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MIDDLE PALAEOLITHIC INDUSTRIAL VARIABILITY AND TOOL TREATMENT DEBITAGE DIVERSITY: SOME INTERCORRELATION STUDIES FOR THE CRIMEAN MICOQUIAN

ABSTRACT: Industrial variability within the Middle Paleolithic Micoquian complex of the Crimea is reflected in the varied occurrence and frequencies of stone tools. Aside from bifacial shaping / thinning flakes and blades within the debitage (items ≥ 3 cm), there are 5 chip types and their subdivisions (mostly items > 1.5–2.9 cm) reflecting differing primary and secondary reduction strategies for Crimean Micoquian Tradition (CMT)assemblages. Detailed study of such chips provides valuable insights into tool production, reshaping and rejuvenation. There is increasing intensity of secondary treatment and re-treatment of flint, and associated activities from Ak-Kaya-genuine assemblages (ephemeral killing / primary butchery stations) through Starosele assemblages (various short-term primary and/or secondary butchery camps) to the Kiik-Koba assemblages (short-term primary and secondary butchery camps). The study confirms that CMT variability reflects a spectrum of anthropogenic and natural influences rather than representing discrete cultural traditions.

KEY WORDS: Middle Palaeolithic – Neanderthals – Crimean Micoquian – tool treatment debitage classification – intercorrelation in between tool typology and tool treatment debitage

INTRODUCTION

Studies of Middle Palaeolithic sites and their finds are increasingly complex, drawing upon multiple disciplines, and adopting varied approaches to artefact analysis. These have resulted in greater awareness of the dynamics of Palaeolithic flint processing, with primary and secondary lithics and their waste products no longer regarded as the static sum of "once and forever" items purposefully produced, used and then left at particular sites. This more

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dynamic view of tool production can be dated from the later 1960s to the 1990s, when studies of core primary flaking technologies demonstrated the morphological and composition diversity of both cores and debitage pieces in single Middle Palaeolithic assemblages, reflecting several underlying purposes (e.g. Marks, Volkman 1986, Baumler 1988, Van Peer 1988, 1992, Demidenko, Usik 1994, 1995a, 2003). Complementing this have been studies of changing tool types and forms through multiple reshaping and rejuvenation during repeated use, influenced by features of site function, use and location in relation to raw material outcrops.

Jelinek was an early pioneer of such "tool transformation" studies (Jelinek 1976, 1988; see also Frison1968) and the approach was further developed for Middle Paleolithic assemblages by H. Dibble (e.g. Dibble 1984, 1995) who convincingly showed that much side-scraper diversity represented different stages in their continuous retouching and rejuvenation. The form and proportions of various side-scraper types in different Middle Palaeolithic assemblages are also influenced by raw material availability and the intensity and duration of their use. As a result, Dibble has shown that there are often no objective reasons for recognising numerous cultures or culturally determined industry variants and types for Mousterian / Middle Palaeolithic assemblages in Western Eurasia.

In sum, many recent technological and typological analyses of Middle Palaeolithic industrial variability have adopted a "*chaine opératoire*" approach. The term and its important meaning are borrowed from the work of French social anthropologists (e.g. Lemonnier 1976, Cazenobe 1987, Balfet 1991). Its use for Middle Palaeolithic studies has allowed investigation of aspects of on- and off-site lithic treatments and use by Neanderthals at some sites (e.g. Geneste 1985, Marks *et al*. 1996) and even to create a concept of regional Middle Palaeolithic variability reflecting natural and anthropogenic factors with associated human settlement patterns (e.g. Chabai *et al*. 2000; see also articles in Conard Ed. 2001). The approach requires analysis of varied data for each site, its palaeoenvironment record, composition and special features of lithic inventories following the "*principle of complementarity*" (Demidenko 2004b). The present paper reviews Crimean Micoquian industrial variability through bifacial and unifacial tool treatment, with rejuvenation debitage classification and morphological peculiarities used as indicators of the intensity and duration of flint treatment processes at Neanderthal Middle Palaeolithic sites in the Crimea.

CRIMEAN MICOQUIAN TRADITION (CRIMEA, UKRAINE): COMMON INDUSTRIAL CHARACTERISTICS

For the past decade the recognition of discrete Ak-Kaya, Kiik-Koba and Starosele Mousterian cultures for understanding the variability in Crimean Middle Palaeolithic assemblages with bifacial tools (e.g. Gladilin 1976, 1985, Kolosov 1983, 1986, Stepanchuk 1991, 2002, 2006) has been replaced by one in which all *in situ* Crimean Middle Palaeolithic assemblages with serial bifacial tools are viewed within the framework of a single Crimean Micoquian Tradition (CMT) (Chabai *et al*. 2000). The approach is based on a data synthesis from interdisciplinary studies and varied archaeological approaches to sites, and the classification and interpretation of their finds. As a result, the CMT is now conceived as three basic industry types (Ak-Kaya-etalon-like, Kiik-Koba and Starosele ones) and as a complex is best described as "*uniformity in diversity*" (Demidenko 2003b).

Industrial diversity in the CMT is not limited to the three basic types: as initially proposed by V.I. Chabai, two more "intermediate types", "Ak-Kaya – genuine" and "Ak-Kaya – Starosele" ones, were also added using Micoquian materials from Zaskalnaya V and VI, and Prolom I and II sites (Chabai *et al*. 2000: 76–78). Moreover, recent (1996–1997 and 1999–2004) excavations at sites of Buran-Kaya III, Siuren I, Chokurcha I, Kabazi II and V and Karabi Tamchin (see in Chabai *et al.* Eds. 2004, 2005, 2006, 2007, 2008, Demidenko *et al*. Eds. 2012) have brought to light more Micoquian materials, making CMT typological diversity and 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. Although Chabai identified five industry types within the CMT (Chabai *et al*. 2000), since 2004 he has used just three (Ak-Kaya, Starosele and Kiik-Koba; Chabai 2004). His reasoning for continuing with the traditional tripartite division is that he views it as better typologically structured and does not lose the internal coherence that is a danger with more than three types (Chabai pers.comm.). At the same time, the two other authors of the 2000 study (Chabai *et al*. 2000) adopted more than three subdivisions for the Micoquian because it better reflected the reality of CMT diversity, and the present author has repeatedly stressed that aspect in his post 2000 publications. Equally, Yevtushenko (1959–2009), working on the KarabiTamchin CMT artefacts emphasised that: … "*assemblages of Level IV/2 and V of Karabi Tamchin exhibit typological and morphological characteristics intermediate between the Starosele and Ak-Kaya facie*" (Yevtushenko 2004: 337), adding that the Karabi Tamchin assemblages "*can be called* "*Starosele – Ak-Kaya*" *rather than* "*Ak-Kaya – Starosele, being different from the latter ones by morphological tool-kit structure*" (Yevtushenko 2003: 217). Accordingly, a recognised Starosele – Ak-Kaya type might increase number of industry types to six. Further, more recent data on CMT tool groups (Veselsky 2008a: Table 7–19, Fig. 7–30) once again confirm the great typological variability of different Crimean Micoquian assemblages that cannot be confined within only three industry types.

Whereas a strict territorial subdivision into a western region with only the Starosele culture / industry and an eastern area with only the Ak-Kaya and Kiik-Koba cultures / industries was earlier suggested by advocates of the distinct cultural traditions approach, this no longer reflects reality; assemblages from all three industry types have been recognized in both the western and eastern Crimean (Chabai 1999, 2004 for Ak-Kaya and Starosele industry types; Demidenko 2000 for Kiik-Koba industry type).

One of the most important recent developments in the analysis of CMT variability is Chabai's proposed structuring of tool class and type variability into three basic tool groups: 1) simple unifacial tools – simple, transverse and double side-scrapers; 2) convergent unifacial tools – all various convergent side-scrapers, points, denticulates and perforators; 3) identifiable bifacial tools (excluding small unidentifiable fragments of bifacial tools). The proportional representation of these groups within various assemblages and different industry types of the CMT (Chabai *et al*. 2000: Table 10) are then quantified. The advantages of such typological structure and subdivisions is that the tool classes and types constitute the dominant part of CM tool-kits, are well-recognised by most archaeologists, and their analysis can also be applied to data from old publications.

The 2000 data for each of the Crimean Micoquian five industry types are represented in *Table 1*. At first sight, such variation of typological indices for the five CMT industry types might represent distinct and different groups. But this is certainly not the case when the overlapping indices between industries are taken into consideration. Adding new data – especially those for the Kiik-Koba industry type from Siuren I rock-shelter and Buran-Kaya III grotto (see Demidenko 2000, 2004d, Chabai 2004) increases overall typological variability in the CMT. Variations of the three basic tool groups as represented by the index ranges are: simple unifacial tools 21.5–58%; convergent unifacial tools 16–61.7%; bifacial tools 9–28.7%. The internal typological ranges for these three tool groups vary between 2.7 and 4 times, with such variation for the different CMT 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 (Chabai – Monigal Eds. 1999: 220–233,Chabai *et al*. 2000: 84–90; Chabai 2004: 205–239).

