Pleistocene-Holocene transition in the Vlakno Cave on the island of Dugi otok (Dalmatia, Croatia) – lithic perspective

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Prijelaz iz pleistocena u holocen u pećini Vlakno na Dugom otoku (Dalmacija, Hrvatska) – litička perspektiva

Pleistocene-Holocene transition in the Vlakno Cave on the island of Dugi otok (Dalmatia, Croatia) – lithic perspective

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U ovom radu predstavljamo rezultate analize litičke industrije iz pećine Vlakno otkrivene u iskopavanjima 2004. i 2007. godine. Radiokarbonski datumi smještaju analiziranu litičku industriju u vrijeme prijelaza iz pleistocena u holocen. Tehnološka i tipološka obilježja litičke industrije pokazuju kontinuitet tijekom navedenog prijelaza. Vrlo jasan kontinuitet može se pratiti i u nabavi sirovine uz određene razlike između kasnoga gornjeg paleolitika i mezolitika koje su mogle biti uvjetovane promjenama u okolišu. Određene prilagodbe lovaca skupljača iz Vlakna na nove okolišne uvjete mogu se pratiti kroz značajniju ulogu morskih izvora prehrane i kopnene malakofaune u strategijama preživljavanja tijekom mezolitika. Pećina Vlakno korištena je kao bazni logor manje grupe lovaca skupljača u vremenu prijelaza iz pleistocena u holocen.

Ključne riječi: litička industrija, prijelaz iz pleistocena u holocen, pećina Vlakno, kasni gornji paleolitik, mezolitik

In this paper we present the results of the analysis of lithic industry from Vlakno Cave, which was discovered during excavations in 2004 and 2007. Radiocarbon dating positions the analysed lithic industry at the time of Pleistocene-Holocene transition. The technological and typological features of the lithic production show continuity during the abovementioned transition. Very clear continuity may also be observed in terms of the procurement of raw material, albeit with certain differences between the Late Upper Palaeolithic and Mesolithic, which could be the result of environmental changes. Certain adaptations of the hunter-gatherers from Vlakno to new environmental circumstances can also be traced through the more significant role of marine food sources and continental malacofauna in subsistence strategies during the Mesolithic. Vlakno cave was used as a residential base of a smaller group of hunter-gatherers at the time of the Pleistocene-Holocene transition.

Key words: lithic industry, Pleistocene-Holocene transition, Vlakno Cave, Late Upper Palaeolithic, Mesolithic

UVOD

Prijelaz iz pleistocena u holocen predstavlja prvu pojavu u arheologiji koja se može promatrati na globalnoj razini, s obzirom na to da ljudi naseljavaju sve svjetske kontinente i glavne otoke, izuzev Antarktika i Grenlanda (Straus 1996). Razdoblje od kasnog glacijala do ranog holocena iznimno je važno jer uključuje cijeli dio posljednjega klimatskog ciklusa s prijelazom iz punih glacijalnih u pune postglacijalne uvjete (Orombelli, Ravazzi 1996). Prijelaz iz pleistocena u holocen ovdje je shvaćen kao razdoblje između okvirno 13 000 i 8000 godina BP (Straus 1996) iako ovo prijelazno razdoblje može biti smješteno i u nešto širi vremenski raspon između 14 000 i 7000 godina BP (Müller-Beck 1998). Arheologija ovog klimatski i okolišno gledano vrlo dinamičnog razdoblja označava se prije svega kao arheologija prijelaza iz pleistocena u holocen čime je već samim imenom dodijeljena određena uloga klimatskim i okolišnim promjenama u oblikovanju ljudskog ponašanja, odnosno istaknuta je važnost promjena u okolišu kojima su se ljudi na različite načine prilagođavali (*e.g.* Straus et al. 1996; Eriksen, Straus 1998). Nasuprot spomenutome, M. Otte (2009) ovo razdoblje označava imenom prijelaz iz paleolitika u mezolitik, ističući da je ekološki kontekst kasnog glacijala i postglacijala omogućio prijelaz u mezolitik, ali da nije bio deterministički. Isti autor ovaj prijelaz smatra najznačajnijim prijelazom u ljudskoj povijesti ne samo zbog svoje univerzalnosti nego zbog toga što predstavlja osnovu za nadolazeću neolitičku proizvodnju hrane.

Istraživanje kasnoga gornjeg paleolitika i mezolitika na prostoru istočnojadranske obale od iznimnog je značenja za proučavanje prilagodbi kasnopleistocenskih i ranoholocenskih lovaca skupljača. Kasni glacijal obilježen je globalnim porastom temperature (Miracle 1995), što dovodi do potapanja priobalnih nizina prisutnih na širem mediteranskom prostoru tijekom kasnoglacijalnog maksimuma, uključujući i jadransku (Shackelton et al. 1984; Miracle 1995; Surić et al. 2005). Multidisciplinarna istraživanja kojima je cilj interpretacija ljudskog ponašanja u kontekstu prijelaza iz pleistocena u holocen na istočnom Jadranu provode se tek odnedavno i vezana su uz istraživanja u Pupićinoj peći (Miracle 2006). Ovo razdoblje koje je obilježeno značajnim promjenama u okolišu predstavlja idealan okvir za proučavanje ljudskog odgovora na te promjene (Jochim 1996).

Pećina Vlakno je jedno od dva nalazišta u Dalmaciji, uz pećinu Zemunicu (Šošić et al. u pripremi), na kojem je zabilježen stratigrafski slijed koji obuhvaća spomenuti prijelaz iz pleistocena u holocen. Cilj istraživanja je utvrditi, na osnovi organizacije litičke proizvodnje, moguće prilagodbe kasnopleistocenskih i holocenskih lovaca skupljača u Vlaknu na dinamične promjene okoliša. Značajne promjene u okolišu, najvidljivije kroz podizanje morske razine, mogle su dovesti s jedne strane do promjene staništa lovačko-skupljačkih zajednica, a s druge do promjena u dostupnosti izvora sirovine, a kao posljedica toga moglo je doći do promjena u organizaciji litičke proizvodnje. Vegetacijske promjene i kolebanja životinjske biomase također su mogla utjecati na strategije iskorištavanja okoliša lovačko-skupljačkih za-

INTRODUCTION

The Pleistocene-Holocene transition is the first occurrence in archaeology that can be observed on a global level, given that humans at that time were colonising all the continents and main islands, except for Antarctica and Greenland (Straus 1996). The period from Late Glacial to early Holocene is extremely important because it includes all of the last climate cycle with a transition from full glacial to full post-glacial conditions (Orombelli, Ravazzi 1996). The Pleistocene-Holocene transition is understood here as the period between about 13 000 and 8000 uncal years BP (Straus 1996), although this transitional period can be placed in a somewhat wider period between 14 000 and 7000 uncal years BP (Müller-Beck 1998). The archaeology of this climatically and environmentally very dynamic period is marked primarily as archaeology of the Pleistocene-Holocene transition, with the name itself allocating a certain role to climate and environmental changes in the shaping of human behaviour, or in other words it highlights the importance of changes in the environment to which people adapted in various ways (e.g. Straus et al. 1996; Eriksen, Straus 1998). As opposed to the above, M. Otte (2009) calls this period the Palaeolithic-Mesolithic transition, pointing out that the environmental context of the Late Glacial and Postglacial enabled the transition to the Mesolithic, but that it was not deterministic. The same author considers this transition the most important one in human history, not only because of its universality but because it represents a foundation for the impending Neolithic food production.

Research of the Late Upper Palaeolithic and Mesolithic on the Eastern Adriatic coast is of exceptional importance for studying the adaptation of Late Pleistocene and Early Holocene hunter-gatherers. The Last Glacial is characterised by a global increase in temperature (Miracle 1995) resulting in the flooding of the coastal plains in the wider Mediterranean area which existed during the Late Glacial Maximum, including the Adriatic plain (Shackelton et al. 1984; Miracle 1995; Surić et al. 2005). Multidisciplinary research aiming at interpreting human behaviour in the context of the Pleistocene-Holocene transition in the eastern Adriatic has been undertaken only since recently and is linked to the exploration of the Pupićina Cave (Miracle 2006). This period is characterised by significant environmental changes and thus presents an ideal framework for studying human responses to these changes (Jochim 1996).

Vlakno Cave is one of the two sites in Dalmatia, together with the Zemunica Cave (Šošić et al. forthcoming), where a stratigraphic sequence was found which encompasses the abovementioned Pleistocene-Holocene transition. The aim of the research is to determine possible adaptations of the Late Pleistocene and Holocene hunter-gatherers in Vlakno to dynamic environmental changes on the basis of the organisation of lithic production. Significant environmental changes, the most prominent one being the elevation of the sea level, could have resulted in changes of the hunter-gatherers' settlement system on the one hand, and in changes in availability of raw material sources on the other hand, jednica, a onda su one posljedično mogle utjecati na strategije nabave sirovine i samu organizaciju litičke proizvodnje (Milliken 1998; Floss 2002). Dostupnost sirovine može biti jedan od najvažnijih faktora u organizaciji litičke proizvodnje (Bamforth 1986; Andrefsky 1994). Prema danas raspoloživim podacima, u Dalmaciji su zabilježena brojna ležišta sirovine (Perhoč 2009a; 2009b; Vukosavljević et al. 2011) i njezinu nabavu treba promatrati prije svega kao sastavni dio strategija preživljavanja (*embedded procurement*) (Binford 1979), a ne kao posebnu aktivnost kojoj je jedini cilj nabava sirovine.

U našem slučaju postoji nekoliko ograničavajućih faktora za cjelovitije sagledavanje arheološke slike na prijelazu iz pleistocena u holocen u Vlaknu. Za Vlakno nam nedostaju analize faune, a litička analiza skupa nalaza iz Vlakna bazirana je na analizi male iskopane površine (≈ 5 m^2). Male iskopane površine u kombinaciji s radiokarbonskim datumima omogućavaju gotovo isključivo proučavanje dijakronijskih promjena u litičkim skupovima nalaza. Široki horizontalni otkopi, za razliku od ovog iz Vlakna, omogućavaju nam uvid u organizaciju prostora i nude širu mogućnost interpretacije ponašanja lovaca skupljača (*e.g.* Galanidou 1999).

VLAKNO U REGIONALNOM GEOGRAFSKOM I PALEOGEOGRAFSKOM KONTEKSTU

Vlakno je smješteno u središnjem dijelu Dugog otoka koji predstavlja najveći i najduži otok zadarskog arhipelaga. Otočni reljef Dugog otoka rezultat je postpleistocenskoga glacioeustatičkog podizanja morske razine. U geološkoj osnovi Dugog otoka dominiraju vapnenci i dolomiti donjokredne i gornjokredne starosti. Crvenica predstavlja najznačajniji i najrasprostranjeniji sediment kvartarne starosti debljine od 1 do 3 m u morfološkim udubinama, dok su deblji nanosi crvenice rijetki (Polje kod Božave, Žmanska jezera). Na području Velog rata zabilježene su koštane breče (Džaja 2003: 5–11). Dugi otok ima dinarski pravac pružanja u dužini od 44,4 km, a širina mu varira od 1,2 do 4,8 km. Površina otoka iznosi 113,3 km^2. Središnji je dio otoka hrptast i viši od sjeverozapadnog i jugoistočnog dijela koji predstavlju niže, razvedene dijelove. Dugi otok obilježava ponajprije krški reljef s prisutnošću različitih krških oblika čija pojava, veličina i gustoća ovise o nagibu reljefa (Duplančić Leder et al. 2004: 13; Džaja 2003: 13–14, 20).

Žmanska jezera predstavljaju jedinu značajniju pojavu površinske slatke vode na Dugom otoku. U njima se akumulira atmosferska voda koja se zadržava zahvaljujući hidrostatskom tlaku (Džaja 2003: 31). Nedostatak stalnih površinskih slatkih voda obilježava i ostale otoke zadarskog arhipelaga, na kojima se sezonske akumulacije površinske vode nakupljaju u lokvama nakon obilnih padalina (Kulušić 1965; Magaš 1984; Bognar et al. 1990; Magaš, Faričić 1999; 2000; Filipi 2001; 2003).

Za Dugi otok karakterističan je mediteranski pluviometrički režim. More u znatnoj mjeri modelira termičke značajke Dugog otoka, tako da su srednje mjesečne temperature tijekom cijele godine više od 8°C (Džaja 2003: 20).

Područje Dugog otoka je neotektonski i seizmički ak-

both of them resulting in a new organisation of lithic technology. Vegetation and animal biomass changes could also have an impact on the strategies of environment use of the hunter-gatherers' groups, and as a consequence they could have an impact on the raw material procurement strategies and the very organisation of lithic technology (Milliken 1998; Floss 2002). Raw material availability can be one of the most important factors in the organisation of lithic technology (Bamforth 1986; Andrefsky 1994). According to currently available data, there are numerous stone raw material sources in Dalmatia (Perhoč 2009a; 2009b; Vukosavljević et al. 2011) and its procurement should be viewed primarily as embedded procurement (Binford 1979), and not as a separate activity whose only aim is raw material procurement.

In our case there are several factors limiting comprehensive viewing of the archaeological record across the Pleistocene-Holocene transition in Vlakno. We are lacking fauna analysis for Vlakno, and the lithic analysis of the lithic assemblage from Vlakno is based on the analysis of a small excavated area (≈ 5 m^2). Small excavated surfaces in combination with radiocarbon dates allow for almost exclusive studying of diachronic changes in lithic assemblages. Wider excavated areas, unlike the one in Vlakno, provide insight into the spatial organisation and give us wider opportunities for interpreting hunter-gatherers' behaviour (e.g. Galanidou 1999).

VLAKNO IN REGIONAL GEOGRAPHICAL AND PALAEOGRAPHICAL CONTEXT

Vlakno is located in the central part of the island of Dugi otok, which is the biggest and longest island of the Zadar archipelago. The island's morphology is the result of the Post-Pleistocene Glacioeustatic sea level rise. Lower Cretaceous and Upper Cretaceous limestone and dolomites are predominant in the geological base of Dugi otok. *Terra rossa* is the most significant and most prevalent sediment from the Quaternary, whose depth is 1 to 3 m in morphological depressions, while thicker sediments of *terra rossa* are quite rare (e.g. Polje near Božava, lakes of Žmanska jezera). Bone breccias are found in the area of Veli rat (Džaja 2003: 5–11). Dugi otok has the same orientation as the Dinaric Alps; it is 44.4 km in length, while its width varies from 1.2 to 4.8 km. The island's surface amounts to 113.3 km^2. The central part of the island is ridge-like and higher than its north-western and south-eastern parts which are lower and more indented. Dugi otok is characterised primarily by the presence of different karst forms whose appearance, size and density depend on the slope of the terrain (Duplančić Leder et al. 2004: 13; Džaja 2003: 13–14, 20).

The lakes of Žmanska jezera present the only significant surface freshwaters on Dugi otok. Atmosphere waters accumulate in those lakes, and are retained there due to hydrostatic pressure (Džaja 2003: 31). A lack of permanent surface freshwaters is characteristic for other islands of the Zadar archipelago, where seasonal accumulation of surface waters accumulates in puddles after heavy precipitation (Kulušić 1965; Magaš 1984; Bognar et al. 1990; Magaš, Faričić 1999; 2000; Filipi 2001; 2003).

tivno zbog podvlačenja jadranske pod dinarsku litosfernu ploču (Džaja 2003: 12).

Jadranski je prostor tijekom kasnog glacijala, a dijelom i postglacijala, izgledao znatno drugačije od današnjeg zbog niže morske razine. Promjena morske razine predstavlja zbroj eustatskih, glacio-hidro-izostatskih i tektonskih faktora, od kojih je prvi globalni i vremenski ovisan, a preostala dva variraju lokalno (Antonioli et al. 2009). Današnji prostor koji ispunjava Jadransko more bio je tijekom kasnoglacijalnog maksimuma jednim dijelom kopno, tzv. Jadranska nizina. Podizanje morske razine dovelo je do postupnog potapanja Jadranske nizine, kao i ostalih priobalnih mediteranskih nizina (Shackleton et al. 1984; Van Andel 1989; Lambeck 1996; Surić, Juračić 2010). Ovakva promjena okoliša dovela je do promjena u dostupnostima prehrambenih izvora i mogla je biti od velike važnosti za kasnogornjopaleolitičke lovce skupljače koji su naseljavali mediteranski prostor, a posebno jadranski s obzirom na to da je on prošao kroz najznatnije promjene (Shackleton et al. 1984), zbog relativno plitkoga sjevernog dijela jadranskog bazena s malim nagibom (0,02°) do dubine od -100 m (Surić, Juračić 2010).

Sjeverni Jadran predstavljao je paleonizinu oko 300x150 km koja je povezivala Apeninski i Balkanski poluotok (Mussi 2002). Prema P. T. Miracleu (1995: 117–118), Jadranska nizina bila je najveća tijekom drijasa I i nije se znatnije smanjila prilikom porasta morske razine od -100 do -93m (oko 12 500 BP) kada je zauzimala oko 92% svoje nekadašnje površine. Između 12 500 i 11 800 BP morska razina se digla na oko -75 m, a Jadranska nizina je pri takvoj morskoj razini zauzimala oko 64% nekadašnje površine. Prije oko 10 500 BP Jadranska nizina pokrivala je 53% nekadašnjeg prostora, a oko 9000 BP samo 17% i bila je svedena na uski pojas u Tršćanskom zaljevu.

Uzimajući u obzir postojanje Jadranske nizine tijekom kasnog glacijala, postoje dva dijametralno suprotna mišljenja u paleolitičkoj arheologiji o važnosti ove paleonizine za lovce skupljače. S jedne strane ona se smatra iznimno bogatim biotopom koji su naseljavala krda biljojeda koja su mogli loviti lovci skupljači (Shackleton et al. 1984: 312; Van Andel 1989: 737; Miracle 1995: 45; Whallon 1999: 338; Boschian, Fusco 2007: 24; Miracle 2007). S druge strane, M. Mussi (2002) smatra da prostor Jadranske nizine i nije bilo tako idealno mjesto za boravak lovaca skupljača jer je ravnica bila hladna i izložena snažnim sezonskim udarima vjetra sa sjevera i da je dijelom bila močvarni prostor koji u hladnim klimatskim uvjetima nije predstavljao tako produktivnu nišu kao što su takva područja tijekom toplih interglacijalnih faza (Mussi 2002: 309–313). Nedostatak prirodnih skloništa u ravnici šibanoj hladnim vjetrovima i potencijalni nedostatak prikladne sirovine za izradu kamenih artefakata za Mussi (2002: 312) predstavlja dodatne poteškoće za lovce skupljače koji bi mogli naseljavati taj danas potopljeni prostor. Zbog toga ona smatra da je nestanak Jadranske nizine mogao imati manje posljedice na ljudski život nego što bi se očekivalo. P. Miracle (2007), na osnovi arheološke slike istar-

Dugi otok is characterised by a Mediterranean pluviometric regime. The sea impacts the thermal features of Dugi otok to a significant extent, so the average monthly temperatures throughout the year are higher than 8°C (Džaja 2003: 20).

The area of Dugi otok has neotectonic and seismic activities due to the Adriatic plate moving under the Dinaric lithosphere plate (Džaja 2003: 12).

The Adriatic area was quite different in the Late Glacial and partly Post-Glacial than it is today, due to a lower sea level. Sea level changes are the sum of eustatic, glacio-hydro-isostatic and tectonic factors, of which the first one is global and time-dependant, while the other two vary locally (Antonioli et al. 2009). Today's area of the Adriatic Sea was partly land during the Last Glacial Maximum, the so called Great Adriatic Plain. The sea level rise resulted in gradual flooding of the Adriatic Plain, as well as other coastal Mediterranean plains (Shackleton et al. 1984; van Andel 1989; Lambeck 1996; Surić, Juračić 2010). This environmental change led to changes in the availability of food sources and could have been of great importance for Late Upper Palaeolithic hunter-gatherers who inhabited the Mediterranean area, particularly the Adriatic area because it underwent the most significant changes (Shackleton et al. 1984), due to the relatively shallow northern part of the Adriatic basin with a low gradient (0.02°) down to -100m (Surić, Juračić 2010).

The North Adriatic was a paleoplain approximately 300x150km in size, which connected the Apennine and Balkan Peninsula (Mussi 2002). According to P.T. Miracle (1995: 117–118) the Adriatic Plain was the biggest during Dryas I and did not shrink significantly during the sea level rise from -100 do -93m (around 12 500 BP) when it occupied approximately 92% of its previous size. Between 12 500 bp and 11 800 BP, the sea level rose to approximately -75m, and the Adriatic Plain at this sea level occupied approximately 64% of its previous size. Before approximately 10 500 BP, the Adriatic Plain covered 53% of its previous space, while around 9000 BP only 17% and was reduced only to a narrow zone in the Gulf of Trieste.

When considering the existence of the Adriatic Plain during Late Glacial, there are two diametrically opposite opinions in Palaeolithic archaeology on the importance of this paleoplain for hunter-gatherers. On the one hand, it is considered to be a very rich biotope inhabited by herds of herbivores that hunter-gatherers could hunt (Shackleton et al. 1984: 312; van Andel 1989: 737; Miracle 1995: 45; Whallon 1999: 338; Boschian, Fusco 2007: 24; Miracle 2007). On the other hand, M. Mussi (2002) believes that the Adriatic Plain was not such an ideal place for residence of hunter-gatherers because the plain was cold and exposed to strong seasonal winds from the North, and that it was partly a swamp which in the cold climate was not such a productive niche as such areas were during warm interglacial phases (Mussi 2002: 309–313). The lack of natural shelters in the plain exposed to cold winds and the potential lack of appropriate raw material for the production of lithic artefacts for Mussi skog poluotoka, smatra da je središte naseljavanja tijekom kasnoglacijalnog maksimuma i snižene morske razine bila Jadranska nizina, a da se zbog naglog poboljšanja klimatskih uvjeta i znatnog potapanja Jadranske nizine tijekom kasnoglacijalnog interstadijala lovci skupljači povlače s Jadranske nizine i intenzivno i višestruko iskorištavaju njezino zaleđe. Isto mišljenje dijele i Boschian i Fusco (2007). M. Mussi (2002: 312) smatra da se za povećanje broja nalazišta na Apeninskom poluotoku nakon oko 14 000 uncal BP ne može iskoristiti jednostavno objašnjenje koje uključuje povlačenje lovaca skupljača s jadranske ravnice prema njezinim marginama kako raste morska razina. Sličan obrazac povećanja broja nalazišta na istočnom Jadranu i u njegovu zaleđu može se pratiti nakon 13 000 uncal BP, i može se barem djelomično povezati s kasnoglacijalnim interstadijalom Bølling/Allerød za vrijeme kojeg dolazi do znatnog potapanja Jadranske nizine (Vukosavljević 2012). U kojoj je mjeri Jadranska nizina bila naseljena od kasnoglacijalnog maksimuma naovamo teško je reći jer su svi zaključci utemeljeni na indirektnim pokazateljima s ruba nekadašnje nizine. Pravi odgovor mogla bi nam dati podvodna istraživanja potencijalno potopljenih nalazišta na što je već davno upozorio Đ. Basler (1985). Kontinuirano taloženje riječnih sedimenata rijeke Po, Adige i drugih rijeka na jadranskom dnu može otežavati lociranje potopljenih nalazišta na otvorenom. Potopljene pećine u tom smislu mogu biti arheološki perspektivnije jer su mogle sačuvati ostatke ljudskog boravka iz kasnog pleistocena i ranog holocena. Dosad nije zabilježeno nijedno arheološko nalazište u podvodnim pećinama na Jadranu (Benjamin, Črešnar 2009: 62). Juračić et al. (2002), te Benjamin i Črešnar (2009) na osnovi opisa prethodno spomenutih autora ističu arheološki potencijal potopljene Y-pećine na Dugom otoku.

Na osnovi GCM-ova (*general circulation model*) prihvaćenih od COHMAP-a Miracle (1995) donosi podatke o paleoklimi na prostoru Jadranske nizine tijekom kasnoglacijalnog maksimuma (18 000 BP) i kasnog glacijala (12 000 BP). On pretpostavlja rast temperature od sjeverozapada prema jugoistoku. Snažne razlike u temperaturama uvjetovane nadmorskom visinom izražene su uz rubove nizine. Zbog zračnih struja (*jet stream*) uz južni rub Jadranske nizine i olujа koje nose sa sobom, sjeverozapadni dio ravnice (nizine) mogao je biti suši od jugoistočnog. Procijenjena prosječna godišnja temperatura za Hvar u vrijeme kasnoglacijalnog maksimuma bila bi 7,5 °C, a u vrijeme kasnoglacijalnog interstadijala 14,4 °C (Miracle 1995: 110). U odnosu na današnji prosjek od 16,4 °C (Miracle 1995: 49), tijekom kasnoglacijalnog maksimuma prosječna godišnja temperatura bila je znatno niža, a tijekom kasnoglacijalnog interstadijala vrijednosti su nešto niže, ali bliske današnjima. Godišnji prosjek padalina tijekom kasnoglacijalnog maksimuma i kasnoglacijalnog interstadijala vrlo je sličan, s tim da su padaline tijekom interstadijala mogle biti ravnomjernije raspoređene kroz godinu. Tijekom drijasa III temperature na Mediteranu su malo pale, ali znatno manje u odnosu na zapadnu Europu. Najznačajnija promjena u južnoj Europi povezana s drijasom III moglo bi biti smanjivanje količine padalina (Miracle 1995: 113).

(2002: 312) present additional difficulties for hunter-gatherers who could have inhabited the area which is flooded today. This is why she believes that the disappearance of the Adriatic Plain could have had fewer consequences on human life than would otherwise be expected. P. Miracle (2007), believes on the basis of the archaeological record of the Istrian Peninsula that the centre of human settlement during the Last Glacial Maximum and lower sea level was the Adriatic Plain, and that due to a sudden improvement in climatic conditions and significant flooding of the Adriatic Plain during the Late Glacial Interstadial the hunter-gatherers retreated from the Adriatic Plain and exploited its hinterlands intensely and repeatedly. Boschian and Fusco (2007) share that same opinion. M. Mussi (2002: 312) believes that the increase in the number of sites on the Apennine Peninsula after ca. 14 000 uncal BP cannot be simply interpreted with the retreat of the hunter-gatherers from the Adriatic Plain towards its margins as the sea level rises. A similar pattern of increase in the number of sites in the East Adriatic and its hinterlands can be observed after 13 000 uncal BP, and it can be, at least partially, related to the Late Glacial Interstadial Bølling/Allerød during which there is a significant flooding of the Adriatic Plain (Vukosavljević 2012). It is difficult to say to what extent the Adriatic Plain was inhabited from the Last Glacial Maximum until today, because all the conclusions are based on indirect indicators from the edges of the former plain. The true answer to this question could be provided by underwater excavations of potentially flooded sites, as emphasised a long time ago by Đ. Basler (1985). Continuous sedimentation of river sediments of the Po River, Adige River and other rivers in the Adriatic seabed can make it difficult to find the flooded open-air sites. In this sense, the flooded caves could be archaeologically most promising because they could have preserved the remains of human presence from the Late Pleistocene and Early Holocene. So far not one archaeological site was found in the underwater caves in the Adriatic (Benjamin, Črešnar 2009: 62). Juračić et al. (2002), and Benjamin and Črešnar (2009) using the descriptions of previously mentioned authors emphasise the archaeological potential of the flooded Y Cave on Dugi otok.

Based on GCM (general circulation model) accepted by COHMAP, Miracle (1995) gives data on the paleoclimate in the territory of the Adriatic Plain during the Last Glacial Maximum (18 000 BP) and Late Glacial (12 000 BP). Miracle assumes the temperature growth from the northwest towards the southeast. Strong differences in temperatures conditioned by the altitude are prominent along the edges of the plain. Due to jet streams along the southern edge of the Adriatic Plain and the storms that they carry, the northwest part of the plain could have been drier than the southeastern one. The estimated average annual temperature for Hvar at the time of the Last Glacial Maximum is 7.5 °C, while at the time of Late Glacial Interstadial it was 14.4 °C (Miracle 1995: 110). Compared to today's average of 16.4 °C (Miracle 1995: 49), during the Last Glacial Maximum the average annual temperature was significantly lower, whi-

Rossignol-Strick et al. (1992) na osnovi analize peludne jezgre s jadranskog dna oko 90 km južno od Dubrovnika donose sliku o paleovegetaciji južnojadranskog prostora. Dio jezgre koji se može smjestiti okvirno između 16 700 i 13 800 BP karakterizira značajna prisutnost peludi *Artemisia*, Graminae i Chenopodiaceae, uz prisutnost bjelogoričnog drveća (hrast, lijeska, brijest, bukva) što sugerira postojanje suhih, ali ne i hladnih travnjaka. Od oko 13 800 BP povećava se količina peludi bora, breze i johe. Nakon 13 200 BP povećava se udio termofilnih bjelogoričnih vrsta koje uključuju grab. Između 10 900 i 10 000 BP opada udio drveća svih vrsta, a raste udio *Artemisia* i Chenopodiaceae. Nakon 9400 BP raste učestalost peludi drveća uz dodatak mediteranskih vrsta (pistacio, maslina i grab) (Rossignol-Strick et al. 1992: 416–417).

Na osnovi ostataka faune iz kasnoglacijalnih slojeva Badnja, Kopačine i Šandalje II Miracle (1995) upotpunjuje sliku o paleoekološkim uvjetima koji su vladali na Jadranskoj nizini i njezinoj periferiji. Ostaci faune sisavaca iz Badnja upućuju na izražen trend povećanja vegetacijskog pokrova i dubine tla. Nedostatak vrsta prilagođenih hladnim uvjetima i dobra zastupljenost vrsta koje preferiraju umjeren okoliš pokazuju da zimske temperature nisu bile ekstremne (Miracle 1995: 141). U faunskom skupu nalaza iz Kopačine nijedna vrsta velikih sisavaca nije indikator određenih paleookolišnih prilika, nego sugeriraju postojanje različitih okoliša, sličnih onima oko Badnja. Vrste prilagođene na hladnoću nisu zabilježene u skupu nalaza (Miracle 1995: 146–148). Ostaci riba, vodozemaca i gmazova iz Šandalje II pokazuju mješavinu vrsta karakterističnih za umjerenu i mediteransku klimu, s obzirom na to da je Istra bila pod klimatskim utjecajem Alpa i Jadranskog mora, kao što je i danas (Paunović 1984). Ostaci ptica iz Šandalje II pokazuju prisutnost mediteranskih vrsta tijekom kasnoglacijalnog maksimuma. Promjena od arktičkih/alpskih vrsta u sloju B/C do mediteranskih vrsta u sloju B/s prema Miracleu (1995: 165) vremenski bi se mogla poklapati sa zabilježenim prijelazom iz stadijala u interstadijal u grenlandskim ledenim jezgrama prije oko 12 500 BP. Ako bi učestalost pojedinih vrsta ptica barem dijelom odražavala zastupljenost određenih biotopa, onda bi se na osnovi toga moglo pretpostaviti da su se šume proširile u vremenu između 21 000 i 11 000 BP, a nakon toga, tijekom drijasa III, smanjila bi se površina koju su pokrivale (Miracle 1995: 167). Glavna razlika između Badnja i Kopačine s jedne strane i Šandalje II s druge strane jest u prisutnosti vrsta prilagođenih na hladnoću (žderonja, arktička lisica, sob) u Šandalji II. Te vrste u Šandalji II nisu grupirane u određenom sloju, nego su prisutne gotovo kroz cijeli stratigrafski slijed u malom broju (Miracle 1995: 171, 177).

Boschian i Fusco (2007) opisuju kasnoglacijalni okoliš Jadranske ravnice kao monoton, ravan i suh okoliš grmoliko-travolikih zajednica. Jednoličnost ovakvog okoliša prekidaju močvarna područja i male površine pokrivene drvećem različitih vrsta borova i nekih bjelogoričnih vrsta koje se vjerojatno najčešće javljaju uz riječne tokove podložne sezonskom plavljenju.

le during the Late Glacial Interstadial the values were somewhat lower, however similar to those today. The annual average precipitation during the Last Glacial Maximum and Late Glacial Interstadial was very similar; however the precipitation during the Interstadial was probably more equally distributed throughout the year. During Dryas III, temperatures in the Mediterranean dropped slightly, but much less compared with Western Europe. The most significant change in South Europe connected to Dryas III could have been a fall in precipitation quantities (Miracle 1995: 113).

Based on an analysis of pollen cores from the Adriatic seabed approximately 90 km south of Dubrovnik, Rossignol-Strick et al. (1992) give us an idea of the paleovegetation of the South Adriatic area. Part of the core that can be approximately situated between 16 700 and 13 800 BP is characterised by a significant presence of the pollen of *Artemisia*, Graminae and Chenopodiaceae, with a presence of deciduous trees (oak, hazel, elm, beech) therefore suggesting the presence of dry but not cold grassland. Since approximately 13 800 BP there is an increase in the quantity of pollen from pine, birch and alder. After 13 200 BPp there is an increase in the share of thermopile deciduous species including hornbeam. Between 10 900 and 10 000 BP there is a drop in the share of trees of all types, but an increase in the share of *Artemisia* and Chenopodiaceae. After 9400 BP there is an increase in the frequency of pollen from trees with the addition of Mediterranean species (pistachio, olive and hornbeam) (Rossignol-Strick et al. 1992: 416–417).

On the basis of faunal remains from Late Glacial layers from Badanj, Kopačina and Šandalja II, Miracle (1995) gives a more complete description of the paleoecological conditions which were prevalent in the Adriatic Plain and its periphery. Mammal faunal remains from Badanj suggest a prominent increasing trend of vegetation cover and soil depth. The lack of species adapted to cold conditions and well-represented species which prefer a moderate climate suggest that winter temperatures were not extreme (Miracle 1995: 141). In fauna assemblage from Kopačina not one large mammal species is an indicator of certain paleoecological conditions, but rather suggest the existence of different environments, similar to those around Badanj. Species adapted to cold were not found in the assemblage (Miracle 1995: 146–148). The remains of fish, amphibians and reptiles from Šandalja II show a mixture of species typical for a moderate and Mediterranean climate, given the fact that Istria was under the climatic influence of the Alps and Adriatic Sea, as it is today (Paunović 1984). The bird remains from Šandalja II show the presence of Mediterranean species during the Last Glacial Maximum. The change from Arctic/Alpine species in layer B/C to Mediterranean species in layer B/s according to Miracle (1995: 165) could overlap in time with the recorded transition from Stadial to Interstadial in the Greenland ice cores before approximately 12 500 BP. If the frequency of certain bird species would at least partly reflect the prevalence of certain biotopes, then it could be assumed that the forests expanded in the period from 21 000 and 11 000 BP, and shrunk after that, during Dryas III (Miracle 1995: 167). The main difference between Badanj and Kopačina on one hand, and Šandalja II on the other, is in the presence of species adapted to cold (wolverine, arctic fox, reindeer) in Šandalja II. These species in Šandalja II are not grouped in a certain layer but are rather present throughout the entire stratigraphic sequence in small numbers

METODOLOGIJA

Terminologija

Kasnoglacijalna litička industrija kasnogornjopaleolitičkih lovaca skupljača na istočnom Jadranu u stručnoj se literaturi označava različitim imenima, kao epipaleolitička (Malez 1979), tardigravetijenska (Malez 1974) ili epigravetijenska (Karavanić 1999), a ona postglacijalnih lovaca i sakupljača kao mezolitička bez preciznije kulturne atribucije, osim u slučaju kasnog mezolitika koji se označava kao kastelnovijen (Komšo 2008), lokalni kastelnovijen (Mihailović 2009) ili para-kastelnovijen (Kozłowski et al. 1994). Ovdje se koriste termini epigravetijen za kasnogornjopaleolitičku industriju i mezolitik za kamene industrije postglacijalnih lovaca skupljača, čime slijedimo primjer Miracle et al. (2000) koji su istaknuli da korištenje termina mezolitik u sjevernojadranskom kontekstu predstavlja prije svega kronološku odrednicu i ne implicira diskontinuitet s kasnim gornjim paleolitikom u regiji.

U tehnološkom i tipološkom dijelu litičke analize korišteni su termini prilagođeni hrvatskom jeziku koje je predložio I. Karavanić (1993; 1994; 1999; 2008), a koji su u najvećoj mjeri ušli u široku primjenu u hrvatskoj znanstvenoj literaturi.

Litička analiza

Litička analiza ovdje provedena uključuje nekoliko aspekata i to tehnološki, tipološki i sirovinski, koji će biti opisani u ovom poglavlju. Kombinacijom spomenutih aspekata litičke analize pokušat će se definirati prisutnost ili odsutnost različitih faza lanca operacija na nalazištu.

Detaljno su obrađeni kameni artefakti koji su veći od 15 mm te artefakti manji od 15 mm ako su retuširani, kao i oni komadi čiji je položaj u proizvodnom lancu vrlo jasno određen, npr. mikrodubila. Za razliku od artefakata koji su detaljno obrađeni i za koje su navedeni bilježeni atributi u nastavku ovog poglavlja, artefakti manji od 15 mm samo su prebrojeni i izvagani.

Kategorije tehnološke analize

Tehnološka analiza uključuje definiranje nekoliko grupa neretuširanih artefakata: lomljevinu, tehničke komade, jezgre i krhotine. Artefakti koji se nisu mogli svrstati jednoznačno ni u jednu od navedenih kategorija svrstani su u grupu neodredivo. Lomljevina označava skupinu artefakata kojoj pripisujemo odbojke, sječiva i pločice (Karavanić 1999: 31). Sve tri kategorije definirane su prema Inizan et al. (1999). Sječiva i pločice uvijek imaju dužinu bar dvaput veću od širine. Primarni kriterij za razlikovanje sječiva i pločica bio je širina, a kao granica je određena širina od 12 mm, po uzoru na Tixierovu klasifikaciju (Tixier 1974). U pločice su svrstani artefakti širine manje od 12 mm, a u sječiva oni sa širinom ≥ 12 mm. Ovakva podjela primjenjivana je često u širem regionalnom kontekstu (Adam 1989; Elefanti 2003). Pogledamo li dijagram dužina i širina sječiva (sl. 1) i pločica, vidjet ćemo da u slučaju Vlakna nije zamijećeno grupiranje artefakata na osnovi širine i zbog toga smo se držali Tixierove klasifikacije. Na dijagramu su prikazani samo cjeloviti neobrađeni primjerci sječiva i pločica s perastim distalnim završetkom, zbog toga što artefakti s izvrnutim i prebačenim završet-

(Miracle 1995: 171, 177).

Boschian and Fusco (2007) describe Late Glacial environment of the Adriatic Plain as a monotonous, flat and dry environment of shrubby-herbaceous communities. Uniformity of this environment is occasionally interrupted by swamp areas and small surfaces covered with trees of different pine species and some deciduous species which most probably appear near river flows which are subject to seasonal flooding.

METHODOLOGY

Terminology

The Late Glacial lithic industry of Late Upper Palaeolithic hunter-gatherers in the Eastern Adriatic is called different names in literature, such as Epipalaeolithic (Malez 1979), Tardigravettian (Malez 1974) or Epigravettian (Karavanić 1999), while the Postglacial hunter-gatherers' industry is called Mesolithic without precise cultural attribution, except in the case of Late Mesolithic which is labelled as Castelnovian (Komšo 2008), local Castelnovian (Mihailović 2009) or para-Castelnovian (Kozłowski et al. 1994). In this paper we use the terms Epigravettian for Late Upper Palaeolithic industry and Mesolithic for the lithic industry of Postglacial hunter-gatherers, in line with Miracle et al. (2000) who emphasised that using the term Mesolithic in the Northern Adriatic context presents primarily a chronological determinant and does not imply discontinuity with Late Upper Palaeolithic in the region.

In the technological and typological part of the lithic analysis we used the terms adapted to the Croatian language, as suggested by I. Karavanić (1993; 1994; 1999; 2008), which are generally widely used in Croatian scientific literature.

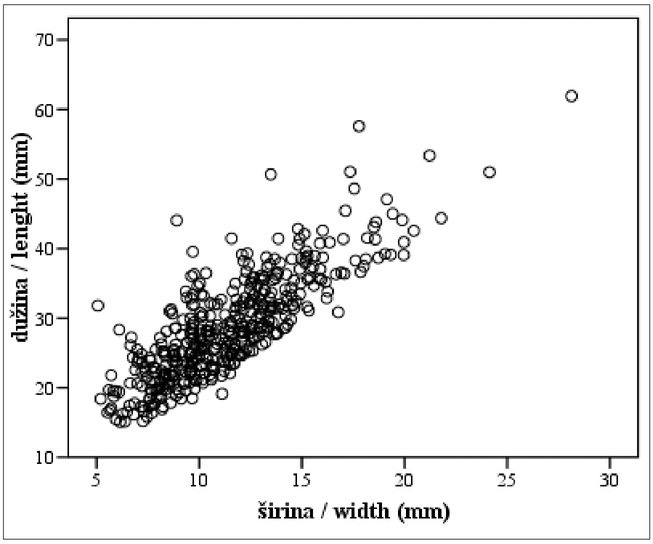
Lithic analysis

Lithic analysis in this paper includes different aspects, in particular technological and typological analyses and analysis of raw material, which will all be described in this section. A combination of the abovementioned aspects of lithic analysis will try to define the presence or absence of different phases of the *chaîne opératoire* at the site.

