LITIKUM

A Kőkor Kerekasztal folyóirata Journal of the Lithic Research Roundtable 3. évfolyam • Volume 3 • 2015



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Litikum A Kőkor Kerekasztal folyóirata Journal of the Lithic Research Roundtable

3. évfolyam • Volume 3 • 2015 Szerkesztők • Edited by Zsolt Mester, György Lengyel, Viola T. Dobosi, Attila Király







HU ISSN 2064-3640 www.litikum.hu

LITIKUM – A KŐKOR KEREKASZTAL FOLYÓIRATA

Litikum - Journal of the Lithic Research Roundtable

Volume 3 • 2015

HU ISSN 2064-3640

A Litikum a kőeszközökkel foglalkozó szakembereket tömörítő Kőkor Kerekasztal évente egyszer megjelenő elektronikus folyóirata (ISSN 2064-3640 (Online)). A Litikum célja olyan tudományos cikkek publikálása, amelyek a Kárpát-medence és a környező területek kőkorát érintik, kőeszközökkel kapcsolatos kutatások eredményeit mutatják be, elméleteket fejtenek ki, módszereket és megközelítési módokat ismertetnek. További információk honlapunkon: https://litikum.hu

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Mogyorósbánya-Újfalusi-dombok, zárójelentés

T. Dobosi Viola

Kivonat

A Duna 208 méter magas teraszán, 1983-ban került elő a felső paleolitikus lelőhely. Kilenc ásatáson, három települési foltot tártunk fel. Az összesen 440 négyzetméterből 360 négyzetméter in situ kultúrréteget bontottunk ki. Å lelőhely a ságvári kultúra sztratotípusa. Az előkerült leletanyag végleges feldolgozása előtt röviden összefoglaljuk a legfontosabb eredményeket. Gazdag eszközkészlete a kultúra különállását igazolja a gravetti entitáson belül. A kulturális hovatartozást meghatározó eszköztípusok mellett jelentősen nőtt a kavics nyersanyag felhasználásának mértéke, ami a laminarizáció alacsony értékét, az ipar kissé atipkus jellegét eredményezi.

Abstract

Mogyorósbánya-Újfalusi-dombok, final report

The Upper Palaeolithic site was discovered at the 208 meters high terrace of the River Danube in 1983. We excavated three occupation areas in course of nine campaigns, unearthing 360 square meters in situ cultural layer out of the whole 440 square meters. The site considered as the stratotype of the Ságvárian culture. Before the ultimate study of findings we summarize here our most important results until today. The rich tool set testifies the distinct status of the Ságvárian inside the Gravettian entity. Beside the lithic types that decided the cultural stand of the assemblage, a newly observed charateristic is the intensive use of pebbles as raw material. This raw material form reduces the degree of laminarization in the collection, which address a quite atypical caracter for the industry.

Kulcsszavak Keywords

Ságvári kultúra, települési jelenségek, eszközkészlet, nyersanyag Ságvárian Culture, settlement features, lithic tools, raw material

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Hivatkozás / Cite as

Dobosi, V. T. (2015) Mogyorósbánya-Újfalusi-dombok, zárójelentés (Mogyorósbánya-Újfalusi-dombok, final report). Litikum 3: 5-12. https://doi.org/10.23898/litikuma0008

Kézirat történet / Article history

Érkezés // Received: 2015. 01. 26. Elfogadás // Accepted: 2015. 09. 25. Közzététel // Published: 2015. 10. 30.

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1. Topográfia

Mogyorósbánya a Gerecse északi peremén Komárom-Esztergom megyei település. A kistérség két meghatározó tájképi eleme a 457 méter magas Gete, a Gerecse különálló legkeletibb tagja, és a bajóti Öreg-kő függőleges sziklafala. A dorogi öblözet után nyugatra folytatódó késő-jégkori Duna-teraszokat széles alluviális síkság választja el a jelenkori medertől, s a Duna jobb parti mellékvizei szabdalják fel. A Mogyorósi-patak bal partján, a délkelet felé enyhén lejtő 208 m tszf. magasságú dombtetőn került elő az őskőkori telep, rálátással a Jankovich barlangra (1. ábra).

A terasz felszínének morfológiáját két tényező határozza meg. Egyrészt a megbontott természetes növénytakaró és a földművelés következtében fellépő intenzív erózió látványosan elegyengette: a terasz magasabb pereméről lehordott humusz a mélyedésekben felhalmozódik. Másrészt a kisebb egyenetlenségeket a múlt század közepén felhagyott, de nem tömedékelt bányajáratok beroskadása eredményezte (nem igazolt magyarázat).

2. Kutatástörténet

A telepet terepbejáráson Homola István fedezte fel a kiékelődött kultúrréteg szétszántott maradványainak összegyűjtésével. A felszínen a leletek két foltban koncentrálódtak (a későbbi I. és II. települési egység).

Az ásatások során (1. táblázat) három, egymástól üres sávokkal elválasztott települési foltot tártunk fel: az I. folt 204 m tszf. magasságban 40 m² területű, a II. folt az I. folttól 25 méterre nyugatra 30 m² területű, a III. folt további 45 méterre ÉÉNy-ra 206 m tszf. magasságban 290 m² területű (Dobosi 1992, 2011).

3. Rétegsor

A déli-délkeleti kitettségű lejtőn a Würm eljegesedés végén minimum 2 méter vastagságban halmozódott fel a lösz. A kultúrréteg a patakvölgy irányában, a terasz peremén kiékelődött, a III. települési folt északi szélén a hajdan



 ábra. Mogyorósbánya-Újfalusi-dombok lelőhely az Öreg-kővel. // Figure 1. The site Mogyorósbánya-Újfalusi-dombok with the Öreg-kő hill in the background.

Kutatás	Leltári szám
Homola I. terepbejárása	Pb.84/251-301
T. Dobosi V. ásatása	Pb.84.302-819
T. Dobosi V. ásatása	Pb.88/751-1046
T. Dobosi V. ásatása	Pb.93/1-375
Homola I. gyűjtése	Pb.99/381-384
T. Dobosi V. ásatása	Pb 2000.584-816
T. Dobosi V. ásatása	Pb.2001.2-174
T. Dobosi V. ásatása	Pb.2006.2.1-34
T. Dobosi V. ásatása	Pb.2009.2.1-94
T. Dobosi V. ásatása	Pb.2009.3.1-9
T. Dobosi V. ásatása	Pb.2010.4.1-2010.4.9
	Homola I. terepbejárása T. Dobosi V. ásatása T. Dobosi V. ásatása T. Dobosi V. ásatása Homola I. gyűjtése T. Dobosi V. ásatása

1. táblázat. A lelőhely kutatásai és a kapcsolódó leletanyag a Magyar Nemzeti Múzeum gyűjteményében. // **Table 1.** Excavations and surveys at the site with inventory number of the collections in the Hungarian National Museum.

vízszintes dombtető (az eredeti járószint) a jelenlegi felszín alatt már 170–180 cm mélyen van. A löszben világosan követhető az 5–10 cm vastag kultúrréteg. A III. települési folt 2 méter mély sarkában felvett szelvényt Ruszkiczay-Rüdiger Zsófia elemezte (Ruszkiczay-Rüdiger 2011). A recens A és a B talajszint alatt magas karbonát tartalmú, rétegzetlen, fakó sárga, típusos lösz következik. A kultúrréteg fölött 50 cmrel gyakoribbá válnak a hajszálgyökerek menti másodlagos mészkiválások (mészmicélium), ami arra utal, hogy az éghajlat szárazodik, füves sztyepp vegetáció a jellemző (2. ábra).

4. Fauna

Krolopp Endre vizsgálta a puhatestű faunát. A *Succinea oblonga* 36 %-os dominanciája a jelenkorinál hűvösebb, füves vegetációt jelez (Krolopp 1992: 17). A gerinces fauna feldolgozatlan. A kultúrréteg preparálása során felismerhető maradványok túlnyomóan *Rangifer tarandus*-hoz tartoztak, s a zsákmány között legalább egy *Equus sp.* biztosan volt.

5. Települési jelenségek

Az ásatási gyakorlatnak megfelelően egy-egy települési folt feltárását addig folytattuk, amíg a szelvény vagy kutatóárok teljesen kiürült. Az I. és II. foltot teljesen feltártuk, a III. foltnak lezártuk a nyugati és déli peremét. Északon a kultúrréteg kiüresedett, már csak szelvényenként 1–2 lelet jelezte a települési felszín szélét, egyben a kultúrréteget. A déli oldalon az utolsó feltárt szelvény GPS-sel rögzített sarkán túl megritkult, de még folytatódott a kultúrréteg. Itt mód nyílik a sztratigráfia későbbi revíziójára, hitelesítésére.

A kultúrréteg a hazai tapasztalatoknak megfelelően nem túl intenzív, ám nagy kiterjedésű – különösen a III. települési folt –, mint az jellemző a ságvári kultúra többi, általános funkciójú telepére. A metszetben a lakófelszínt 5–8 cm vastag, közelítően vízszintes helyzetű, a környezeténél sötétebb sáv jelzi. A település egyrétegű, az eredetileg növényzettel gyéren fedett, laza felszínen a ferdén vagy függőlegesen beágyazódott csontok és kövek a jól követhető kultúrréteg teljes vastagságán gyakran túlnyúlnak. A szintenkénti bontás

nem a település belső sztratigráfiáját jelzi, pusztán technikai szükséglet: a laza löszben csak így lehetett preparálni a felszínt. A rossz megtartású fauna szétszórt, felhasított-öszszetört konyhahulladék, szórványosan különálló fogak vagy állkapocs töredékek. A tűzhelyeket változó nagyságú, határozatlan körvonalú, a szabadtéri tűzhelyekre jellemzően egyenetlenül átégett, vöröses-kormos-hamus foltok képviselik. A legnagyobb közel 1 m². Egy parázstartó lyuknak meghatározható objektum 35 cm átmérőjű, 15 cm mély, lekerekített aljú gödör tele hamuval, faszénnel és erősen átégett csonttöredékkel. Kevés, de jó megtartású, darabos faszén a felszínen szétszórtan is gyűjthető volt.

6. Régészeti leletanyag

Már a nyílt színi telepek kutatásának kezdetén nyilvánvaló volt, hogy Ságvár-Lyukasdomb eszközkészlete elkülönül a Duna-kanyarban, elsősorban Pilismaróton megismert lelőhelyekétől. A magyarázatot változatos kronológiai, topográfiai, klimatikus okokban keresték, s a kulturális kapcsolatok lehetséges irányával igazolták. A múlt század nyolcvanas éveire Mogyorósbánya és néhány más lelőhely előkerülésével és Szob revíziójával körvonalazódott a ságvári kultúra vagy kavics-gravetti, mint a gravetti kultúra fáciese. Geokronológiai háttere a Lascaux–Ságvár interstadiális hazai kimutatása nyomán körvonalazott Ságvár időszak.

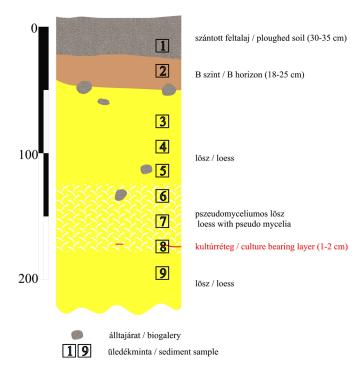
A kultúra legjellemzőbb sajátsága a kavics nyersanyag, ami a mogyorósbányai régészeti leletanyagot is meghatározza. A felső paleolitikumban általánosan használt nyersanyagforrásokat a mogyorósbányaiak is ismerték, ám emellett megnőtt a vegyes összetételű kavicsrétegekből gyűjtött, 6-8 cm-es kavicsok szerepe. Az eszközök átlagmérete kisebb a gravetti kultúra kortárs illetve idősebb lelet-együtteseinek készleteinél. Bár egyelőre nem ismerjük a konkrét kavics-előfordulást, ahonnan a nyersanyagot gyűjtötték, az idősebb teraszkavics-előfordulások általában vegyes öszszetételű és változatos méretű kavicsokból állnak, gyakorlatilag korlátlan mennyiségben. Azaz a számukra megfelelő mérettartományt tudatos válogatás alapján gyűjtötték be. Ez az alapanyag kevéssé gazdaságosan használható ki, sok a "felesleg", a feldaraboláskor előállított/keletkezett, tovább nem hasznosítható hulladék, megnőtt a kavicskérges darabok és az, archaikus jellegű geometrikus kavicseszközök aránya. Az ipar a preferált kavicsnyersanyagból következően kissé atipikus jellegű.

A Mogyorósbányán az összesen mintegy 360 m² települési felszínről 1913 tételben beleltározott régészeti leletanyag 7704 db. Ebből kőnyersanyagú 7598 db. A régészeti és a faunisztikai anyagot a Magyar Nemzeti Múzeum őrzi. A régészeti feldolgozás folyamatban van, itt az előzetes eredményeket foglaljuk össze.

Mogyorósbánya egy általános, vegyes funkciójú, huzamosabb ideig lakott település. Egyelőre nem látjuk a három települési egység típusspektrumai közötti egyezéseket, illetve eltéréseket, ami a lakótér funkciójára utalhatna. A települési foltok közelsége, elrendeződése alapján egyidejű lakottságot feltételezünk. Ennek konkrét bizonyítékai (pl. a magkő

Mogyorósbánya - Újfalusi-dombok 2001

 β szelvény keleti fala / Eastern profile of trench β



2. ábra. Rétegsor. // Figure 2. Stratigraphy.

és a leválasztott penge nem ugyanazon a lakófelszínen van) a részletes elemzés után várhatók.

Az eszközkészlet sajátossága, ami alapján egy új kultúra körvonalazása indokolt, hogy magas a "kavics szekció" aránya, a laminarizáció mértéke a szokásos késő paleolitikus iparokhoz képest alacsony: a szélesség a pengeiparoknál elvárható 50 %-os, vagy az alatti átlag helyett 65 % körül van a hosszúsághoz képest.

A vakarók aránya 25 % körüli, ezen belül a penge-, szilánk- és magas (gyalu) vakarók száma közel azonos (3. ábra). Az árvésők száma meghaladja a vakarókét, mint az a többi gravetti fílumra is jellemző. Arányuk 40 % körüli. Legtöbb a középső élű, majd az oldalsó élű és kettős árvéső következik (4. ábra). A retusált, csonkított pengék aránya nem kiugró, viszont feltűnően kevés a tipikus Gravette-hegy. A tompított hátú mikropengék a ságvári és az epigravetti kortárs idősebb fázisára egyaránt jellemzőek. A kavicseszközök két csoportja közül a tipikusakat a chopperek, chopping-toolok és a gerezdkaparók alkotják, a nem-standard csoportot a gerezdek, szegmensek, fél- és negyed kavicsok képviselik (5. ábra).

Az eszközöket helyben készítették, a szilánk és gyártási hulladék 82 %-ot tesz ki.

A gravetti entitás három fílumának típusmegoszlását csak annak előrebocsátásával lehet összehasonlítani, hogy a vizsgált lelőhelyek egyike sem tekinthető 100 %-osan

lelőhely	vakaró	árvéső	pengehegy	Gravette-hegy	vállas eszköz	tompított	kaparó	kavics
Bodrogkeresztúr*	21,3	29,0	4,0	3,0	1,7	1,0	4,2	0,0
Megyaszó*	26,8	21,0	5,0	1,0	1,4	9,0	7,4	0,0
Hont*	20,0	38,5	0,0	3,8	0,0	11,5	6,2	0,0
Pilismarót**	26,0	33,0	0,9	0,9	1,1	*** 3,3	4,3	0,0
Mogyorósbánya	24,0	39,0	1,3	0,4	1,9	3,5	**** 5,2	3,1

2. táblázat. A gravetti entitás három fílumának típusmegoszlása százalékokban. // Table 2. Lithic tool type proportions concerning the three phyla of the Gravettian entity.

feltártnak. Mogyorósbányán a hiányzó néhány % a III. lelőhelyen a későbbi hitelesítésre bennhagyott 4 méteres tanúszelvény. Eddigi tapasztalataink alapján a települési folt peremén, ezen a néhány négyzetméteren később előkerülő eszközök lényegesen nem módosítják az összképet. Az adatok tájékozódó jellegűek (2. táblázat).

A konkrét értékekben mutatkozó különbségek ellenére a vakarók aránya kiegyensúlyozottnak tekinthető. A 21–39 % között ingadozó árvéső értékekkel együtt az eszközkészlet felét-kétharmadát képviselik. Ezt a szabályt a gravetti entitás egyik meghatározó jellegzetességének is tekinthetjük, szemben például a nyílt színi aurignaci telepek hasonló számaival. A vakarók aránya az árvésőkkel szemben Nagyréde leletanyagában 57:9, Acsa esetében 50:8 a vakarók javára, ami szintén az adott kulturális egységre jellemző adatnak tekinthető.

A leletanyagban található több, mint 100 megmunkálatlan citrus-gerezd alakú kavicshasíték az alsó paleolitikum óta a legkézenfekvőbb forma, mivel a kavics hosszanti felhasítása természetes élű *ad hoc* eszközt eredményez, mely elnagyolva vagy aprólékosan tovább alakítható az igényeknek megfelelően.

6.1. Nyersanyag

A nyersanyagok a korszak általánosan elterjedt és használt, feltehetően azonos, helyi, regionális és *long distance* forrásokból beszerzett kőzetfajtái (3. táblázat).

6.2. Egyéb leletek

Ékszercsiga: 85 db (6. ábra)

Az 1970-es évekig tercier ékszercsiga, a három szobi ékszercsiga halmot kivéve érthetetlen módon mindössze néhány darab került elő régészeti kontextusban, mint becses kuriózum. Azóta jelentősen megnőtt a számuk. A mogyorósbányai mellett Esztergom-Gyurgyalagon 91 darabot találtunk, s Pilismaróton is van néhány. Úgy tűnik, az ékszercsiga általános, kulturális hovatartozástól független

tartozéka legalábbis a Duna-kanyari felső paleolitikus telepeknek. Az Esztergom-gyurgyalagi csigákat a paleontológiai elemzés szerint legalább két, korban és biofáciesben különböző (bádeni és oligocén) lelőhelyről gyűjtötték, közeli, jobb parti lelőhelyről (Magyar 1991: 266) vagy a Börzsöny nyugati peremén kiékelődő középső miocén (?) rétegekből, mint a Szob-Ipolypart ékszercsiga raktárlelet esetében. A források Mogyorósbányán is feltehetően ugyanazok lehettek. Joggal feltételezhető, hogy a távolabbi kortárs lelőhelyeken az ékszercsiga értéke a geológiai forrásoktól való távolsággal arányosan növekedett.

Földfesték, okker, anyagminta: 21 db

A településen szokatlanul sok az okker. Helyenként több dm²-nyi felületen festette halványpirosra a löszt a szétázott okker. Több kisebb, s egy nagyobb darab okker elemzése szerint változó mennyiségű vas-oxidot és alumino-szilikátot, néhány minta kvarcot és kalcitot és viszonylag kevés karbonátot tartalmaz (Mihály 2011: 554).

Borostyán: 1 db

Az eddig előkerült két (Mogyorósbánya, Pilismarót-Pálrét) őskőkori borostyán eredetét, geológiai forrását az infravörös spektrum analízissel nem lehetett azonosítani. (Földvári 1991: 17).

Hegyikristály: 1 db

A hazai lelőhelyeken előkerült néhány hegyikristály penge és szilánk makroszkopikus és fluid zárvány vizsgálata alapján a nyersanyag forrásai "alpi típusú" kvarctelérek lehettek. A telephez legközelebb az Alpok keleti nyúlványain ismerjük ezeket az előfordulásokat, amelyek a Würm idején nem voltak jéggel fedettek. (Dobosi–Gatter 1996: 49).

Ezeken kívül csiszolt homokkő, ammonites-töredék (a Gerecsében felszínen gyűjthető), nummulites (a Mogyorósipatak túlpartján felszínen gyűjthető, kiékelődik?) fordul elő.

^{*} A gravetti entitás idősebb pengés fíluma

^{**} A gravetti entitás fiatalabb pengés/epigravetti fíluma. Feltételezve az egymástól látótávolságra sorakozó 6 települési felszín egykorúságát, a százalékos kiértékelhetőség érdekében az eszközlistákat összevontuk.

^{***} A Pilismarót-Dióson előkerült 14 tompított hátú mikropenge alapján jutottunk arra a következtetésre, hogy a pilisszántói kultúra, amelyet voltaképpen csak a névadó lelőhely reprezentál, nem önálló kulturális egység. A hiányos, aszimmetrikus eszközkészlet nem kultúra-, hanem funkcióspecifikus: a "barlangos" középhegység lábánál megtelepedett epigravettiek alkalmi vadásztanyái, fegyver- vagy szőrmeraktárai lehettek. Mogyorósbánya esetében az egy órán belül elérhető Jankovich-barlang felső rétegösszletének 30 db-os eszközkészlete lehet ilyen.

^{****} Közülük 5 gerezdkaparó a "kavicsos" középső paleolitikus iparok vezérlelete. Ezek önmagukban a felszínen begyűjtve, megtévesztő információt adhatnak a lelőhely kulturális besorolásához!



3. ábra. Vakarók. // Figure 3. End scrapers.



4. ábra. Árvésők. // Figure 4. Burins.



5. ábra. Kavicseszközök. // **Figure 5**. Tools made from pebbles.



6. ábra. Ékszercsigák. // Figure 6. Mollusc shells for personal adornment.

7. Abszolút kor

A debreceni ATOMKI két 14C korhatározást végzett:

- deb-1169: 19 930 ± 300 (Hertelendi 1992: 16)
- deb-9673: 19 000 ± 250, cal. 21 050-20 140

8. A ságvári kultúra hazai lelőhelyei

A névadó lelőhely az 1909 óta ismert Ságvár-Lyukasdomb. Régészeti iparának a valamivel később felfedezett Dunakanyari telepektől eltérő jellegét korán felismerték. Több elmélet magyarázta a hazai felső paleolitikum fiatalabb szakaszában (löszmagdalénien - késő aurignacien - keleti gravetti, a terminológia módosulásai szerint) mutatkozó kettősséget. A jelenleg érvényes feloldása több lépcsős volt. Az első a Lascaux-Ságvár interstadiális kimutatása, ami jelentős előrelépés volt a késő-pleisztocén lösz-sztratigráfia és a régészeti kronológia szinkronizálásában (Gábori-Csánk 1978). A második az újabb, Ságvárhoz kapcsolható lelőhelyek előkerülése, ami bizonyossá tette, hogy a pengés hagyományokat folytató késő paleolitikus lelőhelycsoport kortársaként egy kavics nyersanyagot preferáló népcsoport is megtelepedett a Kárpát-medencében. Népes kultúra, az átmeneti vadásztanyákhoz képest nagy kiterjedésű, tartós megtelepedésre utaló lelőhelyeit ismerjük. A névadó lelőhelyen kívül az ékszercsiga-halmokról nevezetes Szob-Ipolypart, kőlapokkal körbevett, hosszan használt tűzhelyekkel (Markó 2007). A Telecskai-dombok északi peremén Madaras-Téglavetőben több 150-180 cm átmérőjű, gyűrűs szerkezetű tűzhely került elő, amelyeknek talán a hús

nyersanyag*	db	%
vegyes kova	3493	73,21
radiolarit**	299	6,27
erratikus tüzkő	297	6,22
obszidián***	200	4,19
hidro/limnokvarcit	125	2,62
szarukő	19	0,40
kvarcit	325	6,82
hegyikristály	1	0,02
egyéb/mezozoós kőzet	12	0,25
összesen	4771	100,00

- 3. táblázat. A lelőhely nyersanyagai // Table 3. Raw materials of the site.
- * Makroszkopikusan történő csoportosítás, további elemzés folyamatban.
- ** A lelőhelytől nem nagy távolságra (Pisznice, Agostyán) pados megjelenésű radiolarit-előfordulásokat is ismerünk. A kavicskéreg nélküli darabokról egyelőre nem lehet megállapítani, hogy innen vagy egy idős kavicsteraszból gyűjtötték-e őket.
- *** Az obszidián aránya a forrás távolságára tekintettel magas. Összefügghet a felszínen másodlagos forrásokból gyűjthető obszidián-gumók mérete az eszközkészítők igényeinek megfelelő méreteivel.

szárításában-tartósításában lehetett szerepük (Dobosi et al. 1989). Budapest-Corvin téren az erős bolygatás miatt csak kis felületen sikerült feltárni a telephely részletét (Ringer-Lengyel 2008–2009). Az eddig ismertek közül a legnagyobb Mogyorósbánya-Újfalusi-dombok, egyben a ságvári kultúra (korábban kavics-gravetti) sztratotípusa.

Felhasznált irodalom

- Dobosi V. T. 1992. A new Upper Palaeolithic site at Mogyorósbánya. *Communicationes Archaeologicae Hungariae* **1992**: 5–16.
- Dobosi V. T. 2011. Mogyorósbánya, felső paleolit telep. Új eredmények. In: Tóth E., Vida I. (eds.), *Corolla museologica Tibor Kovács dedicata*. Budapest: Magyar Nemzeti Múzeum, 535–548.
- Dobosi V. T., Gatter I. 1996. Palaeolithic tools made of rock crystal and their preliminary fluid inclusion investigation. *Folia Archaeologica* **45**: 31–50.
- Dobosi V. T., Kőhegyi M., Krolopp E., Vörös I., Biró K. T. 1989. Felsőpaleolit telep Madaras-Téglavetőben (Jungpaläolithische Siedlung in Madaras-Téglavető). *Cumania* 11: 9–65.
- Földvári M. 1992. Analysis of the amber from Mogyorósbánya. Communicationes Archaeologicae Hungariae 1992: 16-17.
- Gábori-Csánk V. 1978. Une oscillation climatique à la fin du Würm en Hongrie. *Acta Archaeologica Academiae Scientiarum Hungaricae* **30**: 3–11.
- Hertelendi E. 1992. Radiocarbon dating of the Upper Palaeolithic site at Mogyorósbánya. *Communicationes Archaeologicae Hungariae* 1992: 16.
- Krolopp E. 1992. Mollusc fauna from the Palaeolithic site at Mogyorósbánya *Communicationes Archaeologicae Hungariae* 1992: 17.
- Magyar I. 1991. Palaeolithic trinkets in Esztergom-Gyurgyalag. *Acta Archaeologica Academiae Scientiarum Hungaricae* 43: 264-265.
- Markó A. 2007. The Upper Palaeolithic site at Szob. *Folia Archaeologica* **53**: 7–22.
- Mihály J. 2011. Mogyorósbánya-Újfalusi dombok felsőpaleolit lelőhelyről származó okkerkavics illetve lösz-okker porminták FTIR és FT-Raman vizsgálata. In: Tóth E., Vida I. (eds.), *Corolla museologica Tibor Kovács dedicata*. Budapest: Magyar Nemzeti Múzeum, 554–557.
- Ringer Á., Lengyel Gy. 2008–2009. The Upper Palaeolithic Site at Budapest–Corvin tér. *Praehistoria* **9–10**: 205–211.
- Ruszkiczay-Rüdiger Zs. 2011. Mogyorósbánya-Újfalusi dombok paleolit lelőhely szedimentológiai viszonyai. In: Tóth E., Vida I. (eds.), *Corolla museologica Tibor Kovács dedicata*. Budapest: Magyar Nemzeti Múzeum, 549–553.



Proceedings of the 11th SKAM Lithic Workshop The multifaceted biface - Bifacial technology in Prehistory 20th-22nd of October, 2014, Miskolc, Hungary



Bifaces in plain sight: testing elliptical Fourier analysis in identifying reduction effects on Late Middle Palaeolithic bifacial tools

Kamil Serwatka

Abstract

Nowadays, geometric morphometrics are being widely implemented in lithic studies. Their application is driven by the powerful methods of data analysis offered by morphometric computer software. Additionally, computer programs for digital shape analysis are freeware and easy to handle, even for a non-morphometrician. The results achieved with this software yield interesting conclusions and they offer a new perspective on lithic tools. This presents morphometrics as a potentially useful methodological tool in the field of lithic analysis, which often has to deal with artifacts morphology. The aim of this study is to test the utility of basic shape analyses included in the PAST (Palaeontological Statistics) computer program, and especially elliptical Fourier analysis, in identifying reduction effects on Late Middle Palaeolithic bifacial tools. For this purpose, an assemblage of 147 bifacial tools from Southern Poland was analyzed. The sample comprised of Keilmessergruppen handaxes, Keilmesser and Late Middle Palaeolithic leaf points. The results reveal patterned changes in artifacts proportions, which may have been caused by continuous resharpening/reduction as well as by gradual alteration of tools design, due to their changing function.

Kivonat

A bifaciálisok síkján: a kőeszköz redukció hatásának mérése a késői középső paleolitikum bifaciális eszközein elliptikus Fourier analízis segítségével

A geometrikus morfometria ma széles körben alkalmazott módszer a kőeszköz kutatásban. Alkalmazásának fő mozgatórugója a számítógépes szoftverekben rejlő hatékony adatelemzés lehetősége. A hatékonyságon túl a digitális formaelemző szoftverek ingyenesek és könnyen alkalmazhatók, még azok számára is, akik nem morfometriai szakemberek. A szoftvert alkalmazva érdekes eredményekre tarthatunk számot, ami a kőeszközök értékelésének új perspektíváit nyújtja. A morfometria a kőanalízis morfológiát érintő kérdéseit illetően hasznos módszer lehet. E tanulmány célja a PAST (Palaeontological Statistics) szoftver "elliptikus Fourier analízis" alkalmazásának tesztelése a késői középső paleolitikum bifaciális eszközein. 147 lengyelországi bifaciális eszközt vontunk vizsgálat alá, hogy megállapítsuk forma és kőeszköz redukció kapcsolatát. A mintát Keilmessergruppe szakócák, Keilmesser-ek és késő középső paleolitikus levélhegyek alkották. A vizsgálat a formai arányok változásában sajátos mintázatokat talált, ami utalhat folyamatos újraélezésre/redukcióra, illetve az eszközök dizájnjának fokozatos módosítására, ami az eszközök funkciójának változásaival függhet össze.

Keywords

Late Middle Palaeolithic, geometric morphometrics, Keilmesser, handaxes, leaf points

Kulcsszavak

Késői középső paleolitikum, geometrikus morfometria, Keilmesser, szakócák, levélhegyek

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Cite as / Hivatkozás

Serwatka, K. (2015) Bifaces in plain sight: testing elliptical Fourier analysis in identifying reduction effects on

Late Middle Palaeolithic bifacial tools. Litikum 3: 13-25. https://doi.org/10.23898/litikuma0009

Article history / Kézirat történet Received // Érkezés: 2015. 02 . 04. Accepted // Elfogadás: 2015. 09. 25. Published // Közzététel: 2015. 11. 16.

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1. Introduction

During the past few years, landmark-based morphometrics were repeatedly applied as a methodological tool in numerous lithic studies (i.e. Buchanan-Collard 2010; Lycett et al. 2010; Iovita 2009; Charlin-González-José 2012; Eren-Lycett 2012). Nowadays, geometric morphometry is used as an aid in artefact classification (Buchanan et al. 2007), for the evaluation of the morphological diversity of lithic assemblages (Azavedo et al. 2014) or as an indicator of the reduction effects on stone tools (Iovita 2011; Thulman 2012). This considerable dissemination of geometric morphometry in lithic studies is most likely caused by the promise of powerful statistical methods of shape analysis offered by

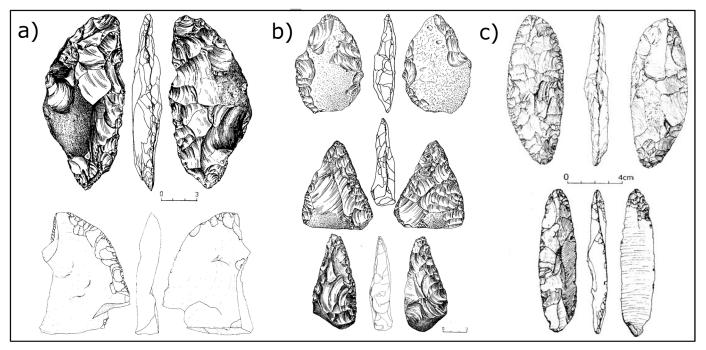


Figure 1. Types of bifacial artifacts considered in the study. a: *Keilmesser*, b: handaxes; c: LMP leaf points (after Kozłowski 2006; Cyrek 2002; Chmielewski 1961). //

ábra. A tanulmányban említett bifaciális eszközök. a: Keilmesser; b: szakócák; c: levélhegyek a késő középső paleolitikumból Kozłowski 2006; Cyrek 2002; Chmielewski 1961. nyomán.

various morphometric software and a relatively easy way of handling of those specialized computer programs.

Due to the emphasis, which geometric morphometry puts on the overall shape of analyzed objects, lithic studies involving morphometrics often focus on bifacial tools. Of all other stone tools, bifaces were made by shaping comparatively large raw material blanks into desired forms. This process may have incorporated the utilization of imposed patterns of artifacts design (or the so called "mental templates"), as well as individual concepts of tool making (Wenban-Smith 2004). There exists a widely accepted notion, that bifaces contain information transcending beyond simple requirements of lithic technology or utilitarian needs (Wynn 1996; Kohn-Mithen 1999; Porr 2005). Some researchers agree that even the oldest known bifacial tools were made with a sense of foresight and planning, and that the process of their production may have involved the use of complex cognitive abilities (i.e. Gowlett 2006; Feliks 2008). This encourages many scholars to use geometric morphometrics in bifacial tools analyses. Given the computing capabilities of morphometric software, it is possible to compare shapes of many objects simultaneously and to seek out patterns in their shape variability, which are hard to grasp using standard metric attributes. Given these advantages, morphometrics stand out as an accurate analytical tool, which can yield potentially interesting results.

Geometric morphometrics are commonly used within the case studies regarding finely crafted bifaces, such as Paleoindian points (see references above). There have been approaches dealing with Lower and Middle Palaeolithic handaxes as well as *Keilmesser* in this manner (for example the works by Costa 2010; Iovita 2009, 2010, 2011; Iovita—McPherron 2011), but such approaches still seem scarce.

Lower and Middle Palaeolithic bifacial tools are often highly variable due to their general asymmetry and they hardly fit into typological terms. Particular difficulties in the process of the identification and classification of Middle Palaeolithic bifacial artifacts can be observed by looking at the state of the research on Keilmessergruppen handaxes and backed knives (subsequently Keilmesser) (i.e. Hauser 1916; Bosinski 1967; Sobczyk 1975; Richter 2000, 2002; Ruebens 2006). Given the strong inclination towards the production of various bifacial tools in this cultural unit, it is often hard to distinguish artifact types, since one form merges into another. Despite these difficulties there exists a strong notion that Middle Palaeolithic stone tools, and especially Keilmesser, were frequently resharpened and reworked, which is considered one of the main reasons for their diversity (Dibble-Rolland 1990; Jöris 1994, 2001; Richter 1997; Pastoors-Schäfer 1999; Pastoors 2001; Migal-Urbanowski 2006). Bearing in mind the value of the studies listed above, it should be emphasized that most of them are based on scar pattern analysis. Despite the utility of this method in terms of understanding of stone tools use life, scar pattern analysis carries a heavy load of arbitrariness. The recognition of scar pattern alignments is mostly carried out using qualitative traits, which serve as an indicator of the alleged subsequent stages of reduction. In the author's opinion, relying solely on such criteria can lead to the misperception of reduction as an imposed scheme and as something that, eventually, must have happened to all tools with specific morphology.

The first aim of this paper is to test whether the typological categories such as handaxes, *Keilmesser* and leaf points coincide with the results of geometric morphometric analysis. It is important that we know if in the perspective of a statistical shape analysis LMP bifacial tools remain separate classes. This doubt stems on the fact that most geometric

morphometrics recognize shape of objects only as a two dimensional outline (Zelditch et al. 2004). The other problem is that archaeologists often use subjective terms of shape description in their classifications. This may lead to intra-observer errors and cause discrepancies between the outcome of classification and the result of a strictly quantitative analysis. If this result will be positive, the second objective will be to evaluate whether there are any indications of reduction effects in the studied assemblage. This concerns mainly *Keilmesser*, but also handaxes. The author expects that the effects of reduction should appear only on the maintainable, or "active" parts of tools (see below) and they should occur as diminishing of these active parts.

2. Keilmessergruppen handaxes

The most descriptive model regarding handaxes reduction through resharpening was created by S.P. McPherron (1995, 1999, 2000, 2003). It was originally developed for Acheulean large cutting tools, but the model is sufficiently broad to be used for other forms of handaxes as well. By studying the African Acheulean handaxe assemblages, McPherron noticed, that most specimens show a pattern of reduction involving mainly the rejuvenation of the tip. This resulted in the transition from pointed to oval morphology in handaxes shape (McPherron 1995, 1999).

Considering *Keilmessergruppen* handaxes, the observations made by M. Urbanowski (2009) are worth mentioning. He had noticed, that some preforms with handaxe-like morphology from Wylotne Rockshelter were reworked into *Keilmesser* by breaking off one of the edges (the so called "Wylotne method").

2.1. Keilmesser

Keilmessergruppen backed knives were first recognized as a separate typological category by S. Krukowski (1939–1948). Later on they were formally defined by W. Chmielewski (1969). Initially, one of the most distinctive features of these artifacts was the paraburin scar resulting from a blow made at the distal end of the tool. This 'Pradnik technique' proved to be a convergent technical feature, which emerged independently in geographically distinct regions, probably as a method of resharpening the working edge (Schild–Wendorf 1977; Marks et al. 2002; Solecki–Solecki 2004).

Keilmesser are highly variable in terms of morphology (Fig. 1: a), which is partly conditioned by the form of accessible raw material blanks (Jöris 2006: fig. 6). Another widely accepted idea is that the reason for such great morphological diversity of these implements was the recurrent rejuvenation of the working edge. Several studies were dedicated to the problem of Keilmesser rejuvenation (i.e. Jöris 1994, 2001; Pastoors–Schäfer 1999; Pastoors 2001). Regarding the studied sample, the experimental approach by W. Migal and M. Urbanowski (2006) occurs as the most relevant. According to the results obtained by the mentioned authors, the consecutive repairs would significantly alter the proportions of Keilmesser. The most obvious outcomes would be:

diminishing of *Keilmesser* elongation, alteration of the shape of the working edge (from convex to straight to concave), diminishing of the angle between the base and the working edge (extending the asymmetry of the tool).

3. The reduction/resharpening concept

The idea that Middle Palaeolithic tools were resharpened derives from the work of American researchers, particularly N. Rolland (1988) and H. Dibble (1984; 1987; 1995). Resharpening seems to be a natural outcome of the utilization of at least some of the stone tool forms. Among the most important factors affecting the occurrence of resharpening in bifacial tools, most researchers point out the availability of good quality raw materials, the distance to their nearest outcrops and the intensity of hunter-gatherer mobility (i.e. Shott 1995; Shott–Weedman 2007; Kelly 1988). According to Middle Palaeolithic contexts, most of these information are often not available due to the fragmentariness of archaeological data. Because of this difficulty, the researches involved in this subject often focus on individual artifacts and their assemblages.

According to the reduction concept, some lithic tools will represent a spectrum of reduction stages, which is characterized by patterned alterations of morphology in comparison to the initial forms. These changes depend mainly on the continuous depletion of stone material in the process of rejuvenation of the maintainable parts of stone tools. Based on technical analyses, these sections are sometimes referred to as "active" parts in contrast to the "passive" areas (sensu Boëda 2001), which were rarely or never modified by knapping.

Depending on the wear intensity, resharpening would eventually affect the geometric properties of a tool causing the change of its proportions. If the bifaces considered here were actually continuously reduced, then the pattern of this reduction should be captured by superimposing all specimens and performing the principal component analysis.

4. Materials

The main sample consists of handaxes (N=42) and *Keilmesser* (N=51). Their outlines were obtained by scanning the illustrations included in the monographs of the main Late Middle Palaeolithic sites in Southern Poland, namely Wylotne Rock shelter, Biśnik Cave and Pietraszyn 49 (**Table 1**). This procedure was applied also by A. Costa who used illustrations of bone and stone bifaces from Castel di Guido or R. Iovita, who used drawings of Stelmoor points as a comparative sample in his study regarding Aterian tanged points (Costa 2010; Iovita 2011).

All the stratified sites from which the studied artifacts derive are homogenous in terms of assemblage integrity and stratigraphical sequences. The only exception is Pietraszyn 49, where lithic artifacts were discovered in a secondary deposit. Despite this fact, the overview of the composition of

Typological category	Site	Raw material	Site type	Stratigraphic unit	Dating	Number of specimens (N)	Reference
	Wylotne	Jurrasic flint	rockshelter	5, 6, 8/7	ca. 100–60 ka BP	38	Kozłowski 2006
Handaxes	Pietraszyn 49	Erratic flint	open air		undetermined	4	Fajer et al. 2001
	Biśnik	Jurrasic flint	cave	5/6	67±15 ka BP	8	Cyrek 2002
	Wylotne	Jurrasic flint	rockshelter	5, 6, 8/7	ca. 100–60 ka BP	32	Kozłowski 2006
Keilmesser	Pietraszyn 49	Erratic flint	open air		undetermined	8	Fajer et al. 2001
Returnesser	Pietrowice Wielkie 8	undetermined	surface find		undetermined	1	Fajer et al. 2001
	Cyprzanów 3	undetermined	surface find		undetermined	1	Fajer et al. 2001
	Nietoperzowa Cave	Jurrasic flint	cave	6, 5a, 4,	30–38 ka BP	25	Chmielewski 1961
Leaf points	Ehringsdorf	Jurrasic flint	cave		undetermined	18	Kot 2013
	Mauern	Jurrasic flint	cave	4, 5	ca. 60–28 ka BP	12	Kot 2013
Sum						147	

Table 1. List of materials used in the study. // 1. táblázat. A tanulmányban bemutatott kőeszközök.

artifact types from Pietraszyn 49 and their technical features confirms the LMP character of this assemblage and its affiliation to the Central European *Keilmessergruppen*.

For comparative purposes, an assemblage of 54 LMP leaf points was used as a correlative sample. The reason for choosing such comparative standard is that LMP leaf points are not very distinct from *Keilmessergruppen* bifaces in terms of chronology and their origin (Richter 2008–2009), yet they represent a more advanced bifacial technology. In the authors opinion, including leaf points in the sample will provide an interesting analogy. The studied points derive mostly from well investigated, stratified sites like Nietoperzowa Cave and Mauern (Table 1).

The sample is suitable for testing the hypothetical reduction trajectories of *Keilmessergruppen* bifaces. The subsequent typological groups contain artifacts of different shapes and sizes, which allows for tracking the hypothetical reduction patterns. The author followed the classification presented in the monographs (**Table 1**). Secondly, the studied assemblages come from different types of sites (cave and open air), which gives a more comprehensive view on artifacts variability.

5. Methods

5.1. Artifact orientation, digitization and superimposition

The author used a standard geometric morphometric method of outline shape analysis based on landmarks (Zelditch et al. 2004: 23). Before the actual analysis a set of procedures, generally consisting of data processing, had to be carried out. They are important for the understanding

of the methodology of this study, therefore will be now described.

To project the outline shape, illustrations of the artifacts were scanned with a Canon CanoScan LiDE 210 scanner at 400 dpi. The image of each artifact was extracted as a single jpg file and oriented in GIMP according to its axis of symmetry. To allow further comparisons between shapes all outlines had to be oriented in the same manner. The method of orientation applied in this study was first described by McPherron and Dibble (1999) and later improved upon by Costa (2010). In it all the bifaces are oriented around their long axis of symmetry, so that the longest orthogonal lines drawn from a central line were equal in length (Costa 2010: Fig. 2.1b). The tip of a biface was used as the point from which the outline was drawn along the biface's perimeter. This outline will then be transformed into a set of equidistant landmarks (see Fig. 2).

