although these industries are usually classified as Typical Mousterian (according to the traditional scheme), in the Balkans they would rather correspond to the non-Levallois facies of the Typical Mousterian – due to the relatively low percentages of Levallois artifacts (Mihailović 2014a). The Middle Palaeolithic facies documented in the coastal zone – the Micromousterian and Denticulate Mousterian – have not been confirmed in the central parts of the Balkans (Mihailović 2014a).

Of the Middle Palaeolithic facies present on the territory of Serbia, we should also mention the Szeletian, recognized by Branko Gavela in the Risovača material during the 1960s (Гавела 1969) and recently confirmed by a revision of the lithic material (Михаиловић и Зорбић 2017). Apart from Risovača, leaf points were also found on the terrace in front of the Šalitrena Pećina (Mihailović et al. 2014), and near Koceljeva in western Serbia (Шарић 2012), demonstrating that the Middle Palaeolithic industries with leaf points – characteristic of the Pannonian (Carpathian) Basin and Lower Danube – were also widespread in peri-Pannonian part of central Serbia.

## UPPER PALAEOLITHIC

### *Chronology of the sites*

The earliest appearance of modern *Homo sapiens* in Europe is associated with the initial Upper Palaeolithic (46–43 ka), which is, in the Balkans, so far recorded only in Bulgaria (Hublin et al. 2020). The oldest Upper Palaeolithic sites from the Central Balkans come from the next phase in the peopling of modern *H. sapiens*, which corresponds to the appearance of the Proto-Aurignacian and Early Aurignacian (Fig. 5, Table 1). A small number of artifacts dated to 41.5–40.2 ka were found

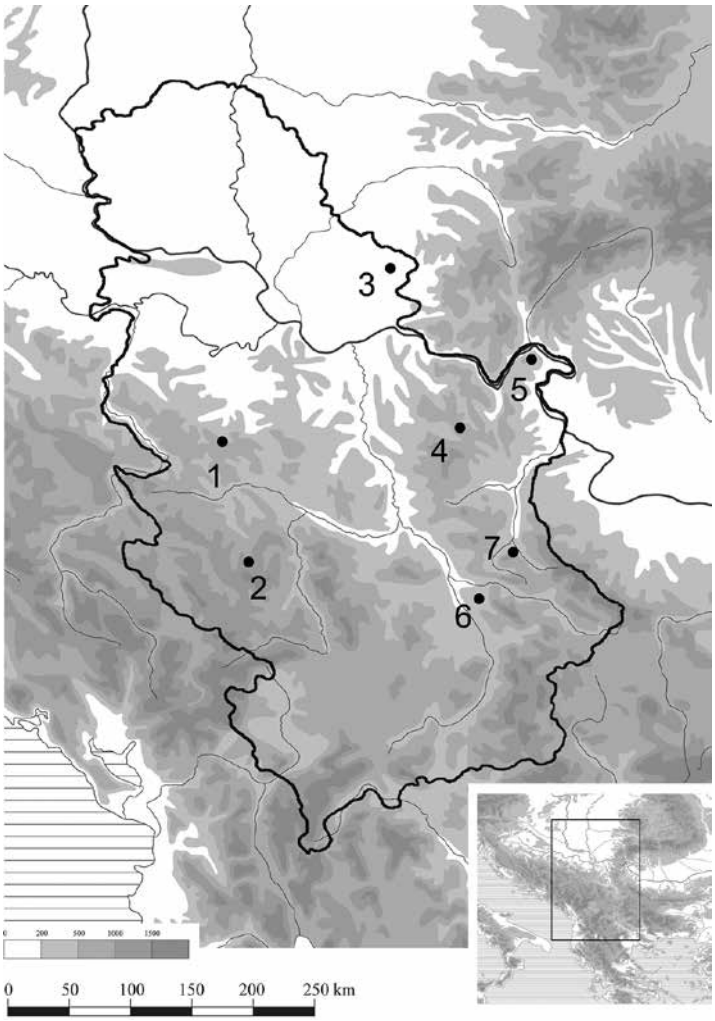


Fig. 5 Upper Palaeolithic sites in Serbia: Šalitrena Pećina (1), Hadži Prodanova Pećina (2), Crvenka–At (3), Velika Pećina (4), Tabula Traiana Cave (5), Meča Dupka (6), Pešturina Cave (7)