A detailed analysis was performed for lithic artefacts bigger than 15 mm and for artefacts smaller than 15 mm if retouched, as well as for those pieces whose position in the *chaîne opératoire* was very clear, such as microburin. Unlike the artefacts which were analysed in detail and whose attributes are presented in the remaining part of this section, the artefacts smaller than 15mm were just counted and weighed.

Categories of technological analysis

The technological analysis includes a definition of several groups of unretouched artefacts: debitage, technical pieces, cores and chunks. Artefacts which could clearly be classified within any of the mentioned categories were placed in the so called undetermined group. Debitage stands for a group of artefacts including flakes, blades and bladelets (Karavanić, 1999: 31). All three categories are defined according to Inizan et al. (1999). Blades and bladelets are always at least twice as long in length as they are in width. The primary criterion for differentiating blades and bladelets was width, and the limit value was 12 mm according to Tixier's classification (Tixier 1974). Bladelets include arte-



Sl. 1 Dijagram dužina i širina za cjelovita sječiva i pločice s perastim distalnim završetkom.

Fig. 1 Scatterplot of length and width for all complete blades and bladelets with feathered distal end.

kom ne predstavljaju željeni proizvod i pogreške su u proizvodnom procesu (Whittaker 1995). U kategoriju odbojaka, sječiva i pločica klasificirani su i fragmenti na kojima je bilo moguće jasno prepoznati ventralnu stranu artefakta, a kod sječiva i pločica paralelni rubovi bili su dodatni kriterij da se fragment svrsta u jednu od ove dvije kategorije.

Za svaku kategoriju u lomljevini određena je količina i vrsta okorine. Na osnovi prisutne količine okorine, sječiva, pločice i odbojci su podijeljeni u tri kategorije: 1) artefakti čija je dorzalna strana potpuno prekrivena okorinom, 2) artefakti čija je dorzalna strana djelomično prekrivena okorinom i 3) artefakti bez okorine. Lomljevina s okorinom podijeljena je prema tipu okorine u tri grupe: 1) s nodularnom okorinom, 2) s valutičnom okorinom i 3) s nodularno-valutičnom okorinom (tipovi okorine prema Perhoč, Altherr 2011: 19).

Kod cjelovite lomljevine i proksimalnih dijelova određen je tip plohka kao okorinski, glatki, diedrični, višeplošni, krilni, linijski, točkasti prema Inizan et al. (1999) i usnati prema Débenath, Dibble (1994).

Tehnički komadi uključuju dotjerujuće odbojke jezgre, okruške, krijestasta sječiva/pločice, krijestaste odbojke, ivere dubila i mikrodubila. Prve četiri kategorije vezane su uz dotjerivanje jezgri, a posljednje dvije kategorije predstavljaju komade koji su u proizvodnom lancu ostatak izrade oruđa.

Dotjerujući odbojci jezgre predstavljaju tehničke komade pomoću kojih je djelomično dotjerana i odstranjena udarna ploha (Inizan et al. 1999), ali i komade pomoću kojih je odstranjena strana jezgre, odnosno lice lomljenja (Brézillon 1983: 97). Okrušci predstavljaju tehničke komade pomoću kojih je odstranjena cjelokupna udarna ploha i na taj način stvorena nova za daljnje lomljenje (Brézillon 1983; Inizan et al. 1999).

Krijestasta sječiva/pločice i krijestasti odbojci klasificirani su prema Inizan et al. (1999). Oni predstavljaju komade

facts whose width is less than 12 mm, while blades are those which are ≥ 12 mm in width. This classification was often applied in a wider regional context (Adam 1989; Elefanti 2003). If we look at the diagram of lengths and widths of blades and bladelets (Fig. 1) we can observe that in the case of Vlakno there was no grouping of artefacts on the basis of width, and that is why we applied Tixier's classification. The diagram shows only complete unretouched blades and bladelets with a feathered distal end, because artefacts with hinged and plunging distal ends are not the intended product and are actually mistakes in the production process (Whittaker 1995). The category of flakes, blades and bladelets also included fragments on which it was possible to clearly recognise the ventral side of the artefacts, while in the case of blades and bladelets parallel edges were an additional criterion to classify a fragment within one of these two categories.

The amount and type of cortex was determined for each category in the debitage. According to the quantities of cortex found, blades, bladelets and flakes were divided into three categories: 1) artefacts whose dorsal side is entirely covered with cortex, 2) artefacts whose dorsal side is partially covered with cortex and 3) artefacts without cortex. Debitage with cortex was classified according to the type of cortex in three groups: 1) with nodular cortex, 2) with pebble cortex and 3) with nodular-pebble cortex (types of cortex according to Perhoč, Altherr 2011: 19).

Butt type was defined for complete specimens of debitage and proximal parts as cortical, plain, dihedral, facetted, winged, linear, punctiform according to Inizan et al. (1999) and lipped according to Débenath, Dibble (1994).

Technical pieces include core renewal flakes, core tablets, crested blades/bladelets, crested flakes, burin spalls and microburins. The first four categories are related to the core preparation and rejuvenation, while the last two categories are related to tool production.

Core renewal flakes are technical pieces with which striking platform was partially rejuvenated and removed (Inizan et al. 1999), but also pieces with which side of the core was removed, that is the flaking face (Brézillon 1983: 97). Core tablets are technical pieces that enable the removal of the entire striking platform and in this way create the new one for further flaking (Brézillon 1983; Inizan et al. 1999).

Crested blades/bladelets and crested flakes are classified according to Inizan et al. (1999). They represent the pieces which are related to core preparation for blade and bladelet production. Their flaking creates a negative which serves as the "template" for further production of blades or bladelets.

Burin spalls are created during the production of burins (Tixier 1974; Inizan et al. 1999), while microburins are the remains of blade segmenting in the microburin technique (Tixier 1974; Inizan et al. 1999).

Cores are pieces of raw material from which flakes, bladelets and blades were chipped (Inizan et al. 1999). This group includes all pieces of raw material which have at least one visible negative of removal. The cores were classified in koji su povezani s pripremom jezgre za lomljenje sječiva i pločica. Njihovim lomljenjem nastaje negativ koji je "vodič" za daljnju proizvodnju sječiva ili pločica.

Iveri dubila nastaju prilikom izrade dubila (Tixier 1974; Inizan et al. 1999), a mikrodubila su ostatak segmentiranja sječiva primjenom proizvodnog postupka mikrodubila (Tixier 1974; Inizan et al. 1999).

Jezgre su komadi sirovine od kojih su odlamani odbojci, pločice i sječiva (Inizan et al 1999). U ovu grupu svrstani su svi komadi sirovine na kojima je vidljiv barem jedan negativ lomljenja. Na osnovi tehnike lomljenja jezgre su podijeljene u sljedeće kategorije: jednoplatformne jezgre, dvoplatformne jezgre, višeplatformne jezgre, rotirajuće jezgre (one kod kojih su negativi i udarne plohe međusobno okomiti), bipolarne jezgre i jezgre-krhotine (amorfnog oblika sa samo jednim negativom lomljenja). Jezgre su podijeljene i na osnovi lomljevine koja se od njih proizvodila na jezgre za odbojke, jezgre za sječiva, jezgre za pločice i kombinirane jezgre (na njima su vidljivi podjednako česti tragovi odbojaka i sječiva/pločica). Prema tome kako su oblikovane, odnosno prema obliku u trenutku odbacivanja, jezgre su podijeljene u sljedeće kategorije: konične, prizmatične, pločaste, globularne, jezgre na odbojku, amorfne i klinaste. Za konične i prizmatične jezgre vidjeti Brézillon (1983). Pločaste jezgre, kao što im ime kaže, imaju pločastu formu koja vrlo vjerojatno nije bila zamišljeni i željeni oblik, nego je jednostavno uvjetovana početnim oblikom i alteracijom sirovine. Ovdje su izdvojene kao posebna kategorija iako bi mogle biti zapravo pribrojene i grupi amorfnih jezgara. Klinaste jezgre su one koje imaju usku udarnu plohu, širi presjek im je četvrtast, a uži trokutast ili trapezoidan s jakom suženom bazom. Dužina cjelovitih jezgri mjerena je kao najduža linearna dimenzija, a ovakvim načinom mjerenja pokušala se izbjeći nekonzistentnost u mjerenju (Andrefsky 2005), s obzirom na to da je u litičkom skupu nalaza velik dio jezgri amorfan, a zabilježene su i jezgre s više udarnih ploha.

Krhotine predstavljaju artefakte neodređenog oblika koji nemaju nikakva dijagnostička obilježja, a nastaju tijekom lomljenja (Karavanić 1999; Inizan et al. 1999).

Kategorije tipološke analize

U okvir tipološke analize ulaze svi komadi koji su obrađeni, odnosno oni na kojima je primijećen retuš. Tipološka analiza najvećim je dijelom utemeljena na tipologiji P.-Y. Demarsa i P. Laurenta za gornji paleolitik (Demars, Laurent 1992). U skladu sa spomenutom tipologijom definirani su sljedeći tipovi: noktoliko grebalo, kobilično grebalo (*grattoir caréné*), zakrivljeni šiljak s hrptom, pločica s hrptom, strugalo, zarubak, svrdlo, dubila (diedrično dubilo, dubilo na slomljenom sječivu i odbojku, transverzalno dubilo). Navedenim tipovima dodani su još sljedeći tipovi: kružno grebalo, grebalo na odbojku, dvostruko grebalo, grebalo na sječivu/pločici, komad s obradom, komad sa sitnom rubnom obradom, odbojak s hrptom, nazubak, udubak i kombinirana oruđa. Među oruđima je izdvojena i kategorija ulomci s obradom, koji zbog svoje fragmentiranosti nisu mogli biti pripisani nijednom od navedenih tipova. Iskrzani komadi su prema tipologiji P.-Y. Demarsa i P. Laurenta svrstani među

the following categories based on the flaking technology: single-platform cores, cores with two striking platforms, cores with more than two striking platforms, rotating cores (the ones where negatives and striking platforms are orthogonal), bipolar cores and cores-chunks (they are amorphous with only one negative of removal). Cores are also classified on the basis of the debitage produced from them, in particular: cores for flakes, cores for blades, cores for bladelets and mixed cores (they have equally often visible traces of flakes and blades/bladelets). Depending on their shape, i.e. on the shape at the moment of discarding, the cores were classified in the following categories: conical, prismatic, tabular, globular, cores on flakes, amorphous and wedge-like. For conical and prismatic cores see Brézillon (1983). Tabular cores, as suggested by their name, have a tabular form which was probably not the one intended and desired, but is simply the result of the initial form and alteration of the raw material block. Here they are singled out as a separate category, although they could be assigned to the group of amorphous cores. Wedge cores are the ones that have a narrow striking platform; their wider cross section is square-like, while the narrower one is triangular or trapezoidal with a very narrow base. The length of complete cores is measured as the longest linear dimension, because with this method of measurement we tried to avoid inconsistencies in measurement (Andrefsky 2005), particularly having in mind that a great portion of cores in the lithic assemblage was amorphous, and also, that there were some cores with several striking platforms.

Chunks are artefacts of undetermined shape which have no diagnostic features, and are generated during flaking (Karavanić 1999; Inizan et al. 1999).

Categories of typological analysis

Typological analysis includes all pieces which were retouched. Typological analysis is mainly based on the typology of P.-Y. Demars and P. Laurent for the Upper Palaeolithic (Demars, Laurent 1992). The following types were defined in accordance with the abovementioned typology: thumbnail endscraper, endscraper *carene,* arched backed point, backed bladelet, sidescraper, truncation, drill, burins (dihedral burin, burin on a broken blade and flake, transversal burin). The following types were added to the abovementioned ones: circular endscraper, endscraper on a flake, double endscraper, endscraper on a blade/bladelet, retouched piece, marginally retouched piece, backed flake, denticulate, notch and combined tools. There is a separate category among the tools – retouched fragments – which could not be attributed to any of the abovementioned categories due to their fragmentation. Splintered pieces are classified among tools according to typology by P.-Y. Demars and P. Laurent, but it seems they would better be categorized among the cores i.e. bipolar cores. M. Shott gave very convincing arguments for classifying splintered pieces into cores and not tools, by using ethnographic, experimental and contextual data (Shott 1989; 1999). However, Shott (1989: 1; 1999: 231) emphasises that human behaviour is complex and that it would be absurd to claim that all splintered pieoruđa, ali čini se da ih je bolje svrstati među jezgre, odnosno bipolarne jezgre. Vrlo uvjerljivu argumentaciju za svrstavanje iskrzanih komada u jezgre, a ne u oruđa, dao je M. Shott koristeći se etnografskim, eksperimentalnim i kontekstualnim podacima (Shott 1989; 1999). Međutim, Shott (1989: 1; 1999: 231) ističe da je ljudsko ponašanje kompleksno i da bi bilo apsurdno tvrditi da su svi iskrzani komadi rezultat istog ponašanja, odnosno različiti komadi mogli su biti rezultat više od jedne aktivnosti. Bez obzira kako ih se klasificiralo, iskrzani komadi svjedoče o primjeni bipolarne tehnologije. U litičkim industrijama koje su više ili manje bliske ovima iz Vlakna iskrzani komadi tumače se kao jezgre (*e.g.* Whallon 1999; Bietti, Cancellieri 2007) ili kao oruđa (Montet-White 1990).

Prilikom tipološke analize za pločice s hrptom su zabilježeni i podaci o tome jesu li jedan ili oba ruba strmo retuširani, kao i oblik distalnog kraja (zašiljen ili tup) kod cjelovitih i onih kod kojih je sačuvan distalni dio artefakta.

Funkcionalna tipologija nalazišta

U pokušaju interpretacije funkcije nalazišta korišteni su omjeri: jezgre : transformacijska oruđa i projektili : transformacijska oruđa, a koji mogu biti dobar pokazatelj je li riječ o radioničkim ili stambenim lokalitetima, ili u slučaju drugog omjera je li riječ o stambenim ili specijaliziranim logističkim lokalitetima (Zilhão 1997). Zilhão (1997) je analizirajući gravetijenska i magdalenijenska nalazišta portugalske Estremadure istaknuo da je opći stambeni karakter nalazišta određen omjerom manjim od 2 između jezgri i transformacijskih oruđa, i omjerom manjim od 1 između projektila i transformacijskih oruđa. Oruđa koja su svrstana u grupu projektila uključuju pločice s hrptom, zakrivljene šiljke s hrptom i geometrijske mikrolite. Oruđa za različite transformacijske aktivnosti uključuju grebala, sječiva s hrptom, odbojke s hrptom, zarupke, strugala, svrdla, dubila, komade sa sitnom rubnom obradom, komade s obradom, nazubke, udupke i kombinirana oruđa. Važno je napomenuti da artefakti koji su ovdje svrstani u grupu projektila nisu uvijek korišteni kao projektili, što pokazuje funkcionalna analiza 120 mikrolita s nalazišta Gleann Mor (Finlayson, Mithen 1997) i zbog toga interpretiranje funkcije nalazišta na osnovi prisutnosti određenih tipova oruđa i njihovih omjera ne može biti potpuno pouzdano. Međutim, u nedostatku funkcionalnih analiza ovakav pristup predstavlja prihvatljivu alternativu.

Lanac operacija

Lanac operacija usmjeren je na opis i razumijevanje svih kulturnih transformacija kroz koje određena sirovina prolazi. To je kronološko raščlanjivanje aktivnosti i mentalnih procesa potrebnih za proizvodnju artefakta i njegovo održavanje u tehnološkom sustavu prapovijesne grupe (Sellet 1993: 106). Prema Selletu (1993: 107), analiza lanca operacija obuhvaća tri razine, od kojih će ovdje biti obuhvaćena samo najniža razina u koju su uključeni sami artefakti.

Za analizu lanca operacija svi artefakti razvrstani su prema tipu sirovine (vidjeti sljedeće poglavlje) kako bi se dobila slika proizvodnih faza za svaku sirovinu. Unutar svake grupe sirovine artefakti su podijeljeni u morfotehnološke grupe koje predstavljaju različite kronološke faze u proizvodnji.

ces are the result of the very same behaviour, meaning that different pieces could be a result of more than one activity. Regardless of how they are classified, splintered pieces are proof of bipolar technology use. In lithic industries which are more or less close to these ones from Vlakno, splintered pieces are interpreted as cores (e.g. Whallon 1999; Bietti, Cancellieri 2007) or as tools (Montet-White 1990).

When performing the typological analysis of backed bladelets, we recorded whether only one or both of the edges are backed, as well as the shape of the distal end (if it is pointed or blunt) for complete pieces and for those artefacts with a preserved distal part.

Functional typology of the site

When attempting to interpret the function of the site, we used the ratios of cores : transformation tools and projectiles: transformation tools, which can be a good indicator if these were workshops or residential bases or, in the case of the second ratio, if it is a residential base or a specialised logistic base (Zilhão 1997). Zilhão (1997) analysed Gravettian and Magdalenian sites of Portuguese Extremadura and concluded that the general residential character of the site was defined by a ratio of less than 2 between cores and transformation tools, and a ratio of less than 1 between the projectiles and transformation tools. The tools which were classified in the projectile category include backed bladelets, arched backed points and geometric microliths. Tools for different transformation activities include endscrapers, backed blades, backed flakes, truncations, sidescrapers, drills, burins, marginally retouched pieces, retouched pieces, denticulates, notches and combined tools. It is important to emphasise that the artefacts which are grouped in the projectile category were not always used as projectiles, as is shown by the functional analysis of 120 microliths from the Gleann Mor site (Finlayson, Mithen 1997), therefore interpretation of the function of the site just on the basis of the presence of certain types of tools and their ratios cannot be fully reliable. However, when there are no functional analyses this approach is an acceptable alternative.

Chaîne opératoire

Chaîne opératoire focuses on describing and understanding all cultural transformations that a certain raw material goes through. It is a chronological analysis of activities and mental processes needed for the production of artefacts and their maintenance in the technological system of a prehistoric group (Sellet 1993: 106). According to Sellet (1993: 107) an analysis of c*haîne opératoire* encompasses three levels, of which only the lowest level will be included here, involving the artefacts themselves.

All artefacts were categorised according to the type of raw material (please see next section) for the purpose of analysing c*haîne opératoire* in order to get an idea of the production phases for each category of raw material. The artefacts were divided within each group into morphotechnological groups that represent different chronological production phases. We were mainly using the technological list produced by I. Karavanić (2004: 82) for Mujina Cave, Pritom smo se uglavnom vodili tehnološkom listom koju je I. Karavanić (2004: 82), po uzoru na J.-M. Genestea, izradio za Mujinu pećinu, s određenim modifikacijama. Prisutnost nodula ili oblutaka označavao bi nultu fazu proizvodnje, odnosno nabavu sirovine. Odbojci, sječiva i pločice potpuno prekriveni okorinom označavali bi sljedeću fazu proizvodnje. Sljedeći kronološki korak u proizvodnji činili bi odbojci, sječiva i pločice koji su djelomično prekriveni okorinom. Odbojci, sječiva i pločice bez okorine, jezgre, dotjerujući odbojci jezgre, okrušci, iveri dubila, krijestasta sječiva/pločice, krijestasti odbojci i mikrodubila činili bi središnju fazu proizvodnje. Krhotine i neodredivi komadi mogli su pripadati bilo kojoj fazi proizvodnje. Odbacivanje oruđa bi predstavljalo završnu fazu cjelokupnog procesa.

Sirovina

Rad na klasifikaciji sirovine iz Vlakna temeljen je na terenskim i laboratorijskim istraživanjima jednog od autora (Z. Perhoč) (Perhoč 2009a; 2009b; Vukosavljević et al. 2011), kao i na referentnom materijalu iz Litoteke Perhoč. Sirovinski tipovi koje je Z. Perhoč izdvojio za Vlakno poslužili su nam kao predložak za cjelokupnu makroskopsku klasifikaciju litičkih skupova nalaza s ovog nalazišta. Na osnovi mikroskopskog ispitivanja ograničenog broja izbrusaka i nabrusaka uzoraka pojedinih sirovinskih tipova Z. Perhoč je litičke artefakte grupirao u nekoliko većih skupina, što mi u ovom radu slijedimo. Za svaku sirovinu bit će navedena boja prema Rock-Color Chart (1995). Za sve artefakte veće od 15 mm određen je tip sirovine. Ovdje navedene kategorije sirovine te provenijencija i kvantitativni podaci vezani uz svaku sirovinu, preliminarni su rezultati rada koji je u tijeku i koji će po završetku biti detaljno objavljeni.

Na osnovi terenskog istraživanja jednog od autora (Z. Perhoč) koji je zabilježio i obradio brojne izdanke rožnjaka u Dalmaciji pokušali smo grupirati potencijalno iskoristive izvore sirovina na osnovi udaljenosti od nalazišta, gdje je to bilo moguće, u tri grupe: 0–20 km, 20–50 km i više od 50 km, te na osnovi toga dobiti okvirnu sliku o ekonomiji nabave sirovine.

Za svaku grupu sirovine doneseni su podaci o njezinoj težinskoj i brojčanoj učestalosti u različitim fazama po nalazištima.

U litičkom skupu nalaza iz Vlakna izdvojene su sljedeće sirovinske skupine: radiolariti, rožnjaci iz eocenskih foraminiferskih vapnenaca (foraminiferski rožnjaci), rožnjaci iz gornjokrednih vapnenaca s planktonskim foraminiferama, rožnjaci iz vapnenaca tipa *Scaglia Rossa* te devitrificirani tufovi i silicificirani glinjaci trijasa. Artefakti s tragovima žarenja svrstani su u kategoriju žareno, a oni artefakti koji se prema svojim makroskopskim obilježjima nisu mogli svrstati ni u jednu kategoriju, pripisani su kategoriji razno.

Radiolariti. Unutar ove skupine sirovine prisutno je nekoliko varijeteta definiranih prema boji: crvenosmeđi (5R 2/2, 10R 3/4, 5YR 3/2), crnocrveni (5R 2/2), zelenkastocrni (5GY 2/1, 5GY 4/1) i tamnozeleni (5G 3/2). Svi varijeteti su svjetlonepropusni i imaju voštani sjaj. S obzirom na male dimenzije artefakata od radiolarita, nije moguća analiza ko-

on the basis of J.-M. Geneste's model with certain modifications. The presence of nodules or pebbles would mark the initial production i.e., the raw material procurement. Flakes, blades and bladelets entirely covered with cortex would signify the next production phase. The next chronological step in production would be flakes, blades and bladelets partially covered with cortex. Flakes, blades and bladelets without cortex, cores, core renewal flakes, core tablets, burin spalls, crested blades/bladelets, crested flakes and microburins, would be the central production phase. Chunks and undetermined pieces could belong to any production phase. The discarding of tools would be the final phase of the entire process.

Raw material

The classification of raw material from Vlakno is based on the field and laboratory research of one of the authors (Z. Perhoč) (Perhoč 2009a; 2009b; Vukosavljević et al. 2011), as well as on the reference material from the Perhoč Lithotec. Raw material types that Z. Perhoč has selected for Vlakno have served us as a template for an entire macroscopic classification of the lithic assemblage from this site. Based on the microscopic research of a limited number of thin sections and polished sections of samples of individual raw material types, Z. Perhoč has grouped lithic artefacts in several larger groups, which we apply in this paper as well. The colour is given for each raw material according to the Rock-Color Chart (1995). Raw material type was determined for all artefacts greater than 15 mm. The categories of raw material listed here and their provenance and the related quantitative data are the preliminary results of work in progress which will be published in detail upon completion.

Using the field research data of one of the authors (Z. Perhoč) who recorded and analysed numerous chert outcrops in Dalmatia, we tried to group potentially usable sources of raw material on the basis of their distance from the site, wherever it was possible, in three groups: 0–20 km, 20–50 km and more than 50 km, in order to get a general idea about the raw material economy.

Data on weight and frequency is given for each group of raw material for each phase.

The following raw material groups were found in the Vlakno lithic assemblage: radiolarites, cherts from Eocene foraminifera limestone (foraminifera cherts), cherts from Upper Cretaceous limestone with planktonic foraminifera, cherts from *Scaglia Rossa* limestone, and devitrified tuffs and Triassic silicified claystone. Artefacts with traces of heating were placed in the burnt category, while the artefacts that according to their macroscopic features could not be allocated to any of the categories, were assigned to the diverse category.

Radiolarites. There are several colour varieties present in this group of raw material: reddish brown (5R 2/2, 10R 3/4, 5YR 3/2), blackish red (5R 2/2), greenish black (5GY 2/1, 5GY 4/1) and dark green (5G 3/2). All these varieties are opaque and have a waxy gloss. Given the small dimensions of the jom bi se utvrdila njihova geološka starost (Špela Goričan usmeno priopćenje 2013).

Foraminiferski rožnjaci. Ovu skupinu čine rožnjaci razvijeni u eocenskim foraminiferskim vapnencima koje karakteriziraju bentoske foraminifere i to miliolide, alveoline i numuliti. Prema boji se mogu izdvojiti dva varijeteta: žućkastosmeđi (10YR 4/2, 10YR 6/2) i sivosmeđi (5Y 4/1). Sirovinu karakterizira svjetlonepropusnost i voštani sjaj, uz prisutnost primjeraka koji imaju porculanski sjaj i svjetlopropusni su, ali neprozirni. U tablicama su označeni kraticom "rožnjaci EVF".

Rožnjaci iz gornjokrednih vapnenaca s planktonskim foraminiferama. Izdvojeno je više bojenih varijeteta: žućkastosmeđi (10YR 6/2, 10YR 4/2), maslinastosivozeleni (5Y 6/1, 5Y 4/1), sivi (N9–N4), crni (N1–N4), smećkastosivi (5YR 5/2 – 5YR 7/2). Sve varijetete karakterizira prisutnost planktonskih foraminifera. Među žućkastosmeđim varijetetom zabilježeni su svjetlonepropusni, kao i svjetlopropusni primjerci voštanog i staklastog sjaja. Maslinastosivozeleni varijetet karakterizira svjetlopropusnost, ali i svjetlonepropusnost i voštani sjaj. Sivi varijeteti su svjetlonepropusni, mat i voštanog sjaja. Crni varijeteti su svjetlonepropusni i mat. Smećkastosivi varijetet je svjetlopropustan i ima voštani sjaj. U tablicama su označeni kraticom "rožnjaci GKVPF".

Rožnjaci iz vapnenaca tipa *Scaglia Rossa*. Rožnjaci iz ove skupine su svjetlonepropusni i voštanog sjaja. Moguće je izdvojiti varijetete sivih, crvenih i smeđih nijansi koji bi prema Rock Color Chart imali sljedeće oznake: varijetet s oznakama 5Y 7/2 i 5R 4/6, varijetet 5Y 5/2 i 10R 4/2, varijetet 5YR 4/4 i N3, varijetet 10YR 4/2, 10YR 5/4 i 10YR 6/6. U tablicama su označeni kraticom "rožnjaci SRV".

Devitrificirani tufovi i silicificirani glinjaci. Riječ je o vulkanskim, pelitnim klastičnim stijenama koje su silicificirane u procesu alteracije. Makroskopski ih je teško pojedinačno odrediti pa ovdje predstavljaju skupinu rožnjaka *sensu lato*. Skupina se ipak makroskopski i mikrofacijelno jasno razlikuje od ostalih ovdje navedenih skupina. Među njima je zabilježeno nekoliko bojenih varijeteta: zelenkastosivi s brojnim nijansama (5GY 4/1, 5GY 6/1, 5G 3/2, N4, 10G 4/2, 10 GY 5/2), tamnocrvenosmeđi (10R 2/2) i zeleni (5G 3/2). To su svjetlonepropusne silicijske stijene voštanog sjaja, a među zelenkastosivima su zabilježeni i primjerci koji su svjetlopropusne silicijske stijene kao i oni koji imaju porculanski sjaj. U tablicama su označeni kraticom "DVT, SG".

POVIJEST ISTRAŽIVANJA, OPIS NALAZIŠTA, STRATIGRAFIJA, KRONOLOGIJA I METODOLOGIJA ISKOPAVANJA

Povijest istraživanja

Pećina Vlakno otkrivena je 2003. godine. Prva iskopavanja koja su bila probnog karaktera provedena su 2004. godine pod vodstvom Z. Brusića na površini od približno 1 m^2. Nastavak istraživanja proveden je također pod vodstvom Z. Brusića 2007. godine kada je proširena postojeća sonda za približno 3 m^2. U ove dvije kampanje iskopana je površina

radiolarite artefacts, it was not possible to perform an analysis which would determine their geological age (Špela Goričan, personal communication 2013).

Foraminifera cherts. This group is composed of cherts which developed in the Eocene foraminifera limestone, characterised by benthic foraminifera, in particular miliolida, *alveolina* and nummulites. There are two colour varieties: yellowish brown (10YR 4/2, 10YR 6/2) and greyish brown (5Y 4/1). The raw material is opaque and has a waxy gloss, however there are specimens that have a porcelain shine and are translucent but are not see-through. They are labelled in the tables as Cherts ELF.

Chert from Upper Cretaceous limestone with planktonic foraminifera. There are several colour varieties: yellowish brown (10YR 6/2, 10YR 4/2), olive greyish green (5Y 6/1, 5Y 4/1), grey (N9-N4), black (N1-N4), brownish grey (5YR 5/2 – 5YR 7/2). All varieties are characterised by the presence of planktonic foraminifera. Among the yellowish brown variety there are opaque as well as translucent specimens of waxy and glassy gloss. The olive greyish green variety is translucent, but also opaque and waxy gloss. Grey varieties are opaque, mat and with a waxy gloss. Black varieties are opaque and mat. The brownish grey variety is translucent and has a waxy gloss. They are labelled in the tables as Cherts UCLPF.

Scaglia Rossa cherts. Cherts from this group are opaque and have a waxy gloss. It is possible to single out varieties of grey, red and brown shades with the following labels according to the Rock Color Chart: variety with labels 5Y 7/2 and 5R 4/6, variety 5Y 5/2 and 10R 4/2, variety 5YR 4/4 and N3, variety 10YR 4/2, 10YR 5/4 and 10YR 6/6. They are labelled in the tables as Cherts SRL.

Devitrified tuffs and silicified claystone. These are volcanic, oolitic clastic rocks which were silicified in the process of alteration. They are difficult to determine macroscopically, therefore here they represent the group of *sensu lato* cherts. However, the group is macroscopically and microfacially different than the other groups listed here. There are several colour varieties: greenish grey with numerous shades (5GY 4/1, 5GY 6/1, 5G 3/2, N4, 10G 4/2, 10 GY 5/2), dark red brown (10R 2/2) and green (5G 3/2). These are opaque siliceous rocks of waxy gloss, and among the greenish grey ones specimens were also found which are translucent siliceous rocks, as well as those with a porcelain glow. They are labelled in the tables as DVT, SCS.

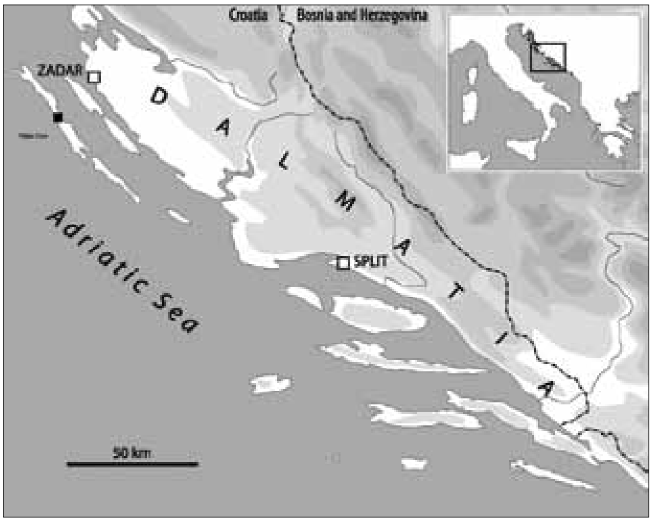
HISTORY OF EXCAVATIONS, DESCRIPTION OF THE SITE, STRATIGRAPHY, CHRONOLOGY AND METHODOLOGY OF EXCAVATIONS

History of excavations

Vlakno Cave was discovered in 2003. The initial excavations were test excavations in 2004 headed by Z. Brusić on a surface of approximately 1 m^2. The excavations continued, also under the leadership of Z. Brusić, in 2007 when the existing trench was extended for approximately 3 m^2. During these two field seasons, approximately 5 m^2 were excavaod približno 5 m^2 do dubine od oko 200 cm od pećinske površine. Od 2010. godine provode se sustavna istraživanja pod vodstvom D. Vujevića i M. Parice kojima je cilj utvrđivanje kompletne stratigrafije nalazišta (Brusić 2005; 2008; Vujević, Parica 2011).

Opis nalazišta

Pećina Vlakno smještena je približno na sredini Dugoga otoka na njegovoj sjeveroistočnoj strani. Pećina se nalazi na najužem dijelu otoka, između Luke i Savra, a nasuprot sjeverozapadne obale otoka Rave (sl. 2 i sl. 3). Danas je udaljena stotinjak metara od obale na nadmorskoj visini od 30 m. Ulaz je orijentiran prema jugu/jugozapadu (Brusić 2005; Vujević, Parica 2011). Široki pećinski ulaz pregrađen je recentnim suhozidom u kojem je ostavljen otvor za ulaz u pećinu. Ispred pećine su također vidljivi ostaci suhozida koji predpećinskom prostoru daju pravokutni tlocrt (Brusić 2005; Vujević, Parica 2011). Površina pećine iznosi oko 30 m^2 (Brusić 2005) (sl. 4). Na osnovi toponima Šipnatica koji nosi uvala ispod pećine, Z. Brusić (2005) pretpostavlja postojanje slatkovodnog izvora u vrijeme niže morske razine u blizini pećine. Ovaj je toponim prema Z. Brusiću često vezan uz izvore vode.



Sl. 2 Karta s položajem pećine Vlakno (autor karte: S. Forenbaher).

Fig. 2 Map showing the position of Vlakno Cave (Map by S. Forenbaher).

Stratigrafija, kronologija i metodologija iskopavanja

Prema radiokarbonskim datumima iz dosadašnjih istraživanja (iz iskopavanja 2004. i 2010. godine) (tab. 1), ostaci ljudskog boravka u Vlaknu mogu se pripisati kasnom gornjem paleolitiku i mezolitiku, odnosno vremenu kasnog glacijala i postglacijala. Z. Brusić (2008: 402) navodi da je tijekom iskopavanja 2007. godine na dubini od oko 200 cm od površine zabilježen sloj napuljskoga žutog tufa (NYT) koji predstavlja dodatni kronološki oslonac za datiranje stratigrafskog slijeda koji se obrađuje u ovom radu (sl. 5). Radiokarbonski datum koji potječe ispod sloja tefre u Vlaknu

ted up to the depth of 200 cm from the cave surface. Since 2010, systematic excavations are being undertaken by D. Vujević and M. Parica with the objective of determining the complete stratigraphy of the site (Brusić 2005; 2008; Vujević, Parica 2011).

Description of the site

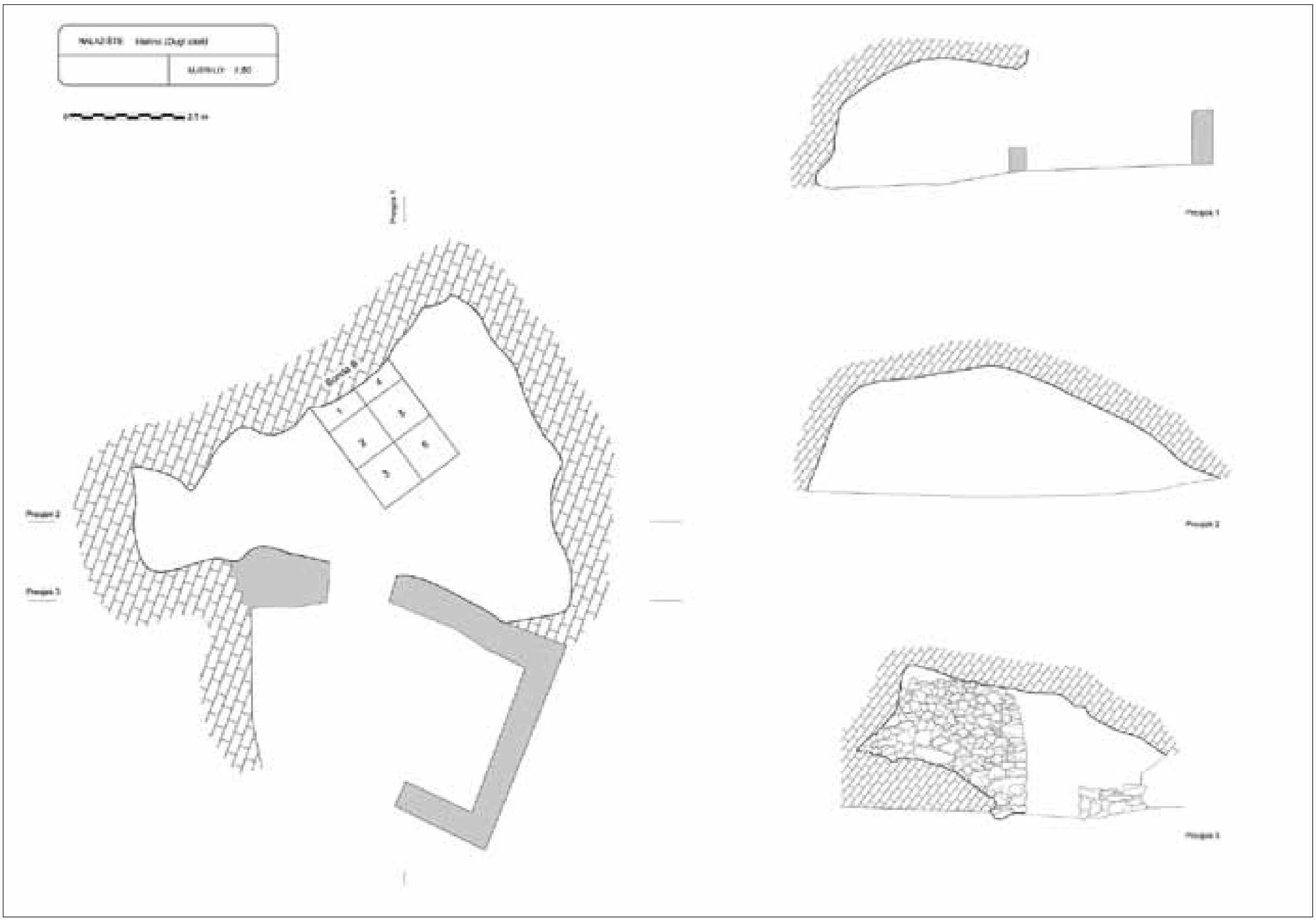
Vlakno Cave is located approximately at the centre of Dugi otok, on its northeastern side. The cave is located on the narrowest part of the island, between Luka and Savar, and opposite to the northwestern coast of Rava Island (Fig. 2 and Fig. 3). Today it is approximately a hundred metres from the sea, at 30 m above sea level. The entrance into the cave is oriented towards the South/Southwest (Brusić 2005; Vujević, Parica 2011). The wide cave entrance is covered with a recent dry wall containing an opening for the entrance into the cave. In front of the cave there are also visible remains of the dry wall that give a rectangular shape to this area (Brusić 2005; Vujević, Parica 2011). The cave surface amounts to approximately 30 m^2 (Brusić 2005) (Fig. 4). Z. Brusić (2005) assumes, based on the toponym *Šipnatica* of the cove below the cave, that there was a freshwater well at the time of the lower sea level near the cave. This toponym according to Z. Brusić is often connected with water wells.

Sl. 3 Pogled sa sjeverozapada, s otočnog hrpta, na položaj pećine (označen bijelim kvadratom), uvalu Šipnaticu, otok Ravu. U zaleđu Rave je otok Iž, iza njega Ugljan, a na horizontu sasvim lijevo vidljiv je Velebit (snimio: N. Vukosavljević).