After performing the orientation, a thin plate spline file was created in TpSutility program (Rohlf 2006). This stores all the images in one tps file and allows a further digitization of the images. The tps file with all the images was then opened in TpSDig (Rohlf 2004), a program used mainly for placing landmarks on specimens.

In natural sciences, when the morphology of living or fossil organisms is taken into account, landmarks are often placed on relevant biological structures (e.g. Querino et al. 2002). Of course one can do the same for lithic artifacts by placing landmarks on the tip or base, but this way the complex shape of bifaces would be reduced to just a few landmarks. In the studied case the best way to capture the outline shape is to set a number of landmarks around the perimeter of an artifact by mapping its contour. To allow further comparison between the tool shapes, the landmarks must correspond to each other, i.e. they need to be placed at equal

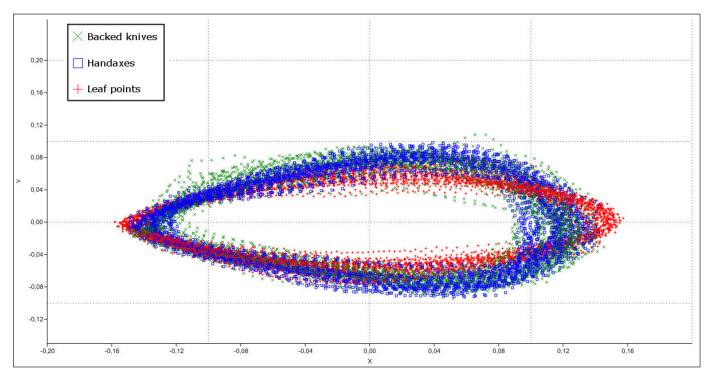


Figure 2. Landmark configuration and the position of all the specimen outlines after conducting the Procrustes superimposition. // **2. ábra.** A jelöletek konfigurációja és az összes vizsgált darab körvonalának helyzete Procrustes megfeleltetés elvégzése után.

distances from each other and according to a standardized configuration. Using the TpsDig outline tool it is possible to draw an outline from the tip, along the perimeter of an artifact, and then transform it into a set of equidistant landmarks (Costa 2010). The number of entered landmarks is left for the user to choose. Costa used seventy-five points (Costa 2010: 27), while Iovita employed sixty landmarks (Iovita 2009). These numbers are chosen on a trade off between the labour-cost of hand-digitizing and the accurate delineation of artifacts shape. I decided that 100 landmarks would describe the outline shape with a greater accuracy, since LMP bifaces contain large natural surfaces and are often irregular. After assigning the landmarks for each specimen, the tps data was opened with PAST (Palaeontological Statistics), a program enabling statistical shape analyses (Hammer et al. 2001).

Landmarks are subject to several kinds of displacements in two-dimensional space, such as rotation and translation (Richtsmeier et al. 2002). These may affect the correct orientation of specimens and cause errors during a comparison of artifacts shapes. One should also bear in mind that some of the digitized outlines were represented in a different scale than the others. To eliminate these changes in landmarks position a Procrustes analysis must first be conducted. Procrustes analysis is a set of mathematical operations which transforms the matrix of XY coordinates so that translation. rotation and the difference of scale is eliminated from the assemblage (Rohlf-Slice 1990) (Fig. 2). Additionally all outlines are superimposed around a centroid, which is the 0,0 coordinate on the XY axis (Hammer et al. 2001). This operation subtracts the mean shape referred to as "consensus" from all the coordinate values, allowing for further tracking of shape deformations of specimens in relation to the

consensus shape. Superimposition scales bifaces dimensions to a common centroid, equalizing their size, while preserving the original shape (Jungers et al. 1995).

5.2. Principal component analysis (PCA) with 95% prediction ellipses

In geometric morphometrics, PCA is a frequently used method of statistical shape analysis. It allows simplification of complex patterns of shape variation, making them easier to interpret. In the studied case, PCA is applied to recognize shape changes which are caused by continuous resharpening of lithic tools.

The set of landmarks is a K×M matrix, that is, a matrix of K number of landmarks in M dimensions (Dryden-Mardia 1998). It is expected that some regions of the tool outlines will overlap since they generally belong to the same typological category, but patterns of their variation and covariation are often complex and difficult to interpret. The purpose of PCA is to simplify those patterns and make them easier to interpret by reducing the number of shape variables (Zelditch et al. 2004: 156). PCA transforms the matrix of landmarks so that most of the variation is described by two hypothetical variables, the so called principal components, which are the X and Y axes on the PCA plot.

To test the accuracy of observations, a 95% ellipse will be applied as a supplement to the PCA analysis. The ellipse is drawn based on the assumption that the data is subjected to a two-dimensional normal distribution. The orientation of an ellipse depends on the correlation coefficient between the variables, for example, the longer axis of an ellipse is approximately imposed according to the regression line of

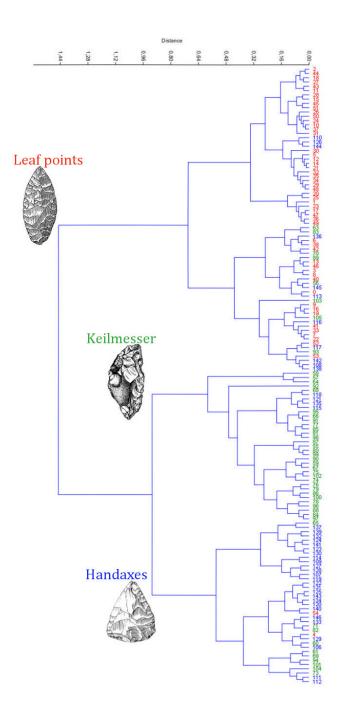


Figure 3. Diagram of the cluster analysis with the Ward's method. // **3.** ábra. A klaszteranalízis dendrogramja (Ward metódus).

values. The probability that a new value will fall in the range of the ellipse (for instance 0.95) is the parameter determining its size (Tracey et al. 1992).

5.3. Cluster analysis with the Ward's method

In order to determine whether the subsequent typological categories established for the analysed bifaces comply with the results of geometric morphometric analysis, the author decided to conduct a cluster analysis. In natural sciences, it is a common way of organizing samples of specimens, which are characterized by high variability. The cladistic analysis groups together specimens, which are most similar in terms of their outline shape, and leaves out those which

differ. By that, it forms a hierarchical tree diagram of clusters, which are spaced by taxonomic distance (Kaufman-Rousseeuw 1990). In the author's opinion, the best variant of cluster analysis for dealing with the problem discussed here is the Ward's method (Ward 1963). Basically, it looks at cluster analysis as an analysis of variance problem, instead of using distance metrics or measures of association. It looks for groups of specimens that it forms into branches, the branches into limbs and eventually into the trunk (de Amorim 2015). If *Keilmesser*, handaxes and leaf points will be recognized as separate categories, the outcome should be a set of three clusters comprising the outlines of subsequent types of artifacts.

5.4. Elliptic Fourier analysis (EFA)

This is a method of shape analysis in landmark-based morphometrics. EFA is based on the results of principal component analysis by following the patterns of regression of shapes designated by 95% ellipses.

In standard landmark-based morphometrics, the shape of an object is defined by a set of landmarks with relevant coordinates located in two dimensional space (Richtsmeier et al. 2002). Elliptic Fourier turns closed curves designated by landmarks into linear combinations of sinusoidal functions with appropriate multiplicators (amplitudes) (Kuhl-Giardina 1982; Ferson et al. 1985). By doing so, EFA serves as a more dynamic approximation of shape changes among the studied specimens, especially when these changes are expected to be gradual (such as continuous reduction of lithic tools). The quality of these approximations can be adjusted by changing the number of amplitudes or harmonics. Increasing their number will simply increase the accuracy of shape representation, but the important thing is to select a trade off between the accuracy of the representation and the level of complexity of the analysis. Examining artifacts shapes in a general manner can aid in finding more comprehensive patterns of reduction. In this study, the author have set the number of harmonics at 5, which gave an accurate overall representation of artifacts form.

6. Results

6.1. Cluster analysis with the Ward's method

The resulting clusters generally correspond with the typological categories established for the LMP bifacial tools. When setting a brake in the middle of the hierarchical distance (0.80), we observe that three, well defined clusters of sizes 72, 36 and 37 emerge on the diagram (**Fig. 3**). The greatest overlap appears between the assemblages of handaxes and *Keilmesser*, since they have been grouped into one, larger cluster at a distance of 0.96. The cluster of leaf points is best defined, since it forms a branch of the highest taxonomic level, which splits up approximately at a distance of 0.70. The other branch forms a cluster comprising of leaf points and also some handaxes and a few *Keilmesser*.

		Knives			Handaxes			Leaf points	
I	PC	Eigenvalue	% variance	PC	Eigenvalue	% variance	PC	Eigenvalue	% variance
	1	0.0049351	37.169	1	0.004922	53.873	1	0.0041795	66.185
	2	0.0030593	23.041	2	0.0014226	15.57	2	0.000665	10.531
	3	0.0016673	12.557	3	0.001092	11.953	3	0.0004884	7.7349
	4	0.0010285	7.7463	4	0.0004367	4.7801	4	0.0002431	3.8494
	5	0.0005537	4.17	5	0.0003116	3.4109	5	0.0001435	2.2717
	6	0.0004958	3.7341	6	0.0001802	1.9728	6	0.000112	1.7741
	7	0.0003602	2.7131	7	0.0001703	1.8643	7	7.82E-05	1.2376
	8	0.0002323	1.7494	8	1.00E-04	1.0941	8	5.76E-05	0.91152
	9	0.0001891	1.4246	9	9.10E-05	0.99559	9	4.73E-05	0.74897
	10	0.0001373	1.0344	10	6.23E-05	0.68244	10	4.23E-05	0.67056
	11	0.000132	0.99426	11	5.93E-05	0.64853	11	3.64E-05	0.57634

Table 2. Eigenvalues and the percentage variance of the selected principal components generated for each typological group. // **2. táblázat.** Az egyes tipológiai csoportok főkomponensei a hozzájuk tartozó százalékos varianciával és sajátértékekkel.

6.2. Principal component analysis

The first two principal components describe 56.021% and 18.544% of the whole variance and only those PCs were taken into account during elliptic Fourier analysis (**Table 3**). To get a more comprehensive view on the distribution of specimens, also PCs two and three were taken into account, since their percentage variance is also of significant quantity. The number of generated PCs is equal to the number of all specimens (N=147), but most of them hold very little of the overall variance, therefore a number of eleven PCs was presented in tables 2 and 3 for comparative purposes.

To compare the eigenvalues and the percentage variance between the assemblages, a set of eleven principal components was also generated for each typological group (**Table 3**). The percentage variance values indicate that leaf points are the most uniform group in terms of outline shape, as the first two principal components describe 76.716% of the overall variance. Knives are the most variable typological group in which the values of the percentage variance are more evenly distributed between the individual principal components. This implies that there is no clear trend in the distribution of their outline shapes.

PC1 axis shows the regression of the most expanded tool shapes towards the most contracted ones. It is hard to define the range of distribution shown by PC2 since there are too few specimens scattered according to this principal component (**Fig. 4**). Most of the knives are distributed according to PC2, but the reason for this arrangement is unclear.

The distribution of specimens according to PCs two and three presents a different view on the outline shapes variability. In this arrangement, most *Keilmesser* are scattered according to component two, while handaxes and especially leaf points, form a tight cluster at the center of the plot. Most *Keilmesser* are scattered randomly and without any pattern of distribution. In this arrangement, tools made out of large blanks, with only initial bifacial retouch along the edge are placed in the same range of values as knives with all over bifacial retouch and a concave working edge, which could be considered as exhausted.

PC	Eigenvalue	% variance
1	0.0082381	56.021
2	0.002727	18.544
3	0.0010987	7.471
4	0.0007311	4.9715
5	0.0004667	3.1737
6	0.000329	2.237
7	0.0002065	1.4043
8	0.0001453	0.98826
9	0.0001228	0.83532
10	8.07E-05	0.54844
11	7.08E-05	0.48119

Table 3. Eigenvalues and the percentage variance of the selected principal components generated for Keilmesser, handaxes and leaf points altogether. //

3. táblázat. A Keilmesser, szakóca és levélhegy tipológiai csoportok összesített főkomponensei a hozzájuk tartozó százalékos varianciával és sajátértékekkel

Interestingly, according to PC two and three, assemblages of handaxes and leaf points overlap and are distributed almost in the same range of the plot (Fig. 5). The 95% ellipses designate a range from crudely shaped specimens, clustered in the lower-right part of the plot to finely shaped, elongated handaxes and leaf points, which were placed on the opposite side of the ellipses range. Some handaxes fall out from the range of the prediction ellipse. Curiously, all of these are specimens from Wylotne, which are very similar to each other. They have straight working edges, a broad, straight base and their outline resembles an isosceles triangle (see Fig. 1: b, specimen in the middle).

6.3. Elliptic Fourier analysis

The set of *Keilmesser* outlines was not involved in the EFA, since there were no indication of any reduction pattern in their assemblage. The results of EFA for handaxes show, that there is a significant pattern of shape change consisting of the transition from specimens with rounded or irregular edges to handaxes with slightly concave contour in their midsection and a pronounced tip (Fig. 6). This pattern

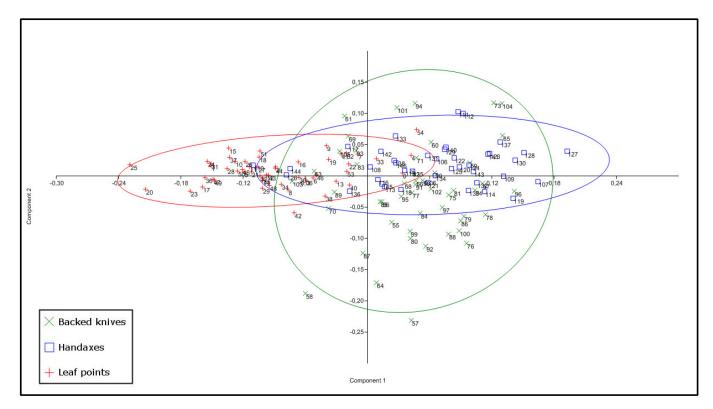


Figure 4. Plot of the PCA analysis for PC one and two with 95% ellipses. // **4. ábra.** Az első és második főkomponens diagramja 95%-os ellipszisekkel.

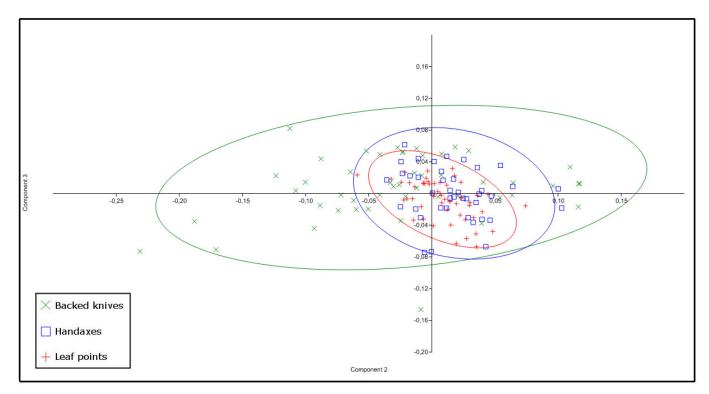


Figure 5. Plot of the PCA analysis for PC two and three with 95% ellipses. // **5. ábra.** A második és harmadik főkomponens diagramja 95%-os ellipszisekkel.

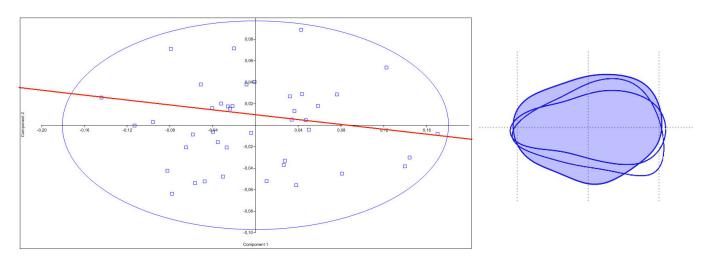


Figure 6. Results of the elliptic Fourier analysis for the handaxes assemblage illustrated by three Fourier shapes. // **6. ábra.** A szakócák elliptikus Fourier analízisének eredményei, három Fourier formával illusztrálva.

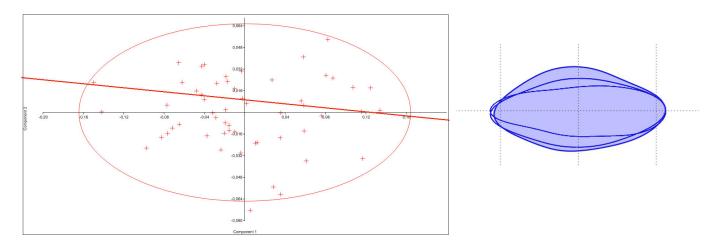


Figure 7. Results of the elliptic Fourier analysis for the leaf point assemblage illustrated by three Fourier shapes. // **7. ábra.** A levélhegyek elliptikus Fourier analízisének eredményei, három Fourier formával illusztrálva.

is best emphasized by the three specimens from Wylotne Rockshelter, which were designated by linear regression (see Fig. 1: b).

As it was mentioned before, LMP leaf points sample was used here only for comparative purposes, but the author noticed that it shows an interesting pattern of shape regression. Three Fourier shapes designated by the linear regression clearly show, that there exists a reduction in the midsection of leaf points, while the tip area and the base are held constant (Fig. 7). This pattern is emphasized by the leaf shaped implements from Nietoperzowa Cave and from Mauern.

7. Discussion

The results show, that the featured typological categories correspond well with results of the geometric morphometric analysis. There exist common areas between all assemblages, but generally, *Keilmesser*, handaxes and leaf points form separate clusters in the scope of geometric morphometric analysis. The greatest overlap exists between

handaxes and knives. It may be due to the fact, that these are closely related typological categories by means of their origin. Their genetic relation was already suggested by Hahn (1991), and also R. Schild described *Keilmesser* as "handaxes with a back" (Schild-Wendorf 1977). It can be observed, that in course of the cluster analysis, the specimens have been organised hierarchically. Of the highest significance are the most homogenous clusters, which are usually paired with a quantitatively smaller cluster with diverse composition of specimens. Given the strictly quantitative character of this analysis, these specimens are in the range of statistical error.

One of the most intriguing outcomes of the PCA is the random distribution of *Keilmesser*. They show no signs of shape regression, which would indicate continuous resharpening. If reduction affected their proportions, then it should come as a diminishing of values on the PCA plot, since the studied assemblage comprises specimens which can be considered as initial as well as exhausted (i.e. **Fig. 1: a**). On the basis of these observations, it is hard to conclude that reduction was the main reason for the diversity of *Keilmesser* shapes.

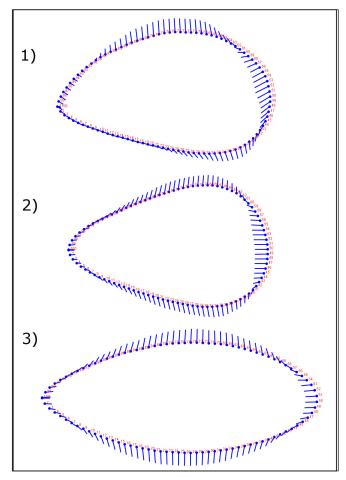


Figure 8. Vectors indicating the shift of landmarks position according to principal component 1, in the assemblage of *Keilmesser* (1), handaxes (2) and leaf points (3). //

8. ábra. Az első főkomponens szerinti jelölet-elmozdulást illusztráló vektorok a *Keilmesser* (1), a szakóca (2) és a levélhegy (3) mintákban.

There exists a strong correlation between the assemblages of handaxes and *Keilmesser*, especially according to PC two and three. This may indicate a common origin of these typological categories. The similar distribution of handaxes and leaf points suggests, that they generally undergo the same type of shape alterations, namely from specimens with expanded, irregular contour to forms, which are elongated and symmetrical. The discrimination of triangular handaxes in course of the analysis of PC two and three is unclear. In the authors opinion, these PCs probably focus on the resemblance of the outline shapes in terms of tools symmetry. That is probably why *Keilmesser* were so scattered according to hese PCs and most handaxes and leaf points (which are generally symmetrical) were clustered around the 0,0 value, which is the centroid of a PCA plot.

Most of the variance in the *Keilmesser* assemblage is caused by the irregularities of natural surfaces, which were preserved in the back and at the base of these tools, probably for improving prehension. PCA landmark vectors show, that regions of the tip and the cutting edge are mostly held constant, while the back and the base undergo serious deformations as compared to the consensus shape (Fig. 8). This indicates that knives were often made of nodules or plaquettes of raw material which significantly differed in sizes and shapes which affected the form of finished tools.

The outline shape of the "active" sections, and especially the working edge, are very similar in most specimens.

The position of handaxes on the PCA plot confirms a shift of proportions from expanded shapes with an oval contour (Fig. 4: specimen 107 – Fajer et al. 2001: Fig. 3; specimen 127, 128 – Targosz 2006: Plate 42, 46) through forms with straight edges and a triangular contour (i.e. Fig. 4: specimen 130, 123 – Boroń 2006: Plate 99; Targosz 2006: Plate 40), to handaxes with straight or slightly concave edges, which are intensively elaborated with flat, surface retouch (Fig. 4: specimens 108, 110, 142 – Fajer et al. 2001: Fig. 4a; Targosz 2006: Plate 43; Fig. 3: 110, 126, 144 – Targosz 2006: Plate 44, 45; Boroń 2006: Plate 104). It is notable that handaxes and leaf points are similarly distributed, mainly according to PC1, which generally shows the transition from broad, oval shapes to the most elongated specimens.

Acheulean handaxes showed a pattern of reduction involving mainly the rejuvenation of the tip. This resulted in the transition from a pointed to oval morphology (McPherron 1995; 1999; 2000; 2003; Iovita–McPherron 2011). In the studied assemblage of KMG handaxes an opposite pattern can be observed. It seems that reduction was in this case aimed at resharpening, or simply depleting the stone material from the edges, but leaving the tip relatively unmodified. In general, this may have had an impact on handaxe outline shape, causing the observed transition from oval morphology towards handaxes with straight or concave edges and a pronounced tip.

The EFA also revealed an interesting pattern present within the leaf point assemblage. The width of these implements undergoes evident contraction, which obviously is due to the changes in leaf point manufacture. The technology of leaf points production changes significantly through time. Throughout the time span of the leaf point industry, they are gradually being replaced by points made of slender blades with flat retouch covering only their proximal or distal sections (the so-called "Jerzmanowice points"). This pattern is observable in the younger episodes of occupation of the Nietoperzowa Cave (Fig. 1: c) and in Mauern as well (Kozłowski 2004: 400–402). The outline shape deformations showed by EFA are very regular and they apply only to the edges of the leaf points, while the proximal and distal areas remain constant, as if the intention was to maintain elongation as well as the tip and base within exactly the same proportions (Fig. 7).

8. Conclusions

The results indicate that the applied method of statistical shape analysis coincides well with the typological categories established for LMP bifaces. However, the outcome of cluster and principal component analysis point out that the subsequent assemblages of LMP biface types are indeed fuzzy sets. All of the studied groups of specimens corresponding with the subsequent tool types contain some specimens of other types. This way, all the typological categories create mixed assemblages, which overlap at some point. This is

probably due to the general similarity of outline shapes featured by LMP bifaces.

In the light of PCA, it cannot be confirmed, that *Keilmesser* were continuously reduced in course of resharpening, at least not to the point where it would significantly alter the morphology of these tools. Instead, the results suggest, that in the studied assemblage we are dealing with outline shape variation, which is caused by irregularities of raw material blanks, out of which *Keilmesser* were made.

The application of elliptic Fourier analysis have yielded some interesting patterns of shape change among handaxes and leaf points. In the first case, we may be dealing with a pattern of reduction, which was due to the continuous depletion of dulled edges of handaxes. This pattern may also be an effect of the knappers intention to obtain a more elongated biface with a pronounced tip.

The pattern observed in the leaf point assemblage is partly an effect of the changing technology of leaf points production. However, the relative constancy with which the proximal and distal parts of these tools were shaped throughout the subsequent episodes of the settlement of Nietoperzowa Cave remains unexplained. At this point, it is hard to properly interpret this pattern of shape alteration. The author would suggest that such change may be due to the gradual improvement of leaf points performance, nevertheless further research on this subject needs to be conducted.

Although the applied method is limited, because it takes no account of the technical and metric features, it may be useful in constructing holistic models of artifact shape reduction (occurring synchronically or diachronically). Nevertheless, to avoid misinterpretation, one should bear in mind two limitations encountered in the course of the discussed analysis. Firstly, the method serves best when applied to quantitatively large assemblages. Lower and Middle Palaeolithic bifaces are often irregular, and a larger sample (one preferably assembled from several sites) will allow for a more comprehensive view. Secondly, including a test sample of different provenance than the main assemblage can assist the interpretation of shape change trajectories and bring in potentially interesting results.

References

- Azavedo S., Charlin J., González-José R. 2014. Identifying design and reduction effects on lithic projectile point shapes. *Journal of Archaeological Science* 41: 297–307. https://doi.org/10.1016/j. jas.2013.08.013
- Boëda E. 2001. Détermination des Unités Techno-Fonctionelles de pièces bifaciales provenant de la couche Acheuléenne C´3 Base du site de Barbas I. In: Cliquet D. (dir.), Les industries à outils bifaciaux du Paléolithique moyen d'Europe occidentale Actes de la table-ronde internationale organisée à Caen (Basse-Normandie France) 14 et 15 octobre 1999. E.R.A.U.L. 98, Liège: Université de Liège, 51–75.
- Boroń T. 2006. Typology and classification of bifaces from Wylotne site in Ojców. In: Kozłowski S. K. (ed.), *Wylotne and Zwierzyniec*.

- Paleolithic Sites in Southern Poland. Kraków: The Polish Academy of Arts and Sciences Warsaw University, 225–245.
- Bosinski G. 1967. *Die mittelpaläolithischen Funde im westlichen Mitteleuropa*. Fundamenta A/4, Köln-Graz: Böhlau-Verlag.
- Buchanan B., Johnson E., Strauss R. E., Lewis P. J. 2007. A Morphometric Approach to Assessing Late Paleoindian Projectile Point Variability on the Southern High Plains. *Plains Anthropologist* **52(203)**: 279–299. https://doi.org/10.1179/pan.2007.019
- Buchannan B., Collard M. 2010. A geometric morphometrics-based assessment of blade shape differences among Paleoindian projectile point types from western North America. *Journal of Archaeological Science* 37: 350–359. https://doi.org/10.1016/j.jas.2009.09.047
- Charlin J., González-José R. 2012. Size and shape variation in late Holocene projectile points of Southern Patagonia: a geometric morphometric study. *American Antiquity* 77(2): 221–242. https://doi.org/10.7183/0002-7316.77.2.221
- Chmielewski W. 1961. *Civilisation de Jerzmanowice*. Wrocław-Warsaw-Kraków: Zaklad Narodowy Imienia Ossolińskich Wydawnictwo Polskiej Akademii Nauk.
- Chmielewski W. 1969. Ensembles micoquo-prondikiens en Europe Centrale. *Geographie polonica* 17: 371–386.
- Cyrek K. (ed.) 2002. *Jaskinia Biśnik. Rekonstrukcja zasiedlenia jaskini* na tle zmian środowiska przyrodniczego. Toruń: Wydawnictwo Uniwersytetu Mikołaja Kopernika.
- Costa A. G. 2010. A Geometric Morphometric Assessment of Plan Shape in Bone and Stone Acheulean Bifaces from the Middle Pleistocene Site of Castel di Guido, Latium, Italy. In: Lycett S. J., Chauhan P. R. (eds.), *New Perspectives on Old Stones: Analytical Approaches to Paleolithic Technologies*. New York: Springer, 23–41. https://doi.org/10.1007/978-1-4419-6861-6_2
- de Amorim R. C. 2015. Feature Relevance in Ward's Hierarchical Clustering Using the Lp Norm. *Journal of Classification* **32(1)**: 46–62. https://doi.org/10.1007/s00357-015-9167-1
- Dibble H. 1984. Interpreting typological variation of Middle Palaeolithic scrapers: Function, style or sequences of reduction? *Journal of Field Archaeology* 11: 431–436. https://doi.org/10.2307/529322
- Dibble H. 1987. The interpretation of Middle Palaeolithic scraper morphology. *American Antiquity* **52**: 109–117. https://doi.org/10.2307/281062
- Dibble H. 1995. Middle Palaeolithic Scraper reduction: background, clarification and overview of evidence to date. *Journal of Archaeological Method and Theory* 2: 299–368. https://doi.org/10.1007/BF02229003
- Dibble H., Rolland N. 1990. A New Synthesis of Middle Palaeolithic Variability. *American Antiquity* **55(3)**: 480–499. https://doi.org/10.2307/281279
- Dryden I. L., Mardia K. V. 1998. *Statistical Shape Analysis*. Chichester: John Wiley & Sons.
- Eren M. I., Lycett S. J. 2012. Why Levallois? A Morphometric Comparison of Experimental 'Preferential' Levallois Flakes versus Debitage Flakes. *PLoS ONE* **7(1)**: e29273 https://doi.org/10.1371/journal.pone.0029273
- Fajer M., Foltyn E., Kozłowski J. K. 2001. Uwagi o kulturze mikockiej na Górnym Śląsku. Przyczynek do genezy kultury mikockiej w Europie Środkowej. *Archeologia Polski* **46**: 31–66.
- Feliks J. 2008. Phi in the Acheulian: Lower Palaeolithic intuition and the natural origins of analogy. In: Bednarik R. G., Hodgson D. (eds.), *Pleistocene palaeoart of the world*. BAR International Series

- 1804, Oxford: Archaeopress, 11-31.
- Ferson S., Rohlf F. J., Koehn R. K. 1985. Measuring shape variation of two-dimensional outlines. *Systemnatic Zoology* **34**: 59–68. https://doi.org/10.1093/sysbio/34.1.59
- Gowlett J. A. J. 2006. The elements of design form in Acheulian bifaces: modes, modalities, rules and language. In: Goren-Inbar N., Sharon G. (eds.), *Axe Age: Acheulian Tool-making from Quarry to Discard*. London: Equinox, 203–221.
- Hahn J. 1991. Erkennen und Bestimmen von Stein- und Knochenartefakten. Einführung in die Artefaktmorphologie.
 Archaeologica Venatoria 10, Tübingen: Verlag Archaeologica Venatoria.
- Hammer Ø., Harper D. A. T., Ryan P. D. 2001. PAST: Paleontological statistics package for education and data analysis. *Palaeontologia Electronica* **4(1)**: 9 (http://palaeo-electronica.org/2001_1/past/issue1_01.htm)
- Hauser O. 1916. *La Micoque. Die Kultur einer neuen Diluvialrasse.* Leipzig: Veit.
- Iovita R. 2009. Ontogenetic scaling and lithic systematics: method and application. *Journal of Archaeological Sciece* **36**: 1447–1457. https://doi.org/10.1016/j.jas.2009.02.008
- Iovita R. P. 2010. Quantifying and comparing stone tool resharpening trajectories with the aid of elliptical Fourier analysis. In: Lycett S., Chauhan P. (eds.), New Perspectives on Old Stones: Analytical Approaches to Palaeolithic Technologies. New York: Springer, 235– 253. https://doi.org/10.1007/978-1-4419-6861-6_10
- Iovita R. 2011. Shape Variation in Aterian Tanged Tools and the Origins of Projectile Technology: A Morphometric Perspective on Stone Tool Function. *PLoS ONE* 6(12): e29029. https://doi. org/10.1371/journal.pone.0029029
- Iovita R., McPherron S. P. 2011. The handaxe reloaded: A morphometric reassessment of Acheulian and Middle Paleolithic handaxes. *Journal of Human Evolution* **61**: 61–74. https://doi.org/10.1016/j.jhevol.2011.02.007
- Jöris O. 1994. Neue Untersuchungen zum Mittelpaläolithikum von Buhlen, Hessen. Technologische Studien zur Pradniktechnik in Horizont IIIb des Oberen Fundplatzes. *Ethnographisch Archäologische Zeitschrift* 35: 88–97.
- Jöris O. 2001. Der spätmittelpaläolithische Fundplatz Buhlen (Grabungen 1966–69). Stratigraphie, Steinartefakte und Fauna des Oberen Fundplatzes. Universitätsforschungen zur prähistorischen Archäologie 73, Bonn: Dr. Rudolf Habelt GmbH.
- Jöris O. 2006. Bifacially backed knives (Keilmesser) in the Central European Middle Palaeolithic. In: Goren-Inbar N., Sharon G. (eds.), Axe Age: Acheulian Tool-making from Quarry to Discard. London: Equinox, 287–310.
- Jungers W. L., Falsetti A. B., Wall C. E. 1995. Shape, relative size, and size-adjustments in morphometrics. *Yearbook of Physical Anthropology* 38: 137–161. https://doi.org/10.1002/ajpa.1330380608
- Kaufman L., Rousseeuw P. J. 1990. Finding Groups in Data: An Introduction to Cluster Analysis. New York: Wiley. https://doi. org/10.1002/9780470316801
- Kelly R. L. 1988. The Three Sides of a Biface. *American Antiquity* **53(4)**: 717–734. https://doi.org/10.2307/281115
- Kohn M., Mithen S. 1999. Handaxes: Products of sexual selection? *Antiquity* 73: 518-526. https://doi.org/10.1017/ S0003598X00065078
- Kot M. A. 2013. The Earliest Middle Palaeolithic Bifacial Leafpoints in Central and Southern Europe. Technological Approach. Unpublished PhD Thesis, Warsaw University Faculty of History, Warsaw.

- Kozłowski J. K. 2004. Świat przed "rewolucją" neolityczną. Wielka Historia Świata 1, Kraków-Warszawa: Fogra-Świat Książki.
- Kozłowski S. K. (eds.) 2006. Wylotne and Zwierzyniec. Paleolithic Sites in Southern Poland. Kraków: The Polish Academy of Arts and Sciences Warsaw University.
- Krukowski S. 1939–1948. Paleolit. Prehistoria ziem polskich. In: Krukowski S., Kostrzewski J., Jakimowicz R. (red.), *Encyklopedia Polska*, t. 4, cz. 1, dział 5, Kraków: PAU, 1–117.
- Kuhl F. P., Giardina C. R. 1982. Elliptic Fourier features of a closed contour. *Computer Graphics and Image Processing* **18**: 236–258. https://doi.org/10.1016/0146-664X(82)90034-X
- Lycett S. J., Von Cramon-Taubadel N., Gowlett J. A. J. 2010. A comparative 3D geometric morphometric analysis of Victoria West cores: implications for the origins of Levallois technology. *Journal of Archaeological Science* 37: 1110–1117. https://doi.org/10.1016/j.jas.2009.12.011
- Marks A. E., Brugal J.-Ph., Chabai V. P., Monigal K., Goldberg P., Hockett B., Peman E., Elorza M., Mallol C., 2002. Le gisement pléistocène moyen de Galeria Pesada (Estrémadure, Portugal): premiers résultats. *Paléo* 14: 77–100.
- McPherron S. P. 1995. A re-examination of the British biface data. *Lithics* **16**: 47–63.
- McPherron S. P. 1999. Ovale and pointed handaxe assemblages: two points make a line. *Préhistoire Européenne* **14**: 9–32.
- McPherron S. P. 2000. Handaxes as a measure of the mental capabilities of early hominids. *Journal of Archaeological Science* 27: 655–663. https://doi.org/10.1006/jasc.1999.0467
- McPherron S. P. 2003. Technological and typological variability in the bifaces from Tabun Cave, Israel. In: Soressi M., Dibble H. L. (eds.), *Multiple approaches to the study of bifacial technologies*. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology, 55–76.
- McPherron S. P., Dibble H. L. 1999. Stone tool analysis using digitized images: examples from the Lower and Middle Paleolithic. *Lithic Technology* **24(1)**: 38–52. https://doi.org/10.1080/01977261.1999.11 720944
- Migal W., Urbanowski M. 2006. Pradnik knives reused. Experimental approach. In: Wiśniewski A., Płonka T., Burdukiewicz J. M. (eds.), *The Stone: Technique and Technology.* Wrocław: Uniwersytet Wrocławksi, Instytut Archeologii SKAM Stowarzyszenie Krzemieniarskie, 73–89.
- Pastoors A. 2001. Die mittelpaläolithische Freilandstation von Salzgitter-Lebenstedt. Genese der Fundstelle und Systematik der Steinbearbeitung. Salzgitter-Forschungen 3, Salzgitter: Archiv der Stadt Salzgitter.
- Pastoors A., Schäfer J., 1999. Analyse des états techniques de transformation, d'utilisation et états post dépositionelles illustrée par un outil bifacial de Salzgitter-Lebenstedt (FRG). *Préhistoire Européenne* 14: 33–47.
- Porr M. 2005. The making of biface and the making of the individual. In: Gamble C., Porr M. (eds.), *The Hominid Individual in Context:* Archaeological investigations of Lower and Middle Palaeolithic landscapes, locales and artifacts. New York: Routledge, 68–81.
- Querino R. B., de Moraes R. C. B., Zucchi R. A. 2002. Relative Warp Analysis to Study Morphological Variations in the Genital Capsule of Trichogramma pretiosum Riley (Hymenoptera: Trichogrammatidae). *Neotropical Entomology* **31(2)**: 217–224. https://doi.org/10.1590/S1519-566X2002000200007
- Richter J. 1997. Der G-Schichten-Komplex der Sesselfelsgrotte. Zum Verständnis des Micoquien. Sesselfelsgrotte III. Quartär-Bibliothek 7, Saarbrücken: Saarbrücker Druckerei und Verlag.

- Richter J. 2000. Social memory among late Neanderthals. In: Orschiedt J., Weniger G.-C. (eds.), Neanderthals and Modern Humans Discussing the Transition. Central and Eastern Europe from 50.000 30.000 B.P. Mettmann: Neanderthal Museum, 30–41.
- Richter J. 2002. Die 14C-Daten aus der Sesselfelsgrotte und die Zeitstellung des Micoquien/M.M.O. *Germania* 80: 1–22.
- Richter J. 2008–2009. The role of leaf points in the Late Middle Palaeolithic Germany. *Praehistoria* **9–10**: 99–113.
- Richtsmeier J. T., Deleon V. B., Lele S. R. 2002. The Promise of Geometric Morphometrics. *Yearbook of Physical Anthropology* **45**: 63–91. https://doi.org/10.1002/ajpa.10174
- Rohlf F. J. 2004. tpsDig. Version 1.40. Stony Brook: SUNY.
- Rohlf F. J. 2006. *tps Utility Program. Version 1.38*. Stony Brook: SUNY.
 Rohlf F. J., Slice D. E. 1990. Extensions of the Procrustes method for the optimal superimposition of landmarks. *Systematic Zoology* 39: 40–59. https://doi.org/10.2307/2992207
- Rolland N. 1988. The interpretation of Middle Palaeolithic variability. *Man* 16: 15-42. https://doi.org/10.2307/2801973
- Ruebens K. 2006. A typological dilemma: Micoquian elements in continental Northwestern Europe during the Last Glacial Cycle (MIS 5d-3). *Lithics: The Journal of the Lithic Studies Society* 27: 58-73.
- Schild R., Wendorf F. 1977. *The Prehistory of Dakhla Oasis and Adjacent Desert*. Wrocław-Warszawa: Ossolineum.
- Shott M. J. 1995. How much is a scraper? Curation, use rates, and the formation of scraper assemblages. *Lithic Technology* **20**: 53–72.
- Shott M., Weedman K. L. 2007. Measuring reduction in stone tools: an ethnoarchaeological study of Gamo hidescrapers from Ethiopia. *Journal of Archaeological Science* **34**: 1016–1035. https://doi.org/10.1016/j.jas.2006.09.009
- Sobczyk K. 1975. Problem prądnika w świetle taksonomii numerycznej. *Sprawozdania Archeologiczne* 27: 255–269.
- Solecki R. L., Solecki R. S. 2004. Bifaces and the Acheulian industries of Yabroud Shelter I, Syria. In: Toussaint M., Draily C., Cordy J.-M. (eds.), General Sessions and Posters. Section 4: Human Origins and the Lower Palaeolithic. Acts of the XIVth UISPP Congress, Liège 2001. BAR International Series 1272, Oxford: Archaeopress, 37–39.
- Targosz M. 2006. Analysis of the flint material of Micoquian-Pradnikian culture from layer 6 at Wylotne Rockshelter in Ojców. In: Kozłowski S. K. (ed.), Wylotne and Zwierzyniec. Paleolithic Sites in Southern Poland. Kraków: The Polish Academy of Arts and Sciences – Warsaw University, 107–160.
- Thulman D. K. 2012. Discriminating Paleoindian point types from Florida using landmark geometric morphometrics. *Journal of Archaeological Science* **39**: 1599–1607. https://doi.org/10.1016/j. jas.2012.01.004
- Tracey N. D., Young J. C., Mason R. L. 1992. Multivariate control charts for individual observations. *Journal of Quality Technology* 2: 88–95. https://doi.org/10.1080/00224065.1992.12015232
- Urbanowski M. 2009. Middle Palaeolithic Handaxes: The Case of Wylotne Rockshelter. In: Burdukiewicz J. M., Cyrek K., Dyczek P., Szymczak K. (eds.), *Understanding the Past*. Warsaw: University of Warsaw, 365–375.
- Ward J. H. Jr. 1963. Hierarchical Grouping to Optimize an Objective Function. *Journal of the American Statistical Association* **58**: 236–244. https://doi.org/10.1080/01621459.1963.10500845
- Wenban-Smith F. F. 2004. Handaxe typology and Lower Palaeolithic cultural development: ficrons, cleavers and two giant handaxes from Cuxton. *Lithics* **25**: 11–21.

- Wynn T. 1996. The evolution of tools and symbolic behaviour. In: Lock A., Peters C. R. (eds.), *Handbook of Human Symbolic Evolution*. Oxford: Oxford University Press, 263–287.
- Zelditch M. L., Swiderski D. L., Sheets D. H., Fink W. L. 2004. *Geometric morphometrics for biologists: a primer*. London: Elsevier Academic Press.

SKAM 2014 Article

This study was presented at the 11th SKAM Lithic Workshop: the multifaceted biface - Bifacial technology in Prehistory. 20th-22nd of October, 2014, Miskolc, Hungary.

The conference papers are published in the Litikum Journal volumes as special contributions. Informations about the conference as well as the abstract book are available on the SKAM 2014 website: http://skam.pannontenger.hu



Proceedings of the 11th SKAM Lithic Workshop
The multifaceted biface - Bifacial technology in Prehistory
20th-22nd of October, 2014, Miskolc, Hungary



Analysis of Organic Compounds: Applications in Archaeology and Earth Science

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Abstract	Analysis of molecular composition of organic matter in lithics can determine correlations between organic matter and rock source. The paper presents the possibilities and limitations of using this method in Earth Sciences and Archaeology.
Kivonat	Szerves alkotóelemek vizsgálata: régészeti és földtudományi alkalmazások
	A kőzetekben található szerves anyagok molekuláris összetétele árulkodó lehet a kőzet eredetének helyét illető- en. E cikkben bemutatjuk ezen elemző módszer felhasználásának lehetőségeit és korlátait a földtudományokban és a régészetben.
Keywords	Flint, Analyses of molecular composition of organic compounds, Archaeology, Earth science
Kulcsszavak	kova, szerves alkotóelemek molekuláris összetételének analízise, régészet, földtudomány
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Cite as / Hivatkozás	Grafka, O., Werra, D.H., Siuda, R. (2015) Analysis of Organic Compounds: Applications in Archaeology and Earth Science <i>Litikum</i> 3: 27–38. https://doi.org/10.23898/litikuma0010
Article history / Kézirat történet	Received // Érkezés: 2015. 08 . 25. Accepted // Elfogadás: 2015. 11. 25. Published // Közzététel: 2016. 02. 02.
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1. Introduction

The majority of tools used by prehistoric communities were made of stone, a material that provided implements with sharp and durable edges. The most suitable type of stone needed to be hard and with a homogeneous structure, for instance obsidian (volcanic glass). But deposits of obsidian were not easy to come by, so early communities turned their attention towards flint, another high-quality raw material commonly occurring in Europe, which became the prime material for tool production in prehistoric times.