Сл. 5 Горњопалеолитска налазишта у Србији: Шалитрена пећина (1), Хаџи Проданова пећина (2), Црвенка–Ат (3), Велика пећина (4), Пећина изнад Трајанове табле (5), Меча дупка (6), Пештурина (7)

| Site | Laboratory code | Layer | Industry | Radiocarbon age ($^{14}$C yrs BP) | σ uncertainty | Calendar range (cal yrs BP) |
|---|---|---|---|---|---|---|
| Baranica Cave[1] | OxA-13827 | 2 | Gravettian? | 23,520 | 110 | 27,850–27,470 |
| Baranica Cave[1] | OxA-13828 | 4 | Proto-Aurignacian | 35,780 | 320 | 41,180–39,700 |
| Tabula Traiana Cave[2] | OxA-23651 | 207 | Proto-Aurignacian | 34,200 | 550 | 40,060–37,120 |
| Tabula Traiana Cave[2] | OxA-35770 | 226 | Mousterian | 46,500 | 2600 | 52,350–46,720 (68% CI) |
| Tabula Traiana Cave[2] | OxA-24818 | 207 | Proto-Aurignacian | 33,450 | 500 | 38,890–36,390 |
| Dubočka-Kozja Cave[2] | OxA-28687 | 4 | Gravettian | 25,370 | 200 | 30,020–29,200 |
| Velika Pećina[3] | BRAMS-3525 | 3/3a | Epigravettian | 16,966 | 51 | 20,658–20,335 |
| Velika Pećina[3] | BRAMS-3527 | 3b1 | Epigravettian | 16,999 | 52 | 20749–20,402 |
| Velika Pećina[3] | RTD-7805 | 3b | Epigravettian | 17,650 | 50 | 21,493–21036 |
| Velika Pećina[3] | BRAMS-3528 | 3b1 | Epigravettian | 18,074 | 57 | 22,186–21,861 |
| Velika Pećina[3] | RTD-7804 | 3b/3c | Epigravettian | 18,865 | 50 | 22,969–22,573 |
| Velika Pećina[3] | BRAMS-3531 | 3b3 | Epigravettian | 19,997 | 68 | 24,204–23,835 |
| Velika Pećina[3] | BRAMS-3534 | 3b1 | Epigravettian | 20,177 | 70 | 24204–23,951 |
| Šalitrena Pećina – entrance[4] | Beta-237690 | 5b | Mousterian | 37,760 | 520 | 42,820–41,360 |
| Šalitrena Pećina – interior [4] | OxA-27948 | 3 | Mousterian | 36,150 | 750 | 42,100–39,290 |
| Šalitrena Pećina – entrance[4] | Beta-237688 | 5a | Aurignacian | 31,980 | 360 | 36,670–35,050 |
| Šalitrena Pećina – entrance[4] | Beta-224720 | 5a | Aurignacian | 30,190 | 400 | 34,940–33,630 |
| Šalitrena Pećina – entrance[4] | OxA-27683 | 5a | Aurignacian | 30,150 | 150 | 34,530–33,880 |
| Šalitrena Pećina – entrance[4] | OxA-27975 | 5a | Aurignacian | 29,700 | 340 | 34,510–33,200 |
| Meča Dupka[5] | OxA-38547 | 3c | Gravettian | 25,420 | 190 | 30,033–29,233 |
| Pešturina Cave[1] | RTK-6446 | 2 | Gravettian | 26,100 | 620 | 31,270–28,990 |
| Pešturina Cave[1] | RTK-6449 | 3 | Charentian | 40,200 | 3600 | >40,660 |
| Pešturina Cave[1] | RTD-7149 | 4 | Charentian | 40,500 | 590 | 45,170–43,080 |
| Pešturina Cave[1] | RTK-6450 | 3/4 | Charentian | 36,200 | 2200 | 46,330–36,340 |
| Hadži Prodanova[1] | RTD-7274 | 2 | Gravettian | 25,200 | 130 | 29,560–28,860 |
| Hadži Prodanova[1] | RTD-7271 | 2 | Gravettian | 25,100 | 130 | 29,470–28,780 |
| Hadži Prodanova[1] | RTD-7270 | 5 | Mousterian | 39,500 | 540 | 44,310–42,510 |
| Hadži Prodanova[1] | RTD-7482 | 5 | Mousterian | 47,700 | 1650 | >49,920 |