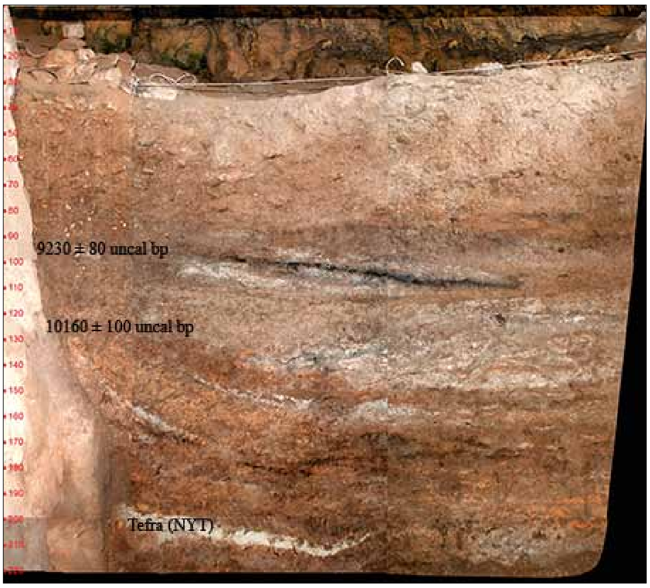
Fig. 3 View from the northwest, from the island ridge, towards Vlakno Cave (position marked with white square), Šipnatica cove, island of Rava. Behind island of Rava there is island of Iž, and further behind island of Ugljan. The Velebit mountain is visible in the far left on the horizon (photographed by N. Vukosavljević).

Stratigraphy, chronology and methodology of excavations

According to radiocarbon dates from the research undertaken so far (from excavations in 2004 and in 2010) (Tab. 1) the remains of human settlement in Vlakno can be attributed to the Late Upper Palaeolithic and the Mesolithic, that is to the time of Late Glacial and Postglacial. Z. Brusić (2008: 402) states that during the excavations in 2007, at the depth of approximately 200 cm from the surface there was a layer of Neapolitan *Yellow Tuff* (NYT) which provides additional chronological confirmation for dating the stratigraphic sequence discussed in this paper (Fig. 5). The radiocarbon



Sl. 4 Tlocrt i presjeci pećine Vlakno (prema Vujević, Parica 2011: 25, sl. 1).
Fig. 4 Plan and cross-sections of Vlakno Cave (after Vujević, Parica 2011: 25, Fig. 1).



Sl. 5 Sjeverni profil sonde istražene 2004. i 2007. godine (prema Brusić 2008: 401, doradio: N. Vukosavljević).
Fig. 5 North profile of the trench excavated in 2004 and 2007 (after Brusić 2008: 401, modified by N.Vukosavljević).

(Beta-277309) (Vujević, Parica 2011) u popriličnom je skladu sa starošću vulkanske erupcije koja je dovela do taloženja napuljskoga žutog tufa (Radić et al. 2008).

date originating from under the tephra layer in Vlakno (Beta-277309) (Vujević, Parica 2011) is quite in line with the age of the volcanic eruption that caused the sedimentation of the Neapolitan *Yellow Tuff* (Radić et al. 2008).

This paper discusses the lithic assemblages found during the excavations in 2004 and 2007. During 2004, ten by ten centimetres thick spits were excavated and the excavated sediment dry sieved (4 mm mesh). The depth of one metre was reached at that time on the 1 m^2 surface (Brusić 2005: 198). The same author mentions in the excavation report from 2007 that during 2004 the depth reached was 150 cm (Brusić 2008: 400). According to field work documents from 2007, during the 2004 excavations, the depth reached along the North profile was between 115 and 120 cm, while in the middle of the quadrant the depth was somewhat greater. Given the fact that 10 cm layers were dug out it can be assumed that they were excavated arbitrarily. Ten layers were dug out during the test excavations in 2004, on average 10 cm thick, or maybe a little bit more. Layer 7 from the 2004 excavations has a radiocarbon date of 9230 ± 80 uncal BP, while layer 10, which is also the deepest layer dug out during that field season, has the radiocarbon date of 10 160 ± 100 uncal BP (Komšo 2008). Stratigraphic changes were observed during the excavations of 2007. All the sediment was dry sieved (3 mm mesh). We grouped 15 excavated and

U ovom radu obrađeni su litički skupovi nalaza koji su otkriveni tijekom iskopavanja 2004. i 2007. godine. Tijekom 2004. iskopavalo se sistemom otkopa po deset centimetara, a sediment je prosijavan kroz sito promjera 4 mm. Tom prilikom dosegnuta je dubina od 1 m na površini od 1 m^2 (Brusić 2005: 198). Isti autor u izvještaju o iskopavanju 2007. godine navodi da je tijekom 2004. dosegnuta dubina od 150 cm (Brusić 2008: 400). Prema terenskoj dokumentaciji iz 2007. godine tijekom iskopavanja 2004. dosegnuta dubina uz sjeverni profil iznosi između 115 i 120 cm, a u sredini kvadranta je i nešto veća. Budući da su se otkopavali slojevi po 10 cm, može se pretpostaviti arbitrarno odvajanje slojeva. Tijekom probnog iskopavanja 2004. godine iskopano je deset slojeva prosječne debljine desetak cm, ili možda malo više. Sloj 7 iz iskopavanja 2004. godine radiokarbonski je datiran i dobivena je starost od 9230 ± 80 uncal BP, a sloju 10, koji predstavlja i najdublji sloj koji je iskopan u toj kampanji, radiokarbonskim datiranjem određena je starost od 10 160 ± 100 uncal BP (Komšo 2008). Tijekom iskopavanja 2007. godine iskopavalo se prateći stratigrafske promjene. Cjelokupni sediment prosijan je kroz sito promjera 3 mm. Na osnovi terenske dokumentacije, 15 iskopanih i dokumentiranih slojeva grupirali smo u šest horizonata. Najmlađi horizont obuhvaćao bi slojeve 1, 2, 3 i 4, nakon kojih slijedi prva stratigrafska promjena. U sloju 4 zabilježeno je oko 800 ljuštura kopnenih puževa koji se mogu preliminarno odrediti kao *Helix* sp. U sloju 1 zabilježeno je vatrište u jugozapadnom dijelu sonde. Sloj 1 opisan je kao rahli sloj sivosmeđe boje u kojem se mjestimično pojavljuje kamenje promjera petnaestak centimetara, kao i korijenje i nekoliko nakupina humusa. Za sloj 2 navedeno je da je nešto svjetliji od sloja 1.

Sljedeći horizont obuhvaća slojeve 5 i 6, u kojima su također pronađene brojne ljušture kopnenih puževa *Helix* sp. U sloju 5 pronađeno je oko 800 komada, a u sloju 6 oko 400 komada. Sloj 5 opisan je kao sloj sive zemlje i gara. Budući da u opisu sloja 6 nije naznačena stratigrafska razlika u odnosu na sloj 5, ova su dva sloja spojena u jedan horizont.

Sloj 7 predstavljao bi naredni horizont, a on se prema terenskoj dokumentaciji razlikuje od sloja iznad i sloja ispod. U ovom sloju također su otkrivene ljušture kopnenih puževa (oko 200 komada), ali u manjoj mjeri nego u superpozicioniranim slojevima.

Sloj 8 subpozicioniran je sloju 7 i prema terenskoj dokumentaciji razlikuje se od sloja 7, kao i od starijih slojeva te je izdvojen kao zaseban horizont. U sloju 8 nisu zabilježene ljušture kopnenih puževa.

Slojevi 9, 10 i 11 grupirani su u sljedeći horizont. Sva tri sloja opisana su kao zapečena svijetla zemlja s pepelom uz prisutnost crvenkaste zapečene zemlje. U sloju 9 zabilježeno je vatrište kao i ostaci stotinjak ljuštura kopnenih puževa. Za ostale slojeve ove faze nije navedena prisutnost puževa. U sloju 10 zabilježena su dva vatrišta u neposrednoj blizini koja su mogla zajedno s navedenim vatrištem iz sloja 9 predstavljati ostatke jedinstvenog vatrišta. Ovo opažanje nije zabilježeno u terenskoj dokumentaciji i predstavlja našu pretpostavku temeljenu na prostornoj bliskosti i maloj dubinskoj razlici navedenih vatrišta.

Slojevi 12, 13, 14 i 15 grupirani su zajedno i čine najra-

documented layers on the basis of field work documents, into 6 horizons. The youngest horizon encompasses layers 1, 2, 3 and 4, after which there is the first stratigraphic change. In layer 4 there are approximately 800 land snail shells that can provisionally be defined as *Helix* sp. Layer 1 is described as a loose layer of a grey-brown colour, in which there are occasional stones 15 cm in diameter, as well as roots and several piles of humus. Layer 2 has a somewhat lighter colour than layer 2.

The next horizon encompasses layers 5 and 6 in which also numerous *Helix* sp. snail shells were found. In layer 5 there were approximately 800 specimens, while in layer 6 there were approximately 400 specimens. Layer 5 is described as a layer of grey soil and soot. Since the stratigraphic difference from layer 5 was not mentioned in the description of layer 6, these two layers were merged into one horizon.

Layer 7 would represent the following horizon which according to field work documents is different than the layer above and layer below. Land snail shells were also found in this layer (approximately 200 specimens), but in smaller numbers than was the case in the superpositioned layers.

Layer 8 is sub-positioned to layer 7, and according to field work documents it is different than layer 7 as well as different from the older layers, and was therefore singled out as a separate horizon. There were no land snail shells found in layer 8.

Layers 9, 10 and 11 were grouped in the next horizon. All three layers were described as burnt light coloured soil with ashes and reddish burnt soil. A fireplace was found in layer 9, as well as the remains of approximately 100 land snail shells. The presence of snails was not mentioned for the other layers of this phase. In layer 10 there were two fireplaces in the immediate vicinity, which together with the mentioned fireplace from layer 9 could actually be the remains of one single fireplace. This observation was not noted in the field work documents, and therefore is only our assumption based on the vicinity and the small difference in the depth of the mentioned fireplaces.

Layers 12, 13, 14 and 15 are grouped together and form the oldest horizon from Vlakno which is discussed in this paper. Layer 12 is described as a layer of dark soil with ashes and pieces of charcoal. According to the plan there was one fireplace in this layer. Layer 13 has a zone of red sediment in the southern part of the trench, which also could be traced in layer 14. According to field work documents "a thin layer of white dusty substance resembling clay" was found in layer 14 in the northwestern part of the trench, which represents the layer of volcanic ashes that Z. Brusić, based on information from B. Lugović, attributes to Neapolitan Yellow Tuff (Brusić 2008: 402). Layer 15 is the last excavated layer during the campaign of 2007.

Using the depths of the excavated layers along the northern profile from the field work documents from 2007 and the information that during the 2004 excavations 10 cm thick layers where dug out, we tried to perform a correlati-

Lab. br. / Lab. No.	uncal BP	cal BP 2σ	Sloj / Layer	Literatura / Reference
Z-3382	9230 ± 80	10590 - 10230	7	Komšo 2008
Z-3383	10160 ± 100	12370 - 11320	10	Brusić 2005; Komšo 2008
Beta-277309	12350 ± 70	14790 - 14080	? (ispod tefre)	Vujević Parica 2011

Tab. 1 Radiokarbonski datumi iz Vlakna.
Tab. 1 Radiocarbon dates from Vlakno Cave.

niji horizont iz Vlakna koji je obrađen u ovom radu. Sloj 12 opisan je kao sloj tamne zemlje s pepelom i komadićima ugljena. Prema tlocrtu u ovom je sloju zabilježeno jedno vatrište. U sloju 13 zabilježena je i zona crvenog sedimenta u južnom dijelu sonde, koja se mogla pratiti i u sloju 14. U sloju 14, u sjeverozapadnom dijelu sonde, prema terenskoj dokumentaciji, pronađen je "tanki sloj bijele praškaste mase koji nalikuje glini", a koji predstavlja sloj vulkanskog pepela koji Z. Brusić, na osnovi podataka B. Lugovića, pripisuje napuljskom žutom tufu (Brusić 2008: 402). Sloj 15 posljednji je iskopani sloj u kampanji 2007. godine.

Koristeći se dubinama istraženih slojeva uz sjeverni profil iz terenske dokumentacije 2007. godine, te podatkom da su tijekom iskopavanja 2004. godine iskopavani slojevi u debljini od po 10 cm, pokušali smo napraviti korelaciju slojeva iz ove dvije kampanje, kako bi istražene slojeve iz 2004. pripisali pojedinim stratigrafskim fazama koje su definirane na osnovi iskopavanja 2007. godine, a navedene su u prethodnim poglavljima. Ovakvom korelacijom dviju kampanja dobili smo i podatke o približnoj starosti pojedinih faza, s obzirom na to da slojevi istraženi u kampanji 2007. nisu radiokarbonski datirani, a iz terenske kampanje provedene 2004. spomenuli smo već dva radiokarbonska datuma. Budući da je riječ o susjednim kvadrantima, ovakav pokušaj korelacije, iako metodološki manjkav, čini se da nije posve neutemeljen ako su podaci o sistemu iskopa po 10 cm u terenskoj kampanji 2004. godine pouzdani. U tablici 2 prikazana je korelacija slojeva između ovih dviju kampanja, faze prema kojima je litički skup nalaza podijeljen i obrađen, kao i apsolutni datumi koji nam daju okvirnu starost određenih horizonata.

Važno je napomenuti da ovakva podjela na horizonte može doživjeti određene promjene ako bi se datirali određeni slojevi iz iskopavanja provedenog 2007. godine. Prije grupiranja slojeva po horizontima komparirali smo tehnološke, tipološke i sirovinske značajke litičkih skupova nalaza između slojeva unutar svake kampanje. Nisu zabilježene značajnije razlike. Nakon toga smo komparirali slojeve između dviju kampanja i također nismo primijetili značajnije razlike.

Z. Brusić (2008: 401) navodi nekoliko keramičkih ulomaka iz gornjih slojeva iskopavanja 2007. godine. Dva ulomka pripisuje kasnobrončanodobnom razdoblju, a jedan rimskom vremenu. U terenskoj dokumentaciji zabilježeno je da je u sloju 2 iz 2007. godine pronađena keramika i vjerojat-

on between the layers from the two field seasons, in order to attribute the excavated layers from 2004 to individual stratigraphic phases which were defined according to the excavations from 2007, and were mentioned in the previous sections. With this correlation of the two campaigns, we acquired data on the approximate age of individual phases, given the fact that the layers excavated in the 2007 campaign were not radiocarbon dated, and we already mentioned the two radiocarbon dates from the 2004 campaign. Since these are neighbouring quadrants, this correlation attempt, despite some methodological flaws, was not so stretched if the data on the 10 cm excavation system in the 2004 campaign was reliable. Table 2 shows the correlation of layers of the two campaigns, the phases according to which the lithic assemblage was classified and analysed, as well as absolute dates that give us the general age of certain horizons.

It is important to emphasise that this classification into horizons could undergo certain changes if certain layers from the 2007 campaign were dated. Before grouping the layers into horizons, we compared technological, typological and raw material features of the lithic assemblage between layers within each campaign. There were no significant differences. After that we compared the layers between the two campaigns and again, we did not observe significant differences.

Z. Brusić (2008: 401) mentions several ceramic sherds from the upper layers excavated in 2007. Two sherds are attributed to the Late Bronze Age, while one is attributed to the Roman times. In field work documents it was recorded that ceramics were found in layer 2 from 2007, and the upper layers mentioned by Z. Brusić can probably be linked to this layer. The ceramic sherds that were found do not necessarily mean that the youngest layers from Vlakno should be attributed to the Late Bronze Age and/or Roman times but rather that the sherds simply sunk through the loose layer after people occasionally inhabited the cave during the Late Bronze Age and Roman times. Vujević and Bodružić (2014) state that the Mesolithic layers in Vlakno can be traced from the very surface, with the presence of few finds from later times in the youngest layer.

The drywall at the cave entrance, as well as the remains of the drywall in the area in front of the cave, tells us of the cave's recent use, maybe as a corral for cattle. This recent use of the cave as a corral was also recorded in, for example, Stolačka peć above Lukovo Šugarje (Forenbaher 2007). In

14C (uncal BP)	2004.	2007.	Horizont / Horizon
	1	1	**Mezolitik III**
	2	2	
	3	3	
	4		
	5	4	
	6	5	**Mezolitik II**
9230 ± 80	7	6	
	8		
	9	7	**Mezolitik I**
10160 ± 100	10	8	**KGP III**
		9	**KGP II**
		10	
		11	
		12	**KGP I**
		13	
tefra (NYT)		14	
		15	

Tab. 2 Korelacija slojeva istraženih 2004. i 2007. godine na osnovi dubina i izdvojeni horizonti. Radiokarbonski datumi potječu iz iskopavanja 2004. godine (KGP = kasni gornji paleolitik).

Tab. 2 Correlation of layers excavated in 2004 and 2007 based on depths and defined horizons. Radiocarbon dates come from 2004 excavation (KGP = Late Upper Palaeolithic).

no se gornji slojevi koje navodi Z. Brusić mogu povezati s ovim slojem. Ovih nekoliko pronađenih ulomaka keramike ne znači nužno da najmlađe slojeve iz Vlakna treba pripisati kasnom brončanom dobu i/ili rimskom vremenu, nego prije da su pronađeni ulomci jednostavno propali kroz rahli sloj nakon što su ljudi povremeno boravili u pećini tijekom kasnoga brončanog doba i rimskog vremena. Vujević i Bodružić (2014) navode da se mezolitički slojevi u Vlaknu mogu pratiti od same površine, uz prisutnost malobrojnih nalaza iz kasnijeg vremena u najmlađem sloju.

Suhozid na pećinskom ulazu, kao i ostaci suhozida u predpećinskom prostoru govore o recentnom korištenju pećine, možda kao tora za stoku. Takvo recentno korištenje pećina kao tora zabilježeno je npr. u Stolačkoj peći iznad Lukova Šugarja (Forenbaher 2007). Ako se pećina koristila kao tor, možda se može pretpostaviti da su brončanodobni i rimskodobni ostaci odstranjeni čišćenjem pećinskog prostora od strane pastira ili tijekom neke druge aktivnosti.

Litički skup nalaza koji je otkriven u iskopavanjima 2004. i 2007. godine podijeljen je u šest horizonata. Tri horizonta, kulturnokronološki gledano, pripisana su kasnom gornjem paleolitiku, a geokronološki samom završetku pleistocena, odnosno kasnom glacijalu (KGP I, KGP II i KGP III), dok bi preostala tri horizonta prema našoj podjeli pripadala mezolitiku, odnosno postglacijalu (Mezolitik I, Mezolitik II i Mezolitik III) (vidjeti tab. 2). Kasnogornjopaleolitički horizonti na osnovi radiokarbonskih datuma nataloženi su između

Horizont / Horizon	N	%	Težina / Wt (g)	%
Mezolitik III	643	6,1	1239,0	7,4
Mezolitik II	2635	24,9	4352,2	26,1
Mezolitik I	2877	27,1	3166,7	19,0
KGP III	1749	16,5	3160,9	19,0
KGP II	1083	10,2	1815,6	10,9
KGP I	1615	15,2	2924,7	17,6
Ukupno / Total	10602	100,0	16659,1	100,0

Tab. 3 Učestalost (po broju i težini) artefakata od lomljenog kamena po horizontima.

Tab. 3 Frequency (by number and weight) of flaked stone artefacts by horizon.

case the cave was really used as a corral it can be assumed that the remains from the Bronze Age and Roman times were removed during the shepherd's cleaning of the cave or during some other activity.

The lithic assemblage which was discovered in the excavations of 2004 and 2007 is divided in six horizons. Three horizons are culturally and chronologically attributed to the Late Upper Palaeolithic, and geochronologically to the very end of the Pleistocene, that is the Late Glacial (KGP I, KGP II and KGP III), while the remaining three horizons according to our classification would belong to the Mesolithic or the Postglacial (Mezolitik I, Mezolitik II and Mezolitik III) (see Tab. 2). The Late Upper Palaeolithic (KGP) horizons, based on radiocarbon dates, were deposited between approximately 14 900 and 10 200 cal BP (see Tab. 1). The lower age border of the Late Upper Palaeolithic layers is confirmed also by the layer of Neapolitan Yellow Tuff. The earliest Mesolithic horizon (I) is probably chronologically very close to the Mezolitik II horizon which was deposited approximately 10 600 cal BP ago, and probably even earlier. For the Mezolitik III horizon, due to the absence of radiocarbon dates, we can only say that it was deposited after the Mezolitik II horizon.

The weight and number of lithic assemblages from individual horizons are shown in Table 3. The smallest number of lithic artefacts was found in the Mezolitik III horizon, and therefore if we take the number of artefacts as the indicator of intensity of activities at the site, this was probably the period with the least intensive activities in the cave. According to this, the most intense stay in the cave was at the very Pleistocene-Holocene transition, during the deposition of the KGP III, Mezolitik I and Mezolitik II horizons.

HORIZON KGP I

The deposition of the earliest Late Upper Palaeolithic horizon discussed in this paper started approximately 12 približno 14 900 i 10 200 cal BP (vidjeti tab. 1). Donju granicu starosti kasnogornjopaleolitičkih slojeva potvrđuje i sloj napuljskoga žutog tufa. Najraniji mezolitički horizont (I) vjerojatno je kronološki vrlo blizak horizontu Mezolitik II koji je nataložen prije oko 10 600 cal BP, a vjerojatno i nešto prije. Za horizont Mezolitik III zbog nedostatka radiokarbonskih datuma možemo samo reći da je nataložen nakon horizonta Mezolitik II.

Težina i brojnost litičkih skupova nalaza koji pripadaju pojedinim horizontima prikazani su u tablici 3.

Najmanji broj kamenih artefakata zabilježen je u horizontu Mezolitik III, a time možda i najmanji intenzitet aktivnosti u pećini, uzmemo li brojnost artefakata kao pokazatelj intenziteta provođenih aktivnosti na nalazištu. Prema tome bi najintenzivniji boravak u pećini bio na samom prijelazu iz pleistocena u holocen, tijekom taloženja horizonata KGP III, Mezolitik I i Mezolitik II.

HORIZONT KGP I

Taloženje najranijega kasnogornjopaleolitičkog horizonta koji se obrađuje u ovom radu počelo je prije približno 12 300 uncal BP. Litički skup nalaza ovoga horizonta čini 1615 artefakata ukupne težine 2924,7 g. Među artefaktima su zabilježena oruđa, lomljevina, jezgre, malobrojni tehnički komadi vezani uz pripremu jezgri i izradu oruđa, krhotine, te artefakti manji od 15 mm (tab. 4).

Lomljevina

Udio lomljevine među neobrađenim artefaktima iznosi gotovo 50%. Učestalost odbojaka među lomljevinom iznosi 78,4%, pločica 16,6%, a sječiva 5%. Približno polovica svih odbojaka sačuvana je cjelovita, a malo nižu, ali podjednaku, učestalost cjelovitosti imaju sječiva i pločice. Perasti završetak distalnog dijela dominira u sve tri kategorije lomljevine, s tim da je kod sječiva niži nego kod pločica i odbojaka. Među sječivima je zabilježena visoka relativna učestalost komada koji imaju prebačeni distalni završetak. Lomljevina bez okorine prisutna je u sve tri kategorije s preko 75%. Relativna učestalost drugotnih pločica i sječiva viša je od one odbojaka. Zabilježena su samo dva prvotna odbojka. Nodularni tip okorine prevladava među artefaktima s okorinom s preko 95%. Zabilježena su samo tri artefakta na kojima je vidljiva valutična okorina. Izuzmemo li artefakte s oštećenim plohkom, onda je glatki plohak dominantan tip među cjelokupnom lomljevinom. Diedrični i višeplošni tip koji bi upućivali na dotjerivanje udarne plohe fasetiranjem vrlo su rijetki (tab. 5).

Jezgre

91 pronađena jezgra čini 5,6% cjelokupnoga litičkog skupa nalaza ovog horizonta (T. 2). Cjelovitih jezgara je 62, a 29 je ulomaka jezgara. Prosječna dužina jezgara iznosi 24,2 mm, a težina 4,6 g. Jezgre za odbojke u potpunosti dominiraju, a nakon njih slijede jezgre za pločice s višestruko manjom učestalošću. Zabilježena je samo jedna jezgra za sječiva i tri kombinirane jezgre, na kojima su vidljivi negativi odbojaka i pločica. Bipolarna tehnika lomljenja je dominantna, a nakon nje slijede jezgre s jednom udarnom plohom.

300 uncal BP. This horizon's lithic assemblage is composed of 1615 artefacts with a total weight of 2924.7 g. Among the artefacts there are tools, debitage, cores, a few technical pieces connected to core preparation and tool production, chunks and artefacts smaller than 15 mm (Tab. 4).

Debitage

The share of debitage among unretouched artefacts is almost 50%. The share of flakes among the debitage is 78.4%, bladelets 16.6%, and blades 5%. Approximately half of all flakes are complete, while complete blades and bladelets have a bit lower but equal frequency. A feathered end of the distal part dominates in all three categories of debitage, however there are fewer among the blades than among bladelets and flakes. Among the blades there is a relatively higher frequency of pieces that have a plunging distal end. Debitage without the cortex is present in all three categories with over 75%. The relative frequency of secondary bladelets and blades is higher than the one of flakes. Only two primary flakes were found. The nodular type of cortex is predominant among the artefacts with a cortex, with a share greater than 95%. Only three artefacts with a visible pebble cortex were found. If we exclude the artefacts with damaged butt, then the plain butt is the predominant type among the entire debitage. Dihedral and facetted butts which would suggest preparation of a striking platform through faceting are very rare (Tab. 5).

Cores

A total of 91 cores were found, which account for 5.6% of the entire lithic assemblage of this horizon (Pl. 2). There are 62 complete cores and 29 core fragments. The average length of cores is 24.2 mm, and weight 4.6 g. Cores for flakes fully dominate, followed by cores for bladelets with a frequency several times lower. Only one core for blades was found and three mixed cores, which have visible negatives of flakes and bladelets. The bipolar flaking technique is predominant, followed by the cores with one striking platform. Two cores were recorded among bipolar cores, out of which one was initially a core with one striking platform, and the other one was the core with two striking platforms. Cores with two or more striking platforms are significantly rarer. Amorphous cores have the highest frequency, followed by cores on flake and wedge cores. Conical and prismatic cores are few. Over 70% of all cores show no traces of preparation, while only 27% have traces of trimming. Only one core has combined traces of faceting and trimming (Tab. 6).

Tools

In the KGP I horizon, 123 tools were found and they account for 7.6% of the lithic assemblage of this horizon (Pl. 1). Approximately half of all the tools were done on flakes, and approximately one third on bladelets. One tool was produced on a crested blade/bladelet. Sidescrapers represent the most frequent type among the tools on flakes, as well as on blades, while backed bladelets represent the most frequent type on bladelets.

Retouched pieces and sidescrapers have equal frequ-

	Ukupno / Total		Neobrađeno / Unretouched		Obrađeno / Retouched		% iskorištenosti / of use
	N	%	N	%	N	%	
Odbojci / Flakes	639	39,6	581	38,9	58	47,2	9,1
Sječiva / Blades	57	3,5	37	2,5	20	16,3	35,1
Pločice / Bladelets	163	10,1	123	8,2	40	32,5	24,5
Dotjerujući odbojci jezgre / Core renewal flakes	1	0,1	1	0,1			
Krijestasta sječiva-pločice / Crested blades-bladelets	5	0,3	4	0,3	1	0,8	20,0
Iver dubila / Burin spalls	2	0,1	2	0,1			
Odbojci / Flakes < 15 mm	224	13,9	224	15,0			
Jezgre / Cores	91	5,6	91	6,1			
Krhotine / Chunks	337	20,9	337	22,6			
Krhotine / Chunks < 15 mm	82	5,1	82	5,5			
Neodredivo / Unidentified	14	0,9	10	0,7	4	3,3	
Ukupno / Total	1615	100,0	1492	100,0	123	100,0	

Tab. 4 Litički skup nalaza iz horizonta KGP I.
Tab. 4 Lithic assemblage from horizon KGP I.

Među bipolarnim jezgrama zabilježene su dvije jezgre, od kojih je jedna inicijalno bila jezgra s jednom udarnom plohom, a druga jezgra s dvije udarne plohe. Jezgre s dvije udarne, kao i s više udarnih ploha znatno su rjeđe. Amorfne jezgre imaju najvišu učestalost, a nakon njih slijede jezgre na odbojku i klinaste jezgre. Konične i prizmatične jezgre su malobrojne. Preko 70% svih jezgara nema nikakve tragove dotjerivanja, a oko 27% ima tragove kvrcanja. Samo jedna jezgra ima kombinirane tragove fasetiranja i kvrcanja (tab. 6).

Oruđa

U horizontu KGP I pronađeno je 123 oruđa i ona čine 7,6% litičkog skupa nalaza ovog horizonta (T. 1). Približno polovica svih oruđa izrađena je na odbojcima, a oko trećina na pločicama. Oko 15% oruđa izrađeno je na sječivima. Jedno oruđe izrađeno je na krijestastom sječivu/pločici. Strugala su najbrojniji tip oruđa na odbojcima, kao i na sječivima, dok su pločice s hrptom najbrojniji tip na pločicama.

Komadi s obradom i strugala imaju podjednaku učestalost i predstavljaju najbrojnije tipove oruđa. Nakon njih slijede pločice s hrptom i zakrivljeni šiljci s hrptom. Noktolika grebala imaju učestalost od 6,5%. Učestalost ostalih tipova prikazana je u tablici 7.

Među pločicama s hrptom samo je jedna bilateralno strmo retuširana, a ostatak unilateralno. Samo dvije pločice imaju zašiljen distalni kraj i obje su unilateralno retuširane.

Iako među oruđima nisu pronađena dubila, prisutnost dvaju ivera dubila upućuje na njihovu izradu u pećini.

Prvotni oblici bez okorine dominiraju među oruđima (91,1%), a ostatak je izrađen na drugotnoj lomljevini. Oruđa nisu zabilježena na prvotnoj lomljevini. Oruđa s okorinom

encies and represent the most numerous types of tools. They are followed by backed bladelets and arched backed points. Thumbnail endscrapers have a share of 6.5%. The frequency of other types is shown in Table 7.

Among backed bladelets only one is bilaterally backed, while the others are unilaterally retouched. Only two bladelets have a pointed distal end and both are unilaterally retouched.

Although burins were not found among the tools, the presence of two burin spalls suggests they were made in the cave.

Blanks without a cortex are predominant among the tools (91.1%), and other tools were made on secondary debitage. Tools were not found in primary debitage. Tools with a cortex were found among endscrapers (1), sidescrapers (3), marginally retouched pieces (1), retouched pieces (2) and denticulates (2) as well as among fragments (2).

The share of complete tools is 49.6%, and the completeness by type is shown in Table 8. Endscrapers on flake, marginally retouched pieces and backed flakes have the lowest rate of completeness.

Raw material

Artefacts made of chert from Upper Cretaceous limestone with planktonic foraminifera are largest in number, followed by chert from *Scaglia Rossa* limestone, and then by chert from Eocene foraminifera limestone. The frequency of other raw materials is under 1%. Relative frequency by weight is similar to the frequency by number, other than in the case of chert from *Scaglia Rossa* limestone where the weight frequency is significantly lower than the frequency by number (Tab. 9).

	Odbojci / Flakes		Sječiva / Blades		Pločice / Bladelets	
	N	%	N	%	N	%
Cjelovitost / Completness						
cijelo / whole	310	53,4	16	43,2	50	40,7
proksimalno / proximal	80	13,8	8	21,6	9	7,3
medijalno / medial	47	8,1			14	11,4
distalno / distal	144	24,8	13	35,1	50	40,7
Tip završetka / Distal end						
perast / feathered	320	70,5	17	58,6	80	80,0
izvrnut / hinged	101	22,2	3	10,3	10	10,0
prebačen / plunging	33	7,3	9	31,0	10	10,0
Količina okorine / Cortex amount						
bez okorine / no cortex	487	83,8	28	75,7	97	78,9
s okorinom / some cortex	92	15,8	9	24,3	26	21,1
100% okorine / cortex	2	0,3				
Tip okorine / Cortex type						
nodularna / nodular	92	97,9	9	100,0	25	96,2
valutična / pebble	2	2,1			1	3,8
Plohak / Butt						
okorinski / cortical	3	0,8				
glatki / plain	244	62,6	15	62,5	21	35,6
diedrični / dihedral	9	2,3	1	4,2		
višeplošni / facetted	2	0,5				
linijski / linear	8	2,1				
točkasti / punctiform	3	0,8	1	4,2	3	5,1
smrskani / smashed	121	31,0	7	29,2	35	59,3

Tab. 5 Morfološka obilježja lomljevine iz horizonta KGP I.
Tab. 5 Morphological characteristics of debitage from horizon KGP I.

zabilježena su među grebalima (1), strugalima (3), komadima sa sitnom rubnom obradom (1), komadima s obradom (2) i nazupcima (2), kao i među ulomcima (2).

Učestalost cjelovitih oruđa iznosi 49,6%, a cjelovitost prema tipovima vidljiva je u tablici 8. Najnižu stopu cjelovitosti imaju grebala na odbojku, komadi sa sitnom rubnom obradom i odbojci s hrptom.

Sirovina

Artefakti od rožnjaka iz gornjokrednih vapnenaca s planktonskim foraminiferama imaju najveću brojčanu učestalost, nakon njih slijede oni od rožnjaka iz vapnenaca tipa *Scaglia Rossa*, a zatim od rožnjaka iz eocenskih foraminiferskih vapnenaca. Ostale sirovine imaju učestalost manju od 1%. Relativna učestalost prema težini pokazuje slične trendove kao i brojčana, osim kod rožnjaka iz vapnenaca tipa *Scaglia Rossa* gdje je težinska učestalost znatno manja od brojčane (tab. 9)

Chaîne opératoire

According to *chaîne opératoire* for each raw material category, it is visible that the production from these raw materials took place in the cave, whereas the initial production phase in the cave, documented by primary flakes, was found only for cherts from Eocene foraminifera limestone and cherts from *Scaglia Rossa* limestone (Tab. 10). A low number of primary debitage may indicate certain preparation of cores outside the cave, maybe on the location of the raw material sources. Radiolarite tools were not found, but we can assume their production based on one burin spall.

HORIZON KGP II

We have no radiocarbon dates for this horizon, but we can generally assume it was deposited between 12 000 and 10 500 uncal BP, whereas deposition probably started somewhat later. This horizon is composed of 1083 artefacts with a total weight of 1815.6 g. The lithic assemblage con-

Lanac operacija

Prema lancu operacija za svaku sirovinsku kategoriju vidljivo je da se proizvodnja od svih sirovina odvijala u pećini, s tim da je inicijalna faza proizvodnje u pećini, koju dokumentiraju prvotni odbojci, zabilježena samo kod rožnjaka iz eocenskih foraminiferskih vapnenaca i rožnjaka iz vapnenaca tipa *Scaglia Rossa* (tab. 10). Mali broj prvotne lomljevine može biti pokazatelj određene pripreme jezgri izvan pećine, možda na samim ležištima sirovine. Oruđa od radiolarita nisu zabilježena, ali možemo pretpostaviti njihovu izradu na osnovi jednog ivera dubila.

HORIZONT KGP II

Za ovaj horizont ne raspolažemo radiokarbonskim datumima, ali možemo u grubo pretpostaviti da je natložen između 12 000 i 10 500 uncal BP, s tim da je početak taloženja vjerojatno počeo nešto kasnije. U ovom horizontu pronađeno je 1083 artefakta čija je težina 1815,6 g. U litičkom skupu nalaza prisutna su oruđa, lomljevina, jezgre, tehnički komadi, krhotine, te artefakti manji od 15 mm (tab. 11). Prisutnost samo jednoga dotjerujućeg odbojka jezgre sugerira rijetko dotjerivanje jezgri tijekom redukcijskog procesa. Krijestasti komadi upućuju na pripremu jezgri za lomljenje sječiva/pločica.

Lomljevina

Udio odbojaka među lomljevinom iznosi 79,1%, pločica 13,5%, a sječiva 7,3%. Najvišu cjelovitost među lomljevinom imaju sječiva (oko 70%), a oko polovica odbojaka i pločica sačuvana je cjelovita. Među svim kategorijama lomljevine udio perastog završetka je sličan i iznosi oko 70%. Među sječivima je zabilježena nešto viša relativna učestalost prebačenih distalnih dijelova, a oni mogu biti dobar pokazatelj izrade sječiva u samoj pećini. Preko 80% odbojaka, sječiva i pločica nema tragove okorine na dorzalnoj strani. Prvotna lomljevina prisutna je samo među odbojcima i to u malom postotku. Nodularni tip okorine u potpunosti dominira među lomljevinom s okorinom, a valutični tip okorine zabilježen je samo u dva slučaja, a nodularno-valutični u samo jednom slučaju. Glatki tip plohka najbrojniji je u svim kategorijama lomljevine, izuzmemo li komade s oštećenim plohkom. Diedrični i višeplošni tip plohka među odbojcima je malobrojan, a među pločicama nije zabilježen. Diedrični tip plohka ima nešto višu relativnu učestalost među sječivima (tab. 12).

Jezgre

U ovom horizontu pronađeno je 30 jezgara koje čine 2,8% litičkog skupa nalaza (T. 3: 16–22). Samo je jedna jezgra fragmentirana. Prosječna dužina jezgara je 28,4 mm, a težina 7 g. Jezgre za odbojke su najbrojnije, a one za pločice i sječiva zabilježene su samo s po jednim primjerkom. Pronađene su i dvije kombinirane jezgre. Prema tehnici lomljenja jednoplatformne jezgre su najbrojnije, a nakon njih slijede bipolarne i višeplatformne s jednakom učestalošću. Dvoplatformne jezgre prisutne su sa 4 primjerka, a jezgre-krhotine sa 3.

Gotovo polovica svih jezgara ima amorfni oblik, a nakon

	N	%
Tehnika lomljenja / Flaking		
jednoplatformna / one platform	26	37,7
dvoplatformna / two platforms	5	7,2
višeplatformna / > two platforms	3	4,3
bipolarna / bipolar	33	47,8
jezgra-krhotina / core-chunk	2	2,9
Oblik jezgre / Core shape		
konična / conical	4	5,8
prizmatična / prismatic	2	2,9
pločasta / tabular	8	11,6
jezgra na odbojku / core on flake	12	17,4
amorfna / amorphous	36	52,2
klinasta / wedge	7	10,1
Vrsta negativa / Type of removal		
odbojak / flake	58	84,1
sječivo / blade	1	1,4
pločica / bladelet	7	10,1
kombinirano / mixed	3	4,3
Priprema udarne plohe / Platform preparation		
bez pripreme / absent	49	71,0
kvrcanje / trimming	19	27,5
kombinirano / mixed	1	1,4

Tab. 6 Morfološka obilježja jezgara iz horizonta KGP I.
Tab. 6 Morphological characteristics of cores from horizon KGP I.

tains tools, debitage, cores, a few technical pieces, chunks and artefacts smaller than 15 mm (Tab. 11). The presence of only one core renewal flake suggests rare core rejuvenation during the reduction sequence. Crested pieces indicate core preparation for the flaking of blades/bladelets.

Debitage

The share of flakes among the debitage is 79.1%, bladelets 13.5%, and blades 7.3%. Blades have the highest rate of completeness among the debitage (approx. 70%), while approximately half of all flakes and bladelets were preserved complete. A feathered end of the distal part dominates in all categories of debitage with around 70%. Among the blades there is a relatively high frequency of plunging distal ends, which may be a good indicator of blade production in the cave. Over 80% of the flakes, blades and bladelets have no traces of cortex on their dorsal side. Primary debitage is

	Odbojak / Flake	Sječivo / Blade	Pločica / Bladelet	Krijestasto sječivo-pločica / Crested blade-bladelet	Neodredivo / Unidentified	Ukupno / Total	%
Grebalo / Endscraper						16	13,0
noktoliko / thumbnail	8					8	6,5
kružno / circular	1					1	0,8
na odbojku / on flake	6					6	4,9
caréné	1					1	0,8
Alatka s hrptom / Backed tool						39	31,7
pločica / bladelet			16			16	13,0
sječivo / blade		4				4	3,3
zakrivljeni šiljak / arched point		2	10			12	9,8
odbojak / flake	6					6	4,9
zarubljena pločica / truncated bladelet			1			1	0,8
Strugalo / Sidescraper	14	6	1			21	17,1
Svrdlo / Drill	2		2			4	3,3
Sitna rubna / Marginally retouched	1	2	1			4	3,3
Komad s obradom / Retouched piece	9	4	8	1		22	17,9
Nazubak / Denticulate	3	2	1			6	4,9
Ulomak / Fragment	7				4	11	8,9
Ukupno / Total	58	20	40	1	4	123	100,0
%	47,2	16,3	32,5	0,8	3,3	100,0	

Tab. 7 Učestalost oruđa prema tipu i prvobitnom obliku iz horizonta KGP I.
Tab. 7 Tool frequency by type and blank in horizon KGP I.

njih najbrojnije su pločaste. Jezgre na odbojku i klinaste imaju učestalost od oko 14%. Konične i prizmatične jezgre su najslabije zastupljene, svaki tip s po jednim primjerkom. Gotovo polovica jezgara nema nikakve tragove dotjerivanja, a istu učestalost imaju i jezgre koje imaju tragove kvrcanja. Samo jedna jezgra ima kombinirane tragove kvrcanja i fasetiranja (tab. 13).

