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Litička analiza materijala iz Mujine pećine

Lithic analysis of materials from Mujina Pećina

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Članak donosi rezultate tipološke, tehnološke i petrografske analize litičkog materijala prikupljenog u istraživanjima od 1995. do 2000. godine te pregled nalazišta rožnjaka u bližoj i daljoj

This article contains the results of typological, technological and petrographic analysis of lithics gathered during research conducted from 1995 to 2000 and an overview of chert deposits

okolici Mujine pećine kod Kaštela. Svi litički nalazi iz slojeva Mujine pećine pripadaju musterijenskoj materijalnoj kulturi pa ih s obzirom na tu činjenicu i rezultate kronometrijskog datiranja (45000 - 39000 godina prije sadašnjosti) nedvojbeno možemo pripisati neandertalcima. Rad donosi rezultate detaljne analiza litičkog materijala iz slojeva B i C te D1 i D2. Sve faze proizvodnje bile su prisutne na nalazištu koje je imalo funkciju radionice. Prisutni su i proizvodi koji svjedoče o korištenju levaloaške metode. Najčešći tipovi alatki su djelomično obrađeni komadići te nazupci i udupci. Ljudi musterijenske kulture koji su povremeno obitavali u Mujinoj pećini služili su se sirovinom iz okolice pećine, ali možda i s udaljenijih mjesta (sa Svilaje). Neandertalci iz Mujine pećine uspješno su prilagodili proizvodnju svojih alatki različitim vrstama najlakše dostupnih sirovinskih materijala, što upućuje na visok stupanj inteligencije, društvenih odnosa i prilagodbene spretnosti tih ljudi.

Ključne riječi: tehnologija, tipologija, petrografska analiza, musterijen, Mujina pećina, Dalmacija, Hrvatska

in the nearer and farther vicinity of the cave called Mujina Pećina at Kaštela. All lithics found in the layers of Mujina Pećina belong to the Mousterian material culture, so given this fact and the results of chronometric dating (45000-39000 years before the present), they can unambiguously be attributed to Neanderthals. This paper presents the results of detailed analysis of lithics from layers B and C and D1 and D2. All production phases were present at the site, which functioned as a workshop. Products are also present which testify to the use of the Levallois technique. The most frequent types of tools are partially retouched pieces and denticulates and notches. The Mousterian culture people temporarily residing in Mujina Pećina used the raw materials from the cave's vicinity, but perhaps from farther afield as well (from Svilaja). The Neanderthals from Mujina Pećina successfully adapted the production of their tools to various types of the most easily available raw materials, which indicates the high degree of intelligence, social cohesion and adaptability of these people.

Key words: technology, typology, petrographic analysis, Mousterian, Mujina Pećina, Dalmatia, Croatia

1. Uvod

Paleolitička nalazišta Hrvatske često se spominju u svjetskoj paleoantropološkoj i arheološkoj literaturi zbog važnih nalaza fosilnih ljudi i njihovih materijalnih kultura. To se ponajprije odnosi na područje Hrvatskoga zagorja, gdje su smještena čuvena nalazišta Krapina i Vindija. Osim ostataka fosilnih ljudi i faune koji su objavljeni u mnogobrojnim stranim i domaćim publikacijama,[1] litički su nalazi proučavani s različitih aspekata na tim i drugim nalazištima sjeverozapadne Hrvatske.[2] Premda je Š. Batović[3] o paleolitičkim nalazištima na otvorenom u sjevernoj Dalmaciji prvi put pisao još prije četrdesetak godina, izostala su intenzivnija istraživanja tog razdoblja Dalmacije i cijeloga hrvatskoga dijela istočnog jadranskog područja. Prvi lokalitet sustavno istražen i kronometrijski datiran na području Dalmacije je Mujina pećina. U ovom radu donosimo rezultate litičke analize (tehnološke, tipološke, petrografske) za gornje i srednje slojeve navedenoga nalazišta (B i C, te D1 i D2). Držimo da su dobiveni rezultati osnova za usporedbu s nalazištima sjeverozapadne Hrvatske, čime dobivamo mogućnost usporedbe ponašanja i prilagodbe neandertalaca na okoliš u dvjema regijama koje su tijekom pleistocena bile različite paleoekološke cjeline.

2. Osnovni podaci o nalazištu

2.1. Smještaj i povijest istraživanja

Mujina pećina nalazi se sjeverno od Kaštela, na približno 260 m nadmorske visine, nedaleko od ceste koja vodi prema Labinštini. Svijetla je, dužine desetak metara (bez predšpiljskog prostora) i širine 8 m; ima zaklonjenu desnu nišu i manji predšpiljski prostor, što je čini ugodnom za život. S predšpiljskoga prostora pruža se pogled na Kaštelanski zaljev i okolni teritorij koji se može uspješno kontrolirati (sl. 1). M. Malez[4] navodi da je još prilikom pregleda nalazišta godine 1977. skupljeno mnoštvo kamenih rukotvorina s obilježjima srednjega paleolitika, a kraći izvještaj o prvome probnom sondiranju 1978. objavio je N. Petrić.[5] Skupljeni materijal bio je dovoljan za odredbu kulture kao musterijenske, a osim jezgara, odbojaka i nepravilno izlomljenih komada (krhotina) pronađen je i veći broj alatki. Ta istraživanja međutim nisu nastavljena. Godine 1995. započeta su sustavna istraživanja Mujine pećine, i to u suradnji Arheološkoga zavoda Filozofskoga fakulteta Sveučilišta u Zagrebu i Muzeja grada Kaštela (tada Zavičajnoga muzeja Kaštela), koja su trajala do 2003. godine.[6] Svih se godina istraživalo istom, vrlo preciznom metodom, koja

1 Primjerice Malez 1979; Smith 1984; Miracle 1991; Wolpoff 1996.
2 Zupanič 1970; Malez 1979; Kurtanjek i Marci 1990; Karavanić 1994; Simek i Smith 1997; Karavanić i Smith 1998; Blaser, Kurtanjek, Paunović; Ahern, Karavanić, Paunović, Janković, Smith 2004.
3 Batović 1965.
4 Malez 1979.
5 Petrić 1979.
6 Karavanić, Bilich-Kamenjarin 1997; Karavanić 2000.

1. Introduction

Palaeolithic sites in Croatia are often cited in world palaeoanthropological and archaeological literature due to the significant discoveries of fossilized hominids and their material cultures. This primarily pertains to the Hrvatsko Zagorje region, where the renowned Krapina and Vindija sites are located. Besides the remains of fossilized hominids and animals published in numerous foreign and domestic publications,[1] the lithic materials have been studied in their various aspects at these and other sites of North-western Croatia.[2] Although Š. Batović[3] wrote about open-air Palaeolithic sites in Northern Dalmatia for the first time about forty years ago, more intense research into this period in Dalmatia and the entire Croatian part of the Eastern Adriatic seaboard is lacking. The first site that was systematically examined and chronometrically dated in the territory of Dalmatia is Mujina Pećina. This work presents the results of lithic analysis (technological, typological, petrographic) from the upper and middle layers of this site (B and C; D1 and D2). We believe that the results so obtained constitute the basis for comparison of sites in North-western Croatia, which afford an opportunity to compare the behaviour and adaptation of Neanderthals to their environment in two regions which were different palaeoecological units during the Pleistocene.

2. Basic data on the site

2.1. Location and history of research

Mujina Pećina lies north of Kaštela, at roughly 260 m above sea level, not far from the road leading to Labinština. It is well-lit, roughly ten meters long (not including the cave entrance) and 8 m wide; it has a sheltered right niche and a small entrance chamber, which makes it a pleasant habitat. The cave's mouth offers a view of Kaštela Bay and the surrounding territory, which can be successfully overseen (Fig. 1). M. Malez[4] stated that many stone handicrafts with Middle Palaeolithic features were collected during an examination of the site in 1977, and a brief report on the first test excavation in 1978 was compiled by N. Petrić.[5] The gathered materials were sufficient to classify the culture as Mousterian, and besides cores, flakes and irregularly fragmented pieces (chunks), a large number of tools was also found. This research did not, however, resume. In 1995, systematic research commenced in Mujina Pećina in cooperation with the Archaeology Institute of the University of Zagreb Faculty of Arts and Letters and the Kaštela City Museum (at the time the Kaštela Territorial Museum), which

1 For example, Malez 1979; Smith 1984; Miracle 1991; Wolpoff 1996.
2 Zupanič 1970; Malez 1979; Kurtanjek & Marci 1990; Karavanić 1994; Simek & Smith 1997; Karavanić & Smith 1998; Blaser, Kurtanjek, Paunović; Ahern, Karavanić, Paunović, Janković, Smith 2004.
3 Batović 1965.
4 Malez 1979.
5 Petrić 1979.

Slika 1.
Pogled s predšpiljskog prostora Mujine pećine na Kaštelanski zaljev koji je tijekom nastanjivanja pećine bio kopno (snimila R. Šošić)

Figure 1.
View from the mouth of Mujina Pećina of Kaštela Bay, which was dry land when the cave was inhabited (photo: R. Šošić)

zadovoljava zahtjevne standarde suvremene arheološke znanosti, a primjenjuje se pri istraživanju paleolitičkih nalazišta (sl. 2). Uzimane su tri dimenzije položaja svih nalaza veličine 2 cm ili više. Nalazi su ucrtavani, a sav iskopani sediment prosijavan je kako bi se skupili i najsitniji nalazi. Vodeći se suvremenim zahtjevima struke, oko jedne trećine sedimenta u špilji ostavljeno je za buduća istraživanja.

2.2. Stratigrafija i kronologija

Preliminarno su analizirani uzorci sedimenta slojeva B, C, D1 i granice slojeva E1 i E2 iz četvornog metra F9. Sediment je rastresit, sa sličnim granulometrijskim značajkama, ali različitim udjelima pojedinih frakcija. Sastoji se od uglastih i poluuglastih fragmenata kršja, zaobljenih i poluzaobljenih čestica pijeska, silta (rijetko), i nešto gline.[7] Svi stratigrafski profili upućuju na kratko razdoblje

continued until 2003.[6] Over these years, research was conducted by the uniform, very precise methods which meet all of the demanding criteria of contemporary archaeological science, and which are applied during research into Palaeolithic sites (Fig. 2). Three dimensional position readings were taken of all items 2 cm or larger. The items were drawn in, and all of the excavated sediments were sieved to collect even the tiniest items. Based on contemporary professional dictates, approximately one third of the sediment in the cave were set aside for future research.

2.2. Stratigraphy and chronology

Sediment samples from layers B, C, D1 and the peripheral layers E1 and E2 from the square meter, F9 underwent preliminary analysis. The sediment was friable, with similar granulometric features, but with different proportions in individual fractions. It

7 Usmeno priopćenje M. Sarkotić.

6 Karavanić, Bilich-Kamenjarin 1997; Karavanić 2000.

sedimentacije bez značajnijih prekida ili hijatusa u procesu taloženja.

Opis slojeva načinjen je prema sjevernom profilu A. Taj je profil otkopan tijekom prve sezone istraživanja 1995 godine.[8] Sljedeće godine iskopani je prostor proširen za po jedan metar prema sjeveru, zapadu i jugu, te tri prema istoku, pri čemu se sjeverni profil proširio, a poslije je potpuno iskopan. Međutim, interpretacija stratigrafije Mujine pećine prikazana ovdje temelji se na originalnom sjevernom profilu A, jer sadrži sloj C, koji se ne pojavljuje u kasnijem sjevernom profilu (sl. 3). Značajke ostalih slojeva opisanih u radu uglavnom su iste na cijelom prostoru obuhvaćenom istraživanjem, uz iznimku sloja E3, koji se uglavnom pojavljuje iznad poda pećine pri ulazu i nije vidljiv u sjevernom profilu, pa ovdje nije opisan.

Boje sedimenta određene su prema "Munsell Soil Colour Charts", u vlažnom stanju.

Sloj E2 - tamnocrvenkastosmeđi (5YR3/3) pjeskovito glinovit sediment, debljine 12 do 18 cm, s kamenim kršjem. Upućuje na relativno toplo razdoblje i veliku prisutnost organske materije.

Sloj E1 - crvenkastosmeđi (5YR4/3) pjeskovito glinovit sediment, debljine 8 do 12 cm, s puno kamenog kršja. Upućuje na relativno toplo razdoblje i prisutnost organske materije.

Sloj D2 - krioklastično kameno kršje sa žućkastocrvenim (5YR4/6) sedimentom debljine 25 do 28 cm. Upućuje na hladnu klimu.

Sloj D1A - krioklastično kameno kršje s malo žućkastocrvenog (5YR5/6) sedimenta debljine 1 do 38 cm. Upućuje na vrlo hladno razdoblje. Na pojedinim dijelovima krioklastično kršje bilo je zasigano.

Sloj D1B - krioklastično kršje s vrlo malo sitnog sedimenta ili bez njega, debljine 1 do 71 cm, urušeno sa stropa ili zidova špilje. Upućuje na vrlo hladno razdoblje. Na pojedinim dijelovima krioklastično kršje bilo je zasigano.

Sloj C - izrazito smeđa (7.5YR4/6) pjeskovita zemlja, debljine 1 do 26 cm, s kamenim kršjem. Sloj isklinjuje i prisutan je samo u četvornim metrima E9, E10, F9, F10, G9 i G10. Upućuje na relativno toplo razdoblje u odnosu na slojeve kompleksa D (D2, D1A, D1B).

Sloj B - izrazito smeđa (7.5YR5/6) pjeskovita ilovača, debljine 12 do 31 cm, s kamenim kršjem. Upućuje na relativno toplo razdoblje u odnosu na slojeve kompleksa D.

Sloj A - tamnosmeđi (7.5YR3/3) humus debljine 2 do 4 cm.

Svi slojevi sadrže litiku musterijenske materijalne kulture i faunističke ostatke. U najgornjem, vrlo tankom, humusnom sloju musterijenski nalazi, koji vjerojatno potječu iz sloja B, pomiješani su sa suvremenim otpatcima.

Metodom Electron Spin Resonance (*ESR*) datirana su 2 zuba iz sloja E1, dok je radiokarbonsko datiranje metodom Accelerator Mass Spectometry (*AMS*) provedeno na 5 uzoraka kolagena

8 Karavanić, Bilich-Kamenjarin 1997; Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002, 944.

consisted of angular and semi-angular fragments of debris, rounded and semi-rounded particles of sand, silt (rarely) and some clay.[7] All stratigraphic profiles indicate a brief period of sedimentation without significant breaks or hiatuses in the sedimentation process.

The description of the layers was made according to northern profile A. This profile was excavated during the first season of research in 1995.[8] In the next year, the excavated area was expanded one meter to the north and three to the east, wherein the northern profile was expanded, and then later entirely excavated. However, interpretation of the stratigraphy of Mujina Pećina is shown here on the basis of the original northern profile A, for it contains layer C, which does not appear on later northern profile (Fig. 3). The features of the remaining layers described in the paper are generally the same throughout the area encompassed by the research, with the exception of layer E3, which generally appears above the floor of the cave at the entrance and is not visible in the northern profile, so it is not described here.

The colours of the sediments are determined according to the *Munsell Soil Colour Charts*, in moist condition.

Layer E2 - dark reddish brown (5YR3/3) sandy argillaceous sediment, 12 to 18 cm thick, with stone debris. Indicates a relatively warm period and high presence of organic matter.

Layer E1 - reddish brown (5YR4/3) sandy argillaceous sediment, 8 to 12 cm thick, with much stone debris. Indicates a relatively warm period and presence of organic matter.

Layer D2 - cryoclastic stone debris with yellowish red (5YR4/6) sediment 25 to 28 cm thick. Indicates a cold climate.

Layer D1A - cryoclastic stone debris with a small quantity of yellowish red (5YR5/6) sediment 1 to 38 cm thick. Indicates a very cold climate. At individual points the cryoclastic debris was calcified.

Layer D1B - cryoclastic debris with a very small quantity of fine sediment or without it, 1 to 71 cm thick, which fell from the ceiling or walls of the cave. Indicates a very cold period. At individual points the cryoclastic debris was calcified.

Layer C - exceptionally brown (7.5YR4/6) sandy sediment, 1 to 26 cm thick, with stone debris. The layer juts in wedge-like fashion and is only present in square meters E9, E10, F9, F10, G9 and G10. Indicates a relatively warm period in relation to the layers of complex D (D2, D1A, D1B).

Layer B - exceptionally brown (7.5YR5/6) sandy loam, 12 to 31 cm thick, with stone debris. Indicates a relatively warm period in relation to the layers of complex D.

Layer A - dark brown (7.5YR3/3) humus 2 to 4 cm thick.

All layers contain Mousterian lithics and faunal remains. In the uppermost, very thin humus layer, the Mousterian items, which probably came from layer B, are intermingled with contemporary waste.

7 Personal communication from M. Sarkotić.

8 Karavanić, Bilich-Kamenjarin 1997; Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002, 944.

Slika 2.
Iskopavanje Mujine pećine (snimio S. Burić)

Figure 2.
Excavation of Mujina Pećina (photo: S. Burić)

dobivenog iz 5 uzoraka kostiju (slojevi B, C, D1, D2 i granica slojeva E1/E2), te na jednom uzorku ugljena iz sloja D2. Srednja vrijednost ESR starosti procijenjena je za sloj E1 (pretpostavljajući 30 posto vlažnosti za izračun stope gama i beta doze zračenja) na 40±7000 godina prije sadašnjosti (EU) i 44±5000 godina prije sadašnjosti (LU) (Rink et al. 2002). Rezultat radiokarbonskog (AMS) datiranja smješta granicu slojeva E1 i E2 na približno 45000 godina prije sadašnjosti. Istom metodom datirani su i mlađi slojevi. Srednja vrijednost za 5 dobivenih rezultata iznosi otprilike 39000 godina prije sadašnjosti. Na temelju kalibrirane krivulje prema Bardu (1990)[9] stvarni (kalibrirani) rezultat za tu vrijednost iznosio bi oko 42000 godina prije sadašnjosti, iako Ramsey i suradnici (2006)[10] smatra da kalibrirane krivulje nisu pouzdane za rezultate starije od 26000 godina prije sadašnjosti i da je termin "pretpostavljena starost" prikladniji. U svakom slučaju, dobiveni datum upućuje na to da je rezultat ESR datiranja u skladu s kalibriranim radiokarbonskom srednjom vrijednosti za gornje slojeve i potvrđuje relativno brzu sedimentaciju.[11]

2.3. Fauna

Faunističku i tafonomsku analizu za musterijenske slojeve D2, D1, C i B Mujine pećine proveo je P. T. Miracle[12] sa Sveučilišta u Cambridgeu, a analiza ostalih slojeva je u tijeku. Utvrdio je nedvojbene tragove ljudske djelatnosti (oštećenja od razbijanja, urezi od rezanja, nagorenost) na kostima divokoze, kozoroga, jelena i velikih bovida - pragoveda i stepskog bizona. Činjenica da ostatci jelena, divokoze i kozoroga u Mujinoj pećini uglavnom

9 Bard, Hamelin, Faribanks, Zindler 1990.
10 Ramsey, Bronk, Buck, Manning, Reimer, van der Plicht 2006.
11 Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002, 944.
12 Miracle 2005.