Table 1 Selection of reliable radiocarbon dates for Palaeolithic sites in Serbia, after: 1. Alex et al. 2019; 2. Borić et al. 2021; 3. Stiner et al. 2021; Tsanova 2012; 4. Marín-Arroyo and Mihailović 2017; 5. Plavšić and Popović 2019

Табела 1 Избор веродостојних радиокарбонских датума за палеолитска налазишта у Србији, према: 1. Alex et al. 2019; 2. Borić et al. 2021; 3. Stiner et al. 2021; Tsanova 2012; 4. Marín-Arroyo and Mihailović 2017; 5. Plavšić and Popović 2019

in Layer 4a of the Baranica Cave (Mihailović, Mihailović and Lopičić 2011), while Tabula Traiana Cave contained Proto-Aurignacian material dated to 42.3–36.9 ka cal BP (Borić et al. 2012). Artifacts of a similar age were also found in the Mala Cave near Majdanpek, where research has just begun; the dates for this site are expected to be published soon.

In southern Banat, the Aurignacian was documented at the Crvenka-At site near Vršac (Михаиловић 1992). The sand layers which contain lithic artifacts were dated using the OSL method to 36.4 ± 2.8 ka (Nett et al. 2021). A large number of Aurignacian artifacts was also collected from Layer 5 of Šalitrena Pećina, which was dated to 36.6–33.2 ka cal BP (Marín-Arroyo and Mihailović 2017). The findings from Bukovac and Orlovača Caves near Despotovac also belong to the (middle) Aurignacian (Dogandžić, McPherron and Mihailović 2014). The Aurignacian layer has been dated to ca 28 ka $^{14}$C BP (Demidenko et al. 2022), but the exact date has yet been published.

The oldest Gravettian artifacts were found in Pešturina Cave, and are dated to more than 30 ka (Alex et al. 2019). A somewhat later age has been estimated previously for Meča Dupka near Cerje in southeastern Serbia (Plavšić and Popović 2019), Dubočka-Kozja Cave in the Danube Gorges (Borić et al. 2021), and more recently for Potpeč Cave near Pirot (southeastern Serbia) and Petrovaradin Fortress – although the dates for these localities were not published yet. The richest Gravettian assemblage comes from Šalitrena Pećina, dated (according to several radiocarbon dates) to between 29.7 and 27.6 ka cal BP (Marín-Arroyo et al. in press).

Unlike the Gravettian, the Epigravettian has been documented only at a handful of sites in Serbia. The cave site of Velika Pećina near Žagubica (eastern Serbia) stands out among these sites, as it yielded numerous lithic artifacts and remains of fauna which were found to be 24–20.5 ka cal BP (Stiner et al. 2022). Few and non-diagnostic Epigravettian finds from Baranica were similarly dated (Mihailović, Mihailović and Lopičić 2011), while slightly later (unpublished) dates of about 20 ka cal BP were obtained for the Epigravettian layer in the cave site of Pećina kod stene in Jelašnica Gorge (Михаиловић, Димитријевић и Драгосавац 2017).