Oruđa

U ovom horizontu pronađeno je 56 oruđa koja čine 5,2% litičkog skupa nalaza (T. 3:1–15, 23). Promatramo li oruđa prema morfotehnološkoj kategoriji na kojoj su izrađena, ona na odbojcima imaju učestalost od 50% i najbrojnija su, dok oruđa na pločicama i sječivima imaju gotovo upola manju učestalost (tab. 14). Najbrojnija oruđa na odbojcima su noktolika grebala, na sječivima su sječiva s hrptom i komadi s obradom, a na pločicama su to pločice s hrptom. Postotak odbojaka iskorištenih za izradu oruđa višestruko je manji od postotka iskorištenosti sječiva i pločica. Sječiva imaju najviši postotak iskorištenosti (tab. 11).

Grebala su najbrojnija grupa oruđa, a među njima su naj-

present in a low percentage only among flakes. The nodular type of cortex is predominant among the debitage with a cortex, while the pebble type of cortex has been found only in two cases, and the nodular-pebble type only in one case. If we exclude the artefacts with damaged butt, then the plain butt is the predominant type among all categories of the debitage. There were only a few dihedral and facetted butts found among the flakes and none were found among the bladelets. Dihedral butts have a somewhat higher relative frequency among the blades (Tab. 12).

Cores

A total of 30 cores were found in this horizon, accounting for 2.8% of its lithic assemblage (Pl. 3: 16–22). Only one core is fragmented. The average length of cores is 28.4 mm, and weight 7 g. Flake cores are the most numerous, while only one core for bladelets and blades was found. Additionally, two mixed cores were found. According to the flaking technology, single-platform cores are the most numerous, followed by bipolar cores and cores with more than two striking platforms with equal shares. Four specimens of cores with two striking platforms were found, as well as three

	N	%
noktoliko grebalo / thumbnail endscraper	8	100,0
kružno grebalo / circular scraper	1	100,0
grebalo na odbojku / endscraper on flake	1	16,7
grebalo *caréné* / endscraper *caréné*	1	100,0
pločica s hrptom / backed bladelet	6	40,0
sječivo s hrptom / backed blade	1	25,0
zakrivljeni šiljak s hrptom / arched backed point	10	83,3
odbojak s hrptom / backed flake	2	33,3
zarubljena pločica s hrptom / truncated backed bladelet	1	100,0
strugalo / sidescraper	12	57,1
svrdlo / drill	2	50,0
sitna rubna / marginally retouched	1	25,0
komad s obradom / retouched piece	10	45,5
nazubak / denticulate	4	66,7

Tab. 8 Učestalost cjelovitih oruđa prema tipu iz horizonta KGP I.
Tab. 8 Frequency of complete tools by type in horizon KGP I.

brojnija noktolika s učestalošću od 16%. Komadi s obradom imaju nešto višu učestalost od noktolikih grebala. Pločice s hrptom imaju također visoku učestalost od oko 14% (tab. 14). Dubila nisu zabilježena među oruđima, ali dva primjerka ivera dubila pokazatelj su njihove izrade na nalazištu. Među oruđima je zabilježeno samo jedno kombinirano oruđe, koje je kombinacija strugala i svrdla. Učestalost ostalih

Sirovina / Raw material	Težina / Weight (g)	%	N	%
radiolariti / radiolarites	14,2	0,5	10	0,8
rožnjaci EVF / cherts ELF	196,4	7,0	103	7,9
rožnjaci GKVPF / cherts UCLPF	2004,0	71,3	816	62,3
rožnjaci SRV / cherts SRL	190,6	6,8	151	11,5
DVT, SG / DVT, SCS	16,6	0,6	12	0,9
razno / diverse	208,4	7,4	93	7,1
žareno / burnt	180,1	6,4	124	9,5
Ukupno / Total	2810,3	100,0	1309	100,0

Tab. 9 Učestalost sirovine prema težini i broju iz horizonta KGP I.
Tab. 9 Raw material frequency (by weight and number) from horizon KGP I.

cores-chunks.

Almost half of all cores are amorphous, followed by tabular cores. The frequency of cores on flake and wedge cores is approximately 14%. Conical and prismatic cores have the lowest frequency, represented by one example each. Almost half of the cores have no traces of preparation, and cores with traces of trimming and faceting have the same frequency. Only one core has combined traces of faceting and trimming (Tab. 13).

	radiolariti / radiolarites	rožnjaci EVF / cherts ELF	rožnjaci GKVPF / cherts UCLPF	rožnjaci SRV / cherts SRL	DVT, SG / DVT, SCS	razno / diverse	žareno / burnt	Ukupno / Total
Prvotni odbojak / Primary flake	0	1	0	1	0	0	0	2
Drugotni odbojak / Secondary flake	0	5	67	10	0	1	9	92
Drugotno sječivo / Secondary blade	0	0	8	0	0	0	1	9
Drugotna pločica / Secondary bladelet	0	2	22	0	0	1	1	26
Odbojak / Flake	4	53	287	56	5	44	38	487
Sječivo / Blade	0	6	18	2	0	2	0	28
Pločica / Bladelet	0	5	60	14	2	8	8	97
Jezgra / Core	2	6	55	13	1	7	7	91
Dotjerujući odbojak jezgre / Core renewal flake	0	0	1	0	0	0	0	1
Krijestasto sječivo-pločica / Crested blade-bladelet	0	1	2	1	0	1	0	4
Iver dubila / Burin spall	1	0	1	0	0	0	0	2
Krhotina / Chunk	3	19	236	16	0	12	51	337
Neodredivo / Unidentified	0	0	4	3	0	0	3	10
								1186
Oruđa / Tools		●	●	●	●	●	●	

Tab. 10 Lanac operacija prema sirovinskim kategorijama u horizontu KGP I.
Tab. 10 Chaîne opératoire by raw material categories from horizon KGP I.

	Ukupno / Total		Neobrađeno / Unretouched		Obrađeno / Retouched		% iskorištenosti / of use
	N	%	N	%	N	%	
Odbojci / Flakes	417	38,5	389	37,9	28	50,0	6,7
Sječiva / Blades	49	4,5	36	3,5	13	23,2	26,5
Pločice / Bladelets	80	7,4	67	6,5	13	23,2	16,3
Dotjerujući odbojci jezgre / Core renewal flake	1	0,1	1	0,1			
Krijestasta sječiva-pločice / Crested blades-bladelets	3	0,3	3	0,3			
Iver dubila / Burin spalls	2	0,2	2	0,2			
Odbojci / Flakes < 15 mm	231	21,3	231	22,5			
Jezgre / Cores	30	2,8	30	2,9			
Krhotine / Chunks	195	18,0	195	19,0			
Krhotine / Chunks < 15 mm	69	6,4	69	6,7			
Neodredivo / Unidentified	6	0,6	4	0,4	2	3,6	
Ukupno / Total	1083	100,0	1027	100,0	56	100,0	

Tab. 11 Litički skup nalaza iz horizonta KGP II.
Tab. 11 Lithic assemblage from horizon KGP II.

	Odbojci / Flakes		Sječiva / Blades		Pločice / Bladelets	
	N	%	N	%	N	%
Cjelovitost / Completness						
cijelo / whole	206	53,0	25	69,4	36	53,7
proksimalno / proximal	44	11,3	5	13,9	11	16,4
medijalno / medial	25	6,4	1	2,8	3	4,5
distalno / distal	114	29,3	5	13,9	17	25,4
Tip završetka / Distal end						
perast / feathered	221	69,1	21	70,0	39	73,6
izvrnut / hinged	93	29,1	5	16,7	13	24,5
prebačen / plunging	6	1,9	4	13,3	1	1,9
Količina okorine / Cortex amount						
bez okorine / no cortex	317	81,5	31	86,1	60	89,6
s okorinom / some cortex	68	17,5	5	13,9	7	10,5
100% okorine / cortex	4	1,0				
Tip okorine / Cortex type						
nodularna / nodular	68	95,8	5	100,0	7	100,0
valutična / pebble	2	2,8				
nodularno-valutična / nodular-pebble	1	1,4				
Plohak / Butt						
okorinski / cortical	1	0,4				
glatki / plain	156	62,4	15	50,0	22	46,8
diedrični / dihedral	7	2,8	3	10,0		
višeplošni / facetted	1	0,4				
krilni / winged	7	2,8				
linijski / linear	9	3,6	4	13,3		
točkasti / punctiform	6	2,4	2	6,7	3	6,4
smrskani / smashed	63	25,2	6	20,0	22	46,8

Tab. 12 Morfološka obilježja lomljevine iz horizonta KGP II.
Tab. 12 Morphological characteristics of debitage from horizon KGP II.

tipova oruđa vidljiva je u tablici 14.

Samo jedna pločica s hrptom retuširana je strmo bilateralno i ima tupi distalni završetak, a ostale su retuširane unilateralno, među kojima dvije imaju zašiljeni distalni kraj.

Blizu 86% svih oruđa izrađeno je na prvotnim oblicima bez okorine. Na prvotnim oblicima s okorinom izrađeno je 1 noktoliko grebalo, 2 grebala na odbojku, 1 sječivo s hrptom, 1 strugalo i 3 komada s obradom.

Udio cjelovitih oruđa je visok i iznosi 71,4%. Najnižu stopu cjelovitosti imaju sječiva s hrptom, dok je kod ostalih tipova cjelovitost iznad 70%. Iznimku predstavlja jedan pronađeni zarubak koji je fragmentiran (tab. 15).

Sirovina

Uvjerljivo najvišu učestalost prema broju, kao i prema težini imaju artefakti od rožnjaka iz gornjokrednih vapnenaca s planktonskim foraminiferama. Nakon toga slijede rožnjaci iz eocenskih foraminiferskih vapnenaca i rožnjaci iz vapnenaca tipa *Scaglia Rossa*, a učestalost ispod 1% imaju radiolariti te devitrificirani tufovi i silicificirani glinjaci. Visok udio sirovine otpada na kategoriju žareno (tab. 16).

Lanac operacija

Najviše faza lanca operacija zabilježeno je među rožnjacima iz gornjokrednih vapnenaca s planktonskim foraminiferama. Započinje skidanjem prvotnih odbojaka, nastavlja se skidanjem drugotne lomljevine, a nakon toga slijedi središnja faza proizvodnje. Lanac operacija u ovoj sirovinskoj kategoriji završen je odbacivanjem oruđa. Lanac operacija među rožnjacima iz eocenskih foraminiferskih vapnenaca započinje skidanjem drugotne lomljevine. Isto možemo pretpostaviti i za rožnjake iz vapnenaca tipa *Scaglia Rossa* iako nisu zabilježene jezgre u ovoj kategoriji. Prisutnost jednoga krijestastog komada upućuje na proizvodnju na nalazištu. Iako su artefakti od radiolarita malobrojni, možemo pretpostaviti *in situ* proizvodnju od ove sirovine, s tim da nam nedostatak lomljevine s okorinom pokazuje moguće dopremanje već pripremljenih jezgri na nalazište (tab. 17). Artefakti od devitrificiranih tufova i silicificiranih glinjaka vjerojatno nisu proizvođeni na nalazištu nego su u pećinu doneseni.

HORIZONT KGP III

Horizont KGP III predstavlja najmlađi kasnogornjopaleolitički horizont nataložen na samom završetku pleistocena prije oko 10 160 uncal BP. Litički skup nalaza čine oruđa, lomljevina, jezgre, tehnički komadi, krhotine i artefakti manji od 15 mm. Pronađeno je 1749 artefakata čija je težina 3160,9 g. U odnosu na ostale izdvojene horizonte upadljiva je iznimno mala učestalost artefakata manjih od 15 mm. Među tehničkim komadima zabilježen je i jedan primjerak mikrodubila (tab. 18).

Lomljevina

Najbrojnija kategorija među lomljevinom su odbojci s učestalošću od 79,2%, nakon kojih slijede pločice sa 13,5% i na kraju sječiva s učestalošću od 7,4%. Malo više od polovice odbojaka sačuvano je cjelovito. Udio cjelovitih sječiva malo

	N	%
Tehnika lomljenja / Flaking		
jednoplatformna / one platform	12	41,4
dvoplatformna / two platforms	4	13,8
višeplatformna / > two platforms	5	17,2
bipolarna / biploar	5	17,2
jezgra-krhotina / core-chunk	3	10,3
Oblik jezgre / Core shape		
konična / conical	1	3,4
prizmatična / prismatic	1	3,4
pločasta / tabular	5	17,2
jezgra na odbojku / core on flake	4	13,8
amorfna / amorphous	14	48,3
klinasta / wedge	4	13,8
Vrsta negativa / Type of removal		
odbojak / flake	25	86,2
sječivo / blade	1	3,4
pločica / bladelet	1	3,4
kombinirano / mixed	2	6,9
Priprema udarne plohe / Platform preparation		
bez pripreme / absent	14	48,3
kvrcanje / trimming	14	48,3
kombinirano / combined	1	3,4

Tab. 13 Morfološka obilježja jezgara iz horizonta KGP II.
Tab. 13 Morphological characteristics of cores from horizon KGP II.

Tools

In this horizon 56 tools were found and they account for 5.2% of its lithic assemblage (Pl. 3: 1–15, 23). An analysis of the tools according to the morphotechnological category on which they were made shows that the tools have a frequency of 50%, while the frequency of tools on bladelets and blades is two times lower (Tab. 14). Thumbnail endscrapers are the most frequent among the tools on flakes; among the tools on blades, the most frequent are backed blades and retouched pieces; and among the tools on bladelets, the most frequent are backed bladelets. The percentage of flakes used for making tools is several times smaller than the percentage of the use of blades and bladelets. Blades have the highest percentage of use (Tab. 11).

Endscrapers are the most frequent tools, among which thumbnail endscrapers are the most numerous with a share of 16%. Retouched pieces are somewhat more frequent than thumbnail endscrapers. Backed bladelets also have a high share of approx. 14% (Tab. 14). Burins were not found among the tools, but two burin spalls indicate they were

	Odbojak / Flake	Sječivo / Blade	Pločica / Bladelet	Neodredivo / Unidentified	Ukupno / Total	%
Grebalo / Endscraper					11	19,7
noktoliko / thumbnail	9				9	16,1
na odbojku / on flake	2				2	3,6
Alatka s hrptom / Backed tool					20	35,7
pločica / bladelet			8		8	14,3
sječivo / blade		4			4	7,1
zakrivljeni šiljak / arched point		1	3		4	7,1
odbojak / flake	4				4	7,1
Zarubak / Truncation		1			1	1,8
Strugalo / Sidescraper	4	1			5	8,9
Svrdlo / Drill		1			1	1,8
Komad s obradom / Retouched piece	4	4	2		10	17,9
Nazubak / Denticulate	3	1			4	7,1
Kombinirano oruđe / Combined tool	1				1	1,8
Ulomak / Fragment	1			2	3	5,4
Ukupno	28	13	13	2	56	100,0
%	50,0	23,2	23,2	3,6		

Tab. 14 Učestalost oruđa prema tipu i prvobitnom obliku iz horizonta KGP II.
Tab. 14 Tool frequency by type and blank in horizon KGP II.

	N	%
noktoliko grebalo / thumbnail endscraper	9	100,0
grebalo na odbojku / endscraper on flake	2	100,0
pločica s hrptom / backed bladelet	6	75,0
sječivo s hrptom / backed blade	1	25,0
zakrivljeni šiljak s hrptom / arched backed point	3	75,0
odbojak s hrptom / backed flake	3	75,0
zarubak / truncation	0	0,0
strugalo / sidescraper	4	80,0
svrdlo / drill	1	100,0
komad s obradom / retouched piece	7	70,0
nazubak / denticulate	3	75,0
kombinirano oruđe / combined tool	1	100,0

Tab. 15 Učestalost cjelovitih oruđa prema tipu iz horizonta KGP II.
Tab. 15 Frequency of complete tools by type in horizon KGP II.

Sirovina / Raw material	Težina / Weight (g)	%	N	%
radiolariti / radiolarites	6,8	0,4	5	0,6
rožnjaci EVF / cherts ELF	82,0	4,7	32	4,1
rožnjaci GKVPF / cherts UCLPF	1315,1	76,2	554	70,8
rožnjaci SRV / cherts SRL	30,9	1,8	21	2,7
DVT, SG / DVT, SCS	11,2	0,6	6	0,8
razno / diverse	79,6	4,6	34	4,3
žareno / burnt	201,1	11,6	131	16,7
Ukupno / Total	1726,7	100,0	783	100,0

Tab. 16 Učestalost sirovine prema težini i broju iz horizonta KGP II.
Tab. 16 Raw material frequency (by weight and number) from horizon KGP II.

je manji od polovice, a relativna učestalost cjelovitih pločica je najniža i iznosi oko 39% (tab. 19).

Relativna učestalost perastog završetka distalnog dijela uvjerljivo je najviša u sve tri kategorije lomljevine. Izvrnuti završetak ima višu relativnu učestalost među odbojcima, a prebačeni među sječivima. Prvotni odbojci prisutni su sa samo 3 primjerka, a učestalost drugotne lomljevine kreće se od 15% među pločicama, preko oko 16% među odboj-

made at the site. Only one combined tool was recorded among the tools, which is a combination of a sidescraper and drill. The frequency of other tool types is shown in Table 14.

Only one backed bladelet is bilaterally backed with a blunt distal end, while the others are unilaterally retouched, and two among them have a pointed distal end.

Almost 86% of all tools were made on blanks without a

	radiolariti / radiolarites	rožnjaci EVF / cherts ELF	rožnjaci GKVPF / cherts UCLPF	rožnjaci SRV / cherts SRL	DVT, SG / DVT, SCS	razno / diverse	žareno / burnt	Ukupno / Total
Prvotni odbojak / Primary flake	0	0	4	0	0	0	0	4
Drugotni odbojak / Secondary flake	0	3	46	1	1	4	13	68
Drugotno sječivo / Secondary blade	0	0	4	0	0	1	0	5
Drugotna pločica / Secondary bladelet	0	0	6	0	0	0	1	7
Odbojak / Flake	0	11	230	11	3	14	48	317
Sječivo / Blade	1	1	23	2	1	3	0	31
Pločica / Bladelet	0	4	45	2	0	1	8	60
Jezgra / Core	1	5	18	0	0	3	3	30
Dotjerujući odbojak jezgre / Core renewal flake	0	1	0	0	0	0	0	1
Krijestasto sječivo-pločica / Crested blade-bladelet	1	0	0	1	0	1	0	3
Iver dubila / Burin spall	0	1	1	0	0	0	0	2
Krhotina / Chunk	1	3	135	2	0	5	49	195
Neodredivo / Unidentified	0	0	1	0	0	0	3	4
								727
Oruđa / Tools	●	●	●	●	●	●	●	

Tab. 17 Lanac operacija prema sirovinskim kategorijama iz horizonta KGP II.
Tab. 17 Chaîne opératoire by raw material categories from horizon KGP II.

cima do oko 30% među sječivima. Nodularni tip okorine prevladava među okorinskom lomljevinom, dok je valutični i nodularno-valutični tip okorine rijedak. Glatki tip plohka najčešći je među lomljevinom, uz visok udio artefakata s oštećenim plohkom. Diedrični i višeplošni plohak slabo su zastupljeni. Nešto viša učestalost diedričnog tipa plohka zabilježena je među sječivima (tab. 19).

Jezgre

26 pronađenih jezgara čini 1,5% litičkog skupa nalaza ovog horizonta (T. 5). Cjelovitih jezgara sačuvano je 17, a ostatak su fragmenti. Prosječna dužina cjelovitih jezgara je 27,3 mm, a težina 7,9 g. Jezgre za odbojke prevladavaju i čine oko polovice svih jezgara, dok jezgre za pločice i kombinirane jezgre imaju podjednaku učestalost. Jezgre za sječiva nisu zabilježene (tab. 20). Sve pronađene kombinirane jezgre imaju negative odbojaka i pločica. Proizvodnja lomljevine od jezgri s jednom udarnom plohom najučestalija je i one čine gotovo polovicu svih jezgri. Nakon njih slijede bipolarne jezgre čija relativna učestalost iznosi oko 24%. Jezgre s dvije udarne plohe i s više udarnih ploha zastupljene su svaka s po dva primjerka, a rotirajuće jezgre s jednim primjerkom. Promatramo li formu jezgri, amorfne su najčešće, a nakon njih slijede jezgre na odbojku. Učestalost ostalih formi jezgri prikazana je u tablici 20. Približno dvije trećine jezgri ima tragove kvrcanja, dok ostatak jezgri nema nikakve tragove dotjerivanja.

Oruđa

Ovom horizontu pripadaju 83 oruđa koja čine 4,8% litičkog skupa nalaza (T. 4). Najbrojnija su oruđa na odbojcima,

cortex. Blanks with a cortex were used for making 1 thumbnail endscraper, 2 endscrapers on a flake, 1 backed blade, 1 sidescraper and 3 retouched pieces.

The share of complete tools is high and amounts to 71.4%. Backed blades have the lowest rate of completeness, while the share of completeness of other tool types is above 70%. The exception is one truncation, which was found fragmented (Tab. 15).

Raw material

Cherts from Upper Cretaceous limestone with planktonic foraminifera have the highest frequency based on their number as well as weight. They are followed by cherts from Eocene foraminifera limestone and cherts from *Scaglia Rossa* limestone, while radiolarites, devitrified tuffs and silicified claystone have a share of less than 1%. A high share of raw materials falls under the burnt category (Tab. 16).

Chaîne opératoire

Most phases within *chaîne opératoire* were recorded among the cherts from Upper Cretaceous limestone with planktonic foraminifera. It starts with the removal of primary flakes, continues with the removal of secondary debitage and is followed by the central production phase. *Chaîne opératoire* in this raw material category was finalised by the discarding of tools. *Chaîne opératoire* among cherts from Eocene foraminifera limestone started with the removal of secondary debitage. We can assume the same for cherts from *Scaglia Rossa* limestone, although no cores were found in this category. The presence of one crested piece suggests *in situ* production for this raw material category. Although there are only a few radiolarite artefacts, we can assume their *in situ* production from this raw material,

	Ukupno / Total		Neobrađeno / Unretouched		Obrađeno / Retouched		% iskorištenosti / of use
	N	%	N	%	N	%	
Odbojci / Flakes	1110	63,5	1056	63,4	54	65,1	4,9
Sječiva / Blades	112	6,4	98	5,9	14	16,9	12,5
Pločice / Bladelets	195	11,2	180	10,8	15	18,1	7,7
Dotjerujući odbojci jezgre / Core renewal flakes	6	0,3	6	0,4			
Okrušci / Core tablets	3	0,2	3	0,2			
Krijestasta sječiva-pločice / Crested blades-bladelets	6	0,3	6	0,4			
Iver dubila / Burin spalls	4	0,2	4	0,2			
Mikrodubila / Microburins	1	0,1	1	0,1			
Odbojci / Flakes < 15 mm	13	0,7	13	0,8			
Jezgre / Cores	26	1,5	26	1,6			
Krhotine / Chunks	266	15,2	266	16,0			
Krhotine / Chunks < 15 mm	1	0,1	1	0,1			
Neodredivo / Unidentified	6	0,3	6	0,4			
Ukupno / Total	1749	100,0	1666	100,0	83	100,0	

Tab. 18 Litički skup nalaza iz horizonta KGP III.
Tab. 18 Lithic assemblage from horizon KGP III.

a ona na pločicama i sječivima imaju podjednaku učestalost. Najbrojnija oruđa na odbojcima su noktolika grebala, na sječivima komadi s obradom, a na pločicama su pločice s hrptom (tab. 21).

Grebala su najbrojnija oruđa u litičkom skupu nalaza, a među njima su najbrojnija noktolika grebala. Jednaku učestalost kao noktolika grebala imaju i pločice s hrptom. Sličnu učestalost, ali malo višu, imaju komadi s obradom. Strugala uz već spomenute tipove imaju također visoku učestalost. U ovom su horizontu zabilježena i dva dubila, što je njihova prva pojava u Vlaknu, ali ranije smo istaknuli da zbog prisutnosti ivera dubila u prethodna dva horizonta možemo pretpostaviti njihovu proizvodnju i ranije. Relativna učestalost ostalih tipova oruđa prikazana je u tablici 21. Jedno kombinirano oruđe kombinacija je strugala i dubila.

Među pločicama s hrptom samo jedna ima bilateralni strmi retuš i njezin distalni kraj je zašiljen. Ostale pločice s hrptom retuširane su unilateralno. Od devet unilateralno retuširanih pločica koje imaju sačuvan distalni završetak, kod dvije je on zašiljen, a kod ostalih je tup.

I u ovom horizontu visok je udio oruđa izrađenih na prvotnim oblicima bez okorine (oko 90%). Oruđa koja su izrađena na prvotnim oblicima s okorinom uključuju noktolika grebala (2), grebala na odbojku (3), strugalo (1), svrdlo (1) i komad s obradom (1).

Malo više od 50% oruđa je cjelovito, a cjelovitost prema tipovima prikazana je u tablici 22.

Sirovina

Rožnjaci iz gornjokrednih vapnenaca s planktonskim foraminiferama prema brojčanoj su učestalosti najzastuplje-

whereas the lack of debitage with cortex points to the possible transport of already prepared cores to the site (Tab. 17). Artefacts from devitrified tuffs and silicified claystone were probably not made on the site, but were brought into the cave.

HORIZON KGP III

The KGP III horizon represents the youngest Late Upper Palaeolithic horizon deposited just at the end of the Pleistocene, approximately 10 160 uncal BP. Its lithic assemblage includes tools, debitage, cores, technical pieces, chunks and artefacts smaller than 15 mm. Altogether 1794 artefacts were found, with a total weight of 3160.9 g. In comparison to other horizons, an extremely small frequency of artefacts smaller than 15 mm can be observed. One microburin was also found among the technical pieces (Tab. 18).

Debitage

Flakes are the most frequent category of debitage making up 79.2%, followed by bladelets with 13.5%, and blades with 7.4%. Approximately half of all the flakes were preserved complete. The share of complete blades is slightly under 50%, while the relative frequency of complete bladelets is lowest and amounts to approximately 39% (Tab. 19).

The relative frequency of feathered distal ends is the highest in all three categories of debitage. Hinged distal ends have a higher relative frequency among the flakes, while plunging distal ends have a higher frequency among the blades. Primary flakes were found in only 3 artefacts, while the frequency of secondary debitage is up to 15% among the bladelets, over 16% among the flakes and up to approximately 30% among the blades. The nodular type of cortex

	Odbojci / Flakes		Sječiva / Blades		Pločice / Bladelets	
	N	%	N	%	N	%
Cjelovitost / Completness						
cijelo / whole	618	58,5	48	49,0	70	38,9
proksimalno / proximal	137	13,0	21	21,4	34	18,9
medijalno / medial	52	4,9	7	7,1	19	10,6
distalno / distal	249	23,6	22	22,4	57	31,7
Tip završetka / Distal end						
perast / feathered	631	72,8	55	78,6	105	82,7
izvrnut / hinged	217	25,0	9	12,9	19	15,0
prebačen / plunging	19	2,2	6	8,6	3	2,4
Količina okorine / Cortex amount						
bez okorine / no cortex	881	83,4	69	70,4	153	85,0
s okorinom / some cortex	172	16,3	29	29,6	27	15,0
100% okorine / cortex	3	0,3				
Tip okorine / Cortex type						
nodularna / nodular	165	94,3	26	89,7	27	100,0
valutična / pebble	7	4,0	3	10,3		
nodularno-valutična / nodular-pebble	3	1,7				
Plohak / Butt						
okorinski / cortical	4	0,5	1	1,4		
glatki / plain	458	60,7	41	59,4	48	46,2
diedrični / dihedral	23	3,1	5	7,2		
višeplošni / facetted	8	1,1				
krilni / winged	24	3,2				
linijski / linear	16	2,1	2	2,9	4	3,8
točkasti / punctiform	13	1,7	3	4,3	7	6,7
smrskani / smashed	209	27,7	17	24,6	45	43,3

Tab. 19 Morfološka obilježja lomljevine iz horizonta KGP III.
Tab. 19 Morphological characteristics of debitage from horizon KGP III.

niji od svih sirovinskih kategorija u horizontu KGP III. Nakon njih najbrojniji su rožnjaci iz vapnenaca tipa *Scaglia Rossa*, ali važno je napomenuti da oni čine samo 1,7%, nasuprot 74,6% rožnjaka iz gornjokrednih vapnenaca s planktonskim foraminiferama. Nakon ove dvije skupine slijede devitrificirani tufovi i silicificirani glinjaci, zatim rožnjaci iz eocenskih foraminiferskih vapnenaca i radiolariti, s udjelom manjim od 1%. Velik dio artefakata pokazuje znakove žarenja. Isti trendovi su prisutni promatramo li težinsku učestalost (tab. 23).

Lanac operacija

Promatramo li lanac operacija u različitim sirovinskim kategorijama, samo za artefakte od rožnjaka iz gornjokrednih vapnenaca s planktonskim foraminiferama možemo pretpostaviti proizvodnju *in situ*, koja uključuje sve faze od skidanja prvotnih odbojaka do odbacivanja oruđa (tab. 24). Malobrojni artefakti od radiolarita i rožnjaka iz eocenskih foraminiferskih vapnenaca vjerojatno su doneseni u pećinu, a možda istu pretpostavku možemo iznijeti i za devitrificirane tufove i silicificirane glinjake iako su nešto brojniji od ar-

is predominant among the debitage with a cortex, while pebble cortex and nodular-pebble cortex types are rare. Plain butts are the most frequent among the debitage, with a high share of artefacts with a damaged butt. Dihedral and facetted butts were rarely found. A somewhat higher frequency of dihedral butts was recorded among the blades (Tab. 19).

Cores

A total of 26 cores were found, accounting for 1.5% of the lithic assemblage of this horizon (Pl. 5). A total of 17 complete cores were found, while others are fragmented. The average length of cores is 27.3 mm, and weight is 7.9 g. Flake cores are predominant and account for approximately half of all cores, while bladelets cores and mixed cores have approximately equal shares. Blade cores were not found (Tab. 20). All the mixed cores found have negatives of flakes and bladelets. The production of debitage from cores with one striking platform was the most frequent and they represent almost half of all cores. This is followed by bipolar cores whose relative frequency is around 24%. Two cores

	N	%
Tehnika lomljenja / Flaking		
jednoplatformna / one platform	8	47,1
dvoplatformna / two platforms	2	11,8
višeplatformna / > two platforms	2	11,8
rotirajuća / rotating	1	5,9
bipolarna / bipolar	4	23,5
Oblik jezgre / Core shape		
konična / conical	1	5,9
prizmatična / prismatic	3	17,6
pločasta / tabular	2	11,8
jezgra na odbojku / core on flake	4	23,5
amorfna / amorphous	7	41,2
Vrsta negativa / Type of removal		
odbojak / flake	8	47,1
pločica / bladelet	4	23,5
kombinirano / mixed	5	29,4
Priprema udarne plohe / Platform preparation		
bez priprema / absent	6	35,3
kvrcanje / trimming	11	64,7

Tab. 20 Morfološka obilježja jezgara iz horizonta KGP III.
Tab. 20 Morphological characteristics of cores from horizon KGP III.

tefakata u prethodno navedene dvije sirovinske kategorije. Artefakti od rožnjaka iz vapnenaca tipa *Scaglia Rossa* također su mogli biti doneseni u pećinu, ali ne možemo isključiti proizvodnju na samom nalazištu s obzirom na to da su artefakti od ove sirovine brojniji od onih u prethodno navedene tri sirovinske kategorije, a među artefaktima od rožnjaka iz vapnenaca tipa *Scaglia Rossa* je i nešto veća učestalost drugotne lomljevine.

HORIZONT MEZOLITIK I

Ovaj horizont predstavlja najraniji mezolitički horizont u Vlaknu koji se vjerojatno može datirati na sam početak holocena, sudeći prema jednom radiokarbonskom datumu iz horizonta Mezolitik II, kao i prema jednom radiokarbonskom datumu iz horizonta KGP III. Litički skup nalaza iz ovog horizonta brojčano je najveći i čini ga 2877 artefakta čija je težina 3166,7 g. U litičkom skupu nalaza prisutna su oruđa, lomljevina, tehnički komadi, jezgre, krhotine i artefakti manji od 15 mm. Mali odbojci i male krhotine čine gotovo polovicu litičkog skupa nalaza (tab. 25).

Lomljevina

Najbrojnija kategorija među lomljevinom su odbojci s učestalošću od 80,1%, nakon kojih slijede pločice i sječiva s učestalošću od 11,3%, odnosno 8,6%. Cjelovitost odbojaka

with two striking platforms and two cores with more than two striking platforms were found, while only one rotating core was found. When analysing the core shape, the most frequent shapes are amorphous, followed by cores on flakes. The frequency of other core shapes is shown in Table 20. Approximately two thirds of cores have traces of trimming, while others have no traces of preparation.

Tools

This horizon includes 83 tools which account for 4.8% of its lithic assemblage (Pl. 4). The most frequent tools are those made on flakes, while tools on bladelets and blades have approximately equal shares. Thumbnail endscrapers are the most frequent among the tools on flakes; among the tools on blades, retouched pieces are the most frequent; and among the tools on bladelets, backed bladelets are the most frequent (Tab. 21).

Endscrapers are the most frequent tools in the lithic assemblage, among which thumbnail endscrapers are the most numerous. Backed bladelets have a similar frequency as thumbnail endscrapers. Retouched pieces have a similar but slightly higher frequency. This horizon toolkit included two burins, which is their first appearance in Vlakno, but their earlier production can be assumed, as we pointed out earlier, on the basis of burin spalls in two previous horizons. The relative frequency of other tool types is shown in Table 21. The one found combined tool is a combination of a sidescraper and drill.

Among backed bladelets only one is bilaterally backed with a pointed distal end. Other backed bladelets were unilaterally retouched. Out of nine unilaterally retouched bladelets which have a preserved distal end, two have a pointed end and seven have a blunt end.

This horizon also has a high share of tools made on blanks without a cortex (approx. 90%). Tools made on blanks with a cortex include thumbnail endscrapers (2), endscrapers on flakes (3), sidescraper (1), drill (1) and retouched piece (1).

A little over 50% of the tools are complete, and the completeness by type is shown in Table 22.

Raw material

Cherts from Upper Cretaceous limestone with planktonic foraminifera have the highest frequency by number among all the raw material categories in the KGP III horizon. They are followed by cherts from *Scaglia Rossa* limestone, but it is important to mention that they have a share of only 1.7% compared to 74.6% of cherts from Upper Cretaceous limestone with planktonic foraminifera. These two groups are followed by devitrified tuffs, silicified claystone, cherts from Eocene foraminifera limestone and radiolarites, all with a share of under 1%. A large share of artefacts shows traces of burning. Same trends are present when we observe the frequency by weight (Tab. 23).

Chaîne opératoire

When analysing *chaîne opératoire* in different raw material categories, *in situ* production that includes all phases from removing primary flakes to discarding tools can be

	Odbojak / Flake	Sječivo / Blade	Pločica / Bladelet	Ukupno / Total	%
Grebalo / Endscraper				21	25,3
noktoliko / thumbnail	13			13	15,7
na odbojku / on flake	7			7	8,4
na sječivu-pločici / on blade-bladelet		1		1	1,2
Alatka s hrptom / Backed tool				16	19,3
pločica / bladelet			13	13	15,7
sječivo / blade		2		2	2,4
odbojak / flake	1			1	1,2
Strugalo / Sidescraper	9	3		12	14,5
Svrdlo / Drill	1	1		2	2,4
Dubilo / Burin				2	2,4
na slomljenom odbojku / on broken flake	1			1	1,2
transverzalno / transversal	1			1	1,2
Sitna rubna / Marginally retouched	5	1		6	7,2
Komad s obradom / Retouched piece	8	4	2	14	16,9
Nazubak / Denticulate	5	1		6	7,2
Udubak / Notch		1		1	1,2
Kombinirano oruđe / Combined tool	1			1	1,2
Ulomak / Fragment	2			2	2,4
Ukupno / Total	54	14	15	83	100,0
%	65,1	16,9	18,1		

Tab. 21 Učestalost oruđa prema tipu i prvobitnom obliku iz horizonta KGP III.
Tab. 21 Tool frequency by type and blank in horizon KGP III.

je nešto iznad 60%, a sječiva i pločica oko 46, odnosno 40%. Perasti završetak distalnog dijela dominantan je među lomljevinom (preko 70%). Nešto veća učestalost prebačenoga distalnog završetka zabilježena je kod sječiva. Lomljevina bez okorine prevladava u sve tri kategorije. Prvotna lomljevina zabilježena je samo među odbojcima i to sa samo 5 primjeraka. Učestalost drugotne lomljevine kreće se od 13% među pločicama do 20% među odbojcima. Nodularni tip okorine je najbrojniji među okorinskom lomljevinom. Valutični tip zabilježen je samo među odbojcima. Nodularno-valutični tip okorine zabilježen je samo na tri artefakta (tab. 26). Ovi podaci o tipu okorine upućuju na primarno iskorištavanje autohtonih ležišta sirovine.

Glatki tip plohka ima najveću učestalost u lomljevini, dok su diedrični i višeplošni tip vrlo rijetki. Ovo nam sugerira rijetko dotjerivanje udarnih plohi jezgri fasetiranjem. U sve tri kategorije lomljevine visoka je učestalost artefakata s oštećenim plohkom (tab. 26).

assumed only for artefacts from Upper Cretaceous limestone with planktonic foraminifera (Tab. 24). A small number of artefacts from radiolarite and cherts from Eocene foraminifera limestone were probably brought into the cave, and maybe the same assumption can be made for devitrified tuffs and silicified claystone, although they are somewhat more frequent than the two previously listed raw material categories. Artefacts made of cherts from *Scaglia Rossa* limestone could have also been brought into the cave, but we cannot rule out *in situ* production in view of the fact that artefacts made from this raw material are more frequent than those in the three previously listed raw material categories, while artefacts from *Scaglia Rossa* limestone also have a slightly higher frequency of secondary debitage.

HORIZON MEZOLITIK I

This horizon represents the earliest Mesolithic horizon in Vlakno, which can be probably dated back to the beginning

	N	%
noktoliko grebalo / thumbnail endscraper	11	84,6
grebalo na odbojku / endscraper on flake	3	42,9
grebalo na sječivu-pločici / endscraper on blade-bladelet	1	100,0
pločica s hrptom / backed bladelet	5	38,5
sječivo s hrptom / backed blade	2	100,0
odbojak s hrptom / backed flake	1	100,0
strugalo / sidescraper	8	66,7
svrdlo / drill	1	50,0
dubilo na slomljenom odbojku / burin on broken flake	1	100,0
dubilo transverzalno / transversal burin	1	100,0
sitna rubna / marginally retouched	2	33,3
komad s obradom / retouched piece	5	35,7
nazubak / denticulate	4	66,7
udubak / notch	0	0,0
kombinirano oruđe / combined tool	1	100,0

Tab. 22 Učestalost cjelovitih oruđa prema tipu iz horizonta KGP III.
Tab. 22 Frequency of complete tools by type in horizon KGP III.

Jezgre

Učestalost jezgara u litičkom skupu nalaza ovog horizonta iznosi 1%. Pronađeno ih je 30, od kojih su 22 cjelovite (T. 7). Prosječna težina jezgara u trenutku odbacivanja je 8,3 g, a dužina 29,3 mm.