When studying prehistoric flint, one of the most interesting issues to be examined is the connection between deposits exploited at the time and the tools recorded at archaeological sites. By following the spread and distribution of particular raw materials we can study the spreading of prehistoric communities, their mobility and mutual contacts, as well as the size and quality of exchange networks.

At the same time, those features which caused siliceous rocks to be highly prized by ancient communities also mean that it is extremely difficult to link a deposit to concrete artefacts found at an archaeological site. That is why researchers try to describe the diagnostic features of siliceous rocks using various petrographic and geochemical methods (e.g. Sieveking et al. 1972; Sieveking, Hart 1986; Sieveking, Newcomer 1987; Schild, Sulgostowska 1997; Allard et al. 2008; Přichystal 2009, 2013; in Poland: Schild 1971; Lech 1980; Michniak 1980; Budziszewski, Michniak 1989; Kamińska-Szymczak, Szymczak 2002; Krajcarz, Krajcarz 2009).

One of the new methods recently introduced to archaeology is analysis of the molecular composition of organic compounds in flint. The method is commonly used in geology and serves to determine the source of the organic matter and its degree of transformation, both thermal and resulting from secondary processes such as its later oxidation or decomposition by microorganisms. It is also applied for correlation between liquid hydrocarbons (crude oil) and

the source rock from which the hydrocarbon originates. The method's success in the case of hydrocarbons, encouraged archaeologists to try it out on flint, in order to connect the flint used to produce tools to the deposit from which it was extracted. The determined organic matter comes from transformation of the mainly soft tissue of organisms that died and were deposited at the bottom of a body of water. The organic compounds of which the organisms were built underwent a series of geochemical transformations, providing hydrocarbons which could be extracted and determined analytically (e.g. Peters et al. 2005; Killops, Killops 2005).

2. Description of the method

The preparation of the sample is time consuming. The first stage entails selecting a piece of rock of appropriate weight. In the case of flint, which has a low organic carbon content, this means about 300 g. The flint is then washed in running water and cleaned mechanically (using an iron brush) to remove all impurities. Finally, the material must be cleaned further, using an organic solvent such as acetone or methanol, in order to remove any contamination by petroleum compounds (very common in the environment today). Also, the rock sample cannot be weathered. The next stage involves grinding the sample to a powder (c. 20 µm in diameter). The powder is placed in cellulose thimbles and undergoes extraction with organic solvents (in our case: dichloromethane and methanol in a ratio of 97:3).

The extraction process, in a Soxhlet extractor lasts about 72 hours for a single sample. The obtained extract is then separated, for instance using a modified chromatography column (Bastow et al. 2007), into three principal fractions: aliphatic, aromatic and polar.

During further stages only the aliphatic and aromatic fractions are used. These are analyzed in a gas chromatograph coupled with a mass spectrometer (GC-MS, in the case of the below mentioned grant a Perkin Elmer Clarus 500). This is done to identify determinable organic compounds. The analysis is carried out using a capillary column (Elite - 5MS 30 \times 0.25 mm, diameter 0.25 μm), where the carrier gas is helium.

For the aliphatic fraction in the gas chromatograph (GC) the following programme is used for the oven: initial temperature of 40 °C is held for one minute and then rises by 20 °C/min to 120 °C. The temperature then rises by 3 °C/min to 300 °C. The final temperature is held for 30 minutes. The complete programme time is 95 minutes.

For the aromatic fraction the following GC programme was used: initial temperature of 40 °C held for 2 min. In the next phase the temperature increased by 10 °C/min to 120 °C and then 4 °C/min until reaching 300 °C. The final temperature was held for 35 min. Complete time of analysis was 90 min. The mass spectrometer worked in the weight range 45–550 Da.

3. Applications in Archaeology and Earth Science

Analysis of the molecular composition of organic matter has been successfully used in geology since the 1960s.

In order to identify the source of the organic matter dispersed in rocks and the transformations it underwent due to temperature changes (being driven deep into the earth), or weathering of rocks, the common approach is to interpret the distribution of whole groups of organic compounds or the presence of single hydrocarbons, so-called biomarkers. For instance, it is thought that when compounds with an odd number of carbon atoms in the molecule dominate among n-alkanes with long hydrocarbon chains (n- C_{25} -n- C_{31}) it would suggest the input of land plants in the organic matter, but this feature gradually disappears with the increased degree of thermal transformation of rocks (e.g. Killops, Killops 2005; Peters et al. 2005).

Biomarkers are organic compounds present in extractable organic matter which indisputably indicate a connection with biological precursors, in spite of the changes they were subject to during, among other things, diagenesis. Owing to the diversity of compounds, biomarkers can often be linked to a concrete group of plants, animals or bacteria from which they originate. Biomarkers are very useful in following the 'geohistory' of oil, its origin and maturation. Complex molecules such as 4 and 5 ring cyclic isoprenoids, i.e. steranes and hopanes, provide the most information.

For instance diterpenoids, cyclic isoprenoids composed of four isoprene units, come from compounds identified in resins of vascular plants, especially resins of conifers. Examples of compounds from this group are norpimarane, labdane, fichtelite, pimarane, isopimarane, abietane or the kaurene group.

A high concentration of fichtelite in the extracted organic matter, together with the presence of abietanes, is considered to indicate the presence in the extract of organic matter originating from the pine family (*Pinaceae*), while extracts containing phenol derivatives of abietanes are thought to indicate a predominance of the cypress family (*Cupressaceae*). In turn, derivates of, among others, β -amiryn, α -amiryn, friedelin and lupeol are considered biomarkers of angiosperms (*Fabiańska* 2007).

Geology uses not only individual biomarkers but also diagrams which take into account the relative concentration of concrete hydrocarbons, also biomarkers. Calculation parameters and diagrams proposed by Marynowski et al. (2000), worked well when the authors analyzed organic matter from the Devonian carbonate rocks of the Holy Cross (Świętokrzyskie) Mountains, as well as from Sylurian siliceous rocks (hornstones, shales and cherts) from the Bardzkie Mountains (Sudetes). One example of such an interpretation is presented in Fig. 1 (Grafka 2013).

The presence and relationship between relative concentrations of organic compounds provides information about

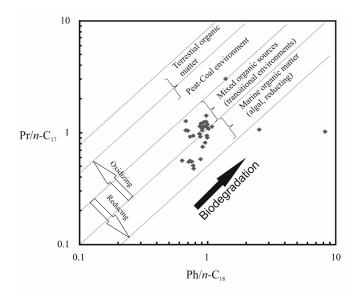


Figure 1. Diagram showing relationship between content of linear isoprenoids of pristane (Pr) and phytane (Ph) and n-alkanes with 17 (n- C_{17}) and 18 (n- C_{18}) carbon atoms in chain. From this we can surmise that the organic matter from outcrops of Early Palaeozoic rocks in Żdanów (Bardzkie Mts.) is of marine origin, mainly algae and was deposited in an oxygen-poor environment (Grafka 2013). //

1. ábra. A prisztán (Pr) és fitán (Ph) lineáris izoprenoid tartalom, valamint a 17 $(n-C_{17})$ és 18 $(n-C_{18})$ atomos szénláncú n-alkán tartalom közötti összefüggést mutató diagram. Ez alapján feltételezhető, hogy Żdanów (Bardzkie-hg.) korai paleozóikumból származó kőzeteinek szerves öszszetevői tengeri eredetűek, főleg algák, melyek oxigénszegény környezetben rakódtak le (Grafka 2013).

the environmental conditions in which the sediments were deposited. Geologists are very interested in rocks which were formed when a body of water suffered oxygen depletion or in euxinic conditions. A well-documented event of this kind in the Late Devonian formations from the Holy Cross Mountains has been described by Marynowski and Filipiak (2007) and Marynowski et al. (2010), and by others elsewhere, for instance in the USA the Devonian–Carboniferous black shale (Brown, Kenig 2004) or in cores drilled in the ocean floor (van Bentum et al. 2012).

Hydrocarbons have also served to determine naturally caused fires in Earth's past (e.g. Marynowski, Simoneit 2009) and, in consequence, have made possible interpretations of climate (e.g. Jiang et al. 1998).

A separate issue is changes taking place in organic compounds when rocks heat up as they sink down into the earth's crust. The changes, often called maturity of organic matter, are connected with the generation of liquid hydrocarbons (thermally mature organic matter). In geology a number of maturity indicators are used based on the relative concentrations of compounds from various groups (e.g. Hunt 1996; Killops, Killops 2005; Peters et al. 2005).

Organic matter in rock is also affected by weathering, biodegradation or water washout. These factors lead to gradual depletion and, finally, complete removal of organic matter from the rock (e.g. Marynowski et al. 2011; Fischer, Gaupp 2005; Sinninghe Damsté et al. 2002; Bastow et al. 2007).

In the more general works of Hunt (1996), Killops and Killops (2005), Peters et al. (2005) or Fabiańska (2007) and in articles such as Greenwood et al. (2006), we can find more detailed information concerning the method discussed here

The methods proposed by researchers in organic geochemistry can also be applied in archaeology. Such work has been done, for instance, by Krajcarz et al. (2013), or in the earlier mentioned research project whose objective is to describe varieties of chocolate flint (Fig. 2; Fig. 3; Table 1).

In the analyzed samples of flint, the main carriers of organic matter are hydrocarbons of polar fraction which represent the heaviest compounds (Fig. 3; Table 1). Their considerable share shows that the organic matter which occurs in flint has undergone great transformations connected with secondary processes (weathering, biodegradation, water washing). These processes have led to removal of lighter organic compounds and concentration of heavier hydrocarbons (e.g. Peters et al. 2005; Killops, Killops 2005; Marynowski et al. 2011).

On the complete chromatogram of the aliphatic fraction (saturated) the elevated background (marked as UCM; see Fig. 4) is clearly visible, evidence of the presence of an unresolved compound mixture. The presence of this mixture is one of the indications that the analyzed material is biodegraded (e.g. Peters et al. 2005; Killops, Killops 2005).

Important components of the aliphatic fraction are n-alkanes (**Fig. 5**). Their distribution begins with a hydrocarbon of 16 atoms in chain (n-C₁₆) and takes on a monomodal character. The maximum of relative concentration was found in compounds with short hydrocarbon chains. Within hydrocarbons of long chains there was a dominance of compounds with odd numbers of carbon atoms in a chain.

The next analyzed group of compounds within the aliphatic fraction is tri- and pentacyclic triterpenoids (**Fig. 6**; **Table 2**, **3**). All samples of the examined flint are characterized by similar distribution within that group. This indicates that the organic matter present in the flint came from a similar source and underwent similar diagenetic processes. The extracts also contained tricyclic triterpenes. The presence of this group is a good prognostic for investigations of correlations between particular occurrences of flint. This group is applied for correlations between crude oil and source rocks (e.g. Killops, Killops 2005; Peters et al. 2005).

Organic compounds from the sterane group also occurred in all analyzed samples and their distribution was similar in each of the analyzed extracts. Additionally, the presence of diasteranes was determined (low retention time; see Fig. 7). These types of diasteranes indicate the presence of clay minerals during the transformation of organic matter (e.g. Peters et al. 2005).

The most distinct differences appear within the distribution of tri- and pentacyclic triterpenoids. The most visible variations were present between samples from the Wierzbica "Zele" flint mine and from the quarry in Błaziny Górne (**Fig. 6B**). In the extracts from "Zele", the compound of relatively highest concentration was C_{23} tricyclic triterpene, while in the extract from Błaziny Górne $C_{30}\alpha\beta$ pentacyclic triterpene. In this extract, the presence of hopanes with the $\beta\alpha$ configuration was determined. The extracts from "Zele" did not contain this compound group. The difference probably results from the lower thermal maturity of the organic matter in the Błaziny Górne flint and/or from lesser influence of secondary processes (e.g. Peters et al. 2005).

The project aims to differentiate between flint materials from various localities. Should the results of analyses be positive, the method could serve in future to determine correlations between flint artefacts and prehistoric mines. However, it must be taken into account that in order to acquire an extract of organic matter dissolvable in solvents, the sample has to be ground before it can undergo extraction.

4. Conclusion

This analysis provides the molecular composition of aliphatic and aromatic fractions. On the basis of thus identified organic compounds, it is possible to determine the original environment of the organic matter (e.g. plant, algal, planktonic, etc.), the environment in which sedimentation of organic matter occurred (e.g. open sea, shelf, delta, lake) or the conditions during sedimentation (e.g. aerobic, anaerobic, euxinic). The method also makes it possible to determine the conditions prevailing in the sediment after the organic matter had been deposited (aerobic, anaerobic) and secondary transformations of organic matter (biodegradation, water washout, weathering). Analysis of molecular composition of organic matter can determine correlations between oil and source rock, and could possibly be used to determine correlations between prehistoric flint artefacts and specific prehistoric mines.

Acknowledgement

The method was first applied to study flint as part of the research project "Diversity of Upper Jurassic 'chocolate' flint from the central Poland from the standpoint of being able to identify them in the archaeological research", project financed from funds provided by the National Science Center – PRELUDIUM 2 DEC-2011/03/N/HS3/03973.

References

- Allard, P., Bostyn, F., Gilignay, F., Lech, J. (eds.) 2008. Flint mining in prehistoric Europe: interpreting the archaeological records. BAR International Series 1891, Oxford: Archaeopress.
- Balcer, B. 1976. Position and stratigraphy of flint deposits, development of exploitation and importance of the świeciechów flint in prehistory. *Acta Archaeologica Carpathica* 16: 179–199.
- Bastow, T. P., van Aarssen, B. G. K., Lang, D. 2007. Rapid small-scale separation of saturate, aromatic and polar components

- in petroleum. *Organic Geochemistry* 38: 1235–1250. https://doi.org/10.1016/j.orggeochem.2007.03.004
- Brown, T. C., Kenig, F. 2004. Water column structure during deposition of Middle Devonian-Lower Mississippian black and green/gray shales of the Illinois and Michigan Basins: a biomarker approach. *Paleogeography, Paleoclimatology, Paleoecology* 215: 59–85. https://doi.org/10.1016/S0031-0182(04)00452-3
- Budziszewski, J. 2008. Stan badań nad występowaniem i pradziejową eksploatacją krzemieni czekoladowych. In: Borkowski, W., Libera, J., Sałacińska, B., Sałaciński, S. (red.), Krzemień czekoladowy w pradziejach. Materiały z konferencji w Orońsku 08-10.10.2003. Studia nad gospodarką surowcami krzemiennymi w Pradziejach 7, Warszawa-Lublin: Państwowe Muzeum Archeologiczne, Instytut Archeologii UMCS, 33-106.
- Budziszewski, J., Michniak, R. 1989. Z badań nad występowaniem, petrograficzną naturą oraz prahistoryczną eksploatacją krzemieni pasiatych w południowym skrzydle niecki Magoń-Folwarczysko. *Wiadomości Archeologiczne* 49/2: 151–190.
- Budziszewski, J., Grużdź, W., Jakubczak, M., Szubski, M. 2015. Chalcolithic raw material economy in light of new data from the "Przyjaźń" mining field in Rzeczkowo (Central Poland). In: Mangado, X., Crandell, O., Sánchez, M., Cubero, M. (eds.), International Symposium on Knappable Materials "On the Rocks", 7-11 September 2015, Barcelona, Abstracts, Barcelona: Universitat de Barcelona, 56.
- Dadlez, R., Marek, S., Pokarski, J. (eds.) 2000. Mapa geologiczna Polski bez utworów kenozoiku, skala 1:1 000 000. Warszawa.
- Fabiańska, M. 2007. Geochemia organiczna węgli brunatnych wybranych złóż Polski. Katowice: Wydawnictwo Uniwersytetu Śląskiego.
- Fischer, C., Gaupp, R. 2005. Change of black shale organic material surface during oxidative weathering: implication for rockwater surface evolution. *Geochemica et Cosmochimica* 69: 1213–1224. https://doi.org/10.1016/j.gca.2004.09.021
- Grafka, O. 2013. Ewolucja materii organicznej drobnoziarnistych utworów staropaleozoicznych Gór Bardzkich (Sudety). Doctoral thesis, University of Warsaw, Warsaw.
- Greenwood, P. F., Leenheer, J. A. McIntyre, C., Berwick, L., Franzmann, P. D. 2006. Bacterial biomarkers thermally released from dissolved organic matter. *Organic Geochemistry* 37: 597–609. https://doi.org/10.1016/j.orggeochem.2005.12.009
- Hunt, J. M. 1996. *Petroleum geochemistry and geology*. New York: W. H. Freeman and Company.
- Jiang, C., Alexander, R., Kagi, R. I., Murray, A. P. 1998. Policyclic aromatic hydrocarbons in ancient sediments and their relationship to paleoclimate. *Organic Geochemistry* 29: 1721–1735. https://doi.org/10.1016/S0146-6380(98)00083-7
- Kamińska-Szymczak, J., Szymczak, K. 2002. Powierzchnie świeżych przełamów wybranych surowców krzemiennych z terenów Polski obserwowanych przy użyciu SEM. In: Matraszek, B., Sałaciński, S. (red.), Krzemień świeciechowski w pradziejach. Materiały z konferencji w Ryni, 22-24.05.2000. Studia nad gospodarką surowcami krzemiennymi w Pradziejach 4, Warszawa: Semper, 297–306.
- Killops, S., Killops, V. 2005. Introduction to Organic Geochemistry.
 2nd edition. Cornwall: Blackwell Publishing. https://doi.org/10.1002/9781118697214
- Krajcarz, M. T., Krajcarz, M. 2009. The Outcrops of Jurassic Flint Raw Materials from South-western Margin of the Holy Cross Mountains. *Acta Archaeologica Carpathica* 44: 183–195.
- Krajcarz, M. T., Cyrek, K., Gola, M. 2013. Osadnictwo paleolityczne w

- jaskini Biśnik w zapisie antropogenicznych biomarkerów. *Prace i Studia Geograficzne* 51: 57–68.
- Lech, J. 1980. Geologia krzemienia jurajskiego-podkrakowskiego na tle innych skał krzemionkowych. Wprowadzenie do badań z perspektywy archeologicznej. *Acta Archaeologica Carpathica* 20: 163–228.
- Marynowski, L., Filipiak, P. 2007. Water column euxinia and wildfire evidence during deposition of the Upper Famennian Hangenberg event horizon from Holy Cross Mountains (central Poland). *Geological Magazine* 144: 569–595. https://doi. org/10.1017/S0016756807003317
- Marynowski, L., Simoneit, B. R. T. 2009. Widespread upper Triassic to Lower Jurassic wildfire records from Poland: evidence from charcoal and polycyclic aromatic hydrocarbons. *Palaios* 24: 785–798. https://doi.org/10.2110/palo.2009.p09-044r
- Marynowski, L., Narkiewicz, M., Grelowski, C. 2000. Biomarkers an environmental indicators in carbonate complex, example from the Middle to Upper Devonian Holy Cross Mountains. *Sedimentary Geology* 137: 187–212. https://doi.org/10.1016/S0037-0738(00)00157-3
- Marynowski, L., Filipiak, P., Zatoń, M. 2010. Geochemical and palynological study of the Upper Famennian Dasberg event horizon from the Holy Cross Mountains (central Poland). *Geochemisty Magazine* 147: 527–550. https://doi.org/10.1017/S0016756809990835
- Marynowski, L., Kurkiewicz, S., Rakociński, M., Simoneit, B. R. T. 2011. Effects of weathering on organic matter: I. Changes in molecular composition of extractable organic compounds caused by paleoweathering of Lower Carboniferous (Tournaisian) maine black shale. Chemical Geology 285: 144–156. https://doi.org/10.1016/j.chemgeo.2011.04.001
- Michniak, R. 1980. Petrograficzia i geneza ciemnych krzemieni z dolnoturońskich osadów okolic Ożarowa nad środkową Wisłą. *Archiwum Mineralogiczne* 36: 83–106.
- Peters, K. E., Walters, C. C., Moldowan, J. M. 2005. The Biomarker Guide. Vol. 2: Biomarkers and Isotopes in Petroleum System and Earth History. Cambridge: Cambridge University Press.
- Přichystal, A. 2009. *Kamenné suroviny v pravěku východní části střední Evropy*. Brno: Masarykova univerzity.
- Přichystal, A. 2013. Lithic raw materials in prehistoric times of eastern Central Europe. Brno: Masarykova univerzity.
- Schild, R. 1971. Lokalizacja prahistorycznych punktów eksploatacji krzemienia czekoladowego na północnowschodnim obrzeżeniu Gór Świętokrzyskich. *Folia Quaternaria* 39: 1–61.
- Schild, R. 1976. Flint mining and trade in polish prehistory as seen from the perspective of chocolate flint of central Poland. A second approach. *Acta Archaeologica Carpathica* 16: 147–177.
- Schild, R., Sulgostowska, Z. (eds.) 1997. Man and flint. Proceedings of the VIIth International Flint Symposium. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences Warsaw.
- Sieveking, G. de G., Hart, M. B. (eds.) 1986. *The scientific study of flint and chert*. Cambridge: Cambridge University Press.
- Sieveking, G. de G., Newcomer, M. H. (eds.) 1987. *The human uses of flint and chert*. Cambridge: Cambridge University Press.
- Sieveking, G. de G., Bush, P., Ferguson, J., Craddock, P. T., Hughes, M. J., Cowell, M. R. 1972. Prehistoric flint mines and their identification as sources of raw material. *Archaeometry* 14: 151– 76. https://doi.org/10.1111/j.1475-4754.1972.tb00061.x
- Sinninghe Damsté, J. S., Rijpstra, W. I. C., Reichart, G.-J. 2002. The influnece of oxic degradation on the sedimentary biomarker

- record II. Evidence from Arabian Sea sediments. *Geochemica* et *Cosmochemica* 66: 2737–2754. https://doi.org/10.1016/S0016-7037(02)00865-7
- van Bentum, E. C., Richart, G. J., Sinninghe Damsté, J. S. 2012. Organic matter provenance, paleoproductivity and bottom water anoxia during the Cenomanian/Turonian Oceanic Anoxic event in the Newfounland Basin (Northern proto North Atlantic Ocean). *Organic Geochemistry* 50: 11–18. https://doi.org/10.1016/j.orggeochem.2012.05.013

SKAM 2014 Article

This study was presented at the 11th SKAM Lithic Workshop: the multifaceted biface - Bifacial technology in Prehistory. 20th-22nd of October, 2014, Miskolc, Hungary.

The conference papers are published in the Litikum Journal volumes as special contributions. Informations about the conference as well as the abstract book are available on the SKAM 2014 website: http://skam.pannontenger.hu

site	type of flint (archaeological name)	symbol of the sample	aliphatic	aromatic	polar
Wierzbica "Zele", Radom District	"chocolate flint"	WZS-28	18.18	2.27	79.55
Wierzbica "Zele", Radom District	"chocolate flint"	WZr81-1	22.78	6.33	70.89
Wierzbica "Zele", Radom District	"chocolate flint"	WZ1B	0.58	0.10	99.33
Wierzbica "Zele", Radom District	"chocolate flint"	WZ2B	9.89	6.59	83.52
Wierzbica "Zele", Radom District	"chocolate flint"	WZ3B	0.00	100.00	0.00
Wierzbica – outcrop, Radom District	"chocolate flint"	WIK1	2.38	7.14	90.48
Orońsko, Szydłowiec District	"chocolate flint"	ORO1	15.91	3.41	80.68
Orońsko, Szydłowiec District	"chocolate flint"	ORO2	48.06	26.60	25.35
Orońsko "Mały Orońsk", Szydłowiec District	"chocolate flint"	MOR1	17.74	8.06	74.19
Tomaszów, Szydłowiec District	"chocolate flint"	TOM1	11.84	0.00	88.16
Polany II, Radom District	"chocolate flint"	POL1	50.59	26.49	22.93
Seredzice, Radom District	"chocolate flint"	SER24-B1	10.00	5.00	85.00
Seredzice, Radom District	"chocolate flint"	SER24-B2	4.55	4.55	90.91
Seredzice "Hapki", Radom District	"chocolate flint"	HAB1	8.70	6.52	84.78
Iłża, Radom District	"chocolate flint"	IL2-SCH	14.81	18.52	66.67
Błaziny Górne, Radom District	"chocolate flint"	BLG-CZK1	11.63	8.84	79.53
Seredzice, Radom District	striped flint	PSP-24BU1	7.32	2.44	90.24
Błaziny Górne, Radom District	striped flint	BLGPSP-1	25.00	12.50	62.50
Krzemionki Opatowskie, Ostrowiec Świętokrzyski District	striped flint	KO-GS1	13.79	1.72	84.48
Krzemionki Opatowskie, Ostrowiec Świętokrzyski District	striped flint	KO-GS2	3.72	87.19	9.09
Borownia, Ostrowiec Świętokrzyski District	striped flint	BOB?2	11.24	2.25	86.52
Borownia, Ostrowiec Świętokrzyski District	striped flint	BOB1	64.29	34.87	0.84
Świeciechów Lasek, Kraśnik District	gray white-spotted flint	SWLAS-1	5.88	5.88	88.24

Table 1. Percentage of aliphatic, aromatic and polar fractions for the exemplary attempts of analyze samples of siliceous rocks (see Fig. 3). // **1. táblázat.** Alifás, aromás és poláris frakciók megoszlása a kovás kőzetminták próbaméréseinél (ld. 3. ábra).

Symbol	Name
C20	C20-tricyclic triterpene
C21	C21-tricyclic triterpene
C22	C22-tricyclic triterpene
C23	C23-tricyclic triterpene
C24	C24-tricyclic triterpene
C25	C25-tricyclic triterpene
C26	C26-tricyclic triterpene
C27	C27-tricyclic triterpene
C28	C28-tricyclic triterpene
C29	C29-tricyclic triterpene
Ts	18α(H)-22,29,30-trisnorneohopan
Tm	17α(H)-22,29,30-trisnorhopan
C29 αβ	C29-17α,21β-30-norhopan
C29 βα	C29-17β21α-hopan
C30 αβ	C30-17α21β-hopan
C30 βα	C30-17β21α-hopan
C31 αβ 22S	C31-17α,21β-29-homohopan 22S
C31 αβ 22R	C31-17α,21β-29-homohopan 22R
C32 αβ 22S	C32-17α,21β-29-bishomohopan 22S
C32 αβ 22R	C32-17α,21β-29-bishomohopan 22R
C33 αβ 22S	C33-17α,21β-29-trishomohopan 22S
C33 αβ 22R	C33-17α,21β-29-trishomohopan 22R

Name	Symbol
C27 13β,17α-diasteran 20S	C27 βα 20S
C27 13β,17α-diasteran 20R	C27 βα 20R
C27 13α,17β-diasteran 20S	C27 αβ 20S
C27 13α,17β-diasteran 20R	C27 αβ 20R
C28 13β,17α-diasteran 20S (24S+R)	C28 βα 20S (24S+R)
C28 13β,17α-diasteran 20R (24S+R)	C28 βα (24S+R)
C27 5α,14α,17α -steran 20S	C27 ααα 20S
C28 13α,17β-diasteran 20S	C28 αβ 20S
C27 5α,14β,17β-steran 20R	C27 αββ 20R
C29 13β,17α-diasteran 20S	C29 βα 20S
C27 5α,14β,17β-steran 20S	C27 αββ 20S
C27 5α,14α,17α -steran 20R	C27 ααα 20R
C29 13 β ,17 α -diasteran 20S	C29 βα 20S
C29 13 β ,17 α -diasteran 20R	C29 βα 20R
C28 5α,14α,17α-steran 20S	C28 ααα 20S
C28 5α,14β,17β-steran 20R	C28 αββ 20R
C28 5α,14β,17β-steran 20S	C28 αββ 20S
C30 13 β ,17 α -diasteran 20R	C30 βα 20R
C29 13α,17β-diasteran 20R i S	C29 αβ 20R i S
C28 5α,14α,17α-steran 20R	C28 ααα 20R
C29 5α,14α,17α-steran 20S	C29 ααα 20S
C29 5α,14β,17β-steran 20R	C29 αββ 20R
C29 5α,14β,17β-steran 20S	C29 αββ 20S
C29 5α,14α,17α-steran 20R	C29 ααα 20R
C30 5α,14β,17β-steran 20R+S	C30 αββ 20R+S
C30 5α,14α,17α-steran 20R	C30 ααα 20R

Table 2. Explanation of compounds name used for tri- and pentacyclic triterpenoids (see Fig. 6 and 7). //

2. táblázat. A tri- és pentaciklikus triterpenoidokra használt jelölések magyarázata (*ld.* 6–7. ábra).

Table 3. Explanation of compounds name used for steranes and diasterans (see Fig. 6 and 7). //

3. táblázat. A szteránokra és diaszteránokra használt jelölések magyarázata (*Id. 6–7. ábra*).

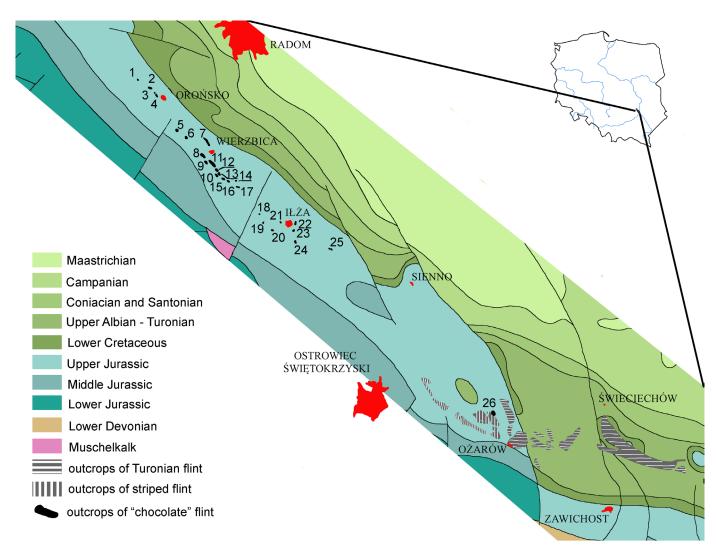


Figure 2. Occurrence of "chocolate" flint in pre-Quaternary formations on the northeastern outskirts of the Holy Cross Mountains. 1 – Chronów-Kolonia, Szydłowiec District; 2 – Guzów Szydłowiec District; 3 – Orońsko "Mały Orońsk" Szydłowiec District; 4 – Orońsko (Orońsk II) Szydłowiec District; 5 – Tomaszów Szydłowiec District; 6 – Rzeczków, Radom District; 7 – Wierzbica quarry, Radom District; 8 – Wierzbica "Zele", Radom District; 9 – Wierzbica "Krzemienica", Radom District; 10 – Polany kolonie IV, Radom District; 11 – Polany kolonie I, Radom District; 12 – Polany kolonie II, Radom District; 13 – Polany kolonie IIa, Radom District; 14 – Polany III, Radom District; 15 – Polany kolonie III, Radom District; 16 – Polany I, Radom District; 17 – Polany II, Radom District; 18 – Pakosław, Radom District; 19 – Seredzice, Radom District; 20 – Seredzice "Kolonia", Radom District; 21 – Iłża "Wąwóz Żuchowiec", Radom District; 22 – Iłża "Krzemieniec" II, Radom District; 23 – Iłża "Krzemieniec" I, Radom District; 24 – Błaziny Górne, Radom District; 25 – Prędocin, Radom District; 26 – Gliniany "Wzgórze Kruk", Opatów District (Schild 1971, 1976; Balcer 1976; Dadlez et al. 2000; Budziszewski 2008; Budziszewski et al. 2015). //

2. ábra. "Csokoládé" kova előfordulások a Szentkereszt-hegység északkeleti peremeinek negyedidőszak előtti formációiban. 1 – Chronów-Kolonia, Szydłowiec körzet; 2 – Guzów Szydłowiec körzet; 3 – Orońsko "Mały Orońsk" Szydłowiec körzet; 4 – Orońsko (Orońsk II) Szydłowiec körzet; 5 – Tomaszów Szydłowiec körzet; 6 – Rzeczków, Radom körzet; 7 – Wierzbica quarry, Radom körzet; 8 – Wierzbica "Zele", Radom körzet; 9 – Wierzbica "Krzemienica", Radom körzet; 10 – Polany kolonie IV, Radom körzet; 11 – Polany kolonie I, Radom körzet; 12 – Polany kolonie II, Radom körzet; 13 – Polany kolonie IIa, Radom körzet; 14 – Polany III, Radom körzet; 15 – Polany kolonie III, Radom körzet; 16 – Polany I, Radom körzet; 17 – Polany II, Radom körzet; 18 – Pakosław, Radom körzet; 19 – Seredzice, Radom körzet; 20 – Seredzice "Kolonia", Radom körzet; 21 – Iłża "Wąwóz Żuchowiec", Radom körzet; 22 – Iłża "Krzemieniec" II, Radom körzet; 23 – Iłża "Krzemieniec" I, Radom körzet; 24 – Błaziny Górne, Radom körzet; 25 – Prędocin, Radom körzet; 26 – Gliniany "Wzgórze Kruk", Opatów körzet (Schild 1971, 1976; Balcer 1976; Dadlez et al. 2000; Budziszewski 2008; Budziszewski et al. 2015).

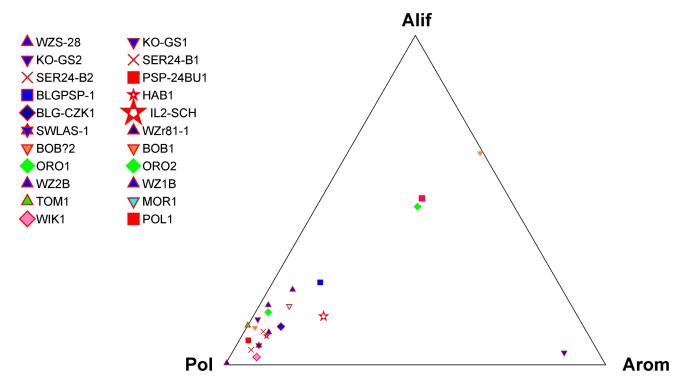


Figure 3. Ternary diagram showing the percentage of each fraction in the extract from the analyzed flint. 100% of the fraction in the corners (Pol polar, Aliph - aliphatic, Arom - aromatic fractions; see Table 1). //

3. ábra. Háromszögdiagram a frakciók megoszlásával a kovamintákban. 100% a sarkokban (Pol - poláris; Aliph - alifás; Arom - aromás frakciók; *ld. 1. Táblázat*).

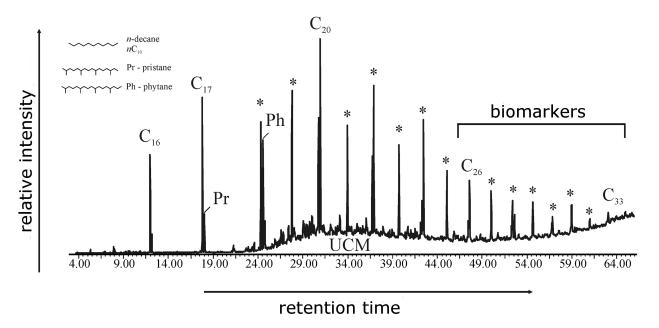


Figure 4. Total ion chromatogram (TIC) of aliphatic fraction. // **4. ábra.** Az alifás frakció teljes ion kromatogramja (TIC).

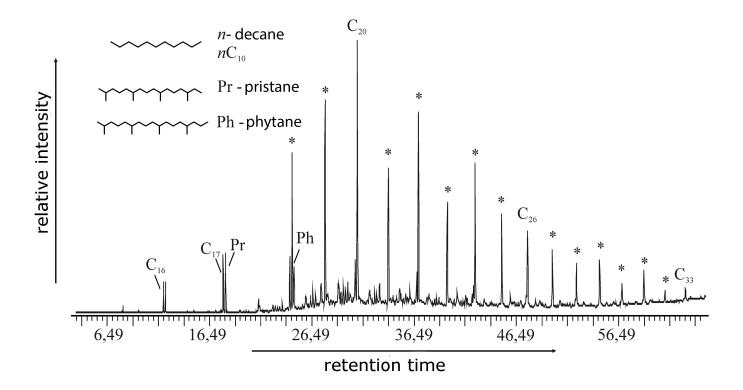
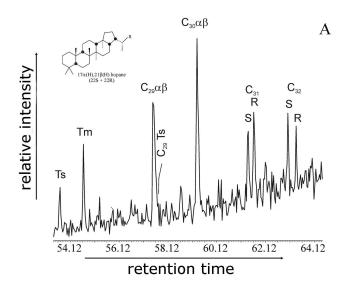


Figure 5. Distribution of n-alkane and isoprenoids (m/z = 71). $C_{16} - n$ -hepthadecane, Pr - pristane, Ph - phytane, *- n-alkanes. // **5. ábra.** n-alkánok és izoprenoidok eloszlása (m/z = 71). $C_{16} - n$ -heptadekán, Pr - prisztán, Ph - fitán, *- n-alkánok.



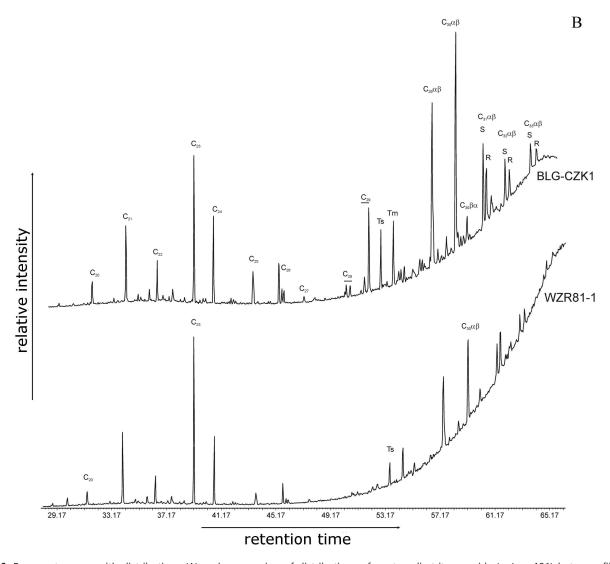


Figure 6. Fragmentograms with distributions (A) and comparsion of distributions of pentacyclic triterpenoids (*m/z* = 191) between flints from Wierzbica "Zele" and Błaziny Górne (*see Table 2 and 3 for identification*). //

6. ábra. Fragmentogramok a pentaciklikus triterpenoidok (*m/z* = 191) eloszlásával (A) és azok összehasonlításával (B) a Wierzbica "Zele" és a Błaziny Górne forrásokból származó tűzkövek esetében (*a jelmagyarázatot lásd a 2. és 3. táblázatban*).

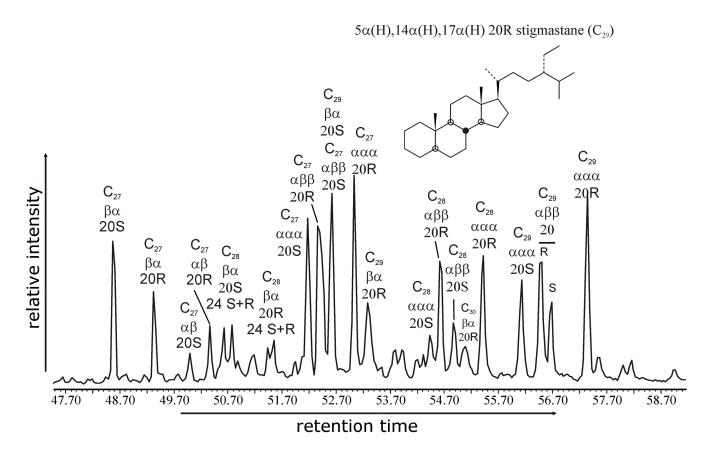


Figure 7. Steranes and diasterans (m/z = 217 + 259) distribution for a flint from outcrop in Błaziny Górne (*identification of shortcuts in Table 2 and 3*). //

7. ábra. Szteránok és diaszteránok (*m/z* = 217 + 259) eloszlása egy, a Błaziny Górne forrásból származó tűzkő esetében (*a rövidítések feloldása a 2. és 3. táblázatban*).



Proceedings of the 11th SKAM Lithic Workshop
The multifaceted biface - Bifacial technology in Prehistory
20th-22nd of October, 2014, Miskolc, Hungary



Flint artefacts from Rivne (Ukraine) in the collection of the District Museum in Toruń

Beata Bielińska-Majewska

Abstract	The aim of this publication is to present and illustrate selected bifacial products from amongst the flint artefacts from Rivne (Ukraine) that are a part of the collection of the Toruń District Museum's Archaeological Department. There is no data on their exact origin or the circumstances in which they were collected, thus analysing them we have to be very cautious. By means of typological and comparative classification we can define them as Late Neolithic to Bronze Age.
Kivonat	Kovakő eszközök Rivnéből a Toruńi Körzeti Múzeum gyűjteményében
	A tanulmány néhány kétoldali megmunkálású kovaeszközt mutat be, melyek Rivnéből (Ukrajna) származnak, és jelenleg a Toruńi Körzeti Múzeum Régészeti Osztálya őrzi őket. A darabok eredet és fellelésük pontos körülményei ismeretlenek, ezért az analízis rendkívül óvatos. Összehasonlító tipológiai vizsgálat alapján a kövek késő neolitikus – korai bronzkori darabok lehetnek.
Keywords	Volhynian flint, bifacial products, Rivne (Ukraine), museum collections
Kulcsszavak	Volhíniai kova, kétoldali megmunkálású darabok, Rivne (Ukrajna), múzeumi gyűjtemény
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Cite as / Hivatkozás	Bielińska-Majewska, B. (2015) Flint artefacts from Rivne (Ukraine) in the collection of the District Museum in Toruń. <i>Litikum</i> 3: 39–45. https://doi.org/10.23898/litikuma0011
Article history / Kézirat történet	Received // Érkezés: 2015. 10 . 18. Accepted // Elfogadás: 2015. 12. 04. Published // Közzététel: 2016. 02. 20.
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© (i) \$	Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. // Ez egy nyílt hozzáférésű publikáció, amit a Creative Commons 4.0 licensze véd. A termék szabadon használható, terjeszthető és sokszorosítható az eredeti szerző és forrás megjelölése mellett.

1. Introduction

District Museum in Toruń has a rich collection of archaeological artefacts accumulated over a long period of time and in various circumstances, such as: products, assemblies, and inventories dating from the Palaeolithic through to modern times. These artefacts come from regular and rescue excavations, as well as surface surveys. Some of the items have been obtained for the museum as gifts from private individuals. The aim of this publication is to present and illustrate selected bifacial products from amongst the flint artefacts that came to the museum in 1949 as a gift from Mikołaj Karpow-Lipski.

2. Data

The presented artefacts are stored in the collection of the Toruń District Museum's Archaeological Department under the inventory number MT/A/191. In the inventory books and catalogue cards these are described as coming from Rivne (Równe) in Ukraine (Fig. 1).

As was pre-determined Mikołaj Karpow-Lipski may be the person about whom Tomasz Bojarczuk writes in his article (Bojarczuk 2010). It should be mentioned that Karpow-Lipski (1896–1981) traveled extensively. Among other places he was in Zdolbuniv, and at the beginning of the World War I he moved with his family to Kostopil in Volhynia, during

World War II he was employed at the experimental station of the German department of medicinal herbs in Rivne (Bojarczuk 2010: 81). As in the museum archives there is no information on the exact location or the specific circumstances of the method of obtaining flint products, we can only assume that the materials were collected by Karpow-Lipski during hikes in and around Rivne.

3. Discussion

The collection transferred to the museum comprises of 24 flint products, which were made from a uniform flint type of good quality – Volhynian flint. This kind of flint occurs, *inter alia* in western Ukraine, north-western part of the Volhynia plane and in Volhynian Polesie (Taras 1997). The publication characterizes 14 flint forms developed with bifacial retouch. Other products which are excluded from the analysis are mainly debris, cores, flakes and blades.