### *Technocomplexes*

There are many unknowns when it comes to the issue of technological variability of the Upper Palaeolithic industries in Southeastern Europe. The assemblages from the sites located in eastern Serbia could be attributed to the Proto-Aurignacian since they contain cores and knapping products associated with this type of industry. However, it should be kept in mind that the finds from these localities are still very few, so final attributions should await additional material. When it comes to Crvenka-At, opinions still differ as to whether the artifacts from this site should be attributed to the Early Aurignacian or Proto-Aurignacian (Михаиловић 1992; Драгосавац 2016; Demidenko et al. 2022). According to another interpretation, the Proto-Aurignacian and Early Aurignacian (which were previously designated as Krems-type Aurignacian and typical Aurignacian; see Михаиловић 1992) occur simultaneously at Crvenka-At. On the other hand, there is no doubt that the arti-

facts from Šalitrena Pećina belong to the middle Aurignacian (Marín-Arroyo and Mihailović 2017).

Regarding the Gravettian, one can distinguish industries in which the Pavlovian-Willendorfian component is present (e.g., Šalitrena Pećina) from generic Gravettian industries with a repertoire of tools limited to abruptly retouched points, endscrapers on blades and flakes, and retouched blades (Mihailović and Mihailović 2007). Similar industries also occur in the early Epigravettian of Velika Pećina and Pećina kod stene. Apart from the common microgravettes, Pećina kod stene also contains truncated backed bladelets. Interestingly, the final Epigravettian industries with geometric tools (segments and triangles) and short and thumbnail endscrapers – which have been well documented in the coastal zone, as well as in the cave sites of Climente II and Cuina Turcului in the Iron Gates Gorges in Romania (Bonsall et al. 2016) – were not detected in the Central Balkans.

## DISCUSSION

Here we will try to examine the technological changes in the Balkan Palaeolithic in a regional context. When it comes to the Lower Palaeolithic, it should be noted that, until recently, only a handful of sites in Southeastern Europe could be chronologically assigned to the Lower Palaeolithic. Lithic assemblages from the oldest sites – Šandalja I, Kozarnika, Marathousa 1, and Dealul Guran – were attributed to pebble core and flake industries. All of them are characterized by the presence of irregular cores and tools made on irregular flakes, while choppers were found only in Šandalja I. The finds from Petrovac 1 fit into the general variability of industries in this period, especially since massive tools made of volcanic rock also appear at this site. Given that Oldowan technology in Europe occurred over a wide time span from 1.6 Ma until 300–400 ka (i.e., until the date for the Dealul Guran material; see Iovita et al. 2012), the chronology of the Petrovac 1 lithic assemblage remains unknown.

Up to the present day, almost nothing is known about Balkan lithic industries from the beginning of the Chibanian (Middle Pleistocene). However, it is worth noting that the centripetal method – assumed to have already occurred in that period (Barsky 2009) – was observed in the upper layer of the Petrovac 1 site. On the other hand, lithic industries from the middle and later parts of the Chibanian (which include small-tool assemblages) are much better known. Apart from Mala Balanica, this type of material is documented at slightly later Balkan sites of Petralona Cave in Greece, the cave of Gajtan in Albania, and Yarimburgaz Cave in European Turkey (Darlas 1995; Kuhn 2010). These industries have no close parallels to the contemporaneous Acheulean industries of Western and Eastern Europe and Southwest Asia. In the Balkans, the Acheulean is reliably documented only at the site of Rodafnidia on Lesbos in Greece (Galanidou et al. 2016), while the other sites associated with this technocomplex contained no typical Acheulean bifaces.

The findings from Velika and Mala Balanica indicate that the roots of Quina technology should not be sought in Western Europe, where it appears only from MIS 7 (Hérisson et al. 2016), but in the Balkans, Anatolia, and Levant, where Qui-

na technology appears since MIS 9 (Mihailović et al. 2022a). As the Levallois method first appeared in Western Europe in MIS 9, which was followed by the eastward expansion of Neanderthals, it can be assumed that the final shaping of the Middle Palaeolithic technological „package" took place only after the establishment of contact between the European and Near Eastern populations. In contrast, the northwest-to-southeast spread of Micoquian elements probably occurred during cold intervals, which were generally characterized by southward population movements. However, it still remains unclear if this appearance of Micoquian-type tools should be attributed to population movements and cultural transmission, or rather to specific functions of backed bifacial tools, which were more commonly used in base camps (Richter 2008).