Sirovina / Raw material	Težina / Weight (g)	%	N	%
radiolariti / radiolarites	0,9	0,0	2	0,1
rožnjaci EVF / cherts ELF	11,2	0,4	9	0,5
rožnjaci GKVPF / cherts UCLPF	2501,6	79,3	1294	74,6
rožnjaci SRV / cherts SRL	39,7	1,3	30	1,7
DVT, SG / DVT, SCS	30,7	1,0	17	1,0
razno / diverse	101,6	3,2	55	3,2
žareno / burnt	469,0	14,9	328	18,9
Ukupno / Total	3154,7	100,0	1735	100,0

Tab. 23 Učestalost sirovine prema težini i broju u horizontu KGP III
Tab. 23 Raw material frequency (by weight and number) from horizon KGP III..

of the Holocene, based on one radiocarbon date from the Mezolitik II horizon as well as one radiocarbon date from the KGP III horizon. This horizon's lithic assemblage is largest in number and includes 2877 artefacts with the total weight of 3166.7 g. The lithic assemblage includes tools, debitage, technical pieces, cores, chunks and artefacts smaller than 15 mm. Small flakes and chunks account for almost half of the lithic assemblage (Tab. 25).

	radiolariti / radiolarites	rožnjaci EVF / cherts ELF	rožnjaci GKVPF / cherts UCLPF	rožnjaci SRV / cherts SRL	DVT, SG / DVT, SCS	razno / diverse	žareno / burnt	Ukupno / Total
Prvotni odbojak / Primary flake	0	0	3	0	0	0	0	3
Drugotni odbojak / Secondary flake	0	1	134	3	0	5	29	172
Drugotno sječivo / Secondary blade	0	0	24	0	0	1	4	29
Drugotna pločica / Secondary bladelet	0	0	24	0	0	0	3	27
Odbojak / Flake	0	3	672	20	10	34	142	881
Sječivo / Blade	0	0	57	1	1	4	6	69
Pločica / Bladelet	1	1	118	4	3	7	19	153
Jezgra / Core	0	0	24	0	0	1	1	26
Dotjerujući odbojak jezgre / Core renewal flake	0	0	5	0	0	0	1	6
Okružak / Core tablet	0	0	3	0	0	0	0	3
Krijestasto sječivo-pločica / Crested blade-bladelet	0	0	5	0	0	0	1	6
Iver dubila / Burin spall	0	0	3	0	0	0	1	4
Mikrodubilo / Microburin	0	0	1	0	0	0	0	1
Krhotina / Chunk	0	1	153	1	2	3	106	266
Neodredivo / Unidentified	1	0	3	0	0	0	2	6
								1652
Alatke / Tools		●	●		●		●	

Tab. 24 Lanac operacija prema sirovinskim kategorijama iz horizonta KGP III.
Tab. 24 Chaîne opératoire by raw material categories from horizon KGP III.

	Ukupno / Total		Neobrađeno / Unretouched		Obrađeno / Retouched		% iskorištenosti / of use
	N	%	N	%	N	%	
Odbojci / Flakes	970	33,7	921	32,9	49	62,0	5,1
Sječiva / Blades	113	3,9	99	3,5	14	17,7	12,4
Pločice / Bladelets	145	5,0	130	4,7	15	19,0	10,3
Dotjerujući odbojci jezgre / Core renewal flakes	6	0,2	6	0,2			
Okrušci / Core tablets	10	0,4	10	0,4			
Iveri dubila / Burin spalls	5	0,2	5	0,2			
Odbojci / Flakes < 15 mm	1050	36,5	1050	37,5			
Jezgre / Cores	30	1,0	30	1,1			
Krhotine / Chunks	251	8,7	251	9,0			
Krhotine / Chunks < 15 mm	292	10,2	292	10,4			
Neodredivo / Unidentified	5	0,2	4	0,1	1	1,3	
Ukupno / Total	2877	100,0	2798	100,0	79	100,0	

Tab. 25 Litički skup nalaza iz horizonta Mezolitik I.
Tab. 25 Lithic assemblage from horizon Mezolitik I.

	Odbojci / Flakes		Sječiva / Blades		Pločice / Bladelets	
	N	%	N	%	N	%
Cjelovitost / Completness						
cijelo / whole	582	63,2	46	46,5	52	40,0
proksimalno / proximal	121	13,1	25	25,3	27	20,8
medijalno / medial	51	5,5	11	11,1	17	13,1
distalno / distal	167	18,1	17	17,2	34	26,2
Tip završetka / Distal end						
perast / feathered	553	73,8	48	76,2	68	79,1
izvrnut / hinged	184	24,6	5	7,9	16	18,6
prebačen / plunging	12	1,6	10	15,9	2	2,3
Količina okorine / Cortex amount						
bez okorine / no cortex	731	79,4	81	81,8	113	86,9
s okorinom / some cortex	185	20,1	18	18,2	17	13,1
100% okorine / cortex	5	0,5				
Tip okorine / Cortex type						
nodularna / nodular	169	88,9	18	100,0	15	88,2
valutična / pebble	20	10,5				
nodularno-valutična / nodular-pebble	1	0,5			2	11,8
Plohak / Butt						
okorinski / cortical	9	1,3				
glatki / plain	483	68,7	40	56,3	42	53,2
diedrični / dihedral	19	2,7	3	4,2	2	2,5
višeplošni / facetted	7	1,0			1	1,3
krilni / winged	15	2,1			1	1,3
linijski / linear	15	2,1	2	2,8	2	2,5
točkasti / punctiform	14	2,0	4	5,6	6	7,6
usnati / lip	1	0,1				
smrskani / smashed	140	19,9	22	31,0	25	31,6

Tab. 26 Morfološka obilježja lomljevine iz horizonta Mezolitik I.
Tab. 26 Morphological characteristics of debitage from horizon Mezolitik I.

Jezgre za odbojke su najbrojnije (oko 72%), slijede jezgre za pločice (oko 23%), te kombinirane jezgre (oko 5%) (tab. 27).

Jezgre s jednom udarnom plohom su najbrojnije, a nakon njih slijede višeplatformne jezgre. Bipolarne jezgre, jezgre s dvije udarne plohe i jezgre-krhotine prisutne su s po dva primjerka (tab. 27). Amorfne jezgre imaju najvišu učestalost, dok su ostale forme jezgara znatno slabije zastupljene. U ovom horizontu jezgre s tragovima kvrcanja i kombiniranim tragovima dotjerivanja nešto su brojnije od jezgri koje nemaju nikakve tragove dotjerivanja.

Oruđa

U ovom horizontu pronađeno je 79 oruđa koja čina 2,8% litičkog skupa nalaza (T. 6). Oruđa na odbojcima su najzastupljenija, a ona na pločicama i sječivima imaju podjednaku učestalost (tab. 28). Noktolika grebala su najbrojnija oruđa izrađena na odbojcima, nazupci na sječivima, a pločice s hrptom na pločicama. Najniži postotak iskorištenosti za izradu oruđa imaju odbojci, a pločice i sječiva imaju podjednak postotak iskorištenosti, približno dvostruko viši nego odbojci.

Najučestaliji tip oruđa su nazupci, a nakon njih slijede noktolika grebala, pa komadi s obradom. Pločice s hrptom imaju učestalost malo višu od 10%, kao i strugala. Zarubak, grebalo na sječivu, dvostruko grebalo i zakrivljeni šiljak s hrptom prisutni su s po jednim primjerkom (tab. 28). Oruđa za različite transformacijske aktivnosti dominiraju.

65 oruđa izrađeno je na prvotnim oblicima bez okorine. Oruđa koja su izrađena na prvotnim oblicima s okorinom uključuju noktoliko grebalo (3), strugalo (3), dubilo (3), komad s obradom (1), nazubak (2) i udubak (2).

Učestalost cjelovitih oruđa iznosi 57%. Cjelovitost prema tipovima vidljiva je u tablici 29.

Sirovina

Brojčana učestalost artefakata od rožnjaka iz gornjokrednih vapnenaca s planktonskim foraminiferama daleko premašuje sve ostale sirovinske kategorije među kojima se ipak ističu rožnjaci iz vapnenaca tipa *Scaglia Rossa* s niskom učestalošću od oko 1%. Ostale prisutne sirovine zabilježene su sa svega nekoliko komada. Velik broj artefakata pripisan je kategoriji žareno. Iste trendove možemo pratiti i kod težinske učestalosti (tab. 30).

Lanac operacija

Artefakti od rožnjaka iz gornjokrednih vapnenaca s planktonskim foraminiferama izrađivani su u pećini. Prva faza lanca operacija je skidanje prvotnih odbojaka, nakon koje slijedi skidanje drugotne lomljevine. Nakon toga slijedi središnja faza proizvodnje koju obilježava lomljevina bez okorine, jezgre i tehnički komadi. Za završnu fazu karakteristično je odbacivanje oruđa. Proizvodnja od rožnjaka iz vapnenaca tipa *Scaglia Rossa* mogla se također odvijati u pećini iako nisu pronađene jezgre. Proizvodnju *in situ* prije svega sugerira jedan dotjerujući odbojak jezgre. Oruđa od ove sirovine nisu zabilježena u špilji, kao ni prvotna lomljevina, što je pokazatelj nešto kraćeg lanca operacija od onoga koji je zabilježen kod rožnjaka iz gornjokrednih vapnenaca s

Debitage

Flakes are the most frequent debitage category with a share of 80.1%, followed by bladelets and blades with 11.3% and 8.6%, respectively. The completeness of flakes is a little over 60%, followed by blades with 46% and bladelets with 40%. Feathered distal ends dominate among the debitage (over 70%). Among the blades there is a relatively higher frequency of artefacts with a plunging distal end. Debitage without a cortex is prevalent in all three categories. Primary debitage was recorded only among the flakes, namely on 5 artefacts. The frequency of secondary debitage is from 13% among the bladelets to 20% among the flakes. The nodular type of cortex is the most frequent among the debitage with a cortex. The pebble type of cortex was recorded only among the flakes. The nodular-pebble type of cortex was found in only three artefacts (Tab. 26). These data on the type of cortex indicate the primary use of autochthonous raw material sources.

Plain butts are most frequent among the debitage, while dihedral and facetted butts were rarely found. This may suggest that preparation of the cores' striking platforms by faceting was rare. All three categories of debitage have a high share of artefacts with damaged butt (Tab. 26).

Cores

The frequency of cores in this horizon's lithic assemblage is 1%. A total of 30 cores were found, of which 22 were complete (Pl. 7). The average core weight at the moment of discarding was 8.3 g and the length 29.3 mm.

	N	%
Tehnika lomljenja / Flaking		
jednoplatformna / one platform	10	45,5
dvoplatformna / two platforms	2	9,1
višeplatforma / > two platforms	6	27,3
bipolarna / bipolar	2	9,1
jezgra-krhotina / core-chunk	2	9,1
Oblik jezgre / Core shape		
konična / conical	1	4,5
prizmatična / prismatic	1	4,5
pločasta / tabular	2	9,1
jezgra na odbojku / core on flake	2	9,1
amorfna / amorphous	14	63,6
klinasta / wedge	2	9,1
Vrsta negativa / Type of removal		
odbojak / flake	16	72,7
pločica / bladelet	5	22,7
kombinirano / mixed	1	4,5
Priprema udarne plohe / Platform preparation		
bez pripreme / absent	10	45,5
kvrcanje /trimming	10	45,5
kombinirano / combined	2	9,1

Tab. 27 Morfološka obilježja jezgara iz horizonta Mezolitik I.
Tab. 27 Morphological characteristics of cores from horizon Mezolitik I.

	Odbojak / Flake	Sječivo / Blade	Pločica / Bladelet	Neodredivo / Unidentified	Ukupno / Total	%
Grebalo / Endscraper					19	24,1
noktoliko / thumbnail	13				13	16,5
na odbojku / on flake	4				4	5,1
na sječivu-pločici / on blade-bladelet		1			1	1,3
dvostruko / double	1				1	1,3
Alatka s hrptom / Backed tool					10	12,7
pločica / bladelet			9		9	11,4
zakrivljeni šiljak / arched point			1		1	1,3
Zarubak / Truncation		1			1	1,3
Strugalo / Sidescraper	7	1			8	10,1
Svrdlo / Drill	1				1	1,3
Dubilo / Burin					3	3,8
ostalo / other	2	1			3	3,8
Sitna rubna / Marginally retouched	2	1	1		4	5,1
Komad s obradom / Retouched piece	7	3	2		12	15,2
Nazubak / Denticulate	9	4	1		14	17,7
Udubak / Notch	3	1	1		5	6,3
Ulomak / Fragment		1		1	2	2,5
Ukupno / Total	49	14	15	1	79	100,0
%	62,0	17,7	19,0	1,3		

Tab. 28 Učestalost oruđa prema tipu i prvobitnom obliku iz horizonta Mezolitik I.
Tab. 28 Tool frequency by type and blank in horizon Mezolitik I.

	N	%
noktoliko grebalo / thumbnail endscraper	13	100,0
grebalo na odbojku / endscraper on flake	1	25,0
grebalo na sječivu-pločici / endscraper on blade-bladelet	0	0,0
dvostruko grebalo / double endscraper	1	100,0
pločica s hrptom / backed bladelet	2	22,2
zakrivljeni šiljak s hrptom / arched backed point	1	100,0
zarubak / truncation	0	0,0
strugalo / sidescraper	4	50,0
svrdlo / drill	0	0,0
dubilo ostalo / burin other	2	66,7
sitna rubna / marginally retouched	3	75,0
komad s obradom / retouched piece	7	58,3
nazubak / denticulate	7	50,0
udubak / notch	4	80,0

Tab. 29 Učestalost cjelovitih oruđa prema tipu iz horizonta Mezolitik I.
Tab. 29 Frequency of complete tools by type in horizon Mezolitik I.

Cores for flakes are the most frequent (approx. 72%), followed by cores for bladelets (approx. 23%), and mixed cores (approx. 5%) (Tab. 27).

Single-platform cores are the most numerous, followed by cores with more than two striking platforms. Bipolar cores, cores with two striking platforms and cores-chunks are present with two examples each (Tab. 27). Amorphous cores have the highest frequency, while other core forms are significantly rarer. In this horizon cores with traces of trimming and combined traces of preparation are relatively more frequent than cores with no traces of preparation.

Tools

In this horizon 79 tools were found and they account for 2.8% of its lithic assemblage (Pl. 6). Tools on flakes are most frequent, while those on bladelets and blades have approximately equal frequency (Tab. 28). Thumbnail endscrapers are the most frequent tools made on flakes, denticulates on blades and backed bladelets on bladelets. Flakes have the lowest percentage of use for making tools, while bladelets and blades have a similar percentage of use, approximately twice as high as the flakes.

The most frequent tool type is denticulate, followed by thumbnail endscrapers and retouched pieces. The frequplanktonskim foraminiferama. Malobrojni artefakti od radiolarita, rožnjaka iz eocenskih foraminiferskih vapnenaca te devitrificiranih tufova i silicificiranih glinjaka vjerojatno nisu proizvođeni u pećini, nego su doneseni (tab. 31).

HORIZONT MEZOLITIK II

Za horizont Mezolitik II raspolažemo s jednim radiokarbonskim datumom koji kronološki smješta ovaj horizont prije oko 9200 uncal BP. U ovom horizontu pronađeno je 2635 artefakata čija je težina 4352,2 g. Litički skup nalaza čine oruđa, lomljevina, jezgre, tehnički komadi, krhotine i artefakti manji od 15 mm (tab. 32). Među tehničkim komadima pronađeno je jedno mikrodubilo, što je drugi takav primjerak u Vlaknu, a prvi u mezolitiku. Riječ je o proksimalnom mikrodubilu (T. 8: 28).

Lomljevina

Najvišu učestalost među lomljevinom imaju odbojci (76,4%), slijede pločice (13,8%), zatim sječiva (9,8%). Relativna učestalost cjelovitih odbojaka (oko 65%) viša je od relativne učestalosti cjelovitih pločica i sječiva (oko 43%). Perasti završetak distalnog dijela je dominantan u sve tri kategorije. Izvrnuti završetak ima nešto višu relativnu učestalost među odbojcima nego među sječivima i pločicama. Zabilježeno je samo 5 komada prvotne lomljevine i to među odbojcima. Udio drugotne lomljevine u sve tri kategorije podjednak je i kreće se između oko 14 i 16%. Preko 90% okorinske lomljevine ima tragove nodularne okorine sugerirajući na eksploatiranje autohtonih ležišta sirovine. Glatki plohak je najbrojniji u svim kategorijama uz visok udio komada s oštećenim plohkom. Malobrojni diedrični i višeplošni tipovi plohaka, uz već spomenute brojne glatke plohke, upućuju na rijetko dotjerivanje udarnih ploha jezgri fasetiranjem (tab. 33).

Sirovina / Raw material	Težina / Weight (g)	%	N	%
radiolariti / radiolarites	8,3	0,3	1	0,1
rožnjaci EVF / cherts ELF	2,0	0,1	1	0,1
rožnjaci GKVPF / cherts UCLPF	2233,8	80,4	1187	77,3
rožnjaci SRV / cherts SRL	20,4	0,7	17	1,1
DVT, SG / DVT, SCS	7,5	0,3	7	0,5
razno / diverse	101,9	3,7	58	3,8
žareno / burnt	403,3	14,5	264	17,2
Ukupno / Total	2777,2	100,0	1535	100,0

Tab. 30 Učestalost sirovine prema težini i broju iz horizonta Mezolitik I.

Tab. 30 Raw material frequency (by weight and number) from horizon Mezolitik I.

ency of backed bladelets as well as sidescrapers is just over 10%. Truncations, endscrapers on blade, double endscrapers and arched backed points are present with one artefact each (Tab. 28). Tools for various transformation activities represent the majority of tools.

A total of 65 tools were made on blanks without a cortex. Tools made on blanks with a cortex include thumbnail endscrapers (3), sidescrapers (3), burins (3), retouched pieces (1), denticulates (2) and notches (2).

The share of complete tools is 57%. The completeness by type is shown in Table 29.

	radiolariti / radiolarites	rožnjaci EVF / cherts ELF	rožnjaci GKVPF / cherts UCLPF	rožnjaci SRV / cherts SRL	DVT, SG / DVT, SCS	razno / diverse	žareno / burnt	Ukupno / Total
Prvotni odbojak / Primary flake	0	0	4	0	0	0	1	5
Drugotni odbojak / Secondary flake	1	0	147	1	0	3	33	185
Drugotno sječivo / Secondary blade	0	0	17	0	0	0	1	18
Drugotna pločica / Secondary bladelet	0	0	16	0	0	0	1	17
Odbojak / Flake	0	0	588	9	2	32	100	731
Sječivo / Blade	0	0	67	0	0	5	9	81
Pločica / Bladelet	0	0	92	3	2	4	12	113
Jezgra / Core	0	1	26	0	0	0	3	30
Dotjerujući odbojak jezgre / Core renewal flake	0	0	5	1	0	0	0	6
Okružak / Core tablet	0	0	9	0	0	1	0	10
Iver dubila / Burin spall	0	0	5	0	0	0	0	5
Krhotina / Chunk	0	0	142	3	2	8	96	251
Neodredivo / Unidentified	0	0	2	0	0	0	2	4
								1456
Oruđa / Tools			●		●	●	●	

Tab. 31 Lanac operacija prema sirovinskim kategorijama iz horizonta Mezolitik I.

Tab. 31 Chaîne opératoire by raw material categories from horizon Mezolitik I.

	Ukupno / Total		Neobrađeno / Unretouched		Obrađeno / Retouched		% iskorištenosti / of use
	N	%	N	%	N	%	
Odbojci / Flakes	1227	46,6	1150	45,5	77	70,6	6,3
Sječiva / Blades	168	6,4	148	5,9	20	18,4	11,9
Pločice / Bladelets	219	8,3	207	8,2	12	11,0	5,5
Dotjerujući odbojci jezgre / Core renewal flakes	6	0,2	6	0,2			
Okrušci / Core tablets	7	0,3	7	0,3			
Krijestasta sječiva-pločice / Crested blades-bladelets	2	0,1	2	0,1			
Iveri dubila	2	0,1	2	0,1			
Mikrodubila / Microburins	1	0,0	1	0,0			
Odbojci / Flakes < 15 mm	376	14,3	376	14,9			
Jezgre / Cores	66	2,5	66	2,6			
Krhotine / Chunks	374	14,2	374	14,8			
Krhotine / Chunks < 15 mm	183	6,9	183	7,2			
Neodredivo / Unidentified	4	0,2	4	0,2			
Ukupno / Total	2635	100,0	2526	100,0	109	100,0	

Tab. 32 Litički skup nalaza iz horizonta Mezolitik II.
Tab. 32 Lithic assemblage from horizon Mezolitik II.

Jezgre

66 pronađenih jezgara čini 2,5% litičkog skupa nalaza ovog horizonta (T. 9). Cjelovitih jezgara je 59, a fragmentiranih 7. Prosječna težina cjelovitih jezgara iznosi 9,5 g, a dužina 30,4 mm. Jezgre za odbojke su najbrojnije, slijede one za pločice i na kraju kombinirane. Sve kombinirane jezgre imaju negative odbojaka i pločica. Proizvodnja lomljevine od jezgara s jednom udarnom plohom predstavlja prevladavajuću redukcijsku strategiju za proizvodnju lomljevine. Nakon toga slijedi proizvodnja od jezgara s dvije udarne plohe, čija je učestalost, iako nešto viša, slična onoj višeplatformnih i bipolarnih jezgara. Amorfne jezgre su najbrojnije, a nakon njih slijede jezgre na odbojku i klinaste jezgre s podjednakom učestalošću od oko 17, odnosno 15%. Konične i pločaste jezgre imaju učestalost od oko 12%.

Na polovici jezgara vidljivi su tragovi kvrcanja, a kombinirani tragovi dotjerivanja zabilježeni su samo kod oko 7% svih jezgara. Malo više od 40% jezgara nema nikakve tragove dotjerivanja (tab. 34).

Oruđa

Pronađenih 109 oruđa čini 4,2% cjelokupnoga litičkog skupa nalaza ovog horizonta (T. 8: 1–27). Oruđa izrađena na odbojcima imaju najveću učestalost (oko 71%), slijede ona na sječivima (oko 18%) i na kraju na pločicama (oko 11%). Strugala su najbrojniji tip oruđa na odbojcima, komadi s obradom na sječivima, a pločice s hrptom su najbrojniji tip među pločicama (tab. 35).

Grebala su najbrojnija skupina oruđa koja čini gotovo četvrtinu svih oruđa, a među njima noktolika grebala imaju najvišu učestalost. Nešto višu učestalost od noktolikih gre-

Raw material

The frequency by number of cherts from Upper Cretaceous limestone with planktonic foraminifera exceeds by far all other raw material categories, of which we can point out cherts from *Scaglia Rossa* limestone with a low frequency of around 1%. Other present raw materials were recorded in only several artefacts. A large number of artefacts were placed in the burnt category. The same trends can be observed when looking at the frequency by weight (Tab. 30).

Chaîne opératoire

Artefacts from Upper Cretaceous limestone with planktonic foraminifera were produced in the cave. The first phase of *chaîne opératoire* was to remove primary flakes and then to remove secondary debitage. This is followed by the central production phase characterised by debitage without cortex, cores and technical pieces. The final production phase is characterised by the discarding of tools. Production from cherts from *Scaglia Rossa* limestone may have also taken place in the cave, although no cores were found. *In situ* production is particularly suggested by one core renewal flake. Tools made from this raw material or primary debitage were not found in the cave, which indicates a relatively shorter *chaîne opératoire* than the one recorded for cherts from Upper Cretaceous limestone with planktonic foraminifera. A small number of artefacts from radiolarite and cherts from Eocene foraminifera limestone as well as devitrified tuffs and silicified claystone were probably not produced in the cave, but were brought into it (Tab. 31).

	Odbojci / Flakes		Sječiva / Blades		Pločice / Bladelets	
	N	%	N	%	N	%
Cjelovitost / Completness						
cijelo / whole	750	65,2	64	43,2	91	44,0
proksimalno / proximal	139	12,1	32	21,6	37	17,9
medijalno / medial	52	4,5	19	12,8	25	12,1
distalno / distal	209	18,2	33	22,3	54	26,1
Tip završetka / Distal end						
perast / feathered	695	72,5	82	84,5	113	77,9
izvrnut / hinged	241	25,1	10	10,3	24	16,6
prebačen / plunging	23	2,4	5	5,2	8	5,5
Količina okorine / Cortex amount						
bez okorine / no cortex	951	82,7	124	83,8	177	85,5
s okorinom / some cortex	194	16,9	24	16,2	30	14,5
100% okorine / cortex	5	0,4				
Tip okorine / Type of cortex						
nodularna / nodular	180	90,5	21	87,5	29	96,7
valutična / pebble	16	8,0	3	12,5		
nodularno-valutična / nodular-pebble	3	1,5			1	3,3
Plohak / Butt						
okorinski / cortical	5	0,6				
glatki / plain	564	63,4	54	56,3	71	55,5
diedrični / dihedral	38	4,3	3	3,1	2	1,6
višeplošni / facetted	8	0,9	2	2,1		
krilni / winged	17	1,9	3	3,1	1	0,8
linijski / linear	21	2,4	8	8,3	7	5,5
točkasti / punctiform	13	1,5	6	6,3	12	9,4
smrskani / smashed	223	25,1	20	20,8	35	27,3

Tab. 33 Morfološka obilježja lomljevine iz horizonta Mezolitik II.
Tab. 33 Morphological characteristics of debitage from horizon Mezolitik II.

bala imaju strugala i komadi s obradom. Pločice s hrptom imaju učestalost od oko 7%. Zabilježeno je samo jedno dubilo te jedno kombinirano oruđe koje je kombinacija strugala i udupka (tab. 35).

Sve pločice s hrptom obrađene su unilateralno i imaju tupi distalni završetak.

Najveći dio oruđa izrađen je na prvotnim oblicima bez okorine (oko 87%). Na prvotnim oblicima s okorinom izrađena su 4 noktolika grebala, 2 grebala na odbojku, 1 grebalo na sječivu/pločici, 4 strugala, 1 komad sa sitnom rubnom obradom i 1 komad s obradom.

Cjelovitost oruđa iznosi 59,6%. Učestalost cjelovitosti prema tipovima prikazana je u tablici 36. Sva grebala na sječivu/pločici su fragmentirana, a nešto višu stopu cjelovitosti imaju pločice s hrptom.

Sirovina

Brojčana učestalost artefakata od rožnjaka iz gornjokrednih vapnenaca s planktonskim foraminiferama je iznad 70%. Ostale sirovine korištene su samo povremeno. Njihova učestalost je oko ili ispod 1%. Isti trendovi vidljivi su ako promatramo težinsku učestalost (tab. 37). Velik udio sirovine je žaren.

HORIZON MEZOLITIK II

For the Mezolitik II horizon we have one radiocarbon date which places this horizon before 9200 uncal BP. This horizon is composed of 2635 artefacts with a total weight of 4352.2 g. The lithic assemblage includes tools, debitage, cores, technical pieces, chunks and artefacts smaller than 15 mm (Tab. 32). One microburin was found among the technical pieces, which is the second such piece in Vlakno, and the first in the Mesolithic. It is a proximal microburin (Pl. 8: 28).

Debitage

The most frequent debitage category are flakes (76.4%), followed by bladelets (13.8%) and blades (9.8%). The relative frequency of complete flakes (approx. 65%) is higher than the relative frequency of complete bladelets and blades (approx. 43%). Feathered distal ends dominate in all three categories. Flakes have a relatively higher frequency of pieces with a plunging distal end compared to blades and bladelets. Primary debitage was recorded only on 5 artefacts among the flakes. The share of secondary debitage in all three categories is similar, ranging from 14% to 16%. Over 90% of the debitage with a cortex has traces of the nodular-

Tehnika lomljenja / Flaking		
jednoplatformna / one platform	28	47,5
dvoplatformna / two platforms	9	15,3
višeplatformna / > two platforms	8	13,6
rotirajuća / rotating	4	6,8
bipolarna / bipolar	7	11,9
jezgra-krhotina / core-chunk	3	5,1
Oblik jezgre / Core shape		
konična / conical	7	11,9
prizmatična / prismatic	3	5,1
pločasta / tabular	7	11,9
globularna / globular	2	3,4
jezgra na odbojku / core on flake	10	16,9
amorfna / amorphous	21	35,6
klinasta / wedge	9	15,3
Vrsta negativa / Type of removal		
odbojak / flake	43	72,9
pločica / bladelet	10	16,9
kombinirano / mixed	6	10,2
Priprema udarne plohe / Platform preparation		
bez pripreme / absent	25	42,4
kvrcanje / trimming	30	50,8
kombinirano / mixed	4	6,8

Tab. 34 Morfološka obilježja jezgara iz horizonta Mezolitik II.
Tab. 34 Morphological characteristics of cores from horizon Mezolitik II.

	Odbojak / Flake	Sječivo / Blade	Pločica / Bladelet	Ukupno / Total	%
Grebalo / Endscraper				26	23,9
noktoliko / thumbnail	15			15	13,8
na odbojku / on flake	7			7	6,4
na sječivu-pločici / on blade-bladelet		4		4	3,7
Alatka s hrptom / Backed tool				13	11,9
pločica / bladelet			8	8	7,3
sječivo / blade		2		2	1,8
odbojak / flake	3			3	2,8
Strugalo / Sidescraper	17			17	15,6
Svrdlo / Drill		1		1	0,9
Dubilo / Burin				1	0,9
ostalo / other	1			1	0,9
Sitna rubna / Marginally retouched	5	1		6	5,5
Komad s obradom / Retouched piece	9	6	2	17	15,6
Nazubak / Denticulate	9	1		10	9,2
Udubak / Notch	8	5	2	15	13,8
Kombinirano oruđe / Combined tool	1			1	0,9
Ulomak / Fragment	2			2	1,8
Ukupno / Total	77	20	12	109	100,0
%	70,6	18,4	11,0		

Tab. 35 Učestalost oruđa prema tipu i prvobitnom obliku iz horizonta Mezolitik II.
Tab. 35 Tool frequency by type and blank in horizon Mezolitik II.

Lanac operacija

S velikom sigurnošću možemo tvrditi da se proizvodnja od rožnjaka iz gornjokrednih vapnenaca s planktonskim foraminiferama odvijala na samom nalazištu, počevši od skidanja prvotne lomljevine, pa do odbacivanja oruđa. Među rožnjacima iz eocenskih foraminiferskih vapnenaca, rožnjacima iz vapnenaca tipa *Scaglia Rossa* te devitrificiranim tufovima i silicificiranim glinjacima nisu pronađene jezgre koje bi bile najbolji pokazatelj proizvodnje na samom nalazištu, ali prisutnost drugotne lomljevine, lomljevine bez okorine, krhotina i oruđa pokazuje da ne možemo u potpunosti isključiti proizvodnju od ovih sirovina u pećini (tab. 38).

HORIZONT MEZOLITIK III

Horizont Mezolitik III predstavlja najmlađi mezolitički horizont u Vlaknu. Ovaj horizont nije apsolutno datiran. Litički skup nalaza manji je od litičkih skupova nalaza iz ostalih horizonata. Pronađena su ukupno 643 artefakta čija je težina 1239 g. Litički skup nalaza čine oruđa, lomljevina, jezgre, tehnički komadi, krhotine i artefakti manji od 15 mm (tab. 39).

Lomljevina

Odbojci imaju najvišu učestalost (oko 72%), slijede pločice (oko 16%) i na kraju sječiva (oko 12%). Indeks cjelovitosti najviši je kod odbojaka, dok je kod pločica i sječiva niži. Me-

type cortex, which suggests exploitation of autochthonous raw material sources. Plain butts are the most frequent in all categories with a high share of artefacts with a damaged butt. A small number of dihedral and facetted butts, together with the already mentioned numerous plain butts, indicate that the preparation of cores' striking platforms by faceting was rare (Tab. 33).

Cores

A total of 66 cores were found, which account for 2.5% of this horizon's lithic assemblage (Pl. 9). A total of 59 complete cores were found, along with 7 fragmented. The average weight of complete cores is 9.5 g and length 30.4 mm. Flake cores are most frequent, followed by bladelet cores and mixed cores. All mixed cores have negatives of flakes and bladelets. Flaking from the cores with one striking platform represents the dominant reduction strategy for debitage production. This is followed by flaking from cores with two striking platforms, whose frequency, although relati-

	N	%
noktoliko grebalo / thumbnail endscraper	14	93,3
grebalo na odbojku / endscraper on flake	4	57,1
grebalo na sječivu-pločici / endscraper on blade-bladelet	0	0,0
pločica s hrptom / backed bladelet	2	25,0
sječivo s hrptom / backed blade	1	50,0
odbojak s hrptom / backed flake	3	100,0
strugalo / sidescraper	10	58,8
svrdlo / drill	1	100,0
dubilo ostalo / burin other	1	100,0
sitna rubna / marginally retouched	4	66,7
komad s obradom / retouched piece	8	47,1
nazubak / denticulate	6	60,0
udubak / notch	10	66,7
kombinirano oruđe / combined tool	1	100,0

Tab. 36 Učestalost cjelovitih oruđa prema tipu iz horizonta Mezolitik II.

Tab. 36 Frequency of complete tools by type in horizon Mezolitik II.

đu distalnim završecima lomljevine prevladava perasti završetak. Prebačeni distalni završetak znatno je učestaliji kod sječiva nego kod odbojaka i pločica. Visok udio lomljevine je bez okorine. Prvotna lomljevina nije prisutna u litičkom skupu nalaza. Kod drugotne lomljevine prevladavaju komadi s nodularnom okorinom. Lomljevina s valutičnom okorinom zabilježena je samo među odbojcima. Glatki tip plohka je dominantan u svim kategorijama lomljevine. Diedrični i višeplošni tip prisutni su samo među odbojcima. Približno trećina svih pločica i sječiva koje su sačuvane cjelovite ili u proksimalnom dijelu ima oštećen plohak, dok je kod odbojaka ta učestalost nešto niža (tab. 40).

Jezgre

33 jezgre čine 5,1% litičkog skupa nalaza ovog horizonta (T. 10: 13–21). Cjelovitih primjeraka je 26, a fragmentiranih 7. Prosječna dužina sačuvanih cjelovitih jezgara je 27,8 mm, a težina 6,5 g. Jezgre za odbojke dominiraju, dok one za pločice i kombinirane imaju višestruko manju učestalost. Sve kombinirane jezgre imaju negative odbojaka i pločica. Jezgre za sječiva nisu pronađene. Više od polovice jezgara su one s jednom udarnom plohom, a nakon njih su najbrojnije bipolarne. Ostale jezgre su zastupljene s po jednim ili dva primjerka (tab. 41). Promatramo li jezgre prema obliku, amorfne imaju najvišu učestalost, a nakon njih slijede klinaste, pa pločaste. Konične i prizmatične jezgre prisutne su s dva, odnosno jednim primjerkom. Malo više od polovice jezgara nema tragove dotjerivanja, a ostatak jezgara ima tragove kvrcanja (tab. 41).

Oruđa

U ovom je horizontu pronađeno 31 oruđe koje čini 4,8%

Sirovina / Raw material	Težina / Weight (g)	%	N	%
rožnjaci EVF / cherts ELF	31,1	0,7	15	0,7
rožnjaci GKVPF / cherts UCLPF	3225,2	77,2	1591	76,6
rožnjaci SRV / cherts SRL	40,6	1,0	23	1,1
DVT, SG / DVT, SCS	9,4	0,2	7	0,3
razno / diverse	209,5	5,0	84	4,0
žareno / burnt	663,9	15,9	356	17,1
Ukupno / Total	4179,6	100,0	2076	100,0

Tab. 37 Učestalost sirovine prema težini i broju iz horizonta Mezolitik II.

Tab. 37 Raw material frequency (by weight and number) from horizon Mezolitik II.

vely higher, is similar to those for cores with more than two striking platforms and bipolar cores. Amorphous cores are the most numerous, followed by cores on flake and wedge cores with an equal frequency of approx. 17% and 15%, respectively. Conical and tabular cores have a frequency of around 12%.

Half of the cores have visible traces of trimming, while combined traces of preparation were recorded on approx. 7% of all cores. Over 40% of cores have no traces of preparation (Tab. 34).

Tools

A total of 109 tools that were found accounts for 4.2% of this horizon's lithic assemblage (Pl. 8: 1–27). Tools on flakes have the highest frequency (approx. 71%), followed by those on blades (approx. 18%) and bladelets (approx. 11%). Sidescrapers are the most frequent among the tools on flakes; retouched pieces among the tools on blades, and backed bladelets among the tools on bladelets (Tab. 35).

Endscrapers represent the largest group of tools, accounting for almost one fourth of all tools, among which thumbnail endscrapers have the highest frequency. Sidescrapers and retouched pieces have a slightly higher frequency than thumbnail endscrapers. Backed bladelets have a frequency of around 7%. Only one burin was found as well as one combined tool which is a combination of a sidescraper and notch (Tab. 35).

All backed bladelets have been unilaterally retouched with a blunt distal end.

The largest part of the tools was made on blanks without a cortex (approx. 87%). Blanks with a cortex were used for making 4 thumbnail endscrapers, 2 endscrapers on flake, 1 endscraper on blade/bladelet, 4 sidescrapers, 1 marginally retouched piece and 1 retouched piece.

The share of complete tools is 59.6%. The frequency of complete tools by type is shown in Table 36. All endscrapers on blade/bladelet are fragmented, while backed bladelets have a slightly higher rate of completeness.

Raw material

The frequency by number of cherts from Upper Cretaceous limestone with planktonic foraminifera exceeds 70%.

	rožnjaci EVF / cherts ELF	rožnjaci GKVPF / cherts UCLPF	rožnjaci SRV / cherts SRL	DVT, SG / DVT, SCS	razno / diverse	žareno / burnt	Ukupno / Total
Prvotni odbojak / Primary flake	0	5	0	0	0	0	5
Drugotni odbojak / Secondary flake	2	162	2	1	4	23	194
Drugotno sječivo / Secondary blade	0	23	0	0	0	1	24
Drugotna pločica / Secondary bladelet	0	28	0	0	0	2	30
Odbojak / Flake	8	735	12	3	46	147	951
Sječivo / Blade	1	103	2	1	5	12	124
Pločica / Bladelet	1	149	3	0	3	21	177
Jezgra / Core	0	51	0	0	4	11	66
Dotjerujući odbojak jezgre / Core renewal flake	0	5	0	0	0	1	6
Okružak / Core tablet	0	6	0	0	0	1	7
Krijestasto sječivo-pločica / Crested blade-bladelet	0	2	0	0	0	0	2
Iver dubila / Burin Spall	0	2	0	0	0	0	2
Mikrodubilo / Microburin	0	1	0	0	0	0	1
Krhotina / Chunk	2	231	2	1	14	124	374
Neodredivo / Unidentified	0	1	0	0	1	2	4
							1967
Oruđa / Tools	●	●	●	●	●	●	

Tab. 38 Lanac operacija prema sirovinskim kategorijama iz horizonta Mezolitik II.
Tab. 38 Chaîne opératoire by raw material categories from horizon Mezolitik II.

litičkog skupa nalaza (T. 10: 1–12). Oruđa na odbojcima su najbrojnija, slijede ona na sječivima i na kraju na pločicama. Komadi s obradom su najučestaliji tip na odbojcima, nazupci na sječivima, a među tri oruđa na pločicama prisutna su tri tipa.

Tipološki gledano, komadi s obradom su najbrojniji tip, a grebala najbrojnija grupa oruđa. Noktolikih grebala ima 4, a pločica s hrptom 1. Dubila nisu prisutna među oruđima,

Other raw materials were rarely used. Their frequency is around or below 1%. The same trends are visible when we observe the frequency by weight (Tab. 37). A large portion of the raw materials is burnt.

Chaîne opératoire

We can establish with great certainty that the production of tools made of cherts from Upper Cretaceous limesto-

	Ukupno / Total		Neobrađeno / Unretouched		Obrađeno / Retouched		% iskorištenosti / of use
	N	%	N	%	N	%	
Odbojci / Flakes	300	46,7	279	45,6	21	67,7	7,0
Sječiva / Blades	52	8,1	45	7,4	7	22,6	13,5
Pločice / Bladelets	64	10,0	61	10,0	3	9,7	4,7
Dotjerujući odbojci jezgre / Core renewal flakes	2	0,3	2	0,3			
Okrušci / Core tablets	1	0,2	1	0,2			
Odbojci / Flakes < 15 mm	53	8,2	53	8,7			
Jezgre / Cores	33	5,1	33	5,4			
Krhotine / Chunks	104	16,2	104	17,0			
Krhotine / Chunks < 15 mm	30	4,7	30	4,9			
Neodredivo / Unidentified	4	0,6	4	0,7			
Ukupno / Total	643	100,0	612	100,0	31	100,0	

Tab. 39 Litički skup nalaza iz horizonta Mezolitik III.
Tab. 39 Lithic assemblage from horizon Mezolitik III.

	Odbojci / Flakes		Sječiva / Blades		Pločice / Bladelets	
	N	%	N	%	N	%
Cjelovitost / Completness						
cijelo / whole	184	65,9	17	37,8	29	47,5
proksimalno / proximal	34	12,2	9	20,0	10	16,4
medijalno / medial	15	5,4	6	13,3	8	13,1
distalno / distal	46	16,5	13	28,9	14	23,0
Tip završetka / Distal end						
perast / feathered	172	74,8	21	70,0	36	83,7
izvrnut / hinged	53	23,0	4	13,3	6	14,0
prebačen / plunging	5	2,2	5	16,7	1	2,3
Količina okorine / Cortex amount						
bez okorine / no cortex	239	85,7	39	86,7	47	77,0
s okorinom / some cortex	40	14,3	6	13,3	14	23,0
Tip okorine / Cortex type						
nodularna / nodular	34	85,0	6	100,0	14	100,0
valutična / pebble	6	15,0				
Plohak / Butt						
okorinski / cortical	2	0,9				
glatki / plain	148	67,9	16	61,5	21	53,8
diedrični / dihedral	7	3,2				
všeplošni / facetted	3	1,4				
krilni / winged	8	3,7	1	3,8		
linijski / linear	4	1,8				
točkasti / punctiform	4	1,8	1	3,8	5	12,8
smrskani / smashed	42	19,3	8	30,8	13	33,3

Tab. 40 Morfološka obilježja lomljevine iz horizonta Mezolitik III.
Tab. 40 Morphological characteristics of debitage from horizon Mezolitik III.

kao ni iveri dubila među tehničkim komadima (tab. 42).