GENERAL FEATURES OF THE CMT

In spite of the evident typological variability of CMT assemblages, it is still possible to link them through three very characteristic features (Demidenko 2003b: 130–131). *First*, the manufacturing "foundation" of the CMT was the systematic and intensive production and re-utilization of bifacial tools using a characteristic Micoquian "plano-convex" technique. The technique was only rarely modified, leading to a few "plano-convex-alternate" or almost "bi-convex" pieces (e.g. a semi-leaf / triangular

TABLE 1. Crimean Micoquian Tradition's 5 industry types and their basic typological indices, according to 3 tool groups (after Chabai *et al*. 2000: Table 10 p. 76).

	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%	21.5–37%
Convergent unifacial tools	21.3–23.8%	16–35%	37–43%	38.9–43.4%	51.9–56.2%
Identifiable bifacial tools	23.6–28.7%	16–27%	9–17%	12.2–13.3%	11.1–14.3%

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 (Demidenko 2000: Fig. 8, 2, Demidenko 2001–2002: Fig. 10, 2, Demidenko, Chabai 2012b: Fig. 6, 10). *Second*, the CMT, by its primary reduction processes, 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 the 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*, high quality flints were almost exclusively used by the Crimean Micoquian Neanderthals for their various flint treatment and re-treatment processes, even for sites really distant from such flint outcrops (c. 20 km or more in a straight direction). At the same time, local low quality flints and/or cherts might also be used, but these are usually rare and even in the best cases (just for a few sites' finds) do not exceed 10% of all cores, tools and debitage pieces.

The 2nd feature deserves a special important comment. In 2001 Yevtushenko discovered and in 2004–6 excavated the new open-air site of Karabai I in the Eastern Crimea (Yevtushenko, Chabai Eds. 2012). Archaeological levels of Units 3, 4 & 5 are Micoquian by tool class and type characteristics but they also contain, aside of "regular" Micoquian cores (simple parallel, radial and discoidal ones), some clear bidirectional cores with facetted main and lateral supplementary striking platforms associated with Levallois-Mousterian assemblages in the Crimea. Yevtushenko and Chabai had no single convincing explanation to account for this, suggesting the possibility of admixture of Levallois-Mousterian and Micoquian finds in the excavated units, or the presence of a new core type within the CMT (Yevtushenko, Chabai 2012: 151). A further possible explanation is proposed by the present author: the Karabai I Micoquian may belong to the East European Middle Palaeolithic Micoquian with developed core reduction methods, and be unrelated to the CMT with its rather poor core reduction processes. Accordingly, not all Crimean Micoquian assemblages might necessarily relate to the CMT, with some representing non-indigenous tool complexes brought to the peninsula by Neanderthals from continental Eastern Europe. More studies of the Karabai I Micoquian artefacts are needed to explore this suggestion.

These three fundamental features of the Crimean Micoquian make it quite distinct from other East European and Northern Caucasus Micoquian industries (e.g. Gladilin 1976, 1985), leading to the designation Crimean Micoquian Tradition (Chabai *et al*. 2000, Chabai 2004, Demidenko 2003b). Other typological features of the Middle Palaeolithic Micoquian tradition, and differences in various tool class and type frequencies again reflect variability in site function and some specific bifacial and unifacial multiple tool reduction models and rejuvenation processes (e.g. Demidenko Ed. 2004, Demidenko 2004b, Demidenko, Uthmeier 2013a).

An interesting and intriguing feature of the CMT is its chronology, which extends for most of the Upper Pleistocene from the beginning of the Last Interglacial (c. 120 000 BP uncalibrated BP) to the Interpleniglacial period of the Last Glacial (up to c. 36–35 000 uncalibrated BP) when Micoquian Neanderthals were occupying and/or frequently visiting the Crimea. In the early 2000s Chabai developed a chronological framework for the Late Middle Palaeolithic – Early Upper Palaeolithic transition in the Crimea, where the latest Middle Palaeolithic Micoquian assemblages were associated with the Arcy interstadial, c. 28 000 uncalibrated BP (see Chabai 2004, 2008, 2011a, 2011b, 2012). The present author has supported Chabai's proposed scheme, with its late survival of Middle Palaeolithic Neanderthals, and the rather late appearance of Early Upper Palaeolithic *Homo sapiens* in the Crimea (see Demidenko 2008, 2011, Demidenko *et al*. Eds. 2012). Most recently a new, older chronology has been proposed for the transition in the Crimea in which the latest Middle Palaeolithic Neanderthals survive until the Huneborg interstadial, c. 36–35 000 uncalibrated BP (Demidenko 2012a, 2014a, 2014b, 2014c). In other words, more than one chronology is now current for the transition within the Crimea, and this should be kept in mind by when considering recent developments in the Palaeolithic archaeology of the region.

Anyway, keeping in mind such an extended chronology, the CMT is again set apart by another characteristic: persisting for no less 80 kyr, the tradition preserved its basic industrial features with no obvious technological changes. This unchanging and long-lasting existence has several important implications.

First, flint treatment habits and components were, on the one hand, conservative in form and, on the other hand, 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 kyr interval. The Last Interglacial and different interstadials are mainly characterized by varying southern-boreal 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 hunted ungulates remained constant during the Upper Pleistocene, focusing primarily on *Equus hidruntinus, Saiga tatarica, Bovinae* and *Cervus elaphus* (see Chabai, Uthmeier 2006). The only exception for the fauna structure was during the Last Interglacial (light pine forests with an admixture of broad-leaved trees for MIS 5d) when saiga is not recorded.

The CMT's conservative nature is well evidenced by the fact that no techno-typological changes occurred within it even when it coexisted with another Middle Palaeolithic, Levallois-Mousterian industry, and with two Early Upper Palaeolithic, (Eastern Szeletian and Early Aurignacian of Krems-Dufour type / Proto-Aurignacian) industries in the Crimea during the Interpleniglacial period of the Last Glacial (Chabai 2004, Demidenko 2000, 2004d, 2008). 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 CMT 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 at Kabazi II site (see Chabai *et al*. Eds. 2005), and the present Crimea's then island geography should be kept in mind. If we reject Neanderthal boat use during the Last Interglacial, we should conclude that the first appearance of Micoquian tradition-bearing Neanderthals in the Crimea occurred before it was an island, during OIS 6, when the Black Sea was much lower and the Crimea an integrated part of the East European southern territories. This implies an even longer duration for the CMT, assuming a probable initial settlement during at least OIS 6.

CRIMEAN MICOQUIAN TRADITION SITE FUNCTION TYPES: DEFINITIONS AND METHODS

Our analysis of CMT sites took, several factors into account, including: topography and location within the surrounding environment, i.e. open-air, rock-shelter and grotto / cave sites; distance from high quality flint outcrops; identification of sediment accumulation rate and 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. Flint use models were defined through core primary 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 artefacts) 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 artefacts brought to the site, the use made of imported and locally gathered 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 Crimean Micoquian Neanderthals' site system appears, explaining the broad typological variability of the flint assemblages (see, among many others, Chabai 1999, 2004, Chabai, Monigal Eds. 1999, Chabai *et al*. 2000, Chabai *et al*. Eds. 2004, 2005, 2006, 2007, 2008, Demidenko 2000, 2001–2002, 2003a, 2003b, 2004a, 2004b, 2004c, 2004d, Demidenko Ed. 2004, Demidenko, Uthmeier 2013a, Marks, Chabai 2001).

TOOL SHAPING AND REJUVENATION DEBITAGE – A CLASSIFICATION ATTEMPT BASED ON BURAN-KAYA III GROTTO, LAYER B CMT FLINT ASSEMBLAGE OF KIIK-KOBA INDUSTRY TYPE

On the basis of accounts relating to debitage from other Palaeolithic sites including hand-axes, various bifacial tools, including leaf shaped points (Bordes 1961, 1972, Newcomer 1971, Schild, Wendorf 1977, Bradley, Sampson 1986, Demidenko, Usik 1993, 1995b), as well as our own studies of CMT bifacial debitage from the

1990s Starosele excavations, we have identified a series of morphological features for bifacial shaping / thinning flakes and blades that characterise CMT materials. These features are: "*a faceted, plain, or linear*, *but usually lipped butt (because of the extensive use of soft stone and bone retouchers) which has an obtuse angle in relation to the ventral surface of the blank*" and "*numerous dorsal scars, especially proximally positioned (similar to Upper Palaeolithic debitage with traces of* "*striking platform abrasion*"*); incurvate and twisted profiles; mainly trapezoidal (expanding towards the distal end) in shape, with few blunt (thick) extremities, and generally thin bodies*" (Chabai, Demidenko 1998: 40) (*Figure1: 1–8*).

These features apply to most CMT bifacial debitage irrespective of location, since they are mainly associated with the Middle Palaeolithic soft hammer technique for basic bifacial plano-convex tool treatment, and especially the re-shaping of bifacial tools. They differentiate such debitage from that characteristic on Acheulian "bi-convex" hard hammer technique (e.g. Newcomer 1971, Bradley, Sampson 1986, Debenath, Dibble 1994) and Upper Palaeolithic bi-convex thin biface soft hammer technique, sometimes associated with pressure technique (e.g. Bradley *et al*. 1995, Monigal 2004).