The electron spin resonance (ESR) method was used to date two teeth from layer E1, while radiocarbon dating using the accelerator mass spectrometry (AMS) method was conducted on five samples of collagens obtained from five bone samples (layers B, C, D1, D2 and the boundary between layers E1/E2), and on one charcoal sample from layer D2. The mean value of ESR age has been estimated for layer E1 (assuming 30 percent humidity to compute the rate of gamma and beta radiation doses) at 40±7000 years before the present (EU) and 44±5000 before the present (LU) (Rink et al. 2002). The results of radiocarbon (AMS) dating places the boundary of layers E1 and E2 at approximately 45000 before the present. The more recent layers were dated using the same method. The mean value for the five results obtained is roughly 39000 years before the present. Based on the calibrated curve according to Bard (1990),[9] the actual (calibrated) result for this value would be approximately 42000 years before the present, even though Ramsey and colleagues (2006)[10] believes that the calibrated curves are not reliable for results older than 26000 years before the present and that the term "assumed age" would be more appropriate. In any case, the date obtained indicates that the result of ESR dating complies with the calibrated radiocarbon mean value for the upper layers and confirms relatively rapid sedimentation.[11]

2.3. Fauna

Faunistic and taphonomic analysis for the Mousterian layers D2, D1, C and B in Mujina Pećina was conducted by P. T. Miracle[12] from Cambridge University, while analysis of the remaining layers is under way. He ascertained unambiguous traces of human activity (damage due to breakage, incisions from cutting, charring) on the bones of chamois, ibexes, deer and large bovines - aurochs and steppe bison. The fact that the deer, chamois and ibex remains in Mujina Pećina generally come from adult animals and exhibit traces of chopping of the carcasses indicates the important role of hunting in the lives of the Mousterian people from Mujina Pećina.[13] On the other hand, the remains of equids and hares at the site were probably brought by carnivores rather than people. The damage to the bones clearly demonstrate that the carnivores came to the cave after people had left it, in order to take advantage of the food and waste they left behind. The cave was also a bear's den, and the remains of wolves were also found there, although these fierce animals were not hunted here.[14]

The faunal remains from Mujina Pećina also reflect the differences in the presence of animal species between the two stratigraphic complexes studied, particularly in their frequency. The relative

9 Bard, Hamelin, Fairbanks, Zindler 1990.
10 Ramsey, Bronk, Buck, Manning, Reimer, van der Plicht 2006.
11 Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002, 944.
12 Miracle 2005.
13 Miracle 2005, 103.
14 Miracle 2005, 103.

potječu od odraslih jedinki te pokazuju tragove komadanja trupla, upućuje na važnu ulogu lova u životu musterijenskih ljudi iz Mujine pećine.[13] S druge pak strane, ostatke ekvida i zeca na lokalitet su vjerojatno donijele zvijeri, a ne ljudi. Iz oštećenja na kostima vidljivo je da su zvijeri dolazile u špilju nakon što bi je ljudi napuštali, kako bi se okoristile ostatcima hrane i otpadcima koji su ostali nakon čovjeka. Špilja je bila i medvjeđi brlog, a pronađeni su i vučji ostatci, no te opasne životinje ondje nisu bile lovljene.[14]

Faunistički ostatci iz Mujine pećine također pokazuju razlike u zastupljenosti životinjskih vrsta između dva proučavana stratigrafska kompleksa, pogotovo u njihovoj učestalosti. Relativna učestalost divokoze/kozoroga, ekvida i velikih mesoždera značajno se povećava od slojeva D1/D2 prema slojevima B i C, dok se učestalost zeca i jelena značajno smanjuje. Iako je prisutnost jelena i zeca često indikator "umjerenih klimatskih prilika", i smanjenje njihova broja moglo bi ukazivati na promjenu prema hladnijoj i sušoj klimi u slojevima B i C, Miracle[15] smatra da su sedimentološke analize pouzdaniji indikator lokalne klime, jer ostatci faune odražavaju selekciju plijena koju su provodili ljudi i/ili ostali "sakupljači kostiju".

2.4. Strukture staništa i sezonalnost

Posebno zanimljiva otkrića su dvije lokacije unutar sloja D2 Mujine pećine s većom koncentracijom ugljena i izgorenog kamenja, koje najvjerojatnije predstavljaju vatrišta. Ona nisu posebno omeđena, nego je vatra zapaljena na stanišnoj razini. Oko jednoga vatrišta koje je bilo u desnoj niši, pronađen je veći komad jelenjega roga te nekoliko porazbacanih kamenih rukotvorina i kosti. Zahvaljujući analizi ugljena koju je provela Meta Culiberg,[16] doznali smo da su praljudi iz Mujine pećine kao loživo za vatru upotrebljavali borovicu (*Juniperus* sp.), koju su vjerojatno skupljali u okolici te prije paljenja sušili.

Ako promatramo učestalost nalaza po slojevima, najviše ih je u najdubljim, tj. u najstarijim (E3, E2 i E1), dok ih je u sloju B više nego u slojevima D2 i D1. Stoga se može činiti da je špilja dugotrajnije bila nastavana u najdubljim razinama, dok druge razine vjerojatno samo svjedoče o kraćim lovnim epizodama. No, to ne mora biti točno jer je ustanovljeno da velike koncentracije nalaza u slojevima mogu nastati i kao posljedica uzastopnih kratkih boravaka u špilji[17] ili tijekom kratkoga razdoblja ako je djelatnost bila izrazito intenzivna. U sloju D1 Mujine pećine (četvorni metar D7) otkrivena je mala zastupljenost litičkih nalaza, kao i mala koncentracija litičkih i faunističkih nalaza u desnom dijelu špilje, dok je u sloju D2 primijećena povećana koncentracija faunističkih nalaza u desnoj špiljskoj niši, u kojoj je nađeno i

frequency of chamois/ibexes, equids and large carnivores increases considerably from layers D1/D2 toward layers B and C, while the frequency of hares and deer decline significantly. Even though the presence of deer and hares is frequently an indicators "moderate climate circumstances", and a decline in their numbers may indicate a transition to a cooler and drier climate in layers B and C, Miracle[15] believes that a sedimentological analysis is a more reliable indicator of the local climate, because the faunal remains reflect selection of prey carried out by people and/or other "bone collectors".

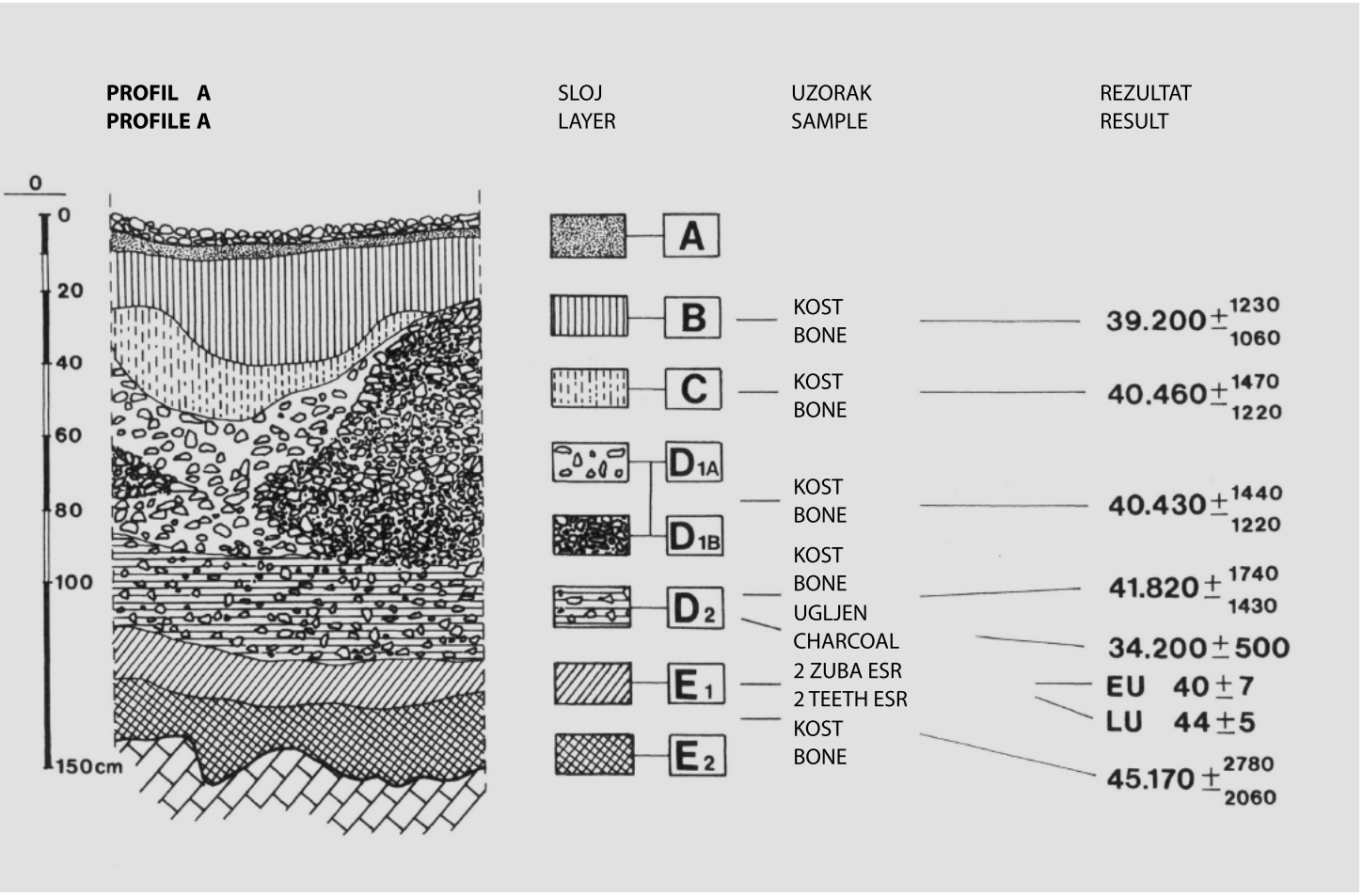
2.4. Structure of habitats and seasonality

Particularly interesting discoveries are two locations within layer D2 of Mujina pećina with a higher concentration of charcoal and charred stones, which were probably fire-places. They were not specifically bordered, rather the fires burned at the habitat level. A large deer antler and several scattered stone handicrafts and bones were found around one of the fire-places which was in the right niche. Thanks to analysis of the charcoal conducted by Meta Culiberg,[16] we have learned that the prehistoric people from Mujina Pećina used juniper wood (*Juniperus* sp.) as fuel for their fires; it was probably gathered in the vicinity and dried prior to ignition

If the frequency of the discoveries per layer is observed, most are in the lowest, i.e. oldest layers (E3, E2 and E1), while there are more in layer B than in layers D2 and D1. It may therefore seem that the cave was inhabited for longer periods at the lower levels, while the other periods probably testify to brief hunting expeditions. However, this need not be accurate, for it has been ascertained that high concentrations of items in layers may also result from consecutive brief stays in the cave[17] or during brief periods if the activity was exceptionally intense. In layer D1 of Mujina Pećina (square meter D7) a small presence of lithics was found, and a small concentration of lithic and faunistic items in the right part of the cave, while in layer D2 an increased concentration of faunistic items were observed in the cave's right niche, where one of the two fire-places was also discovered. This is not surprising, since this is a sheltered spot, which was perhaps the most pleasant to stay in when temperatures were low and harsh winds were blowing.[18] Based on the discovery of deciduous teeth and foetal and/or neonatal animal bones, Preston T. Miracle[19] ascertained that during the period of formation of layer B, the people in Mujina Pećina came during the autumn, and perhaps visited it in the spring as well. During the period of layer D1, they may have come here in spring-time. People did not stay in the cave during the summer nor winter, when bears resided in it. We still do not have such data for the lowest layers (E3, E2 and E1). Perhaps their summer or

13 Miracle 2005, 103.
14 Miracle 2005, 103.
15 Miracle 2005, 90-91.
16 Usmeno priopćenje.
17 Vidi Conard 1996.

15 Miracle 2005, 90-91.
16 Personal communication.
17 See Conard 1996.
18 Karavanić 2003, 44.
19 Miracle 2005, 101.



Slika 3.
Stratigrafski profil "A" Mujine pećine (prema Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002, slika 3; crtež M. Perkić)

Figure 3.
Stratigraphic profile A of Mujina Pećina (after Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002, Fig. 3; drawing by M. Perkić)

jedno od dvaju vatrišta. To ne čudi s obzirom na činjenicu da je riječ o zaklonjenom mjestu, koje je možda bilo najugodnije mjesto za boravak pri niskim temperaturama i oštrim vjetrovima.[18] Na temelju nalaza mliječnih zuba te fetalnih i/ili neonatalnih životinjskih kostiju Preston T. Miracle[19] ustanovio je da su u razdoblju nastajanja sloja B ljudi u Mujinu pećinu dolazili tijekom jeseni, a možda bi je posjetili i u proljeće. Tijekom proljeća možda su onamo došli u razdoblju sloja D1. Ljudi u špilji nisu boravili tijekom ljeta, ni zimi, kad su u njoj bili medvjedi. Takve podatke za najdublje slojeve (E3, E2 i E1) još nemamo. Možda im je ljetno ili zimsko stanište bilo blizu tadašnje obale, pa je prekriveno izdizanjem morske razine i/ili uništeno valovima.

3. Tehnološka i tipološka analiza
3.1. Metode

Tehnološka analiza obuhvatila je materijal iz slojeva B, C, D1 i D2 koji je iskopan u razdoblju od 1995. do 2000. i sadrži 626 litičkih

winter habitat was close to the seashore of that time, so it has been covered by the higher sea-level and/or destroyed by tidal action.

3. Technological and typological analysis
3.1. Methods

Technological analysis encompassed materials from layers B, C, D1 and D2 which were excavated during the period from 1995 to 2000 and contains 626 lithic items. Due to the smaller number of items and great similarity of materials from layers B and C, on the one hand, and D1 and D2 on the other, they were treated as single unit. To conduct the technological analysis, a modified list of technological types was used which was constructed on the basis of the model drawn up by Jean-Michel Geneste[20] when analyzing the Mousterian materials from Vaufrey Cave in South-west France (Dordogne). This list was adapted by I. Karavanić[21] to the materials from Mujina Pećina and it contains 24 categories (see Table 1), with names adapted to the Croatian language based on the advice of T. Ladan.

18 Karavanić 2003, 44.
19 Miracle 2005, 101.
20 Geneste 1985; Geneste 1988.
21 Karavanić 2004, Table 1, 82.

nalaza. Zbog manjeg broja nalaza i velike sličnosti materijal iz slojeva B i C, s jedne strane, te D1 i D2, s druge, tretiran je kao cjelina. Za provedbu tehnološke analize korišten je modificirani popis tehnoloških tipova konstruiran po uzoru na popis koji je Jean-Michel Geneste[20] načinio pri analizi musterijenskog materijala iz špilje Vaufrey u jugozapadnoj Francuskoj (Dordogne). Taj je popis I. Karavanić[21] prilagodio materijalu iz Mujine pećine i on sadrži 24 kategorije (vidi tablicu 1), čiji su nazivi prilagođeni hrvatskom jeziku prema savjetima T. Ladana.

Nulta kategorija označava nultu fazu proizvodnje, odnosno sabiranje sirovinskog materijala, kategorija 1 označava početni proces proizvodnje (prva faza proizvodnje) - skidanje okorine i formiranje jezgara. Stoga tu fazu označavaju tzv. prvotni odbojci čija je dorzalna strana više od 50 posto prekrivena okorinom. Središnji dio procesa proizvodnje, odnosno druga faza, označen je cijepanjem odbojaka koji još sadrže nešto okorine (tzv. drugotni odbojci, kategorije 2 i 3), te dobivanjem različitih proizvoda bez okorine, tj. kategorija od 4 do 17. Valja upozoriti da drugotni odbojci na drugim lokalitetima mogu još uvijek upućivati na prvu fazu proizvodnje, tj. skidanje okorine i oblikovanje jezgre. Međutim, često korištenje malih oblutaka u Mujinoj pećini, što zahtijeva štednju materijala, dovodi do zaključka da su drugotni odbojci na tom nalazištu cijepani kako bi se na njima izrađivale alatke, a ne samo formirala jezgra, pa stoga ovdje predstavljaju drugu fazu proizvodnje. Različiti tipovi proizvoda odbijenih tijekom druge faze imenovani su od 4 do 10, dok su komadi od kojih su odbijani (jezgre) i njihovi ulomci razvrstani od 11 do 17. Kategorije 18 i 19 posebni su tipovi odbojaka, koji također pripadaju drugoj fazi, a njihovo je odbijanje uvjetovano nastavkom tehnološkog procesa; naime, u jednom trenutku proizvodnje ti se odbojci moraju odstraniti od jezgre kako bi se proces nastavio. Prisutnost kategorije 20 znači da se treća faza proizvodnje, tj. završna faza - izradba same alatke (dodatna, odnosno završna obradba) odvijala na nalazištu, a kategorije od 21 do 24 mogle su nastati u bilo kojoj fazi proizvodnje ili pak predstavljaju komadiće sirovinskog materijala koji je raspucan prirodnim procesima.

Nakon što su svi litički nalazi analizirani s tehnološkog aspekta, svi oni koji su sadržavali tragove dodatne obrade analizirani su tipološki (179 komada). Zbog velike zastupljenosti komadića s obradom odlučeno je da se ne primjenjuje tipologija F. Bordesa,[22] jer taj tip u njoj ne postoji. Štoviše, učestalost strugala nije bila izrazita, pa primjena mnoštva podtipova tih oruđa, prema navedenoj tipologiji, ne bi bila korisna. Stoga su alatke razvrstane po sljedećim osnovnim tipovima: 1. strugala, 2. nazupci i udupci, 3. komadići s obradbom, 4. gornjopaleolitički tipovi, 5. razno (tablica 2).