Pronađena je samo jedna pločica s hrptom koja je retuširana unilateralno.

Na prvotnim oblicima bez okorine izrađeno je 74,2% oruđa. Na prvotnim oblicima s okorinom izrađena su grebala na odbojku (2), strugalo (1), udubak (1) i komadi s obradom (4).

Indeks cjelovitosti oruđa iznosi 54,8%, a cjelovitost prema tipovima vidljiva je u tablici 43.

Sirovina

Dominantno korištena sirovina u ovom horizontu su rožnjaci iz gornjokrednih vapnenaca s planktonskim foraminiferama. Ostale sirovine zastupljene su s učestalošću nižom od 1%. Brojčana i težinska učestalost pokazuju vrlo sličan trend. Velik broj artefakata je žaren (tab. 44).

Lanac operacija

Promatramo li lanac operacija u različitim sirovinskim kategorijama dolazimo do zaključka da se od rožnjaka iz eocenskih foraminiferskih vapnenaca, rožnjaka iz gornjokrednih vapnenaca s planktonskim foraminiferama i rožnjaka iz eocenskih vapnenaca tipa *Scaglia Rossa* proizvodnja

ne with planktonic foraminifera took place on the site itself, starting with the removal of primary flakes and ending with the discarding of tools. No cores were found among the cherts from Eocene foraminifera limestone, cherts from *Scaglia Rossa* limestone and devitrified tuffs and silicified claystone, which would be the best indicator of their *in situ* production, but the presence of secondary debitage, debitage without a cortex, chunks and tools indicates that we cannot completely rule out production in the cave using these raw materials (Tab. 38).

HORIZON MEZOLITIK III

The Mezolitik III horizon represents the youngest Mesolithic horizon in Vlakno. This horizon has not been absolutely dated. The lithic assemblage is smaller than the lithic assemblages of other horizons. A total of 643 artefacts were found, with a total weight of 1239 g. Its lithic assemblage includes tools, debitage, cores, technical pieces, chunks and artefacts smaller than 15 mm (Tab. 39).

Debitage

Flakes have the highest frequency (approx. 72%), followed by bladelets (approx. 16%) and blades (approx.

	N	%
Tehnika lomljenja / Flaking		
jednoplatformna / one platform	14	53,8
dvoplatformna / two platforms	1	3,8
višeplatformna / > two platforms	2	7,7
rotirajuća / rotating	1	3,8
bipolarna / bipolar	6	23,1
jezgra-krhotina / core-chunk	2	7,7
Oblik jezgre / Core shape		
konična / conical	2	7,7
prizmatična / prismatic	1	3,8
pločasta / tabular	5	19,2
jezgra na odbojku / core on flake	3	11,5
amorfna / amorphous	9	34,6
klinasta / wedge	6	23,1
Vrsta negativa / Type of removal		
odbojak / flake	18	69,2
pločica / bladelet	5	19,2
kombinirano / mixed	3	11,5
Priprema udarne plohe / Platform preparation		
bez pripreme / absent	14	53,8
kvrcanje / trimming	12	46,2

Tab. 41 Morfološka obilježja jezgara iz horizonta Mezolitik III.
Tab. 41 Morphological characteristics of cores from horizon Mezolitik III.

12%). The completeness index is highest for flakes and lower for bladelets and blades. A feathered distal end dominates among debitage. Plunging ends are significantly more frequent among the blades than among the flakes and bladelets. A high share of debitage is without a cortex. Primary debitage is not present in the lithic assemblage. The nodular type of cortex is predominant among the debitage with a cortex. Debitage with a pebble cortex was recorded only among the flakes. Plain butts are the most frequent in all categories of debitage. Dihedral and facetted butts have been found only among the flakes. Approximately one third of all complete and proximal bladelets and blades have a damaged butt, while in case of flakes this frequency is relatively lower (Tab. 40).

Cores

A total of 33 cores account for 5.1% of this horizon's lithic assemblage (Pl. 10: 13–21). There were 26 complete and 7 fragmented cores. The average length of preserved complete cores is 27.8 mm, and weight 6.5 g. Flake cores are predominant, while cores for bladelets and mixed cores have a frequency several times lower. All mixed cores have negatives of flakes and bladelets. Cores for blades were not found. More than half of the cores are single-platform cores followed by bipolar cores. Other cores are present with only one or two specimens (Tab. 41) According to their form, amorphous cores have the highest frequency, followed by wedge and tabular cores. Conical and prismatic cores were present with two pieces and one piece respectively. Slightly more than half of the cores have no traces of preparation, while other cores have traces of trimming (Tab. 41).

Tools

	Odbojak / Flake	Sječivo / Blade	Pločica / Bladelet	Ukupno / Total	%
Grebalo / Endscraper				8	25,8
noktoliko / thumbnail	4			4	12,9
na odbojku / on flake	4			4	12,9
Alatka s hrptom / Backed tool				1	3,2
pločica / bladelet			1	1	3,2
Zarubak / Truncation			1	1	3,2
Strugalo / Sidescraper	1			1	3,2
Svrdlo / Drill	1			1	3,2
Komad s obradom / Retouched piece	6	2		8	25,8
Nazubak / Denticulate	3	4		7	22,6
Udubak / Notch	1	1	1	3	9,7
Ulomak / Fragment	1			1	3,2
Ukupno / Total	21	7	3	31	100,0
%	67,7	22,6	9,7		

Tab. 42 Učestalost oruđa prema tipu i prvobitnom obliku iz horizonta Mezolitik III.
Tab. 42 Tool frequency by type and blank in horizon Mezolitik III.

	N	%
noktoliko grebalo / thumbnail endscraper	4	100,0
grebalo na odbojku / endscraper on flake	0	0,0
pločica s hrptom / backed bladelet	0	0,0
zarubak / truncation	1	100,0
strugalo / sidescraper	1	100,0
svrdlo / drill	1	100,0
komad s obradom / retouched piece	7	87,5
nazubak / denticulate	2	28,6
udubak / notch	1	33,3

Tab. 43 Učestalost cjelovitih oruđa prema tipu iz horizonta Mezolitik III.
Tab. 43 Frequency of complete tools by type from horizon Mezolitik III.

odvijala *in situ*, dok su artefakti od devitrificiranih tufova i silicificiranih glinjaka vjerojatno doneseni u pećinu. Među rožnjacima iz gornjokrednih vapnenaca s planktonskim foraminiferama drugotna lomljevina dokumentira prisutnost više faza lanca operacija nego kod rožnjaka iz eocenskih foraminiferskih vapnenaca i rožnjaka iz eocenskih vapnenaca tipa *Scaglia Rossa* gdje ona nije zabilježena (tab. 45).

SAŽETAK, KOMPARACIJA I INTERPRETACIJA LITIČKOG SKUPA NALAZA IZ VLAKNA

Litički skupovi nalaza koji su obrađeni u ovom radu kronološki se mogu smjestiti u raspon od kasnoglacijalnog interstadijala do vjerojatno predboreala/boreala. Prema brojnosti litičkih skupova nalaza možemo pretpostaviti najintenzivnije aktivnosti u pećini tijekom horizonata KGP III, Mezolitik I i Mezolitik II, koji se kronološki smještaju na sam završetak pleistocena i na početak holocena. Aktivnosti najslabijeg intenziteta mogle su se događati tijekom najmlađeg horizonta (Mezolitik III), u kojem je pronađen najmanji litički skup nalaza.

U litičkim skupovima nalaza svih horizonata prisutna su oruđa, lomljevina, jezgre, tehnički komadi i artefakti manji od 15 mm. Brojnost artefakata manjih od 15mm u horizontu KGP III znatno je manja u usporedbi s ostalim horizontima. Jedna od interpretacija mogla bi biti da su se u vremenu trajanja ovog horizonta oruđa izrađivala u manjoj mjeri nego u drugim horizontima, ali njihova prisutnost ne ostavlja mogućnost ovakvoj interpretaciji. Za ovako mali broj artefakata manjih od 15 mm teško je ponuditi zadovoljavajući odgovor.

U horizontima KGP III i Mezolitik II zabilježeno je po jedno mikrodubilo. Njihov mali broj pokazuje da su ona mogla nastati spontano, kao greška u procesu proizvodnje artefakata s hrptom (Inizan et al. 1999: 82; De Wilde, De Bie 2011: 737), a ne kao nusproizvod sustavne primjene ove tehnike za proizvodnju tzv. *piquant-trièdre* i geometrijskih mikrolita (trokuta, trapeza i segmenata). Sustavnom primjenom ove tehnike, mikrodubila se pojavljuju u znatnijem broju u litičkim skupovima nalaza (usp. Perlès 1987; 1999).

A total of 31 tools were found in this horizon, which account for 4.8% of its lithic assemblage (Pl. 10: 1–12). Tools on flakes are the most frequent, followed by those on blades and bladelets. The most frequent tools on flakes are retouched pieces and on blades the most frequent are denticulates, while among three tools on bladelets three types are present.

When analysing the types, retouched pieces are the most frequent type, while endscrapers are the most numerous group of tools. There are 4 thumbnail endscrapers and 1 backed bladelet. Burins are not present among the tools and neither are burin spalls among the technical pieces (Tab. 42).

Only one backed bladelet was found which was unilaterally retouched.

Blanks without cortex were used for making 74.2% of the tools. Blanks with a cortex were used for making endscrapers on flake (2), sidescraper (1), notch (1) and retouched pieces (4).

The share of complete tools is 54.8%, and the completeness by type is shown in Table 43.

Raw material

The predominantly used raw material in this horizon was chert from Upper Cretaceous limestone with planktonic foraminifera. The frequency of other raw materials is under 1%. Frequencies by number and weight show very similar trends. A large number of artefacts are burnt (Tab. 44).

Chaîne opératoire

When analysing *chaîne opératoire* in different raw material categories, we may conclude that the production using cherts from Eocene foraminifera limestone, cherts from Upper Cretaceous limestone with planktonic foraminifera and cherts from Eocene *Scaglia Rossa* limestone took place *in situ*, while artefacts from devitrified tuffs and silicified claystone were probably brought into the cave. Secondary debitage among the cherts from Upper Cretaceous limestone with planktonic foraminifera demonstrates the presence of longer *chaîne opératoire*, which was not recorded for the cherts from Eocene foraminifera limestone and the cherts from Eocene *Scaglia Rossa* limestone (Tab. 45).

SUMMARY, COMPARISON AND INTERPRETATION OF THE VLAKNO LITHIC ASSEMBLAGE

Lithic assemblages that were analysed in this paper may be chronologically placed within the range from the Late Glacial Interstadial probably to the Preboreal/Boreal. According to the size of lithic assemblages, we can assume that the most intensive activities in the cave took place during the horizons KGP III, Mezolitik I and Mezolitik II, which are chronologically placed at the time of the Pleistocene-Holocene transition. The lowest intensity of activities may have occurred during the youngest horizon (Mezolitik III), in which the smallest lithic assemblage was found.

Lithic assemblages of all horizons include tools, debitage, cores, technical pieces and artefacts smaller than 15 mm. The number of artefacts less than 15mm is considera-

Sirovina / Raw material	Težina / Weight (g)	%	N	%
rožnjaci EVF / cherts ELF	5,7	0,5	2	0,4
rožnjaci GKVPF / cherts UCLPF	899,6	74,4	398	71,1
rožnjaci SRV / cherts SRL	10,4	0,9	5	0,9
DVT, SG / DVT, SCS	5,9	0,5	3	0,5
razno / diverse	46,9	3,9	18	3,2
žareno / burnt	241,1	19,9	134	23,9
Ukupno / Total	1209,5	100,0	560	100,0

Tab. 44 Učestalost sirovine prema težini i broju iz horizonta Mezolitik III.

Tab. 44 Raw material frequency (by weight and number) from horizon Mezolitik III.

Za sve horizonte iz Vlakna karakterističan je visok udio odbojaka među lomljevinom (između 70 i 80%). Učestalost pločica kreće se između oko 11 i 16%. Sječiva imaju najnižu učestalost među lomljevinom (između oko 4 i 9%). Relativna učestalost sječiva među lomljevinom postupno raste od starijih prema mlađim horizontima.

Promatramo li postotak iskorištenosti pojedinih kategorija lomljevine za izradu oruđa, uvijek je najviši postotak iskorištenosti među pločicama, a najniži među odbojcima, izuzev u horizontima Mezolitik II i III gdje je postotak iskorištenosti odbojaka viši od onoga sječiva.

Proizvodnja odbojaka usmjerena je na dobivanje odbojaka malih dimenzija čija dužina rijetko prelazi 40 mm. Distribucija dužine cjelovitih odbojaka s perastim distalnim završetkom pokazuje vrlo slične vrijednosti, između horizonata, uz nešto manje dimenzije odbojaka u najranijem horizontu KGP I, upućujući na tehnološki kontinuitet u proizvodnji ovog tipa lomljevine (sl. 6). Velika podudarnost

bly lower in the KGP III horizon compared to other horizons. One interpretation could be that during this horizon fewer tools were produced than in other horizons, but their presence leaves no room for such an interpretation. It is hard to provide a satisfying answer for such a low number of artefacts smaller than 15 mm.

One microburin was found in both the KGP III and Mezolitik II horizons. This indicates that each of them could have been made spontaneously, as an error in the process of producing backed artefacts (Inizan et al. 1999: 82; De Wilde, De Bie 2011: 737), and not as a result of the systematic application of the microburin technique for the production of the so called *piquant-trièdre* and geometric microliths (triangles, trapezoids and segments). Microburins become significantly more present in lithic assemblages with a systematic application of this technique (cf. Perlès 1987; 1999).

A high share of flakes among the debitage (between 70 and 80%) is characteristic for all horizons from Vlakno. The frequency of bladelets ranges between 11 and 16%. Blades have the lowest frequency among the debitage (between 4 and 9%). The relative frequency of blades among the debitage gradually rises from older to younger horizons.

When analysing the percentage of the use of certain debitage categories for making tools, the percentage of use is always the highest among the bladelets and lowest among the flakes, except in horizons Mezolitik II and III where the percentage of the use of flakes is higher than those of blades.

The production of flakes was aimed at making flakes of smaller dimensions, whose length rarely exceeds 40 mm. Distribution by length of complete flakes with feathered distal ends shows very similar values between all horizons, while flakes have relatively smaller dimensions in the earliest KGP I horizon, thus indicating technological continuity in the production of this type of debitage (Fig. 6). The high similarity in the distribution between the horizons is visible

	rožnjaci EVF / cherts ELF	rožnjaci GKVPF / cherts UCLPF	rožnjaci SRV / cherts SRL	DVT, SG / DVT, SCS	razno / diverse	žareno / burnt	Ukupno / Total
Drugotni odbojak / Secondary flake	0	28	0	0	1	11	40
Drugotno sječivo / Secondary blade	0	6	0	0	0	0	6
Drugotna pločica / Secondary bladelet	0	13	0	0	0	1	14
Odbojak / Flake	1	169	2	2	10	55	239
Sječivo / Blade	0	26	0	1	3	9	39
Pločica / Bladelet	0	35	0	0	0	12	47
Jezgra / Core	1	26	1	0	1	4	33
Dotjerujući odbojak jezgre / Core renewal flake	0	1	0	0	1	0	2
Okružak / Core tablet	0	1	0	0	0	0	1
Krhotina / Chunk	0	65	1	0	2	36	104
Neodredivo / Unidentified	0	2	1	0	0	1	4
							529
Oruđa / Tools		•				•	

Tab. 45 Lanac operacija prema sirovinskim kategorijama iz horizonta Mezolitik III.

Tab. 45 Chaîne opératoire by raw material categories from horizon Mezolitik III.

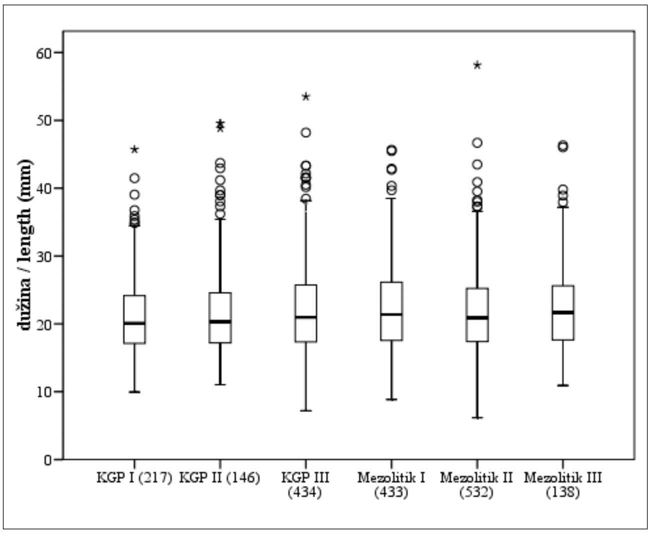
u distribuciji između horizonata vidljiva je promatraju li se širina i debljina odbojaka.

Distribucija dužine sječiva i pločica pokazuje slične trendove između horizonata (sl. 7 i sl. 8). Pločice su nešto kraće u najranijem horizontu KGP I, dok su pločice najduže u horizontu KGP II. Uspoređujemo li dužine pločica i sječiva, vidljivo je da su sječiva duža od pločica.

Tijekom svih horizonata, sudeći prema učestalosti nodularne okorine od preko 90% među lomljevinom, ponajprije se iskorištavaju autohtona ležišta sirovine. Lomljevina s valutičnom okorinom prisutna je u svim horizontima s malim udjelom.

Glatki tip plohka dominira u svim kategorijama lomljevine kroz sve horizonte. Diedrični i višeplošni tip plohka koji bi bili pokazatelji dotjerivanja udarne plohe jezgri fasetiranjem rijetki su među lomljevinom u svim horizontima.

U svim horizontima zabilježene su jezgre koje pokazuju primjenu različitih načina redukcije jezgri. One s jednom udarnom plohom dominiraju u svim horizontima, osim u KGP I gdje bipolarne jezgre imaju najvišu učestalost, a nakon njih slijede jezgre s jednom udarnom plohom. Učestalost ostalih tipova jezgri koji su izdvojeni prema tehnici lomljenja varira kroz vrijeme, ali bez jasnih trendova. Promatramo li formu jezgri, amorfne prevladavaju u svim horizontima, uz brojne klinaste jezgre i one na odbojcima.
Od jezgri su se u najvećoj mjeri proizvodili odbojci, što nam uz brojne pronađene odbojke, ilustrira i visoka učestalost jezgri s negativima odbojaka. One su daleko najbrojnije u svim horizontima. Nakon jezgri za odbojke u većini horizonata slijede jezgre za pločice. U cjelokupnom litičkom skupu



Sl. 6 Boxplot za dužinu cjelovitih neobrađenih odbojaka s perastim distalnim završetkom po horizontima. Horizontalne crte unutar pravokutnika označavaju vrijednosti medijana, pravokutnici predstavljaju raspon vrijednosti 25–75%, "repovi" dijagrama pokazuju minimalne i maksimalne vrijednosti, izdvojene vrijednosti (autlajeri) označene su krugom, a ekstremne vrijednosti zvjezdicom.

Fig. 6 Boxplot for length of complete unretouched flakes with feathered distal end by horizons. Horizontal lines within the boxes show median values, boxes represent 25–75% data ranges, whiskers show minimum and maximum values, outliers are represented with circles and extreme values with asterisks.

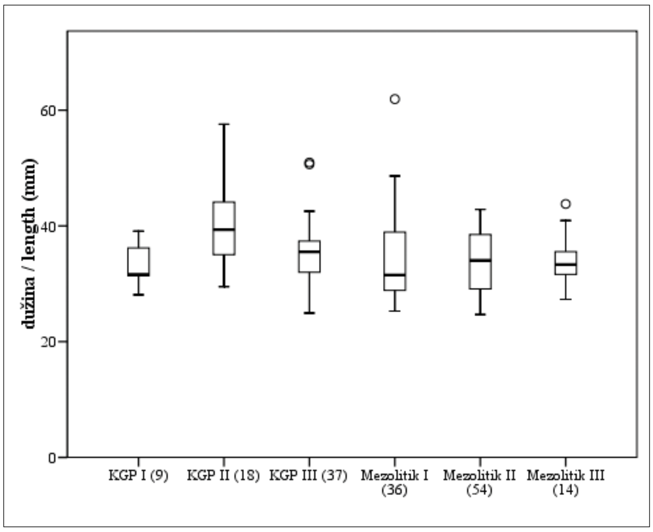
when observing the width and thickness of the flakes.

The distribution by length of blades and bladelets shows similar trends between the horizons (Fig. 7 and Fig. 8). Bladelets are slightly shorter in the earliest KGP I horizon, while they are longest in the KGP II horizon. When comparing the length of bladelets and blades, it is visible that blades are longer than bladelets.

Based on the frequency of a nodular cortex of over 90% among the debitage, it was primarily autochthonous raw material sources that were used during all horizons. A small share of debitage with a pebble-type cortex is present in all horizons.

Plain butt is the predominant type among all the categories of debitage during all horizons. Dihedral and facetted butts that would indicate preparation of a core's striking platform by faceting are very rare among the debitage in all horizons.

Cores that show the application of different core reduction were recorded in all horizons. Single-platform cores are predominant in all horizons, except in KGP I where the highest frequency was recorded for bipolar cores followed by single-platform cores. The frequency of other core-types defined according to the flaking technique varies over time, but without clear trends. When analysing the core shape, most frequent shapes in all horizons are amorphous, with numerous wedge cores and cores on flake. Cores were predominantly used to produce flakes, something which is, along with many found flakes, illustrated by a high share of flake cores. These are by far the most numerous in all horizons. Bladelet cores follow the flake cores in most of the



Sl. 7 Boxplot za dužinu cjelovitih neobrađenih sječiva s perastim distalnim završetkom po horizontima. Horizontalne crte unutar pravokutnika označavaju vrijednosti medijana, pravokutnici predstavljaju raspon vrijednosti 25–75%, "repovi" dijagrama pokazuju minimalne i maksimalne vrijednosti, izdvojene vrijednosti (autlajeri) označene su krugom, a ekstremne vrijednosti zvjezdicom.

Fig. 7 Boxplot for length of complete unretouched blades with feathered distal end by horizons. Horizontal lines within the boxes show median values, boxes represent 25–75% data ranges, whiskers show minimum and maximum values, outliers are represented with circles and extreme values with asterisks.

nalaza iz Vlakna zabilježena je samo jedna jezgra za sječiva, u horizontu KGP I. Uzimajući u obzir prisutnost sječiva u svim horizontima i gotovo potpuni nedostatak jezgri za sječiva, postavlja se pitanje što se događalo s jezgrama za sječiva. One su mogle biti odnesene s nalazišta, ali ne možemo isključiti mogućnost da su sječiva i pločice proizvođene tijekom istoga redukcijskog slijeda tijekom kojeg su se u ranijoj fazi, dok su jezgre bile veće, proizvodila sječiva, a s reduciranjem jezgri proizvodila su se mala sječiva, odnosno pločice. Ovakva pretpostavka mogla bi se provjeriti jedino primjenom spajanja artefakata s ciljem rekonstrukcije proizvodnog procesa. Važno je napomenuti da u litičkom skupu nalaza iz Vlakna nije zabilježena nijedna jezgra koja izravno potvrđuje kombinaciju proizvodnje sječiva i pločica. Dužine cjelovitih jezgara pokazuju sličan stupanj redukcije u većini horizonata, uz nešto intenzivnije iskorištavanje jezgara u najstarijem i najmlađem horizontu (sl. 9).

U svim fazama oruđa su u prvom redu izrađivana na odbojcima. Omjeri oruđa na sječivima i pločicama variraju od podjednakih u horizontima KGP II, KGP III i Mezolitik I, preko dvostruko brojnijih oruđa na pločicama u KGP I, do brojnijih oruđa na sječivima u horizontima Mezolitik I i Mezolitik II.

Pojedini horizonti razlikuju se po tipološkoj raznolikosti koja može biti jednim dijelom povezana s veličinom retuširanog skupa nalaza. U horizontima u kojima je zabilježen najmanji broj oruđa (KGP II i Mezolitik III) zabilježena je i najmanja tipološka raznolikost (tab. 46). U horizontu KGP III s druge strane zabilježen je najveći broj tipova oruđa iako u ovom horizontu nije otkriven najveći broj oruđa. Prema tome možemo zaključiti da je tipološka raznolikost samo jednim dijelom povezana s veličinom retuširanog skupa nalaza.

Indeks cjelovitosti oruđa pokazuje određene sličnosti između pojedinih horizonata (tab. 46). U vrijeme najintenzivnijeg iskorištavanja pećine (KGP III, Mezolitik I i Mezolitik II) indeks cjelovitosti oruđa pokazuje veliku sličnost. Cjelovitost oruđa u horizontu Mezolitik III, kad je aktivnost u pećini bila najslabijeg intenziteta, pokazuje slične vrijednosti kao i u vremenu najintenzivnijeg iskorištavanja pećine. Prema tome, čini se da fragmentiranost oruđa ne možemo povezati s intenzitetom aktivnosti koje su provođene u pećini. Budući da iskorištavanje sirovine, na što ćemo se osvrnuti detaljno kasnije, pokazuje iste obrasce kroz vrijeme, onda možemo isključiti i sirovinu kao razlog za različit stupanj fragmentiranosti oruđa u pojedinim horizontima.

Rezultati tipološke analize za svaki pojedini horizont pokazuju da je repertoar tipova oruđa koja su prisutna poprilično ujednačen u svim horizontima. Ta sličnost vidljiva je među kasnogornjopaleolitičkim, kao i među mezolitičkim horizontima. Usporedimo li repertoar tipova između kasnoga gornjeg paleolitika i mezolitika, također možemo reći da se u najvećoj mjeri podudaraju i da bi razlikovanje mezolitičkih od kasnogornjopaleolitičkih horizonata bilo zapravo nemoguće bez radiokarbonskih datuma.

Učestalost pojedinih tipova upućuje na određene razlike između horizonata (sl. 10 i sl. 11). Tako u horizontu KGP I imamo najnižu relativnu učestalost noktolikih grebala od svih horizonata, a udio pločica s hrptom u ovom horizontu

horizons. Only one core for blades was found in the entire Vlakno lithic assemblage, namely in the horizon KGP I. Taking into account the presence of blades in all horizons and almost non-existent cores for blades, the question is what happened to the cores for blades? They could have been taken away from the site, but we cannot exclude the possibility that blades and bladelets were produced during the same reduction sequence, whereas blades were produced when cores were larger, and reduced cores were then used for the production of bladelets. Such an assumption may be verified only by using the refitting of artefacts in order to reconstruct the production process. It is important to mention that no cores were recorded in the Vlakno lithic assemblage that would directly confirm the combined production of blades and bladelets. Lengths of complete cores show a similar degree of reduction in most of the horizons, with a slightly more intensive use of cores in the oldest and youngest horizons (Fig. 9).

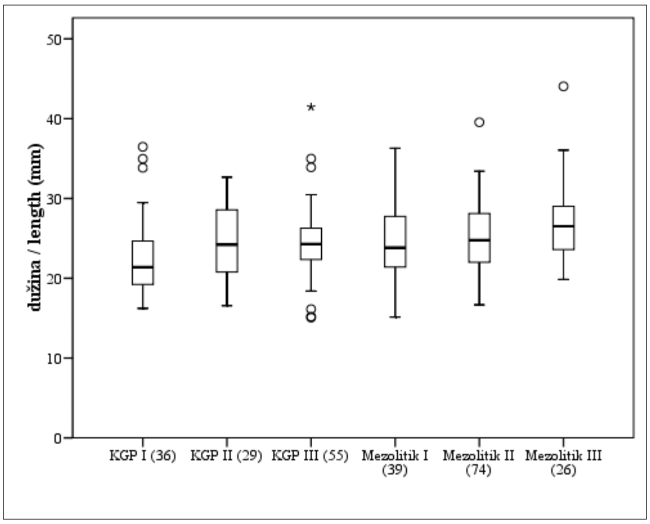
In all phases tools were primarily made on flakes. The ratio between tools on blades and tools on bladelets varies from a relatively equal ratio in horizons KGP II, KGP III and Mezolitik I, over twice as more tools on bladelets in KGP I, to more numerous tools on blades in horizons Mezolitik I and Mezolitik II.

Individual horizons differ according to their typological diversity which can be partly connected to the size of the retouched assemblage. The horizons in which the lowest number of tools was recorded (KGP II and Mezolitik III), the lowest typological diversity was also recorded (Tab. 46). On the other hand, the largest number of tool types was recorded in horizon KGP III, although this horizon did not have the largest number of tools. Therefore, we can conclude that the typological diversity is only partly connected to the size of the retouched assemblage.

The index of the completeness of tools shows certain similarities between individual horizons (Tab. 46). At the time of the most intensive use of the cave (KGP III, Mezolitik I and Mezolitik II), the completeness index shows great similarities. The completeness of tools in the horizon Mezolitik III, when the intensity of activities in the cave was the lowest, shows similar values as at the time of most intensive use of the cave. Thus, it seems that we cannot connect the rate of fragmentation of tools with the intensity of activities in the cave. Since the use of raw materials, which is detailed below, shows the same patterns over time, we can rule out raw materials as the reason for different fragmentation levels of tools in particular horizons.

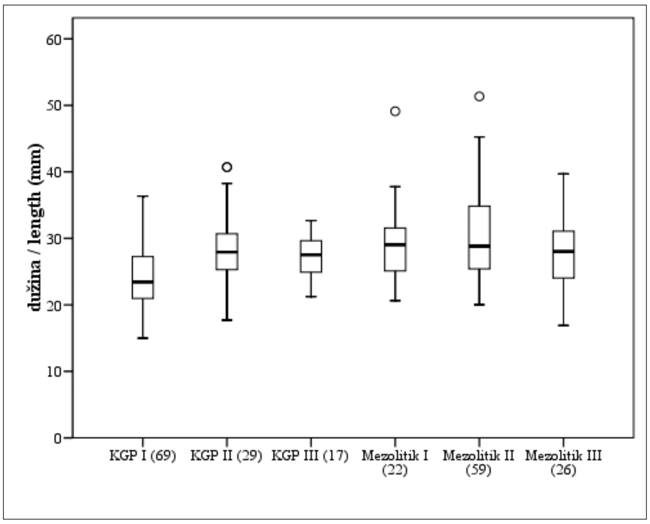
The results of a typological analysis for each individual horizon show that the range of present tool-types is quite similar in all horizons. This similarity is visible among the Late Upper Palaeolithic as well as Mesolithic horizons. When comparing the range of types between the Late Upper Palaeolithic and Mesolithic, we can also say they are highly consistent and that the differentiation between the Mesolithic and Late Upper Palaeolithic horizons would be practically impossible without radiocarbon dates.

The frequency of individual types points to certain differences between the horizons (Fig. 10 and Fig. 11). Thus, in



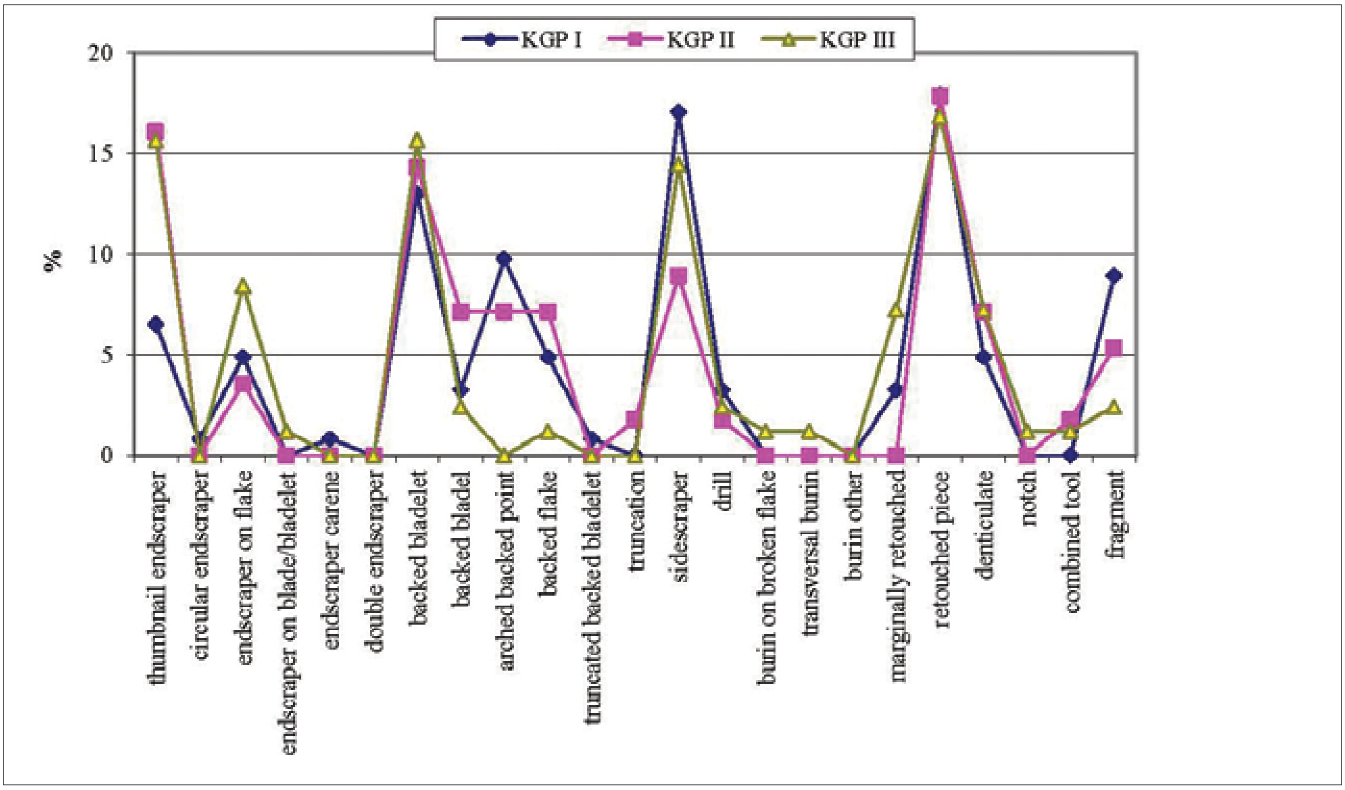
Sl. 8 Boxplot za dužinu cjelovitih neobrađenih pločica s perastim distalnim završetkom po horizontima. Horizontalne crte unutar pravokutnika označavaju vrijednosti medijana, pravokutnici predstavljaju raspon vrijednosti 25–75%, "repovi" dijagrama pokazuju minimalne i maksimalne vrijednosti, izdvojene vrijednosti (autlajeri) označene su krugom, a ekstremne vrijednosti zvjezdicom.

Fig. 8 Boxplot for length of complete unretouched bladelets with feathered distal end by horizons. Horizontal lines within the boxes show median values, boxes represent 25–75% data ranges, whiskers show minimum and maximum values, outliers are represented with circles and extreme values with asterisks.



Sl. 9 Boxplot za dužinu cjelovitih jezgara po horizontima. Horizontalne crte unutar pravokutnika označavaju vrijednosti medijana, pravokutnici predstavljaju raspon vrijednosti 25–75%, "repovi" dijagrama pokazuju minimalne i maksimalne vrijednosti, izdvojene vrijednosti (autlajeri) označene su krugom, a ekstremne vrijednosti zvjezdicom.

Fig. 9 Boxplot for length of complete cores by horizons. Horizontal lines within the boxes show median values, boxes represent 25–75% data ranges, whiskers show minimum and maximum values, outliers are represented with circles and extreme values with asterisks.



Sl. 10 Učestalost oruđa u horizontima KGP I–III.

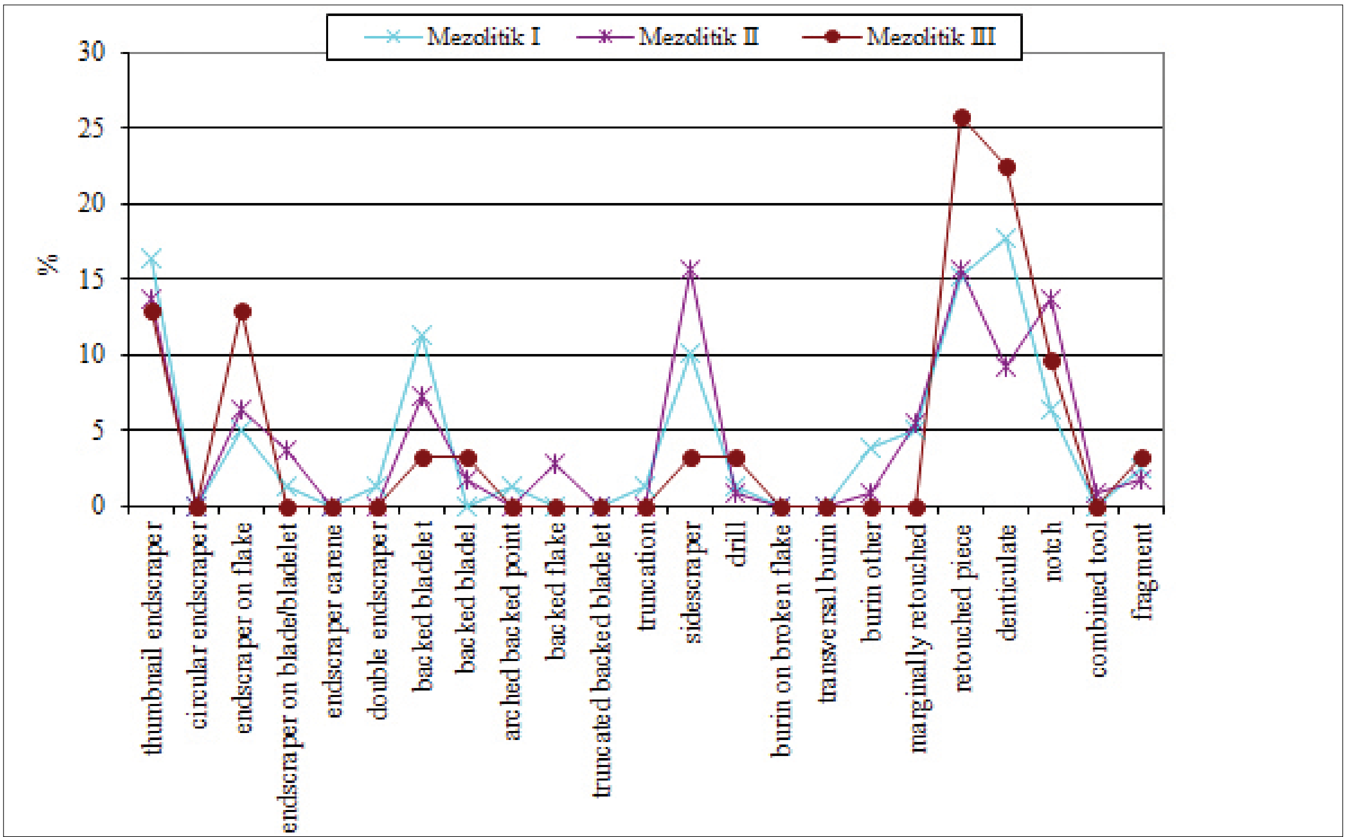
Fig. 10 Tool frequency in horizons LUP I-III.