It is clear that shaping and/or thinning debitage from bifacial forms does not represent all shaping and rejuvenation / reshaping waste products for CMT assemblages. Additional pilot studies were undertaken by the present author for Starosele and Kabazi V sites assemblages, but a larger scale study was needed for a CMT assemblage with numerous artefacts consisting of multiple tools, flakes and blades (debitage pieces no less than 3cm by maximum dimension), and especially chips (< 3cm size) that comprise the basic primary and secondary tool waste treatment products. Such an assemblage is provided by the 1996 excavations at Buran-Kaya III grotto (eastern Crimea), which yielded a rich CMT industry of Kiik-Koba type in layer B, subdivided into levels B and B1 (see Demidenko Ed. 2004, Demidenko 2004b). Layer B was excavated over almost 7 m^2, yielding 17 342 pieces. The assemblage is characterized by a paucity of core-like objects (21), a prevalence of tools over debitage pieces (545 tools *versus* 444 flakes and blades –1.23 : 1) and a great quantity of various chips – 15 600. This material was used as core data for the CMT tool shaping and rejuvenation / reshaping waste product studies (Demidenko 2003b, 2004b, 2004c).

It would be difficult to find a better CMT assemblage for the study. Layer B contained a great density of flint artefacts (almost 2500 items per 1m^2); a relatively distant location from the nearest high quality flint outcrops (more than 10 km); and a relatively slow accumulation rate of c. 20 cm for the layer. As a result, the layer B Neanderthals' artefacts were compacted into two stratigraphically distinct levels of one layer. The Micoquian Neanderthals' visits to the grotto had already been considered to represent "*specific short-term camps of C2 type*" based upon intensive secondary faunal (ungulate) exploitation / utilization requiring the use of a large number of flint tools that were not readily available because of the distance from high quality flint sources. There is therefore evidence for multiple use and re-use of bifacial and unifacial tools, with extensive resharpening and rejuvenation episodes in addition to the tools brought to the site with edge(s) already retouched.

The starting point for the attempt to define basic criteria for tool shaping / reshaping of debitage pieces was those items (flakes and blades – ≥ 3 cm by length and/or width) related to shaping and thinning of bifacial tools. These are well represented among the layer B debitage and tool blanks: 29.3% of flake debitage, 13.8% of blade debitage, 25.4% of unifacial tools, and 49.2% of retouched pieces. However, it is impossible to differentiate flakes and blades coming from unifacial tool treatment and re-treatment processes, given the small size of unifacial tools (2.98 cm long × 3.00 cm wide × 0.68 cm thick). Such small unifacial tools not only characterise Kiik-Koba industry tool-kits with high indices of intensity and duration of flint use/re-use and the sites' considerable remoteness from high quality flint outcrops, but they are also usually typify all CMT variants. This relative uniformity of unifacial tools appears to be due to the common CMT technology of primary flint treatment processes when bifacial tool debitage predominates over core detached debitage, and the entire resulting debitage is rather small (Demidenko 1996; Marks *et al*. 1996). Unifacial secondary retouch of such comparatively small debitage pieces could only occasionally lead to the removal of further flakes > 3 cm by size, so that unifacial tool secondary products are very mostly just chips. It is therefore only possible to recognize shaping and thinning items originating from bifacial tool reduction among the CMT flakes and blades.

The vast majority of small chips (≤ 1.5 cm) were recovered during both excavation and double screening of sediments during the 1996 excavations, but not from flotation that would certainly have significantly increased the sample of pieces < 1.0 cm. While many chips resulted from primary flaking, more than half were the result of tool production and rejuvenation. And there are particular problems in studying small chips: the preservation state may not be clear; there are difficulties in understanding the dorsal scar pattern and in recognising "abrasion-like treatment" (traces of retouching and retouch rejuvenation of tools' working edges) on the intersections of their butts and the upper parts of the dorsal surfaces as the butts are too small. As a result, it is often impossible to differentiate small chips into different groups according to flint treatment processes. Thus, only some very specific tool treatment chips can be identified from CMT assemblages, such as rejuvenation by-products of unifacial and bifacial convergent tool tips, and the rare "double-ventral" Janus / Kombewa chips from the ventral basal thinning of unifacial tools (see details below). Other small chips are just counted, noting only the presence/absence of primary cortex on them.

On the basis of the above, we subdivided the layer B chips (15 466 items, omitting134 rejuvenation chips of unifacial/ bifacial convergent tools' tips) into two subgroups by size: pieces ≤ 1.5 cm – 10 649 / 61.4% and pieces > 1.5–2.9 cm – 4 817 / 27.8%. Such chips' metrical subdivision demonstrates the numerical predominance (> twice) of smaller over larger chips (68.9% versus 31.1%), reflecting the dominance of intensive multiple reshaping and re-utilization processes at the grotto. This impression is reinforced by considering the numbers of small chips (10 649) and larger ones (4 817) together with the relatively rare flakes and blades (444) from the debitage (66.9%, 30.3%, and 2.8% respectively).

In total, five basic reduction types have been identified from almost 5 000 larger-sized chips recovered from Buran-Kaya III, layer B, with most also divided into 9 sub-types (see Appendix 1).

The above scheme includes just about all possible Micoquian morphological and reduction variants of larger-sized chips (> 1.5–2.9 cm) and also some specific smaller-sized chips, such as Janus / Kombewa (sub-type 2D) and rejuvenation chips of unifacial and bifacial convergent tools' tips (type 3). This categorisation provides the basis for quantifying the percentage of each type and sub-type within different flint reduction processes and helps clarify some aspects of tool rejuvenation / resharpening actions.

Chip types 1–3 with their 9 sub-types reflect various techniques for shaping and especially the reshaping / rejuvenation of both bifacial and unifacial tools, chip type 4 is of "neutral" reduction type, whereas chip type 5 is unidentifiable in terms of a reduction approach. Analysis of all identifiable 3066 larger-sized chips, including 134 rejuvenation chips of unifacial and bifacial convergent tools' tips and, excluding the 1885 type 5 unidentifiable chips, can lead to real understanding of on-site tool shaping and reshaping processes for the layer B assemblage. The numbers and percentages of chip types "1–3" (1633 items / 53.3%) and "4" (1433 items / 46.7%) should not be viewed as definitive frequencies for each sub-type for tool resharpening and rejuvenation, but rather as "ball park" indicators of tool treatment tendencies.

Type 1 chips reflect basic bifacial tool treatment, mainly repeating the morphology from bifacial reduction of large-sized debitage (≥ 3 cm – flakes and blades).They are divided into two sub-types according to the presence or absence of so-called "butt abrasion treatment." The presence of such detached 1B chips derives from the reshaping / rejuvenation of bifacial tools' already retouched lateral edges. Usage of the "butt abrasion treatment" criteria allows us to compare proportions of 1A (39 items) and 1B (65 items) chips, and to identify a predominance of multiple reshaping / rejuvenation / resharpening processes for bifacial tools over their initial shaping processes.

2A chips (1294 items / 79.2% of all 1–3 chips) are the most numerous among chip types, reflecting their frequent occurrence from both uni- and bifacial tools, although it is not possible to determine whether they derived from the former or the latter. None the less such a large number of 2A chips points to the basic intensity and extended duration of multiple tool reshaping and re-utilization at the grotto.

2B and 2C chips reflect both the length of resharpened tools' edges and some errors in resharpening actions. The most characteristic feature of these chips is their wide (> 1 cm) butt, distributed along the entire width of a chip's proximal end, being wider than the chip's distal part, and having intensive "butt abrasion-like treatment", actually representing part of a tool's retouched edge, removed by such chip. The two sub-types are differentiated into items of fine resharpening of tools' lateral edges (2B – 65 pieces) and radical resharpening (2C – 20 pieces) formed by an unsuccessful, too strong soft hammer / retoucher blow that missed the very edge of a tool, (as with 2B chips) but at some distance from the edge, where the chip was quite thick (2C) and the blow resulted in a removal negative, morphologically similar to a "Clactonian notch" on a tool. No layer B tool has such a clear unretouched notched edge, indicating such unsuccessful removals have been definitely reshaped by detachment of more rejuvenation chips. Again the presence of these specific and also rather common chips (85 items) is a good indication of intensive and multiple resharpening of bifacial and unifacial tools' retouched edges. The chips also evidence the high skills of CMT flintknappers, in view of the >×3 prevalence (65 vs. 20) of 2B retouch chips from the fine resharpening of tools' lateral edges over 2C retouch chips derived from the radical resharpening of tools' lateral edges.

Although not frequent, 2D and 2E chips (13 and 3 respectively) are still valuable in understanding unifacial tool secondary treatment processes. They derive, as other type 2 chips do, from secondary retouching of already retouched edges, but represent an "accommodation element" formed for basal and terminal ventral thinning of unifacial tools. Again, the actual number of recognized pieces is less important than their actual presence which immediately signals an intensity of unifacial tools' various thinnings.