On the basis of the initial macroscopic materials analysis, it seems that these products could originate from one site. They are characterized by a similar technique and style of make. The general condition of the artefacts is good. Among the presented products there are the following forms: four axes (including one preform), five tool fragments (including likely fragments of the points and handles), two sickleshaped knifes, one probable cutting tool preform and two unspecified products. The products are shown in the figures (Fig. 2–5).

Based on preliminary characteristics we can say that the surfaces of the axes are developed by large planar retouch, and the edges are finished with fine retouch. These tools have straight or slightly curved sides. On one of the axes there are fragmentary remains of cortex (Fig. 2.1). Only one of the axes is smaller in size compared with the others and is covered with a patina (Fig. 2.2). As mentioned earlier, one of the specimens is probably an axe preform (Fig. 2.4). The first of the two bifacial knife specimens is made by means of a careful retouch of the surface (Fig. 3.1), while the second is developed carelessly (Fig. 3.2). Amongst the tools there was also a point preform or a point with a marked handle (Fig. **3.3**). Its lower (ventral) side is covered with surface retouch, while the upper (dorsal) side shows fragmentary remains of cortex. Portions of the edges are developed with nearedge retouch. Among the tool fragments there are: a point fragment (of a very precise surface retouch) (Fig. 4.1), two probable handles (Fig. 4.2-3) and two tool fragments (one a probable axe fragment, Fig. 4.4). In the analyzed material there were also two unspecified products (Fig. 5.1–2).

In thematic literature the selected tools, mainly points and knives occur under various names. Bifacial projectile points are divided into several types and subtypes, such as: daggers, points, spearheads and bifacial projectile points (Libera 2001). They are made of flat or fragmented natural concretions, flakes or blades. Their surfaces are formed with flat two-sided regular retouch. Similarly, the bifacial knives in Polish literature also carry various names. They are called i.e. sickles or sickle-shaped knives (Libera 2001). These were

made of flat nodules massive blades and flakes. Their surfaces are formed flat as described above and evened out along the edges, occasionally with the use of denticulated retouch. It should be mentioned that in the Early Bronze Age prepared-core technique was used. It allowed production of specialised tools (of high quality raw material), such as: sickles, axes, etc.

4. Conclusions

Concluding it should be noted that the presented flint artefacts are loose finds lacking stratigraphic and cultural context, which makes practically impossible to define their chronological and cultural affiliation. In addition, the already mentioned lack of detailed historical data on their acquisition and circumstances of the discovery leads to a very careful typological and comparative classification. Nonetheless, the analyzed materials were defined as probably Late Neolithic to Bronze Age.

Presented flint products have not been previously published. These materials should be treated as archival sources that complement our knowledge on obtaining artefacts to museums in the early twentieth century. In addition, they complement our data on this category of artefacts stored in museum collections.

Acknowledgements

The author would like to thanks M.A. Maciej Majewski for the English translation and arrangement of figures and M.A. Krzysztof Deczyński for taking photographs of the artefacts.

References

Bojarczuk T. 2010. Mikołaj Karpow-Lipski (1896-1981), ogrodnikhodowca roślin. Rocznik Polskiego Towarzystwa Dendrologicznego 58: 79–82.

Libera J. 2001. Krzemienne formy bifacjalne na terenach Polski i zachodniej Ukrainy (od środkowego neolitu do wczesnej epoki żelaza). Lublin: Wydawnictwo Uniwersytetu Marii Curie-Skłodowskiej.

Taras H. 1997. Krzemieniarstwo kultury trzcinieckiej na wyżynach Wschodniowielkopolskiej i Zachodniowołyńskiej oraz na zachodnim Podlasiu. In: J. Lech and D. Piotrkowska (eds.), *Z badań nad krzemieniarstwem epoki brązu i wczesnej epoki żelaza.* Warszawa: Wydawnictwa Naukowe PWN, 163–183.

SKAM 2014 Article

This study was presented at the 11th SKAM Lithic Workshop: the multifaceted biface - Bifacial technology in Prehistory. 20th–22nd of October, 2014, Miskolc, Hungary. The conference papers are published in the Litikum Journal volumes as special contributions. Informations about the conference are available on the SKAM 2014 website: http://skam.pannontenger.hu



Figure 1. Location of Rivne (Równe), Ukraine. // 1. ábra. Rivne (Równe) földrajzi helyzete Ukrajnában.

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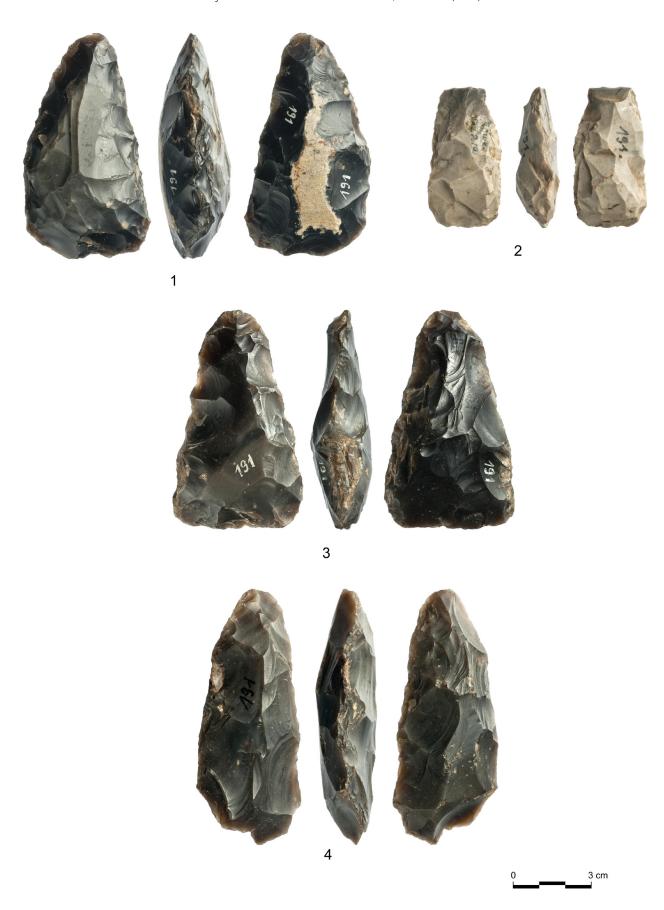


Figure 2. Rivne (Równe), Ukraine. Flint artefacts. 1–3: axes; 4: axe preform. // **2. ábra.** Rivne (Równe), Ukrajna, kova eszközök. 1–3: balták; 4: félkész balta.



Figure 3. Rivne (Równe), Ukraine. Flint artefacts. 1: sickle-shaped knife; 2: sickle-shaped knife preform (?); 3: point preform (?). // **3. ábra.** Rivne (Równe), Ukrajna, kova eszközök. 1: sarló alakú kés; 2: félkész sarló alakú kés (?); 3: félkész hegy (?).



Figure 4. Rivne (Równe), Ukraine. Flint artefacts. 1: point fragment; 2–3, 5: tool fragments; 4: axe (?) fragment. // **4. ábra.** Rivne (Równe), Ukrajna, kova eszközök. 1: hegy töredéke; 2–3, 5: töredékes eszközök; 4: balta töredéke (?).



Figure 5. Rivne (Równe), Ukraine. Flint artefacts. 1–2: tools. // **5. ábra.** Rivne (Równe), Ukrajna, kova eszközök. 1–2: eszközök.



Proceedings of the 11th SKAM Lithic Workshop
The multifaceted biface - Bifacial technology in Prehistory
20th-22nd of October, 2014, Miskolc, Hungary



Open-air site complex with leaf-points at Szécsénke (Cserhát Mountains, Northern Hungary) Preliminary results

Attila Péntek

Abstract

Based on extensive field surveys of the past decade the Late Middle Palaeolithic and Initial Upper Palaeolithic occupation was very intensive in the Cserhát Mountains. There are some very characteristic clusters in the site distribution. One of the important ones is those of in the vicinity of Legénd and Szécsénke villages. In this paper we will review the lithic material of an interpreted Palaeolithic site complex at Szécsénke village. The compound term "site complex" does not necessary mean simultaneity of the affected sites, by this term rather a kind of techno-typological relation between the collected chipped stone assemblages will be stressed. The affected sites seem to have a Szeletian-like character which resembles the well researched Moravian Szeletian. On the base of the raw material utilization and of techno-typological considerations a kind of intra-cultural development can be observed.

Kivonat

Nyíltszíni lelőhelykomplexum levélhegyekkel Szécsénkénél (Cserhát-hegység, Észak-Magyarország) - előzetes eredmények

Az elmúlt évtized kiterjedt terepbejárásai alapján intenzív megtelepedéssel számolhatunk a Cserhát-hegységben a késő iközépső paleolitikum és a korai felső paleolitikum időszakában. A lelőhelyek megoszlása jellegzetes halmazokat rajzol ki. A jelentős lelőhelyek Legénd és Szécsénke környékén találhatók. A "lelőhelykomplexum" terminus nem feltétlenül jelez egyidejűséget a megtelepedések között, inkább kőanyagaik techno-tipológiai hasonlóságaira utal. A bemutatott lelőhelyek Szeleta ipar jellegzetességekkel rendelkeznek, összességében a morvaországi Szeleta iparra emlékeztetnek. A kőnyersanyagok használata, illetve techno-tipológiai megfontolások alapján egyfajta belső kulturális fejlődés is megfigyelhető a leletanyagokban.

Keywords

Cserhát Mountains, Northern Hungary, felsitic porphyry, leaf-shaped tool, Micoquian-Bábonyian industry, Szeletian industry, site complex, settlement dynamics, landscape use pattern

Kulcsszavak

Cserhát-hegység, Észak-Magyarország, kvarcporfír, levéleszköz, Micoquien-Bábonyien ipar, Szeleta ipar, lelőhelykomplexum, település dinamika, tájhasználat mintázatai

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Cite as / Hivatkozás

Péntek, A. (2015) Open-air site complex with leaf-points at Szécsénke (Cserhát Mountains, Northern Hungary). Preliminary results. *Litikum* 3: 47–70. https://doi.org/10.23898/litikuma0012

Article history / Kézirat történet

Received // Érkezés: 2015. 04 . 10. Accepted // Elfogadás: 2015. 06. 10. Published // Közzététel: 2016. 04. 25.

Kezirat tortenet

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"If you understand, things are such as they are; if you don't understand, things are such as they are."

Zen Koan

1. Introduction

The discussed area next to Szécsénke is situated in Nógrád County, Northern Hungary, in the Western Cserhát Mountains, westwards from the Galga River. The river forms an important geological and geographical border between the Central and Eastern Cserhát Mountains of volcanic origin and the sedimentary Western Cserhát Mountains.

One Palaeolithic settlement in the discussed area with published archaeological material is the Legénd-Káldy-tanya complex (Markó-Péntek 2003-2004). The assemblage contains 1006 chipped stone artefacts. In the raw material usage the hydrothermal or limnic raw materials ("limnic silicites", Přichystal 2010) dominate the assemblage with more than three quarters of the total (76.34 %). A relatively small amount (6.34 % of the total) could be regarded as local from the environs of Galgagyörk and Püspökhatvan, about 20-25 km from the site (Cs. Balogh-Dobosi 1995; Markó 2005). A somewhat bigger part (17.23 % of the total) with a very characteristic yellowish white, whitish yellow, or reddish patina originates from the hydrothermal outcrops of the Mátra Mountains (45-50 km as the crow flies to the East of the

site). The geological source of the majority of the limnic silicites could not be identified exactly. A possible provenance from Central Slovakia can not be excluded. In Central Slovakia the nearest primary limnic silicite outcrops are situated in the Žiar-Basin, along the Hron (Garam) River, in the environs of Stará Kremnička, Lurila, Slaská villages. They are characterized by vegetal and pollen remains. Typically, they have a great variability of colours, with prevailing light, white, greyish-black and black colours. The artefacts made of these variants of limnic silicites have a very intense patina (Kaminská 2001: 84; Kaminská 2013: 100). In the Legénd-Rovnya site (Péntek-Zandler 2013b), there is a flake core with greyish-white stripes. At Hont-Csitár (Zandler 2010) and Hont-Babat (Zandler 2012a), there are also some pieces stemming likely from those outcrops in Central Slovakia. Of these sites more anon in this paper.

The extralocal felsitic porphyry (metarhyolite) from a source 110 km away in the Bükk Mountains, is the second most abundant raw material assortment on the site (18.49 %). Some years ago a PGAA analysis was carried out with positive results on some archaeological samples of the Cserhát Mountains too (Markó et al. 2003: 297-314). The presence of all known obsidian variants at the site should be stressed. Even the very rare "red" or mahogany variant is present (Bíró et al. 2005: 94, Fig. 3.3). The raw material use of the Legénd-Káldy-tanya complex can be compared with the data on the raw material circulation during the Middle Palaeolithic in Northern Hungary (Markó 2009a).

In the tool type composition of the raw materials the limnic silicite dominates with 36 pieces, followed by the felsitic porphyry with 22 pieces out of the 67 tools.

The tool types have a very broad spectrum. Among the tools, those of Middle Palaeolithic character, such as leafpoints, bifaces and side-scrapers dominate. There are some typical Micoquian tools like *Bocksteinmesser*, *Faustkeilblatt*, *groszak* (*Typ Heidenschmiede*, Bosinski 1967: 33). The endscrapers have no Upper Palaeolithic affinity at all. The lateral edges of the bifacial tools were worked with the WGKmethod (*wechselseitig-gleichgerichtete Kantenbearbeitung*, Bosinski 1967: 43). The assemblage could be connected to the Bábonyian industry (Ringer 1983) which has a very close relation to the Central European Micoquian (Bosinski 1967) or *Keilmessergruppe* (Mania 1990: 145; Veil et al. 1994: 40; Bosinski 2000-2001: 112; Conard-Fischer 2000: 11-12).

2. The site complex and its surroundings

The sites belonging to the interpreted site complex are located on both sides of the Halyagos Streamlet which is a tributary of the Galga River. The valley of the streamlet is a so-called pseudo "dead end valley". This phenomenon is well known in the Cserhát Mountains, where the most Middle Palaeolithic and Early Upper Palaeolithic sites are lying along or at the heads of "dead end valleys". Without striving to completeness we could mention some characteristic examples like Vanyarc-Szlovácka-dolina, the eponym site of the "Vanyarc-type" industry (Markó 2007; 2012),

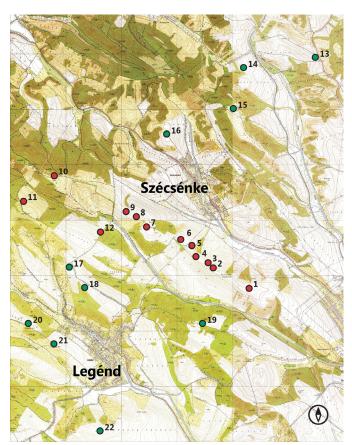


Figure 1. The Szécsénke site-complex (1-12) and its environment (13-22). // **1. ábra.** Szécsénke lelőhelykomplexum (1-12) és környezete (13-22).

1: Szécsénke-Kis-Ferenc-hegy, 2-3: Szécsénke-Berecz-oldal-1, 4: Szécsénke-Berecz-oldal-2E, 5: Szécsénke-Berecz-oldal-2W, 6: Szécsénke-Berecz-oldal-3, 7-9: Szécsénke-Berecz-oldal-4, 10: Kétbodony-Halyagos-hegy, 11: Legénd-Rovnya, 12: Legénd-88, 13: Becske-Júlia-major, 14: Becske-4, 15: Becske-Büdös-tó-hegy, 16: Szécsénke-Visak, 17: Legénd-Káldy-tanya-1-3, 18: Legénd-Káldy-tanya-5, 19: Legénd-Pápai-hegy, 20: Legénd-Gubány-dűlő (Menyecskés), 21: Legénd-Gubány-dűlő, 22: Legénd-Hosszú-földek.

Debercsény-Mogyorós, belonging to the Moravian Szeletian (Markó 2009b). The same or very similar situation can be observed at the site of Hont-Csitár in the Ipoly Valley, belonging to the Szeletian of Moravian type (Zandler 2010) and at Demjén-Szőlő-hegy by Eger, with some Aurignacian characteristic (Zandler 2012b: 23). Presumably the choice of these topographical situations must have had a deliberate practical reason. Such dead-end valleys are very suitable to the "head-'em-off-at-the-pass" hunting strategy of reindeers (Baales 1999; Baang-Andersen 2008). Since they were not able to follow the herds directly (Burch 1972), hunters located their camps near valley bottlenecks. One hunter group drove the animals into the bottleneck where an other group were already waiting. The hunters were thus enabled to kill a large number of animals in a short time. The exhausted supplies could be restocked and the hunters and their families moved on.

In a distance of about 10 km westward from the Galga River there is the wide valley of the Lókos Streamlet. The Romhány Basin (valley-dilation, Láng 1967: 59) and the Lókos Valley divide the Cserhát Mountains and the Börzsöny Mountains. During the prehistoric times this valley

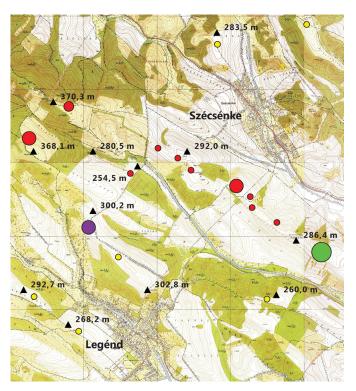


Figure 2. The Szécsénke site-complex and its environment

The green circle on the right side of the map denotes the Szécsénke-Kis-Ferenc-hegy site, the red circles indicate the other sites belonging to the site complex. The purple circle denotes the Legénd-Káldy-tanya site and the yellow ones indicate Palaeolithic sites with bifacial tools, not discussed in this paper. //

2. ábra. A Szécsénke lelőhelykomplexum és környezete. A jobb oldali nagy zöld kör jelöli Szécsénke-Kis-Ferenc-hegy lelőhelyet, a vörös körök pedig a komplexumhoz tartozó többi lelőhelyet. A lila kör Legénd-Káldy-tanya lelőhelyet jelöli, a sárga körök a cikkben nem tárgyalt paleolitikus korú lelőhelyek bifaciális eszközökkel.

had to play a great role in migration, since it is located on a NW-SE oriented axis connecting the sites of the Southern Cserhát and the Galga Valley to those of the Ipoly Valley. Actually both sides of the Ipoly River and the environs of the village Hont in the Ipoly Valley are very rich in Palaeolithic settlements. Recently in connection with the Romhány-Diós-út site, Viola T. Dobosi dealed with the importance of the Romhány or Nógrád Basin (Dobosi 2011).

Running directly south of Szécsénke, there was a main migration corridor connecting the Galga Valley and the Romhány Basin. The pseudo "dead end valley" of the Halyagos Streamlet represents an alternative route.

On **Fig. 1.** the Palaeolithic sites of the surrounding area can be seen. The central part of this area, with the discussed sites of the site complex is enlarged on **Fig. 2.** The green circle on the right side of the map denotes the Kis-Ferenc-hegy site, red circles indicate the other sites belonging to the site complex. The purple circle denotes the above mentioned Legénd-Káldy-tanya site and the yellow ones indicate Palaeolithic sites with bifacial tools, not discussed in this paper.

In the formation of the surface of the Cserhát Mountains young tectonic movements played a dominant role, the valleys of the discussed area are all forecasted tectonic erosion-valleys. These valleys have asymmetric cross-sections,

where the two sides are characterized by differing slope angles and rock exposures. One side of the slope is gentle and covered with thick loess-like soil. This soil and the underlying rock allochtonously could drag even under the level of the alluvia. In contrast, the other slope bordering the valley is steep, loess-like soil does not occur and either the rocks of the overlying mountain belt or the eruptive ones emerge. The steep slope means abrasion, destruction and transportation of the surface of the earth. The assumption that these steep valleys had been formed due to glacial solifluction, gelisolifluction contradicts the fact that they were formed partly due to recent tectonic movements. However not only with south-facing sloping but rather equally, they occur with the most differing exposition, while in a case of glacial solifluction, gelisolifluction the south-facing sloping would be the most frequent.

The Berecz-oldal is an about 3.5 km long steep, ascending hillside, located on the northern side of the Halyagos Valley. At the upper verge of the hillside there is a relatively flat plateau of 50-150 m width, where the Palaeolithic sites or find concentrations occur. The other, northern slope to the valley of the Szécsénke Streamlet is rather moderate.

2.1. The Szécsénke-Kis-Ferenc-hegy site

The site with the richest archaeological material of the site complex is the Kis-Ferenc-hegy (KFH) site. It is lying on the plateau of about 250×200 m area on the asymmetrical hill-comb, located between the valleys of the Szécsénke and Halyagos streamlets at an altitude of 265-270 m a.s.l.. Its relative altitude is 70 m from both valley floors. In the southwest corner of the site there is an approximately 50×50 m gravel bed. Its geological age is Upper Oligocene Chattian Stage, belonging either to the Budafok Sand Formation (Hámor 1985: 234) or the Pétervására Sandstone (Korpás 1988: 64-66). It consists of quartzite pebbles, diverse siliceous pebbles (hereafter shortly silex), radiolarite pebbles, hydrothermal chunks, petrified woods and can be regarded as a potential raw material source. The chipped stone assemblage processed so far by the authors from the site contains 1084 lithic artefacts (Péntek-Zandler 2013a).

2.1.1. The raw materials in the archaeological assemblage

The most dominant raw material is limnic silicite with 466 pieces (42.44 % of the total), but its ratio is substantially lower among tools: with 21 pieces it amounts to only 17.65 %. Thanks to the Miocene postvolcanic activity this raw material is very common in the Cserhát Mountains. The limnic silicite originates from the hydro- or limnic quartzite banks in the vicinity of Galgagyörk or Püspökhatvan. Two raw materials, silex and quartzite, could be regarded as local. We use the term silex as general and not as a petrographic term as the distinction between the diverse types of siliceous pebbles is very problematic. This raw material category contains a kind of porous silicified volcanic rock of yellowish colour, which is manifested in pebble form. The ratio of silex with 185 pieces is 17.07 % in the total assemblage but it is significantly higher among tools (37 pieces,

31.09 %). The ratio of the 9 quartzite pieces in the total assemblage is only 0.83 %, but there are three notched tools made of this material. Quartzite is a common raw material at archaeological sites in the Cserhát Mountains. Based on our observations, it is mainly related to Middle Palaeolithic or Early Upper Palaeolithic sites. However, recently clean-cut traces of intensive quartzite usage were found at Csővár-Arany-hegy in a Gravettian assemblage and at the Aurignacian site Legénd-Hosszú-földek (Péntek 2015b). According to K. Valoch it is the characteristic raw material of the so-called "Begleitindustrie" (collateral industry) at some Moravian and Slovakian Szeletian sites (Valoch 1955: 28-32). In relation to the quartzite or quartz it is worth mentioning the Bavarian Szeletian site Zeitlarn. There is no concordance in the judgement of cultural affiliation of the site. In T. Hopkinson's view the end-scrapers at Zeitlarn "are made on broad blades' or flakes and are closely similar to pieces from the Miqoquian of the Sesselfelsgrotte some 30 km to the west and described by Richter [1997] as ,mikrokratzer". (Hopkinson 2006: 232). In the relatively small excavated assemblage there are surprisingly many crystalline quartz (kristalliner Quarz), 23 pieces which is 19.7 % of the total (Heinen-Beck 1997: 77). The only long distance raw material, the "Szeletian felsitic porphyry" (metarhyolite) is represented by 412 pieces, with an extraordinary high ratio of 38.01 %. A raw material of uncertain provenience is the radiolarite, it is represented in the assemblage by 18 pieces (1.66 %). With the naked eyes it is very similar to the Carpathian radiolarite, however radiolarite was also described in pebble form at the east side of the Börzsöny Mountains in the so-called Nagyoroszi Pebble Formation (Gyalog-Budai 2002: 220). Moreever, actually all potential raw material sources in the Cserhát Mountains, pebble outcrops or gravel beds contain some radiolarite pebbles of good knapping quality.

2.1.2. The archaeological assemblage

The Palaeolithic industry is a typical flake-industry, no laminarity could be observed. Detailed technological analysis has not been carried out so far, we have no concrete theory about the applied debitage, but there are no traces of the Levallois-debitage. The debitage-material represents 86.81 % of the total assemblage: The ratio of the flakes greater than 15 mm including the elongated, "blade-like" flakes (13 pieces) is 31.20 %, that of the flakes less than 15 mm is 55.81 %. Among the flakes they are mainly flakes that originated from the shaping and preparation of the cores and from tool making and retouching. Among the flakes no raw material preference could be observed. Traces of Upper Palaeolithic blade technology are scarce, there are only 3 tools made on blades or on "blade-like" blanks: two high end-scrapers of definite Aurignacian character, made of silex and a leafpoint made of limnic silicite of which more anon.

In the assemblage collected from the surface there are 119 formal tools belonging to the Palaeolithic industry. Most of the tools are made of felsitic porphyry (53 pieces, 44.54 %), followed by silex (37 pieces, 31.09 %), limnic silicite (21 pieces, 17.65 %), radiolarite (5 pieces, 4.20 %) and quartzite (3 pieces, 2.52 %). Among the Palaeolithic formal tools we distinguished 5 fundamental tool categories.

There are altogether 34 pieces of flake end-scrapers (28.57 %). There is a great dual raw material preference, 14 pieces were made of silex, 13 pieces of felsitic porphyry, 5 pieces of limnic silicite and 2 pieces of radiolarite. The end-scrapers have a very varied morphology. Besides the circular ones there are atypical nosed end-scrapers, carinated (keeled) pieces (grattoir caréné) and particularly fan-shaped forms with narrow base too. Among the Upper Palaeolithic types (carinated end-scrapers, Aurignacian-like high end-scrapers) there are no pieces made of felsitic porphyry. The base of some pieces seems to be intentionally broken, perhaps because of hafting purpose. In these cases there is a slightly acute angled break surface and a lip on the lower edge (Jennings 2011: 3646, 3650). In the case of felsitic porphyry the base of the tool is sometimes the naturally cleavage surface along a diaclase or joint. A joint is a natural fracture in the continuity of either a layer or body of rock that lacks any visible or measurable movement parallel to the surface (plane) of the fracture.

There are pieces with retouched lateral edge(s). As a matter of fact these tools are combination tools of an end-scraper and a side-scraper. This phenomenon was mentioned by K. Valoch in relation to the archaic lithic material of Jezeřany I. and II (Valoch 1966: 14). This could also be found at other Moravian Szeletian sites as for example Trboušany (Hladíková 2002: 77, Obr. 8:7), Neslovice (Valoch 1973: 13, Tab. I/2,4), Vedrovice V (Valoch 1993: 35, Abb. 14:12; 49, Abb. 28:1), Vincencov (Svoboda-Přichystal 1987: 10, Tab. I.: 5), Želešice III (Skrdla et al. 2014: 92, Fig. 12:13, 98, Fig. 12: 13, 15, 16) and even in Bavaria at Zeitlarn (Heinen-Beck 1997: 84, Abb. 7:5,6). Most end-scrapers show partial ventral thinning or retouch, or at least the bulb is eliminated. This attribute is well known in the Moravian or Bavarian Szeletian, for example Trboušany (Hladíková 2002: 78, Obr. 9:3,4,7) and in Zeitlarn (Schönweiss-Werner 1986: 10, Abb. 3:8; Heinen-Beck 1997:84, Abb. 7:5,6). Ventral thinning could be associated in the Cserhát Mountains mainly with Micoquian-Bábonyian assemblages, for example at Galgagyörk-Csonkás-hegy (Markó et al. 2002: 249, Fig 2.1, 2.4) and Legénd-Káldy-tanya (Markó-Péntek 2003-2004: 169, Fig. 4.7). M. Oliva in his paper dealing with the industries of Jezeřany suggests that the ventral retouching is in some way genetically related to leaf points (Oliva 1979: 47).

On the base of a piece made of felsitic porphyry a Clactonian notch could be found similar to pieces occurring in Zeitlarn (Heinen–Beck 1997: 84, Abb. 7:6). There is an atypical nosed end-scraper made of felsitic porphyry. Analogous pieces could be found in Vedrovice V (Valoch 1993: 35, Abb. 14:2,3), Vincencov (Svoboda–Přichystal 1987: 10, Tab. I:1) or even in Zeitlarn (Schönweiss–Werner 1986: 10, Abb. 3:4-6).

It is noteworthy to mention the carinated end-scraper made of silicified volcanic rock (**Fig. 3.1**). Both lateral edges are retouched, the base has a narrow fan-tail like shape and is thinned on the ventral face. As a matter of fact it is a combination of a double side-scraper and an end-scraper. Typological resemblances are found in Moravia, for example at Ondratice (Oliva 1992: 51, Fig.5).

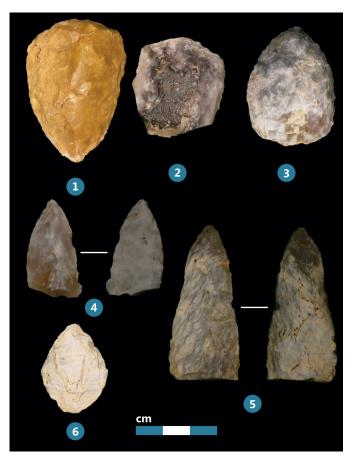


Figure 3. Selected tools from the Szécsénke Kis-Ferenc-hegy site. 1-3: end-scrapers made on flakes, 4: "pointe à face plane"-like leaf-point; 5-6: leaf-points (1-3: siliceous pebble, 4: limnic silicite of Cserhát Mts., 5-6: felsitic porphyry). //

3. ábra. Eszközök Szécsénke-Kis-Ferenc-hegyről. 1-3: szilánkkaparók, 4: "pointe à face plane"-szerű levélhegy; 5-6: levélhegyek (1-3: kovakavics, 4: cserháti limnoszilicit, 5-6: kvarcporfír).

The tool category of the *leaf-shaped tools* consists of 20 pieces (16.81 %). There is a definitive raw material preference, 13 pieces are made of felsitic porphyry, 5 pieces of silex and 2 pieces of limnic silicite. Most of the tools are symmetric or perhaps slightly asymmetric to the longitudinal axis, that is, all these pieces could be interpreted as leaf-points. Morphologically the pieces show a highly variable picture. K. Valoch in 1960 discussed this question in much detail (Valoch 1960: 30–31). He stated that it is very rare if on a site only one form of leaf-shaped tools can be found (e.g. Moravany-Dlhá). In Moravia it is much more frequent that a variety of leaf-shaped tool shapes occur at the same site (Ořechov I, II; Modřice; Neslovice).

In the assemblage there are pieces with biconvex, planoconvex and parallelogramm cross sections. Nine pieces are broken fragments with an average length of 15-25 mm and we can determine with great probability that they are all base fragments. There is a piece with a notch at the base, maybe because of hafting. Very characteristic are some pieces with a relative short, wide and massive form.

The above mentioned piece made of a "blade-like" blank is plano-convex. On the ventral side only the edges are retouched (**Fig. 3.4**). Similar *pointe* à *face plane* leaf-points occur in the assemblage of Ondratice (Valoch 1967: 13, Tab. V/1; 21, X/1; 28, XIV/1), Neslovice (Valoch 1973: 17, Tab. V/6;

28, XVI/2) and Jezeřany (Oliva 1979: 48 and Taf. II/9) either as parallel phenomenon or as an influence of the Jerzmanowician industry, postulated by Chmielewski (1961). At the Moravian Szeletian site Želešice III both the unstratified surface collection and the excavated material yielded characteristic Jerzmanowice-type points. But only the surface collection contains leaf-points (Škrdla et al. 2014: 98-99, Fig. 12). The Jerzmanowice-type points are present at Vedrovice V (Valoch 1993: 45, Abb. 24:5, Abb. 25:3) and at the surface site Bratčice I where the raw material distribution and techno-typological point of view is very similar to Želešice III (Škrdla et al. 2014: 99). According to P. Škrdla et al., the most important feature of the Moravian Szeletian is the presence of the Jerzmanowice-type points which is regarded as type artefact of the Lincombian-Ranisian-Jerzmanowician technocomplex (Flas 2006; 2011).

A general characteristic is the so-called WGK-method which is a typical attribute of the late Middle Palaeolithic Micoquian industry. According to the authors the WGK is present in the Bábonyian-Szeletian technocomplex (Ringer-Mester 2000: 267-268). Zs. Mester carried out a detailed morphometrical analysis on the leaf-shaped tools of the Jankovichian and Szeletian industries. He concluded that the façonnage alterne, which in his opinion more or less corresponds to the WGK-method, is without doubt present in the production of the leaf-shaped tools of the Szeleta Cave (Mester 2008-2009: 91). In another paper, dealing with the leaf-points of the Szeleta Cave, Zs. Mester defines the alternate shaping of the edges as a two-step method: "the first step is a series of removal along the edge on one face (dorsal or ventral) and second is the same operation on the other face." (Mester 2010: 110). This defined method could be correlated with the WGK-method. After a well-founded morphometrical analysis and comparing the Early Szeletian bifacial point features to the Jankovich Cave bifacial tools, he came to the conclusion that: "on the basis of the lithic technology of bifacial tools that the Jankovichian and the Early Szeletian belong to the same archaeological culture, and there is no provable relation on technological ground between the Early and Developed Szeletian" (Mester 2010: 121).

The tipped distal fragment made of felsitic porphyry with the narrow, slender, elongated form and plano-convex cross section is the biggest ((57)×26×12 mm) leaf-point fragment in the assemblage. (Fig. 3.5).

There are 23 pieces (19.33 %) in the category of the *side-scrapers*. There is a very pronounced raw material preference, 13 pieces are made of felsitic porphyry, 5 pieces of silex, 4 pieces of local limnic silicite and only one piece of Carpathian radiolarite. Morphologically they are highly variable, most of the pieces are simple straight or convex side-scrapers but there are convergent or transversal pieces too. Especially the pieces made of felsitic porphyry are relatively small in dimensions. The obvious reason could have been the saving, economizing housekeeping with this long distance raw material.

In the Crimea most of the Kiik-Koba facies sites "may represent palimpsests where the distance from raw material

encouraged the reuse and extensive rejuvenation of tools, resulting in high percentages of tools with multiple-retouched edges and overall small size." (Marks-Chabai 2001: 194).

At some pieces the elimination of the bulb could be observed. There are two natural backed pieces (*racloir à dos naturel*). K. Valoch mentioned the existence of such pieces from the archaic material of Jezeřany I. and II. (Valoch 1966: 38, Fig. XIX/4; 43, XXII/3).

On the **Fig. 4.1** there is a side-scraper of small dimensions is made of Carpathian radiolarite. The 31×21×5 mm tool has a subtriangular form and its right edge is bifacially retouched. On the **Fig. 3.2** a double or convergent side-scraper made of local silex can be seen. The dorsal face is finely elaborated in an invasive manner. The proximal end is thinned from the ventral face, the butt is prepared. Dimensions: 46×34×12 mm.

There are altogether 15 *bifacial tools* in the assemblage (12.61 %). This tool category contains the bifacially worked artefacts which are hardly, or because of their recent state (breakage, plough marks) not unambiguously classifiable. There are also pieces that were abandoned because of either technical knapping accident or other reasons, such as raw material flaws.

There is a fragment of a bifacial tool, which, due to its acute-angled subtriangular form after breakage, could function as a bifacial knife. On the hypotenuse of the triangle a special kind of detachment can be seen which suggests the so called *Prądnik*-spall. O. Jöris in the Micoquian (Micoquo-Prondnikian) assemblage of the Bu-III layer of the Buhlen Cave in Germany could set apart some *Prądnik-Schaber* (Jöris 2001: 32, Abb. 4.15; 4.16,1,3-5,7-11; 4.17,1-2). Bifacial knifes (*Keilmesser*) occur sporadically in the material of the archaic Moravian Szeletian sites, such as Jezeřany I. and II. too, where even the *Prądnik*-technique is not unknown. In connection with Keilmesser he wrote: "an einigen Exemplaren beobachtet man Spuren der Prondnik-Technik (XI/1-3), die hier und da auch an Schabern zu sehen sind (XII/4)." (Oliva 1979: 48) (Fig. 4.2).

The last tool category of *other tools* or *worked pieces* contains 27 pieces altogether (22.69 %). Out of the most typical tools the following pieces could be emphasized:

- 1. Tranchets (chisels): 3 pieces (2.52 %). These are corelike fashioned chisel-like tools. Similar pieces could be found for example in Neslovice (kernförmig bearbeitete meißelartige Artefakte, Valoch 1973: 11 and Taf. XIII/2).
- 2. Notched tools: 4 pieces (3.36 %). Out of these, 2 pieces are made on massive quartzite flake with deep, unretouched Clactonian notches. J. W. P. van der Drift suggests that the deep hollow fracture, often called Clactonian notch is made in oblique bipolar technique by placing one contact point a small distance from the edge and another contact point at a greater distance from the edge. The reduction face of the struck stone shows a convex fracture between the impact popints, and the perpendicular direction this same fracture shows a deep concave surface (van der Drift 2009: 9 and Fig. 5G). Another two pieces are made of felsitic porphyry. One of the pieces

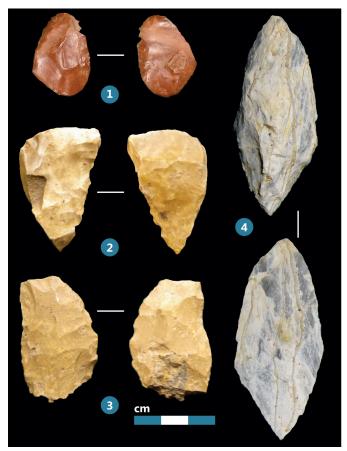


Figure 4. Selected tools from the Szécsénke Kis-Ferenc-hegy site. 1: side-scraper, 2-3: bifacial tools, 4: limace (1: Carpathian radiolarite, 2-3: siliceous pebble, 4: felsitic porphyry). //

4. ábra. Eszközök Szécsénke-Kis-Ferenc-hegyről. 1: kaparó, 2-3: bifaciális eszközök, 4: limace (1: kárpáti radiolarit, 2-3: kovakavics, 4: kvarcporfír).

is actually a combined tool, on the left edge there is a notch, on the right edge two nose-like tips (micro borers) can be seen.

- 3. There is a splintered piece (pièce esquillée).
- 4. There is a borer made of quartzite.
- 5. Tools made on cores which was regarded by K. Valoch as a typical feature of the Moravian Szeletian (Valoch 1966: 24) are represented by a burin made of limnic silicite.

A very interesting and relatively rare tool in the Hungarian Palaeolithic is the *limace* made of felsitic pophyry. The ventral face of the tool (the natural cleavage surface of the raw material) is unworked, the dorsal face is rough-andready worked. On the right side of the dorsal face, a little recent damage can be seen. The tool has an approximately deltoid form and measures 76x32x12 mm. With its morphometrical characteristics the tool resembles the 1B-type of Szeletian bifacial foliate tools, broad, elongated and symmetrical (laurel leaf shape) with pointed base (Mester 2010: 110; 2011: 25) (Fig. 4.4).

2.1.3. Discussion of the KFH site

In the assemblage, those typical to the Middle Palaeolithic (side-scrapers, bifacial tools) make up the 31.93 % of the tools. Most of the end-scrapers have a rather archaic character, only some atypical pieces represent Upper Palaeolithic types. With the exception of the above mentioned core-burin, there are no burins and only one borer made of quartzite among the tools. The ratio of the leaf-shaped tools is high. The elaboration is sometimes relatively rudimentary, does not measure up to the refinement typical for the leaf-shaped tools of the Developed Szeletian. Among the other worked pieces the number of archaic tools, such as tranchets, notched tools made of quartzite, backed knifes is very significant. The industry is a typical flake-industry, the laminarity is anecdotical.

All tools have typological, morphological analogies in the Moravian or Bavarian industries with leaf-points, that have the general denomination of Szeletian industry since the fundamental paper written by F. Prošek (Prošek 1953). According to the original definition of Prošek, the Szeletian is characterized by the predominance of the leaf-shaped tools and side-scrapers, the Upper Palaeolithic tools play a subordinate role. End-scrapers occur relatively in force, burins only sporadically, backed pieces as good as never. Similar phenomena could be found notably in the Moravian archaeological materials originating from surface collections. Vedrovice V was the first site where traces of the Szeletian, as defined by Prosek, have been found at a greater area, under relatively undisturbed conditions (Valoch 1993). The investigations carried out by J. K. Kozłowski established the Interpleniglacial age of the site Dzierżysław in Southern Poland and affiliated its findings with the Szeletian of Moravian type (Bluszcz et al. 1994).Zeitlarn, a site that has been partially excavated, previously known only by surface collection, also belongs to this industry (Heinen-Beck 1997). Based on the fact that end-scrapers are made on "broad blades" or flakes and show closely similarity to pieces from the Micoquian of the Sesselfels Cave ("Mikrokratzer", Richter 1997), T. Hopkinson takes the attitude that there is no reason to attribute the assemblage of Zeitlarn to a "transitional industry" (Hopkinson 2004: 232). In Austria only several single occurences of leaf-points are reported (Trnka 1990; Nigst 2006). The leaf-point at Schletz (Lower Austria) came to light under stratified conditions, but as an isolated find without any accompying artefacts, so its cultural association is problematic. Hitherto in Austria there is only one significant Micoquian assemblage in the Gudenus Cave (Derndarsky 2001).

M. Oliva published the list of the Bordes-indices for 13 Moravian Szeletian sites (Oliva 1995: 90). The list is primarily based on the evaluation of surface finds in which cases the possibility of some mixing with other industries (Micoquian, Bohunician, Aurignacian) could not be excluded. Though the tool composition of a stone industry is determined by several circumstances (for example climatic, faunistic and even general way-of-living circumstances), the index values with a relatively great deviation are referring perhaps some sort of techno-typological development. M. Oliva made a techno-typological revision on the chipped stone assemblage of Jezeřany. The conclusion of this revision and new evaluation is noteworthy to cite word-forword: "Die Bearbeitung des neueren und reichen Sammelgutes aus Jezeřany hat erwiesen, daß seine Micoquien-Komponente

wesentlich stärker ist als die erste Veröffentlichung annehmen ließ (Valoch 1966). Man kann deshalb die ganze Kollektion im großen und ganzen dem mittelpaläolithischen Micoquien vom Typ Rörshain gleichsetzen. Die Jezeřany-Industrie unterscheidet sich von diesem Typ allerdings durch das Vorkommen einiger älterer Micoque-Elemente (Keilchen, Prondnik-Technik), durch die Menge von Geröllgeräten und die Anwesenheit jungpaläolithischer Typen." (Oliva 1979: 54).

It is very instructive to set the above idea agains the opinion of Z. Nerudová about the collection of Jezeřany and its relation to Micoquian: "Les similarités dans l'économie des matières premières et dans le débitage, la présence des nucléus dicoïdes et enfin la similitude de la typologie et technologie signalent la parenté du Szélétien archaïque de Jezeřany I avec le Micoquien de Bořitov V et de Kůlna, couche 6a." (Nerudová 1996: 36).

In a relatively recent paper Nerudová analysed the Moravian Szeletian lithic industry from a technological point of view. On the basis of this analysis it could be stated that "the Moravian Szeletian is a dynamicly developing culture, which is influenced by the Micoquian, in its initial phase, interacts with the Bohunician in its middle phase, and ends as the advanced Szeletian touched by the Aurignacian. The oldest Szeletian collections are non-blade and non-Levallois ones represented by sites Vedrovice V, Jezeřany I and Moravský Krumlov IV-3." (Nerudová 2008-2009: 56).

From the assemblage of Jezeřany, regarded to be nearly related to the Micoquian, to the younger ("more developed") sites, the ratio of the end-scrapers and in general, of the Upper Palaeolithic components (burins, borers) gradually increases and at the same time the ratio of the side-scrapers, bifacial and leaf-shaped tools decreases. In our opinion the Szécsénke-Kis-Ferenc-hegy site fit well in this trend and could be regarded as belonging to a relatively early phase of the Szeletian industry of Moravian type.