	KGP I	KGP II	KGP III	Mezolitik I	Mezolitik II	Mezolitik III
broj oruđa / number of tools	123	56	83	79	109	31
broj tipova / number of types	14	12	15	14	14	9
% cjelovitih oruđa / of complete tools	49,6	71,4	55,4	57	59,6	54,8

Tab. 46 Veličina retuširanih skupova nalaza, broj tipova oruđa i postotak cjelovitih oruđa po horizontima.
Tab. 46 Size of retouched assemblages, number of types of tools and frequency of complete tools by horizons.

dvostruko premašuje udio noktolikih grebala. U sljedeća dva horizonta omjeri noktolikih grebala i pločica s hrptom među oruđima su podjednaki, a nakon toga u svim mlađim horizontima noktolika grebala imaju višu učestalost od pločica s hrptom. Za sve horizonte karakteristična je niska učestalost dubila ili njihov potpuni nedostatak. Funkcionalnom analizom litičkih skupova nalaza s nalazišta Solutré, W. Banks (2004) je pokazao da su slomljeni odbojci i sječiva, odnosno njihove plohe loma bile korištene kao *ad hoc* dubila. Možda nisku učestalost dubila u Vlaknu treba promatrati u kontekstu potencijalnog iskorištavanja slomljenih odbojaka i sječiva na spomenuti način. Zakrivljeni šiljci s hrptom češći su u kasnom gornjem paleolitiku nego u mezolitiku gdje je pronađen samo jedan primjerak. U analiziranom litičkom skupu nalaza nisu pronađeni geometrijski mikroliti. U svim horizontima zabilježen je visok udio komada s obradom. U mezolitičkim horizontima učestalost nazubaka i udubaka znatno je viša nego u kasnogornjopaleolitičkim horizontima. Koji je uzrok različitim učestalostima oruđa u različitim horizontima? Jedno od objašnjena moglo bi biti funkcionalno, kao i situacijska potreba za određenim oruđi-

the KGP I horizon we find the lowest relative frequency of thumbnail endscrapers from all horizons, while the share of backed bladelets exceeds the share of thumbnail endscrapers in this horizon by more than twice. The shares of thumbnail endscrapers and backed bladelets are relatively equal in the next two horizons, while in all the following younger horizons thumbnail endscrapers are more frequent than backed bladelets. All horizons have a low frequency of burins or a complete lack thereof. By means of use-wear analysis of lithic assemblages from the site Solutré, W. Banks (2004) has shown that broken flakes and blades were used as *ad hoc* burins. Maybe the low frequency of burins at Vlakno can be observed in the context of the potential use of broken flakes and blades in that way. Arched backed points are more frequent in the Late Upper Palaeolithic than in the Mesolithic, where only one such artefact was found. No geometric microliths were found in the analysed lithic assemblage. A high share of retouched pieces was recorded in all horizons. The frequency of denticulates and notches in the Mesolithic horizons is significantly higher than in the Late Upper Palaeolithic horizons. What is the cause of different



Sl. 11 Učestalost oruđa u horizontima Mezolitik I–III.
Fig. 11 Tool frequency in horizons Mesolithic I-III.

ma u određenom trenutku.

Ekonomija nabave sirovine i njezina iskorištavanja pokazuje u najvećoj mjeri kontinuitet od najranijeg do najkasnijeg horizonta u Vlaknu. U svim horizontima prevladavaju rožnjaci iz gornjokrednih vapnenaca s planktonskim foraminiferama čija je brojčana učestalost preko 70% u svim horizontima, osim u horizontu KGP I gdje je malo niža i iznosi oko 60%. Udio rožnjaka iz eocenskih foraminiferskih vapnenaca postupno opada idući od starijih prema mlađim fazama boravka u pećini. Isti trend vidljiv je i kod radiolarita tijekom kasnoga gornjeg paleolitika. Artefakti od radiolarita postupno nestaju u mezolitiku, a prisutan je samo jedan artefakt u horizontu Mezolitik I. Devitrificirani tufovi i silicificirani glinjaci pojavljuju se u malom broju u svim horizontima bez vidljivih vremenskih trendova. Rožnjaci iz vapnenaca tipa *Scaglia Rossa* imaju najvišu učestalost u horizontu KGP II, a nakon toga je njezin udio znatno manji i kreće se od oko 3% do ispod 1% u horizontu Mezolitik III. Za sve horizonte karakterističan je visok udio žarene sirovine, što ne iznenađuje zato što je u pećini evidentirano nekoliko vatrišta na maloj površini.

Na osnovi terenskih i petrografskih istraživanja moguće je pretpostaviti potencijalna ležišta za navedene sirovine. U radijusu od 20 km od Vlakna mogli su biti prikupljani rožnjaci iz gornjokrednih vapnenaca s planktonskim foraminiferama. Potencijalno ležište ove sirovine mogao je biti Veli rat na sjeverozapadnom dijelu Dugog otoka koji je već dugo poznat u literaturi kao bogato ležište rožnjaka (Malez 1979b; Batović 1988), ali Z. Perhoč ostavlja otvorenom mogućnost da sirovina može potjecati i s Premude. Nama se čini vjerojatnijom mogućnost da se ova sirovina dopremala u pećinu s lokacije koja je bliže samoj pećini, dakle s Velog rata, jer su troškovi transporta sirovine do pećine u tom slučaju manji.

U radijusu od 20 do 50 km od Vlakna mogli su biti prikupljani rožnjaci iz eocenskih foraminiferskih vapnenaca. Moguća, dosad poznata, ležišta ove sirovine su kopneni obalni pojas s najbližim izdancima na području Pajić-Visočane, južno od Ražanca. Potencijalna još bliža ležišta ove sirovine moguća su i u eocenskim pojasevima na Ugljanu, Pašmanu, Molatu i Kornatu, ali je ova mogućnost još uvijek neistražena. Dio varijeteta iz ove skupine sirovine možda bi mogao potjecati i s položaja Kremenik kod Primoštena i Saldun na Čiovu, ali je manja vjerojatnost za ovu mogućnost podrijetla zbog njihove udaljenosti od Vlakna.

U radijusu većem od 50 km mogli su biti prikupljani radiolariti, rožnjaci iz eocenskih vapnenaca tipa *Scaglia Rossa*, te devitrificirani tufovi i silicificirani glinjaci. Ovisno o bojenim varijetetima u skupini radiolarita moguće je pretpostaviti nekoliko potencijalnih područja s kojih su radiolariti mogli biti doneseni u Vlakno. Moguće ishodište crvenosmeđih radiolarita mogle bi biti rijeke sa sabirnim područjem stijena u *mélangeu* ofiolitskog kompleksa (Una, Bosna, Sava od Kupe, Neretva), a manje vjerojatno ishodište je Crnogorsko primorje zbog udaljenosti od Vlakna. Za crnocrvene radiolarite moguće ishodište mogli bi biti glaciofluvijalni sedimenti iz Ozlja koje Kupa nosi do Karlovca i dalje do Siska. Zelenkastocrni i tamnozeleni radiolariti mogli bi potjecati iz Kremešnice ili obližnje Kupe od Desnog Sredička kod Lasi-

frequencies in different horizons? One of the explanations may be the functional as well as the situational need for particular tools at a particular time.

The economy of raw material procurement clearly demonstrates continuity from the earliest to the latest horizon at Vlakno. All horizons are predominated by cherts from Upper Cretaceous limestone with planktonic foraminifera whose frequency by number is over 70% in all horizons, other than in the KGP I horizon where it is slightly lower with around 60%. The share of cherts from Eocene foraminifera limestone is gradually declining from older to younger phases of the cave's occupancy. The same trend is also visible in radiolarites during the Late Upper Palaeolithic. Radiolarite artefacts gradually disappear in the Mesolithic, with only one artefact found in the Mezolitik I horizon. Devitrified tuffs and silicified claystone have a low share in all horizons without visible time trends. Cherts from *Scaglia Rossa* limestone have the highest frequency in the KGP II horizon, after which its share is significantly lower, ranging from approx. 3% to under 1% in the Mezolitik III horizon. All horizons have a high share of burnt raw material, which is not surprising since several fireplaces on a small surface area were documented in the cave.

Potential sources of the listed raw materials may be assumed on the basis of field and petrographic research. Cherts from Upper Cretaceous limestone with planktonic foraminifera could have been collected in the radius of 20 km of Vlakno. Potential sources of this raw material could have been in Veli Rat in the north-western part of Dugi Otok which has been long-known in the literature as a rich source of cherts (Malez 1979b; Batović 1988), but Z. Perhoč leaves room for the possibility that the raw material could have also come from Premuda. Here we consider the possibility that raw materials were transported to the cave from a location closer to the cave itself, which is Veli rat, because the costs of transporting raw material to the cave were lower in that case.

Cherts from Eocene foraminifera limestone could have been collected in the radius of 20–50 km from Vlakno. Potential and already known sources of this raw material are located in the coastline belt with nearest outcrops in the area Pajić-Visočane, south of Ražanac. Potential and even closer sources of this raw material may be in the Eocene belts in Ugljan, Pašman, Molat and Kornat, but this possibility still remains unexamined. A part of varieties within this raw material group could have also originated from the location Kremenik near Primošten and Saldun on Čiovo, but their distance from Vlakno makes this possibility less likely.

Radiolarites, cherts from Eocene *Scaglia Rossa* limestone and devitrified tuffs and silicified claystone could have been collected in the radius of over 50 km. Depending on the colour varieties in the radiolarite group it is possible to assume several potential areas from which radiolarites could have been brought to Vlakno. A likely origin of reddish brown radiolarites could be rivers with their catchment of rocks in ophiolitic melange (Una, Bosna, Sava to Kupa, Neretva), and a less likely origin is the Montenegrin coast, due to its distance from Vlakno. A likely origin of blackish red radiolarites nje. Moguće je, ali još neistraženo, podrijetlo sirovine artefakata od radiolarita iz Jablanice, Vrbasa i Ukrine. Korelacija provedena temeljem terenskog istraživanja, mikroanalize geoloških uzoraka i arheoloških nalaza upućuju na moguće apeninsko podrijetlo crvenih rožnjaka iz vapnenaca tipa *Scaglia Rossa*. Ovdje predložena interpretacija podrijetla ove sirovine razlikuje se od ranije predložene interpretacije (Vukosavljević 2012). Dugom otoku najbliža autohtona ležišta tih rožnjaka su gornjokredni i gornjoeocenski vapnenci u regiji Marche (Moretti, Scarsella 1967; usp. Cancellieri 2010). Vrlo rasprostranjeni alohtoni izdanci rožnjaka tipa *Scaglia Rossa* (sipari, tla, aluviji i riječni šljunci) dopiru do same obale zapadnog Jadrana. Nasuprot toj pretpostavci, rijetki nalazi manje-više zaobljenih sitnih valutica takvog rožnjaka i djelomično očuvanih nodula koje smo zabilježili u šljuncima nekoliko uvala jugozapadne obale Dugoga otoka, otvaraju dodatna geološka i arheološka pitanja podrijetla. Pretpostavka da su te dugootočke valutice od rožnjaka tipa *Scaglia Rossa* podrijetlom iz južnog Tirola (Monti Lessini) (Bosellini et al. 1967; Bianchi et al. 1968) koje je u Jadransku nizinu naplavila paleorijeka Po s pritokama i druge južnotirolske rijeke, prije svega Adige, manje je vjerojatna. Naime, ustanovili smo da Po već kod Piacenze nosi vrlo mali postotak šljunka s neznatnim učešćem silicijskih stijena i to gotovo isključivo radiolarita ligurskog podijetla, a do delte kod Adrie dopire samo pijesak. U šljunčanom nanosu Adige kao i šljunku riječne terase kod Zevia u provinciji Verona, velik je udio rožnjaka lessinskog podrijetla iz vapnenaca tipa *Scaglia Rossa*, ali kredne starosti. S druge strane, brojne apeninske rijeke sa sabirnim područjem klasta u gornjokrednim i gornjoeocenskim ležištima rožnjaka tipa *Scaglia Rossa* koje utječu u zapadni Jadran, kao i drugi alohtoni i autohtoni izdanci, vjerojatniji su izvori sirovine artefakata iz Vlakna od tih crvenkastih rožnjaka. Moguće naplavine klasta rožnjaka u paleojadransku nizinu, topografija i dostupnost tih izvora sirovine za izradu litičkih artefakata lovcima skupljačima na njezinoj istočnoj strani, otvorena su pitanja kao i gore opisan paleogeografski karakter nizine. Ležišta devitrificiranih tufova i silicificiranih glinjaka koji su iskorištavani u Vlaknu vjerojatno treba tražiti na području sjevernog Velebita i Like, točnije u Popovači kod Donjeg Pazarišta, a u obzir dolazi i Neretva, kao i široki prostor trijaskih naslaga Bosne i Hercegovine, ali ta mogućnost još nije istražena.

Ekonomija nabavljanja sirovine u radijusu od 20 km od Vlakna u potpunosti je dominantna u svim fazama s vidljivim trendom postupnog porasta od starijih prema mlađim horizontima. Udio sirovine s udaljenosti između 20 i 50 km jest malen i postupno opada od kasnogornjopaleolitičkih prema mezolitičkim slojevima. Udio sirovine s udaljenosti veće od 50 km najveći je u horizontu KGP I i iznosi oko 15% te značajno opada prema mlađim horizontima (sl. 12). Iako postoji vrlo slična slika nabave i iskorištavanja sirovine tijekom kasnoga gornjeg paleolitika i mezolitika, bazirana ponajprije na lokalnoj sirovini, možemo istaknuti i određene razlike. Udio sirovine s udaljenosti većih od 20 km veći je tijekom kasnoga gornjeg paleolitika nego tijekom mezolitika. Nabavljanje sirovine tijekom mezolitika gotovo je u potpunosti usmjereno na lokalna ležišta, a sporadična prisutnost artefakata od sirovine s većih udaljenosti svjedoči o pokretima lovaca skupljača, ali ne i o sustavnom uključi-

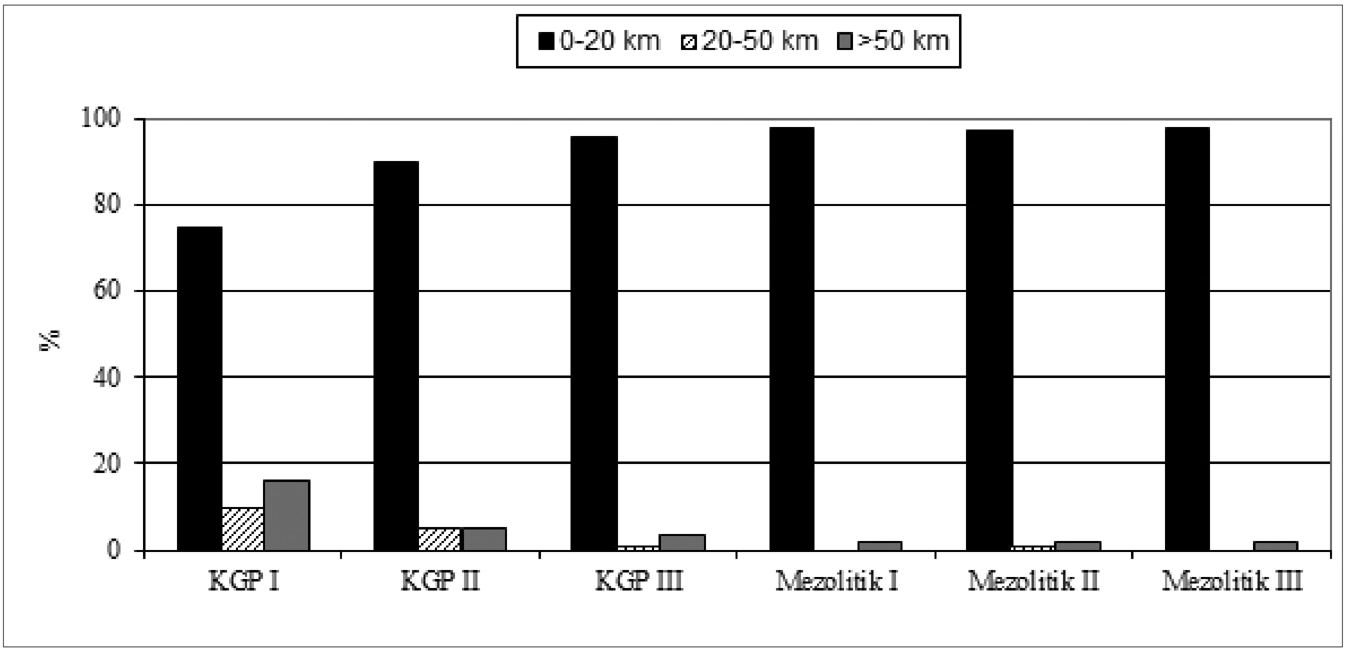
could be glaciofluvial deposits from Ozalj which the Kupa carries to Karlovac and further to Sisak. Greenish black and dark green radiolarites could originate from Kremešnica or the nearby Kupa up to Desno Sredičko near Lasinja. It is also possible, but still unexamined, that the raw material for radiolarite artefacts originates from Jablanica, Vrbas and Ukrina. The correlation carried out on the basis of field-research, microanalysis of geological samples, and archaeological finds indicates that the likely origin of the red cherts from *Scaglia Rossa* limestone could have been in the Apennines. The suggested interpretation of this raw material's origin is different from the earlier suggested interpretation (Vukosavljević 2012). The nearest autochthonous sources of these cherts are the Upper Cretaceous and Upper Eocene limestone in the region Marche (Moretti, Scarsella 1967; cf. Cancellieri 2010). Widely distributed allochthonous outcrops of cherts from *Scaglia Rossa* limestone (talus deposits, soils, alluvial and river gravels) reach almost the coast of the Western Adriatic. Contrary to that assumption, rare findings of relatively rounded small pebbles of such chert and partially preserved nodules, that we recorded in gravels of several bays on the south-western coast of Dugi Otok, lead to further geological and archaeological questions of origin. A less likely assumption is that these pebbles of chert from *Scaglia Rossa* limestone from Dugi Otok originate from South Tyrol (Monti Lessini) (Bosellini et al. 1967; Bianchi et al. 1968) and were flooded into the Adriatic Plain by the paleoriver Po and its tributaries as well as other South Tyrolean rivers, notably Adige. In fact, we have noted that Po already at Piacenza carries a very small percentage of gravel with a negligible share of silica rocks that almost entirely consists of radiolarites of ligurian origin, while only sand reaches the delta at Adria. The gravel sediment of Adige as well as the gravel of the river terrace at Zevia in the Verona province has a large share of Monti Lessini cherts from *Scaglia Rossa* limestone, but of the Cretaceous age. On the other hand, numerous Apennine rivers with their catchment area of clasts in the Upper Cretaceous and Upper Eocene outcrops of cherts from *Scaglia Rossa* limestone which flow into the western Adriatic, as well as other allochthonous and autochthonous outcrops, are a more likely source of raw materials of these reddish cherts found in Vlakno. Potential aggregations of chert clasts into the paleo-Adriatic plain, the topography and availability of these raw material sources for making lithic artefacts to hunters-gatherers on its eastern side are questions that remain open together with the question of the above-described paleogeographic nature of the plain. The sources of devitrified tuffs and silicified claystone that were exploited in Vlakno should probably be sought in the area of Northern Velebit and Lika or, more precisely, in Popovača near Donje Pazarište, while the Neretva may also be considered as well as the wide area of the Triassic sediments in Bosnia and Herzegovina, but that possibility is still unexamined.

Raw material economy in the radius of 20 km from Vlakno is fully predominating in all phases with a visible trend of a gradual increase from older to younger horizons. The share of raw materials from distances between 20 and 50 km vanju sirovina s većih udaljenosti u ekonomiju nabave sirovine.

Zbog iznimno velikog broja otoka u zadarskom arhipelagu, kao i zbog nedostatka precizne batimetrijske karte za to područje, teško je napraviti pouzdaniju procjenu kad današnji Dugi otok postaje otok. Za MIS 2 ne postoje podaci o relativnoj promjeni razine Jadranskog mora (Surić, Juračić 2010: 164–165), pa nam preostaje napraviti procjenu prema globalnim oscilacijama morske razine (Fairbanks 1989; Van Andel 1990). Podaci za MIS 1, odnosno holocen upućuju na to da je relativna razina Jadranskog mora prije oko 9800 BP bila niža za više od 41,5 m u odnosu na današnju, prije oko 7000 BP bila je niža za više od 10 m. Ovi podaci generalno dobro odgovaraju promjenama globalne morske razine (Surić, Juračić 2010: 166). Ove procjene razine Jadranskog mora u različitim fazama holocena izračunate su bez podataka o tektonskim aktivnostima za istočnojadransku obalu. Za preciznu rekonstrukciju relativne morske razine Jadranskog mora u različitim područjima bilo bi nužno ukalkulirati i podatke o tektonskim pokretima za svako pojedino područje kako bi se dobili precizni paleogeografski podaci koji bi bili od velikog značenja za interpretaciju kasnoglacijalnog i postglacijalnog naseljavanja istočnog Jadrana. Lokalni podaci neophodni su za arheološko istraživanje koje zahtijeva dobru vremensku i prostornu preciznost (Van Andel 1989: 736). U vrijeme taloženja posljednjega kasnogornjopaleolitičkog horizonta iz Vlakna globalna razina mora bila je niža za oko 65 m i Dugi otok je vjerojatno još uvijek bio kopno. Vujević i Parica (2011) navode da je Dugi otok u tom vremenu preko Molata i Ista na sjeveru bio spojen s današnjom obalom. U vrijeme taloženja horizonta Mezolitik II relativna razina Jadranskog mora bila je oko 40 m niža u odnosu na današnju i okvirno oko toga vremena bi se moglo pretpostaviti formiranje otočnog okoliša Dugog otoka. Je li manji udio sirovine s većih udaljenosti u mezolitiku poslje-

is low and gradually decreases from Late Upper Palaeolithic towards Mesolithic layers. The share of raw materials from distances over 50 km is highest in the KGP I horizon, amounting to approx. 15% and decreases significantly towards the younger horizons (Fig. 12). Although there is a very similar picture of raw material procurement and use during the Late Upper Palaeolithic and Mesolithic based primarily on local raw materials, we can also point out certain differences. The share of raw materials from distances over 20 km is higher during the Late Upper Palaeolithic than during the Mesolithic. Raw material procurement during the Mesolithic was almost entirely focused on local sources, while the sporadic presence of raw materials from greater distances provides evidence of hunter-gatherers' movements, but not of systematic inclusion of raw materials from greater distances into the raw material economy.

Due to an exceptionally large number of islands in the Zadar archipelago, as well as due to the lack of a precise batimetric map of that area, it is hard to make a reliable assessment of when today's Dugi Otok became an island. For MIS 2 there is no data on the relative change of the Adriatic Sea level (Surić, Juračić 2010: 164–165), so we are left with making an assessment based on the global sea level oscillations (Fairbanks 1989; van Andel 1990). Data for MIS 1 i.e. the Holocene indicate that the relative level of the Adriatic Sea before 9800 BP was more than 41.5 m lower compared to the present, and before 7000 BP it was more than 10 m lower. These data generally correspond well to the global sea level changes (Surić, Juračić 2010: 166). These assessments of the Adriatic Sea level in different stages of the Holocene were calculated without data on tectonic activities for the eastern Adriatic coast. A precise calculation of the relative Adriatic Sea level in different areas would require the inclusion of data on tectonic movements for each individual area in order to obtain precise paleogeographical



Sl. 12 Učestalost sirovine (prema broju) prema udaljenosti potencijalnih ležišta od Vlakna po horizontima (bez skupine žareno i razno).
Fig. 12 Relative frequency (by number) of potential distances of raw material sources from Vlakno Cave for each horizon (excluding burnt and diverse groups).

dica stvaranja otočnog okoliša? Na ovo pitanje teško je dati pouzdan odgovor jer nemamo detaljnu paleogeografsku rekonstrukciju zadarskog arhipelaga iz vremena prijelaza pleistocena u holocen, ali treba ostaviti otvorenom mogućnost da je podizanje morske razine barem djelomično uvjetovalo kretanje lovaca skupljača tijekom holocena pa je onda udio sirovine s većih udaljenosti koji je prisutan u kasnom gornjem paleolitiku, u mezolitiku postao još manji.

Na osnovi omjera jezgri i transformacijskih oruđa, te omjera projektila i transformacijskih oruđa možemo zaključiti da je karakter boravka u Vlaknu u svim fazama izrazito stambenog karaktera (tab. 47). Mala površina pećine upućuje na mogući boravak male grupe lovaca skupljača. Zbog malog i ograničenog prostora boravka moglo bi se postaviti pitanje odražavaju li empirijski podaci navedenih omjera zaista stambeni karakter boravka u pećini.

A. Sinclair (1997) je na primjeru male pećine Megalakkos u Epiru pokazao da postoje određeni problemi u interpretaciji funkcije malih nalazišta na osnovi litičkog skupa nalaza, bez obzira koristimo li se intuitivnom interpretacijom baziranom na empirijskim podacima ili teorijskom, odnosno etnoarheološkom interpretacijom u kojoj se arheološki dokazi uspoređuju s očekivanim podacima koji su dobiveni *a priori* modeliranjem. On smatra da oštra distinkcija između stambenog i logističko-lovačkog karaktera nalazišta nije najprikladniji interpretacijski model za iskorištavanje doline rijeke Voïdomatis.

Čini se da slične probleme možemo vidjeti i na primjeru Vlakna. Za detaljniju interpretaciju funkcije nalazišta u različitim fazama nedostaju nam podaci o strategijama preživljavanja.

ZAKLJUČAK

U pećini Vlakno dokumentiran je kontinuitet u naseljavanju od kasnoga gornjeg paleolitika do mezolitika. Promatramo li litičku industriju iz Vlakna u kontekstu prijelaza iz pleistocena u holocen, možemo reći da je karakterizira tehnološki i tipološki kontinuitet od oko 12 500 uncal BP pa do poslije 9000 uncal BP i da promjene u okolišu nisu znatnije utjecale na karakter litičkih industrija. Na primjeru Vlakna kontinuitet je vidljiv i u iskorištavanju sirovine, koje je prije svega bazirano na lokalnim izvorima, odnosno onima do udaljenosti od 20 km od nalazišta. Okolišne promjene

data which would be of great significance for the interpretation of the Late Glacial and Postglacial population dynamics of the eastern Adriatic coast. Local data is necessary for archaeological research which requires good temporal and spatial precision (van Andel 1989: 736). At the time of deposition of the last Late Upper Palaeolithic horizon from Vlakno, the global sea level was about 65 m lower, so Dugi Otok was probably still a part of the mainland. Vujević and Parica (2011) state that at that time Dugi Otok was connected to today's coast over Molat and Ist. At the time of deposition of the Mezolitik II horizon, the relative Adriatic Sea level was about 40 m lower compared to the present sea level and the forming of an island environment of Dugi otok can be generally assumed around that time. Is the smaller share of raw materials from greater distances the result of an island environment? It is hard to give a reliable answer to this question because we do not have a detailed paleogeographic reconstruction of the Zadar archipelago at the time of the Pleistocene-Holocene transition, but the possibility should remain open that the rising sea level has at least partially influenced the movements of hunter-gatherers during the Holocene, thus the share of raw materials from greater distances that is present in the Late Upper Palaeolithic has become even smaller in the Mesolithic.

Based on the ratio between cores and transformation tools on the one hand, and the ratio between projectiles and transformation tools on the other, we can conclude that Vlakno Cave was used as a residential base (Tab. 47). The little surface area of the cave points to the potential residence of a smaller group of hunter-gatherers. Due to a small and confined space of residence, a question could be raised whether the empirical data of the listed ratios really reflects the residential character of the cave's occupancy.

On the example of a small cave Megalakkos in Epirus, A. Sinclair (1997) showed that there are certain problems in interpreting the function of small sites based on their lithic assemblage, regardless of whether we're using intuitive interpretation based on empirical data or theoretical i.e. ethnoarchaeological interpretation in which archaeological evidence is compared with the expected data obtained by *a priori* modelling. He considers that the strict distinction between the residential and logistic-hunting function of the site is not the most appropriate interpretation model for the use of the Voïdomatis river valley.

It seems that we encountered similar problems in the

	jezgre : transformacijske alatke / cores : transformation tools	projektili : transformacijske alatke / projectiles : transformation tools
KGP I	1,1	0,34
KGP II	0,73	0,29
KGP III	0,38	0,19
Mezolitik I	0,45	0,15
Mezolitik II	0,67	0,08
Mezolitik III	1,14	0,03

Tab. 47 Funkcija nalazišta na osnovi strukture litičkog skupa nalaza po horizontima.
Tab. 47 Site function based on structure of lithic assemblage by horizons.

vjerojatno su dovele do smanjivanja udjela sirovine s većih udaljenosti od starijih prema mlađim horizontima.

Kontinuitet između kasnog epigravetijena i ranog mezolitika na istočnojadranskoj obali i njezinu zaleđu pretpostavili su Kozłowski i Kozłowski (1979), a potvrdio je Mihailović (2009) na osnovi analiza litičkih skupova nalaza iz Crvene stijene i Trebačkog krša. Analiza litičkog skupa nalaza iz Vlakna, uz radiokarbonske datume, potvrdila je i kronološki učvrstila prethodne zaključke. Osim na dalmatinskim i crnogorskim nalazištima, ovakav kontinuitet može se pratiti i na istarskim nalazištima. U širem kontekstu obalnih europskih krajolika, tehnološki kontinuitet litičke proizvodnje na prijelazu iz pleistocena u holocen vidljiv je i na prostoru Kantabrije (Straus 1995), mediteranskog dijela Španjolske (Aura et al. 1995), Portugala (Bicho 1994), dijelom i na Apeninskom poluotoku (Bietti 1990).

Određene prilagodbe na nove uvjete života mogle bi se pratiti u postupnom porastu morskih izvora prehrane i kopnene malakofaune u Vlaknu, ali nam, nažalost, nedostaju kvantitativni podaci koji bi nam jasno pokazali kad se te promjene počinju događati i koja je važnost morske faune u strategijama preživljavanja lovaca skupljača iz Vlakna. Za ilustraciju nam može poslužiti rastući trend učestalosti kopnenih puževa *Helix* sp. otkrivenih u Vlaknu od starijih prema mlađim fazama (sl. 13). Prisutnost ljuštura kopnenih puževa može biti dobar indikator mezolitičkih strategija preživljavanja širokog spektra kakve su zabilježene u Pupićinoj peći (Rizner et al. 2009), Veloj spili (Čečuk, Radić 2005), kao i u širem mediteranskom kontekstu (Lubell 2004a; 2004b). Z. Brusić (2008: 401) navodi da su u Vlaknu u gornjim slojevima pronađeni brojni ostaci morske faune koja postupno nestaje u donjim slojevima. Možemo pretpostaviti da se gornji slojevi barem dijelom odnose na razdoblje mezolitika. Međutim, važno je još jednom istaknuti da mezolitička industrija iz Vlakna pokazuje kontinuitet s kasnim epigravetijenom iako je nalazimo u kontekstu s brojnim ostacima morskih izvora prehrane i kopnene malakofaune.

Litička industrija iz Vlakna, epigravetijenska, kao i mezolitička, sugerira nam da Vlakno treba promatrati kao bazni logor manje grupe lovaca skupljača tijekom kasnog glacijala i postglacijala. Zanimljivu pretpostavku o rasporedu naselja na istočnojadranskom prostoru u vremenu nakon kasnoglacijalnog maksimuma iznijeli su Shackleton et al. (1984). Uz uvjet da je Jadranska nizina predstavljala bogat biotop koji su iskorištavali lovci skupljači, oni su pretpostavili mogućnost postojanja baznih logora na današnjim jadranskim otocima zbog njihova položaja koji je omogućavao nadgledanje Jadranske nizine. Ako su naši zaključci o funkciji nalazišta točni, a koji su utemeljeni na učestalosti određenih kategorija litičkog skupa nalaza, onda možemo reći da je pretpostavka koju su iznijeli Shackleton et al. (1984: 312) barem dijelom dobila potvrdu. Ovdje treba dodati da nas na isti zaključak navodi i analiza litičkih skupova nalaza iz Kopačine i Vele spile (Vukosavljević 2012).

Zbog kontinuiteta u litičkoj proizvodnji koji je vidljiv između kasnog glacijala i postglacijala u Dalmaciji, a i šire, nužno je stalno proširivati bazu radiokarbonskih datuma, case of Vlakno. A more detailed interpretation of the site's function in different phases would require more data on subsistence strategies.

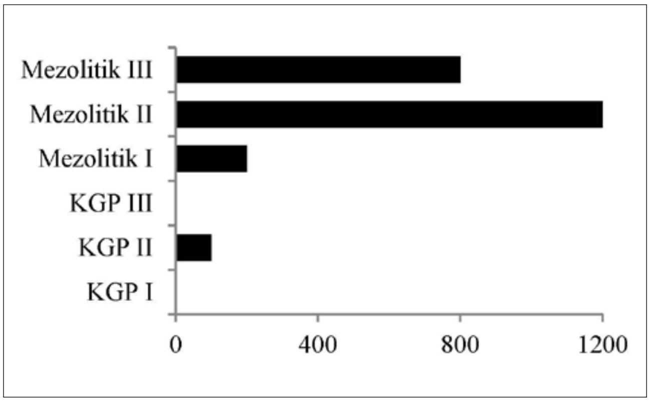
CONCLUSION

The continuity of settlement from the Late Upper Palaeolithic to the Mesolithic is clearly documented in the cave Vlakno. When analysing the lithic industry from Vlakno Cave in the context of the Pleistocene-Holocene transition, we can say that it is characterised by technological and typological continuity from approx. 12 500 uncal BP to after 9000 uncal BP and that environmental changes did not have a significant impact on the lithic industries. In the case of Vlakno Cave, continuity is also visible in the exploitation of raw materials, which was primarily based on local sources i.e. those within a distance of 20 km from the site. Environmental changes probably caused the decrease of raw materials from greater distances from older towards younger horizons.

Continuity between the Late Epigravettian and Early Mesolithic on the East Adriatic coast and its hinterland was assumed by Kozłowski and Kozłowski (1979), and confirmed by Mihailović (2009) based on analyses of lithic assemblages from the Crvena stijena and Trebački krš sites. The analysis of the Vlakno lithic assemblage, together with radiocarbon dates, confirmed and chronologically reinforced the previous conclusions. In addition to the sites in Dalmatia and Montenegro, such continuity may also be traced in the Istrian sites. Within the wider context of coastal European landscapes, the technological continuity of lithic production across the Pleistocene-Holocene transition is also visible in the area of Cantabria (Straus 1995), the Mediterranean part of Spain (Aura et al. 1995), Portugal (Bicho 1994), and partly on the Apennine peninsula (Bietti 1990).

Certain adaptations to new environmental circumstances could be traced through the gradual increase of marine food resources and terrestrial malacofauna in Vlakno, but unfortunately we are lacking quantitative data that would clearly show when these changes started to take place and what is the significance of marine fauna in subsistence strategies of hunter-gatherers from Vlakno Cave. A growing trend of the frequency of land snails *Helix sp.* found in Vlakno from older to younger phases may serve as an illustration (Fig. 13). The presence of land snail shells may be a good indicator of the Mesolithic broad spectrum subsistence strategies, which were recorded in Pupićina peć (Rizner et al. 2009), Vela spila (Čečuk, Radić 2005), as well as in the wider Mediterranean context (Lubell 2004a; 2004b). Z. Brusić (2008: 401) states that upper layers in Vlakno contained numerous remains of marine fauna that gradually disappeared in lower layers. We can assume that the upper layers are at least partly related to the Mesolithic period. However, it is important to once more point out that the Mesolithic industry from Vlakno shows continuity with the Late Epigravettian, although it is found in context with numerous remains of marine food resources and terrestrial malacofauna.

The lithic industry from Vlakno during both the Epigravettian and the Mesolithic suggests that Vlakno should be



Sl. 13 Broj ljuštura kopnenih puževa Helix sp. po horizontima.
Fig. 13 Helix sp. shells frequency by horizons.

kako iz novih tako i iz starih iskopavanja, kako bismo kroz bolju kronološku rezoluciju mogli bolje sagledati dinamiku i obrasce naseljavanja istočnojadranske obale.

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observed as a residential base of a smaller group of hunter-gatherers during the Late Glacial and Postglacial. An interesting assumption on the distribution of settlements in the eastern Adriatic at the time after the Last Glacial Maximum was made by Shackleton et al. (1984). Provided that the Great Adriatic Plain represented an abundant biotope used by hunter-gatherers, they assumed the possibility of residential bases existing on today's Adriatic islands which, due to their position, enabled monitoring of the Adriatic Plain. If our conclusions about the site's function are accurate, and these are based on the frequency of particular lithic assemblage categories, we can say that the assumption made by Shackleton et al. (1984: 312) has been at least partially confirmed. It should be mentioned that the same conclusion is supported by the analyses of lithic assemblages from Kopačina and Vela spila (Vukosavljević 2012).

Because of the continuity of lithic technology during the Late Glacial and Postglacial in Dalmatia and elsewhere, it is necessary to continually expand the base of radiocarbon dates, both from new and old excavations, in order to obtain a better chronological resolution that would provide us with an improved understanding of settlement dynamics and patterns on the eastern Adriatic coast.

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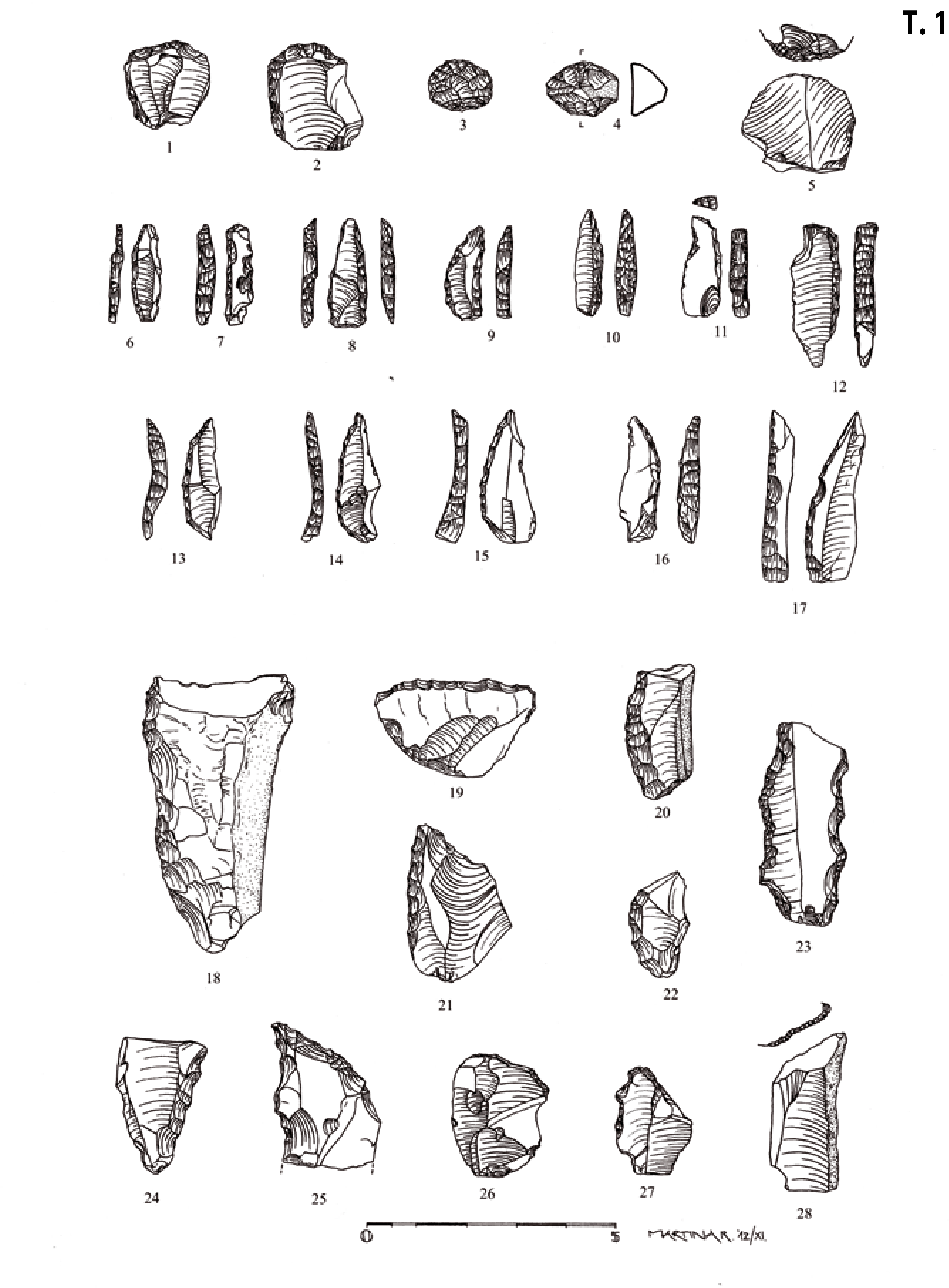
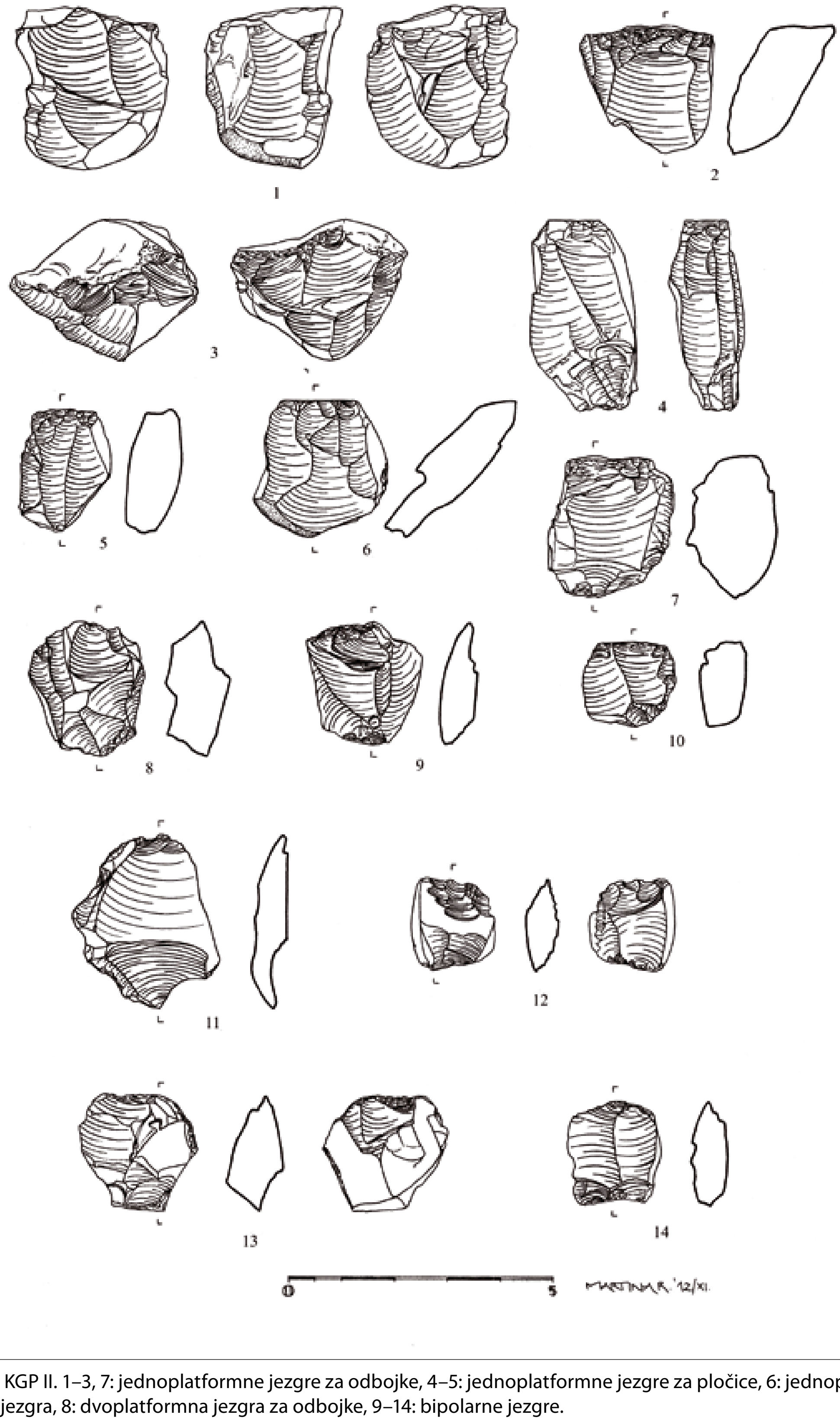


T. 1 Horizont KGP I. 1–2: noktolika grebala, 3: kružno grebalo, 4: grebalo caréné, 5: grebalo na odbojku, 6–12: pločice s hrptom, 13–17: zakrivljeni šiljci s hrptom, 18–22: strugala, 23–24: nazupci, 25: svrdlo, 26–28: komadi s obradom.