Finally, rejuvenation chips from unifacial and bifacial convergent tools' tips (3A and 3B) are probably the most significant and easily recognisable direct support for the multiple rejuvenation of pre-formed unifacial and bifacial tools. These pieces serve as very clear indicators of the multiple on-site resharpening of retouched edges from both unifacial and bifacial convergent scrapers and, more often, from points, whilst also serving as evidence for the transformation of convergent tool shapes during rejuvenation. Unifacial tool tips have retouch only on the dorsal surface of one of two triangular transverse terminations (*Figure 3: 1–3*), while bifacial rejuvenation pieces have rough scars and retouch scars on both ventral and dorsal surfaces of one of the two triangular terminations (*Figure 3: 4–7*). There are virtually twice as many examples from unifacial tools (88) as from bifacial ones (46). It is also important to note that these specific rejuvenation pieces from convergent tool tips are not derived from intentional removal of the tips; rather, they are accidental chips from resharpening edges adjacent to tips and result from excessive blows, instead of the detachment of a tiny portion of a retouched edge. Usually, these specific rejuvenation pieces from convergent tool tips are either not defined at all for Middle Palaeolithic assemblages or very rarely illustrated in publications, e.g. the German Micoquian (Wetzel, Bosinski 1969: Tafel 18, 10–12, 14–15; Tafel 19, 2, 9, Mania, Toepfer 1973: Tafel 29, 4, Richter 1997: Tafel 102, 6) and the Zagros-like Mousterian industry of Erevanskaya Cave in Armenia (Eritsyan 1972: Fig. 14, 15, 16). The scarcity of identification of these specific tool resharpening waste products is mainly due to their beinge it simply included in a common category of retouched tools, with no special attention paid to them, or identified as just tool fragments. At the same time, the paucity of these items in many Middle Palaeolithic assemblages could be explained by a lack of significant tool rejuvenation on site, so their recognition is really important. Moreover, 3A & 3B chips also allow us to evaluate the multiple, intensive character of unifacial and bifacial tool rejuvenation when comparing these rejuvenation chips with the respective bifacial and unifacial convergent tools: 142 unifacial convergent tools cf. 88 rejuvenation chips from their tips (1.6 : 1) and 23 bifacial convergent tools cf. 46 rejuvenation chips from their tips (0.5 : 1). The data demonstrate that while unifacial convergent tools display appreciable secondary treatment, there is much more frequent multiple retouch for bifacial convergent tools. It is also worth noting again the association of chips 1–3 and 4, and their probable reduction roles, in the layer B flint assemblage. The numerical frequencies (53.3% for 1–3 chips and 46.7% for 4 chips) should be viewed with caution since there is no absolute certainty of identifying all 2A and type 4 chips as it is sometimes very hard to differentiate them. A more cautious approach to evaluating the roles of 1–3 chip types in tool reduction is to omit type 2A chips from the 1–3 chip total, resulting in 339 among 3066 identifiable larger chips (11.1%). Overall the numerical and morphological data testify to intensive processes for the multiple shaping and reshaping / rejuvenation / resharpening / and re-utilization of unifacial, and especially bifacial, tools.

BURAN-KAYA III, LAYER B TOOL SHAPING AND REJUVENATION DEBITAGE DATA AND THEIR IMPORTANCE FOR UNDERSTANDING CMT FLINT REDUCTION PROCESSES

Bifacial tool reduction is traditional for European Micoquian bifaces and results in a plano-convex cross-section (Bonch-Osmolowski 1940, Lyubin 1965, Bosinski 1967, Boëda 1995). It consists of a series of operational steps on a blank–usually a plaquette and less often a thick flake. First, relatively large flakes are detached and some chips removed from the blank's lower (plano)surface followed by intensive working of the convex surface with the removal of differently-sized flakes, chips, and even some blades (Chabai, Demidenko 1998: 50). Removals struck from the convex surface of bifacial tools exceed the number of removals from the plano surface, minimally with a ratio of 4–5: 1. Debitage from the plano surface usually lacks the morphological characteristics associated with bifacial reduction; in the rare cases where refitting on to the plano surface is possible (see Demidenko, Usik 1993: Fig. 2, 2, 1995b: Fig. 2, 2, Chabai 2005: Fig. 6–14, 3), the pieces lack features such as platform lipping, angle, and abrasion, and are generally flat in profile. They could come from any type of reduction, including our type 4 "regular" chips from core reduction. This means that no more than c. 75–80% of large removals could be identified as originating from the convex surface treatment. Moreover, experimental replication of five British Upper Acheulean hand-axes (Bradley, Sampson 1986), using hard hammer mode and a quartzite hammerstone application, showed that only 23% in this wholly bifacial waste sample could be so classified (*sic!*). These data came from a typical Upper Acheulean bi-convex reduction technique that, by definition, should permit a greater number of recognizable bifacial flake debitage than would be the case in the Micoquian plano-convex reduction. Thus, the bifacial reduction pieces in Buran-Kaya III, layer B debitage are quantitatively important. Taking into account the many regular flakes and blades (the waste products of any flint reduction), it can be supposed that the debitage assemblage is about equally divided between products of core reduction and those of bifacial tool production and reshaping. Almost half (49.2%), of the blanks that would subsequently become retouched pieces were produced during bifacial tool shaping and reshaping which is significant. Since perhaps no piece was brought into the grotto already retouched, potentially all pieces were used as initial tools with all subsequent reduction carried out on-site. It is no exaggeration to claim that debitage by-products of bifacial tool reduction are dominant compared to blanks produced from cores.

All 9 sub-types of tool treatment and rejuvenation chips are represented in the assemblage, making this the basic and distinctive characteristic. The prevalence of "simple" 2A chips among types 1–3 types is understandable by the presence among the 2A chips of items coming from both bifacial and unifacial tools. On the other hand, 1A and 1B sub-types, representing an initial treatment and then shaping / thinning of the convex surfaces of bifacial plano-convex tools are much less numerous. There are also instances of 2B, 2C and 2D chips that indicate some specificity of purpose, and occasional "malfunctions" of multiple resharpenings of the already retouched edges of both unifacial and bifacial tools, as well as the formation of so-called "accommodation elements" associated with unifacial tools' thinning. Finally, serial rejuvenation chips of unifacial and bifacial convergent tools' tips show a significant (almost double) prevalence of such chips coming from unifacial convergent tools (88) compared with those from bifacial convergent tools (46).The associations of unifacial and bifacial convergent tools and their respective rejuvenation chips reveals the much greater incidence of terminal resharpening / reshaping / rejuvenation of bifacial tools (23 tools, 46 chips – 1 : 2) compared with unifacial convergent tools (142 tools, 88 rejuvenation chips – 1.6 : 1).

It is clear that Buran-Kaya III layer B represents a site with intensive reduction of unifacial and especially bifacial tools, both through multiple resharpening of their already retouched edges, and various reshaping and/or re-utilization of their forms. Detailed data on Buran-Kaya III layer B tools' retouch types and angles, shapes and their variations, metrical parameters etc., all reinforce conclusions based on debitage size and morphology, and the high intensity and long duration of flint treatment processes at the site, with most activity devoted to multiple secondary tool re-treatments.

The data allowed us to trace two general unifacial tool reduction models expressed in three different ways (Demidenko 2004a, 2004c). The first model for normal blanks (tool blanks with greater length than width) can follow two different paths. The first progresses from simple straight and convex side-scrapers into sub-triangular / semi-crescent side-scrapers and points and then into triangular / sub-crescent and crescent / leaf-shaped / hook-like side-scrapers and points. The second path progresses from simple / transverse side-scrapers into semi-trapezoidal elongated side-scrapers and points then into semi-crescent side-scrapers and points, thence to sub-crescent and crescent side-scrapers and points / hook-like points. The second model is for transverse blanks (greater width than length), where a single path goes from simple / transverse side-scrapers into semi-trapezoidal side-scrapers, points, and denticulates, into sub-trapezoidal and trapezoidal / leaf-shaped side-scrapers, points, denticulates, and perforators, and/or sub-crescent and crescent / triangular side-scrapers and points / hook-like points. These three trajectories usually paralleled one another through a considerable size decrease for normal blanks, ending their multiple transformations as transverse flakes and chips. It is also worth noting that the tendency to rejuvenate / reshape convergent tools resulted, in a few cases, even in points being transformed into perforators. Moreover, differential thinning of unifacial tools, with most occurring on convergent forms, provides more evidence that these types were usually heavily reduced. The bifacial reduction data demonstrate a great emphasis on point shaping and reshaping. Additional bifacial data such as the prevalence of broken bifacial tools over complete ones (2.2 : 1); the clear dominance of convergent pieces; frequent bifacial tool re-utilization; denticulation, thinning, and alternate modifications of the plano-convex technique leave no doubt that there was very intensive on-site production and rejuvenation applied to bifacial tools, markedly greater than that applied to unifacial tools.

This greater intensity of bifacial exploitation reflects both primary and secondary reduction. Unifacial tools are distinct tools, with reshaping, retouching and rejuvenation involved in producing their variants, as well as the characteristics of the tool blanks – core-like and bifacial debitage to produce flakes, blades and chips. Bifacially worked pieces are not only typologically tools, but also the source of debitage products for unifacial tools, given that they are large and thick flakes and mostly plaquettes. Bifacial tools therefore have two interrelated roles in reduction output – during manufacture and then rejuvenation processes both the manufacture of bifacial tools and the production of debitage items took place. If we combine these considerations with the long distance between Buran-Kaya III and the flint sources in the East Crimea where plaquettes and large flakes were available to Micoquian Neanderthals, it becomes clear that many unifacial and bifacial tools, as well as bifacial preforms, were brought into the grotto in an already prepared form.