2.1.4. Connections in Hungary

To make a comparison with other assemblages from Hungarian open-air sites, there is one salient example, Hont-Csitár in the Ipoly Valley, where the Gábori couple excavated a somewhat mixed, inhomogeneous Palaeolithic material mainly of Middle and Upper Palaeolithic character in 1969. Unfortunately, the field documentation is missing, therefore the assemblage lost heavily from its information bearing significance. K. Zandler took up the challenge, since the new investigations in the Cserhát Mountains made it necessary to revisit and publish the excavated material of the site (Zandler 2010).

The revisited chipped stone assemblage contains 1581 pieces. At Hont-Csitár there is a very diverse raw material composition (17 different types), which is likely attributable to the mixed character of the assemblage. The limnic quartzite dominates both in the total (83.81 %) and among the tools (69.9 %). The ratio of the felsitic porphyry is 5.59 % of the total and 9.1 % of the tools. Other raw materials play only a subordinate role. The local and regional raw

materials originate from the Börzsöny and Cserhát Mountains. Quartzite pebbles occur on the banks of the nearby rivers and streamlets or in some gravel beds. Nummulitic chert is found in the Ipoly Valley, in South Slovakia and mainly in the Cserhát Mountains from where many gravel beds containing this raw material are known (Markó-Kázmér 2004). The Carpathian radiolarite is known from the White Carpathians (Vlára River Basin, Cheben-Cheben 2010), from the *Nagyoroszi Pebble Formation* (Gyalog-Budai 2002: 220), and from Transdanubia. Opalites can be found in the Börzsöny or Mátra Mountains (Bíró 1986) and even in the environs of Eger (Kozłowski-Mester 2003-2004: 116).

The primary sources of extralocal raw materials like felsitic porphyry, jasper, lydite and hornstone are lying in the Mátra and Bükk Mountains (Dobosi 1978; Bíró 1984). There are both Carpathian 1 and 2 type obsidians from the Tokaj Mountains and Eastern Slovakia (Rosania *et al.* 2008 with further references). Finally there are some Northern flint pieces, perhaps erratic flint from the Upper Oder Basin or Jurassic flint from the Kraków-Częstochowa Plateau (Kozłowski 2013: 65) from at least 350 km distance as the crow flies.

Regarding lithic technology, it can be stated that the Levallois-technique is not representated and laminarity is relatively low. Tools made on blades come out at 10 % of the whole collection. Cores are simple and less prepared. The WGK-method is present by the edge-elaboration of the bifacial tools.

The most important characteristic of the collection is the co-presence of Middle and Upper Palaeolithic tool types. Most of the Middle Palaeolithic tool types like side-scrapers, leaf-shaped tools are made of limnic quartzite and felsitic porphyry. Upper Palaeolithic tool types are made of limnic quartzite or radiolarite. The few tools made of Transdanubian radiolarite could be related to a younger Neolithic industry, possibly to the Zseliz or Lengyel culture. The most dominant tool types are different side-scrapers (20.45 %) and bifacially worked leaf-shaped tools (19.32 %). The shape of these latter tools is in general slightly asymmetric to the longitudinal axis. Among the end-scrapers there are some pieces made on blades and few Aurignacian types also can be observed. The occurrence of lateral edge retouch is rare.

K. Zandler came to the conclusion that the observed technology and tool type composition of the assemblage show evident similarity with the Bábonyian and Szeletian sites of the Bükk and Cserhát Mountains as well as the Moravian Szeletian sites. According to these similarities the Hont-Csitár assemblage could be placed in the Moravian Szeletian circle.

However there are some substantial differences between Hont-Csitár and Szécsénke-Kis-Ferenc-hegy. The collection of the KFH site seems to be very homogeneous, maybe that is why the raw material spectrum is much more steady. Local limnic silicite has a lower ratio both in the total and also among the tools. There are significantly more felsitic porphyry and siliceous pebbles both in the total collection

and also among the tools. At the KFH site there is absolutely no laminarity, even elongated, "blade-like" flakes are very rare. In contrast, at Hont-Csitár the number of retouched blades is relatively high and there are many retouched flakes too. These do not necessarily belong to the Palaeo-lithic material with leaf-shaped tools. In the tool composition, thanks to this fact, the indices for the side-scrapers and leaf-shaped tools are actually lower. Regarding typology, in point of side-scrapers, leaf-points and bifacial tools there are no significant differences between the discussed assemblages. One important fact, which indicates a more archaic character of the KFH assemblage, is the form of the end-scrapers. The ratio of the Aurignacian-like end-scrapers is comparable, however at Hont-Csitár there are also end-scrapers made on blades.

Despite these discrepancies and differencies, the indices for the tool types of Hont-Csitár could be compared with the indices of the KFH site and even with the indices gained by M. Oliva for the Moravian Szeletian sites (Oliva 1995). On the basis of this comparison, the Hont-Csitár site could be connected to the younger or developed phase of the Szeletian industry of Moravian type.

2.2. The Szécsénke-Berecz-oldal sites

In northwestern direction about 500 m from the above reviewed KFH site four distinct find concentrations or sites of various sizes can be found. The distinction is not unconditionally theoretical, actually there are 20-30 m wide gaps without finds between the concentrations. The average thickness of the loess-like cover is 25-30 cm. Below it there is a reddish-brown coloured paleo soil, from which the lithic artefacts come to light. The greater part of the area was for a long time uncultivated.

The first of the four sites, Szécsénke-Berecz-oldal **BO-1** streches out on an elongated area of 250×25-30 m. Here, possibly due to ploughing activity two find concentrations were mixed together. Now it seems to be one and the same site, namely the chipped stone artefacts can be found fast continously, but there are two distinct, more dense spot at both ends of the site.

The small but characteristic assemblage consists of 122 artefacts. Amongst the raw materials local limnic silicite dominates, followed by silex. There are 8 tools in the assemblage, 3 of them are made of silex, 2 end-scrapers made on flake and a fragment of a leaf-point.

Three pieces, an end-scraper, a leaf-shaped tool and a side-scraper are made of limnic silicite of Mátra Mountains origin which has an anecdotical role in the total with a ratio of 7.38 %. These artefacts were carried to the site likely as finished tools. Two tools are made of felsitic porphyry, both pieces are leaf-points. The one piece is near symmetrical to the longitudinal axis. The longitudinal section (lateral view) is biconvex, the cross section is plano-convex. The shape of the tool is slightly deltoid (willow-leaf form) which is known from some unpublished Palaeolithic assemblages in the Cserhát Mountains and occur at numerous sites in the

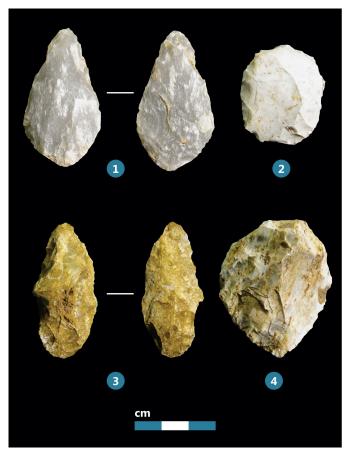


Figure 5. Selected tools from the Szécsénke Berecz-oldal BO-1 Palaeolithic site. 1: leaf-point, 2, 4: end-scrapers; 3: abandoned leaf-point (1: felsitic porphyry, 2: siliceous pebble, 3-4: limnic silicite of Mátra Mts.). //

5. ábra. Eszközök Szécsénke Berecz-oldal BO-1 paleolitikus lelőhelyről. 1: levélhegy, 2, 4: vakarók; 3: felhagyott levélhegy (1: kvarcporfír, 2: kovakavics, 3-4: mátrai limnoszilicit).

Moravian Szeletian. The edges are worked with WGK. Dimensions: 56×30×8 mm (**Fig. 5.1**). Another leaf-point made of limnic silicite of the Mátra Mountains is abandoned due to raw material flaws (**Fig. 5.3**). It is noteworthy to mention a quartzite flake core with traces of short hinge fracture scars (**Fig. 17.1**).

The Szécsénke-Berecz-oldal BO-2E (East) site streches out on an elongated area of 100×25 m directly over a ravine. There are 161 artefacts from this find concentration. The raw material composition is very heterogenous. Most of the pieces are made of local limnic silicite (52.17 %) but the role of silex is significantly higher as usual in the Cserhát Mountains (32.30 %). There are also 3 pieces made of nummulitic chert (Markó-Kázmér 2004). All other raw materials, such as quartzite, Mátra limnic silicite, Carpathian radiolarite, C1 type obsidian, Northern erratic flint are represented only by a few pieces. An artefact is made of a raw material which resembles lydite, perhaps also from the Mátra Mountains. There are altogether 14 tools in the assemblage, eight of them are end-scrapers made on flake, there is an end-scraper made on blade and five other worked tools, not exactly classifiable. Six tools are made of local limnic silicite, 4 pieces of silex, 1-1 pieces of nummulitic chert, quartzite, radiolarite and of an unidentified raw material. It is noteworthy

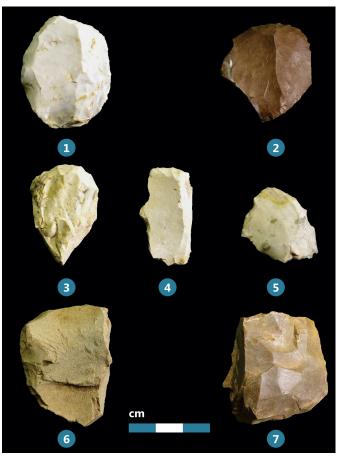


Figure 6. Selected artefacts from the Szécsénke Berecz-oldal BO-2E Palaeolithic site. 1-3: end-scrapers made on flakes, 4: end-scraper made on blade, 5-6: side-scrapers, 7: unipolar core (1, 6: siliceous pebble, 2, 7: Carpathian radiolarite, 3-4: limnic silicite of Cserhát Mts., 5: limnic silicite of Mátra Mts.). //

6. ábra. Eszközök Szécsénke Berecz-oldal BO-2E paleolitikus lelőhelyről. 1-3: szilánkkaparók, 4: pengevakaró, 5-6: kaparók, 7: egy leválasztási felszínű magkő (1, 6: kovakavics, 2, 7: kárpáti radiolarit, 3-4: cserháti limnoszilicit, 5: mátrai limnoszilicit).

to mention three blades or "blade-like" flakes which are made of Mátra limnic silicite. A nicely elaborated end-scraper made on a slightly *déjeté* flake, made of Carpathian radiolarite has a very fine retouched half-steep convex working edge. Its butt is plain. Dimensions: 35×37×12 mm (**Fig. 6.2**). There is an unifacial, unipolar Carpathian radiolarite core with short flaking scars. Dimensions: 39×38×20 mm (**Fig. 6.7**).

The Szécsénke-Berecz-oldal **BO-2W** (West) lies directly next to BO-2E and takes up a bigger area of 100×35-40 m. The assemblage consists of 262 artefacts. Among tools end-scrapers have a great dominance (**Fig.** 7). Again, raw material utilization shows a heterogenous picture here. The local limnic silicite dominates evidently (56.49 %), followed by limnic silicite of Mátra Mountains origin (16.41 %) and local silex (12.98 %). There are some pieces of nummulitic chert, quartzite, Carpathian radiolarite, C2 type obsidian and felsitic porphyry. There are 22 tools, 11 end-scrapers made on flake, 4 end-scrapers made on blade, 1 side-scraper and 6 not classifiable worked pieces. Nine tools are made of local limnic silicite, 7 pieces of silex, 4 pieces of Mátra limnic silicite, 1-1 piece of radiolarite and felsitic porphyry. This latter tool is an end-scraper made on "blade-like" flake (*éclat*

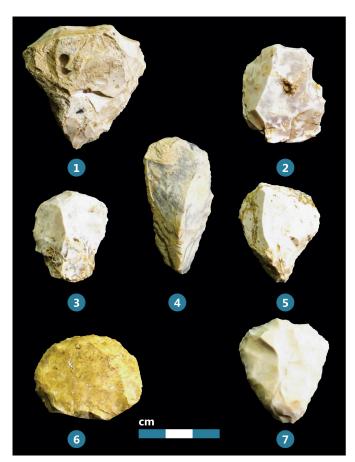


Figure 7. Selected tools from the Szécsénke Berecz-oldal BO-2W Palaeolithic site. 1-3, 5-7: end-scrapers made on flakes; 4: end-scraper made on a blade-like flake (*éclat débordant*) (1-3: limnic silicite of Cserhát Mts., 4: felsitic porphyry, 5-6: limnic silicite of Mátra Mts., 7: siliceous pebble). //

7. ábra. Eszközök Szécsénke Berecz-oldal BO-2W paleolitikus lelőhelyről. 1-3, 5-7: szilánkvakarók; 4: pengeszerű szilánkon készült vakaró (*éclat débordant*) (1-3: cserháti Imnoszilicit, 4: kvarcporfír, 5-6: mátrai limnoszilicit, 7: kovakavics).

débordant, Fig. 7.4). Beyond tools 4 blades made of limnic silicite of Mátra Mountains origin are worth to mention.

The next site, Szécsénke-Berecz-oldal BO-3 streches out on an area of about 250×50 m. It has an assemblage of 633 artefacts. Beside the dominant local raw materials, limnic silicite (68.56 %), silex (12.32 %) there are nummulitic chert, quartzite, limnic silicite of Mátra Mountains origin, radiolarite, felsitic porphyry and a piece of vein quartz. Long-distance felsitic porphyry is relatively abundant with 48 pieces (7.58 %). Among tools (33 pieces altogether), the 14 endscrapers made on flake dominate, there are 4 leaf-shaped tools, 3 side-scrapers, 1 bifacial tool and 11 other tools hardly classifiable. The silex raw material has a dominance with 15 tools, there are 9 tools made of local limnic silicite, 2 pieces made of Mátra limnic silicite, 3-3 pieces of radiolarit and felsitic porphyry and a little microlitic retouched quartz tool. The majority of the blades (5 of 8 pieces) are made of local limnic silicite.

On **Fig. 9.4** a base fragment of a broken leaf-point made of local limnic silicite can be seen. The oblique fracture surface is heavily patinated, the breakage could have been a

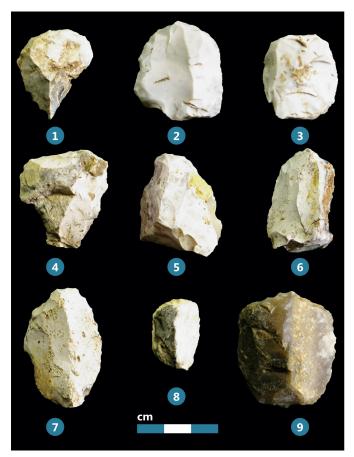


Figure 8. Selected tools from the Szécsénke Berecz-oldal BO-3 Palaeolithic site. 1-8: end-scrapers made on flakes (1-6: limnic silicite of Cserhát Mts., 7-8: siliceous pebble). //

ábra. Eszközök Szécsénke Berecz-oldal BO-3 paleolitikus lelőhelyről.
 1-8: szilánkvakarók (1-6: cserháti limnoszilicit, 7-8: kovakavics).

knapping accident. The tip of the point is broken and patinated too. This tool has a clearly asymmetrical shape, its left lateral edge is slightly curved, the right one is rather straight. Both longitudinal and cross sections are plano-convex. The ventral face is thinned, both edges are retouched (WGK). Dimensions: 47×34×9 mm.

The one side-scraper of great dimensions is made of felsitic porphyry. Its left edge is bifacially retouched, the right edge is retouched only from the ventral face. On the surface traces of a diaclase (yellowish spots) can be seen. Due to a large detachment in the middle of the ventral face the tool has a slightly concavo-convex profile. Dimensions: 66×39×15 mm (Fig. 9.5).

The clearly biggest tool of the assemblage is a side-scraper made of local silex. Its left edge and the distal part of the right edge are retouched. Dimensions: 92×67×29 mm (**Fig. 10.1**). Some of such "gigantoliths" could be found in the excavated material from the Eger-Kőporos-tető site excavated by L.Vértes (Vértes 1951).

The last Szécsénke-Berecz-oldal site **BO-4** consists actually of 3 little find concentrations on an area of 700 m length with only some pieces. The unity of these concentrations is obviously questionable, more than problematic, but for the sake of simpleness we discuss them together. The loess-like

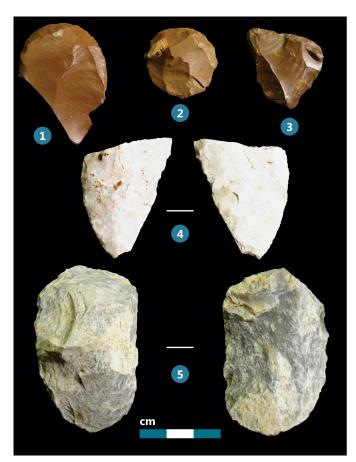


Figure 9. Selected tools from the Szécsénke Berecz-oldal BO-3 Palaeolithic site. 1: end-scraper made on flake, 2: circular end-scraper, 3: side-scraper of sub-triangular form, 4: asymmetric leaf-point, 5: side-scraper (1-3: Carpathian radiolarite, 4: limnic silicite of Cserhát Mts., 5: felsitic porphyry). //

9. ábra. Eszközök Szécsénke Berecz-oldal BO-3 paleolitikus lelőhelyről. 1: szilánkvakaró, 2: körvakaró, 3: szubtrianguláris kaparó, 4: aszimmetrikus levélhegy, 5: kaparó (1-3: kárpáti radiolarit, 4: cserháti limnoszilicit, 5: kvarcporfír).

soil cover at the foot of the Halyagos Mountain is relatively thick, perhaps due to understandable loess accumulation.

In the first concentration there are 7 pieces, 5 pieces of them are of local limnic silicite, 1-1 piece of silex and limnic silicite of Mátra Mountains origin. A quartzite notched tool of great dimensions (54×33×21 mm) with simple unretouched Clactonian notch is the only tool (Fig. 11.2). In the second concentration there are 6 artefacts, 4 of them are raw material chunks. There is a blade made of local limnic silicite and a flake core made of silex. In the third concentration among the 7 artefacts, there are 3 pieces made of local limnic silicite, 2-2 pieces of silex and radiolarite. There are 3 tools, an end-scraper and a worked piece made of limnic silicite. The third one is probably a base fragment of a leafpoint made of radiolarite. The longitudinal section could not be established, the cross section is slightly biconvex. The edges are worked with WGK. Dimensions: (38)×31×10 mm (Fig. 11.1). Leaf-shaped tools made of Carpathian radiolarite are very scarce. The only known Palaeolithic industry with leaf-shaped tools which used radiolarite (of Transdanubian types) regularly is the Jankovichian industry postulated by Vera Gáboriné Csánk (Gábori Csánk. 1993). Dealing with leaf-shaped tools, Zs. Mester mentioned the published

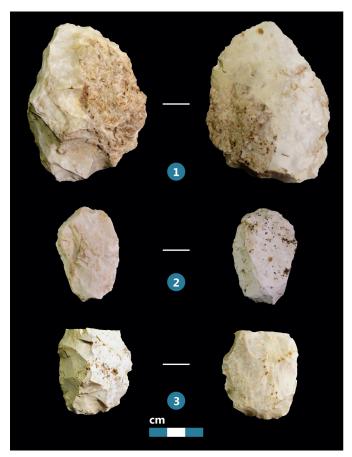


Figure 10. Selected tools from the Szécsénke Berecz-oldal BO-3 Palaeolithic site. 1: side-scraper of large dimensions, 2-3: bifacial tools (1-2: siliceous pebble, 3: limnic silicite of Cserhát Mts.). //

10. ábra. Eszközök Szécsénke Berecz-oldal BO-3 paleolitikus lelőhelyről. 1: nagy méretű kaparó, 2-3: bifaciális eszközök (1-2: kovakavics, 3: cserháti limnoszilicit).

examples of radiolarite artefacts that could be, on technotypological grounds, related to the Jankovichian industry (Mester 2008-2009: 82). The list of finds from the Cserhát Mountains contained two fragments with bifacial working made of Transdanubian (Szentgál-type) radiolarite at Galgagyörk-Májóka-3 (Markó et al. 2002: 255). This list could be extended now with an unpublished side-scraper fragment made of radiolarite from Buják-Rózsás-tető. This hill is the origin of a tabular, layered form of hydro- or limnic quartzite of better quality containing only few and small fossils (Markó 2005: 53–54).

2.3. The Legénd-88 (LG-88) find concentration

Fig 1.12 is a small find concentration. Stray finds were found here on a dirt road, at close quarters, actually next to the valley-sole. These finds are 4 leaf-points, 1 side-scraper with damaged working edge made on a silex pebble slice and a flake of felsititic porphyry. The loessy cover of the hilltop is thick, neither a larger archaeological site nor evidence of a smaller ephemeral hunting station could be localized. A seemingly reasonable situation would be the hypotetically assumption that the culture-bearing layer was somehow damaged by the forestry turnover on the dirt road. But in this curious case, four out of six stray finds are leaf-points, which is unusually high ratio. Actually we have

absolutely no adequate geological explanation for this enigmatic phenomenon.

Basal fragment of a leaf-point made of local nummulitic chert. The tool has a narrow, elongated, symmetrical shape. Both the longitudinal and the cross section are biconvex. The edges are worked with WGK. On the whole, the shaping and the elaboration of this tool has rather a somewhat Micoquian-like character. Dimensions: 55×34×16 mm (Fig. 11.3).

Leaf-point made of local silex. The shape is approximately symmetrical to the longitudinal axis. Both longitudinal and cross sections are biconvex. The edges are worked with WGK. Dimensions: 62×36×13 mm (Fig. 12.1). In his paper dealing with the morphometrical analysis of the leaf-points of the Szeleta Cave, Zs. Mester defines 3 groups concerning of their length and width. Group 3 includes the smallest tools (length between 72 and 34 mm, width between 40 and 24 mm, and thickness between 12 and 8 mm). This group is characterized by a low length/width ratio, and the greatest width is found between the middle of the length and the lower third of the tools. The most interesting result of the conducted analysis is the identical data set between Group 3 and the bifacial leaf-points of the Jankovich Cave. The above described leaf-point fits well in the Group 3 (3B-type because of the pointed base) of Szeletian bifacial foliate tools (Mester 2010: 111; 2011: 25).

This tool with its unusual short and broad form (length/width ratio is 1,72) is a proper rarity in the Cserhát Mountains. There is only one vague morphological analogy at the relatively near site of Debercsény-Mogyorós attributed to the Szeletian industry (Markó 2009b: 157, Fig. 2.1). Further analogies can be found e.g. at Korlát-Ravaszlyuk (Simán 1999: 31, Table IV), at Jezeřany I (Oliva 1979: 62, Taf. III:4, IV:4), at Vedrovice V (Valoch 1993: 44, Abb.23: 4-5) and in the upper layer of Dzierźysław I. (Bluszcz *et al.* 1994: Fig. 6.2).

There are several pieces with similar morphological characteristics in the find horizon Ranis 2 of the Ilsenhöhle (Hülle 1977: 79, Taf. 21: 2, 52, Taf. 22: 2, 53, Taf. 23: 2, 55), in the Weinberghöhle caves at Mauern (Bohmers 1951: 55-56, Taf. 26: 2, 3; Zotz 1955: 97, Bild 46) or at Kösten (Zotz 1959: 51: 73, 52: 73-75). These sites are related to the Altmühlian (*Altmühlgruppe*) with blattspitzen of southern Germany.

Leaf-point made of C2E type grey-banded obsidian from the environs of Mád, Erdőbénye, Olasz-liszka. The shape is approximately symmetrical. Both the longitudinal and the cross section is biconvex. Dimensions: 46×(29)×7 mm (Fig. 12.2). Leaf-points made of obsidian are extremely rare.

- A broken piece is reported from the Szeleta Cave by Zs. Mester (Mester 2011: 37). Its cross section is biconvex. The edges are retouched with alternating retouching technique. Dimensions: (58)×(33)×(10) mm (Inv.N°: 53.4.25).
- Another broken piece was mentioned by K. Simán (Simán 1985) at Sajószentpéter-Nagykorcsolás in Micoquian-Bábonyian context. Its both faces are thinned but only partially retouched. Dimensions: 22×28×9 mm (Inv. N°: 82.8.55.).

In Micoquian-Bábonyian context there is an interesting surface find from Galgagyörk-Csonkás-hegy made of Carpathian 2T obsidian (Markó 2004). It is a base fragment intentionally broken down from the tool. The edges are worked with WGK. The surface is covered by thick dehidration cortex. Dimensions: (22)×(24)×(12) mm.

Basal fragment of a leaf-point made of local silex. The tool has a narrow, elongated, symmetrical shape. The longitudinal cross section is plano-convex, the cross section is biconvex. The edges are worked with WGK. Dimensions: 76×33×13 mm (Fig. 12.3).

2.4. The Kétbodony-Halyagos-hegy (HH) site

In the bushy area on the top of the Halyagos-hegy with an altitude of of about 375 m a.s.l. no archeological site could be localized, but due to the erosion on a steep dirt road leading to the top of the hill stray finds could be found. The collected assemblage consists of 459 pieces. The raw material composition is very colourful. In the raw material utilization the local limnic silicite dominates (52.72 %) but the ratio of the felsitic porphyry is very high too (30.94 %). Apart from these raw materials there are silex, quartzite, limnic silicite of Mátra Mountains origin, C1 and C2 type obsidian, erratic flint, jasper and unidentified raw materials. From felsitic porphyry as long distance raw material there are even tools. The great number of chunks, flakes and chips proves that intensive tool making and tool maintenance was practised on the site. Among the 13 tools, there are 2 end-scrapers, 1-1 leaf-point made of local limnic silicite and felsitic porphyry, 2 side-scrapers and 7 other worked pieces.

The shape of the leaf-point made of local limnic silicite is approximately symmetrical to the longitudinal axis. Both the longitudinal and the cross sections are plano-convex. The top-view is slightly deltoid. The edges are worked with WGK. Dimensions: 47×24×9 mm (Fig. 13.1).

The leaf-point made of felsitic pophyry is abandoned due to the fracture properties of the raw material. The ventral face is a natural cleavage surface along a diaclase. Because of the cleavage properties of the raw material and due to a large hinge fracture the tool could not have been finished. The shape is approximately symmetrical to the longitudinal axis. Both the longitudinal and the cross section are planoconvex. Dimensions: 54×23×10 mm (Fig. 13.2).

A double side-scraper made of felsitic porphyry. The convex left edge is retouched rough-and-ready with semi-Quina retouch. The right edge is rather straight, it is bifacially retouched. The rough-and-ready notch seems to be intentional. Dimensions: 47×24×9 mm (Fig. 13.3).

There is an unusual combination of a double side-scraper and a splintered piece (*pièce esquillée*) made of Mátra limnic silicite. Dimensions: 37×31×8 mm (Fig. 13.4).

The very heterogenous raw material composition and first of all the typological characteristics indicate that the assemblage consists the remains of probably more than one Palaeolithic industries. Among the other worked pieces there is a fragment of a backed bladelet characteristic for the Gravettian entity.

2.5. Legénd-Rovnya (LGR) site

2.5.1. Geographical location

The site is situated 3 km northwest of the village Legénd, on the northeastern fringe of the Romhányi Mountains, about 500 m from the 385.4 m high Rovnya Summit. The site is located on an approximately 250×100 meter relatively flat plateau. The relative height from the sole of the Halyagos Streamlet is about 60-70 m. South of the site one can find some "dead end valleys". The most important of them is the source of the Sápi Streamlet. Due to afforestation the site can not be collected anymore. The assemblage of the site was recently published in Hungarian language with a short English résumé (Péntek–Zandler 2013b) and there is an unpublished paper in English (Péntek 2015a).

2.5.2. Raw materials of the archaeological assemblage

The chipped stone assemblage contains 972 pieces. The most dominant raw material is local limnic silicite with 756 pieces (77.78 %). Two raw material assortments, silex and quartzite, should be regarded as local. The ratio of the silex with 166 pieces is 17.08 % in the total assemblage but it is significantly higher among the tools with 22 pieces, namely 47.83 %. The ratio of the 19 pieces quartzite in the total assemblage is 1.95 %. All other raw materials have an anecdotical role. The two long distance raw materials, felsitic porphyry and Carpathian 1 type obsidian are represented by 5-5 pieces (0.51 %). There are 13 pieces of Carpathian radiolarite (1.34 %) and 6 pieces of erratic flint (0.62 %).

2.5.3. Technology and typology

The Palaeolithic industry is a typical flake-industry, the laminarity is very low, there are only 2 Aurignacian-like retouched blades and two Gravettian-like backed bladelets. There are no signs of Levallois-debitage, the application of the bifacial technique can be observed only at the leaf-shaped tools.

In the assemblage collected from the surface there are 54 formal tools mostly made of limnic quarzite. The Palaeolithic and younger prehistoric stone tools were separated on strict techno-typological basis. We classified 46 tools belonging to the Palaeolithic industry. Among the Palaeolithic formal tools we distinguished 4 fundamental tool categories. The given percentages have only informative value since the number of the tools is less than 100.

There are altogether 16 pieces of flake *end-scrapers* (34.78 %). The blanks have generally a massive, slightly elongated, blade-like form. There is a raw material preference, 4 pieces were made of limnic quartzite, 1 piece of radiolarite and the rest of silex. Morphologically the end-scrapers are very variable, most of the pieces have a convex working edge. The Upper Palaeolithic end-scraper types are

represented by 6 rather atypical pieces, there are 5 pieces of carinated end-scrapers and one nosed end-scraper. However, on the whole, typologically end-scrapers make an Aurignacian-like impression. On Fig. 16.7 a carinated end-scraper made of siliceous pebble can be seen. One small sized subcircular end-scraper resembles the so called groszak (*Typ Heidenschmiede*, Bosinski 1967: 33) of the Micoquian industries. The lateral retouching is not so frequent, but it is a common phenomenon at the Moravian Szeletian sites e.g. at the recently excavated Želešice III (Škrdla *et al.* 2014: 92, Fig. 12:13, 98, Fig. 12: 13, 15, 16).

Ventral thinning of the proximal part and elimination of the bulb occur sometimes. These phenomena are well known at the Moravian or Bavarian Szeletian sites like Trboušany (Hladíková 2002: 78, Obr. 9: 3, 4, 7) and Zeitlarn (Schönweiss-Werner 1986: 10, Abb. 3: 8; Heinen-Beck 1997: 84, Abb. 7: 5, 6.) as well as in the Cserhát Mountains, for example at Galgagyörk-Csonkás-hegy (Markó *et al.* 2002: 249, Fig 2.1, 2.4) and Legénd-Káldy-tanya (Markó-Péntek 2003-2004: 169, Fig. 4.7).

On one occasion the direction of the detachment could not be determined unambiguously, that is why this piece can be classified perhaps rather as side-scraper. It has a very characteristic attribute typical for the Polish or German Micoquian industries (*Keilmessergruppe*), namely the so-called Prądnik-technique. It is present at some archaic Szeletian sites in Moravia as Jezeřany I. and II. (Oliva 1979: 48). We have another example in the Cserhát Mountains, the above mentioned bifacial knife from the KFH site.

The tool category of the *leaf-shaped tools* consists of 5 pieces (10.87 %). Three pieces were made of silex, 1-1 piece of limnic quartzite and of felsitic porphyry. Altogether 3 pieces could be interpreted as leaf-points. A common characteristic is the WGK. The 2 small sized leaf-points should be correlated to the nearby Szeletian site at KFH site, a greater but broken piece resembles the Micoquian-Bábonyien pieces of the Legénd-Káldy-tanya (Markó-Péntek 2003-2004: 168, Fig.3).

On **Fig. 14.1** a leaf-point made of felsitic porphyry can be seen. The shape is symmetrical. Both the longitudinal section and the cross section are plano-convex. The top-view is slightly rhomboid (trapezoid). The edges are worked with WGK. Dimensions: 49×22×8 mm. Another leaf-point made of local silex, has a near biconvex longitudinal and cross section. The piece has an unusual asymmetrical shape, the left edge is curved, the right edge is rather angular. The edges are worked with WGK. Dimensions: 47×27×9 mm (**Fig. 14.2**, **Fig. 16.1**). A leaf-point made of local silex, has a near biconvex longitudinal and cross section. The piece has a narrow, symmetrical, elongated form, which is present even in the Micoquian-Bábonyian industry (Zandler-Béres 2014: 76, Fig. 5). The edges are worked with WGK. Dimensions: (44)×24×10 mm (**Fig. 14.3**, **Fig. 16.3**).

There are 6 pieces (13.04 %) in the category of the *side-scrapers*. Two double side-scrapers were made of felsitic porphyry, one of them can be seen on **Fig. 16.2**. From the

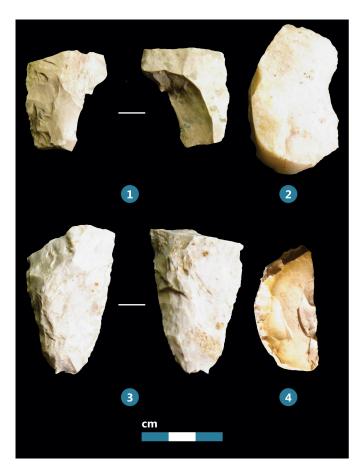


Figure 11. Selected tools from the Szécsénke Berecz-oldal BO-4 (1-2) and Legénd-#88 (3-4) Palaeolithic sites. 1: base fragment of a leafpoint, 2: notched tool, 3: side-scraper, the working edge is damaged; 4: basal fragment of a leaf-point (1: Carpathian radiolarite, 2: quartzite, 3: siliceous pebble slice, 4: nummulitic chert). //

11. ábra. Eszközök Szécsénke Berecz-oldal BO-4 (1-2) és Legénd-#88 (3-4) paleolitikus lelőhelyekről. 1: levélhegy bázistöredéke, 2: völgyelt eszköz, 3: roncsolt munkaélű kaparó; 4: levélhegy bázistöredéke (1: kárpáti radiolarit, 2: kvarcit, 3: kovakavics gerezd, 4: nummuliteszes kova).

2 simple side-scrapers with straight working edge, 1 piece was made of nummulitic chert, 1 piece of radiolarite. Two large pieces were made of quartzite. The one piece is a side-scraper or roughly elaborated denticulated tool on a massive *déjeté* flake. Only the approximately straight distal part of the right edge is grossly retouched, actually denticulated. Dimensions: 64×46×22 mm. The ventral face shows a typical pronounced bulb of percussion (Fig. 15.1). The other quartzite side-scraper is a natural backed tool (*racloir à dos naturel*) on a massive *déjeté* flake. The left edge forms the back, the right edge is rough-and-ready, but bifacially elaborated. Dimensions: 66×44×19 mm (Fig. 15.2).

The last tool category of *other tools* or *worked pieces* contains 19 pieces altogether (41.30 %). Of these tools only few pieces could be identified precisely, the most pieces are namely broken. It is worthy to emphasize the presence of two Aurignacian-like retouched blades (Fig. 16.4-5). One of the latter has an oblique distal end with two notches. The two backed bladelets seem to belong to the Upper Palaeolithic Gravettian culture. These finds should maybe correlated to the Gravettian site at Romhány-Diós (Simán 1993; Dobosi 2011), which lies about 8-10 km west from our site.

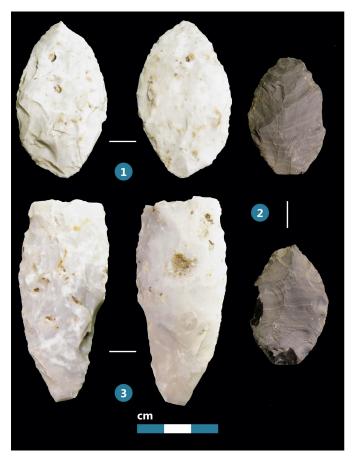


Figure 12. Selected tools from the Legénd-#88 Palaeolithic site. 1-3: leaf-points (1,3: siliceous pebble, 2: Carpathian C2E type grey-banded obsidian). //

12. ábra. Eszközök Legénd-#88 paleolitikus lelőhelyről. 1-3: levélhegyek (1,3: kovakavics, 2: kárpáti C2E típusú szürke sávos obszidián).

Unfortunately until now there are very scarce traces of the Upper Palaeolithic in the Middle and Western Cserhát Mountains. Most of the Gravettian sites can be found in the valley of the Galga River, for example at Püspökhatvan (Cs. Balogh–Dobosi 1995) and Csővár–Arany-hegy with unpublished archaeological material. The site at Erdőtarcsa-Daróci-hegy (Zandler 2008) yielded a typologically mixed material. The Upper Palaeolithic types seem to belonging rather to the Aurignacian. In the direct environs of Legénd village recently some small find concentrations have been found (Legénd-Hosszú-földek, Legénd-Remete) with very strong Upper Palaeolithic affiliation.

2.5.4. Discussion of the LGR site

The artefacts collected from the surface are not suitable for a more minute cultural classification, which is mainly due to the relatively few number of tools. We regard the Palaeolithic material of the site as inhomogeneous. A possible explanation for this fact could be the optimal topographical situation for hunting. Therefore the area was very attractive during prehistoric times. On the opposite side of the valley of the Halyagos Streamlet, on the Halyagos-hegy, about 750 m from the LGR site at an altitude of cca. 375 m a.s.l. there is the above mentioned HH site with unpublished material. It seems to be evident that these two sites had the same or very similar strategic importance as

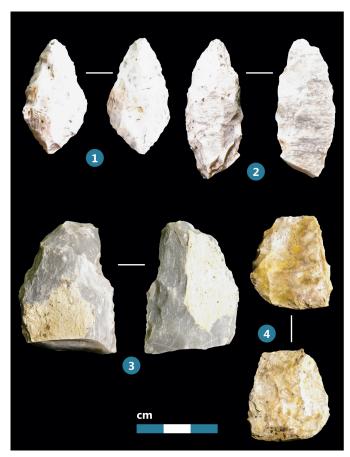


Figure 13. Selected tools from the Kétbodony-Halyagos-hegy (HH) Palaeolithic site. 1: leaf-point, 2: leaf-point, it is abandoned due to the fracture properties of the raw material, 3: double side-scraper, 4: splintered piece (pièce esquillée) (1: limnic silicite of Cserhát Mts., 2-3: felsitic pophyry, 4: limnic silicite of Mátra Mts.). //

13. ábra. Eszközök Kétbodony-Halyagos-hegy (HH) paleolitikus lelőhelyről. 1: levélhegy, 2: levélhegy, melyet az anyagban lévő repedés miatt félbehagytak, 3: kettős kaparó, 4: pikkelyretusú darab (*pièce esquillée*) (1: cserháti limnoszilicit, 2-3: kvarcporfír, 4: mátrai limnoszilicit).

hunting stations ("high-stands" or "watchposts") in controlling the movement of game animals in the valley.

Among the Palaeolithic tools there are both tools which are characteristic for the Micoquian-Bábonyian and that ones which are characteristic for the Szeletian industry and there are some more or less typical Upper Palaeolithic (Aurignacian and/or Gravettian) types too.

3. Conclusion

3.1. Raw material utilization of the affected sites

The main characteristics can be summarized as follows (Table 1, Table 2):

- The most dominant raw material is the local limnic silicite, probably from Galgagyörk and Püspökhatvan (Cs. Balogh–Dobosi 1995).
- Utilization of other local raw materials in the region such as silex and quartzite is as intensive as at the KFH site. The ratio of the used silex is extraordinary high on the BO-2E (32.3 % of the total).
- In contrast to the KFH site the occurence of the limnic

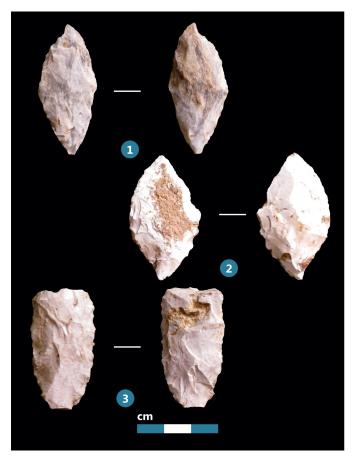


Figure 14. Selected tools from the Legénd-Rovnya (LGR) Palaeolithic site. 1-3: leaf-points (1: felsitic pophyry, 2: limnic silicite of Cserhát Mts., 3: siliceous pebble). //

14. ábra. Eszközök Legénd-Rovnya (LGR) paleolitikus lelőhelyről. 1-3: levélhegyek (1: kvarcporfír, 2: cserháti limnoszilicit, 3: kovakavics).

silicite of the Mátra Mountains can be observed as well. It is markedly high on the BO-2W (16.54 %). Strikingly few debris of those limnic silicite could be found, because of the distance to the raw material sources, most artefacts were imported either as finished tools or as blanks for tool production.

- There are some exotic regional materials such as jasper, lydite of uncertain origin. They are probably from the Mátra Mountains but in small amounts they can be found even in some gravel beds in the Cserhát Mountains.
- All pieces of the Carpathian radiolarite of uncertain provenance belong to the dark brown colour variant but without the greenish marbly pattern characteristic of the White Carpathians (Vlára Valley). This raw material is represented mostly by tools, no or very few debitage can be found. The ratio of the tools made of radiolarite is in general somewhat higher as at the KFH site.
- In contrast to KFH,the role of the long distance felsitic porphyry raw material seems to be subordinated at the other sites, there are mainly tools made of it. The only exception with a ratio of 30.94 % is the HH (Halyagoshegy) site, where besides tools, considerable amount of chunks and debitage, even small retouching chips can be found, proving local tool making and resharpening. In connection with the side-scrapers of small dimensions made of felsitic porphyry at the KFH site it was above expected that there was a saving housekeeping practised. That is namely the important factor, which should be stressed, the need to "maximize the number of flakes"

(or edges) per core at the expense of flake size" in oder to save raw material (Kuhn 1995: 33).

Other long distance raw materials such as Northern erratic flint are represented only sporadically with a few pieces.

3.2. Techno-typological remarks

The main characteristics can be summarized hereinafter.

- All sites show a flake-industry character but in contrast to the KFH site a little bit higher laminarity can be observed elsewhere, and there are some blade cores (abandoned and exhausted) too. However, the ratio of blades is nowhere higher than 3.11 % (at BO-2E site).
- Among the tools the end-scrapers are the most frequent.
 They have various morphology but the evidently Upper Palaeolithic types are lacking. There is generally a definitive raw material preference, the mostly pieces are made of local limnic silicite and silex.
- The lateral retouching of the end-scrapers has a very frequent occurrence, but the ventral thinning and the elimination of the bulb is relatively rare compared to the KFH site.
- There are relatively less side-scrapers, the most pieces are made of felsitic porphyry and silex, but there are even rough-and-ready made pieces made of quartzite on the LGR site.
- The shape and the dimensions of the leaf-points are various. There are both wide and narrow leaf form with tipped base, and there are some pieces with rounded base again. There are narrow, elongated points which occur both in the Micoquian-Bábonyian as well in the Szeletian industry. The pieces with slightly deltoid or rhomboid top-view are present too.
- The longitudinal section is generally biconvex. The most pieces have plano-convex or biconvex cross sections. A common technological characteristic is the so-called WGK (wechselseitig gleichgerichtete Kantenbearbeitung) which is a typical attribute of the Micoquian-Bábonyien industry and is not an alien phenomenon in the Early Szeletian industry.
- In contrast to the KFH site apart from the the leafpoints, other types of bifacial tools occur only sporadically or even fail.

We regarded the Kis-Ferenc-hegy site at Szécsénke as a relatively early, open-air Szeletian site.

If we consider the differences between the KFH site and the sites in the discussed site complex as the signs of some kind of development, we should attribute these sites culturally related to the KFH site but possibly belonging to a younger or developed phase of the Szeletian or of a Szeletian-like industry with leaf-points. A detailed techno-typological comparison with the collection from the Hont-Csitár site, as benchmark, would be more than desired.

3.3. Some thoughts about settlement dynamics and landscape use pattern

According to the recent cognitions, based only on the intense surface collections, it would be a very hazardous trial to present an interpretation on the above reviewed sites and on their relationship.