The zero category designates the zero phase of production, meaning the collection of raw materials, category 1 designates initial production (first production phase) - removal of cortex and formation of cores. This phase is therefore indicated by so-called primary flakes on which over 50 percent of the dorsal side is covered with cortex. The central part of production, i.e. the second phase, is designated by knapping of flakes which still contain some cortex (so-called secondary flakes, categories 2 and 3), and the obtainment of various products without cortex, i.e. categories 4 through 17. It bears noting that secondary flakes at other sites can still indicate the first production phase, i.e. removal of cortex and formation of cores. However, the frequent use of small pebbles in Mujina Pećina, which requires saving of materials, leads to the conclusion that the secondary flakes at this site were knapped so that tools could be made on them, and not just to form cores, so here they represent the second production phase. Various types of products flaked during the second phase were named from 4 to 10, while pieces of them were flaked (cores) and their fragments were classified from 11 to 17. Categories 18 and 19 are special types of flakes, which also belong to the second phase, and their flaking depended on the emergence of a technological process; namely, at one point in production these flakes had to be removed from the core so that the process could continue. The presence of category 20 means that the third production phase, i.e. the final phase, - crafting of the tools themselves (additional retouching or finishing) proceeded at the site, while categories 21 to 24 may have appeared in any production phase or they were small pieces of raw materials which cracked due to natural processes.

After the lithics underwent technological analysis, all of those containing traces of retouch were typologically analyzed (179 pieces). Due to the high presence of small retouched pieces, the decision was made not to apply the typology of F. Bordes,[22] because this type does not exist in it. Moreover, according to the aforementioned typology, it would not even be useful. Thus the tools are classified based on the following basic types: 1. sidescrapers, 2. denticulates and notches, 3. retouched pieces, 4. Upper Palaeolithic types, 5. various (Table 2).

3.2. Results of technological and typological analysis

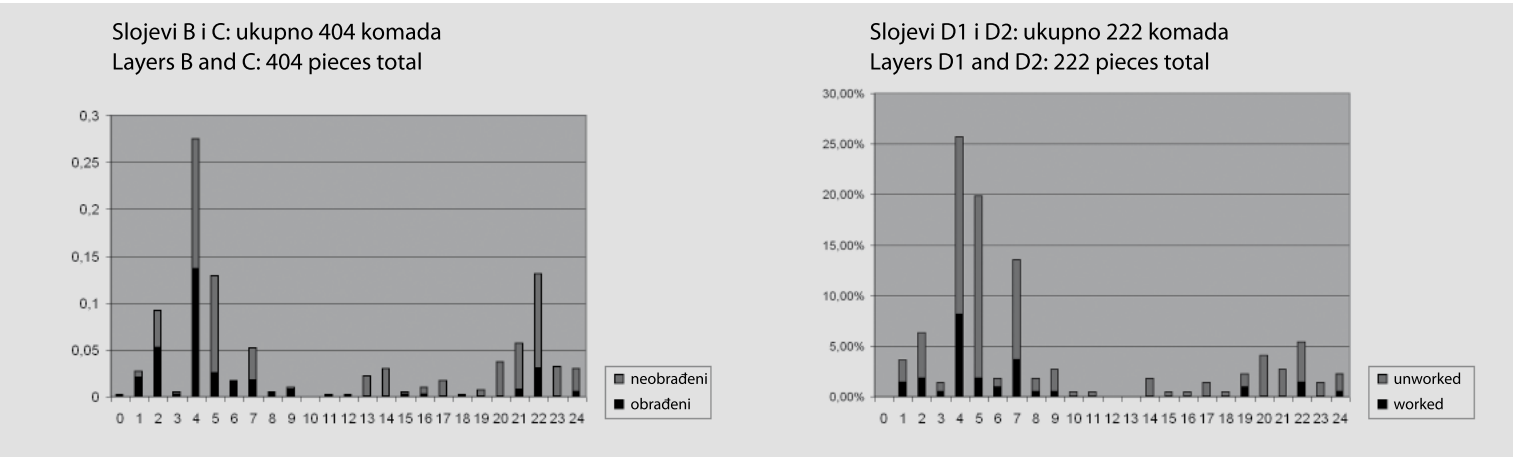
Layers B and C contain a total of 404 stone handicrafts, of which 132 (32.67 percent) are tools (Tables 1 and 2, Figs. 4, 5, 6 and 7). Layer B contains 362 handicrafts, while layer C contains 42 handicrafts. Flakes are the most common category in layers B and C (27.29 percent of all lithic products). Many of these are small flakes (2 cm or smaller flakes), whose share in the débitage is 12.88 percent. If flakes with cortex and Levallois flakes are added to these flakes and small flakes, the frequency of all flake types becomes a high 58.42 percent. Cortex flakes account for 12,38 percent of the débitage. The frequent use of cortex flakes to make tools indicates a high degree of economy. After flakes, the most frequent are

20 Geneste 1985; Geneste 1988.

21 Karavanić 2004, Tablica 1, 82.

22 Bordes 1961.

22 Bordes 1961.



Slika 4.
Grafikon učestalosti tehnoloških tipova po slojevima: 0. gomolj ili oblutak, 1. prvotni odbojak, 2. drugotni odbojak, 3. nož s prirodnim hrptom, 4. odbojak, 5. odbojčić, 6. sječivo, 7. levaloaški odbojak, 8. levaloaško sječivo, 9. levaloaški šiljak, 10. pseudolevaloaški šiljak, 11. poliedar, 12. diskoidna jezgra, 13. jezgre za odbojke s okorinom, 14. jezgre za odbojke bez okorine, 15. levaloaška jezgra, 16. ulomci jezgara s okorinom, 17. ulomci jezgara bez okorine, 18. krestasti odbojak, 19. dotjerujući odbojak jezgre, 20. odbojak od dodatne obrade, 21. krhotina s okorinom, 22. krhotina bez okorine, 23. okrhci, 24. neodredivi komadić

Figure 4.
Chart showing frequency of technology types by layers: 0. nodule or pebble, 1. primary flake, 2. secondary flake, 3. naturally-backed knife, 4. flake, 5. small flake, 6. blade, 7. Levallois flake, 8. Levallois blade, 9. Levallois point, 10. pseudo-Levallois point, 11. polyhedron, 12. discoid core, 13. cores for flakes with cortex, 14. cores for flakes without cortex, 15. Levallois core, 16. fragments of cores with cortex, 17.fragments of cores without cortex, 18. crested flake, 19. platform renewal flake, 20. retouched flake, 21. chunk with cortex, 22. chunk without cortex, 23. small chunks, 24. indeterminate piece

3.2. Rezultati tehnološke i tipološke analize

Slojevi B i C sadrže ukupno 404 kamene rukotvorine, od kojih su 132 (32,67 posto) alatke (tablice 1 i 2, slike 4, 5, 6 i 7). Sloj B sadrži 362 rukotvorine, a sloj C 42 rukotvorine. Odbojci su najčešće zastupljena kategorija u slojevima B i C (27,29 posto od svih litičkih proizvoda). Mnogobrojni su i odbojčići (odbojci od 2 cm ili manje) čiji udio u lomljevini iznosi 12,88 posto. Ako odbojcima i odbojčićima pridodamo odbojke s okorinom i levaloaške odbojke, učestalost svih tipova odbojaka doseže čak 58,42 posto. Okorinskih odbojaka ima čak 12,38 posto u lomljevini. Često korištenje okorinskih odbojaka za izradu alatki upućuje na visok stupanj ekonomičnosti. Nakon odbojaka, po učestalosti slijede krhotine s okorinom i bez okorine (18,81 posto) (tablica 1, slika 4). Najčešće su u sloju B. Mnoge od njih vjerojatno su nastale zbog nepravilnog lomljenja nekih lokalnih rožnjaka koji imaju pukotine. U slojevima B i C levaloaška lomljevina nije mnogobrojna - 28 primjeraka (6,94 posto), uključujući i jednu levaloašku jezgricu (slika 7, br. 13). Zastupljenost različitih tehnoloških kategorija u slojevima B i C upućuje na proizvodnju rukotvorina *in situ* (tablica 1, slika 4).

Najčešći tipovi alatki u slojevima B i C su nazupci i udupci (39,69 posto) (tablica 2, slika 5). Nakon njih dolaze komadići s obradbom (27,48 posto) i tzv. gornjopaleolitički tipovi (15,27 posto). Strugala su zastupljena sa 12,21 posto. Ostale su alatke (5,34 posto) uvrštene u "razno" (slika 6 i 7). Značajke alatki iz ovih slojeva su njihove male dimenzije (slika 8), po čemu podsjećaju na tzv. mikromusterijen.[23]

chunks with or without cortex (18.81 percent) (Table 1, Fig. 4). They are most frequent in layer B. Many of them probably appeared due to irregular knapping of some local cherts which have fractures. In layers B and C, Levallois débitage is not numerous - 28 examples (6.94 percent), including a small Levallois core (Fig. 7, no. 13). The presence of different technological categories in layers B and C indicates the production of handicrafts *in situ* (Table 1, Fig. 4). The most common tools in layers B and C are denticulates and notches (39.69 percent) (Table 2, Fig. 5). These are followed by retouched pieces (27.48 percent) and so-called Upper Palaeolithic types (15.27 percent). Sidescrapers account for 12.21 percent. The others are tools (5.34 percent) classified as "various" (Figs. 6 and 7). The features of the tools from these layers are their small dimensions (Fig. 8), whereby they recall the so-called Micro-Mousterian.[23]

Layers D1 and D2 contain 222 lithics, of which 47 (21.17 percent) are tools (Tables 1 and 2, Figs. 9 and 10), which is considerably less than in layers B and C, even when we take into consideration the quantity of the excavated sediment. The relatively low presence of archaeological items in these layers, which emerged during a relatively cold period, indicates that people only sporadically and briefly used the cave.[24] However, there is a considerably higher quantity of Levallois débitage (as much as 18.46 percent) than in the upper layers (Table 1, Fig. 4). The most numerous Levallois examples are flakes. Also present are Levallois points and blades, and one Levallois small core (layer D2). Some Levallois products may have been produced at the site itself, while others may have

23 Karavanić 2000, 777.

23 Karavanić 2000, 777.
24 Karavanić 2000, 777.

	Tehnološki tip		**Slojevi B i C**				**Slojevi D1 i D2**			
		Faza proizvodnje	obrađenih količina	%	neobrađenih količina	%	obrađenih količina	%	neobrađenih količina	%
0	gomolj ili oblutak	0	0	0,00%	1	0,25%	0	0,00%	0	0,00%
1	prvotni odbojak	1	8	1,98%	3	0,74%	3	1,35%	5	2,25%
2	drugotni odbojak	1	21	5,20%	16	3,96%	4	1,80%	10	4,50%
3	nož s prirodnim hrptom	1	1	0,25%	1	0,25%	1	0,45%	2	0,90%
4	odbojak	2A	55	13,61%	56	13,86%	18	8,11%	39	17,57%
5	odbojčić	2A	10	2,48%	42	10,40%	4	1,80%	40	18,02%
6	sječivo	2A	6	1,49%	1	0,25%	2	0,90%	2	0,90%
7	levaloaški odbojak	2A	7	1,73%	14	3,47%	8	3,60%	22	9,91%
8	levaloaško sječivo	2A	2	0,50%	0	0,00%	1	0,45%	3	1,35%
9	levaloaški šiljak	2A	3	0,74%	1	0,25%	1	0,45%	5	2,25%
10	pseudolevaloaški šiljak	2A	0	0,00%	0	0,00%	0	0,00%	1	0,45%
11	poliedar	2B	0	0,00%	1	0,25%	0	0,00%	1	0,45%
12	diskoidna jezgra	2B	0	0,00%	1	0,25%	0	0,00%	0	0,00%
13	jezgre za odbojke s okorinom	2B	1	0,25%	9	2,23%	0	0,00%	0	0,00%
14	jezgre za odbojke bez okorine	2B	0	0,00%	12	2,97%	0	0,00%	4	1,80%
15	levaloaška jezgra	2B	0	0,25%	1	0,25%	0	0,00%	1	0,45%
16	ulomci jezgara s okorinom	2B	1	0,25%	3	0,74%	0	0,00%	1	0,45%
17	ulomci jezgara bez okorine	2B	0	0,00%	7	1,73%	0	0,00%	3	1,35%
18	krestasti odbojak ili sječivo	2C	0	0,00%	1	0,25%	0	0,00%	1	0,45%
19	dotjerujući odbojak jezgre	2C	0	0,00%	3	0,74%	2	0,90%	3	1,35%
20	odbojak od dodatne obradbe	3	0	0,00%	15	3,71%	0	0,00%	9	4,05%
21	krhotine s okorinom	razno	3	0,74%	20	4,95%	0	0,00%	6	2,70%
22	krhotine bez okorine	razno	12	2,97%	41	10,15%	3	1,35%	9	4,05%
23	okrhci	razno	0	0,00%	13	3,22%	0	0,00%	3	1,35%
24	neodredivi komadić	razno	2	0,50%	10	2,48%	0	0,00%	5	2,25%
	ukupno		132	32,67%	272	67,33%	47	21,17%	175	78,83%

Tablica 1.
Tehnološki tipovi musterijenske industrije Mujine pećine koji čine tri glavne proizvodne faze

	Technology type		**Layers B and C**				**Layers D1 and D2**			
		production phase	worked quantity	%	unworked quantity	%	worked quantity	%	unworked quantity	%
0	nodule or pebble	0	0	0,00%	1	0,25%	0	0,00%	0	0,00%
1	primary flake	1	8	1,98%	3	0,74%	3	1,35%	5	2,25%
2	secondary flake	1	21	5,20%	16	3,96%	4	1,80%	10	4,50%
3	naturally-backed knife	1	1	0,25%	1	0,25%	1	0,45%	2	0,90%
4	flake	2A	55	13,61%	56	13,86%	18	8,11%	39	17,57%
5	small flake	2A	10	2,48%	42	10,40%	4	1,80%	40	18,02%
6	blade	2A	6	1,49%	1	0,25%	2	0,90%	2	0,90%
7	Levallois flake	2A	7	1,73%	14	3,47%	8	3,60%	22	9,91%
8	Levallois blade	2A	2	0,50%	0	0,00%	1	0,45%	3	1,35%
9	Levallois point	2A	3	0,74%	1	0,25%	1	0,45%	5	2,25%
10	pseudo-Levallois point	2A	0	0,00%	0	0,00%	0	0,00%	1	0,45%
11	polyhedron	2B	0	0,00%	1	0,25%	0	0,00%	1	0,45%
12	discoid core	2B	0	0,00%	1	0,25%	0	0,00%	0	0,00%
13	flaking core with cortex	2B	1	0,25%	9	2,23%	0	0,00%	0	0,00%
14	flaking core without cortex	2B	0	0,00%	12	2,97%	0	0,00%	4	1,80%
15	Levallois core	2B	0	0,25%	1	0,25%	0	0,00%	1	0,45%
16	fragments of core with cortex	2B	1	0,25%	3	0,74%	0	0,00%	1	0,45%
17	fragments of core without cortex	2B	0	0,00%	7	1,73%	0	0,00%	3	1,35%
18	crested flake or blade	2C	0	0,00%	1	0,25%	0	0,00%	1	0,45%
19	retouch core flake	2C	0	0,00%	3	0,74%	2	0,90%	3	1,35%
20	retouched flake	3	0	0,00%	15	3,71%	0	0,00%	9	4,05%
21	chunk with cortex	razno	3	0,74%	20	4,95%	0	0,00%	6	2,70%
22	chunk without cortex	razno	12	2,97%	41	10,15%	3	1,35%	9	4,05%
23	small chunks	razno	0	0,00%	13	3,22%	0	0,00%	3	1,35%
24	indeterminate piece	razno	2	0,50%	10	2,48%	0	0,00%	5	2,25%
	total		132	32,67%	272	67,33%	47	21,17%	175	78,83%

Table 1.
Technological types of Mousterian industry in Mujina Pećina consisting of three production phases

	Tip alatke	Slojevi B i C		Slojevi D1 i D2	
		obrađenih količina	%	obrađenih količina	%
1	strugalo	17	12,21%	5	10,64%
2	udubak i nazbuak	52	39,69%	14	29,79%
3	obrađeni komadić	36	27,48%	19	40,43%
4	gornjopaleolitički tipovi	20	15,27%	5	10,64%
5	razno	7	5,34%	4	8,51%
	ukupno	132	100,00%	47	100,00%

Tablica 2.
Zastupljenost pojedinih tipova alatki u slojevima B i C te D1 i D2

	Tool type	Layers B and C		Layers D1 and D2	
		worked quantity	%	worked quantity	%
1	sidescraper	17	12,21%	5	10,64%
2	notch and denticulate	52	39,69%	14	29,79%
3	retouched piece	36	27,48%	19	40,43%
4	Upper Palaeolithic types	20	15,27%	5	10,64%
5	various	7	5,34%	4	8,51%
	total	132	100,00%	47	100,00%

Table 2.
Presence of individual tool types in layers B and C and D1 and D2

Slojevi D1 i D2 sadrže 222 litička nalaza, od kojih su 47 (21,17 posto) alatke (tablica 1 i 2, slike 9 i 10), što je znatno manje nego u slojevima B i C, čak i kad uzmemo u obzir količinu otkopanog sedimenta. Relativno mala zastupljenost arheoloških nalaza u tim slojevima, nastalima tijekom relativno hladnog razdoblja, upućuje da su se ljudi sporadično i kratko koristili špiljom.[24] Međutim, levaloaške lomljevine ima znatno više (čak 18.46 posto) nego u gornjim slojevima (tablica 1, slika 4). Najbrojniji levaloaški primjerci su odbojci. Prisutni su također levaloaški šiljci i sječiva, te jedna levaloaška jezgrica (sloj D2). Neki su levaloaški proizvodi mogli biti proizvedeni na samom nalazištu, dok su drugi mogli biti doneseni s nekog drugog mjesta. U slojevima D1 i D2 dominiraju odbojci (25,68 posto), a odbojčići (odbojci od 2 cm ili manje) također su vrlo česti (19,82 posto) (tablica 1, slika 4). Okorinski odbojci čine 11,26 posto lomljevine (na njima su rjeđe izrađivane alatke nego u slojevima B i C). Krhotine su zastupljene sa 8.,1 posto, što je nešto manje nego u gornjim slojevima (tablica 1). U slojevima D1 i D2 među alatkama dominiraju komadići s obradbom koji čine čak 40,43 posto svih alatki (tablica 2, slika 5). Nazupci i udupci, najčešće zastupljeni tipovi u slojevima B i C, čine 29,79 posto alatki u D1 i D2. Strugala i gornjopaleolitički tipovi čine po 10,64 posto.