Given such flint scarcity at the site and thus the need for stringent resource exploitation, both the very intensive on-site rejuvenation / resharpening of the tools introduced there, *and* the need to create new tools on-site from products transported there can readily be explained. Flint plaquettes and core-like pieces were used for unifacial and bifacial tool production. Core-like pieces for primary flaking and the shaping of new bifacial tools together with there shaping / rejuvenation of transported bifacial tools supplied the grotto's Neanderthal inhabitants with blanks suitable for unifacial tool production. However, new bifacial tool manufacturing was limited to the use of rare primary blanks – plaquettes and some large and thick flakes – which were not produced on-site during primary or secondary flint treatment processes and which were among the only intentionally transported flint items to the site. There is no other explanation for the production of very few new bifacial tools at the grotto but a massive reshaping / re-utilization / rejuvenation process for bifacial tools and their preforms. The high intensity and long duration of bifacial exploitation is also evident in the high proportion of fragmented pieces, the range of their representation in secondary re-treatment processes and the features of bifacial tools, reflecting exploitation of a scarce resource.

The intensity and duration of tool modification and rejuvenation is, closely connected to intensive on-site primary and especially secondary butchering of hunted ungulate carcasses and their consumption there (see Patou-Mathis 2004). Because of their distance from high quality flint sources, the Buran-Kaya III Neanderthals had to make repeated use of the same tools, resulting in many resharpening and rejuvenation episodes.

These observations are confirmed by use-wear studies of the tools and their rejuvenation chips (Giria 2004a, 2004b, 2004c), where there is a high percentage of bifacial and unifacial convergent forms with non-utilitarian wear traces that correspond to those obtained during an experiment where flint pieces placed together in a leather bag were transported over a long period of time (Giria 2004a: 156). The intensity of wear suggests that the tools were constantly carried for use during hunting, for instance, while simpler tools (simple and transverse side-scrapers) were usually left at the site. It is also possible that the wear pattern reflects the duration of tool use and that they underwent more intense wear than did the simple tools (Giria 2004a: 157). Well pronounced traces of use occur most often on bifacial and unifacial convergent tool tip rejuvenation pieces possibly used for meat / raw hide cutting (Giria 2004a: 158).

Transformation analysis data based on studies of separate raw material units, as well as special bifacial tool treatment data are also in accord with the typological and use-wear data (see Uthmeier 2004a, 2004b, Richter 2004, Kurbjuhn 2004).

The Buran-Kaya III layer B assemblage bearing sediments are best understood as a palimpsest of short-term C2 type camps (Demidenko 2004a: 149, 2004c: 71, 2004d: 258–259). New dates have also resulted in reappraisal of Layer B's geochronology and sedimentation peculiarities. It was formerly thought that Buran-Kaya III layer B dated from the Denekamp / Arcy interstadial, and had the lowest sedimentation rate of all Crimean sites with Kiik-Koba industry type of CMT (e.g., Chabai *et al*. 2000, Chabai 2004, Chabai, Uthmeier 2006). New AMS dates for Upper Palaeolithic levels 6-2 and 6-1 at c. 35–34 and 32–31 000 uncalibrated BP (Prat *et al*. 2011), and a reconsideration by the present author for levels 6-5 through 6-1 / 5-2 from the Late

Aurignacian / Early Gravettian and Epigravettian to the Southern Caucasus Early Upper Palaeolithic have implications for layer B, which is stratigraphically below these levels. Buran-Kaya III layer B with its Kiik-Koba type industry is more likely to date from the Les Cottes / Huneborg interstadial. Now the whole c. 1 m thick sequence for Buran-Kaya III level C ("Eastern Szeletian") to layer B – levels 6-5 – 6-1 / 5-2 – was characterized by a fairly high deposition rate, leaving almost no sterile horizons between archaeological layers and levels for the time period c. 36–31 000 uncalibrated BP (Demidenko 2012a, 2014a, 2014b). Accordingly, Buran-Kaya III's levels B and B1did not accumulate during a phase of very slow sedimentation, and several Micoquian Neanderthal occupational episodes accumulated within just one c. 20 cm thick stratigraphic layer, due mainly to very intensive human activity at the site.

ASSEMBLAGES' TOOL SHAPING AND REJUVENATION DEBITAGE DATA AND THEIR FLINT REDUCTION MEANING IN THE CONTEXT OF CMT INDUSTRIAL VARIABILITY

The Buran-Kaya III layer B study demonstrates that close analysis of tool shaping, thinning, reshaping and rejuvenation debitage data can provide significant information on the intensity, duration and distinctive features of artefact secondary treatment processes in the CMT (*Table 2*).

<u>The Ak-Kaya-genuine industry type represents ephemeral killing / primary butchering stations for carcasses dismembering (type A).</u>

Published data are from Early Last Glacial cultural bearing sediments at Kabazi II open-air site, (level IIA/4 of Unit II and upper levels of Unit III), over areas of 10–36 m^2 (Chabai 1998, 1999; see also in Chabai *et al*. Eds. 2006). Here *"core reduction ... did not play a significant role, if it occurred at all"; "unifacial tools with length more than 5 cm ... have been brought to the site in the already prepared shape"*, while *"unifacial tools with length less than 4 cm were basically produced on bifacial tool debitage waste"* at the site and having bifacial tools´ preforms and their debitage, *"there is no doubt of bifacial tool production at the site"*, although *"there are some unquestionable data on imported bifacial tools"* to the site (Chabai 1999: 63). Bifacial shaping / thinning flakes and blades, as well as 1A, 1B and 2A chips detached from both bifacial and unifacial tools are well represented at Kabazi II; on the other hand, 2B, 2C, 2D, 3A and 3B chips are not represented at all there, reflecting a complete absence of multiple reshaping and rejuvenation of tools' previously retouched edges. The lack of these indicative chips correlates well with a rarity of convergent side-scrapers, the absence of any convergently shaped denticulated tools, and the occurrence of just a few points among a set of unifacial tools, whereas bifacial tools are numerous (no less than 20% of all identifiable tools) with only a few indications of their re-utilization.

Modifying some of Chabai's data for the Kabazi II Unit III assemblages (Chabai 1999: Table 2), one can derive a tripartite tool structure: 20 tools / (54.1%) of simple unifacial tools (simple, transverse and double side-scrapers), 7 (18.9%) of convergent unifacial tools (all convergent side-scrapers, points, denticulates and perforators), 10 (27%) of identifiable bifacial tools. Very similar structures are known for other Kabazi II, Micoquian (Ak-Kaya-genuine) industry type assemblages from Last Interglacial deposits (see Chabai 2005). Absence of the specific tool rejuvenation chips noted above point to the common ephemeral nature of Neanderthal visits to Kabazi II open-air sites concerned with limited, specific activity – the rotational and systematic hunting of *Equus hydruntinus* followed by primary butchering of the horses' carcasses. Body parts rich in meat were then transported to other sites such as Kabazi V rock-shelter for specialised secondary butchering.

<u>The Starosele industry type represents various short-term primary and/or secondary butchery camps focused on ungulate carcass dismembering</u>

Materials representing the Starosele Micoquian are well known from the1990s excavations at Starosele and Kabazi V sites. Both short-term primary and secondary butchery camps of B type are known, such as Starosele site, level 1 with an excavated area of c. 30 m^2, and short-term, mainly secondary butchery camps of C1 type, such as various levels in Unit III of the Kabazi V rock-shelter, with areas of c. 8–12 m^2 (Chabai *et al*. 2000). The Starosele and Kabazi V assemblages are similar to those from Kabazi II with limited primary (core-like) flint treatment processes and basically bifacial tool reduction, but with additional indications of secondary tool treatment processes because of the sites' differing functional specificity (see Marks *et al*. 1996, Yevtushenko 1998). According to Chabai's accounts (Chabai *et al*. 2000: Table 10), the Starosele and Kabazi

TABLE 2. All Kiik-Koba and some Starosele and Ak-Kaya industry types' assemblages: techno-typological and variability data. Notes: * accounts on the basis of all definable debitage pieces (≥ 3 cm) and blanks of unifacial tools and retouched pieces; ** accounts on the basis of unifacial tools only; *** accounts on the basis of debitage pieces (≥ 2 cm) only. Data sources: Buran-Kaya III (Demidenko 2004c), Siuren I (Demidenko 2000; 2001–2002), Kiik-Koba (Demidenko 2013c), ProlomI – recalculated from Stepanchuk (2002), Starosele – recalculated from Marks, Monigal (1998), Kabazi V – recalculated from Yevtushenko (1998), Kabazi II – recalculated from Chabai (1999).