Both social and cultural factors should be considered in the study of the Middle to Upper Palaeolithic transition (Mihailović 2020), especially when one takes into account the complexity of social and cultural conditions in the northern Balkans during the transition. In this period, the territory of the Balkan Peninsula was simultaneously inhabited by the makers of the late (i.e., Typical) Mousterian (Šalitrena Pećina), Charentian (Petrovaradin Fortress, Pešturina Cave), industries with leaf points (Risovača), and the initial Upper Palaeolithic (Bacho Kiro and Temnata Dupka Caves in Bulgaria etc).

Recent research has shown that the Aurignacian does not occur in the hilly-mountainous parts of the Balkans or the Adriatic zone and that there is a chronological priority of the Proto-Aurignacian and Early Aurignacian in the Banat and the Danube basin relative to the Aurignacian of the Western Balkans (Mihailović, Mihailović and Lopičić 2011). This supports the views that, in the second wave, modern humans spread into Europe from the east or from the northeast – moving along the Danubian Corridor (Conard and Bolus 2003), and the area of Aurignacian populations included low hills of the Central and Southeastern Europe (Hauck et al. 2018).

The variability factors of the Proto-Aurignacian and Early Aurignacian should be interpreted in a similar fashion. Although it seems that the Proto-Aurignacian in northern Bulgaria and northeastern Serbia (Kozarnika, Baranica, Mala Pećina, Tabula Traiana Cave) occurred prior to the Campanian Ignimbrite (CI) eruption, and the Early Aurignacian only after CI eruption, the fact is that almost all Proto-Aurignacian sites represent temporary camps set in the hilly-mountainous zone and that the sites with the Early („typical") Aurignacian or those where the two facies mix are located in the lowlands, near mineral resources. Therefore, we cannot rule out that the Proto-Aurignacian and the Aurignacian – rather than representing distinct cultural entities – merely reflect differences in mobility, availability of resources, and the length/nature of site occupation.

The situation is somewhat different when it comes to the Gravettian, given that the cultural regionalization within this technocomplex is quite well documented. The Central European component in the industries from Šalitrena Pećina, Kozarnika Cave, and Temnata Dupka Cave is clearly recognizable (Kozłowski 1999; Tsanova 2003; Mihailović 2008). In this context, the question arises as to what are the causes of the decline in technological and typological diversity that occurred at the beginning of the Last Glacial Maximum (LGM) (Maier and Zimmermann 2017). We

believe that this was due to the disintegration of the Central European Gravettian, which could have occurred when the Gravettian population underwent contraction and perhaps moved southward – as indicated by the concentration of Epigravettian sites on the eastern Adriatic coast and in its immediate hinterland.

Many authors believe that the Epigravettian of the Mediterranean should be distinguished from the Epigravettian of Central and Eastern Europe, and it was once assumed that the Mediterranean Epigravettian spread from the coastal region to the interior of the Balkans at the end of the LGM (Kozłowski and Kozłowski 1979; Boroneanț 1999). This scenario was long unsupported, but it was revived recently with the palaeogenetic research showing that ~14,000 years ago, if not even earlier, the local population was replaced by the population of the so-called Villabruna cluster – originating from the Near East (Posth et al. 2023).

It can be assumed that during the LGM, when the sea level dropped by about 120 m, human populations aggregated in the lowland (now submerged) areas in the Adriatic and Aegean basins. Hunter-gatherer communities inhabited the palaeo-Adriatic lowland, which is probably also the reason why the Villabruna cluster appears as early as ~17 ka on the Apennine Peninsula (Bortolini et al. 2021). The central parts of the Balkan Peninsula were probably inaccessible to these populations due to the glaciations and impassibility of the Dinaric Alps. For this reason, the penetration into the interior of the Balkans could have only happened later, after the improvement of the climate in the Late Glacial Period. Since it deals with a rather complex phenomenon, this hypothesis is difficult to test at the moment. However, genetic analyses of the human remains from the Iron Gates region showed that these Mesolithic hunter-gatherers probably originated from the population that appeared at the beginning of the Late Glacial Period, first in the Balkans, and then in other parts of Europe (Mathieson et al. 2018).