3.3. Usporedba s drugim musterijenskim nalazištima

U Mujinoj pećini levaloaška metoda češće je bila rabljena u starijim slojevima (D2 i D1) nego u mlađim (C i B), što je slučaj i kod mnogobrojnih drugih musterijenskih nalazišta. Primjerice, taj je fenomen prisutan u Krapini,[25] čiji su slojevi čak približno 90.000 godina stariji od onih iz Mujine pećine,[26] a nalazišta pontinijenskog musterijena u središnjoj Italiji pokazuju tehnološku promjenu od proizvodnje levaloaških odbojaka prema noževima s prirodnim hrptom, koja se zbila prije pedesetak tisuća godina.[27]

Uz alatke uobičajene veličine za musterijensku kulturu, u velikom broju pronađene su i one malih dimenzija. Ta se pojava obično naziva mikromusterijenom, premda dio znanstvenika sumnja

24 Karavanić 2000, 777.
25 Simek, Smith 1997, 572.
26 Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002.
27 Kuhn 1995.

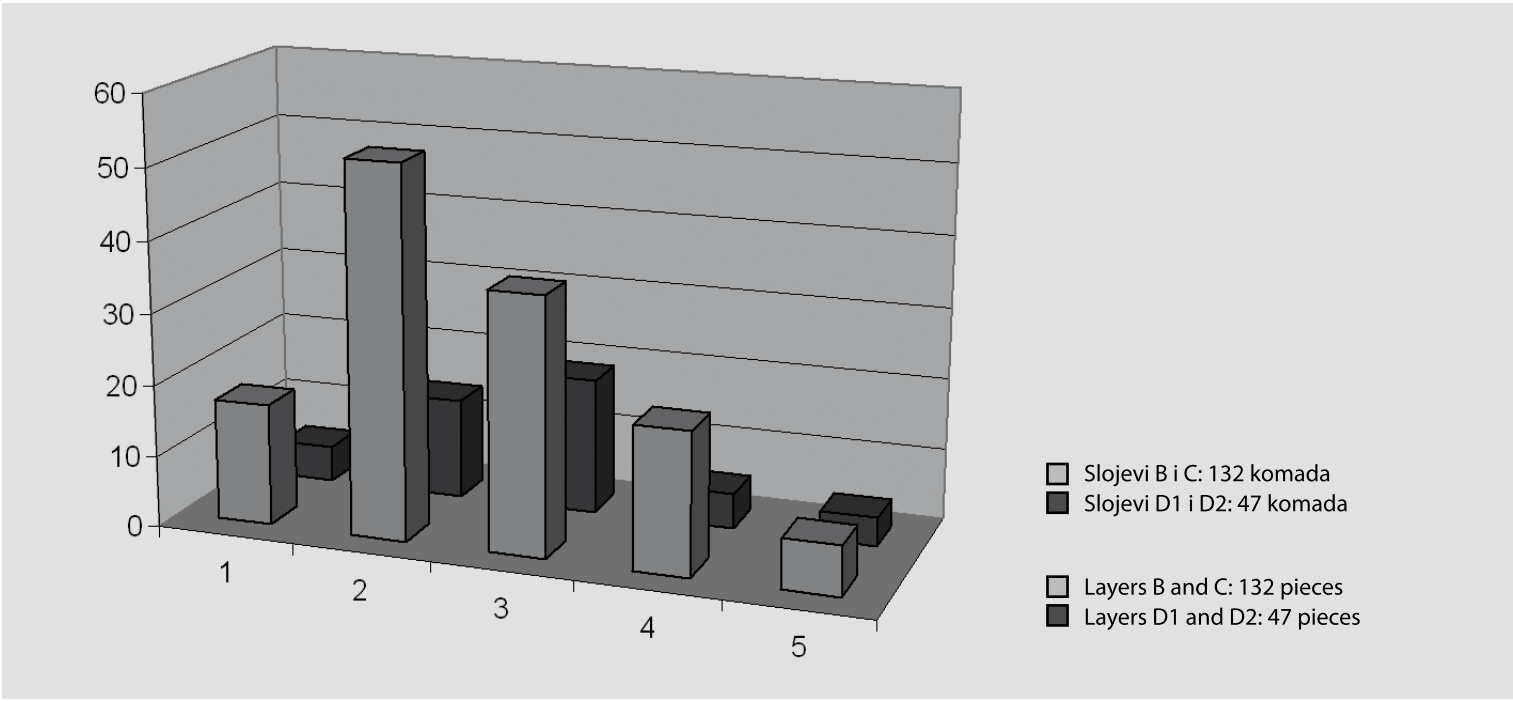
been brought from some other site. In layers D1 and D2, flakes dominate (25.68 percent), while small flakes (2 cm or smaller flakes) are also quite common (19.82 percent) (Table 1, Fig. 4). Cortex flakes account for 11.26 percent of the débitage (tools were made on them less frequently than in layers B and C). Chunks account for 8.1 percent, which is somewhat less than in the upper layers (Table 1). In layers D1 and D2, the tools are dominated by retouched pieces which account for 40.43 percent of all tools (Table 2, Fig. 5). Denticulates and notches, the most frequent types in layers B and C, account for 29.79 percent of the tools in D1 and D2. Sidescrapers and Upper Palaeolithic types account for 10.64 percent.

3.3. Comparison with other Mousterian sites

In Mujina Pećina, the Levallois method was more often employed in the older layers (D2 and D1) than in the younger ones (C and B), which is the case at many other Mousterian sites as well. For example, this phenomenon was present in Krapina,[25] where the layers are roughly 90,000 years older than those in Mujina Pećina,[26] and the Pontinien Mousterian sites in Central Italy demonstrate a technological change from production of Levallois flakes to naturally backed knives, which occurred approximately fifty thousand years ago.[27]

Besides tools of standard sizes for the Mousterian culture, those with smaller dimensions were also found in high numbers. This phenomenon is normally called the Micro-Mousterian, although some scholars question the suitability of this term. Small-dimension Mousterian tools were found at other sites in the Eastern Adriatic seaboard, such as Pandžerovica on the island of Dugi, the wider Ražanac area near Zadar[28] and Crvena Stijena in Montenegro.[29] They come from sites of the so-called Pontinien Mousterian in the western part of Central Italy, i.e. partially on the coast of the Tyrrhenian Sea and its hinterland,[30] and, for example, the Asprochalico site in Epirus in North-western Greece.[31]

25 Simek, Smith 1997, 572.
26 Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002.
27 Kuhn 1995.
28 Vujević 2007.
29 Malez 1979; Basler 1983.
30 Kuhn 1995.
31 Papagianni 2000.



Slika 5.
Grafikon učestalosti tipova alatki po slojevima: 1. strugalo, 2. udubak i nazubak, 3. obrađeni komadić, 4. gornjopaleolitički tipovi, 5. razno

Figure 5.
Chart showing frequency of tool types by layers: 1. sidescraper, 2. notch and denticulate, 3. retouched piece, 4. Upper Palaeolithic types, 5. various

u prikladnost tog izraza. Musterijenske alatke malih dimenzija pronađene su i na drugim nalazištima istočne jadranske obale, kao što su Panđerovica na Dugom otoku, šire područje Ražanca kod Zadra[28] i Crvena stijena u Crnoj Gori.[29] One dolaze i na nalazištima tzv. pontinijenskoga musterijena u zapadnome dijelu središnje Italije, tj. dijelu obale Tirenskoga mora i zaleđu,[30] te primjerice na nalazištu Asprochalico u Epiru u sjeverozapadnoj Grčkoj.[31]

Uočljiva je razlika u veličini alatki između slojeva B i C (manje alatke) i slojeva D1 i D2 (veće alatke) (slika 8). Ista je situacija zabilježena u ostalim dijelovima središnje Europe, gdje se, čini se, industrije s malim alatkama pojavljuju češće tijekom razdoblja umjerene klime nego u slojevima nataloženim tijekom hladnijih razdoblja.[32] Doduše, veličina pojedinih alatki u Mujinoj pećini prije bi mogla biti rezultat veličine i kvalitete lokalnog sirovinskog materijala nego planske proizvodnje manjih alatki.[33]

To potvrđuju ostatci okorine na jezgrama koja nije u potpunosti mogla biti odstranjena te često obrađivanje odbojaka s okorinom zbog što ekonomičnijega korištenja materijala za izradbu alatki. Međutim, drugi uzrok malih dimenzija leži u nekim lokalnim rožnjacima, koji imaju pukotine i zato nisu posebno pogodni za cijepanje odbojaka. Od većih komada vrlo je teško odbiti velik

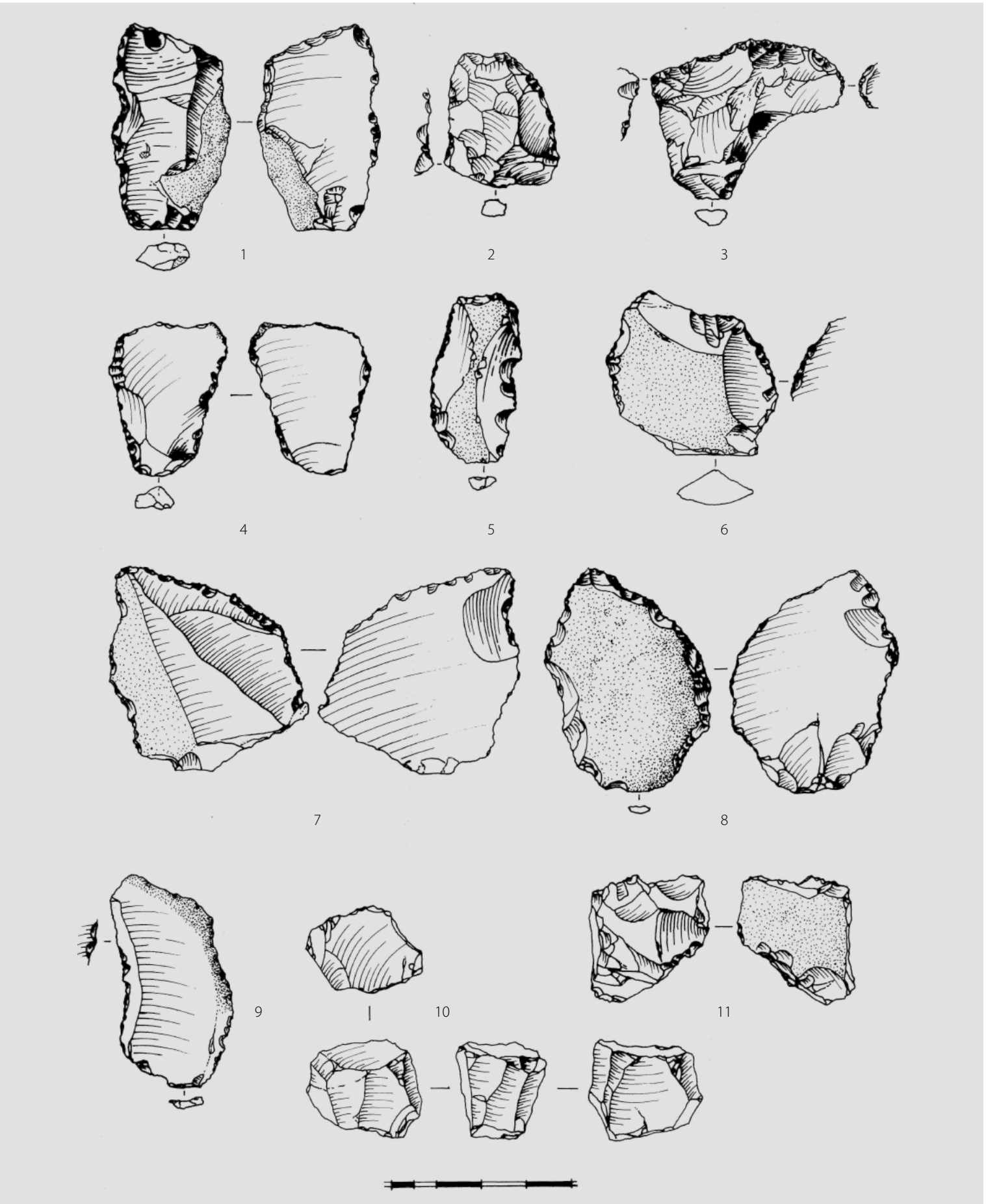
A difference in the sizes of the tools is noticeable between layers B and C (smaller tools) and layers D1 and D2 (larger tools) (Fig. 8). An identical situation was recorded in the other parts of Central Europe, where, it would appear, small tool industry appeared more often during moderate climatic periods than in layers that sedimented during colder periods .[32] To be sure, the size of individual tools in Mujina Pećina could primarily be due to the size and quality of the local raw materials than the planned production of small tools.[33]

This is confirmed by cortex remains on cores which could not be entirely removed, and the frequent working of flakes with cortex to ensure the most economical possible use of materials to craft tools. However, another cause of the small sizes lies in some of the local cherts, which have cracks and are thus not particularly suitable for knapping flakes. It is very difficult to knap a large flake from the larger pieces, and when this is in fact accomplished, then worked the flake often fractures into two or more pieces, which was ascertained in an experiment conducted by I. Karavanić at the suggestion of M. Leney.[34] Based on this experiment, a large presence of chunks (categories 21 and 22) and small chunks (category 23) was ascertained. They were generated during production due to use of local, poor quality chert which knaps irregularly.

The fact that the size of local and available raw materials dictated the size of the tools has been confirmed at Mousterian

28 Vujević 2007.
29 Malez 1979; Basler 1983.
30 Kuhn 1995.
31 Papagianni 2000.
32 Svoboda, Ložek, Vlček 1996.
33 Karavanić 2000; Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002.

32 Svoboda, Ložek, Vlček 1996.
33 Karavanić 2000; Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002.
34 Karavanić 2000.



Slika 6.
Izbor rukotvorina iz sloja B: 1. i 8. nazubak, 2., 3., 6., 7. i 9. strugalo, 4. nazubak, 5. udubak, 10. i 11. jezgra za odbojke

Figure 6.
Selection of handicrafts from layer B: 1. & 8. denticulate, 2., 3., 6., 7. i 9. sidescraper, 4. denticulate, 5. notch, 10. & 11. flaking core

odbojak, a kada se to i postigne, pri obradbi ruba odbojak često puca na dva ili nekoliko komada, što je eksperimentom na poticaj M. Leneya ustanovio I. Karavanić.[34] Eksperimentom je protumačena i velika zastupljenost krhotina (kategorije 21 i 22) i okrhaka (kategorija 23). One su nastale tijekom proizvodnog procesa zbog uporabe lokalnih rožnjaka lošije kvalitete, koji se nepravilno lome.

Činjenica da veličina lokalnoga i dostupnog sirovinskog materijala uvjetuje veličinu alatki, potvrđena je na musterijenskim lokalitetima diljem Europe.[35] Ta je pojava možda povezana s klimatskom prilagodbom jer je pojava malih alatki uglavnom povezana s interglacijalima tijekom donjega i srednjeg paleolitika.[36] U sloju G3 na lokalitetu Vindija najučestaliji tip alatki su jednostavni komadići s obradom, a potom nazupci i udupci. Iako su smješteni u različitim geografskim područjima i klimatskim zonama, postoje sličnosti u prevladavajućim tipovima alatki između Mujine pećine i Vindije, s jedne strane, te Mujine pećine i Crvene stijene u Crnoj Gori (sloj XIII), s druge strane, koja se nalazi u istoj klimatskoj zoni kao i Mujina pećina.[37] Tvrdnja da je velika količina nazubaka i udubaka karakteristična za kasni srednji paleolitik istočne jadranske obale potkrijepljena je tipologijom i kronometrijskim datiranjem slojeva B i C Mujine pećine[38] iako je ista manifestacija zabilježena i u kontinentalnoj Hrvatskoj (špilja Vindija).[39]

Postoje razlike u tipologiji alatki između lokaliteta na istočnoj obali Jadrana te onih središnjeg dijela zapadne Italije. Najčešći tip alatke u musterijenu (pontinijen) ovog potonjeg područja je strugalo.[40] No, prema kraju musterijena taj se obrazac mijenja, barem u nekim dijelovima Italije. Primjerice, na lokalitetima obale Lacija (Gr. Del Fossellone, Gr. Barbara), te Ligurije (Riparo, Mochi, Arma delle Maine), raste učestalost nazubaka i udubaka, dok učestalost odbojaka pada do ispod 20 posto.[41] Tipologija litičkih nalaza na tim lokalitetima vrlo je slična onoj u slojevima B i C Mujine pećine, što možda upućuje na istu djelatnost ili pak slične djelatnosti.

4. Petrografske analize
4.1. Metode petrografskih analiza
4.1.1. Makroskopska analiza

Tijekom duljeg razdoblja prirodoslovnog istraživanja (botaničko i paleontološko istraživanje) jedan od autora (V. G.) dobro je upoznao teren srednje Dalmacije. Usputno, uz stratigrafsku kontrolu sakupio je mnogo uzoraka silicijskog stijenskog materijala. Separirani su uzorci s lokaliteta: splitski poluotok, Kozjak, najbliža okolica Mujine pećine te sa Svilaje iz okolice selâ Muć, Sutina, Radunić, Ogorje i Zelovo. Od tih je uzoraka

34 Karavanić 2000.
35 Vértes 1964; Mussi 2001.
36 Mussi 2001.
37 Basler 1983.
38 Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002.
39 Janković, Karavanić, Ahern, Brajković, Mauch Lenardić, Smith 2006.
40 Kuhn 1995; Mussi 2001.
41 Mussi 2001.