	Kiik-Koba type				Starosele type		Ak-Kaya type
	Buran-Kaya III, layer B	Siuren I, lower layer / Units H & G	Kiik-Koba, Layer IV	Prolom I	Starosele, level 1	Kabazi V, complex C – levels II/4a, II/7	Kabazi II, levels III/1A – III/3
Ilam	9.1*	?	15,6*	11.4**	18.0*	7.9*	6.2*
IFl	39.7*	?	38.1*	36.9***	45.7*	52.6*	?
IFst	13.9*	?	18.7*	26.1***		23.8*	?
Simple Unifacial Tools	99 / 38%	14 / 24,1%	82 / 30.4%	223 / 31%	49 / 45,8%	26 / 42,6%	20 / 48,8%
Convergent Unifacial Tools	133 / 51,2%	37 / 63,8%	146 / 54.1%	399 / 55,6%	44 / 41,1%	24 / 39,4%	7 / 17,1%
Bifacial Tools	28 / 10,8%	7 / 12,1%	42 / 15.5%	96 / 13,4%	14 / 13,1%	11 / 18%	14 / 34,1%
Identifiable Unifacial Tools	269 pieces	52 pieces	242 pieces	671 pieces	111 pieces	56 pieces	32 pieces
Scrapers	61%	38,5%	56.3%	49,5%	64,9%	62,5%	75%
simple	30,5%	3 items + ?	35,3%	41,0%	30,6%	51,5%	45,8%
transverse	20,1%	1 item + ?	16,9%	12,3%	18,1%	11,4%	12,5%
double	9,8%	2 items + ?	8,1%	13,9%	19,4%	11,4%	25,0%
convergent	39,6%	6 items + ?	39,7%	32,8%	31,9%	25,7%	16,7%
Points	31,2%	59,6%	40,5%	43,2%	18,9%	26,8%	9,4%
Denticulates + Notches	5,2%	1,9%	2,0%	2,8%	15,3%	10,7%	15,6%
"Upper Paleolithic" types	2,6%	?	1,2%	4,5%	0,9%		
Identifiable Bifacial Tools	28 pieces	6 pieces	42 pieces	96 pieces	14 pieces	11 pieces	14 pieces
Bifacial Preforms	3,6%	?	no	?	42,9%	63,6%	28,6%
Bifacial Points	57,1%	1 item +?	59,5%	66,7%	50,0%	27,3%	21,4%
Bifacial Scrapers	32,1%	2 item +?	38,1%	33,3%	7,1%	9,1%	50,0%
Single- and double- edged	14,2%	1item +?	4,8%	15,6%			14,3%
Convergent	17,9%	1 item +?	33,3%	17,7%	7,1%	9,1%	35,7%
Denticulates	7,2%	?	2,40%	?			
All Bifacial Convergent Tools	85,7%	2 item +?	95,20%	84,40%	100%	100%	80%
identifiable unifacial tools: core-like pieces	12.8 : 1	10.4 : 1	22 : 1	10.5 : 1	12.3 : 1	18.7 : 1	16 : 1
Identifiable unifacial tools: core-like pieces + identifiable bifacial tools	5.5 : 1	4.3 : 1	4,6 : 1	4.2 : 1	4.8 : 1	4.0 : 1	2.0 : 1
Average density per sq. m of identifiable unifacial and all bifacial tools	48,9	?	9,4	19,3	4,4	5,7	< 1

V tool-kits are characterized by a tripartite tool structure as follows: unifacial simple types – 44.3–48.1%; unifacial convergent types – 38.9–43.4%; identifiable bifacial tools – 12.2–14.3%. In comparison to the Ak-Kaya-genuine indices from the ephemeral killing / primary butchering stations of Kabazi II (Unit III), Starosele industry type indices from Starosele and Kabazi V short-term primary and/or secondary butchery camps demonstrate a lower share of unifacial simple types, more than twice as many unifacial convergent types and, at the same time, only half the frequency of identifiable bifacial tools. Such tool structure diversity interconnects with the functional variability of Micoquian sites and their find complexes in the Crimea.

The basic characteristics of the Starosele and Kabazi V debitage data are represented below. Numerous bifacial debitage (flakes and blades) and 2A, 1B and 1A chips (in descending numerical order) occur in addition to small numbers of 2B, 2C, 3A and 3B chips. But the latter sub-types are in fact represented by a few pieces. There are only 3 of 2B and 2C chips, and 3 each of 3A and 3B chips in the Starosele level 1 assemblage, and just 3 each of 2B and 3B chips in the Kabazi V Unit III, level 5 assemblage (A. I. Yevtushenko 1996 excavations). No 2D chips were recognized. The small numbers of 2B, 2C and 3A, 3B rejuvenation chips from retouched edges point to only sporadic tool edge reshaping in contrast to the intensive activity at Buran-Kaya III.

Comparison of 3A &3B chip frequencies with those of unifacial and bifacial convergent tools is informative. At Starosele level 1 there are 44 identifiable unifacial convergent tools (side-scrapers and points) and just 3 type 3A rejuvenation chips (14.7 : 1), with 8 identifiable bifacial convergent tools (7 points and 1 side-scraper) and 3 type 3B rejuvenation chips (ratio 2.7 : 1) (Marks, Monigal 1998: Table 7–9). At Kabazi V , Unit III, level 5 the corresponding figures are: 15 unifacial convergent tools (again, only side-scrapers and points) and no 3A rejuvenation chips, together with 4 bifacial convergent tools and only 2 type 3B rejuvenation (ratio 2 : 1). Data from the early 2000s excavation of the Starosele industry type assemblage at Kabazi V site agree well with the 1996 excavation data from the site (see in Chabai *et al*. Eds. 2008). The above data demonstrate occasional intensive secondary treatment processes for a few tools in Starosele industry type of CMT assemblages. It is also worth noting the higher degree of rejuvenation for the admittedly rarer bifacial compared with unifacial convergent tools already noted for the Buran-Kaya III layer B Kiik-Koba type CMT.

All in all, the functions of the Starosele and Kabazi V sites (short-term primary and/or secondary butchery camps) shows a shift of basic typological indices toward those of the Starosele type having, compared with Ak-Kaya-genuine assemblages, a significantly higher share of unifacial convergent tools, some reduction of unifacial simple tools and a radical reduction of identifiable bifacial tools. Only some occurrence of specific rejuvenation chips from the multiple retouching and rejuvenation of unifacial and bifacial convergent tools confirms the "intermediate" typological position of Starosele industry assemblages between the functionally differentiated sites with Ak-Kaya-genuine and Kiik-Koba industry assemblages, and their data on the modest intensity and duration of flint secondary treatment processes.

Examination of tool treatment data from Ak-Kaya-genuine and Starosele industry assemblages reinforce the conclusion that materials from Kiik-Koba type industry sites represent the most extreme tool reduction data for CMT assemblages.

Other Kiik-Koba type industry materials representing short-term primary and secondary butchery camps associated with ungulate carcasses dismembering

Three other collections are included in the Kiik-Koba industry type of CMT: Kiik-Koba grotto, layer IV; Prolom I grotto, and Micoquian artefacts from the 1920s excavation lower layer and the 1990s excavation Units H and G at Siuren I rock-shelter (see Demidenko 2000, 2001–2002, 2004a, 2004d, Demidenko 2012b, Chabai *et al*. 2000, Stepanchuk 2002, Demidenko, Uthmeier 2013a). The assemblages from Buran-Kaya III, Kiik-Koba and Prolom I are similar in having unifacial simple tools below 40% and unifacial convergent tools of more than 50% (Chabai *et al*. 2000: Table 10). Buran-Kaya III, Kiik-Koba and Prolom I tool-kits contain respectively: unifacial simple tools 38% – 30.4% – 31%; unifacial convergent tools 51.2% – 54.1% – 55.6%; identifiable bifacial tools – 10.8% – 15.5% – 13.4%. The three assemblages' characteristics result from multiple Micoquian Neanderthals' visits to the sites with very intensive activity there.

Siuren I rock-shelter. The finds from Siuren I rock shelter occupy a special place within Kiik-Koba industry type assemblages. The three or four lowermost "hearth / ashy levels" of the 1920s lower layer, and the 1990s Units G and H contain among numerous Proto-Aurignacian finds some separate Micoquian flint artefacts and bone retouchers. The co-occurrence of Micoquian and Proto-Aurignacian finds are interpreted by the present author (Demidenko 2000, 2001–2002, Demidenko 2012b) as cultural remains left after alternating visits to the rock-shelter by both Late Middle Palaeolithic (Micoquian) Neanderthals (frequent, very ephemeral occupations) and Early Upper Palaeolithic (Proto-Aurignacian) *Homo sapiens* (frequent occupations with intensive short-term primary and secondary butchery camps) during the stadial between the Hengelo and Les Cottes / Huneborg interstadials for the 1990s Unit H, and the Les Cottes / Huneborg interstadial for the 1920s lower layer and the 1990s Unit G (Demidenko 2012a). Given the rather rapid sedimentation, Proto-Aurignacian levels "absorbed" the rare Micoquian artefacts, creating an archaeological sequence with only Proto-Aurignacian levels containing additional Micoquian pieces, instead of the actual interstratification of Micoquian and Proto-Aurignacian levels. If sedimentation were slower the deposit would consist of one thick layer containing mainly Proto-Aurignacian with some Micoquian artefacts.