## CONCLUSION

We believe that a reconstruction of the cultural sequence should be the first step in the study of the Palaeolithic of any geographical region. This is also the reason why in our previous work in the Central Balkans we have focused on cultural and technological changes in the Palaeolithic. After comparing the cultural sequence in the Balkans with that in Western Europe, it became clear that the Palaeolithic of Southeastern Europe cannot be properly understood without considering the cultural changes in the whole of Western Eurasia. It has been demonstrated that this territory includes technocomplexes which are absent in Western Europe; moreover, those that do occur in Western Europe often appear earlier or in a modified form in Southeastern Europe.

Research in the Central Balkans also contributed to our understanding of the causes of the spatial and temporal variability of Palaeolithic technocomplexes. When it comes to Western Europe, there has been a lot of discussion about whether cultural facies testify to the social and cultural identity of Palaeolithic groups, differences in the function of habitations, or perhaps differences in mobility and the way resources were used. Of course, all these factors must be taken into account

when considering the variability of Palaeolithic technocomplexes in Southeastern Europe. However, research has shown that the variability of Palaeolithic industries in the Balkans could be significantly influenced by population movements between Southwest Asia and Southeastern and Central Europe, as well as between the Pannonian Basin and the Adriatic east coast.

The general absence of the Acheulean technocomplex in the Lower Palaeolithic of the Balkans, and the occurrence of pebble core and flake and small-tool industries could be explained by the assumption that the bearers of these industries belonged to biologically different hominin groups, which populated Europe in several waves. However, there is currently no evidence for this assumption and other explanations have also been given for the absence of the Acheulean (see Lycett and Bae 2010).

In contrast, the appearance of the Middle Palaeolithic in the Balkan Peninsula seems to have something to do with cultural shifts and/or cultural transmission from the Levant, since it has been shown that the entire area of the Eastern Mediterranean, including the Southern and Central Balkans, represented a single cultural space. It is important to point out that the makers of the Yabrudian assemblages are currently unknown, while the early Quina Mousterian of Balanica has been associated with the early Neanderthals – which were not yet present in the Near East at that time. This probably means that there was a transfer of technology between different hominin species at 300–200 ka and that Neanderthals later continued to use that technology along with other methods of knapping.

New research also provided preliminary insights into the spatial and temporal variability of Mousterian industries. Quartz industries with Quina artifacts (i.e., Charentian of Southeastern Europe) were widespread in the southern Pannonian Basin and the peri-Pannonian area, but one should bear in mind the possibility that the similarities between lithic industries in Central and Southeastern Europe (i.e., Pešturina Cave) could be due to population movements from the north, at the time when steppe influences penetrated into the Southern Morava Valley. The appearance of Micoquian elements at Petrovaradin Fortress, and the later appearance of industries with leaf points, could be explained in a similar way.

The variability of the Upper Palaeolithic industries must be also viewed from the aspect of demographic factors: the Proto-Aurignacian and Early Aurignacian are related to the appearance and different waves of expansion of modern *Homo sapiens*, the Gravettian and early Epigravettian to the demographic crisis and population movements towards the Adriatic zone during the LGM, and the appearance of the Mediterranean Epigravettian for the recolonization of the inner parts of the Balkans during the Late Glacial Period. It should be kept in mind that all these questions are still open and only future research will be able to provide definitive answers.

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# ХРОНОЛОГИЈА И СУКЦЕСИЈА ПАЛЕОЛИТСКИХ ТЕХНОКОМПЛЕКСА У СРБИЈИ

*РЕЗИМЕ*

Због веома малог степена истражености, о хронологији и периодизацији палеолитских технокомплекса на територији Србије донедавно уопште није могло да се расправља. Међутим, након истраживања и датовања многих палеолитских налазишта која су испитивана током последње две деценије, то је постало могуће. У овом раду настојали смо да пружимо прелиминарни увид у хронологију и сукцесију палеолитских технокомплекса на територији Србије и да проблем варијабилности индустрија размотримо у ширим регионалним оквирима.