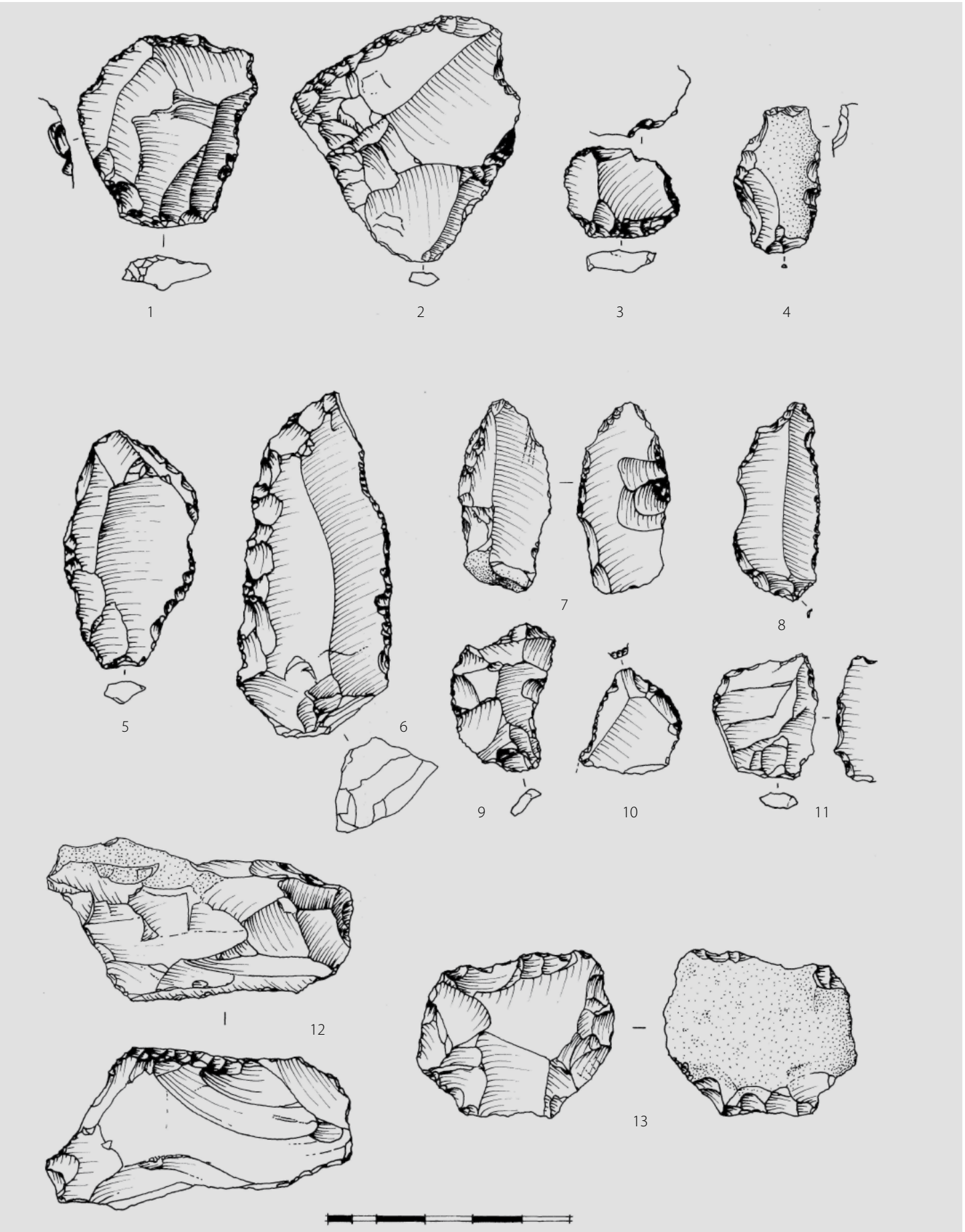
sites throughout Europe.[35] This phenomenon may be tied to climatic adjustments, for the appearance of small tools is generally associated with the interglacial periods during the Lower and Middle Palaeolithic.[36] The most frequent tool type in layer G3 at the Vindija site is the simple retouched piece, followed by denticulates and notches. Even though they are located in different geographic regions and climatic zones, there are similarities in the overriding tool types between Mujina Pećina and Vindija, on the one hand, and Mujina Pećina and Crvena Stijena in Montenegro (layer XIII) on the other, which is in the same climatic zone as Mujina Pećina.[37] The assertion that large quantities of denticulates and notches are characteristic of the late Middle Palaeolithic in the Eastern Adriatic seaboard is backed by the typology and chronometric dating of layers B and C of Mujina Pećina,[38] even though the same phenomenon was also recorded in inland Croatia (Vindija Cave).[39]

There are differences in tool typology between sites on the Eastern Adriatic and those of the central portion of Western Italy. The most frequent type of tool in the Mousterian (Potinien) of this latter region is the sidescraper.[40] However, toward the end of the Mousterian this pattern changed, at least in some parts of Italy. For example, at sites on the shores of Lazio (Gr. Del Fossellone, Gr. Barbara), and Liguria (Riparo, Mochi, Arma delle Maine), the frequency of denticulates and notches grows, while the frequency of flakes falls below 20 percent.[41] The typology of lithics at these sites is very similar to that of layers B and C in Mujina Pećina, which may indicate the same or similar activities.

4. Petrographic analysis
4.1. Petrographic analysis methods
4.1.1. Macroscopic analysis

During the course of long-term natural history research (botanical and paleontological research), one of the authors (V.G.) became very familiar with the Central Dalmatian terrain. Incidentally, in the course of stratigraphic control he collected many silicon rock samples. Samples from the following sites were separated: Split Peninsula, Kozjak, immediate vicinity of Mujina Pećina, and Svilaja from the village of Muć, Sutina, Radunić, Ogorje and Zelovo. Out of these samples, a reference collection was compiled and stored at the Natural History Museum in Split. The samples were examined macroscopically, using a magnifying glass, and the surface of the samples was inspected under reflected light with linear magnification of the images, 25 times and 56 times. Seventy-nine samples of unworked débitage and tools from Mujina Pećina were similarly examined. The samples from the cave were compared

35 Vértes 1964; Mussi 2001.
36 Mussi 2001.
37 Basler 1983.
38 Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002.
39 Janković, Karavanić, Ahern, Brajković, Mauch Lenardić, Smith 2006.
40 Kuhn 1995; Mussi 2001.
41 Mussi 2001.



Slika 7.
Izbor rukotvorina iz slojeva B i C. Sloj C: 1.nazubak, 2. strugalo, 3. i 4. udubak. Sloj B: 5. i 6. strugalo, 7. nazubak, 8. svrdlo, 9. grebalo-svrdlo, 10. izmjenično dubasti šiljak, 11.svrdlo, 12. jezgra za odbojke, 13. levaloaška jezgra

Figure 7.
Selection of handicrafts from layers B and C. Layer C: 1. denticulate, 2. sidescraper, 3. and 4. notch. Layer B: 5. and 6. sidescraper, 7. denticulate, 8. drill, 9. endscraper-drill, 10. alternating retouched bec, 11. drill, 12. flaking core, 13. Levallois core

sastavljena referentna kolekcija deponirana u Prirodoslovnome muzeju u Splitu. Uzorci su pregledani makroskopski, povećalom, a površina uzoraka pregledana je u reflektiranom svjetlu s linearnim povećanjem slike 25x i 56x. Na isti način analizirano je sedamdeset i devet uzoraka neobrađene lomljevine i alatki iz Mujine pećine. Obavljena je komparacija uzoraka iz pećine s materijalom u referentnoj zbirci. Na taj su način uzorci iz pećine klasificirani prema lokalitetima gdje se sirovina nalazi deponirana u naslagama. Za određeni broj uzoraka preporučena je mineraloška analiza.

4.1.2. Mikroskopska analiza uzoraka

Mineraloško-petrografska determinacija provedena je na 30 uzoraka u Mineraloško-petrografskom zavodu Prirodoslovno-matematičkog fakulteta Sveučilišta u Zagrebu. Uzorci su pregledani makroskopski i pomoću binokularne leće, nakon čega je odabrano 15 uzoraka od kojih su načinjeni mikroskopski izbrusci, koji su analizirani i determinirani pomoću polarizacijskog mikroskopa. Korištena je također metoda kvalitativnog određivanja prisutnosti karbonatne komponente s razrijeđenom 4-postotnom HCl .

Na temelju izbrusaka ostali je litički materijal razvrstavan u 5 definiranih kategorija uz korištenje binokularne leće (povećanje 20x).

4.2. Rezultati petrografskih analiza
4.2.1. Rezultati makroskopske analize

Četrdeset i devet uzoraka iz pećine su rožnjaci iz eocenskih naslaga. Sedam uzoraka sadrži silificirane eocenske makroforaminifere. Zastupljeni su rožnjaci različite boje: mliječno bijeli, bjeličasti, svjetlosivi do tamnosivi, sivo-smeđi i crni; na oštrici neki su uzorci napola prozirni, a neki su neprozirni. Od svega toga osam je ulomaka od sirovine koja nije dobra za izradu alatki; poneki je primjerak prirodno odlomljen.

Dva uzorka iz pećine su anizički rožnjaci. Jedan od njih je rožnjak s akcesornim hematitom (po površini malo limonitičan). Sadrži mikrofosile (vjerojatno radiolarije) i dosta spikula. Potječe iz uslojenih naslaga čerta koje su povezane s piroklastičnim šejlima.

Jedanaest uzoraka iz pećine su ladinički rožnjaci.

Sedamnaest uzoraka nije bilo moguće klasificirati prema horizontu nalaza sirovine i lokalitetu. Moguće je isključiti lokalitete s kojih je sakupljen referentni materijal. Vjerojatno je većina tih uzoraka ladiničke starosti. Materijal je homogen, veoma dobar za izradu alatki. U odnosu na referentni materijal, sirovina za ove rukotvorine nije bila eocenski rožnjak. Prema boji, neklasificirani uzorci su bijeli, sivi do tamnosivi i crveno-smeđi. Na prijelomu su glatki, mat površine, fino porozni i svilenasti. Ovih sedamnaest uzoraka ili 22 posto svih analiziranih dopušta pretpostavku da su barem neki iz područja udaljenijeg od Suvove na Svilaji.

4.2.2. Rezultati mikroskopske analize

Makrofiziografskim i mikrofiziografskim pregledom utvrđeno je da svi uzorci pripadaju rožnjacima. Oni se mogu razvrstati u pet skupina, različitih po strukturi i sastavu. Razlike u sastavu očituju

with the materials in the reference collection. In this manner, the samples from the cave were classified according to sites where the raw materials is stored in deposits. Mineralogical analysis was recommended for a certain number of samples.

4.1.2. Microscopic analysis of samples

A mineralogical-petrographic determination was made for 30 samples in the Mineralogy and Petrography Department of the University of Zagreb Natural Science and Mathematics Faculty. The samples were examined macroscopically with the help of binocular lenses, after which 15 samples were processed such that microscopic scrapings were taken and analyzed, and determined with the help of a polarizing microscope. Also employed was the method of qualitative determination of the presence of carbonate components with diluted 4-percent HCl.

Based on the scrapings, the remaining lithics were classified into five defined categories with the use of binocular lenses (magnification by 20).

4.2. Results of petrographic analysis
4.2.1. Results of macroscopic analysis

Forty-nine samples from the cave are cherts from Eocene sediments. Seven samples contain silicified Eocene macro-foraminifers. Cherts of various colour were recorded: milk white, whitish, light and dark grey, grey-brown and black; at the edges some samples are semi-transparent, while some are opaque. Out of these, eight fragments are made of raw material that is not suitable for tool production; some examples are naturally fractured.

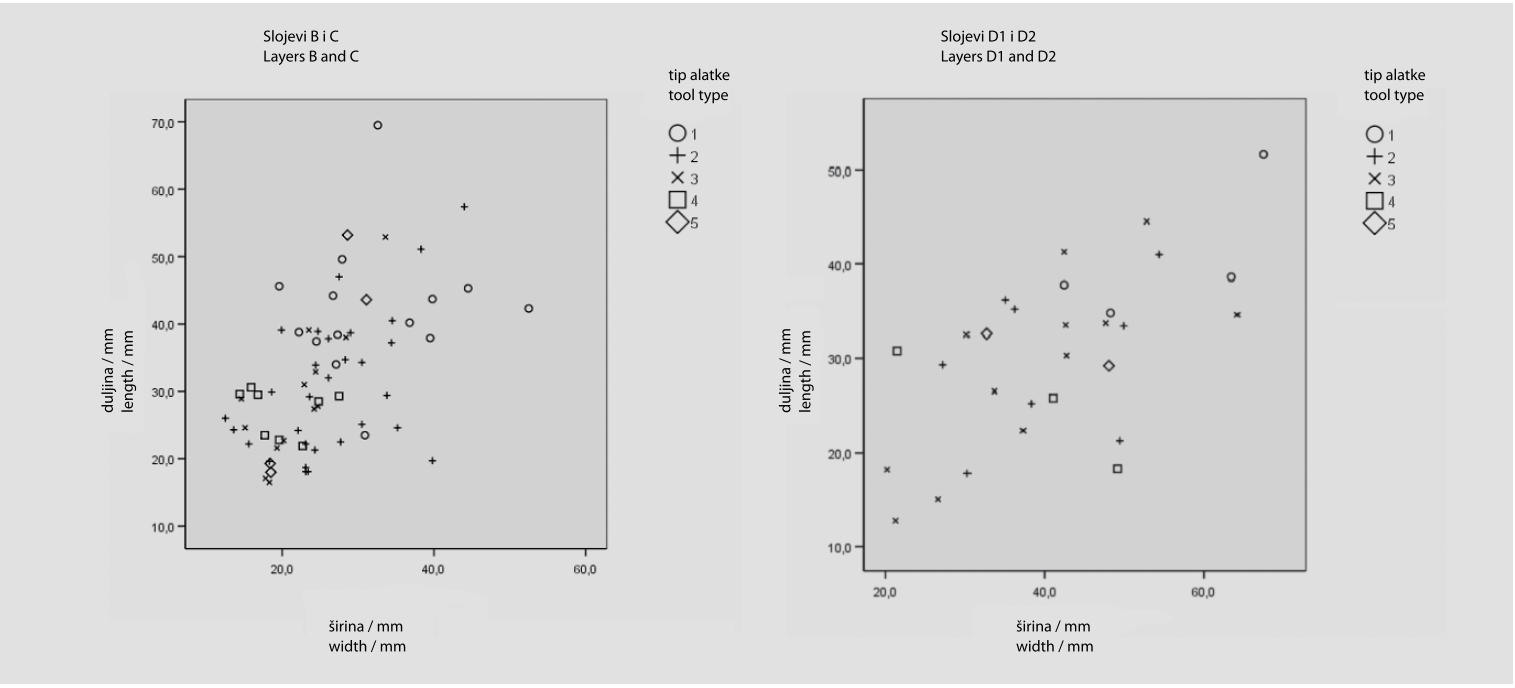
Two samples from the cave are Anisian cherts. One of them is a chert with accessory haematite (slightly limonitic on the surface). It contains microfossils (probably radiolarians) and a considerable amount of spiculae. It comes from layered chert deposits associated with pyroclastic shales.

Eleven samples from the cave are Ladinian cherts.

Seventeen samples could not be classified according to horizons of raw material finds and sites. It is possible to exclude sites from which the reference materials were gathered. It is likely that most of these samples are Ladinian in age. The material is homogenous, probably quite good for making tools. In comparison to the reference material, the raw materials for these handicrafts was not Eocene chert. Based on colour, the unclassified samples are white, grey and dark-grey and red-brown. At fractures they are smooth, with matte surface, finely porous and silky. These seventeen samples, or 22 percent of all analyzed samples, allow for the hypothesis that at least some are from the area farther afield than Suvova at Svilaja.

4.2.2. Results of microscopic analysis

Macro- and micro-physiographic examinations have ascertained that all samples are cherts. They can be classified into five groups, differing in terms of structure and composition. The differences in



Slika 8.
Omjer dužine i širine alatki iz slojeva B i C te D1 i D2. Tipovi alatki: 1. strugalo, 2. udubak i nazubak, 3. obrađeni komadić, 4. gornjopaleolitički tipovi, 5. razno

Figure 8.
Ratio of length to width of tools from layers B and C and D1 and D2. Tool types: 1. sidescraper, 2. notch and denticulate, 3. retouched piece, 4. Upper Palaeolithic types, 5. various

se u sadržaju karbonatne komponente, te vrsti i udjelu pojedinih vrsta skeletnih čestica.

(1) Prvu skupinu (14 komada) čine uzorci mliječno-svjetlosive do tamnosive boje, koji ne reagiraju s razrijeđenom HCl. Obojenje može biti jednolično, zonarno raspoređeno, u nepravilnim mrljama, a jedan uzorak je tigrasto prošaran u tamnijim nijansama sive boje. Neki od uzoraka su poluprozirni na rubovima, no većina ih je neprozirnih. Zonarnost boje očituje se u tamnijem središnjem dijelu, koji čini glavninu uzorka i tankom, svjetlije obojenom (svjetlosivo, žućkasto) obrubu. Osnovna mikrofiziografska značajka ove skupine rožnjaka je homogena sitnozrnata osnova, koja se sastoji od mikrokristaliničnog kvarca u kojoj se nalaze rasute različite sitne skeletne čestice, radiolarije i planktonske foraminifere globigerinsko-globorotalijske asocijacije (slika 11, 1). U nekim uzorcima prisutne su i spikule spužvi. Skeleti radiolarija su rekristalizirani u kvarc mikrokristalinične strukture ili, rjeđe, u kalcedon. Foraminifere su djelomično ili potpuno silicificirane (slika 11, 1).

(2) Rožnjaci ove skupine (5 komada) su svjetlosive, tamnosive do svijetle smećkaste boje. Obično je središnji i veći dio uzorka tamniji i prozirniji, dok je rubni dio svjetlosive do bijele boje, neproziran, i obrubljuje cijeli artefakt u nejednolikoj debljini (najviše 4 mm). To je posljedica trošenja koje napreduje od površine prema središtu. Uzorke karakterizira prisutnost velikih bentičkih foraminifera vidljivih i prostim okom. U osnovi od mikrokristaliničnog kvarca nalaze se silicificirani ostatci eocenskih bentičkih foraminifera, numulita i

composition are apparent in the content of carbonate components, and the type and share of individual types of skeletal particles.

(1) The first group (14 pieces) consists of milky-light grey to dark grey samples, which do not react to diluted HCl. The colour may be uniform, zonally distributed in irregular spots, while one sample has a tiger-stripe pattern in darker nuances of grey. Some of these samples are semi-transparent at the edges, but most are opaque. The zonally-distributed quality of the colour comes to the fore in the darker central portion, which accounts for the majority of the samples, and the thin, lighter coloured (light grey, yellowish) edge. The basic micro-physiographic feature of this group of cherts is the homogenous fine-grain matrix, which consists of micro-crystal quartz containing various dispersed tiny skeletal particles, radiolarians and planktonic foraminifers of globigerine-globorotalian associations (Figs. 11, 1). In some samples sponge spiculae are also present. Radiolarian skeletons are recrystallized into quartz of microcrystalline structure or, more rarely, into chalcedony. Foraminifers are partially or entirely silicified. (Figs. 11, 1).