Categorisation of the Siuren I CMT tool-kits based on only 58 flint tools that can be definitely related to Micoquian occupations at the rock-shelter: 40 pieces from the 1920s lower layer and 18 pieces from the 1990s Units H and G. They comprise the following counts for the three tool groups: unifacial simple tools (14 items / 24.1%); unifacial convergent tools (37 items / 63.8%); identifiable bifacial tools (7 items / 12.1%) (Demidenko 2001–2002). Comparing these with the data from Buran-Kaya III, Kiik-Koba and Prolom I suggests that the Siuren I Micoquian assemblages may well represent the most reduced tool-kits for the whole set of Kiik-Koba industry type assemblages in the Crimea. The limited nature of the assemblage militates against firm identification of a particular variant (see Chabai 2004). However, it is likely that Micoquian Neanderthals used

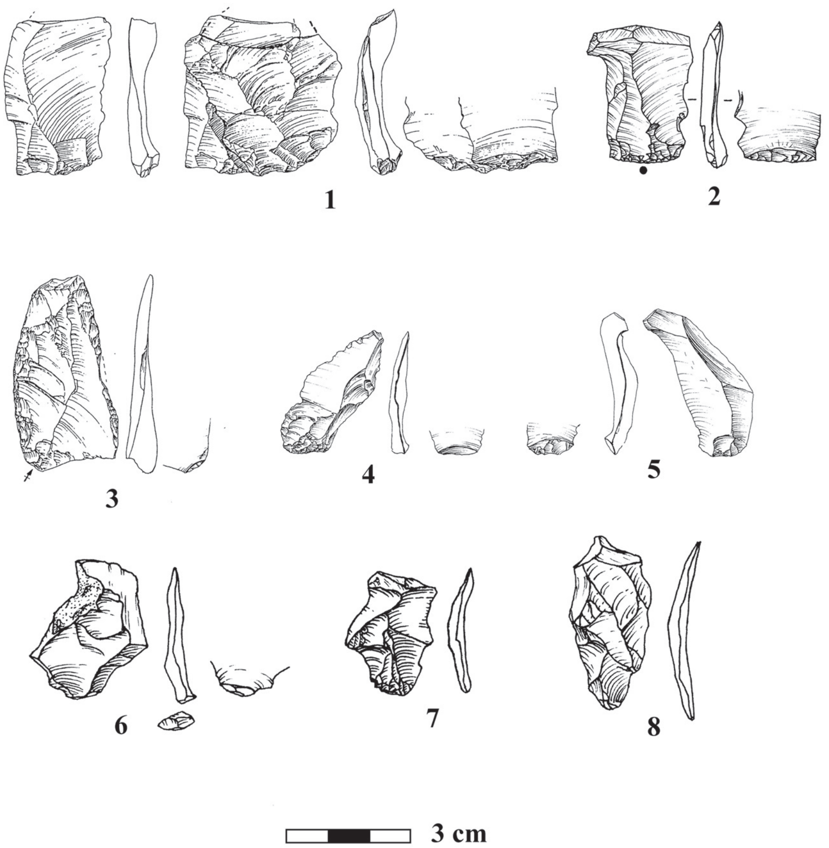

FIGURE. 1. Crimean Micoquian "bifacial debitage": 1, two refitted bifacial shaping / thinning flakes; 2, 6, 7, bifacial shaping / thinning flakes; 3, double side-scraper on bifacial shaping / thinning blade; 4, 5, 8, bifacial shaping / thinning blades. 1 & 3, Starosele site, level 1, modified after Marks *et al*. 1996; 2, Siuren-I rock-shelter, Unit H, modified after Demidenko 2000; 4–5, Buran-Kaya III grotto, layer B, modified after Demidenko 2004c; 6–8, Kiik-Koba, Layer IV, modified after Demidenko 2013c.

the small number of flint artefacts during their ephemeral stays at Siuren I and that the primary and/or secondary butchering of hunted ungulate carcasses led to much reshaping and rejuvenation of tools brought to the rock-shelter. Taken together, the data from the Kiik-Koba industry type sites demonstrate the most intensive degree of secondary flint treatment within the CMT. As noted above, this reflects both a deficit of high quality flint because of the distance from outcrop sources, and the functional specificity of the ephemeral / short-term primary and secondary C2 butchery camps.

It is worth examining in more detail the three assemblages' debitage data. The Siuren I 1990s excavation (12 m^2 area) recovered Micoquian finds from the lowermost Unit H up to the uppermost level Gb1–Gb2 (Demidenko 2000, 2001–2002, Demidenko, Chabai 2012a: 130–133, 2012b: 205, 208–210). Aside from 20 tools, it also contained 23 tool treatment flakes and chips. There are just 2 flakes >3 cm and 21 chips. By type and sub-type data, they are: 2 × 1B tool treatment flakes for 1 bifacial thinning piece (*Figure 1: 2*) and 1 × 2A common retouch piece. 21 tool treatment chips as

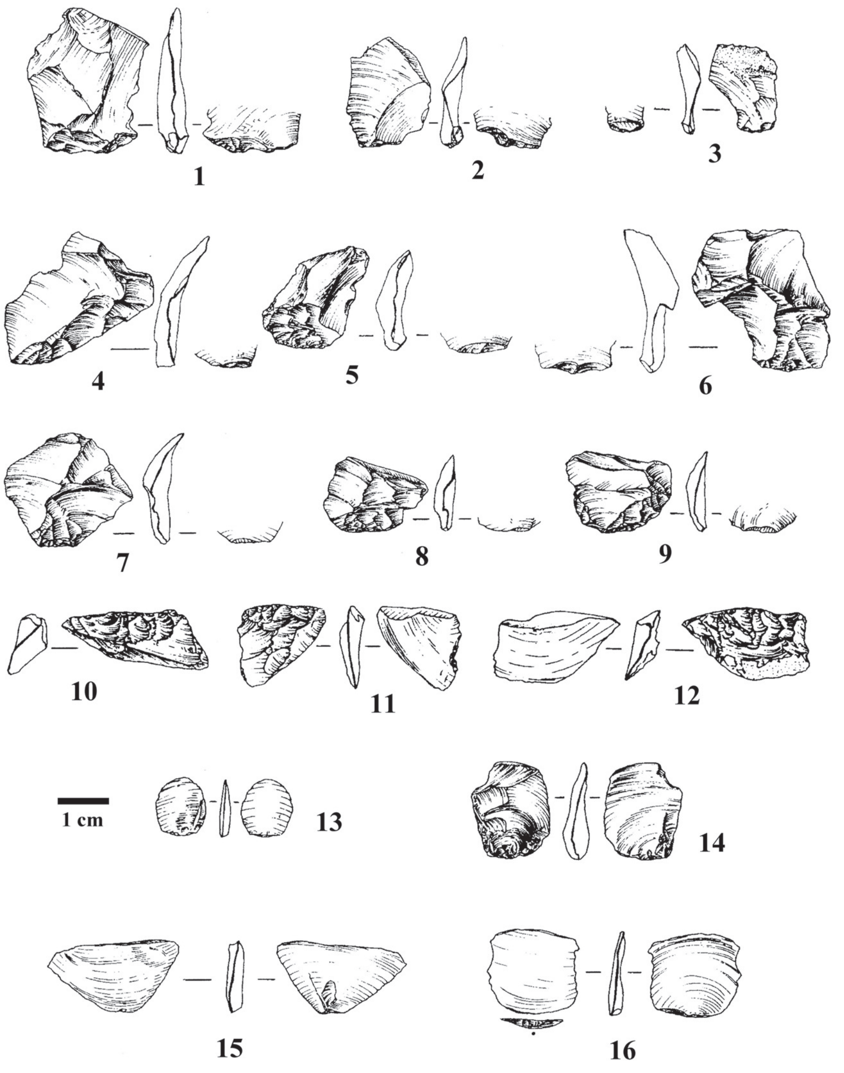

FIGURE 2. Buran-Kaya III, layer B, modified after Demidenko 2004c: 1–3, bifacial initial treatment chips of sub-type "1A"; 4–6, bifacial thinning chips of sub-type "1B"; 7–9, common retouch chips of both bifacial and unifacial tools of sub-type "2A"; 10, 11, retouch chips from fine resharpening of tools' lateral edges of sub-type "2B"; 12, retouch chips from radical resharpening of tools' lateral edges of sub-type "2C"; 13, 14, "Janus / Kombewa" chips from basal ventral thinning of unifacial tools of sub-type "2D"; 15, 16, "Janus / Kombewa" chips from terminal ventral thinning of unifacial tools of sub-type "2E".

follows: 1 × 1A bifacial initial treatment piece (*Figure 4: 1*); 1 × 1B bifacial thinning piece (*Figure 4: 2*); 16 × 2A common retouch pieces (*Figure 4: 3–4*); 1 × 2D "Janus / Kombewa" chip from the basal ventral thinning of a unifacial tool (*Figure 4: 5*); 1 × 3A rejuvenation piece of a unifacial convergent tool's tip (*Figure 4: 6*); and 1 × 3B rejuvenation piece of a bifacial convergent tool's tip (*Figure 4: 7*). These 1990s finds from Siuren I highlight and confirm the clear Neanderthal tendency for bringing tools already produced to the rock-shelter followed by their intensive reshaping and rejuvenation there.

The Siuren I lower layer of c. 85 m^2area excavated in the 1920's (the stratigraphic analogue of the 1990s excavation Unit G) (Demidenko 2000, 2001–2002, Demidenko 2012b, Demidenko 2012c) also contained 5 cores and 40 tools that are typically Crimean Micoquian. There is also debitage and tool chips from the 1920s excavations at the Department of Archaeology, Peter the Great Museum of Anthropology and Ethnography (Kunstkamera museum) St.-Petersburg, which I briefly examined in 1999 (Demidenko 2001–2002: 373, Demidenko 2003b: 149–150). I identified 3 × 3A rejuvenation chips from unifacial convergent tools' tips from 1927 excavation squares 12 – Г, Е, Ж and 11 – Г of the lower layer. This testifies not only to Micoquian tool presence in the lower layer, but also to rejuvenation chips as also known from1990s Units H and G.