На територији Србије је у претходној деценији потврђено неколико доњопалеолитских налазишта. Вероватно најстарије међу њима – што ће се знати када се добију апсолутни датуми – представља локалитет Петровац 1 код Лебана у јужној Србији. У геолошком слоју 3 тог локалитета прикупљени су многобројни артефакти који могу да се припишу индустријама са језгрима и одбицима (модус 1, према Кларку). Слична налазишта констатована су и у долини Западне Мораве (Гвозденац и Косовска коса), али је њихова старост такође непозната. За разлику од њих, у Малој Баланици су, у слоју 3, датованом у период пре више од 400 хиљада година, нађени окресани артефакти који би условно могли да се определе у „скупове са малим оруђем" (*Small-tool assemblages*).

Најстарији артефакти из средњег палеолита приписани су раном кина комплексу, а констатовани су у слоју 3 Велике Баланице и у слоју 2 Мале Баланице. Ти слојеви су, термолуминисценцијом изгорелог кремена и ESR методом, датовани у период пре 240–290 хиљада година. Најранија појава левалоа артефаката потврђена је у слоју 2 Велике Баланице, који је прелиминарно датован у маринске изотопске стадијуме 7 и 6. Од тада до краја средњег палеолита, на готово свим налазиштима присутни су и левалоа и кина артефакти. Почевши од последњег интерглацијала, у перипанонској области и у источној Србији јавља се шарантијен средњоевропског типа, док је у западној Србији и деловима источне Србије присутан „типични" мустеријен без кина елемената. Бифацијалне индустрије појављују се у два маха. У слоју 2b Петроварадинске тврђаве (датованом ОСЛ методом у период пре 90 хиљада година) нађени су артефакти који би могли да се вежу за рани микокијен Карпатског басена, док су на налазиштима у северној Србији (Рисовача, Шалитрена пећина – тераса, Коцељева) констатовани листолики шиљци који су опредељени у селетијен. Хронологија ових налазишта за сада није позната.

Иницијални горњи палеолит није са сигурношћу потврђен ни на једном локалитету, док је појава протоорињасијена и орињасијена добро документована. Налазишта која су опредељена у протоорињасијен потичу из периода пре Кампанијске (CI) ерупције, а она на којима се мешају протоорињасијенски и орињасијенски елементи (Црвенка–Ат, Буковац, Орловача, Шалитрена пећина) су помоћу $^{14}C$ метода датована у време после ерупције.

У граветијену се јављају два типа индустрија. Индустрије са средњоевропским (павловијенско-вилендорфијенским) елементима потврђене су у Шалитреној пећини, док је генерички граветијен, с веома уским спектром оруђа, присутан на свим осталим налазиштима. Већина граветијенских локалитета на централном Балкану радиометријски је датована у период непосредно пре максимума последњег глацијала. Из максимума глацијала потиче неколико епиграветијенских локалитета, међу којима се издваја Велика пећина, датована у период пре 20–24 хиљаде година. Пећина код стене опредељена је у време пре 20–18 хиљада година, али датуми за њу још увек нису објављени.

Поставља се питање зашто на централном Балкану, а и шире, нема налазишта из финалног епиграветијена упркос чињеници да је управо њега обележила смена популација и појава кластера Вилабруна. Археолошки и генетички показатељи указују на то да је почетком максимума последњег глацијала дошло до агрегације становништва у јадранској зони, укључујући тзв. Палеојадранску низију, која се у то време формирала на подручју северног Јадрана. Становништво које је тада насељавало централне делове Балкана се, по свему судећи, знатно проредило. Постоје индиције, али не и сигурни докази, да су у позном глацијалу, када су Динариди постали проходни, носиоци медитеранског епиграветијена населили средишње делове полуострва.