(2) Cherts of this group (5 pieces) are light grey, dark grey to light brown. Normally the central and larger portion of the sample is darker and more transparent, while the edges are light grey to white, opaque and they border the entire artefact in a non-uniform thickness (4 mm at the most). This is a result of wear which progresses from the surface toward the middle. The samples are characterized by the presence of large benthic foraminifers visible to the naked eye. In the basis

diskociklina, te ostatci bodljikaša i briozoa (slika 11, 2). Kod većine fosila prvotna građa je ostala prepoznatljiva, a katkad je djelomično zadržan i primarni karbonatni sastav skeleta. To pokazuje i reakcija s razrijeđenom HCl, koja je lokalna i vezana samo uz pojedine fosilne čestice. U pojedinim unutarskeletnim šupljinama prisutan je kalcedonski oblik kvarca (slika 11, 2).

(3) Treća skupina rožnjaka (4 komada) prepoznaje se po sivo-smećkastoj boji i specifičnom pjeskovitom izgledu. Pjeskovit izgled odraz je strukture stijene koju karakteriziraju pakirane čestice veličine vrlo finozrnatog pijeska. Te čestice predstavljaju bioklastični vapnenački materijal (rotaliidne foraminifere, fragmenti briozoa, bodljikaša, algi, peloidne čestice) koji je djelomično ili potpuno silicificiran (slika 11, 3). Sporadično se pojavljuju i radiolarije. Između čestica se nalazi mikrokristalinični kvarc (slika 11, 3) i rjeđe kalcedon. Zbog mnoštva vapnenačkih čestica koje nisu u potpunosti okremenjene, prisutna je i zamjetnija količina karbonatne komponente (uzorci u reakciji s razrijeđenom HCl pokazuju slab šumeći efekt), koja izostaje u površinskom dijelu, koji u obliku tanke svjetlosive do bijele linije obrubljuje neke uzorke.

(4) U četvrtu skupinu (3 komada) izdvojeni su rožnjaci svjetlosmećkaste i svjetlosive boje koje karakterizira sitnozrnata osnova izgrađena od mikrokristaliničnoga kvarca i djelomično od kalcita (slaba šumeća reakcija s razrijeđenom HCl), u kojoj se nalaze ostatci ljušturica školjkaša, malih bentičkih foraminifera i sporadično radiolarija (slika 11, 4). Pojedini skeletni ostatci upućuju na numulite, ali zbog uništenosti strukture nemoguća je sigurna identifikacija. Skeletne čestice rijetke su i raspršene u sitnozrnatoj osnovi. Jedan uzorak od kojeg je načinjen preparat, pokazuje zonarnost u boji i djelomično u sastavu. Idući od sredine uzorka prema površini, izdvajaju se tri zone s obzirom na boju: tamnosiva, svjetlosiva te svjetlosivi do smećkasti tanki površinski ovoj. Količina karbonatne komponente (određena na temelju kvalitativne procjene) također se smanjuje idući od središta prema površini. Na samoj površini vidljive su kalupne šupljine četvrtastog oblika, nastale najvjerojatnije otapanjem skeletnih ostataka.

(5) Zadnju skupinu rožnjaka (4 komada) karakterizira tamnosmeđa do crna boja i prisutnost radiolarija u većem broju. U mikrokristaliničnoj do kriptokristaliničnoj osnovi od kvarca i sitnih listića sericita nalazi se mnoštvo radiolarija izmijenjenih u mikrokristalinični kvarc ili kalcedon (slika 11, 5). Radiolarije čine glavninu čestica, a uz njih se još sporadično pojavljuju sitni vapnenački fosili, potpuno okremenjeni.

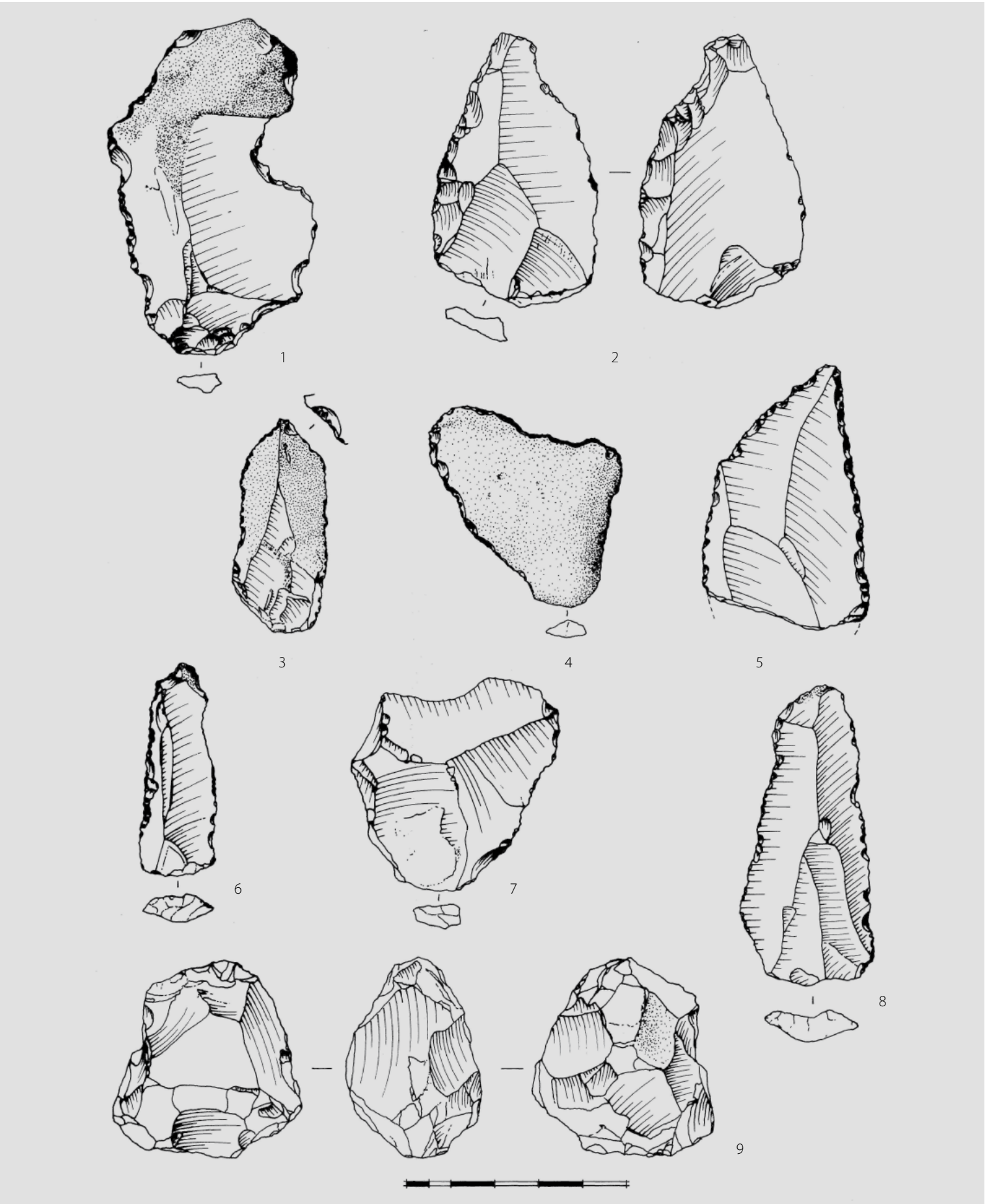
Osobine rožnjaka prvih četiriju skupina nedvojbeno pokazuju da se radi o rožnjacima zamjene. Svi su nastali okremenjivanjem prvotno karbonatne stijene. Prva skupina rožnjaka nastala je silicifikacijom laporovitog pelagičkog vapnenca eocenske starosti. Druga skupina jasno ukazuje da su rožnjaci nastajali silicifikacijom

made of microcrystalline quartz, there are silicified remains of Eocene benthic foraminifers, nummulites and discocyclina, and the remains of echinoderms and bryozoa (Fig. 11, 2). In most fossils, the primary material has remained recognizable, and sometimes even partially retained the primary carbonate skeletal structure. This is further indicated by the reaction with diluted HCl, which is local and tied to individual fossil particles. In individual intraskeletal cavities, the chalcedonic form of quartz is present (Fig. 11, 2).

(3) The third group of cherts (4 pieces) is recognized by its grey-brown colour and specific sandy appearance. The sandy appearance is a reflection of the rock structure, characterized by packed particles the size of fine-grained sand. These particles are bioclastic limestone materials (rotaliida foraminifers, fragments of bryozoa, echinoderms, algae, peloid particles) which are partially or fully silicified (Fig. 11, 3). Radiolarians also appear sporadically. Microcrystalline quartz (Fig. 11, 3) and more rarely chalcedony can be found between the particles. Due to the abundance of limestone particles which have not fully turned to flint, a more notable quantity of carbonate components is present (samples in reaction with diluted HCl demonstrated a weak fizzing effect), which is missing in the surface portion, which borders some samples in the form of a thin light grey or white line.

(4) The fourth group (3 pieces) encompasses light-brownish and light grey cherts characterized by a fine-grain matrix composed of microcrystalline quartz and partially of calcite (weak fizzing reaction in diluted HCl), which contains remains of mollusc shells, small benthic foraminifers and, sporadically, radiolarians (Fig. 11, 4). Individual skeletal remains indicate nummulites, but unambiguous identification is impossible due to the devastation of the structure. The skeletal particles are rare and dispersed in the fine-grain matrix. One sample used to make the solution indicates zonality in colour and partially in its content. Going from the middle of the same sample toward the surface, three colour-based zones can be distinguished: dark grey, light grey, and light grey to brownish thin surface film. The quantity of carbonate components (determined on the basis of qualitative estimates) also declines going from the middle to the surface. On the surface itself, square-shaped moulded cavities are visible, most likely formed by the dissolution of skeletal remains.

(5) The final group of cherts (4 pieces) is characterized by a dark-brown to black colour and the presence of a large number of radiolarians. In the microcrystalline to cryptocrystalline matrix consisting of quartz and tiny leaves of sericite, there are a multitude of radiolarians alternating in microcrystalline quartz or chalcedony (Fig. 11, 5). Most of the particles consist of radiolarians, and limestone fossils, entirely transformed to flint, appear alongside them sporadically.



Slika 9.
Izbor rukotvorina iz sloja D1: 1., 3. i 4. nazubak, 2. strugalo, 5. musterijenski šiljak, 6. svrdlenica, 7. levaloaški odbojak, 8. levaloaško sječivo, 9. poliedar

Figure 9.
Selection of handicrafts from layer D1: 1, 3 and 4. denticulate, 2. sidescraper, 5. Mousterian point, 6. atypical perforator, 7. Levallois flake, 8. Levallois blade, 9. polyhedron

eocenskih, numulitno-diskociklinskih vapnenaca. Matična stijena za postanak rožnjaka treće skupine bio je biokalkarenit eocenske starosti. Četvrta skupina rožnjaka, koja također sadrži relikte prvotne, karbonatne stijene, nastala je silicifikacijom sitnozrnatog vapnenca muljne potpore, sa sporadičnim skeletima. Nejasni ostatci, vjerojatno numulita, sugeriraju da su i ti vapnenci eocenske starosti. Peta skupina rožnjaka, s mnoštvom radiolarija, predstavlja primarne rožnjake nastale akumulacijom radiolarija (pelagičkih organizama) i rekristalizacijom njihovih, originalno opalnih skeleta u mikrokristalinični ili kalcedonski kvarc.

Sve su rukotvorine pregledane binokularnom lećom te su svrstane u jednu od 5 mikroskopski definiranih skupina. U oba "stratigrafska kompleksa", B i C te D1 i D2, najučestalija je skupina 1, s udjelom od 71,78 posto u slojevima B i C te 78,83 posto u slojevima D1 i D2. Rukotvorina koje pripadaju skupini 2 je 18,81 posto u slojevima B i C, a 13,06 posto u slojevima D1 i D2. Ostale su skupine zastupljene s manje od 10 posto: skupina 3, sa 5,94 posto (B i C), odnosno 6,31 posto (D1 i D2), skupina 4, sa 0,99 posto (B i C), odnosno 0,45 posto (D1 i D2), te skupina 5, sa 0,74 posto u slojevima B i C, dok u slojevima D1 i D2 nije uopće zastupljena. Dio rukotvorina nije bilo moguće svrstati ni u jednu od skupina i one su svrstane u skupinu "razno". Riječ je od 1,73 posto u slojevima B i C, te 1,35 posto u slojevima D1 i D2.

5. Nalazišta silicijskog stijenskog materijala u okolici Mujine pećine i usporedba s rezultatima petrografskih analiza

5.1. Uvod

Nakon što su izneseni rezultati petrografskih analiza materijala držimo korisnim iznijeti nekoliko podataka o bližim i daljim nalazištima silicijskoga stijenskog materijala koja upućuju na moguća mjesta sabiranja sirovina i kretanja musterijenskih populacija iz Mujine pećine.

Horizonti bogati rožnjacima nalaze se u eocenskim naslagama te u svim naslagama formiranim pretaloživanjem eocenskih, zatim u naslagama malma (ili vršni horizont kimeridgea ili donji horizont tithona) i u naslagama srednjeg trijasa u aniziku (vršni dio horizonta piroklastičnih šejla s anizičkim amonitima) i ladiniku (horizont sivih vapnenaca u vulkansko-marinskom kompleksu naslaga i horizont giroporelnih svjetlosivih vapnenaca iznad vulkansko-marinskog kompleksa naslaga).

5.2. Nalazišta rožnjaka u bližoj okolici Mujine pećine

Zapadni obronak dugačkog klanca u predjelu Plano na kojem je smještena Mujina pećina izgrađen je od naslaga gornje krede. Obronak na suprotnoj strani, dakle istočni, izgrađen je od debelo uslojenog eocenskog vapnenca s čestim pojavama žila i gomolja rožnjaka. Rožnjak oslobođen korozijom vapnenca viri iz izdanaka. Također se nalazi rasut po obronku i po dnu klanca. Različite je kvalitete za izradu alatki - od veoma dobre homogene strukture do lošeg prirodno raspucalog materijala, te do nepotpuno silificiranog. Boje variraju od bijele do sive i tamnosive te sivo-smeđe. Moguće je naći veće gomolje teške oko dva kilograma

The features of cherts in these four groups unambiguously demonstrate that they are diagenetic cherts. All of them have originated from the initially carbonate rock. The first group of cherts originated after silicification of the marly pelagic Eocene limestone. The second group clearly indicates that the cherts originated by silicification of Eocene, nummulite-discocyclina limestone. The source rock for the origin of the cherts of the third group was Eocene biocalcarenite. The fourth group of cherts, which also contains relicts of the original, carbonate rock, originated due to silicification of fine-grain limestone of the matrix-supported fabric, with sporadic skeletons. Unclear remains, probably nummulites, suggest that these limestones are also Eocene. The fifth group of cherts, with their abundance of radiolarians, are primary cherts which originated by accumulation of radiolarians (pelagic organisms) and recrystallization of their originally opal skeletons into microcrystalline and chalcedonic quartz.

All of the artefacts were examined under a binocular lens and they were classified into one of the five microscopically defined groups. In both "stratigraphic complexes", B and C, and D1 and D2, the most common is group 1, with a share of 71.78 percent in layers B and C, and 78.83 percent in layers D1 and D2. Artefacts belonging to group 2 account for 18.81 percent in layers B and C, and 13.06 percent in layers D1 and D2. The other groups account for less than 10 percent: group 3 with 5.94 percent (B and C) and 6.31 percent (D1 and D2), group 4 with 0.99 percent (B and C) and 0.45 percent (D1 and D2), and group 5 with 0.74 percent in layers B and C, and entirely absent in layers D1 and D2. A part of the artefacts could not be classified in any group and they were classified in the "various" group. This accounts for 1.73 percent in layers B and C, and 1.35 percent in layers D1 and D2.

5. Silicon rock deposits in the vicinity of Mujina Pećina and comparison with the results of petrographic analysis

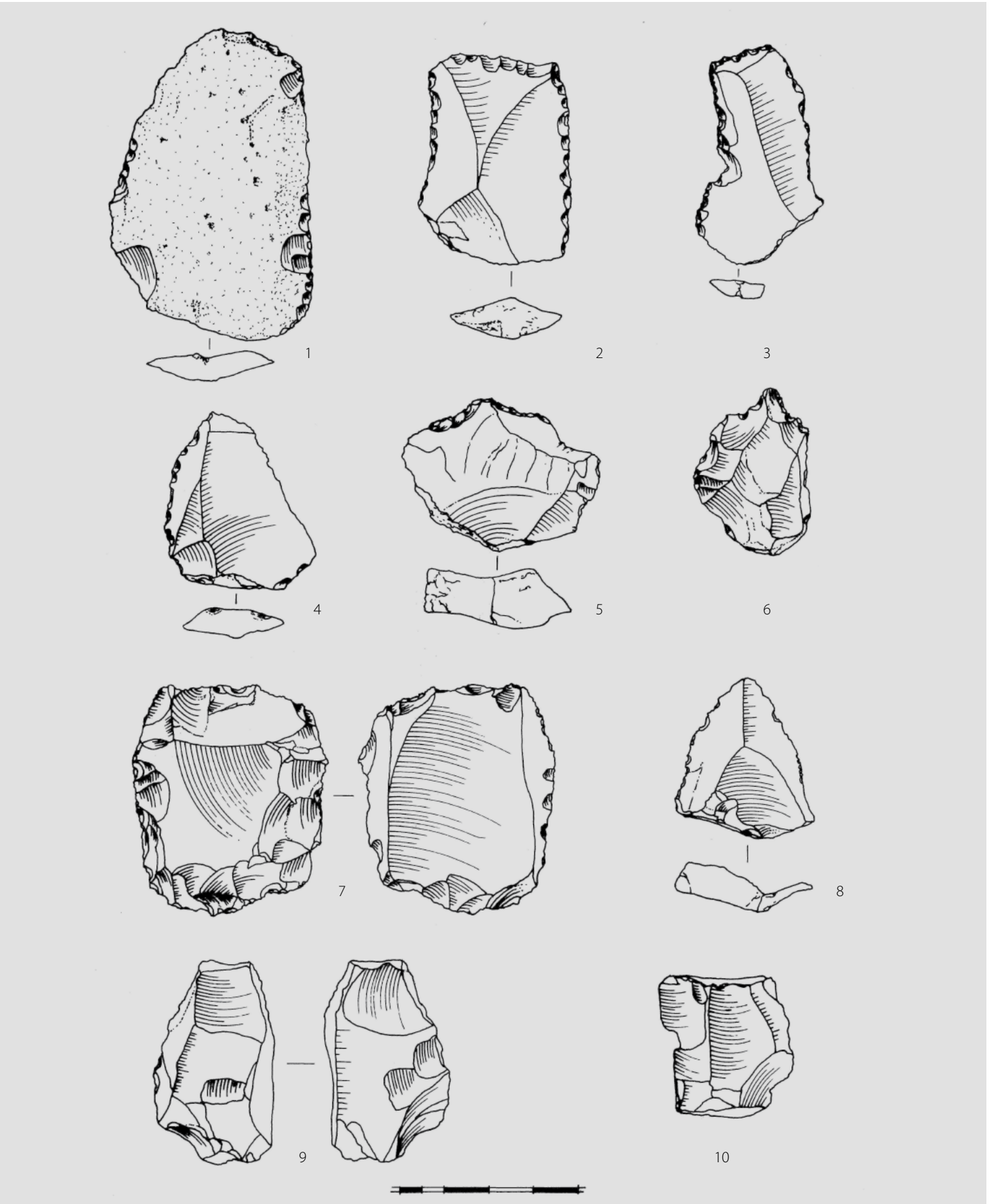
5.1. Introduction

After presentation of the results of petrographic analysis, we believe it useful to present some data on the nearer and more distant silicon rock deposits which indicate possible sites to gather raw materials and movement of Mousterian populations from Mujina Pećina.