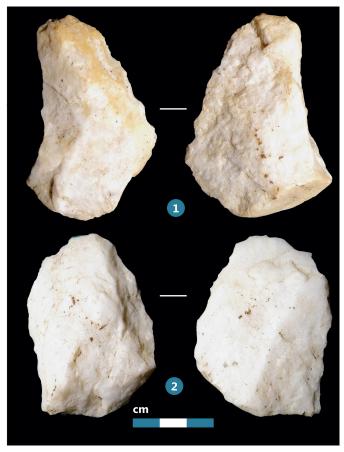


Figure 15. Selected quartzite tools from the Legénd-Rovnya (LGR) Palaeolithic site. 1: side-scraper or roughly elaborated denticulated tool; 2: side-scraper with a natural back (*racloir à dos naturel*). //

15. ábra. Eszközök Legénd-Rovnya (LGR) paleolitikus lelőhelyről. 1: kaparó, vagy durván kiképzett fogazott eszköz; 2: természetes hátú kaparó (*racloir à dos naturel*).

As M. Bolus stated in his paper (Bolus 2004: 204) the spectrum of the variables providing at least limited informations concerning the settlement system is wide. It includes not only the regional distribution of sites, the landscape use, raw material procurement, but the spatial organization and functional differentation of the sites as well.

Several Middle Palaeolithic settlement types concerning the intensity and duration of occupations and the number of activities carried out on the site, are known from the Crimea (Marks-Chabai 2001: 191-195; Chabai-Uthmeier 2006; Bataille 2010; 2012). Ephemeral sites (both kill-butchering loci and camps) have a significant trait in the raw material procurement, namely the utilization of mostly imported resources. That is, the occurence of local (originating less than 5 km from the site) raw material assortments is very rare and there are only scattered data about on-site core reduction or tool making. The tool composition is narrow and related mainly to the "kill-butchery" activity. These occupations, mainly the kill-butchering loci, represent one of the most ephemeral, limited-activity site types which is archaeologically visible (Marks-Chabai 2001: 191). However, very striking is the investigation on the two horizons of the deeply stratified Middle Palaeolithic site Kabazi II, belonging to the Crimean Micoquian (Bataille 2012).

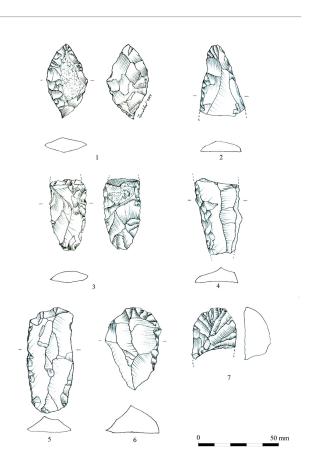


Figure 16. Selected tools from the Legénd-Rovnya (LGR) Palaeolithic site. 1, 3: leaf-points, 2: double side-scraper, 4: retouched blade, 5: retouched, truncated blade, 6: end-scraper made on flake, 7: carinated end-scraper (1, 4-6: limnic silicite of Cserhát Mts., 2: felsitic porphyry, 3,7: siliceous pebble) [drawn by K. Zandler]. //

16. ábra. Eszközök Legénd-Rovnya (LGR) paleolitikus lelőhelyről. 1, 3: levélhegyek, 2: kettős kaparó, 4: retusált penge, 5:retusált és csonkított penge, 6: szilánkvakaró, 7: orros vakaró (1, 4-6: cserháti limnoszilicit, 2: kvarcporfír, 3,7: kovakavics) [rajz: Zandler K.].

To sum up, "It is obvious that the investigated Micoquian levels exhibit an ephemeral character. Levels III/2 and III/1 represent butchering stations of very short duration. Only few stone artifacts belong to single occupations. The main activities focus on the provisioning of camp sites with game while the lithic material can be interpreted as by-products for meat processing." (Bataille 2012: 204).

In short-term camps the blanks and tools arriving at the site from some distance occur with the local raw material together. Lithic raw material economy varies according to distance from a raw material source. On the surface activity or functionality zones or specific tool distribution patterns or densities could be observed. These camps seem to reflect a somewhat larger range of activities and, perhaps, a somewhat greater duration of occupation. The tool spectrum according to the activities could be also somewhat broader.

In the considerably amount of literature dealing with settlement dynamics, settlemens structure etc. there are some quasi synonym denominations for the term "base camp", which was occupied for a considerable period, e.g. for a

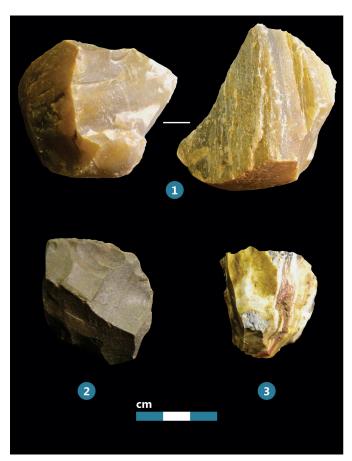


Figure 17. 1: flake core from the BO-1 site; 2-3: selected flake cores from the BO-2E site (1: quartzite, 2: orthoquartzite, 3: limnic silicite of Mátra Mts.). //

17. ábra. 1: szilánkmagkő a BO-1 lelőhelyről; 2-3: szilánkmagkő példák a BO-2E lelőhelyről (1: kvarcit, 2: ortokvarcit, 3: mátrai limnoszilicit).

number of months. A. Verpoorte (Verpoorte 2006, after Kelly) uses the term "central place", at T. Hopkinson we find its equivalent as "center of social action" (Hopkinson 2006: 229). In the assemblages of the "base camps" the tool making from the local raw material seem to be extended with the processing of long distance raw materials. Because of the greater permanency of residence, a larger number of activities took place over time, resulting in greater number and variability of artefacts, the tool composition is much more rich and various.

Another classification was proposed especially in connection with the sites of the Blattspitzen complex in Central Europe by M. Bolus (Bolus 2004). In his paper he summarizes the archaeological evidence for this technocomplex with regard to the spatial organization and functional interpretation of the sites and on that base he identifies three site types. The first type includes large open-air sites, which are often situated near raw material sources. In most cases these sites are known for extensive surface scatters, sometimes with several smaller find concentrations, which are separated from each other by gaps, areas without lithic finds. This type of sites, like Vedrovice V in Moravia (Czech republic) or Zeitlarn in Bavaria was repeatedly visited over a long period of time and should be interpreted as palimpsests. An important argument in summing up the features of these sites that the raw material of the artefacts indicates

a well-aimed exploitation of the nearby raw material sources, the leaf-points seem to have been made on the spot. An another aspect is the high amount of debris at the site which should reflect the remains of knapping activities from several settlement occupation events.

The second type of sites is defined as cave sites with relatively few archaeological material, containing at times more than one Blattspitzen horizons. The density of finds is higher but still relatively low compared to the rich open-air sites of the first group. These sites have a less clear or uncertain function, the small number of artefacts and the sometimes limited toolkit do not indicate long-term stays. It is more plausible that these sites were repeatedly used for short-term stays, most probably related to hunting activities. In general there is no evidence for leaf-point production.

The third group composed both of open-air and cave sites. These are characterized with small or very small Blatt-spitzen assemblages. It is always questionable to put a single stray find of a leaf-point into this category without further investigations of the find spot. The majority of the sites of this third group could be interpereted as remains of short-term hunting stays.

We must proceed by the process of elimination to try to fit in the sites at Szécsénke in some classification scheme. The little scattered find concentrations like BO-4 an LG-88 should be interpreted most probably as ephemeral sites, perhaps hunting stations *sensu* Marks and Chabai (2001) or belonging to the third group *sensu* Bolus (2004).

Concerning the raw material composition, exclusive of the above mentioned sites, there are seemingly four different distribution schemas:

- KFH site: a relatively balanced distribution between the local raw materials, limnic silicite and siliceous pebbles and the long distance raw material, felsitic porphyry, 42–17-38 % respectively.
- HH site: a relatively balanced distribution between the local raw materials, limnic silicite and siliceous pebbles and the long distance raw material, felsitic porphyry, 54-6-31 % respectively. Unpronounced presence of other regional and long distance raw materials.
- BO-1, BO-3, LGR: absolute dominance of the local raw materials, mostly limnic silicite. Unpronounced presence of other regional and long distance raw materials.
- BO-2E, BO-2W: absolute dominance of the local raw materials, the ratio between limnic silicite and siliceous pebbles is more balanced. Unpronounced presence of other regional and long distance raw materials.

Based on the aforementioned assemblages, no sites should be either interpreted as ephemeral sites or as base camp sensu Marks and Chabai (2001). They should belong to the provisional camps but alone the surface collection would never prove the existence of surface activity or functionality zones. It was mentioned above that the BO-1 site is possibly composed from two smaller find concentrations. The site can be regarded most probably as the remains of two short-term stays and should be put in the third group sensu Bolus (2004).

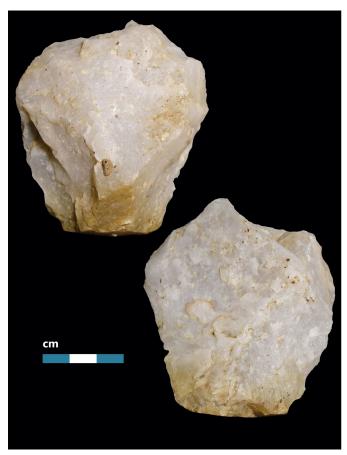


Figure 18. Quartzite flake core from the BO-3 Palaeolithic site. // **18. ábra.** Kvarcit szilánkmagkő a BO-3 paleolitikus lelőhelyről.

During the surface collection not even on the richest site, KFH could be separate find or tool concentrations observed. There is no indication for specific activity or functionality zones, hence it does not fulfill the defining criteria for a site being base camp. On the contrary, the artefact distribution is rather balanced overall. It seems to be very life-like to imagine a short-term stay of a prehistoric group of 5-8 families, maybe 30-40 people on an area of 150-250×100-200 m in order to hunting and stocking their supply. This statement should be valid actually for all the sites KFH, BO-1, BO-2E, BO-2W, BO-3, HH, LGR, and so they can be regarded as belonging to the first group *sensu* Bolus (2004). However these sites can be interpreted likely as palimpsests of several short-term stays.

Hopefully, due to further surface collection activities, the intrasite relations could be cleared in some degree too. So, for example the connection or relation between the BO-2E and BO-2W sites is not clear. It is thinkable that as a matter of fact, there is only one site. An other question to be answered is the function of the HH site and its relation to the opposing site LGR, lying on the southern side of the Halyagos Streamlet. Aside from the felsitic porphyry, the two sites have a more or less similar raw material composition. On techno-typological grounds both site seem to yielded a mixed material. Most probably we should regard the assemblage of the HH site partly, taking notice of the high amount of felsitic porphyry, being in connection or relation with the KFH site.

Szécsénke site complex		RM1 Lo- cal LS		RM	12 Loca	al		RM	3 Mesc	olocal	RM4	RN Extra		RM6 Extra- local	RM7	RM8	
Lithic artefacts / Raw material		Cserhát limnic silicite	Andesite	Nummulitic chert	Quartz	Quartzite	Siliceous pebble	Jasper	Lydite	Mátra limnic silicite	Radiolarite	Obsidian C1	Obsidian C2	Felsitic porphyry	Erratic flint	Unidentifiable	Total <i>n </i> %
Szécsénke-Kis- Ferenc-hegy	n	460	0	0	0	9	185	0	0	0	18	0	0	412	0	0	1084
	%	42,44	0,00	0,00	0,00	0,83	17,07	0,00	0,00	0,00	1,66	0,00	0,00	38,01	0,00	0,00	100,00
Szécsénke-BO-1	n	81	0	1	0	6	20	0	0	9	0	0	0	4	1	0	122
	%	66,39	0,00	0,82	0,00	4,92	16,39	0,00	0,00	7,38	0,00	0,00	0,00	3,28	0,82	0,00	100,00
Szécsénke-BO-2E	n	84	0	3	0	4	52	0	0	8	7	1	0	0	1	1	161
	%	52,17	0,00	1,86	0,00	2,48	32,30	0,00	0,00	4,97	4,35	0,62	0,00	0,00	0,62	0,62	100,00
Szécsénke-BO-2W	n	148	0	5	0	9	34	0	0	43	7	0	1	15	0	0	262
	%	56,49	0,00	1,91	0,00	3,44	12,98	0,00	0,00	16,41	2,67	0,00	0,38	5,73	0,00	0,00	100,00
Szécsénke-BO-3	n	434	3	8	1	25	78	0	0	30	6	0	0	48	0	0	633
	%	68,56	0,47	1,26	0,16	3,95	12,32	0,00	0,00	4,74	0,95	0,00	0,00	7,58	0,00	0,00	100,00
Kétbodony- Halyagos-hegy	n	242	0	0	0	1	26	1	0	18	16	1	2	142	3	7	459
	%	52,72	0,00	0,00	0,00	0,22	5,66	0,22	0,00	3,92	3,49	0,22	0,44	30,94	0,65	1,53	100,00
Legénd-Rovnya	n	756	2	0	0	19	166	0	0	0	13	5	0	5	6	0	972
	%	77,78	0,21	0,00	0,00	1,95	17,08	0,00	0,00	0,00	1,34	0,51	0,00	0,51	0,62	0,00	100,00

Table 1. Szécsénke site complex, distribution of artefacts according to raw materials. // **1. táblázat.** Szécsénke lelőhelykomplexum, leletek megoszlása nyersanyag szerint.

A. Markó made a very interesting statement about the distribution of the felsitic porphyry is his paper dealing with the small Szeletian-like assemblage with leaf-points of Debercsény-Mogyorós (Markó 2009b). The spread of this raw material reaches its maximum in the Szeletian period compared with the Micoquian-Bábonyian period, and at the same time the intensity of the utilization eases down.

This maximum spread is about 340 km in the cases of Ondratice I. and Ořechow II. sites in Moravia. There is a leaf-point both in Ořechow II. (Čermáková 1993: 9, Obr. 1:5; Valoch 2000:292) and in Ondratice I. (Valoch 1987: 266; Valoch 2000: 292) made of felsitic porphyry. The above statement should have a partial validity. The decrease or

even the lack of felsitic porphyry could be observed at the Legénd-Rovnya (LGR) site (Péntek–Zandler 2013b) as well as at the Buják-Szente site (Péntek–Zandler 2014). That should be the case at the other above discussed sites at Szécsénke too, exclusive of the KFH and HH sites, under the presumption these two latter sites are belonging to the earlier phase of the Szeletian. A plausible explanation for the decrease of the amount of the felsitic porphyry should be the assumption, that in the younger, developed phase of the Szeletian either it comes through or sustains a kind of "depreciation" or the outcrops were eventually not available. Unfortunately we do not even know whether the decrease was a gradual process, or a sudden, abrupt event.

Szécsénke site complex		RM1 Lo- cal LS		RM	12 Loca	al		RM	3 Mesc	olocal	RM4		⁄15 Ilocal	RM6 Extra- local	RM7	RM8	
Tools / Raw material		Cserhát limnic silicite	Andesite	Nummulitic chert	Quartz	Quartzite	Siliceous pebble	Jasper	Lydite	Mátra limnic silicite	Radiolarite	Obsidian C1	Obsidian C2	Felsitic porphyry	Erratic flint	Unidentifiable	Total <i>n </i> %
Szécsénke-Kis- Ferenc-hegy	n	21	0	0	0	3	37	0	0	0	5	0	0	53	0	0	119
	%	17,65	0,00	0,00	0,00	2,52	31,09	0,00	0,00	0,00	4,20	0,00	0,00	44,54	0,00	0,00	100,00
Szécsénke-BO-1	n	0	0	0	0	0	3	0	0	3	0	0	0	2	0	0	8
	%	0,00	0,00	0,00	0,00	0,00	37,50	0,00	0,00	37,50	0,00	0,00	0,00	25,00	0,00	0,00	100,00
Szécsénke-BO-2E	n	6	0	1	0	1	4	0	0	0	1	0	0	0	0	1	14
	%	42,86	0,00	7,14	0,00	7,14	28,57	0,00	0,00	0,00	7,14	0,00	0,00	0,00	0,00	7,14	100,00
Szécsénke-BO-2W	n	9	0	0	0	0	7	0	0	4	1	0	0	1	0	0	22
	%	40,91	0,00	0,00	0,00	0,00	31,82	0,00	0,00	18,18	4,55	0,00	0,00	4,55	0,00	0,00	100,00
Szécsénke-BO-3	n	8	0	0	1	0	14	0	0	2	3	0	0	3	0	0	31
	%	25,81	0,00	0,00	3,23	0,00	45,16	0,00	0,00	6,45	9,68	0,00	0,00	9,68	0,00	0,00	100,00
Kétbodony- Halyagos-hegy	n	2	0	0	0	0	0	0	0	3	1	0	0	4	0	3	13
	%	15,38	0,00	0,00	0,00	0,00	0,00	0,00	0,00	23,08	7,69	0,00	0,00	30,77	0,00	23,08	100,00
Legénd-Rovnya	n	15	0	0	0	2	22	0	0	0	4	0	0	3	0	0	46
	%	32,61	0,00	0,00	0,00	4,35	47,83	0,00	0,00	0,00	8,70	0,00	0,00	6,52	0,00	0,00	100,00

Table 2. Szécsénke site complex, distribution of tools according to raw materials. // **2. táblázat.** Szécsénke lelőhelykomplexum, eszközök megoszlása nyersanyag szerint.

Beside the fact that the typological characteristics of the tools originating from the KFH site indicate the inherence to the Early Szeletian, it can be stated that these people had a substantial knowledge about the capacity of the region, among other thing about the local raw material resources. That is, for these people the stay at the KFH site was for sure not the very first time in the Cserhát Mountains. Taking into account the high amount of felsitic porphyry at several Late Middle Palaeolithic and Middle to Upper Palaeolithic transitional sites in the Cserhát Mountains it should be obviously assumed that a kind of "circulating settlement system" could have been existed here (Marks-Chabai 2001: 197 ff. after Mortensen 1972) based on the regular commute between the Bükk and the Cserhát Mountains.

Binford (Binford 1980: 5) made an essential distinction between a "foraging strategy" and a "logistic strategy". The main difference is how human groups move through landscape to acquire the necessary resources. With the "foraging strategy" people move to sources of nutrition ("circulating systems" sensu Mortensen 1972). With "logistical strategies" group members bring resources to the group's residential location ("radiating system" sensu Mortensen 1972).

In a "circulating system" a band of foragers moves through the landscape according to seasonal cycles and establishes campsites near to food resources. All incoming activities were done within such campsites, that is each settlement represents the range of activities carried out by the group during a short period of time. Each site could be regarded as self-sufficient. The "radiating settlement system" is also characterized by the existence of a central campsite (the focus of habitation) which is supplied by a set of action specific stations ("locations", Binford 1980: 9; "activity-specific sites", Marks-Chabai 2001; Bernbeck 1997). These action specific stations could be correlated to the so-called "provisioning stations", stations for resource procurement, by G. Bataille (Bataille 2010: 69).

Unfortunately such long-term residential "base camps" could not be attested neither in the Bükk Mountains nor elsewhere at the southern foot of the Mátra Mountains, that is, the existence of a "radiating settlement system" could be excluded. In the early phase of the Szeletian, the regular wandering from the Bükk Mountains to the Cserhát Mountains must have been a "Getting from A to B" event. And it must have been a relatively rapid-flowing, insinuating action because in the intervening areas only very limited traces, that is only a little amount of felsitic porphyry, of this wandering could be found. In this early phase the regional raw material assortments from the Mátra Mountains are absolutely lacking. Some expansion or a further migration during the developing of the Szeletian industry in the direction of the Mátra Mountains should be thinkable. Weniger (Weniger 1991: 84) denotes movements within a local context area as micro moves, the relocation of a camp site into another local context area ("Nutzungsareal") as macro moves. In a case of such "macro move", it could have been not impossible the unavailability or limited availability of the felsitic porphyry. And from that time the increased occurence of the regional raw materials originating from the Mátra Mountains at the sites in the Cserhát Mountains which belong to this younger, developed phase of the Szeletian, is not surprising at all. This hypotethical model about felsitic porphyry exploitation of the Szeletian industry could not be applied to the Micoquian-Bábonyian industry. In the above described assemblage of Legénd-Káldy-tanya raw material from the Mátra Mountain region is abundant. It is unknown how and when they get in touch with the raw materials of the Mátra Mountains.

In connection with the recurrent occupation of the Late Middle Palaeolithic site Kabazi II in Crimea, G. Bataille remarked that, "the high share of local raw material in connection with only few workpieces imported as single pieces emphasise that people already were present in the core region" (Bataille 2010: 70). The dominance of local raw material, such as limnic silicite, siliceous pebbles, nummulitic chert and quartzite and the joint occurence with imported tools could be observed at some sites at Szécsénke. At the BO-1 site for example there is a little assemblage containing 110 artefacts, the local raw materials dominate (limnic silicite with 70.91 %, siliceous pebble with 14.55 %), there are very few or no debris of import raw materials. From the 8 tools there are 4 pieces made of local silex, 2-2 pieces are made of limnic silicite stemming from the Mátra Mountains and from felsitic porphyry.

In connection with the "G-Komplex" of Sesselfelsgrotte J. Richter (Richter 1997: 262; Richter 2001: 209 ff.) wrote that

occupation cycles start with small assemblages of broad spectrum raw material procurement. He denotes these small assemblages as "Initialinventare". This fact might mark the arrival of a given group in one region where never had been before, coming from a remote one, a so-called macro move sensu Weniger (Weniger 1991). Dispersed and heterogenous raw materials will be used. The occupation cycles end with mostly larger assemblages of more specialized raw material procurement. Occupations marked by the utilization of few different and primarily local raw material sources will be called as "Konsekutivinventare", since groups already dwell for a longer period of time in a given region. Initialinventare might originate from the beginning reconnaissance and exploitation of a region whereas Konsekutivinventare document a deeper knowledge of resources and might arise from a time when people had already been present in the region for weeks or months.

Taking into consideration the above mentioned aspects of the discussed site complex at Szécsénke, there is an apparently contradictionary situation. On the basis of the techno-typological features, the KFH site seem to belonging the earlier phase, the other sites, apart from the HH site, with its most probably inhomogeneous archaeological material, are belonging to a younger, developed phase of the Szeletian industry. Hence, a genetic or diachronic developmental sequence could be established. But taking into account the raw material composition, there is a somewhat reversed hierarchy among the sites. The collection from the KFH site seems to represent a consecutive assemblage with a wellbalanced steady raw material composition which document a deeper knowledge of resources. This knowledge might arise from the time when people had already been in the region. At the same time, all the other collections with both regional raw materials from the Mátra Mountains as with long distance raw materials represent initial assemblages.

This and other kinds of seemingly contradictory problems would be cleared only due to excavations or at least test sondages.

Acknowledgements: I would like to express my gratitude to Zsolt Mester and Attila Király for their technical advices.

References

Baales, M. 1999. Economy and Seasonality in the Ahrensburgian. In: Kozłowski, S. K., Gruba, J., Zaliznyak, H. H. (Hrsg.): *Tanged points cultures in Europe. Kolloquium Lublin 1993.* Lubelskie materialy archeologiczne 13. Lublin, 64–75.

Baang-Andersen, S. 2008. Prehistoric reindeer hunting in the southern Norwegian highlands. In: Grimaldi, S., Perrin, T. (eds.) Mountain environments in prehistoric Europe: settlement and mobility strategies from the Palaeolithic to the Early Bronze Age. Proceedings of the XVth World Congress (Lisbon, 4-9 September 2006) Oxford: Archaeopress, 63-70.

Bataille, G. 2010. Recurrent occupations of the Late Middle Palaeolithic Station Kabazi II, Unit II, Level 8 (Crimea, Ukraine) - Seasonal adaption, procurement and processing of resources. *Quartär* 57: 43–77.

- Bataille, G. 2012. Stones and Bones. The Reconstruction of Occupational Palimpsests in the Late Middle Palaeolithic of Crimea (Ukraine). In: Cascalheira, J., Gonçalves, C. (eds.) *Actas das IV Jornadas de Jovens em Investigação Arqueológica JIA 2011(2) Promontoria Monográfica 16*, Faro, 201–209.
- Bernbeck, R. 1997. Theorien in der Archaologie. Tübingen Basel 1997
- Biró, K. T. 1984. Őskőkori és őskori pattintott kőeszközeink nyersanyagának forrásai – Sources of Lithic Raw Materials for Chipped Implements in Hungary. *Archaeológiai Értesítő* 111: 42–52.
- Biró, K. T., 1986. The raw material stock for chipped stone artefacts in the Northern Mid-Mountains Tertiary in Hungary. In: Biró, K. T. (ed.), Papers forthe 1st International Conference on Prehistoric Flint Mining and Lithic Raw Material Identification in the Carpathian Basin, Budapest-Sümeg 1986. Budapest: Magyar Nemzeti Múzeum, 183–195
- Biró, K. T., Markó, A., Kasztovszky, Zs. 2005. 'Red' obsidian in the Hungarian Palaeolithic characterisation studies by PGAA. *Praehistoria* 6: 109–140.
- Bluszcz, A., Kozłowski, J. K., Foltyn, E. 1994. New Sequence of EUP Leaf Point Industries in Southern Poland. *Préhistoire Européenne* 6: 197–222. https://doi.org/10.1016/0009-2614(94)00402-1
- Bohmers, A., 1951. Die Höhlen von Mauern. Teil I. Kulturgeschichte der altsteinzeitlichen Besiedlung. *Palaeohistoria* 1: 1–107.
- Bolus, M. 2004. Settlement analysis of sites of the Blattspitzen complex in Central Europe. In: Conard, N. (ed.) Settlement Dynamics of the Middle Paleolithic and Middle Stone Age. Vol. II. Tübingen: Kerns Verlag, 201–226.
- Bosinski, G. 1967. Die mittelpaläolitische Funde im Westlichen Mitteleuropa. Köln-Graz: Böhlau-Verlag
- Bosinski, G. 2000-2001. El Paleolítico Medio en Europa Central. *Zephyrus* 53-54: 79-142.
- Burch, E. S. 1972. The Caribou/Wild Reindeer as a human resource. *American Antiquity* 37: 339–368. https://doi.org/10.2307/278435
- Chabai, V. P., Uthmeier, T. 2006. Settlement Systems in the Crimean Middle Palaeolithic. In: Chabai, V. P., Richter, J., Uthmeier, T. (eds.) *Kabazi II: The 70 000 Years since the Last Interglacial*. Simferopol Cologne: Shlyak, 297–359.
- Cheben, I., Cheben, M. 2010. Research on radiolarites of the White Carpathian Klippen Belt. *Slovenská Archeológia* 58(1): 13–52.
- Chmielewski, W. 1961. *La civilisation de Jerzmanowice. Wrocław-Warszawa-Kraków.* Instytut Historii Kultury Materialnej Polskej Akademii Nauk
- Conard, N. J., Fischer, B., 2000. Are there Recognizable Cultural Entities in the German Middle Palaeolithic? In: Ronen, A., Weinstein-Evron, M. (eds.), *Towards Modern Humans: Yabrudian and Micoquian, 400-50 kyears ago*. BAR International Series 850, Oxford, pp. 7–24.
- Csongrádi-Balogh, É., Dobosi, V. 1995. Paleolithic settlement traces near Püspökhatvan. *Folia Archaeologica* 44: 37–59.
- Čermáková (Nerudová), Z. 1993. Listovité hroty z lokality Ořechov II. Sborník prací Filozofické fakulty Brněnské Univerzity E 38: 7-14.
- Derndarsky, M., 2001. Die Forschungen in und zu der Gudenushöhle.
 In: Daim, F., Kühtreiber, Th. (Hrsg.), Sinn & Sein. Burg & Mensch,
 Katalog der Niederösterreichischen Landesausstellung 2001.
 Katalog des Niederösterreichischen Landesmuseums, Neue Folge
 Nr. 434. St. Pölten: Niederösterreichisches Landesmuseum,
 224-226.
- Dobosi, V. T. 1978. A pattintott kőeszközök nyersanyagáról Über das Rohmaterial der retuschierten Steingeräte. *Folia Archaeologica* 29: 7–19.

- Dobosi, V. T. 2011. Őskőkori lelőhelyek Romhány környékén. (Gyombola Gábor gyűjtése). Folia Archaeologica 55: 9–23.
- Flas, D. 2006. La transition du Paléolithique moyen au supérieur dans la plaine septentrionale de l'Europe. Les problematiques du Lincombien-Ranisien-Jerzmanowicien. Thèse de doctorat soutenue le 25 août 2006 à l'université de Liège.
- Flas, D. 2011. The Middle to Upper Paleolithic transition in Northern Europe: the Lincombian-Ranisian-Jerzmanowician and the issue of acculturation of the last Neanderthals. *World Archaeology* 43(4): 605–627. https://doi.org/10.1080/00438243.2011.624725
- Gábori Csánk, V. 1993. *Le Jankovichien. Une civilisation paléolithique en Hongrie.* E.R.A.U.L. 53, Liège.
- Gyalog, L., Budai, T. 2002. Javaslatok Magyarország földtani képződményeinek litosztratigráfiai tagolására. Proposal for new lithosratigraphic units of Hungary. *A Magyar Állami Földtani Intézet Évi Jelentése* 2002, 195–232.
- Hámor, G. 1985. A Nógrád-cserháti kutatási terület földtani viszonyai. The geology of the Nógrád-Cserhát area. Geologica hungarica, Series geologica Tomus 22, Budapest
- Heinen, M., Beck, D. 1997. Ausgrabungen auf dem Szeletien-Fundplatz Zeitlarn, Lkr. Regensburg. *Beiträge zur Archäologie in der Oberpfalz* 1: 71-88.
- Hladíková, L. 2002. Szeletian chipped industry from Trboušany I. Časopis Moravského Musea 87: 57–80
- Hopkinson, T. 2004. Leaf points, landscapes and environment change in the European Late Middle Palaeolithic. In: Conard, N. (ed.), Settlement Dynamics of the Middle Paleolithic and Middle Stone Age. Vol. II. Tübingen: Kerns Verlag, 227–258
- Hülle, W. M. 1977. Die Ilsenhöhle unter Burg Ranis/Thüringen. Eine paläolithische Jägerstation. Stuttgart, Gustav Fischer Verlag
- Jennings, T. A. 2011. Experimental production of bending and radial flake fractures and implications fro lithic technologies. *Journal of Archaeological Science* 30: 1–8.
- Jöris, O. 2001. Der spätmittelpaläolithische Fundplatz Buhlen (Grabungen 1966-69) – Stratigraphie, Steinartefakte und Fauna des Oberen Fundplatzes. Bonn, Dr. Rudolf Habelt GmbH
- Kaminská, Ľ. 2001. Die Nutzung von Steinrohmaterialien im Paläolithikum der Slowakei. *Quartär* 51/52: 81–106.
- Kaminská, Ľ. 2013. Sources of raw materials and their use in the Palaeolithic of Slovakia. In: Mester, Zs. (ed.), *Papers of the Vise-grád fund project n° 21110211*. Kraków-Budapest: Polish Academy of Arts and Sciences, Kraków and Institute of Archaeological Sciences of the Eötvös Loránd University, 99–110.
- Korpás, L. (szerk.) 1998. *Magyarázó a Börzsöny és a Visegrádi-hegység földtani térképéhez*. Budapest: A Magyar Állami Földtani Intézet Térképmagyarázói
- Kozłowski, J. K., Mester, Zs. 2003-2004. Un nouveau site du Paléolithique supérieur dans la région d'Eger (Nord-est de la Hongrie). *Praehistoria* 4-5: 109-140.
- Kozłowski, J. K. 2013. Raw materials procurement in the Late Gravettian of the Carpathian Basin. In: Mester, Zs. (szerk.) *The lithic raw material sources and interregional human contacts in the Northern Carpathian regions*. Krakkó: Polska Akademia Umiejętności Archiwum Nauki PAN i PAU, 63–86.
- Kuhn, S. L. 1995. Mousterian Lithic Technology. An Ecological Perspective. Princeton, N. J.: Princeton University Press. https://doi.org/10.1515/9781400864034
- Láng, S. 1967. A Cserhát természeti földrajza. Budapest: Akadémiai Kiadó
- Mania, D. 1990. Auf den Spuren des Urmenschen. Die Funde von Bilzingsleben. Berlin-Stuttgart: Deutscher Verlag der

- Wissenschaften, Theiss Verlag
- Markó, A. 2004. Újabb kőeszköz a galgagyörki Csonkás-hegyről. Ősrégészeti Levelek. Prehistoric Newsletter 6: 10–12.
- Markó, A. 2005. Limnokvarcit a Cserhát hegységben. *Archeometriai Műhely* 2005/4: 52–55.
- Markó, A. 2007. Preliminary report on the excavations of the middle palaeolithic site Vanyarc Szlovácka-dolina. *Communicationes Archaeologicae Hungaricae*: 5-18.
- Markó, A. 2009a. Raw material circulation during the Middle Palaeolithic period in northern Hungary, In: Ganczarski, J. (red.), Surowce naturalne w Karpatach oraz ich wykorzystanie w pradziejach i wczesnym średniowieczu. Krosno: 107–119.
- Markó, A. 2009b. Levéleszközös leletegyüttes Debercsényből. Leafshaped industry from Debercsény. *Archeológiai Értesítő* 134: 155–163. https://doi.org/10.1556/ArchErt.134.2009.9
- Markó, A. 2012. Középső-paleolitikus leletegyüttesek Vanyarc környékén. Doctoral thesis. Manuscript, Budapest: ELTE-BTK
- Markó, A., Péntek, A., Béres, S. 2002. Chipped stone assemblages from the environs of Galgagyörk (Northern Hungary). *Praehistoria* 3: 245–257.
- Markó, A., Bíró, K., Kasztovszky, Zs. 2003. Szeletian felsitic porphyry: non-destructive analysis of a classical palaeolithic raw material. *Acta Archaeologica Scientiarum Hungaricae* 54: 297-314. https://doi.org/10.1556/AArch.54.2003.3-4.1
- Markó, A., Péntek, A. 2003-2004. Raw material procurement strategy on the palaeolithic site of Legénd Káldy-tanya (Cserhát Mountains, Northern Hungary). *Praehistoria* 4-5: 165–177.
- Markó, A., Kázmér, M. 2004. The use of nummulitic chert in the Middle Palaeolithic in Hungary. In: Fülöp, É., Cseh, J. (szerk.), Die aktuellen Fragen des Mittelpaläolithikums in Mitteleuropa Topical issues of research of Middle Palaeolithic period in Central Europe Tata: Komárom-Esztergom County Museum Directorate, 53–64.
- Marks, A. E., Chabai, V. P. 2001. Constructing Middle Palaeolithic settlement systems in Crimea: potentials and limitations. In: Conard, N. J. (ed), Settlement dynamics of the Middle Paleolithic and Middle Stone Age. Tübingen, Kerns Verlag, 179–204.
- Mester, Zs. 2008-2009. Les outils foliacés de la grotte Jankovich : la renaissance d'un problème ancien. *Praehistoria* 9-10: 81-98.
- Mester, Zs. 2010. Technological analysis of Szeletian bifacial points from Szeleta Cave (Hungary). *Human Evolution* 24(1-2): 107-124.
- Mester, Zs. 2011. A magyarországi középső és felső paleolitikum bifaciális levéleszközeinek technológiája. In: Bíró K., Markó A. (szerk.), Emlékkönyv Violának. Tanulmányok T. Dobosi Viola tiszteletére. Papers in honour of Viola T. Dobosi. Budapest: Magyar Nemzeti Múzeum, 15–42.
- Nerudová, Z. 1996. Szeletienská kolekce z Jezeřan I a její vztah k micoquienu = La collection széletienne de Jezeřany I et sa relation avec le Micoquien. *Acta Musei Moraviae* 81: 13–36.
- Nerudová, Z. 2008-2009. The Technology of the Szeletian Lithic Industry in the Context of Moravian EUP Cultures. *Praehistoria* 9-10: 47-60.
- Nigst, P.R., 2006. The first modern humans in the Middle Danube Area? New evidence from Willendorf II (eastern Austria). In: Conard, N. J. (ed.), *When Neanderthals and Modern Humans Met.* Tübingen: Kerns Verlag, 269–304.
- Oliva, M. 1979. Die Herkunft des Szeletien im Lichte neuer Funde von Jezeřany. *Acta Musei Moraviae* 64: 45–78.
- Oliva, M. 1992. The Szeletian occupation of Moravia, Slovakia and Bohemia. *Acta Musei Moraviae* 77: 35–50.
- Oliva, M. 1995. Le Séletien de Tchécoslovaque: industrie lithique

- et répartion géographique. Paléo Supplement 1995, pp. 83-90. https://doi.org/10.3406/pal.1995.1383
- Péntek, A. 2015a. Open air site with leaf-points at Legénd-Rovnya (Cserhát Mountains, North Hungary). Unpublished paper. https://www.academia.edu/19305468/A._P%C3%A9ntek_Open_air_site_with_leaf-points_at_Leg%C3%A9nd-Rovnya_Cserh%C3%A1t_Mountains_North_Hungary
- Péntek, A. 2015b. *Quartz and quartzite as raw materials in the Hungarian Palaeolithic*. Unpublished paper. https://www.academia.edu/19726218/A._P%C3%A9ntek_Quartz_and_quartzite_as_raw_materials_in_the_Hungarian_Palaeolithic
- Péntek, A., Zandler, K. 2013a. Nyíltszíni Szeletien telep Szécsénke-Kis-Ferenc-hegyen. *Litikum* 1: 36-49.
- Péntek, A., Zandler, K. 2013b. Nyíltszíni levéleszközös telep Legénd-Rovnyán. Open-air Site with Leaf-points at Legénd-Rovnya. Neograd. A Dornyay Béla Múzeum Évkönyve 37: 23–45.
- Péntek, A., Zandler, K. 2014. Buják-Szente, egy nyíltszíni paleolit telep. *Litikum* 2: 3–16.
- Prošek, Fr. 1953. Le Szeletien en Slovaquie. *Slovenská Archeológia* 1: 178–194.
- Přichystal, A. 2010. Classification of lithic raw materials used for prehistoric chipped artefacts in general and siliceous sediments (silicites) in particular: the Czech proposal Javaslat a pattintott kőeszközök készítésére használt kőeszközök osztályozására, általános tekintetben, különös tekintettel a kovakőzetekre és a kovás üledékekre. *Archeometriai Műhely* 2013/3: 177–181
- Richter, J. 1997. Sesselfelsgrotte III. Der G-Schichten-Komplex der Sesselfelsgrotte Zum Verständnis des Micoquien. Quartär-Bibliothek Band 7. Saarbrücken: Saarbrücker Druckerei und Verlag
- Richter, J. 2001. For lack of a wise old man? Late Neanderthal landuse patterns in the Altmühl River Valley; Bavaria. In: Conard, N. J. (ed.) *Settlement Dynamics of the Middle Paleolithic and Middle Stone Age, Vol. 1.* Tübingen: Kerns Verlag, 205–219.
- Ringer, Á. 1983. Bábonyien Eine mittelpaläolitische Blattwerkzeugindustrie in Nordostungarn. Dissertationes Archaeologicae Ser. II. No. 11, Budapest
- Ringer, Á., Mester, Zs. 2000. Résultats de la révision de la grotte Szeleta entreprises en 1999 et 2000. *Anthropologie (Brno)* 38: 261–270.
- Rosania, C. N., Boulanger, M. T., Bíró K., Ryzhov, S., Trnka, G., Glascock, M. D. 2008. Revisiting Carpathian obsidian. *Antiquity* 82(318)
- Schönweiss, W., Werner, H.-J. 1986. Ein Fundplatz des Szeletien in Zeitlarn bei Regensburg. *Archäologisches Korrespondenzblatt* 16(1): 7–12.
- Simán, K. 1985. Paleolit leletek Sajószentpéteren. A *Herman Ottó Múzeum Évkönyve* 22-23: 9–20.
- Simán, K. 1993. Őskőkori leletek Nógrád megyében. Fünde aus der Vorzeit im Komitat Nógrád. *A Nógrád Megyei Múzeumok Év-könyve* 18: 247–252.
- Simán, K. 1999. Bifaciális eszközök Korlát-Ravaszlyuk-tető lelőhelyen (Bifacial implements on Korlát-Ravaszlyuk-tető site). *A Herman Ottó Múzeum Évkönyve* 37: 29–44.
- Škrdla, P., Nejman, L., Rychtaříková, T., Nikolajev, Lisá, L. 2014. New observations concerning the Szeletian in Moravia. *Quartär* 61: 87-101.
- Svoboda, J., Přichystal, A. 1987. Szeletská industrie z Vincencova (Otaslavice, okr. Prostějov). Szeletian industry from Vincencov (Otaslavice near Prostéjov). *Acta Musei Moraviae* 52: 5–19.
- Trnka, G. 1990. Ein neuer paläolithischer Blattspitzenfund aus

- Schletz in Niederösterreich. *Archäologie Österreichs* 1(1-2): 20-24.
- Valoch, K. 1955. Die Erforschung der paläolitischen Fundstätte in Rozdrojovice bei Brünn. *Acta Musei Moraviae* 40: 5–32.
- Valoch, K. 1960. Die Blattspitzenindustrie von Ořechov bei Brno (Brünn). (Zugleich ein Beitrag zur Problematik des Szeletien). Anthropozoikum 10: 35–47.
- Valoch, K. 1966. Die altertümlichen Blattspitzenindustrie von Jezeřany (Südmähren). Acta Musei Moraviae 51: 5–60.
- Valoch, K. 1967. Die altsteinzeitlichen Stationen im Raum von Ondratice in Mähren. *Acta Musei Moraviae* 52: 5-45.
- Valoch, K. 1973. Neslovice, eine bedeutende Oberflächenfundstelle des Szeletien in Mähren. *Acta Musei Moraviae* 58: 5–76.
- Valoch, K. 1987. The raw materials used in the Moravian Middle and Upper Palaeolithic. In: Biró, K. T. (ed.), *Papers forthe 1st International Conference on Prehistoric Flint Mining and Lithic Raw Material Identification in the Carpathian Basin, Budapest–Sümeg 1986.* Budapest: Magyar Nemzeti Múzeum, 263–268.
- Valoch, K. 1993. Vedrovice V, eine Siedlung des Szeletien in Südmähren. *Quartär* 43-44: 7–93.
- Valoch, K. 2000. Das Szeletien Mährens seine Wurzeln und Beziehungen. In: Mester, Zs., Ringer, Á. (dir.), A la recherche de l'Homme Préhistorique, Volume commémoratif de Miklós Gábori et de Veronika Gábori-Csánk. ERAUL 95, Liège, 287–294.
- van der Drift, J. W. P. 2009. Bipolar technique in the Old Palaeolithic. Aktieve Praktijk Archeologie Nederland, APAN/extern: 1-15. https://doi.org/10.5117/NEDTAA2010.1.DISC421
- Veil, S., Breest, K., Höfle, H.-C., Meyer, H.-H., Plisson, H., Urban-Küttel, B., Wagner, G.A., Zöller, L. 1994. Ein mittelpaläolithischer Fundplatz aus der Weichsel-Kaltzeit in der norddeutschen Tiefebene bei Lichtenberg. Landkreis Lüchow-Dannenberg. Zwischenbericht über die archäologischen und geowissenschaftlichen Untersuchungen 1987–1992. Germania 72: 1–65.
- Verpoorte, A. 2006. Neanderthal energetics and spatial behaviour. *Before Farming* 2006/3: 1-6. https://doi.org/10.3828/bfarm.2006.3.2
- Vértes, L. 1951. Мезолитические находки на вершине горы Кёпорош при г. Эгер (Венгрия). Acta Archaeologica Academiae Scientiarum Hungaricae 1: 153–190.
- Weniger, G.-C.1991. Überlegungen zur Mobilität jägerischer Gruppen im Jungpaläolithikum. Urgeschichte als Kulturanthropologie. Beiträge zum 70. Geburtstag von Karl J. Narr, Teil II. *Saeculum* 24(1): 82–103. https://doi.org/10.7788/saeculum.1991.42.1.82
- White, R. 1989. Husbandry and herd control in the upper Paleolithic; A critical review of the Evidence. *Current Anthropology* 30: 609–632. https://doi.org/10.1086/203789
- Zandler, K. 2006. *Paleolit lelőhelyek Eger környékén*. Egyetemi szakdolgozat. Kézirat. ELTE-BTK Budapest.
- Zandler, K. 2008. Nyíltszíni paleolit lelőhely Erdőtarcsa-Daróci hegyen. Open-air Palaeolithic site at Erdőtarcsa-Daróci-hegy. Paläolitische Freilandstation in Erdőtarcsa-Daróci-Berg. A Nógrád Megyei Múzeumok Évkönyve 32: 46–66.
- Zandler, K. 2010. Paleolit telep Hont-Csitáron. A palaeolithic site at Hont-Csitár. In: Guba Sz., Tankó, K. (eds.), "Régről kell kezdenünk…" Studia Archaeologica in honorem Pauli Patay. Régészeti tanulmányok Nógrád megyéből Patay Pál tiszteletére. Szécsény: Nógrád Megyei Múzeumok Igazgatósága, 23–49.
- Zandler, K. 2012a. Késő középső és felső paleolit szórvány leletek Hont-Babatról. *A Nógrád Megyei Múzeumok Évkönyve* 36: 105-120.