Pl. 1 Horizon KGP I. 1–2: thumbnail endscrapers, 3: circular endscraper, 4: carinated endscraper, 5: endscraper on flake, 6–12: backed bladelets, 13–17: arched backed points, 18–22: sidescrapers, 23–-24: denticulates, 25: drill, 26–28: retouched pieces.

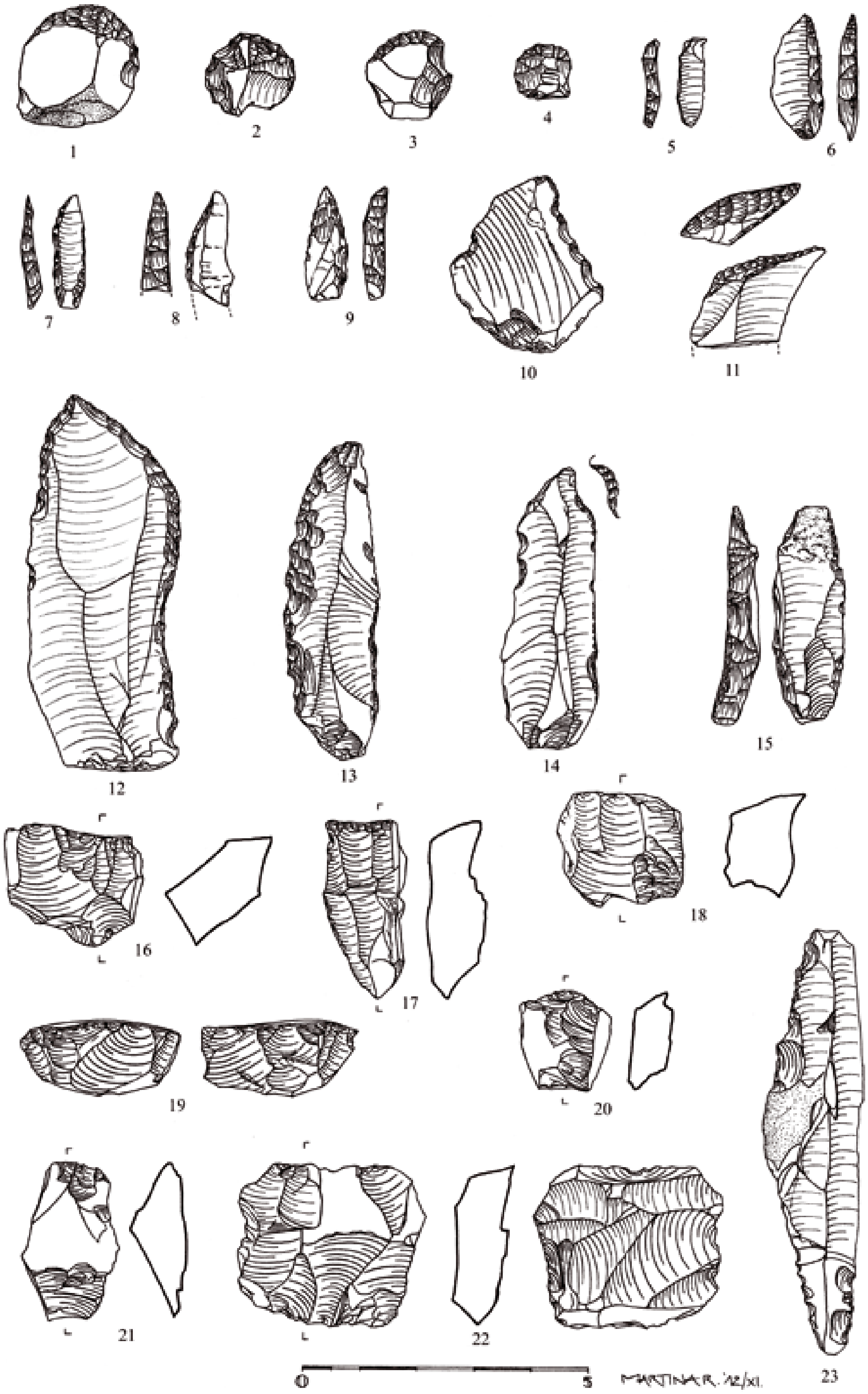
T. 2



T. 2 Horizont KGP II. 1–3, 7: jednoplatformne jezgre za odbojke, 4–5: jednoplatformne jezgre za pločice, 6: jednoplatformna kombinirana jezgra, 8: dvoplatformna jezgra za odbojke, 9–14: bipolarne jezgre.

Pl. 2 Horizon KGP II. 1–3, 7: single-platform flake cores, 4–5: single-platform bladelet cores, 6: single-platform mixed core, 8: flake core with two platforms, 9–14: bipolar cores.

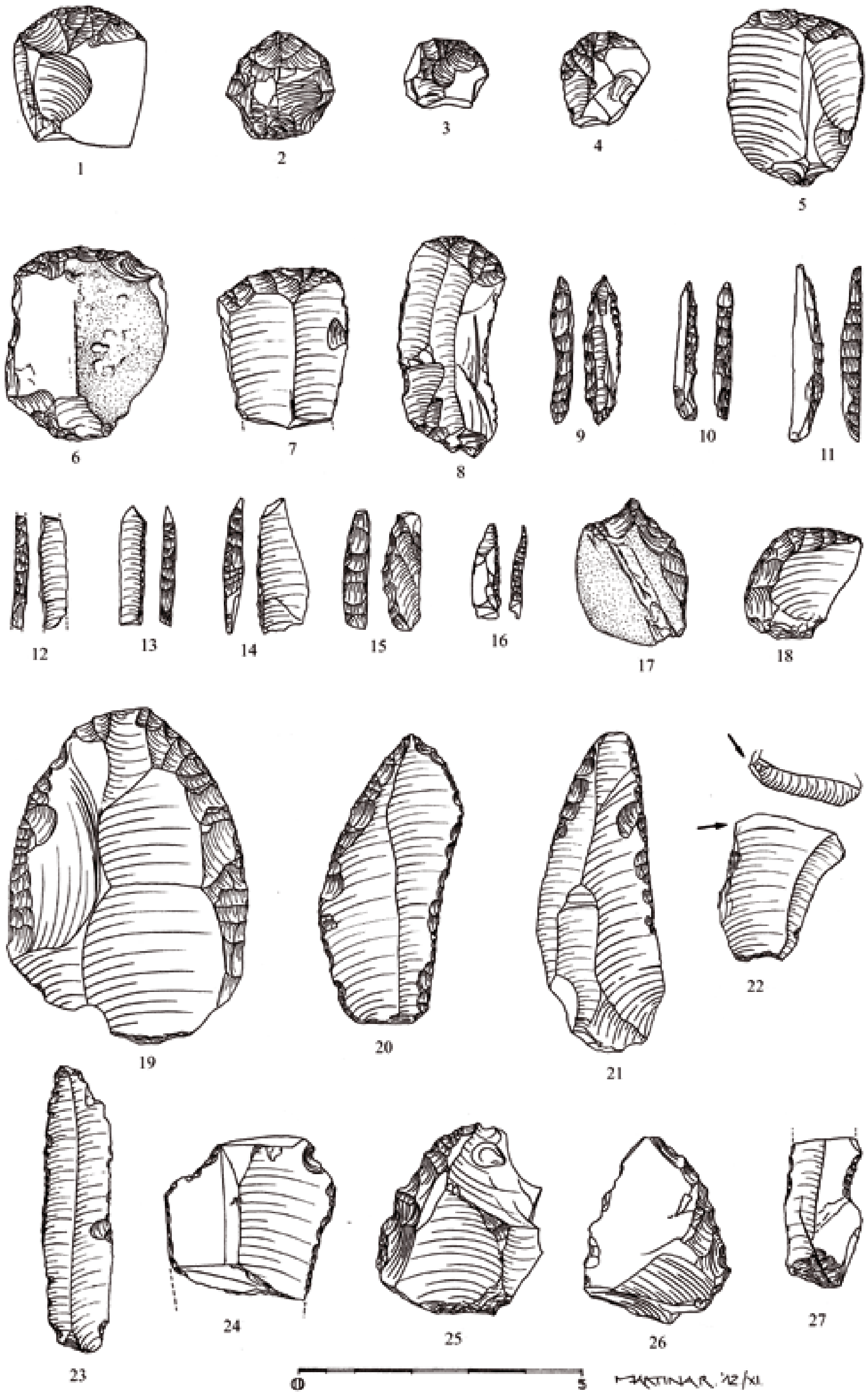
T. 3



T. 3 Horizont KGP II. 1–4: noktolika grebala, 5–7: pločice s hrptom, 8–9: zakrivljeni šiljci s hrptom, 10: nazubak, 11: zarubak, 12: strugalo-svrdlo, 13: strugalo, 14: svrdlo, 15: sječivo s hrptom, 16, 19: jednoplatformne jezgre za odbojke, 17: jednoplatformna jezgra za pločice, 18: dvoplatformna jezgra za odbojke, 20–21: bipolarne jezgre, 22: višeplatformna jezgra, 23: komad s obradom.

Pl. 3 Horizon KGP II. 1–4: thumbnail endscrapers, 5–7: backed bladelets, 8–9: arched backed points, 10: denticulate, 11: truncation, 12: sidescraper-drill, 13: sidescraper, 14: drill, 15: backed blade, 16, 19: single-platform flake cores, 17: single-platform bladelet core, 18: flake core with two platforms, 20–21: bipolar cores, 22: multi-platform core, 23: retouched piece.

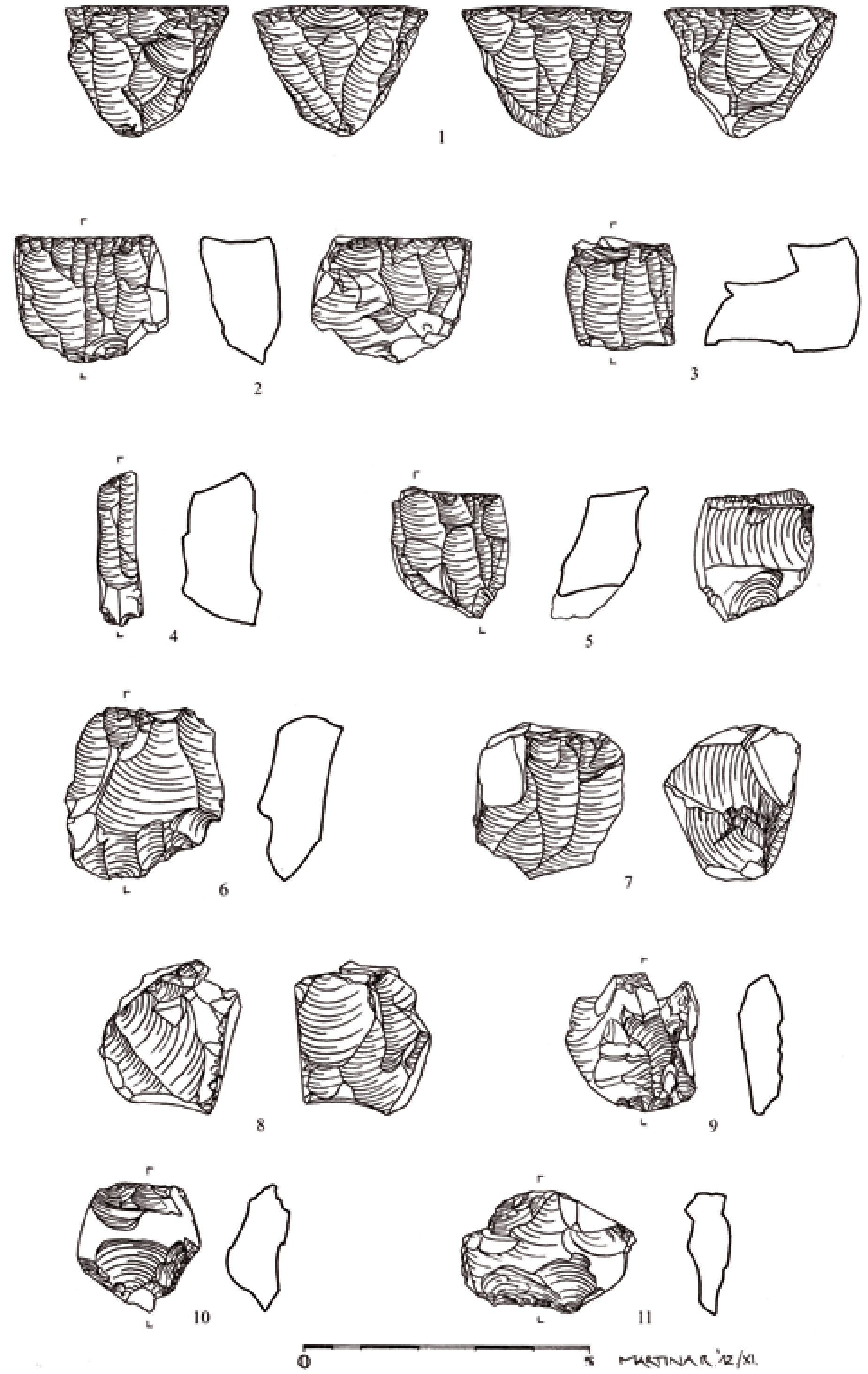
T. 4



T. 4 Horizont KGP III. 1–5: noktolika grebala, 6–7: grebalo na odbojku, 8: grebalo na sječivu/pločici, 9–16: pločice s hrptom, 17: svrdlo, 18–20: strugala, 21: komad s obradom, 22: transverzalno dubilo, 23–24: komadi sa sitnom rubnom obradom, 25–26: nazupci, 27: udubak.

Pl. 4 Horizon KGP III. 1–5: thumbnail endscrapers, 6–7: endscrapers on flake, 8: endscraper on blade/bladelet, 9–-16: backed bladelets, 17: drill, 18–20: sidescrapers, 21: retouched piece, 22: transversal burin, 23–24: marginally retouched pieces, 25–-26: denticulates, 27: notch.

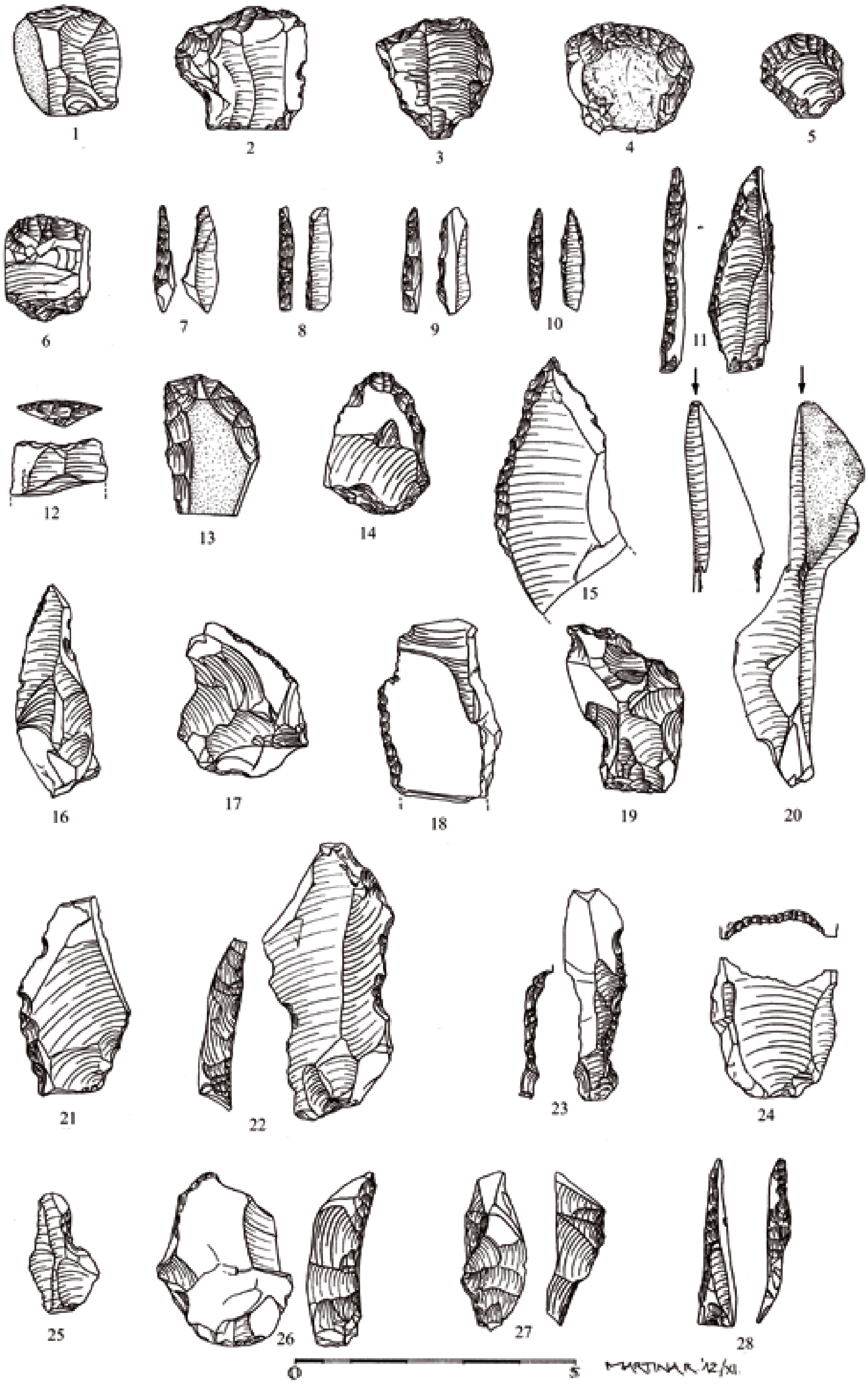
T. 5



T. 5 Horizont KGP III. 1–2: jednoplatformne kombinirane jezgre, 3–4: jednoplatformne jezgre za pločice, 5: rotirajuća kombinirana jezgra, 6: dvoplatformna kombinirana jezgra, 7: višeplatformna jezgra za odbojke, 8: jednoplatformna jezgra za odbojke, 9–11: bipolarne jezgre.

Pl. 5 Horizon KGP III. 1–2: single-platform mixed cores, 3–4: single-platform bladelet cores, 5: rotating mixed core, 6: mixed core with two platforms, 7: multi-platform flake core, 8: single-platform flake core, 9–11: bipolar cores.

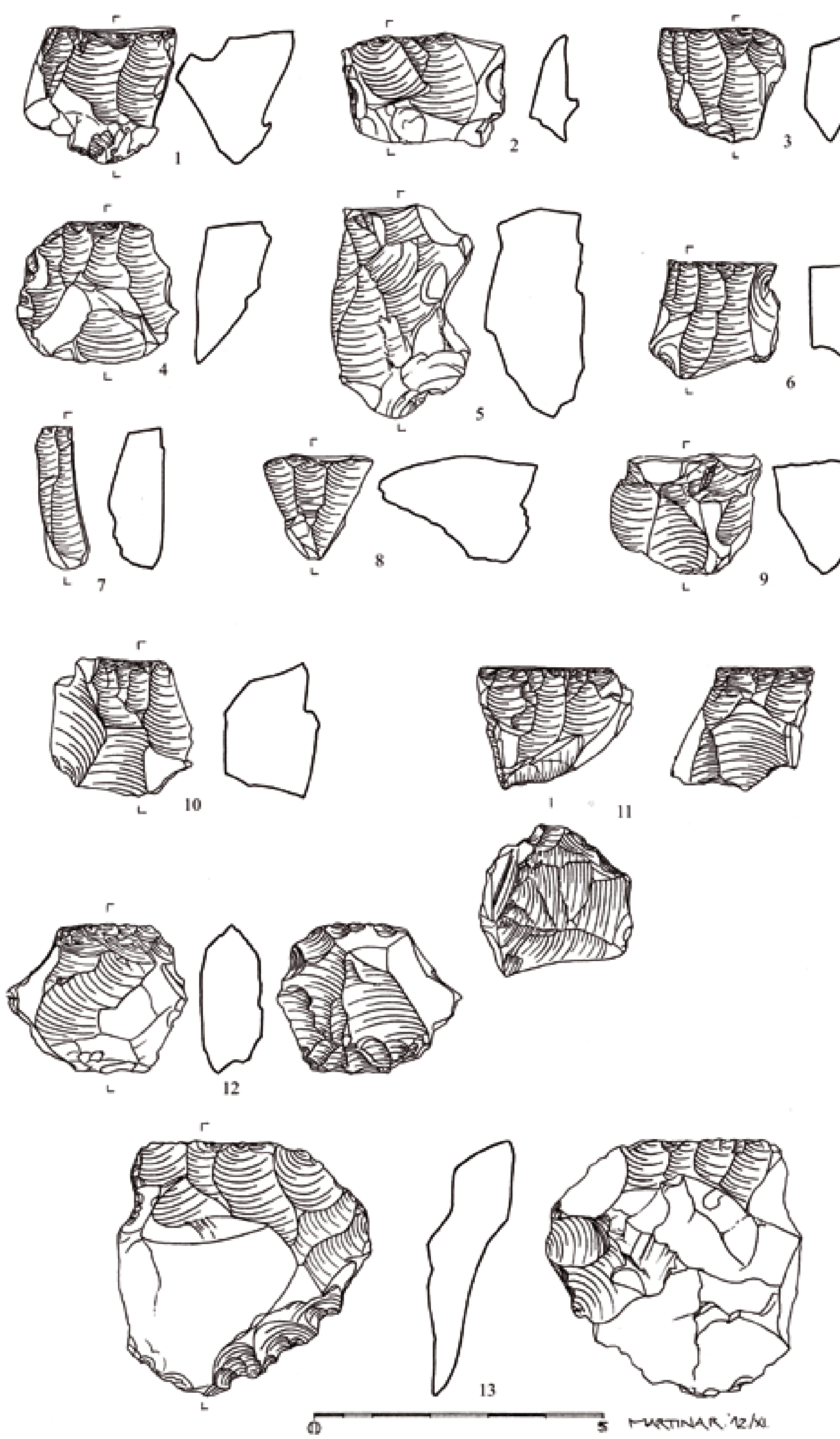
T. 6



T. 6 Horizont Mezolitik I. 1–5: noktolika grebala, 6: dvostruko grebalo, 7–10: pločice s hrptom, 11: dubilo, 12: zarubak, 13–14: strugala, 15: svrdlo, 16–17: komadi sa sitnom rubnom obradom, 18: komad s obradom, 19, 21–23: nazupci, 20: dubilo, 24–25: udupci, 26–27: okrušci, 28: iver dubila.

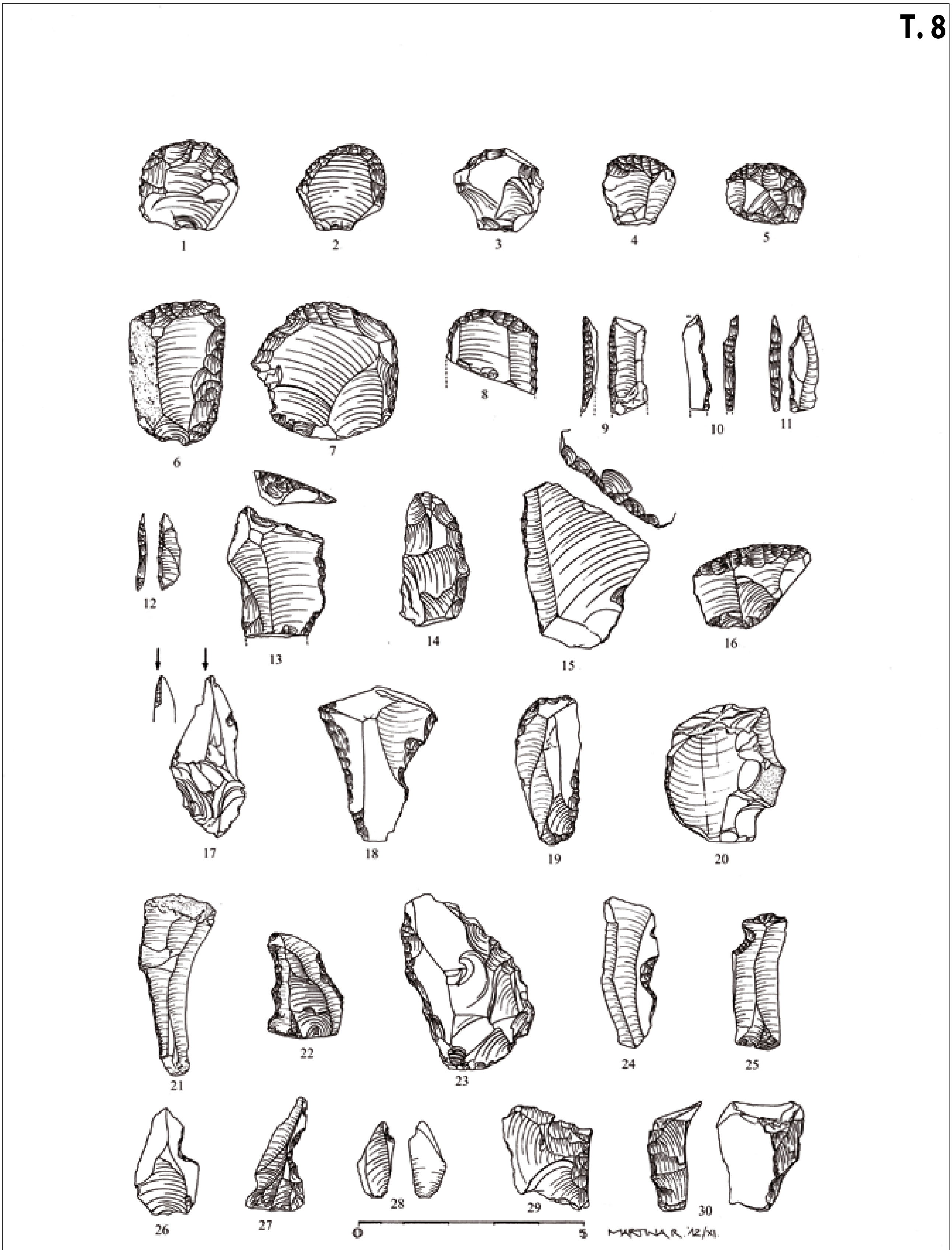
Pl. 6 Horizon Mezolitik I. 1–-5: thumbnail endscrapers, 6: double endscraper, 7–10: backed bladelets, 11: burin, 12: truncation, 13–14: sidescrapers, 15: drill, 16–17: marginally retouched pieces, 18: retouched piece, 19, 21–23: denticulates, 20: burin, 24–25: notches, 26–27: core tablets, 28: burin spall.

T. 7



T. 7 Horizont Mezolitik I. 1: jednoplatformna kombinirana jezgra, 2, 5: jednoplatformne jezgre za odbojke, 3–4, 6–8: jednoplatformne jezgre za pločice, 9: dvoplatformna jezgra za odbojke, 10–11, 13: višeplatformne jezgre za odbojke, 12: bipolarna jezgra.

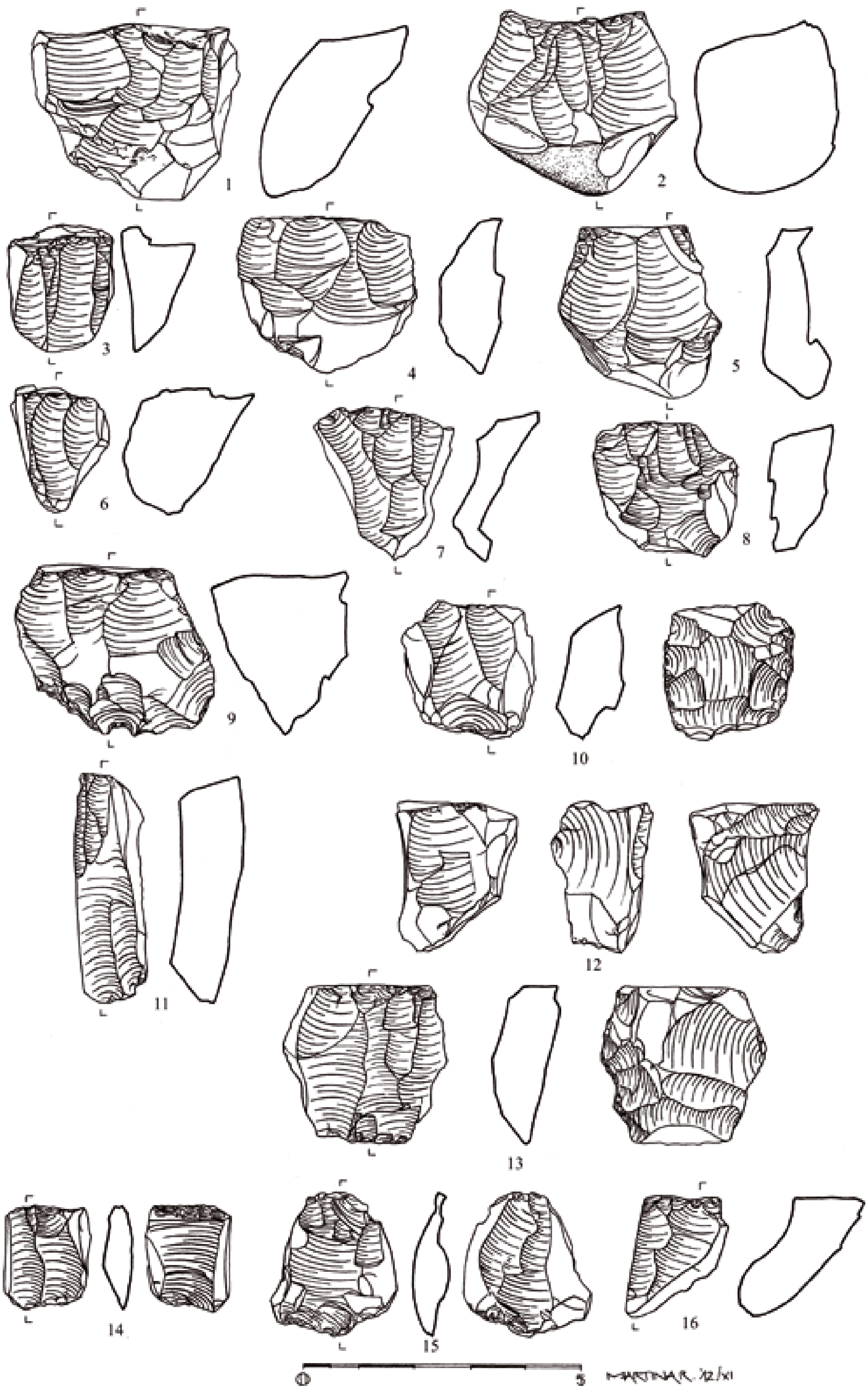
Pl. 7 Horizon Mezolitik I. 1: single-platform mixed core, 2, 5: single-platform flake cores, 3–4, 6–8: single-platform bladelet cores, 9: flake core with two platforms, 10–11, 13: multi-platform flake cores, 12: bipolar core.



T. 8 Horizont Mezolitik II. 1–5: noktolika grebala, 6–7: grebala na odbojku, 8, 13: grebala na sječivu/pločici, 9–12: pločice s hrptom, 14–16, 18: strugala, 17: dubilo, 19: komad s obradom, 20–21: komadi sa sitnom rubnom obradom, 22–23: nazupci, 24–27: udupci, 28: mikrodubilo, 29: dotjerujući odbojak jezgre, 30: okružak.

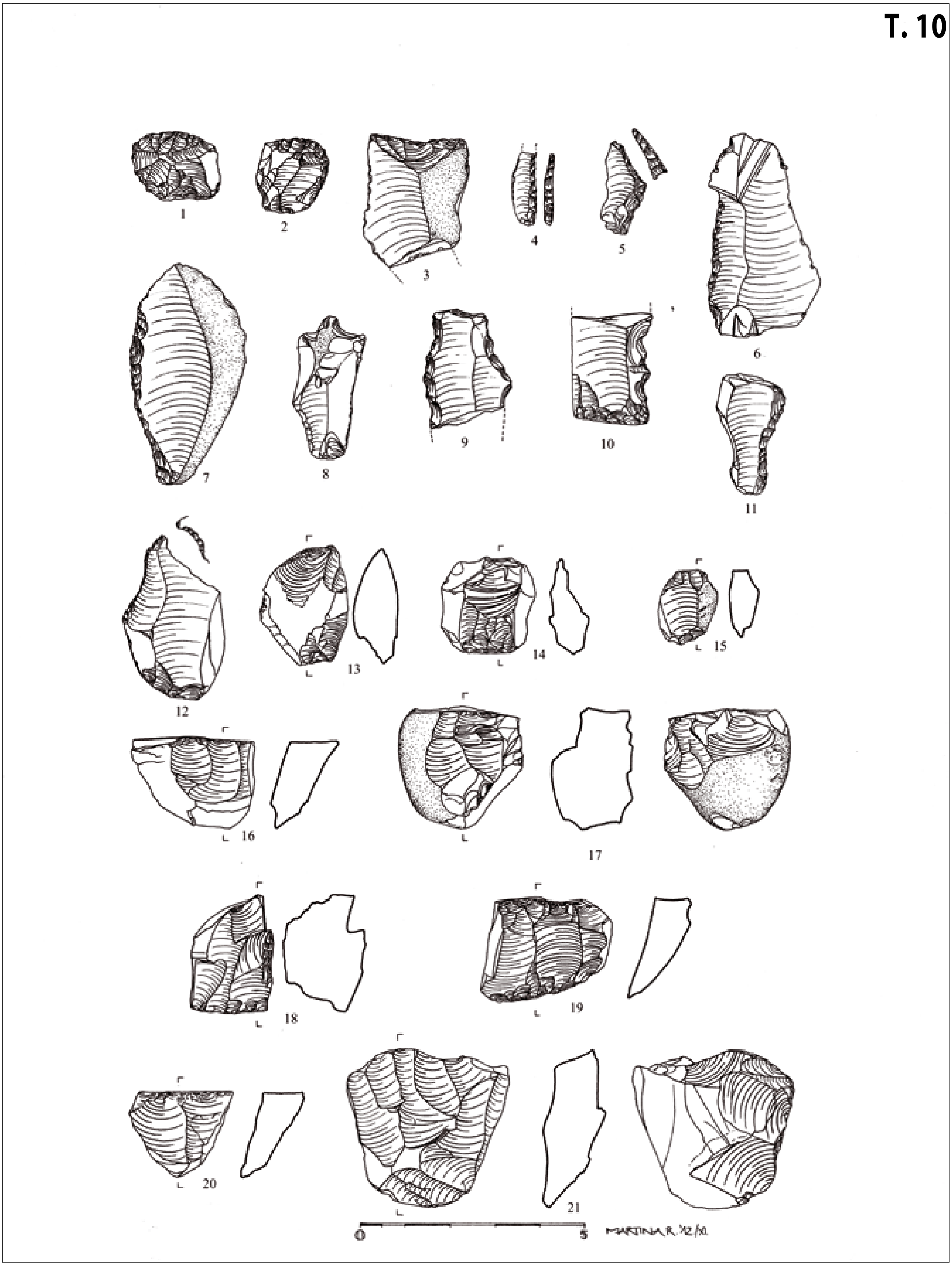
Pl. 8 Horizon Mezolitik II. 1–5: thumbnail endscrapers, 6–7: endscrapers on flake, 8, 13: endscrapers on blade/bladelet, 9–12: backed bladelets, 14–16, 18: sidescrapers, 17: burin, 19: retouched piece, 20–21: marginally retouched pieces, 22–23: denticulates, 24–27: notches, 28: microburin, 29: core renewal flake, 30: core tablet.

T. 9



T. 9 Horizont Mezolitik II. 1: jednoplatformna kombinirana jezgra, 2, 4–5, 16: jednoplatformne jezgre za odbojke, 3, 6–7: jednoplatformne jezgre za pločice, 8: dvoplatformna jezgra za odbojke, 9, 12: višeplatformne jezgre za odbojke, 10: rotirajuća jezgra za odbojke, 11: dvoplatformna jezgra za pločice, 13: rotirajuća kombinirana jezgra, 14–15: bipolarne jezgre.

Pl. 9 Horizon Mezolitik II. 1: single-platform mixed core, 2, 4–5, 16: single-platform flake cores, 3, 6–7: single-platform bladelet core, 8: flake core with two platforms, 9, 12: multi-platform flake cores, 10: rotating flake core, 11: bladelet core with two platforms, 13: rotating mixed core, 14–15: bipolar cores.



T. 10 Horizont Mezolitik III. 1–2: noktolika grebala, 3: grebalo na odbojku, 4: pločica s hrptom, 5: zarubak, 6–8: komadi s obradom, 9–10: nazupci, 11: udubak, 12: svrdlo, 13–15: bipolarne jezgre, 16–17, 20: jednoplatformne jezgre za odbojke, 18: višeplatformna jezgra za odbojke, 19: dvoplatformna jezgra za pločice, 21: višeplatformna kombinirana jezgra.

Pl. 10 Horizon Mezolitik III. 1–2: thumbnail endscrapers, 3: endscraper on flake, 4: backed bladelet, 5: truncation, 6–8: retouched pieces, 9–10: denticulates, 11: notch, 12: drill, 13–15: bipolar cores, 16–17, 20: single-platform flake cores, 18: multi-platform flake core, 19: bladelet core with two platforms, 21: multi-platform mixed core.