Horizons rich in cherts can be found in Eocene deposits and in all deposits formed by resedimentation of Eocene rock, and in malm deposits (or the peak horizon of Kimmeridge or the lower Tithon horizon) and in deposits of the Mid-Triassic in the Anisian (peak horizon of pyroclastic shales with Anisian ammonites) and Ladinian (grey limestone horizon in the volcanic-marine deposit complex and the light-grey limestones with dasyclad green algae Gyroporella above the volcanic-marine deposit complex).

5.2. Chert deposits in the immediate vicinity of Mujina Pećina

The western slope of a long gorge in the Plano area, in which Mujina Pećina is located, is composed of Upper Cretaceous deposits. The opposite side of this slope, i.e. the eastern side, is composed of thickly layered Eocene limestone with the frequent appearance



Slika 10.
Izbor rukotvorina iz sloja D2: 1. i 2. strugalo, 3. razno, 4. i 5. pseudo - alatka, 6. svrdlo, 7. nazubak, 8. levaloaški šiljak, 9. i 10. jezgra za odbojke

Figure 10.
Selection of handicrafts from layer D2: 1. and 2. sidescraper, 3. various, 4. and 5. pseudo-tool, 6. drill, 7. denticulate, 8. Levallois point, 9. and 10. flaking core

koji su homogene građe te ih je moguće lomiti prema želji. Iduće nalazište u blizini nalazi se ispod zaseoka Barade u selu Segetu. Ondje se nalazi debeli horizont numulitnog vapnenca koji prelazi u debeli horizont numulitnoga glinovitog vapnenca s dosta makrofosil, među kojima su česti iregularni ježinci roda *Conoclypeus*. U tom gornjem horizontu ima mnogo rožnjaka kvalitetnog za izradu alatki, deponiranog u obliku žila i gomolja. Iduće nalazište rožnjaka koje je blizu pećine nalazi se na putu prema gori Malački. To je vapnenačko-glinoviti horizont u kojemu je rožnjak deponiran u obliku zaobljenih gomolja koji mogu biti teški i više od četiri kilograma. Kvalitetan je za izradu alatki. Iznad toga, blizu samog gorskog prijevoja, u naslagama gornje krede koje su u vezi s ribljim vapnencima nalaze se male depozicije šarenog rožnjaka.

5.3. Nalazišta rožnjaka na planini Kozjaku, na splitskom poluotoku i u podmorju Kaštelanskog zaljeva te na otoku Čiovu

Svi su ovi lokaliteti u blizini Mujine pećine. Najznačajnije nalazište na Kozjaku je u horizontu eocenskog numulitnoga glinovitog vapnenca koji se proteže južnom stranom udoline sela Blaca (Rupotina Gornja) prema Vučivici. Taj je horizont bogat fosilnom makrofaunom i gomoljima rožnjaka dobre kvalitete za izradu alatki.

Prema makrofosilnoj fauni (isti brojni iregularni ježinci, dekapodni rakovi, školjkaši, puževi i makroforaminifere) ovaj horizont odgovara horizontu eocenskoga glinovitog vapnenca kod Barada (sav ovaj fosilni materijal sakupljen na oba lokaliteta deponiran je u Prirodoslovnom muzeju u Splitu). Isti horizont, ali s malo makrofosila nalazi se sjevernije od Blaca, na sjevernoj strani udoline ispod Bašić brijega, te se pojavljuje još sjevernije, kod sela Konjskog. Sve je to južni dio Splitske zagore.

Na južnim padinama Kozjaka mjestimično se nalazi (ispod trupina lapora) horizont numulitnih klastita koji sadrži slabo cementiran šljunak eocenske i gornje kredne starosti te, osim makroforaminifera, i druge, što izbrušene, što polomljene, eocenske makrofosile. U tom horizontu česti su ulomci rožnjaka različite kvalitete za izradu alatki. Taj horizont može biti i vapnenačko-glinovit, temeljno sitnozrnato klastičan i glinovit, ali, s uklopljenim različitim šljunkom i makrofosilima, također može biti prevladavajuće grubo klastičan vapnenački. Ovaj je horizont veoma zastupljen na cijelom splitskom poluotoku, te u podmorju Kaštelanskog zaljeva (primjerice zapadno od hridi Školjić, na oko dvadesetak metara dubine, gdje s podmorskim hridinama izgrađuje pličinu. Te su hridine iste kao one na kopnu baze poluotoka (Kamen, Kila, Kitoje i druge). Hridine su uklopljene u horizontu numulitnih glinovitih klastita. To je isti neotektonski oblik. Numulitni klastiti s glinovitim cementom lako erodiraju, te su česti nalazi šljunka po vododerinama, gdje

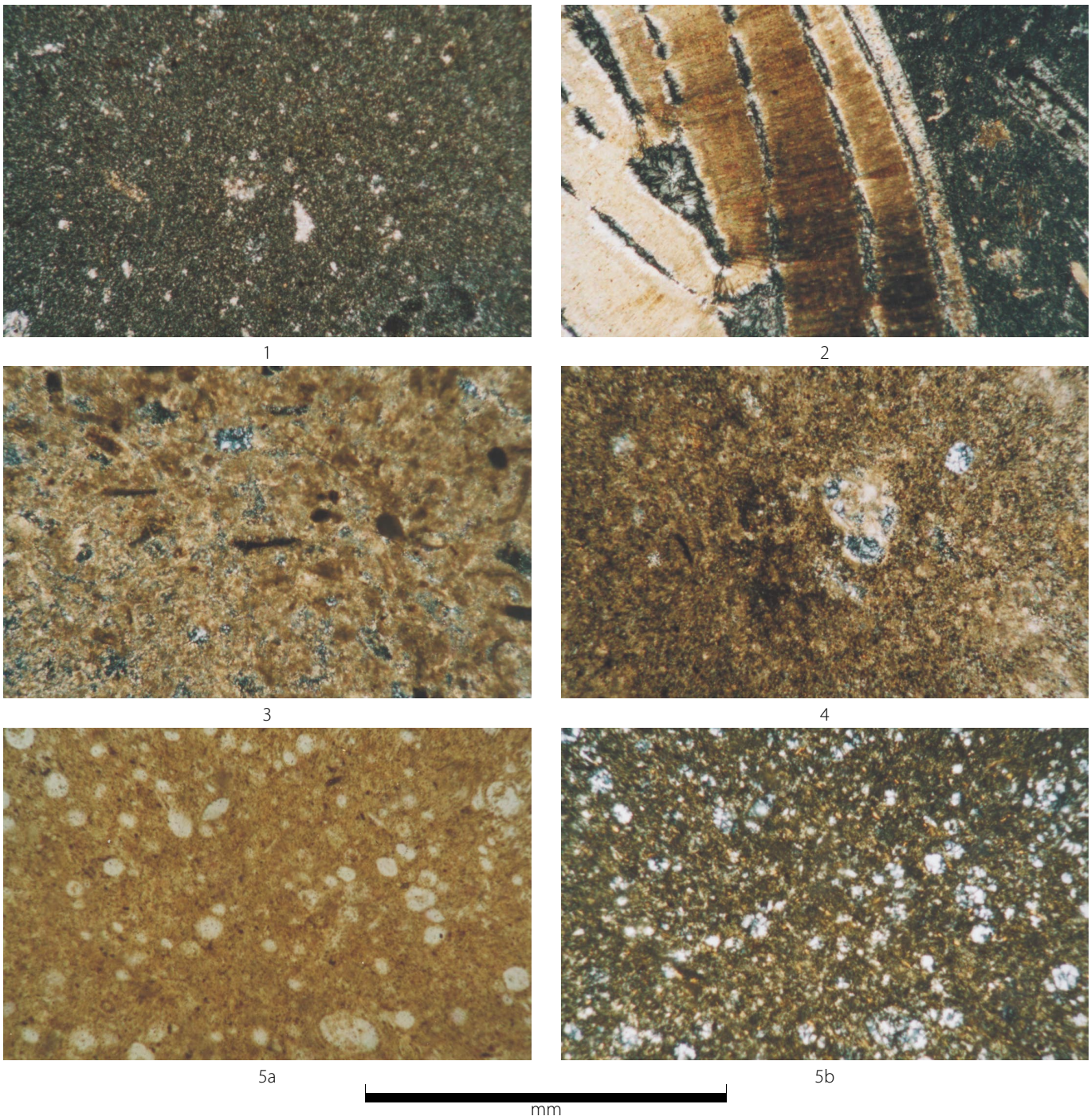
of chert veins and nodules. Chert freed of limestone by corrosion juts out in spurs. It can also be found scattered along the slope and the bottom of the gorge. Its quality for tool-making differs: from very good homogenous structures to poor, naturally fissured materials, and to entirely silicified. The colour varies from white to grey and dark grey to grey-brown. It is possible to find larger nodules of approximately two kilograms which are homogenous in composition and can be reduced as desired. The next deposit in the vicinity is below the hamlet of Barade in the village of Seget. There one can find a thick horizon of nummulite limestone which becomes a thick horizon of nummulite argillaceous limestone with a considerable amount of macrofossils, among which irregular urchins of the genus *Conoclypeus*. In this upper horizon there are many cherts of suitable quality for tool-making, deposited in the form of veins and nodules. The next chert site close to the cave is along the route to the mountain called Malački. This is a limestone-clay horizon in which chert is deposited in the form of rounded nodules weighing as much as four kilograms. Its quality is suitable for tool-making. Somewhat higher, close to a mountain pass in Upper Cretaceous deposits which contains small deposits of colourful chert in association with fish-based limestones.

5.3. Chert deposits on Kozjak Mountain, on the Split peninsula and the seafloor of Kaštela Bay, and on the island of Čiovo

All of these deposits are in the vicinity of Mujina Pećina. The most important deposit on Kozjak is in the horizon of Eocene nummulite argillaceous limestone which extends along the southern side of the valley of the village of Blace (Rupotina Gornja) toward Vučivica. This horizon is rich in fossil macrofauna and chert nodules of good tool-making quality.

Based on the macrofossil fauna (the same irregular urchins, decapod crabs, molluscs, snails and macroforaminifers), this horizon corresponds to the Eocene argillaceous limestone horizon at Barade (all of this fossil material collected at both sites is held in the Natural History Museum in Split). The same horizon, but with less macrofossils, can be found north of Blace, on the northern side of the valley below Bašić Brijeg hill, and it appears even farther north, at the village of Konjsko. All of this is the southern part of Split's elevated hinterland (*Splitska zagora*).

At places on the southern slopes of Kozjak, there is (below trunks of marl) a horizon of nummulite clastites containing poorly cemented Eocene and Upper Cretaceous gravel and, besides macroforaminifers, other either polished or fractured Eocene macrofossils. Chert fragments of varying quality to craft tools are frequent in this horizon. This horizon may be limestone-argillaceous, fundamentally fine-grain clastic and argillaceous, but, with various incorporated gravels and macrofossils, it may also be predominantly coarse clastic limestone. This horizon is very common through the Split peninsula, and on the seafloor of Kaštela Bay (e.g. west of the Školjić reef, at a depth of



Slika 11.
Mikoskopski izbrusci rožnjaka (snimio D. Kurtanjek)
1. Prva skupina rožnjaka. Homogena struktura građena od mikrokristaliničnog kvarca s potpuno silicificiranim pelagičkim foraminiferama (dolje desno). Ukršteni nikoli.
2. Druga skupina rožnjaka. Fragment numulita s djelomično sačuvanom primarnom strukturom i karbonatnom mineralogijom u osnovi od mikrokristaliničnog kvarca. Unutarskeletne šupljine ispunjene su kalcedonom. Ukršteni nikoli.
3. Treća skupina rožnjaka. Mikrofotografija dobro sortiranih bioklastičnih fragmenata, zrnate potpore koji su djelomično ili potpuno silicificirani. Mikrokvarc se pojavljuje kao zamjena karbonatnih zrna i kao vezivo u porama. Ukršteni nikoli.
4. Četvrta skupina rožnjaka. U osnovi od mikrokristaliničnog kvarca i djelomično od kalcita vidi se foraminifera (centar), fragment školjkaša i radiolarija (gore desno). Ukršteni nikoli.
5. Peta skupina rožnjaka. Mikrofotografija radiolarijskog rožnjaka, sastavljenog od mikrokristaliničnog i kriptokristaliničnog kvarca s radiolarijama sačuvanim u obliku mikrokvarca ili kalcedona. (a) Polarizirano svjetlo. (b) Ukršteni nikoli.

Figure 11.
Photomicrographs of chert (photograph: D. Kurtanjek)
1. First chert group. Homogenous structure made of microcrystalline quartz with fully silicified pelagic foraminifers (lower right). Crossed polars.
2. Second chert group. Nummulite fragment with partially preserved primary structure and carbonate mineralogy in the matrix of microcrystalline quartz. In individual intraskeletal cavities, the chalcedonic form of quartz is present. Crossed polars.
3. Third chert group. Microphotograph of well sorted bioclasitc fragments, fine-grain matrix partially or fully silicified. Micro-quartz appears as a replacement for carbonate grains and as bonding in pores. Crossed polars.
4. Fourth chert group. In the matrix of microcrystalline quartz and partially of calcite, foraminifers (centre), mollusc fragments and radiolarians (upper right) are visible. Crossed polars.
5. Fifth chert group. Microphotograph of radiolarian cherts, composed of microcrystalline and cryptocrystalline quartz with radiolarians preserved in the form of micro-quartz or chalcedony. (a) Plane - polarized light. (b) Crossed polars.

je lako naći kvalitetne komade rožnjaka. Na zapadnom dijelu splitskoga poluotoka (Marjan) isti je horizont mjestimično zastupljen blizu obale na sjevernoj i južnoj strani, te mjestimično i drugdje, dok je sjeverna padina većinom izgrađena od debelo uslojenog numulitnog (i numulitno - alveolinskog) vapnenca sa čestim depozicijama rožnjaka u obliku žila i gomolja. Rožnjake u naslagama Marjana opisuje Kerner.[42] Otok Čiovo djelomično je izgrađen od eocenskog, a djelomično od gornjekrednog vapnenca. Ima i numulitnih klastita. Na Čiovu u okolici Trogira ima kvalitetnog rožnjaka u eocenskom vapnencu. Na južnoj strani otoka uz obalu nalaze se naslage numulitnog vapnenca, a u podmorju ima numulitnih klastita.

5.4. Nalazišta silicijskoga stijenskog materijala u Suvovoj na Svilaji

Horizont piroklastičnih šejla s proslojcima vapnenca i djelomično silificiranog vapnenca te s rožnjakom u gornjem dijelu[43] proteže se cijelim terenom pojave srednjeg trijasa, a dobro je otvoren na Beznovom kuku. Na terenu Gornje Suvove otvoren je na bilu Jazinke i na sjevernoj padini gore Visovca, a malo istočnije od Suvove blizu vrha gore Bukovik. Također, ovaj je horizont otvoren zapadnije kod izvora potoka Vrbe blizu sela Vrbe. Mjestimično u gornjem dijelu sadrži aniziče amonite od kojih su neki silificirani. Na tim gornjim razinama ukupne debljine naslaga do dva metra mogu se naći gomolji kvalitetnoga zanimljivog rožnjaka crveno-smeđe i tamnozelene boje što ga Kerner[44] spominje kao jaspis. Ovaj rožnjak vjerojatno je isti koji spominju Šćavničar i suradnici,[45] a značajan je zbog lake prepoznatljivosti u odnosu na ostale vrste rožnjaka. To je najmlađi anizički horizont Svilaje. Horizont rožnjaka bijele, smeđe i zelenkaste boje, rjeđe crveno ispruganog, koji potječe od dobro uslojenog silificiranog biodetritičnog vapnenca s malo primjesa sitnog piroklastičnog materijala, nalazi se na sjevernom obronku Visovca iznad zaseoka Pekići, tj. južno od potoka Suvove. Ove naslage možda su prijelazne iz anizika u ladinik ili najstarije ladiničke. Dalje prema zapadu također na sjevernom obronku Visovca nalaze se deblje uslojeni sivi vapnenci sa žilama i gomoljima tamnosivog do crnog rožnjaka. Ove naslage nalaze se iznad horizonta s anizičkim amonitima, te su vjerojatno donje ladiničke. Na drugoj strani Suvove (sjevernoj) iznad samog suhog korita nalaze se giroporelni vapnenci izgrađeni povezivanjem stromatolita koji sadrže sivi, zelenkasti i crni rožnjak u obliku velikih gomolja. To je poznati kresivac iz Suvove. Krhotine tog rožnjaka nalaze se nanesene u šljunku potoka u Donjoj Suvovoj zajedno s krhotinama efuziva. Sve su to ladinički sedimenti. Ovi sedimenti s rožnjacima, gornji anizik i ladinik okružuju efuzive. Između naslaga efuziva također ima

42 Kerner 1916, str. 63, 64.
43 Te rožnjake spominje Kerner 1916, str. 20, 21, u vezi s ptihitnim vapnencem.
44 Kerner 1916, str. 21.
45 Šćavničar, Šćavničar, Šušnjara 1984, str. 40.

approximately twenty meters, where it forms shoals together with subsea rocks. These rocks are the same as those on the mainland base of the peninsula (Kamen, Kila, Kitoje and others). The rocks are incorporated in the horizon of nummulite argillaceous clastites. This is the same neo-tectonic form. Nummulite clastites with argillaceous cement erode easily, and gravel can often be found in water-formed gullies, where it is also possible to find quality chert. On the western side of the Split Peninsula (Marjan) the same horizon is partially present near the seashore on the northern and southern sides, and partially elsewhere, while the northern slope is mainly made of thickly layered nummulite (nummulite-alveoline) limestone with frequent chert deposits in the form of veins and nodules. Cherts in the deposits of Marjan are described by Kerner.[42] The island of Čiovo is partially made of Eocene, and partially of Upper Cretaceous limestone. There are also nummulite clastites. There is quality chert in Eocene limestone on Čiovo and in the vicinity of Trogir. There is nummulite limestone on the southern side of the island along the coast, and nummulite clastites on the seafloor.