- Zandler, K. 2012b. A paleolitikum kőiparai Eger környékén. *Gesta* 11: 147–203.
- Zandler, K., Béres, S. 2011. Három nyíltszíni paleolit lelőhely revizíója: Bükkmogyorósd, Csokvaomány, Nekézseny. Revision of three open-air palaeolithic sites in the Bükk Mountains, NE-Hungary. In: Biró, T. K., Markó, A. (eds.), Emlékkönyv Violának. Tanulmányok T. Dobosi Viola tiszteletére. Papers in honour of Viola T. Dobosi. Budapest: Magyar Nemzeti Múzeum, 55-76
- Zandler, K., Béres, S. 2014. Revision of three open-air palaeolithic sites in the Bükk Mountains, NE-Hungary. In: Biró, K. T., Markó, A., Bajnok, K. P. (eds.), Aeolian scripts. New ideas on the lithic world. Studies in honour of Viola T. Dobosi. Inventaria Praehistorica Hungariae XIII. Budapest: Magyar Nemzeti Múzeum, 63–76.
- Zotz, L. F. 1955. *Das Paläolithikum in den Weinberghöhlen bei Mauern. Ludwig Röhrscheid Verlag Bonn. Quartär-Bibliothek, Bd. 2.* Bonn:
 Ludwig Röhrscheid Verlag
- Zotz, L. F. 1959. Kösten, ein Werkplatz des Praesolutréen in Oberfranken. Quartär-Bibliothek, Bd. 3. Bonn: Ludwig Röhrscheid Verlag

SKAM 2014 Article

This study was presented at the 11th SKAM Lithic Workshop: the multifaceted biface - Bifacial technology in Prehistory. 20th–22nd of October, 2014, Miskolc, Hungary. The conference papers are published in the Litikum Journal volumes as special contributions. Informations about the conference are available on the SKAM 2014 website: http://skam.pannontenger.hu



Proceedings of the 11th SKAM Lithic Workshop The multifaceted biface - Bifacial technology in Prehistory 20th-22nd of October, 2014, Miskolc, Hungary



Palaeolithic industries with bifacial technologies and Crimean Micoquian Tradition as one of their Middle Palaeolithic industrial examples

Yuri E. Demidenko

А	bst	ra	ct

This paper discusses various aspects of Palaeolithic industries having bifacial tool traditions, with an emphasis on Middle Palaeolithic Micoquian materials in Crimea (Ukraine). The described lithic artifact data and their complex analyses testify a great proportional variability of the same tool classes and types in various Crimean Micoquian Tradition assemblages, caused by a dynamic and many-sided Neanderthal group differences on flint reduction models as well as primary and secondary faunal exploitation at functionally variable sites. Also, there is a discussion on a genuine role of Micoquian bifacial backed knife ("Keilmesser") types in the Crimean Micoquian. These types appear to be not intentionally manufactured tool types, representing instead various reduction stages of bifacial side-scraper and point production sequences where natural platforms (backed areas) of plaquette and thick flake blanks did serve as necessary technological elements of the process.

Kivonat

Bifaciális technológiát használó paleolitikus iparok és a krími Micoquien tradíció, mint példa a középső paleolitikumból

A tanulmány kétoldali megmunkálású eszközöket használó paleolitikus iparok jellegzetességeit tárgyalja. Ezeken belül főleg a Krím-félsziget (Ukrajna) középső paleolitikus Micoquien leletegyütteseivel foglalkozik. A kőeszközvizsgálatok adatai alapján a krími Micoquien eszközkészlet lelőhelyenként nagy változatosságot mutat. Ennek okai az eszközöket előállító neandervölgyi embercsoportok eltérő, dinamikus kőmegmunkálási technológiái, valamint a többrétű fauna-hasznosítás a különféle rendeltetésű táborhelyeken. A tanulmány emellett foglalkozik a Micoquien bifaciális, tompított hátú késeinek ("Keilmesser") használatával a krími Micoquienben. E kések tipológiai sokfélesége nem eltérő eszközkészítési koncepciók eredménye, sokkal inkább különböző megmunkálási fázisok nyoma. Természetes ("kérges") hátú, bifaciális megmunkálású kaparókról és hegyekről van szó, melyek morfológiája még őrzi az eredeti nyersanyag – plakett vagy nagyméretű szilánk – eredeti felszíneit.

Keywords

Kulcsszavak

 $Palae olithic,\,Bifacial\,tools,\,Middle\,Palae olithic,\,Micoquian,\,Crimean\,\,Micoquian\,\,Tradition,\,Bifacial\,\,Backed\,\,Knife$

paleolitikum, bifaciális eszközök, középső paleolitikum, Micoquien, krími Micoquien tradíció, bifaciális kés

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Cite as / Hivatkozás

Demidenko, Yu. (2015) Palaeolithic industries with bifacial technologies and Crimean Micoquian Tradition as one of their Middle Palaeolithic industrial examples. *Litikum* 3: 71–85. https://doi.org/10.23898/litikuma0013

Article history / Kézirat történet

Received // Érkezés: 2015. 10. 01. Accepted // Elfogadás: 2015. 12. 10. Published // Közzététel: 2016. 04. 27.

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This paper is dedicated to the memory of Vladislav N. Gladilin (1935 – 2015) – an outstanding Ukrainian & Soviet Palaeolithic archaeologist, my professor & extraordinary person

1. Introductory notes on some peculiar biface production situations in various Palaeolithic industries

My long experience on studies of Palaeolithic artifact assemblages having bifacial tool technologies led me to the recognition of some interesting technological features there. Traditionally, we know that Acheulean is characterized by a "bi-convex" manner of hand-axe production using hard-hammer technique; Central and East European Middle Palaeolithic Micoquian is known by a "plano-convex" manufacture manner of various knives, points and side-scrapers with again using hard-hammer technique; and coming to Upper Palaeolithic, for example, Solutrean, Szeletian and Streletskaya industries throughout different regions in Europe, it is seen a "bi-convex" manner of different point fabrication applying, however, soft-hammer technique. This is a general scheme that is used in many textbooks

for students and/or general publications (e.g. Bordes 1961; Bordes 1992; Debénath, Dibble 1994) and this is basically correct. But going deeper into some details for concrete lithic assemblages of the above-noted Palaeolithic technocomplexes, I always see some degree of bifacial technology variability that is very important not to overlook during our studies. Cases of such variability in bifacial technologies can be shortly described as follows.

1.1. An Acheulean example

I know personally to some extent lithic materials of Nadaouiyeh Aïn Askar, an Upper Acheulian multi-level site from Central Syria that was excavated between 1989 and 2003 by a Swiss team from Basel University headed by J.-M. Le Tensorer (e.g. Le Tensorer et al. 2007; Jagher 2011). Concerning the Upper Acheulean, this site has the world's richest biface assemblage, where the Swiss team excavated a part of a Homo erectus skull and more than 12 000 bifaces, although "10 331 bifacials have been discovered in layers where the archaeological context was completely modified by geological phenomena" (Jagher 2011: 213). A thorough morphological analysis of the differently shaped bifaces added by some technological data allowed the colleagues to differentiate seven subsequent Upper Acheulean "cultural evolutional" stages at Nadaouiyeh Aïn Askar. Very most of the recovered Nadaouiyeh Aïn Askar bifaces were produced by the basic for Acheulian "bi-convex" manner using hard-hammer technique. But taking a closer look at some Nadaouiyeh Aïn Askar bifaces from different archaeological layers, I see another sort of biface variability there. The "bi-convex" production manner still dominates but there are several "plano-convex" and "plano-convex-alternate" pieces (the latter bifaces are probably results of severe reshaping of "plano-convex" pieces) like the respective items in the Central and East European Micoquian. Accordingly, Acheulian "bi-convex" manner of hand-axe production was not the only (!) one during the end of Lower Palaeolithic.

1.2. Upper Palaeolithic examples

Taking Upper Palaeolithic industries with bifaces, again a "bi-convex" manner on bifacial tool production is present but at the very different level of its technological maintenance. First, the very basic produced tool types were variously shaped projectile bifacial points. Second, a soft-hammer technique was used for point manufacture. Third, as I well know, lithics of both Streletskaya industry (European part of Russia and Ukraine) and "Eastern Szeletian" Buran-Kaya III, level C (Crimea, Ukraine), as well as Central European Szeletian Moravany-Dlha points (Slovakia), a pressure technique was often additionally applied during the last phase of bifacial point production (Demidenko 2014c). So, there is an absolutely different and advanced variant of the "biconvex" manner of bifacial technology in Upper Palaeolithic in contrast to the Acheulean. Curiously enough, in almost every concrete assemblage, there are always cases when a few Upper Palaeolithic bifacial points have been produced by "plano-convex-like" manner, like at Streletskaya sites of Kostenki 12, layer III in Russia (e.g. Anikovich et al. 2007: Fig. 116, 1) and Vys site in Ukraine (Zaliznyak et al.

2013: Fig. 9, 11-12; 10, 10). Moreover, even taking the chronologically much later French Solutrean record, for example, at Maîtreaux site, it was recognized a "previously unknown asymmetrical scheme" for production of large-sized ('Type J') laurel leaf bifacial points, shaped actually by the abovementioned "plano-convex" manner, and "this asymmetrical approach may be applied to any raw material that has one flat face", and the whole production process was often complemented by "some pressure flaking technique towards the end of the shaping sequence" (Aubry et al. 2008: 52-57). Thus, it is possible to note that sometimes when an Upper Palaeolithic flintknapper had a massive flake with flat ventral surface and curved thick dorsal surface or a morphologically similar lithic block / piece for bifacial point production, this person was quite naturally using the "plano-convex" treatment manner, although the dominant treatment manner for the Upper Palaeolithic bifacial points was still "bi-convex". The presence of a few bifacial "plano-convex" and "plano-convex-alternate" points among the prevailing "bi-convex" points within both Early Upper Palaeolithic (Szeletian sensu lato and Streletskaya industries in Central and Eastern Europe) and Late Middle Upper Palaeolithic (Solutrean industry in Western Europe) indicates a situational / ad hoc supplementary bifacial point treatment manner. Accordingly, such foliate pieces do not indicate generic industrial connections between these Early Upper Palaeolithic and Late Middle Upper Palaeolithic industries with bifaces and Middle Palaeolithic Micoquian industries, as it was again recently proposed by G. Bataille for Crimean Micoquian and "Eastern Szeletian" and Streletskaya industry in Ukraine and Russia (Bataille 2013).

There is also an interesting situation with bifacial leaf points for two Central European Initial Upper Palaeolithic sites. One of the in situ Bohunician industry sites, Brno-Bohunice (Bohunician - the Central European Early Emiran industry with Levallois bidirectional point primary flaking technology. Valoch 1976; Tostevin, Škrdla 2006), and also Korolevo II site, layer II (the Central European Early Emiran-like industry with similar bidirectional primary flaking technology but with no strictly speaking Levallois points. Gladilin, Demidenko 1989; Usik 1989; Demidenko, Usik 1993a; 1993b; 1995) also demonstrate production of bifacial leaf points with a soft-hammer technique, having mainly "plano-convex" pieces at Korolevo II and "bi-convex" pieces at Brno-Bohunice found together (sic!) with bifacial reduction debitage at both sites. The co-occurrence of bifacial points and their reduction debitage indicates bifacial point production at the sites. The problem, however, is that such Initial Upper Palaeolithic assemblages are now well known in the Near East, in Central and Eastern Europe, and as far away as in Russian Southern Siberia and Mongolia, and only the above-named two sites' assemblages from Central Europe do have bifacial points. It is theoretically possible that the discussed bifacial points represent an influence of Late Micoquian and/or Szeletian technologies onto Early Emiran ones in Central Europe during the Initial Upper Palaeolithic, when Homo sapiens spread throughout Eurasia. On the other hand, P. Škrdla proposed at the 2014 SKAM conference in Miskolc that even modern excavation methods are often not able to differentiate a palimpsest of two

industrially different human occupations within one archaeological level at a site why, in his opinion, it cannot be excluded that bifacial leaf points and their specific reduction debitage do in fact represent indicative "material remains" of a Szeletian occupation at a mostly Bohunician settlement, Brno-Bohunice. Following Škrdla's hypothesis, a similar palimpsest situation could be also suspected for Korolevo II site where bifacial components (tools and debitage) could testify a short-term Micoquian occupation within the mainly Early Emiran-like occupation. With such new hypothesis, it is clear that more work should be done for further discussion about important Initial Upper Palaeolithic sites and theirartefacts.

Finally, when we come to Middle Palaeolithic Central and East European Micoquian industries with bifacial tool technologies, mainly their "plano-convex" manner is seen with either hard- or soft-hammer technique.

2. Middle Palaeolithic and Micoquian identification in Central and Eastern Europe

2.1. The term "Middle Palaeolithic"

Since the time of Gerhard Bosinski's published PhD dissertation "Middle Palaeolithic in West Central Europe" (Bosinski 1967), it is possible to say that such terms as "Middle Palaeolithic" and "Micoquian" became more or less generally accepted in Palaeolithic Archaeology of Central and Eastern Europe, although the former term, "Middle Palaeolithic", only started to be in a real use in Eastern Europe from the early 1990s after the collapse of the Soviet Union.

The term "Middle Palaeolithic" for European Palaeolithic industries with prepared core reductions and a high proportion of various well-retouched tools on flakes, which was certainly the scientific merit and achievement of G. Bosinski with, of course, some other colleagues work, naming, first of all, Alain Tuffreau, actually became widely accepted after A. Ronen's Haifa (Israel) conference in 1980 (see articles of Bosinski and Tuffreau in Ronen (ed.) 1982). Since that time the following basic differences were underlined between the "Middle Palaeolithic" and F. Bordes' "Mousterian". First, instead of a mere geochronological limit of the "Mousterian" at the Last Glacial ("Würmian") time period, the "Middle Palaeolithic" has not got a geochronological limit. "And for us, it is obvious that the Middle Palaeolithic begins before stage 5, at least to about 200,000 and there may be some Quinaor Ferrassie-like industries back to 300,000. There are few sites before 300,000 but quite a few for the 200,000 period" (Bosinski 1988: 160) and also later - "We got in Europe Middle Palaeolithic sites from 350,000 years and we include the late Acheulean as a part of the Middle Palaeolithic" (Bosinski 2000: 227), not forgetting Tuffreau's indicative notion for Northern France as well - "The Middle Palaeolithic covers a vast period of time comprising several glacials and interglacials from isotope stage 8 to the first half of stage 3" (Tuffreau 1992: 59-61). Here we can also add an important remark on the subject acknowledging Bosinski's role for the "Middle

Palaeolithic chronology" - "Hence, in contrast to Bordes, G. Bosinski (1967) and others have considerably broadened the concept of the »Middle Palaeolithic« by including also the »pre-Eemian period«" (Müller-Beck 1988: 233). Going further, there is also a good notion on the Middle Palaeolithic in southern France from 1988 - "The time span involved ranges from the beginning of the Riss glacial complex up to the end of early Würm, following the French Alpine chronology applied to the region, perhaps from 200 - 500 Kyr up to 38 Kyr" (Rolland 1988: 161). Second, it was also agreed that Middle Palaeolithic "represents the final stage of the Early Palaeolithic in Western Europe" and "it consists of a predominantly flake-tool technocomplex made with prepared-core, or mode 3 (Clark 1969: 31), primary flaking techniques (Levallois or disc-core), resulting in more standardized toolkits. This broad definition encompasses pre-Würmian, later Acheulean, Pre-mousterian and »Tayacian« occurrences" (Rolland 1988: 161).

It is again worth noting Bosinski's opinion on industrial characteristics for the Middle Palaeolithic. According to him, some industries lacking Levallois and/or some other developed primary reduction methods based on systematical core striking platform faceting and flaking surface preparation but, at the same time, having some bifacial tools and serial tools on flakes with well-elaborated retouched edges. Bosinski particularly well discussed Middle Palaeolithic industrial status for Late Acheulean and Yabrudian with Levantine colleagues during a conference also organized by A. Ronen, held in Haifa (Israel), but in 1996. He noted the following basic industrial features for such technocomplexes distinguishing them from Lower Palaeolithic: "The Middle Palaeolithic is characterized by a marked variation of types including bifaces and flake types", "The Yabrud material is Middle Palaeolithic. The variability of scrapers and the presence of points make it a Middle Palaeolithic. How old - I do not know!" and on Schäfer's straight question on Middle Palaeolithic industrial features, he again and again underlined: "It is the variability of retouched flake tools" (Bosinski 2000: 24). Accordingly, so-called developed and typologically varied tool-kits with well-retouched tools on flakes is a basic typological criteria to differentiate Middle Palaeolithic assemblages from Lower Palaeolithic ones but no site geochronology, that is why Bosinski did not care about the Yabrudian dates then, now known to be no younger than ca. 300,000 years ago. At the same time, Middle Palaeolithic includes some typologically specific technocomplexes / industries that were not recognized by F. Bordes as West European Mousterain, like, for example, the central topic of the present paper - Central and East European Micoquian Hence, the industrial spectrum of the Eurasian Neanderthal lithic assemblages are much variable, where Mousterian is just an integral part of Middle Palaeolithic.

Coming back to Bosinski's Middle Palaeolithic concept, it is also important to underline his differentiation of chronological and industrial criteria for establishing frames for Lower and Middle Palaeolithic epochs in favor of the "lithic criteria". Thus, Bosinski has actually broken chronological borders between Lower and Middle Palaeolithic. I even remember some of our personal discussions on the matter from the early 1990s in Kiev when he was also using an

example with a hypothetical assemblage coming from the surface having no dates. And if such an assemblage's lithics were of Middle Palaeolithic character, they had to be called Middle Palaeolithic ones. The industrial approach for distinction between Lower and Middle Palaeolithic assemblages / industries was also shared by my professor Vladislav N. Gladilin in the 1990s (e.g. Gladilin, Sitlivy 1990: 16-22). Accordingly, I grew up under this approach and that's why I, like Bosinski, also consider Yabrudian as an Early Middle Palaeolithic technocomplex in contrast to some other colleagues working in the East Mediterranean Levant, still discussing Yabrudian within Lower Palaeolithic.

There is one more basic feature that also very much unites Mousterian and Middle Palaeolithic throughout various regions of Eurasia. That is their humans, the technocomplexes' / industry types' makers, the Neanderthals. That's why we even see some well done published maps with sites where Neanderthal bone remains were found in different regions of Eurasia from Iberian peninsula in the West to Altai (Southern Siberia, Russia) in the East (e.g. Serangeli, Bolus 2008: Figs. 1 & 2). All physical anthropology data at hand do pint out the Neanderthal origin in Europe, their subsequent evolution and distribution within the Continent and also their dispersal into some but not all Asian regions. But Neanderthals have not been found in Africa, in that "Homo sapiens homeland" since ca. 200,000 years ago. By lithic artifacts, the time period in between ca. 200,000 and 40,000 years ago is called Middle Stone Age in sub-Saharan Africa. On the other hand, the respective lithic assemblages in Northern Africa have been usually named as Mousterian and/or Middle Palaeolithic ones. But the situation started to be changed in Northern Africa when the former Mousterian and Middle Palaeolithic industries some colleagues began to relate with Middle Stone Age due to the industries' real techno-typological differences from Eurasian Mousterian and/or Middle Palaeolithic, their close industrial affinity to African materials and also because of the same human makers, Homo sapiens (e.g. Kleindienst 2001; Van Peer, Vermeersch 2007; Garcea 2012; Dibble et al. 2013). All in all, it is needed to acknowledge some real differences in between Eurasian Mousterian / Middle Palaeolithic and African Middle Stone Age. The present author has no doubts that some special comparison studies of concrete Middle Palaeolithic and Middle Stone Age lithic assemblages (specially made tools on organic materials are well known for Middle Stone Age but about completely absent in Middle Palaeolithic) will certainly demonstrate their differences in a detailed way.

At the same time, remembering the absence of any Neanderthal bone remains and Middle Palaeolithic assemblages in Africa, it is also worth not to forget the presence of African Middle Stone Age sites in the East Mediterranean Levant (Tabun-C type Levallois-Mousterian with early *Homo sapiens* bone remains ca. 170,000 – 90/85, 000 years ago in Israel, Lebanon and Syria – Bar-Yosef 2000; a sort of Terminal Nubian Mousterian ca. 40,000 years ago in Central Syria – Demidenko 2013d) and in Arabian peninsula (Nubian Mousterian / Nubian Complex ca. 100,000 – 75,000 years ago in Oman and Saudi Arabia – Petraglia, Rose (eds.) 2009; Rose,

Marks 2014). As a result, it will be possible to investigate several "penetration waves" of Middle Stone Age *Homo sapiens* into non-African Asian adjacent territories during different time periods between MIS 6–3. That's why it is methodologically not correct to lump together sites and their assemblages under the term "Middle Palaeolithic" for various European, Asian and African (*sic!*) regions that sometimes happens till now (e.g. Groucutt, Scerri (eds.) 2014). Thus, established since the early 1980s and correctly applied term "Middle Palaeolithic" for Eurasian Neanderthal lithic technocomplexes and industry types proved to be very useful for Palaeolithic Archaeology studies.

2.2. "Central and East European Micoquian" subject with a special reference to the Crimean materials

G. Bosinski also played a decisive role for understanding and studying the so-called Central and East European Micoquian lithic assemblages in the 1960s and 1970s. He (1967) defined Central European lithic assemblages having serial bifaces, and, namely, Micoquian hand-axes, elongated hand-axes with flat ventral surface ("Halbkeile"), pointed hand-axes shorter 6 cm ("Fäustel"), backed knives ("Keilmesser"), side-scrapers and leaf points ("Blattspitzen"), under the terminological umbrella "Micoquian". It is worth mentioning here that many so-called flat bifacial tools are now known as bifacial "plano-convex" tools. Also, the actual position of the present author should be underlined that bifacial backed knives, side-scrapers and leaf points do always dominate in various proportions at almost all Central European Micoquian assemblages. It was also quite logical at that time to name the assemblages as Micoquian because a number of tool types morphologically looked similar enough to the chronologically earlier French Acheulian Micoquian and there were also some ideas on generic connections between these West European and Central European industries. Also, Bosinski has defined four Micoquian inventory-groups (Bockstein, Klausennische, Schambach, Rörshain) with prevalence of particular bifacial tool classes and types for each of the groups. Moreover, in his 1967 book he showed that at least some East European Middle Palaeolithic materials and, first of all, Crimean ones (Ukraine) from sites of Kiik-Koba, Chokurcha I, Volchi Grot and Starosele are similar enough to the Central European Micoquian and even defined one more "Keilmesser" of Wolgograd type for the Sukhay Mechetka / Stalingradskaya site in southern Russia.

Bosinski's 1967 book also had some definite influence on Soviet Palaeolithic archaeologists working with East European Mousterian assemblages containing series of bifacial tools. Seeing obvious similarities between Eastern and Central European bifacial assemblages, some Soviet archaeologists also started to interpret respective East European materials as real Micoquian at the 2nd "understanding level" with more comparable materials available after the 1st one realized by the pioneering scientific work on the subject by Gleb A. Bonch-Osmolowski in the 1930s (Bonch-Osmolowski 1940; see also in Demidenko 2013a). For example, newly discovered and analyzed in the1960s and 1970s Khotylevo and Richta site materials were said to be Micoquian (Zavernyaev 1978; Smirnov 1979).

But I must admit that the most systematic and fruitful Micoquian studies in Eastern Europe were realized by my professor Vladislav N. Gladilin (Kiev) between the mid 1970s and late 1980s. Again, the investigations were conducted under some influence of Bosinski's work but also by Gladilin's own deep understanding of the East European material. Using his own artifact classification system, realdifferences became present in comparsion with the West European Mousterian / Middle Palaeolithic. However before, in the mid 1960s and the early 1970s (Gladilin 1966; 1971), he modified and used Bordesian terms, such as "Levallois-Mousterian of Acheulean Tradition" (Starosele; Antonovka II; Khotylevo I), "Mousterian with Acheulean Tradition" (Antonovka I; Sukhaya Mechetka; Volchi Grot, lower layer; Chokurcha I) and "Micro-Mousterian with Acheulean Tradition" (Kiik-Koba, upper layer; Volchi Grot, middle layer; Ilskaya, lower layer; Orel). This terminology was similar to the former attribution of Crimean Starosele materials as "Mousterian of Acheulean Tradition" in the 1950s (Formozov 1958). But since the mid 1970s, Gladilin (1976; 1985) started to apply different names for his "variants", "facies" and "industry types" of East European Middle Palaeolithic assemblages with bifacial tools. Particularly Crimean materials were grouped as "Mousterian with bifacial tools" and "Micro-Mousterian with bifacial tools" variants. Then, "Mousterian with bifacial tools" had representatives of two facies in Crimea: "Eastern Micoquian facies" with numerous and often asymmetrical (mainly crescent by shape) bifacial knives / side-scrapers (Starosele industry type) and "Bockstein facies" also having many bifacial asymmetrical knives but with a back / platform, like Bockstein, Klausennische and Prondnik / Pradnik knives ("Keilmessers") (Ak-Kaya industry type). Also, "Micro-Mousterian with bifacial tools" was represented in Crimea by "Kiik-Koba facies" and its Kiik-Koba industry type with numerous and small-sized bifacial and unifacial points and knives / side-scrapers. Gladilin even defined one archaeological culture for Crimean "Micro-Mousterian with bifacial tools" - Kiik-Koba culture.

A special note is need to be made here. In the 1970s and 1980s it was like a fashion to recognize archaeological cultures in Middle and even Lower Palaeolithic in the Soviet Union and Gladilin was one of the active advocates of Palaeolithic archaeological cultures at that time. Remembering the facies names, "Eastern Micoquian" and "Bockstein", Bosinski's data indeed influenced Gladilin's industrial studies. Accordingly, "facies" were introduced by Gladilin for the grouping of generically related industry types, while the latter term did serve for determining archaeological cultures. Also, the "facies" did serve for Gladilin as "taxonomy bridges" linking East European industries with the Central European ones and the "Eastern Micoquian" and "Bockstein" facies have been defined to connect particular industries between West and East, and even to show Micoquian Neanderthal migrations from Central to Eastern Europe. On the other hand, materials of "Kiik-Koba facies" (Kiik-Koba grotto, upper layer and Prolom I grotto in Crimea) were thought to be probably generically connected to Vértesszőlős materials in Hungary (Central Europe). This was mainly explained by a dominance of small-sized tools in both groups of industries.

3. The Crimean Micoquian Tradition

Gladilin has been only partially involved into Crimean Middle Palaeolithic studies by giving theoretical and methodical advices to his friend and colleague Yuri G. Kolosov (Kiev), who was actually excavating Middle Palaeolithic sites in Crimea since the late 1960s up to mid 1990s. Namely, Kolosov found and excavated a group of now-famous Zaskalnaya and Ak-Kaya sites in buried rock-shelters in Eastern Crimea. This work ended up by his recognition of one further Middle Palaeolithic culture with bifaces - the Ak-Kaya Mousterian culture that was considered, following Gladilin's ideas, as a genuine Micoquian culture similar to Bosinski's Bockstein and Klausennische inventory-groups in Central Europe (Kolosov 1983; 1986). Also, Kolosov with his two pupils, Vadim N. Stepanchuk and Victor P. Chabai, published a book on Crimean Middle Palaeolithic in 1993 where they also additionally defined Starosele Mousterian culture with bifacial tools (Kolosov et al. 1993).

Starting from 1993, it is possible to say that two Ukrainian archaeological teams have been working on Crimean Palaeolithic. The first team was of Kolosov and Stepanchuk who were continuing both the excavations and the elaboration of the archaeological culture paradigm for the interpretation of Middle Palaeolithic industrial variability. The cultural paradigm was based on a strong assumption that almost all tools, their classes and types were deliberately produced for specific labor tasks. The cultural paradigm for Middle Paleolithic studies has been driven by Stepanchuk until real absurdity with some "syncretic Middle Palaeolithic traditions" when literally each culture with bifacial tool production was inhabited a clearly delimited area in either Western or Eastern Crimea. Culturally distinct groups of Neanderthals had been living there, sharing "common features of material and spiritual culture", "primitive thoughts peculiarities", and "social structures of Neanderthal communes". Concrete Distinct Neanderthal population size was calculated for the Crimea in 240 individuals, with a possible minimal number of 175, endogamous and, at the same time, exogamous Neanderthal groups were hypothesized, various artistic, non-utilitarian, utilitarian objects, etc. were identified although these were not based on any use-wear analysis (see in Demidenko 2013b: 49-51).

The second team was headed by Chabai and, from the archaeological side, was also supplemented by Alexander I. Yevtushenko (1959-2009), the present author and since 1999 Andrei P. Veselsky. The second Ukrainian archaeological team worked together with archaeologists from the West (thanks to the fall of Soviet iron curtain) – Tony Marks (USA) and Marcel Otte (Belgium) and their associates and students who were than complemented since 2000 year by Jürgen Richter and Thorsten Uthmeier (Germany) together with their associates and students. Our archaeological team was also added by a number of natural sciences specialists from Russia, Moldova, USA, Canada, France, and England.

As a result of 20 years work, we've got "two tracks" of flint and fauna materials from nine newly excavated, functionally variable multi-level stratified sites with Middle

	Ak-Kaya etalon-like	Ak-Kaya- genuine	Ak-Kaya- Starosele	Starosele	Kiik-Koba
simple unifacial tools	52.5 – 58%	41 – 57.5%	43 – 52%	44.3 – 48.1%	24.1 – 38%
convergent unifacial tools	21.3 – 23.8%	16 – 35%	37 – 43%	38.9 – 43.4%	51.2 – 63.8%
identifiable bifacial tools	23.6 – 28.7%	16 – 27%	9 – 17%	12.2 – 13.3%	10.8 – 15.5%

Table 1. Crimean Micoquian Tradition's 5 industry types and their basic typological indices, according to 3 tool groups (modified after Chabai et al. 2000: Table 10; Demidenko 2015: Table 2) // **1. táblázat.** A krími Micoquien tradíció öt ipara és alapvető tipológiai indexeik három eszközcsoportra vonatkozóan (Chabai et al. 2000: Table 10; Demidenko 2015: Table 2 nyomán).

Palaeolithic and Early Upper Palaeolithic materials (Starosele, Kabazi II, Kabazi V, Buran-Kaya III, Siuren I, Karabi Tamchin, Karabai I, Chokurcha I, Sary-Kaya sites). Aside of many articles, our international team published four books in English in Belgium (Marks, Chabai (eds.) 1998; Chabai et al. 1999; Chabai et al. 2004; Demidenko et al. 2012), five books in English in Ukraine (Chabai et al. (eds.) 2005; 2006; 2007; 2008; Yevtushenko, Chabai (eds.) 2012), one book in English in Germany (Demidenko, Uthmeier 2013) and three books in Russian in Ukraine (Chabai et al. 2000; Chabai 2004; Demidenko (ed.) 2004), with new data and new interpretations of previously investigated assemblages from different sites.

The first scientific goal of our investigations was the establishment of a Crimean Palaeolithic geochronology through receiving various absolute dates, fauna, small mammal and pollen data because there was not any well established chronological data for the Crimean Palaeolithic during Soviet times. Simultaneously, the second goal was to understand industrial variability of Crimean Middle Palaeolithic, first and foremost those assemblages having serial bifacial tools.

Delegating some assemblages into one of the previously recognized three cultures - Ak-Kaya, Starosele and Kiik-Koba posed a problem, because all three have the same tool classes and types, and reasons of cultural subdivision was actually the different proportional distribution of the same tools. That's why it had to be taken into consideration some non-cultural reasons for the Middle Palaeolithic industrial variability. Also, Crimean assemblages with bifacial tools had not been named Mousterian anymore being indeed much different from West European Mousterian. Since 1993 they are called Middle Palaeolithic, being related to the Micoquian technocomplex. There is also a good personal example of the Crimean Middle Palaeolithic assemblages' difference from the West Eurasian Mousterian that is worth to note here. When we have started our work with Tony Marks, there was a question what typological system are we going to use for classification of Crimean lithic artifacts. Of course, Tony was always using the well-known type-list of F. Bordes (1961). On the other hand, Chabai and Yevtushenko were using classification of my professor Gladilin that I was also already using for my studies of Palaeolithic assemblages in the Ukrainian Transcarpathian region (Gladilin 1976). And when Tony looked through several Crimean flint assemblages with bifacial tools, he agreed that the existing great variety of both bifacial and unifacial convergent tools is impossible to put into Bordes' tool types, while Gladilin's system with a great diversity of tool shapes will really allows us the detailed classification of Crimean tools (see Chabai, Demidenko 1998).

As a result, our 2nd team replaced the "cultural paradigm" by an approach in which all in situ Crimean Middle Palaeolithic assemblages with bifacial tools are viewed within the framework of a single Crimean Micoquian Tradition (Chabai et al. 2000). The approach is based on a data synthesis from interdisciplinary studies and varied archaeological methods on sites, and the classification and interpretation of their finds. That's why, the Crimean Micoquian is now conceived as three basic industry types (Ak-Kaya-etalonlike, Kiik-Koba and Starosele ones) and it is best described as "uniformity in diversity" (Demidenko 2003; 2015). Moreover, industrial diversity in the Crimean Micoquian is not limited to the three basic types two more "intermediate types", "Ak-Kaya – genuine" and "Ak-Kaya – Starosele" ones, were also added by Chabai using Micoquian materials from Zaskalnaya and Prolom sites (Chabai et al. 2000: 76-78). Moreover, the late 1990s and the early 2000s excavations at sites of Buran-Kaya III, Siuren I, Chokurcha I, Kabazi II and V and Karabi Tamchin have brought to light more Micoquian materials, making Crimean Micoquian typological diversity and their Neanderthals' settlement system even more mosaic. The result virtually erases any quantitative "index gaps" between known industry types, making for a large group of find complexes with more or less "smooth and continuous" typological variation that originated from functionally variable site types (**Table 1**). Here it is needed to note that although Chabai initiated the recognition of five industry types within the Crimean Micoquian Tradition in 2000, since 2004 he uses just three types (Ak-Kaya, Starosele and Kiik-Koba, Chabai 2004) thinking that the traditional tripartite division is better structured typologically.

The data for each of the five industry types show an indicative pattern of change for three basic tool group indices in the following order: from Ak-Kaya-etalon-like through Ak-Kaya-genuine – Ak-Kaya-Starosele – Starosele to Kiik-Koba industry types. Simple unifacial tools (simple, transversal and double side-scrapers) decline from almost 60% down to ca. 25%. Convergent unifacial tools increase from a little more than 20% up to ca. 60%. Identifiable bifacial tools decline from almost 30% down to 11 – 15%. Accordingly, only Ak-Kaya-etalon-like and Kiik-Koba industry types' flint assemblages, situated at the extremes of these index variability, can be actually well recognized, while the three "intermediate" industry types do in fact represent "transitional varieties" of the Crimean Micoquian Tradition

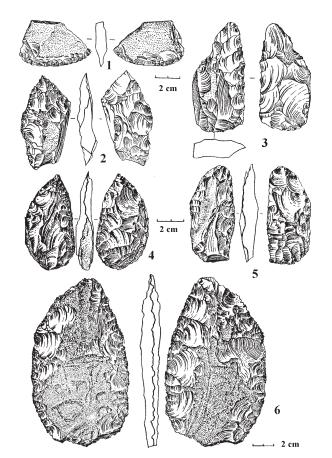


Figure 1. Various Zaskalnaya V and VI sites' Micoquian bifacial "backed knives": 1: *Bockstein* type; 2–3: *Klausennische* type; 4–5: Prondnik / Pradnik type; 6: Ak-Kaya type (modified after Kolosov 1978). //

 ábra. Különféle Micoquien "tompított hátú kések" Zaskalnaya V és VI lelőhelyekről. 1: Bockstein típus; 2–3: Klausennische típus; 4–5: Prondnik / Pradnik típus; 6: Ak-Kaya típus (Kolosov 1978 nyomán).

industrial variability. The internal typological ranges for the three tool groups vary between 2.7 and 4 times, with such variation for the different Crimean Micoquian Tradition assemblages reflecting diversity in site function that, in turn, results from differences in the use of flint reduction models and primary and secondary faunal exploitation.

Some more observations have led me to the following two conclusions.

First, both unifacial and especially bifacial tool reduction data in the Crimean Micoquian flint assemblages do additionally demonstrate the following tendency: "the greater the proportion of convergent side-scrapers and points, the greater is the intensity of tool reshaping and rejuvenation in a tool-kit" (Demidenko 2003: 153; 2004a: 147; 2013c: 127; 2015: 148). This tendency explains the high number of convergent tools in Kiik-Koba type industry and their more moderate occurrence in other industry types, not in a cultural sense, but in terms of Neanderthal groups' life histories at different sites and for different activities.

Second, one of the consequences of the first conclusion is that complex analyses of sites and their bifacial tools allow us to doubt the often discussed, so-called bifacial backed knife ("Keilmesser") types as real, intentionally manufactured tool types. Instead they probably just reflect various

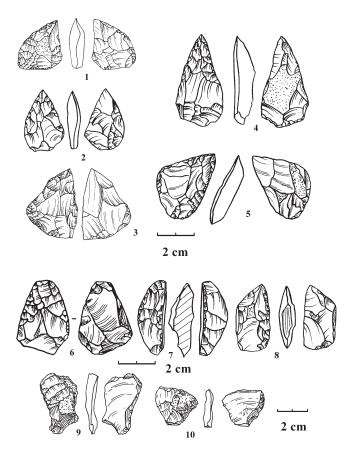


Figure 2. Kiik-Koba grotto, Micoquian layer IV bifacial tools and specific spalls: 1–5: bifacial "plano-convex" points; 6–7: single-edged "plano-convex" bifacial side-scrapers / similar to *Bockstein* knife type; 8: subtrapezoidal elongated "plano-convex" bifacial side-scraper naturally backed / similar to *Klausennische* knife type; 9–10: Prondnik-like / Pradnik-like para-burin spalls (modified after Demidenko 2013c). //

2. ábra. Kiik-Koba-barlang, Micoquien IV réteg, bifaciális eszközök és speciális pattintékok. 1–5: bifaciális "plánkonvex" hegyek; 6–7: egy élű "plánkonvex" bifaciális kaparók / a Bockstein típusú késekhez hasonlítanak; 8: nyújtott trapéz alakú, "plánkonvex" bifaciáls kaparó kérges háttal / a Klausennische típusú késhez hasonlít; 9–10: Prodink-szerű / Pradnikszerű álvéső pattintékok (Demidenko 2013c nyomán).

reduction stages of bifacial side-scraper and point manufacture and reshaping / rejuvenation in the Crimean Micoquian (e.g. Demidenko 2013c).

Generally speaking, the following intercorrelation pattern for some specific tool types and site types could be also traced. On one hand, taking sites near high quality flint outcrops either representing short-term home camps in rock-shelters (Ak-Kaya and Zaskalnaya) or primary killing/butchery sites (Sary-Kaya, Kabazi II, Units III, V - VI). Their flint assemblages are characterized by many largesized bifacial backed knives and a few bifacial points and convergent side-scrapers. On the other hand, analyzing primary and secondary butchery short-term camps situated far away from high quality flint outcrops with evident indications on high intensity and extended flint exploitation (Buran-Kaya III, Kiik-Koba) and various short-term sites with not just primary killing/butchering activity (Starosele, Kabazi V, Karabi Tamchin I), as a rule, there are a few, if any, of small-sized bifacial backed knives and many bifacial convergent tools - points and side-scrapers. Also, taking a closer morphological look at Crimean bifacial backed knives, another regularity becomes surprisingly evident. Quite a few of Crimean "Keilmesser" types are indeed similar to Central European Bockstein and Klausennische bifacial backed knives but such pieces usually produced on flint plaquettes probably often have to be understand as partially treated bifaces with natural platforms - the plaquette's flat edges covered by primary cortex (Fig. 1: 1-3). When bifacial treatment spread over the previously unworked parts of the plaquette / thick flake support, morphology of the piece changes from backed knife to convergent side-scraper or point, without natural back (Fig 2: 1-5). For this reason the Crimean Bockstein and Klausennische-like bifacial pieces probably should not be considered as genuine special bifacial backed knife types. It is also confirmed by absence of Central European Prondnik / Pradnik bifacial knives with technologically important, so-called para-burin resharpening spalls along the knives' cutting edge (e.g. Krukowski 1939-1948; Kowalski 1967; Chmielewski 1969; Kozlowski 1972; Sobczyk 1975; Kulakovskaya et al. 1993; Sudol 2013; 2014) in the Crimean Micoquian and in the whole East European Micoquian record. This absence contributes to the view of the present author, that according to morphological, technological, rejuvenation / resharpening and functional characteristics, Prondnik / Pradnik bifacial knives are indeed the only strictly speaking knives known in European Middle Palaeolithic Micoquian. Kolosov recognized some Prondnik / Pradnik bifacial knives for Zaskalnaya sites in the 1970s and 1980s but the illustrated pieces are not real Prondniks / Pradniks (Fig. 1: 4-5) and he never identified any Prondnik / Pradnik para-burin resharpening spalls. Nevertheless, it is important to note my recent identification of three Prondnik-like / Pradnik-like para-burin spalls (Fig. 2: 9-10) among the Kiik-Koba grotto, Micoquian layer IV materials (Demidenko 2013c: p. 112 and Fig. IV-16: 10-11). These pieces are definitely pseudo-Prondnik / Pradnik spalls reflecting very intensive and multiple but only general reshaping and rejuvenation of bifacial tools at Kiik-Koba, as Prondnik / Pradnik knives have not been recognized at the site. Thanks to my Polish colleagues Krzysztof Sobczyk and Stanislaw Kowalski I had an opportunity to study briefly Ciemna cave Prondnik / Pradnik bifacial knives and their specific resharpening spalls in 1992 at Krakow Archaeological Museum and I know how such pieces look like and serially go together (sic!) - that is not the case in Crimean nor in East European Micoquian industries and their assemblages. Thus, the discussed typologically bifacial backed knives from Crimea do not seem to be specifically produced on purpose as backed knives. Instead they are either mostly just initially / partially treated large-sized bifaces in Ak-Kaya-etalon-like and Ak-Kaya-genuine industry type assemblages or usually exhausted recurrently reshaped small bifaces in assemblages particularly belonging to Kiik-Koba industry type (Fig. 2: 6-8).