5.4. Silicon rock deposits in Suvova at Svilaja

Pyroclastic shale horizons with embedded limestone layers and partially silicified limestone and chert in the upper portion[43] extends over the entire terrain where the Middle Triassic appears, and it is opened well at Beznov kuk. In the Gornja Suvova terrain, it is open on the summit of Jazinka and on the northern slope of Visovac mountain, and slightly east of Suvova near the peak of Bukovik. Also, this horizon is open west of the source of the Vrba stream near the village of Vrba. At places in the upper portion it contains Anisian ammonites of which some are silicified. At these upper levels of the total thickness of the deposits up to two meters, one can find nodules of high-quality and interesting red-brown and dark green chert, which Kerner[44] referred to as jasper. This chert is probably the same as that mentioned by Šćavničar et al.,[45] and it is significant due to its easy recognizability in comparison to other types of chert. This is the youngest Anisian horizon of Svilaja. The horizon of white, brown and greenish, and more rarely striped red, chert, which originated in a well-layered silicified biodetritic limestone with a slight mixture of tiny pyroclastic materials can be found on the northern slope of Visovac above the hamlet of Pekići, i.e. south of the Suvova stream. These deposits perhaps mark the transition from the Anisian into the Ladinian or the oldest Ladinian. Farther west, also on the northern slope of Visovac, there are more thickly layered grey limestones with veins and nodules of dark grey to black chert. These deposits are above the horizon with Anisian ammonites, and they are probably Lower Ladinian. On the other (northern) side

42 Kerner 1916, pp. 63, 64.
43 These cherts are mentioned by Kerner 1916, pp. 20, 21 with reference to ptychite limestone.
44 Kerner 1916, p. 21.
45 Šćavničar, Šćavničar, Šušnjara 1984, p. 40.

rožnjaka nastalog silificiranjem marinskih sedimenata. Kerner[46] spominje *pietra verde* (zeleno vulkansko kamenje), a taj efuziv iz Suvove dobar je za izradu alatki. Općenito, izbor silicijskog stijenskog materijala u vulkansko-marinskom kompleksu naslaga srednjeg trijasa na prostoru Suvove i najbliže okolice je velik, a ima ga mnogo i kvalitetnog za izradu alatki. Šćavničar i suradnici[47] navode nekoliko razina s rožnjacima u horizontima srednjeg trijasa Suvove na Svilaji, od kojih su važniji: silificirani vapnenac s proslojcima gomolja rožnjaka s radiolarijama na prijelazu anizik-ladinik, mlađi ladinički tufovi s proslojcima rožnjaka i rožnjak u vapnencu, najmlađe ladiničke naslage s rožnjakom. Nalazišta na Svilaji udaljena su gorskim putovima trideset i pet do četrdeset kilometara od Mujine pećine.

5.5. Usporedba s rezultatima petrografskih analiza

U bližoj okolici Mujine pećine (područje u krugu od 5-15 km) poznate su eocenske vapnenačke stijene koje su tokom dijageneze djelomično silicificirane,[48] te stoga sadrže nodule i/ili proslojke rožnjaka. Tako na brdu Marjanu u Splitu, u okolici Trogira, te na otoku Čiovu izdanjuju naslage eocenskih foraminiferskih vapnenaca u svim svojim varijetetima (biokalkareniti, biokalciruditi, biokalcisiltiti).[49] U njima su nastajali rožnjaci koji odgovaraju rožnjacima druge, treće i četvrte skupine. U okolici Trogira (Ivkovići) pojavljuju se laporoviti vapnenci i lapori s globigerinsko-globorotalijskom zajednicom tzv. prijelazne naslage,[50] unutar kojih su mogli nastati rožnjaci prve skupine. Sve te vapnenačke stijene dezintegrirane su i pretaložene u mlađim klastičnim naslagama, a zajedno s njima i rožnjaci. Dokumentirana je tako pojava pretaloženih rožnjaka u facijesu flišolikih laporovitih vapnenaca[51] unutar kojeg se i nalazi sama pećina. Te naslage prostiru se u krugu 3-5 km oko pećine. Iznad Kaštela, dakle cijelom južnom padinom Kozjaka prostiru se pretežno klastične eocenske naslage tipa megabreča, breča, brečokonglomerata, koje također sadrže pretaložene rožnjake.[52] Ti rožnjaci pojavljuju se u obliku valutica u laporovitom matriksu ili kao sastavni dio većih klasta vapnenaca.[53]

Tamni, radiolarijski rožnjaci pete skupine pripadaju srednjetrijaskim rožnjacima, koje primarno najbliže nalazimo na jugoistočnim padinama Svilaje (Muć Gornji, Zelovo Sutinsko). No, i takvi se rožnjaci mogu naći pretaloženih u mlađim, eocenskim klastičnim naslagama i recentnim potočnim nanosima u bližoj okolici spilje (zaleđe Kaštela, Splita).[54]

46 Kerner 1916, str. 26, 27.
47 Šćavničar, Šćavničar, Šušnjara 1984, str. 40-42.
48 Kerner 1903; Kerner 1914; Marinčić, Magaš, Borović 1971; Magaš i Marinčić 1973; Marjanac 1987; Marjanac 1993.
49 Magaš, Marinčić 1973.
50 Magaš, Marinčić 1973.
51 Marinčić, Magaš, Borović 1971.
52 Kerner 1903; Magaš, Marinčić 1973; Marjanac 1987.
53 Kerner 1903; Marjanac 1987.
54 Usmeno priopćenje T. Marjanca.

of Suvova, above the actual dry stream bed, there are Gyroporella limestones made by the bonding of stromatolites which contain grey, greenish and red chert in the form of large nodules. This is the well-known flint from Suvova. Fragments of this chert can be found deposited in the gravel of the stream in Donja Suvova together with extrusive rock. All of these are Ladinian sediments. These sediments with chert, the Upper Anisian and Ladinian encircle extrusive rocks. There are also cherts formed by silicified marine sediments between the extrusive deposits. Kerner[46] mentions *pietra verde* (green volcanic rock), and this extrusive rock from Suvova is good for tool-making. In general, the selection of silicon rock material in the volcanic-marine complex of deposits of the Middle Triassic in the territory of Suvova and its immediate vicinity is great, and much of it is of suitable quality for tool-making. Šćavničar et al.[47] specify several levels with cherts in the Middle Triassic horizons of Suvova at Svilaja, of which the more significant are: silicified limestone with embedded chert nodules with radiolarians at the Anisian-Ladinian transition, younger Ladinian tuffs interspersed with chert and chert in limestone, the youngest Ladinian deposits with chert. The deposits at Svilaja are thirty-five to forty kilometres from Mujina Pećina by mountain trails.

5.5. Comparison with the results of petrographic analysis

Eocene limestones are known in the immediate vicinity of Mujina Pećina (the area within a 5-15 km radius), which were partially silicified during diagenesis,[48] and they thus contain chert nodules and/or embedded layers. Thus, on Marjan Hill in Split, in the Trogir vicinity, and on the island of Čiovo, deposits of Eocene foraminifer limestone appear in all of their variants (biocalcarenites, biocalcirudites, biocalcisiltites).[49] Cherts emerged in them which correspond to the cherts of the second, third and fourth groups. In the Trogir vicinity (Ivkovići) marly limestones and marls appear with a globigerine-globorotalian community of so-called transition deposits,[50] within which cherts of the first group may have emerged. All of these limestones disintegrated and were resedimented to younger clastic deposits, and cherts together with them. Thus, the appearance of resedimented cherts in the facies of the flysch-like marly limestone,[51] within which the cave itself is located, has been documented. These deposits extend within a 3-5 km radius around the cave. Above Kaštela, thus the entire southern slope of Kozjak, predominantly clastic Eocene deposits extend such as mega-breccia, breccia, and breccio-conglomerates, which also contain resedimented cherts.[52] These cherts also appear in the form of pebbles in a marly

46 Kerner 1916, pp. 26, 27.
47 Šćavničar, Šćavničar, Šušnjara 1984, pp. 40-42.
48 Kerner 1903; Kerner 1914; Marinčić, Magaš, Borović 1971; Magaš and Marinčić 1973; Marjanac 1987; Marjanac 1993.
49 Magaš, Marinčić 1973.
50 Magaš, Marinčić 1973.
51 Marinčić, Magaš, Borović 1971.
52 Kerner 1903; Magaš, Marinčić 1973; Marjanac 1987.

6. Zaključci

Svi litički nalazi Mujine pećine mogu se pripisati musterijenskoj materijalnoj kulturi. Premda nalazi fosilnih ljudi nisu pronađeni, s obzirom na materijalnu kulturu i činjenicu da je nalazište datirano prije dolaska ranih modernih ljudi u Europu,[55] možemo ga sa sigurnošću pripisati neandertalcima. Sve faze proizvodnje bile su prisutne na nalazištu koje je po tome imalo funkciju radionice (vidi sliku 4). Prisutni su i proizvodi koji svjedoče o korištenju levaloaške metode, ali su oni češći u slojevima D1 i D2 nego u B i C. Dvije male levaloaške jezgre iz slojeva B i D2 pokazuju da su ljudi koji su ovdje živjeli spretno primijenili tu metodu na malim gomoljima lokalnih rožnjaka, što može upućivati na visok stupanj prilagodbene fleksibilnosti te populacije.[56] Drugim riječima, ljudi iz Mujine pećine bili su dovoljno inteligentni i spretni da jednu metodu koja se obično izvodila na velikim komadima kvalitetnoga rožnjaka primijene na sasvim malim komadima istoga sirovinskog materijala, do kojih su mogli doći u svom neposrednom okolišu. Razlike u tipologiji između slojeva B i C te D1 i D2 možda odražavaju različite aktivnosti koje su se odvijale na lokalitetu.[57] Primjerice, jednostavno obrađeni komadići koji su najčešći tip alatke u slojevima D1 i D2 možda upućuju na obavljanje nekoliko djelatnosti koje uključuju rezanje, za razliku od slojeva B i C, gdje su nazupci i udupci prevladavajući tipovi alatki. Tu hipotezu potvrđuje tafonomija. Urezi od rezanja na faunističkim ostatcima iz slojeva D1 i D2 gotovo su dva puta učestaliji nego na onima iz slojeva B i C.[58]

Poznavanje nalazišta silicijskog stijenskog materijala u bližoj i daljoj okolici Mujine pećine vrlo je važno za pokušaj rekonstrukcije korištenih izvora sirovina i radijusa kretanja populacija musterijenskih lovaca i sakupljača u Dalmaciji. Mnogo eocenskog rožnjaka nalazi se u neposrednoj blizini Mujine pećine te u cijeloj okolici Kaštelanskog zaljeva i na dnu zaljeva; odnosno, taj je kraj izgrađen od naslaga tercijara. Ostala nalazišta silicijskog stijenskog materijala nalaze se na obroncima planine Svilaje u Dalmatinskoj zagori (horizonti u naslagama malma i srednjeg trijasa). Marginalno i u gornje krednim naslagama (cenoman) može se naći rožnjak, no nema značajnih nalazišta. Gomolji i ulomci rožnjaka eocenske starosti često se nalaze u naslagama kvartara u subrecentnim i recentnim slojevima litogenih tala. Često su komadi rožnjaka kao valutice nagomilani u potopljenim koritima potoka te u plitkom podmorju. Takvih nalazišta ima u Kaštelanskom zaljevu. Kako su eocenske naslage i naslage formirane pretaloživanjem eocenskih široko rasprostranjene, ne možemo točno reći odakle potječe

55 Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002; Trinkaus, Moldovan, Milota, Bilgăr, Sarcina, Athreya, Bailey, Rodrigo, Mirca, Higham, Bronk Ramsay, van der Plicht 2003.
56 Karavanić, Balen 2003.
57 Vidi Binford, Binford 1969.
58 Miracle 2005, Tablica 5.

matrix or as a component of larger limestone clasts.[53]

Dark, radiolarian cherts of the fifth group are Middle Triassic cherts, which are closest primarily on the south-east slopes of Svilaja (Muć Gornji, Zelovo Sutinsko). However, even these cherts can be found resedimented in younger, Eocene clastic deposits and in recent stream-bed detritus in the vicinity of the cave (Kaštela and Split hinterland).[54]

6. Conclusions

All lithics discovered in Mujina Pećina can be attributed to the Mousterian culture. Although no fossilized human remains were found, given the material culture and the fact that the site dates to a time prior to the arrival of modern humans in Europe,[55] we can certainly attribute it to Neanderthals. All phases of production were present at the site, which thereby functioned as a workshop (see Fig. 4). Also present were products which testify to the use of the Levallois method, but they are more frequent in layers D1 and D2 than in B and C. Two small Levallois cores from layers B and D2 indicate that the people who lived here skilfully used this method on small nodules of local cherts, which may indicate a high degree of adaptable flexibility of this population.[56] In other words, the people from Mujina Pećina were sufficiently intelligent and adroit to apply a method normally used on large, quality cherts on entirely small pieces of the same raw material which they found in their immediate vicinity. The differences in typology between layers B and C and D1 and D2 perhaps reflect different activities which proceeded at the site.[57] For example, the simply retouched pieces which are the most frequent tool type in layers D1 and D2 may indicate the conduct of several activities which include cutting, as opposed to layers B and C, where denticulates and notches were the predominant tool types. This hypothesis is confirmed by taphonomy. Cutting incisions on faunistic remains from layers D1 and D2 are almost twice as common as on those from layers B and C.[58]

Knowledge of silicon rock deposits in the nearer and farther vicinity of Mujina Pećina is very important to an attempt to reconstruct the sources of raw materials used and the radius of movement by the population of Mousterian hunters and gatherers in Dalmatia. Many Eocene cherts are located in the immediate vicinity of Mujina Pećina and in the entire surroundings of Kaštela Bay and even on the bay's seafloor; this region is made of tertiary deposits. The remaining silicon rock deposits can be found on the slopes of Svilaja in the Dalmatian highlands (horizons in malm and

53 Kerner 1903; Marjanac 1987.
54 Verbal communication from T. Marjanac.
55 Rink, Karavanić, Pettit, van der Plicht, Smith, Bartoll 2002; Trinkaus, Moldovan, Milota, Bilgăr, Sarcina, Athreya, Bailey, Rodrigo, Mirca, Higham, Bronk Ramsay, van der Plicht 2003.
56 Karavanić, Balen 2003.
57 Vidi Binford, Binford 1969.
58 Miracle 2005, T. 5.

sirovina za izradu alatki, no vjerojatno je da su ljudi koristili sirovinu ponajprije iz blizine svojeg boravišta. Isto se odnosi i na sirovinu iz naslaga srednjeg trijasa, koje su također rasprostranjene. Tu u obzir dolaze i rožnjaci iz naslaga jure i krede. Od udaljenijih mjesta korištenje sirovine sa Svilaje (približno 40 km od Mujine pećine) vrlo je vjerojatno. Ne možemo isključiti razmjenu alatki između migrirajućih skupina ljudi. Raznolikost alatki po boji, izgledu površine (glatka, mat, svilenasta), koje su izrađene od sirovine s različitih lokaliteta (od same pećine do obronaka planine Svilaje te vjerojatno i šire) dopuštaju pretpostavku da je tim ljudima uz funkcionalnost bila važna i raznolikost. Neotektonski oblici upućuju da je i prije približno 40.000 godina sirovina bila jednako dostupna kao i danas.

Neandertalci iz Mujine pećine živjeli su devedesetak tisuća godina nakon krapinskih, a možda istodobno s jednom skupinom istih ljudi iz Vindije (sloj G3). Premda su prebivali u drugačijem okolišu, na obama su područjima (Hrvatsko zagorje i Dalmacija) ti ljudi uspješno prilagodili proizvodnju svojih alatki različitim vrstama najlakše dostupnih sirovinskih materijala. Sve to govori o visoku stupnju inteligencije, društvenih odnosa i prilagodbene spretnosti neandertalaca, kojih ponašanje nije moralo isključivo ovisiti o uvjetima koje je pred njih postavljao okoliš.[59]
Potrebno je nastaviti rad na istraživanjima srednjeg paleolitika Dalmacije kako bi se dobilo više relevantnih podataka za rekonstrukciju okoliša i djelatnosti musterijenskih populacija u ovom dijelu Mediterana.

7. Zahvale

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59 Vidi Patou-Mathis 2000.

Middle Triassic deposits). Chert can also be found marginally in the Upper Cretaceous layers (Cenomanian), but there are no significant deposits. Nodules and fragments of Eocene chert can often be found in quaternary layers in sub-recent and recent layers of lithogenic soils. Often pieces of chert accumulated as pebbles in flooded stream beds and in marine shoals. There are also such deposits in Kaštela Bay. Since the Eocene deposits and deposits formed by resedimentation are widely distributed, we cannot say accurately whence the raw materials to make tools came, but it is likely that people primarily used materials in the vicinity of their abode. The same pertains to raw materials from Middle Triassic deposits, which are also widespread. Cherts from Jurassic and Cretaceous layers also come into consideration here. Of the more distant exploitation sites, raw materials from Svilaja (approximately 40 km form Mujina Pećina) are very likely. We cannot exclude exchanges of tools between migrating groups of people. The diversity of the tools in terms of colour and surface appearance (smooth, matte, silky) and the fact that they were made of raw materials from different sites (from the cave itself to the slopes of Svilaja and probably farther afield) allow for the hypothesis that besides functionality, these people also valued diversity. Neotectonic forms indicate that approximately 40,000 years ago, raw materials were equally available as they are today.

The Neanderthals from Mujina Pećina lived ninety thousand years after those in Krapina, and perhaps parallel to a group of the same people from Vindija (layer G3). Although they resided in different environments, in both territories (Hrvatsko Zagorje and Dalmatia) these people successfully adapted the production of their tools to various types of the most easily available raw materials. All of this speaks of the high degree of intelligence, social relations and adaptable flexibility of the Neanderthals, whose behaviour did not have to exclusively depend on the conditions placed before them by the environment.[59]

It will be necessary to continue research into the Middle Palaeolithic in Dalmatia in order to obtain more relevant data to reconstruct the environment and activity of the Mousterian populations in this part of the Mediterranean.

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59 See Patou-Mathis 2000.

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