The proposed suggestion for rejection of the "type status" of bifacial backed knives in Crimean Micoquian can be also well demonstrated by eight so-called specific bifacial knives in assemblages of Zaskalnaya and Ak-Kaya sites, defined by Kolosov in the 1970s and 1980s (Kolosov 1978; 1983; 1986). In addition to the above-noted Bockstein, Klausennische

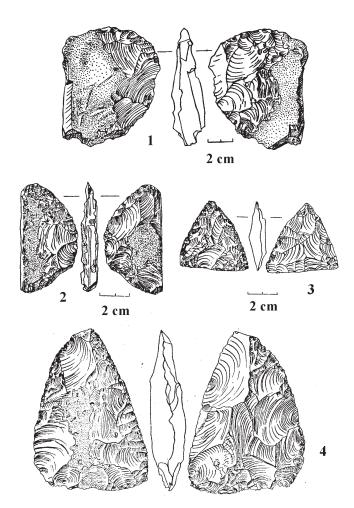


Figure 3. Various Ak-Kaya III, Zaskalnaya V and VI sites' Micoquian bifacial "backed knives": 1–2: Semi-Discoidal type; 3: Triangular type; 4: Crescent type (modified after Kolosov 1978). //

3. ábra. Különféle Micoquien "tompított hátú kések" Ak-Kaya III, Zaskalnaya V és VI lelőhelyekről. 1–2: félkör alakú típus; 3: háromszög alakú típus 4: félhold alakú típus (Kolosov 1978 nyomán).

and Prondnik / Pradnik types, he recognized knives of Ak-Kaya, Semi-Discoidal, Triangular, Crescent Types and also Knives with a Handle. Looking at the knife types' definitions with their illustrations, the following situation definitely appears.

Ak-Kaya knife type with two retouched converging edges but no back (**Fig. 1: 6**) was defined after the presence of the plaquette support's original cortical areas at both surfaces, that the knapper supposedly left out intentionally "to avoid a sliding of a human's fingers while working by a knife" (Kolosov 1978: 12). But in our opinion, such bifaces should be regarded as simply crescent side-scrapers, escaping such modern subjectivity in typological analysis of Palaeolithic artifacts.

Semi-Discoidal knife type has convex retouched edge and another edge which is naturally backed. Taking Kolosov's illustrations, it is seen that some of such pieces are either pre-cores or bifacial pre-forms (Fig. 3: 1), while other pieces are just partially treated flint plaquettes, partly similar to the Bockstein knife type, but having a strongly convex retouched edge (Fig. 3: 2).

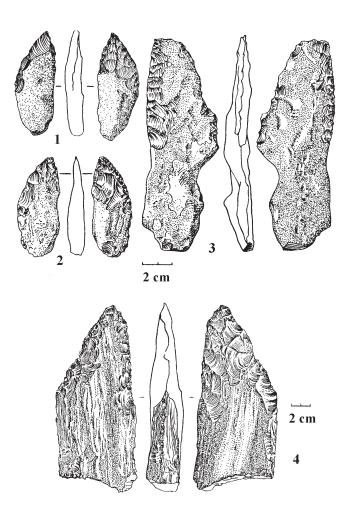


Figure 4. Various Chokurcha I, Zaskalnaya V and IX sites' Micoquian bifacial knives with a handle (modified after Kolosov 1978). //

4. ábra. Különféle nyelezett Micoquien "tompított hátú kések" Chokurcha I, Zaskalnaya V és IX lelőhelyekről. (Kolosov 1978 nyomán).

Triangular knife type, according to Kolosov's data, is mostly represented by real unifacial points and side-scrapers on flakes without any additional treatment or with various ventral thinnings. Several pieces are small-sized bifacial triangular points and side-scrapers with retouch all around their edges (Fig. 3: 3). In our opinion, the latter bifaces do represent extremely and repeatedly reshaped and retouched items, being in the end of a reduction sequence of many bifacial tools in Crimean Micoquian.

Crescent knife type is actually all around convergently retouched biface with one lateral edge being convex and another lateral edge is straight (Fig. 3: 4). In our opinion, depending on thickness and sharpness of the pieces'terminations, such pieces should be classified as crescent points or side-scrapers.

Knives with a handle are "one of the most specific tool types at Ak-Kaya culture" (Kolosov 1978: 14). They are large-sized pieces (ca. 7–20 cm long) on flint plaquettes and a handle (natural part of a plaquette) occupies ca. half of the knives' length. But taking a closer look at the illustrations, it is obvious that they are only partially retouched bifacial sidescrapers or even bifacial pre-forms (Fig. 4: 1-4).

Thus, summing up Kolosov's Crimean Micoquian data about "specific bifacial knife types", it is reasonable to make the following tripartite conclusion now. First, some of the types are not morphologically and technologically knives at all (Ak-Kaya, Crescent and Triangular ones) lacking any specific back and/or resharpening spall negatives. These are crescent / trapezoidal and triangular bifacial side-scrapers and points representing either advanced (crescent / trapezoidal) or even exhausted (triangular) tool reduction stages when all flint plaquettes' edges were already retouched and the resulting tools are well shaped and even reshaped. Second, so-called Semi-Discoidal pieces and Knives with a Handle types are really initially treated bifacial tools, being, typologically speaking, either only initial pre-forms or only partially retouched side-scrapers. Third, coming back to the Bockstein and Klausennische bifacial knife types, their intermediate position is obvious between the above-discussed initial / partially treated bifaces and bifaces with advanced / exhausted characteristics. These so-called typical Central European "Keilmesser" types of basic triangular (Bockstein) and crescent / trapezoidal (Klausennische) shapes among the Crimean Micoquian bifacial tools could be even often regarded as large-sized bifacial semi-products (sic!) at Zaskalnaya and Ak-Kaya sites, due to the still preserved natural platform covered by primary cortex on one lateral edge of a plaquette support. If extensive secondary treatment occurs on the "backed knives" their natural platforms disappear, the "Bockstein and Klausennische" are transformed into triangular and crescent / trapezoidal bifacial side-scrapers and points. At the same time, "Bockstein and Klausennische" backed bifaces but of a small-size (less than 5 cm long) are represented by a few examples at Kiik-Koba industry type assemblages, like Buran-Kaya III, layer B and Kiik-Koba, layer IV (Demidenko 2004a; 2004b; 2013c), where they show clear exhausted secondary treatment characteristics but still with a natural platform. The platform presence at these small-sized "bifacial knives" is explained by particular physical properties of the flint raw material and treatment circumstances, that obscuring removal of the natural platform around the tool edges. It must be again and again underlined that the platform presence at Crimean Micoquian "bifacial knives" is technologically connected to a whole process of bifacial "plano-convex" and sometimes "plano-convex-alternate" secondary treatment processes when a platform was needed for the transformation of a bifacial pre-form into a bifacial tool. The platform need also explains involvement of thick flakes into the Micoquian bifacial tool production. The technological "platform necessity" for the Middle Palaeolithic Micoquian bifacial "plano-convex" tool production is, however, not present in West European Mousterian of Acheulean Tradition bifacial "bi-convex" (sic!) manufacture, this is why backed bifaces occurs there rarely. Accordingly, the already noted intercorrelation pattern for the Crimean Micoquian appears:

1) the occurrence of many large-sized bifacial backed knives and a few bifacial points and convergent side-scrapers at sites near high quality flint outcrops with no high indices of both flint and ungulate carcasses exploitation (Ak-Kaya / Zaskalnaya, Sary-Kaya sites and Kabazi II site, Units III, V - VI), and

2) presence of a few, if any, of small-sized bifacial backed knives and many small-sized bifacial points and side-scrapers with any backs at sites located far away from high quality flint outcrops having high indications of both flint and ungulate carcasses exploitation (Buran-Kaya III, Kiik-Koba).

Being aware of the Crimean Micoquian bifacial backed knife problems already in the beginning of our 1990s studies, it was proposed to view such bifacial backed tools as various bifacial side-scrapers and points, similar to the well-known Central European "Keilmesser" types (Chabai, Demidenko 1998: 46). In the light of new investigations and analyses summarized in the present paper, it is clear that the 1998 approach was correct and it is useful to continue its application for both typological classification of various bifacial side-scrapers and points similar to some particular "Keilmesser" types and chaîne opératoire / tool reduction sequence secondary treatment process understanding.

3.1. Crimean Micoquian Tradition: basic industrial characteristics

In spite of the evident typological variability of Crimean Micoquian Tradition assemblages, it is still possible to link them through three very characteristic features (Demidenko 2003; 2015).

First, the flint treatment 'foundation' of the Crimean Micoquian was the systematic and intensive production and re-utilization of bifacial tools using a characteristic Micoquian "plano-convex" technique. It is worth noting here that the term "bifacial tool plano-convex technique" and its technological features were introduced into Palaeolithic Archaeology by Russian archaeologist Gleb A. Bonch-Osmolowski in his famous Kiik-Koba grotto book, by his analyses of the grotto's Micoquian upper layer flint artifacts (Bonch-Osmolowski 1940; see also in Demidenko 2013a). This technique was sometimes modified, leading to creation of "plano-convex-alternate" (Demidenko 2004a: Fig. 9-11, 6 at Buran-Kaya III, layer B; Demidenko 2013c: Fig. IV-11, 6; IV-13, 4) or even almost "bi-convex" pieces (e.g., a semi-leaf / triangular point with a concave base from level Gc1-Gc2 in the 1990s excavations at Siuren I rock-shelter due to the tool's multiple and intensive re-treatment and transformation. See Demidenko 2000: Fig. 8, 2; Demidenko 2001-2002: Fig. 10, 2; Demidenko, Chabai 2012: Fig. 6, 10).

Second, as for the primary reduction processes, Crimean Micoquian is characterized by a clear dominance of bifacial tool treatment and re-treatment debitage products over proper core reduction debitage for almost any given assemblage. Accordingly, most of the debitage blanks for unifacial tool production were products of bifacial tool reduction, multiple re-shaping and rejuvenation. Sets of unifacial tools are, first of all, characterized by a large number of various convergently shaped forms, often with many points present. Third, Crimean Micoquian Neanderthals have been almost exclusively using high quality flints for their various lithic treatment and re-treatment processes, even for sites really distant from such flint outcrops (c. 20 km or more in a straight direction), like at Kiik-Koba and Karabi Tamchin I.

These three fundamental features makethe Crimean Micoquian quite distinct from other Central and East European Micoquian industries, leading to the designation Crimean Micoquian Tradition (Chabai et al. 2000; Chabai 2004; Demidenko 2003; 2004b; 2015). Other typological features Palaeolithicand differences in various tool class and type frequencies of the Middle Palaeolithic Micoquian tradition reflect variability in site function and some specific bifacial and unifacial multiple tool reduction models and rejuvenation processes.

3.2. Crimean Micoquian Chronology

The Crimean Micoquian Tradition chronology extends for most of the Upper Pleistocene from the beginning of the Last Interglacial (ca. 120 000 BP) to the Interpleniglacial period of the Last Glacial (up to Arcy interstadial, ca. 28 000 BP uncalibrated – Chabai et al. 2000; Chabai 2003; 2004; 2008; 2011 or to Huneborg interstadial, 36 – 35 000 BP uncalibrated – Demidenko 2012; 2014a; 2014b; 2014c) when Micoquian Neanderthals were occupying Crimea. Keeping in mind such an extended chronology, the Crimean Micoquian is again set apart by another characteristic: persisting for no less 80 000 years, the tradition preserved its basic industrial features with no obvious technological changes. This unchanging and long-lasting existence has several important implications.

Flint treatment habits and components were conservative in form but, at the same time, well adapted to the changing palaeoenvironments of the Crimean Upper Pleistocene. If they had not been so adapted, they would either have changed over time or the Crimea would have been depopulated by Micoquian Neanderthals during certain periods. Indeed, pollen data for the Crimean sites (Gerasimenko 1999; 2004; 2005), indicates that Micoquian Neanderthals lived in quite variable and changing landscapes, with the palaeoenvironmental evidence structured into two basic groupings over the 80 ky interval. The Last Interglacial and different interstadials are mainly characterized by varying southernboreal forest / forest-steppe, whereas stadial intervals are represented by boreal / southern-boreal forest-steppe - boreal forest-steppe - boreal xeric forest-steppe - boreal xeric grassland. The range of main hunted ungulates remained constant during the Upper Pleistocene, focusing primarily on Equus hidruntinus, Saiga tatarica, Bovinae, Cervus elaphus and Mammuthus (see Chabai, Uthmeier 2006). The only exception for the fauna structure was during the Last Interglacial (light pine forests with an admixture of broadleaved trees for MIS 5d) when saiga and mammoth are not recorded.

The conservative nature of the Crimean Micoquian Tradition is well evidenced by the fact that no techno-typological changes occurred even when it coexisted with another Middle Palaeolithic, Levallois-Mousterian industry, and with two Early Upper Palaeolithic ("Eastern Szeletian" and Proto-Aurignacian) industries in the Crimea during the Interpleniglacial period of the Last Glacial (Chabai et al. 2000; Chabai 2003; 2004; 2011; Demidenko 2000; 2004b; 2008; 2014c). As a result, we have no evidence of Micoquian

Neanderthals borrowing any aspects of these three industries. Thus, it is possible to postulate universal characteristics of the Crimean Micoquian Tradition that reflect the ability of its makers to survive and adapt for at least 80 000 years in the Crimea. The earliest known in situ Micoquian complexes are from the Last Interglacial levels of Unit VI at Kabazi II site (see Chabai, Richter, Uthmeier, eds., 2005), and Crimea's then island geography should be kept in mind. If we do not support Neanderthal boat use during the Last Interglacial, we have to conclude that the first appearance of Micoquian Neanderthals in the Crimea occurred before it was an island, during OIS 6, when the Black Sea was much lower and the Crimea was an integrated part of the East European southern territories. This implies an even longer duration for the Crimean Micoquian, assuming a probable initial settlement during at least OIS 6.

3.3. Crimean Micoquian Tradition site function types

Our team's analysis of Crimean Micoquian sites took several factors into account, including: topography and location within the surrounding environment, i.e., open-air, rockshelter and grotto / cave sites; distance from high quality flint outcrops; identification of sediment accumulation rate & geological characteristics; site taphonomy; archaeological materials; find density and cultural level thickness; structure of archaeological levels, e.g., hearth, organic remains and presence/absence of construction elements; palaeontological and archaeozoological data on Neanderthal primary and/or secondary butchering processes of ungulate body carcasses; seasonality data. Lithic use models were defined through primary core reduction data and initial tool production processes on- and off-site; artefact class and group occurrence within a given assemblage (pre-cores, cores, tools, debitage, chips, as well as the occurrence of specific items, e.g., primary elements, lateral overshot & crested pieces and bifacial & unifacial tool shaping and especially rejuvenation artifacts) and their mutual correlation, with an emphasis on different combinations for debitage - core-like pieces, tool - core-like pieces, and specific tool shaping and/or rejuvenation items - tools. Such flint model treatment data allow consideration of raw materials and artifacts brought to the site, the use of imported and local pieces on-site, and pieces exported from the site. In combination with other data, particularly archaeozoological evidence, it is then possible to identify "ephemeral killing / primary butchering stations", "ephemeral and short-term primary and/or secondary butchering camps" and possibly "base camps". As a result of such studies, a complex and mosaic-like Crimean Micoquian Neanderthals' site radiating system appears, explaining the broad typological variability of the flint assemblages (see Chabai et al 1995; 2000; Chabai, Marks 1998; Marks, Chabai 2001; Chabai 2004; Chabai, Uthmeier 2006).

4. Concluding considerations

The above-represented data and ideas on different Palaeolithic industries with bifacial tool production traditions with an emphasis on the Crimean Micoquian lead us to the following considerations. The thorough morphological and technological analyses of bifacial tools and various debitage associated with them allow us to recognize not only a basic reduction method for production and rejuvenation of bifacial tools at any given Palaeolithic assemblages and its industry, but also some special treatment and re-treatment methods caused either by blank type peculiarities or by some tools' reshaping / rejuvenation traits. Accordingly, it is possible to trace some bifacial tool variability at each assemblage / industry and then to understand and explain the recognized variability.

The particular example of the Crimean Middle Palaeolithic industries with bifacial tools demonstrates well causes and processes of a traditional "cultural paradigm" replacement by a synthesis approach, based on a combination of various interdisciplinary studies and archaeological methods on sites and the classification and interpretation of their finds. This change in approach explains why the variability of industries' is understood now in the frames of just one Crimean Micoquian Tradition reflecting "uniformity in diversity" principles. According to the data analyzed, it clearly appears that Crimean Micoquian industrial variability should be not explained by strictly delimited areas of several culturally distinct Neanderthal tribes but, instead, by a dynamic and many-sided Neanderthal groups, differentiated by lithic reduction models and primary, as well as secondary faunal exploitation at functionally variable sites. Aside of the three basic industrial features of the Crimean Micoquian Tradition that make it distinct from other Central and East European Micoquian industries, there have been recognized two more interesting trends that explain its "industrial variability fluctuations".

First, it has been traced that "the greater the proportion of convergent side-scrapers and points, the greater is the intensity of tool reshaping and rejuvenation in a tool-kit" indicating Neanderthal economic activity at different sites. Such an "indicative tool key" certainly helps to understand different proportional representation of the same tool classes and types in various Crimean Micoquian industry types and their assemblages. Also, the Central European Middle Palaeolithic Micoquian bifacial backed knife ("Keilmesser") types appear to be not real, intentionally manufactured tool types in the Crimean Micoquian. They probably demonstrate various reduction stages of bifacial side-scraper and point manufacture, where natural platforms (backed areas) of plaquette and thick flake blanks did serve as a necessary technological element in fabrication and reduction of bifacial side-scrapers and points. As a result of different manufacture / reduction stage situations for various bifacial tools at Crimean Micoquian sites, more large-sized "backed bifacial knives" are known for short-term home camps in rock-shelters and primary killing/butchery sites near high quality flint outcrops (Ak-Kaya-etalon-like and Ak-Kayagenuine industry types), whereas only a few, if any, smallsized "backed bifacial knives" are present at primary and secondary butchery short-term camps situated far away from high quality flint outcrops, with evident indications on high intensity and extended flint exploitation (Kiik-Koba industry type) and various short-term sites with not just primary killing/butchering activity (Ak-Kaya - Starosele

and Starosele industry types). Accordingly, the former site assemblages have a lesser number of not backed bifacial convergent side-scrapers and points, while the latter site assemblages are characterized by much more numbers of the not backed bifacial convergent side-scrapers and points, achieving its numerical climax namely at Kiik-Koba industry type assemblages known about the most intensive lithic reduction characteristics.

5. Final suggestion

Keeping in mind that Central European Middle Palaeolithic Micoquian is usually now called "Keilmessergruppe" (since Veil et al. 1994; see for an overview Conard, Fischer 2000; Jöris 2006), due to a common occurrence of different "Keilmesser" / "bifacial backed knife" types in the technocomplex's assemblages, it is worth to make a special investigation on their reduction stage position within the whole set of bifacial tools for Micoquian / "Keilmessergruppe" assemblages, aside of the ones with Prondnik / Pradnik bifacial knives. If "bifacial backed knives" play in many non-Prondnik / Pradnik Central and East European Micoquian / "Keilmessergruppe" assemblages mainly the same initial / partial reduction role for production of various bifacial tools as in the Crimean Micoquian, then the term "Keilmessergruppe" is in danger, and the term "Middle Palaeolithic Micoquian" for the related Central and Eastern European assemblages is still valid but with a need of more specifications. This is, however, subject for a next separate paper that is beyond the scope of the present paper. As usual, when more work is done, more work is needed to be done and, paraphrasing one of the famous expressions of Claude Lévi-Straus, it is possible to say that the present paper does not only provides some answers, but also gives some new questions for future studies.

Acknowledgements

I am very thankful to Zsolt Mester for his kind invitation to 11th SKAM Lithic Workshop held in Miskolc (Hungary) in October of 2014. I am also deeply grateful to again Zsolt Mester, and György Lengyel, Péter Szolyák, Béla Rácz for all their logistical support in bringing me to Miskolc and then back to Ukraine, as well as for my good stay in Miskolc (Hungary) and Berehove / Beregszász (Transcarpathian Ukraine).

References

- Aubry Th., Bradley B., Almeida M., Walter B., Neves M. J., Pelegrin J., Lenoir M., Tiffagom, M. 2008. Solutrean laurel leaf production at Maîtreaux: an experimental approach guided by technoeconomic analysis. *World Archaeology* 40/1: 48–66. https://doi.org/10.1080/00438240701843538
- Anikovich M.V., Anisyutkin N.K., Vishnyatsky L.B. 2007. Key problems of Middle-Upper Palaeolithic transition in Eurasia. St.-Petersburg: Nestor-Historia. (In Russian)
- Bar-Yosef O. 2000. The Middle and Early Upper Palaeolithic in

- Southwest Asia and neighboring regions. In: Bar-Yosef, O., Pilbeam D. (eds.) *The geography of Neandertals and modern humans in Europe and the Greater Mediterranean*. Cambridge MA: Peabody Museum Bulletin, 8. pp. 107–156.
- Bataille G. 2013. Der Übergang vom Mittel- zum Jungpaläolithikum auf der Halbinsel Krim und in der Kostenki-Borshchevo-Region am Mittel-Don. Adaptionsstrategien spät-mittelpaläolithischer und früh-jungpaläolithischer Gruppen. PhD Dissertation thesis, Cologne: Universität zu Köln.
- Bonch-Osmolowski G. A. 1940. *Kiik-Koba Cave*. Palaeolithic of the Crimea Series volume 1. Moscow. (In Russian)
- Bordes F. 1961. *Typologie du Paléolithique ancien et moyen.* 2 vols., Bordeaux: Delmas.
- Bordes F. 1992. *Leçons sur le Paléolithique. Paléolithique en Europe. T. II.* Paris: Presses du CNRS.
- Bosinski G. 1967. Die mittlepaläolithischen Funde im westlichen Mittleuropa. Fundamenta A/4. Köln-Graz: Böhlau Verlag.
- Bosinski G. 1988. Participation in discussions after papers. In: Dibble H. L., Montet-White A. (eds.), *Upper Pleistocene Prehistory of Western Eurasia*. Philadelphia: University Museum, University of Pennsylvania.
- Bosinski G. 2000. Participation in discussions after papers. In: Ronen A., Wienstein-Evron M. (eds.), *Toward Modern Humans*. The Yabrudian and Micoquian 400 – 50 k-years ago. Proceedings of a congress held at the University of Haifa November 3-9, 1996. BAR International Series 850. Oxford: Archaeopress.
- Chabai V.P. 2003. The chronological and industrial variability of the Middle to Upper Palaeolithic transition in Eastern Europe. *Trabalhos de Arqueologia* 33: 71–88.
- Chabai V. P. 2004. The Middle Palaeolithic of Crimea: stratigraphy, chronology, typological variability & Eastern European context. Simferopol: Shlyakh. (In Russian)
- Chabai V. P. 2008. Kabazi V in the context of the Crimean Middle Palaeolithic. In: Chabai, V., Richter J., Uthmeier, Th. (eds.), Kabazi V: interstratification of Micoquian & Levallois-Mousterian camp sites. Palaeolithic Sites of Crimea, Vol. 3, Part 2. Simferopol—Cologne: Shlyakh. pp. 509–524.
- Chabai V. P. 2011. The chronological frames and environmental conditions of the Crimean Middle and Early Upper Palaeolithic: the state of art. In: Gerasimenko N. P. (ed.), *Quaternary studies in Ukraine. To the XVIII congress of the INQUA, Bern 2011.* Kyiv, pp. 140–157.
- Chabai V.P., Marks A.E., Yevtushenko A.I. 1995. Views of the Crimean Middle Palaeolithic: past and present. *European Prehistory* 7: 59–79.
- Chabai V.P., Monigal K. (eds.) 1999. *The Middle Palaeolithic of Western Crimea, Vol. 2.* ERAUL 87. Liège: Université de Liège.
- Chabai V. P., Demidenko Yu. E. 1998. The classification of flint artifacts. In: Marks, A. E., Chabai, V. P. (eds.), *The Middle Palaeolithic of Western Crimea, vol. 1.* ERAUL 84. Liège: Université de Liège. pp. 31–51.
- Chabai V.P., Marks A.E. 1998. Preliminary Synthesis: Middle Palaeolithic assemblage variability in Western Crimea. In: Marks A.E., Chabai V.P. (eds.), *The Middle Palaeolithic of Western Crimea, vol. 1.* ERAUL 84. Liège: Université de Liège. pp. 355–367.
- Chabai V. P., Demidenko Yu. E., Yevtushenko A. I. 2000. *Palaeolithic of the Crimea: methods of investigations and conceptual approaches*. Simfeopol-Kiev (In Russian)
- Chabai V. P., Monigal K., Marks A. E. (eds.) 2004. *The Middle Palaeolithic and Early Upper Palaeolithic of Eastern Crimea, Vol. 3.* ERAUL 104. Liège: Université de Liège.

- Chabai V. P., Richter J., Uthmeier Th. (eds.) 2005. *Kabazi II: Last Interglacial occupation, environment & subsistence. Palaeolithic Sites of Crimea, Vol. 1.* Simferopol Cologne: Shlyakh.
- Chabai V. P., Uthmeier Th. 2006. Settlement systems in the Crimean Middle Palaeolithic. In: Chabai V. P., Richter, J., Uthmeier, Th. (eds.), *Kabazi II: the 70 000 years since the Last Interglacial. Palaeolithic Sites of Crimea, Vol. 2.* Simferopol Cologne: Shlyakh. pp. 297–359.
- Chabai V. P., Richter J., Uthmeier Th. (Eds.) 2006. *Kabazi II: the 70 000 years since the Last Interglacial. Palaeolithic Sites of Crimea, Vol.* 2. Simferopol –Cologne: Shlyakh
- Chabai V. P., Richter J., Uthmeier Th. (Eds.) 2007. Kabazi V: interstratification of Micoquian and Levallois Mousterian camp sites. Palaeolithic Sites of Crimea, Vol. 3, Part 1. Simferopol Cologne: Shlyakh
- PalaeolithicChmielewski W. 1969. Ensembles Micoquo-Prondnikiens en Europe Centrale. *Geographia Polonica* 17: 371–386.
- Conard N. J., Fischer B. 2000. Are there recognizable cultural entities in the German Middle Palaeolithic? In: Ronen A., Wienstein-Evron M. (eds.), *Toward Modern Humans. The Yabrudian and Micoquian 400 50 k-years ago. Proceedings of a congress held at the University of Haifa November 3-9, 1996.* BAR International Series 850. Oxford: Archaeopress, pp. 7–24.
- Debénath A., Dibble H. L. 1994. *Handbook of Palaeolithic Typology. Volume One: Lower and Middle Palaeolithic of Europe.* Philadelphia: University Museum, University of Pennsylvania
- Demidenko Yu. E. 2000. "Crimean Enigma" Middle Palaeolithic artifacts within Early Aurignacian of Krems-Dufour complexes at Siuren I: alternative hypothesis for solution of the problem. *Stratum plus* 1: 97–124. (In Russian)
- Demidenko Yu. E. 2001–2002. Find complexes of Siuren I rock-shelter, lower cultural bearing sediments (Crimea). *Stratum plus* 2: 350–382. (In Russian)
- Demidenko Yu. E. 2003. Tool treatment pieces as indicators of peculiarities and intensity of Neanderthals flint working processes and life activities at Middle Palaeolithic sites in the context of Crimean Micoquian Tradition industrial variability. *Archeological Almanac* 13: 128–157. (In Russian)
- Demidenko Yu. E. (ed.) 2004. Buran-Kaya III rock-shelter, layer B the etalon find complex for Kiik-Koba type industry of Crimean Micoquian Tradition. Complex analysis of flint artifacts. Kyiv Simferopol: Shlyakh (In Russian)
- Demidenko Yu. E. 2004a. Buran-Kaya III layer B: the lithic assemblage. In: Chabai V. P., Monigal K., Marks, A. E. (eds.), *The Middle Palaeolithic and Early Upper Palaeolithic of Eastern Crimea*. ERAUL 104. Liège: Université de Liège. pp. 113–149.
- Demidenko Yu. E. 2004b. Kiik-Koba type industry sites and layer B of Buran-Kaya III in the context of Crimean Middle Palaeolithic Micoquian Tradition. In: Demidenko Yu. E. (ed.), *Buran-Kaya III rock-shelter, Layer B the etalon find complex type industry of Crimean Micoquian Tradition*. Kiev Simferopol: Shlyakh. pp. 256–268. (In Russian)
- Demidenko Yu. E. 2008. The Early and Mid-Upper Palaeolithic of the North Black Sea region: an overview. *Quartär* 55: 99–114.
- Demidenko Yu.E. 2012. North Black Sea region Early Upper Palaeolithic and human migrations into the region from different territories. In: Modes of contact and displacements during the Eurasian Palaeolithic. Colloque international dans le cadre de la commission 8 (Paléolithique supérieur) de l'UISPP. Université de Liège (Belgique), 29–30–31 mai 2012, p. 19.
- Demidenko Yu. E. 2013a. Gleb A. Bonch-Osmolowski an

- outstanding Palaeolithic archaeologist of the first half of the 20th century. In: Demidenko Yu. E., Uthmeier Th., *KiikKoba grotto, Crimea (Ukraine). Re-analysis of a key site of the Crimean Micoquian.* Koelner Studien zur Praehistorischen Archaologie Band 3. Rahden: Verlag Marie Leidorf GmbH. pp. 15–21.
- Demidenko Yu. E. 2013b. History of investigations: the 1920s excavations and their interpretation. In: Demidenko Yu. E., Uthmeier, Th., *KiikKoba grotto, Crimea (Ukraine).Re-analysis of a key site of the Crimean Micoquian.* Koelner Studien zur Praehistorischen Archaologie Band 3. Rahden: Verlag Marie Leidorf GmbH. pp. 23–60.
- Demidenko Yu. E. 2013c. Kiik-Koba grotto, layer IV Micoquian flint artifacts: techno-typological data and reduction models. In: Demidenko Yu. E., Uthmeier, Th., KiikKoba grotto, Crimea (Ukraine).Re-analysis of a key site of the Crimean Micoquian. Koelner Studien zur Praehistorischen Archaologie Band 3. Rahden: Verlag Marie Leidorf GmbH. pp. 73–127.
- Demidenko Yu. E. 2013d. *The Early Emiran of Initial Upper Palaeolithic:* origin hypotheses. Paper presented at Leipzig MPI Initial Upper Palaeolithic workshop.
- Demidenko Yu. E. 2014a. Crimean Late Middle Palaeolithic to Early Upper Palaeolithic Transition. In: Smith C. (ed.), *Encyclopedia of Global Archaeology*. New York: Springer Science+Business Media, pp. 1753–1766. https://doi.org/10.1007/978-1-4419-0465-2 1863
- Demidenko Yu. E. 2014b. Crimean Upper Palaeolithic. In: Smith C. (ed.), *Encyclopedia of Global Archaeology*. New York: Springer Science+Business Media, pp. 1782–1791. https://doi.org/10.1007/978-1-4419-0465-2_1864
- Demidenko Yu.E. 2014c. The Great North Black Sea region Early Upper Palaeolithic and human migrations into the region from different territories. In: Otte M., Le Brun-Ricalens E. (eds.), Modes of contact and mobility during the Eurasian Palaeolithic. Proceedings of the Liege UISPP 6th Commission Conference (May 28 31, 2012). ERAUL 140 & ArcheoLogiques 5. pp. 171-185.
- Demidenko Yu.E. 2015. Middle Palaeolithic industrial variability and tool treatment debitage diversity: some intercorrelation studies for the Crimean Micoquian. *Anthropologie* 53(1-2): 127–155.
- Demidenko Yu. E., Usik V. I. 1993a. On the lame à crête technique in the Palaeolithic. *European Prehistory* 4: 33–48.
- Demidenko Yu. E., Usik V. I. 1993b. Leaf points of the Upper Palaeolithic industry from the 2nd complex of Korolevo II and certain methodical problems in description and interpretation of the category of Palaeolithic tools. *European Prehistory* 9: 49–62.
- Demidenko Yu. E., Usik V. I. 1995. Sur les critères de reconnaissance de la fabrication in situ des pointes foliacées: l'exemple de Korolevo II. *Paleo, supplement N 1 (Actes du Colloque de Miskolc, 1991)*: 213–216. https://doi.org/10.3406/pal.1995.1399
- Demidenko Yu. E., Chabai V. P. 2012. Unit G: lithic artifacts. In: Demidenko, Yu. E., Otte M., Noiret P. (eds.), Siuren I rock-shelter. From Late Middle Palaeolithic and Early Upper Palaeolithic to Epi-Palaeolithic in Crimea, Vol. 4. ERAUL 129. Liège: Université de Liège. pp. 135–211.
- Demidenko Yu. E., Otte M., Noiret P. (eds.) 2012. Siuren I rock-shelter. From Late Middle Palaeolithic and EarlyUpper Palaeolithic to Epi-Palaeolithic in Crimea, Vol. 4. ERAUL 129. Liège: Université de Liège.
- Demidenko Yu. E., Uthmeier Th. 2013. *Kiik-Koba grotto, Crimea (Ukraine). Re-analysis of a key site of the Crimean Micoquian.*Koelner Studien zur Praehistorischen Archhaologie Band 3. Rahden: Verlag Marie Leidorf GmbH.

- Dibble H.L., Aldeias V., Jacobs Z., Olszewski D.I., Rezek Z., Lin S.C., Alvarez-Fernández E., Barshay-Szmidt C.C., Hallett-Desguez E., Reed D., Reed K., Richter D., Steele T.E., Skinner A., Blackwell B., Doronicheva E., El-Hajraoui M. 2013. On the industrial attribution of the Aterian and Mousterian of Maghreb. *Jour-nal of Human Evolution* 64: 194–210. https://doi.org/10.1016/j. jhevol.2012.10.010
- Jagher R. 2011. Nadaouiyeh Aïn Askar Acheulean variability in the Central Syrian desert. In: Le Tensorer J.-M., Jagher R., Otte M. (eds.), The Lower and Middle Palaeolithic in the Middle East and the neighbouring regions. Basel Symposium (May 8-10 2008). ERAUL 126, Liège: Université de Liège, pp. 209-224.
- Jöris O. 2006. Bifacially backed knives (Keilmesser) in the Central European Middle Palaeolithic. In: Goren-Inbar N., Gonen S. (eds.), Axe Age. Acheulian Tool-making from Quarry to Discard. London: Equinox, pp. 287–310.
- Formozov A. A. 1958. *The cave site of Starosele and its place in the Palaeolithic.* Materials and Investigations of the Archeology of the USSR 71, Moscow. (In Russian)
- Garcea E.A. A. 2012. Successes and failures of human dispersal from North Africa. *Quaternary International* 270: 119–128. https://doi.org/10.1016/j.quaint.2011.06.034
- Gerasimenko N. P. 1999. Late Pleistocene vegetational history of Kabazi II. In: Chabai V. P., Monigal K. (eds.), *The Palaeolithic of Crimea. The Middle Palaeolithic of Western Crimea, vol.* 2. ERAUL 87. Liège: Université de Liège, pp. 115–141.
- Gerasimenko N. P. 2004. Vegetational history of Buran-Kaya III. In: Chabai V. P., Monigal K., Marks A. E. (eds.), *The Palaeolithic of Crimea. The Middle Palaeolithic of Western Crimea*, vol. 3. ERAUL 104. Liège: Université de Liège, pp. 19–34.
- Gerasimenko N. P. 2005. Vegetation evolution of the Kabazi II site. In: Chabai, V. P., Richter J., Uthmeier, Th. (eds.), *Kabazi II: Last Interglacial occupation, environment & subsistence. Palaeolithic Sites of Crimea, Vol. 1.* Simferopol Cologne: Shlyakh, pp. 25–49.
- Gladilin V. N. 1966. The distinct types of stone industries in the Mousterian of the Russian Plain and Crimea and their place in the early Palaeolithic of the USSR. Proceedings of the VIIth international congress of proto- and prehistorians. Moscow, pp. 14-18. (In Russian)
- Gladilin V. N. 1971. The Early Palaeolithic. Archaeology of the Ukrainian SSR. Kiev, pp. 9–39. (In Ukrainian)
- Gladilin V. N. 1976. The problems of the Early Palaeolithic of Eastern Europe. Kiev: Naukova Dumka. (In Russian)
- Gladilin V. N. 1985. The Early Palaeolithic. *Archeology of the Ukrainian* SSR 1: 12–53. (In Russian)
- Gladilin V. N., Demidenko Yu. E. 1989. Upper Palaeolithic stone tool complexes from Korolevo. *Anthropologie* 26(2–3): 143–178.
- Gladilin V. N., Sitlivy V. 1990. Acheulean of Central Europe. Kiev: Naukova Dumka. (In Russian)
- Groucutt H. S., Scerri E. M. L. (eds.). 2014. Lithics of the Late Middle Palaeolithic: post MIS 5 technological variability and its implications. *Quaternary International* 350. https://doi.org/10.1016/j.quaint.2014.09.012
- Kleindienst M. R. 2001. What is the Aterian? The view from Dakhleh Oasis and the western desert, Egypt. In: Marlow C. A., Mills A. J. (eds.), *The Oasis Papers 1: The Proceedings of the First Conference of the Dakhleh Oasis Project*. Oxford: Oxbow Books, pp. 1-14.
- Kolosov Yu. G. 1978. Specific tool types of Ak-Kaya Mousterian culture in Crimea. In: Telegin D. Ya., Kolosov Yu. G., Neprina V. I. (eds.), *Tools of Stone Age*. Kiev: Naukova Dumka, pp. 6-19. (In Russian)

- Kolosov Yu. G. 1983. The Mousterian sites of the Belogorsk district. Kiev: Naukova Dumka. (In Russian)
- Kolosov Yu. G. 1986. *The Ak-Kaya Mousterian culture*. Kiev: Naukova Dumka. (In Russian)
- Kolosov Yu. G., Stepanchuk V. N., Chabai V. P. 1993. *The Early Palaeolithic of the Crimea*. Kiev: Naukova Dumka. (In Russian)
- Kowalski S. 1967. Ciekawsze zabytki paleolityczne z najnowszych badań archeologicznych (1963–1965) w Jaskini Ciemnej w Ojcowie, pow. Olkusz. *Materiały Archeologiczne* 8: 39–46.
- Kozlowski J.K. 1972. On the typological classification of Stone Age artifacts. *Sprawozdania Archeologiczne* 24: 455–466.
- Krukowski S. 1939–1948. Paleolit. In: Krukowski S., Kostrzewski K., Jakimowicz R. (eds.), *Prahistoria ziem polskich. Encyklopedia Polska, vol. IV, part 1 (5)*. Kraków, pp. 29–60.
- Kulakovskaya L., Kozlowski J. K., Sobczyk K. 1993. Les couteaux micoquiens du Würm ancien. *European Prehistory* 4: 9–32.
- Le Tensorer J.-M., Jagher R., Rentzel P., Hauck T., Ismail-Meyer K., Pümpin C., Wojtczak D. 2007. Long-term site formation processes at the natural springs Nadaouiyeh and Hummal in the El Kowm Oasis, Central Syria. *Geoarchaeology* 22 (6): 621–639. https://doi.org/10.1002/gea.20177
- Marks A. E., Chabai V. P. (eds.) 1998. *The Middle Palaeolithic of Western Crimea, vol. 1.* ERAUL 84. Liège: Université de Liège.
- Marks A. E., Chabai V. P. 2001. Constructing Middle Palaeolithic settlement patterns in Crimea: potentials and limitations. In: Conard, N. J. (ed.), *Settlement dynamics of the Middle Palaeolithic and Middle Stone age*. Tübingen: Kerns Verlag, pp. 179–204.
- Müller-Beck H.-J. 1988. The ecosystem of the "Middle Palaeolithic" (Late Lower Palaeolithic) in the Upper Danube region. A stepping-stone to the Upper Palaeolithic. In: Dibble H. L., Montet-White A. (eds.) *Upper Pleistocene Prehistory of Western Eurasia*. Philadelphia: University Museum, University of Pennsylvania, pp. 233–254.
- Petraglia M. D., Rose J. I. (eds.) 2009. The evolution of human populations in Arabia: paleoenvironments, prehistory and genetics. Dordrecht: Springer.
- Rolland N. 1988. Observations on some Middle Palaeolithic time series in southern France. In: Dibble H. L., Montet-White A. (eds.), *Upper Pleistocene Prehistory of Western Eurasia.* Philadelphia: University Museum, University of Pennsylvania, pp. 161–179.
- Ronen A. (ed.) 1982. The transition from Lower to Middle Palaeolithic and the origin of modern man. BAR International Series 151. Oxford: Archaeopress.
- Rose J.I., Marks A.E. 2014. "Out of Arabia" and the Middle Upper Palaeolithic transition in the southern Levant. *Quartär* 61: 49–85.
- Serangeli J., Bolus M. 2008. Out of Europe the dispersal of a successful European hominin form. *Quartär* 55: 83–98.
- Smirnov S. V. 1979. Mousterian site of Rikhta. Short Communications of the Institute of Archeology AN USSR (Moscow) 157: 9-14. (In Russian)
- Sobczyk K. 1975. Problem prądnika w świetle taksonomii numerycznej. *Sprawozdania Archeologiczne* 27: 255–268.
- Sudoł M. 2013. Kultura mikocka na ziemiach polskich. Maszynopis pracy doktorskiej w archiwum UMK. Toruń.
- Sudoł M. 2014. Mikockie inwentarze krzemienne pochodzące z badań Stefana Krukowskiego w Jaskini Ciemnej. Pradnik. *Prace i materially museum im. prof. Władysława Szafera* 24: 99–130.
- Tostevin G., Škrdla P. 2006. New excavations at Bohunice and the question of the uniqueness of the type-site for the Bohunician industrial type. *Anthropologie* 44(1): 31–48.

- Tuffreau A. 1992. Middle Palaeolithic settlement in Northern France. In: Dibble H. L., Mellars P. (eds.), *The Middle Palaeolithic: adaptation, behavior, and variability*. Philadelphia: University Museum, University of Pennsylvania, pp. 59–73.
- Usik V. I. 1989. Korolevo transition from Lower to Upper Palaeolithic according to reconstruction data. *Anthropologie* 27(2–3): 179–212.
- Valoch K. 1976. *Die altsteinzeitliche Fundstelle in Brno-Bohunice*. Studie AU ČSAV IV, I. Prague: Academia.
- Van Peer P., Vermeersch P. M. 2007. The place of Northeast Africa in the early history of modern humans: new data and interpretations on the Middle Stone Age. In: Mellars P., Boyle K., Bar-Yosef O., Stringer C.B. (eds.), Rethinking the Human Revolution. New Behavioural and Biological Perspectives on the Origin and Dispersal of Modern Humans. Cambridge: McDonald Institute for Archeological Research, pp. 187–198.
- Veil S., Breest K., Höfle H.-C., Meyer H.-H., Plisson H., Urban B., Wagner G. A., Zöller L. 1994. Ein mittelpaläolithischer Fundplatz aus der Weichsel-Kaltzeit bei Lichtenberg, Lkr. Lüchow-Dannenberg: Zwischenbericht über die archäologischen und geowissenschaftlichen Untersuchungen. *Germania* 72: 1–66.
- Zaliznyak L. L., Belenko N. N., Ozerov P. I. 2013. Site of Vys and its place in Upper Palaeolithic of Ukraine. In: Zaliznyak L. L. (ed.), The oldest time period of Novomirgorod region. Stone Age of Ukraine 15, pp. 75–105. (In Ukrainian)
- Zavernyaev F.M. 1978. *Palaeolithic site of Khotylevo*. Leningrad: Nauka (In Russian)
- Yevtushenk A. I., Chabai V. P. (eds.) 2012. *Karabai I, the Palaeolithic site in Eastern Crimea*. Archaeological Almanac 26. (In Russian)

SKAM 2014 Article

This study was presented at the 11th SKAM Lithic Workshop: the multifaceted biface - Bifacial technology in Prehistory. 20th–22nd of October, 2014, Miskolc, Hungary. The conference papers are published in the Litikum Journal volumes as special contributions. Informations about the conference are available on the SKAM 2014 website: http://skam.pannontenger.hu