Taking into account the recognized 4 rejuvenation chips from unifacial convergent tools' tips (3A) and 1 rejuvenation chip from a bifacial convergent tool's tip (3B) and comparing these with the 10 unifacial

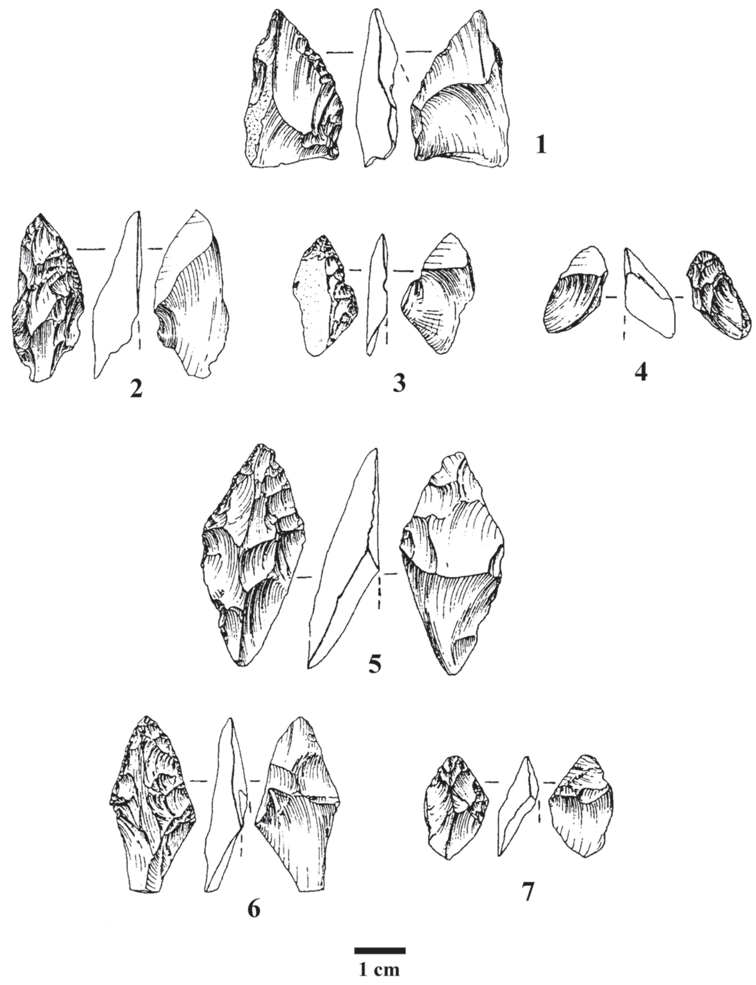

FIGURE 3. Buran-Kaya III, layer B, modified after Demidenko 2004c: 1–4, rejuvenation pieces on resharpening of unifacial convergent tools' tips of sub-type "3A"; 5–7, rejuvenation pieces on resharpening of bifacial convergent tools' tips of sub-type "3B".

convergent tools and just 1 bifacial convergent tool recovered from the excavation areas where the rejuvenation chips were found gives ratios of, 2.5 tools: 1 chip for unifacially treated items, and 1 tool: 1 chip for bifacially treated items. Bearing these data in mind in light of the Siuren I Micoquian's maximal index of unifacial convergent tools and minimal index of unifacial simple tools among the four KiikKoba CMT tool-kits the affiliation of the Siuren I Micoquian to the KiikKoba variant is indeed evident.

Prolom I grotto. The site was found and completely excavated by Yu. G. Kolosov in the 1970s (Kolosov 1979, Kolosov *et al*. 1993, Stepanchuk 1991, 2002; see also Demidenko 2003a, 2003b, 2004a, 2013a). The excavated area of c. 68m^2 revealed a Pleistocene sediment sequence composed of two layers <1 m thick in total. The two stratigraphic layers were considered as two archaeological layers and both were regarded as "*Kiik-Koba Mousterian cultur*e" with bifacial tools (according to Kolosov and Stepanchuk) and further displaying, following Stepanchuk, an enigmatic "*para-Micoquian or Charentoid para-Micoquia*" or "*atypical Charentian with features of a Micoquian influence*". Using the present author's approach, the Prolom I materials belong to the Kiik-Koba industry type of the CMT. The site's material has not been fully analysed: in particular, only approximations, not precise counts, of tools and debitage from each of the two layers are available (see Demidenko 2013a: 49–50).

It is accordingly necessary to combine data from the two layers and to treat them as one archaeological unit. A total of almost 11,000 flint pieces and c. 1150 tools were recovered, including pieces with marginal and/or irregular retouch. According to my recalculation of Stepanchuk's data (Stepanchuk 2002: 66–82), unifacial and bifacial convergent side-scrapers and points are frequent in the Prolom I total tool-kit: 399 pieces / 61.3%, and 67 pieces / 71.3%, respectively. On the basis of such convergent tool data, the Prolom I Micoquian assemblage fits very well into the Kiik-Koba type CMT.

At the same time, there are a number of problems with the Prolom I materials. Stepanchuk used only a very small sample to establish the debitage characteristics: faceting indices are based on 14 blades and 72 flakes; dorsal scar pattern types on 54 blades and 423 flakes; metrics based on measurements of 54 blades and 390 flakes of the 2859 flakes and 125 blades there. Furthermore, there is no information on tool treatment pieces in Stepanchuk's publications, as they were not recognized in the late 1980s when he worked on the Prolom I artefacts. It is therefore not possible to evaluate the variability and quantities of specific flint artefacts. But curiously enough, rejuvenation chips of unifacial and bifacial convergent tools' tips (3A and 3B) have been recognized by the present author among the following tools categorised by Stepanchuk as "*unidentifiable unifacial and bifacial tools*" under the term "*terminal fragments of points / tips of pointed tools*" (Stepanchuk 2002: 73, 74, 80, 82, Table XXXIX: 1–7, 10–12, 14, 17–21, 25–26). Thanks to the illustrations, it is also possible to differentiate rejuvenation chips into 3A unifacial (Stepanchuk 2002: Table XXXIX: 1–2, 4, 10–12, 14, 17–19, 26) and 3B bifacial types (Stepanchuk 2002: Table XXXIX: 3, 5–7, 20–21, 25). Besides, according to the illustrated items, it seems that 3A and 3B rejuvenation chips might well outnumber real terminal fragments of unifacial and bifacial convergent tools, although it is impossible to determine exact numbers due to mixing with true terminal fragments of various convergent tools (see Stepanchuk 2002: Table XXXIX: 8–9, 13, 15–16, 22–24). It is only possible to note the numbers of all Stepanchuk's so-called "*terminal fragments of points / tips of pointed tools*" including our 3A and 3B rejuvenation chips: 64 for unifacial and 39 for bifacial tools. There is no certainty that some rejuvenation chips were not included within other artefact categories (e.g. some tool groups). But, given a series of indicative rejuvenation chips for the Prolom I assemblage, it is reasonable to suggest the presence of other categories of shaping / thinning and rejuvenation items within it. More detailed characterisation of the Prolom I Micoquian artefacts must await further analysis.

Kiik-Koba grotto. The Kiik-Koba grotto finds, excavated by G. A. Bonch-Osmolowski in the 1920s, have been only partially studied using either labelled cores and tools together with very limited data on unlabelled debitage and chip collections (e.g. Bonch-Osmolowski 1940) or restricted data on just labelled cores and tools (e.g. Gladilin 1976, 1985; see also Demidenko, Uthmeier 2013b). Stepanchuk (1991, 2002) reported the loss of up to 75% of the finds from the 1920 excavations, with predominantly labelled cores and tools only present in the Kunstkamera Museum collections. However, in 2001 it became clear to the present author that all the artefacts excavated during the 1920s are still present in the Kunstkamera museum, and a new re-study of all material from the upper archaeological Micoquian layer (lithological layer IV) was undertaken in 2003, together with the fauna stored at the Zoological Institute of the Russian Academy of Sciences (see Demidenko, Uthmeier 2013b). The layer IV Micoquian assemblage consists of 2658 items, including 417 tools, which have been studied in detail by the present author and Th. Uthmeier (Demidenko 2013b, 2013c, Uthmeier 2013) using the same approach as for the Buran-Kaya III, layer B assemblage.

As noted above, the Kiik-Koba layer IV assemblage consists of unifacial simple tools (30.4%); unifacial convergent tools (54.1%); identifiable bifacial tools (15.5%). The Buran-Kaya III collection is similar to Kiik-Koba, but with a higher percentage of simple unifacial tools (38%) and somewhat fewer unifacial convergent and bifacial tools (51.2% and 10.8%, respectively). This pattern reflects a slightly higher degree of intensive tool reduction by Kiik-Koba Neanderthals compared with those at Buran-Kaya III, taking into account of differences between simple and convergent unifacial tools for the two tool-kits (Chabai

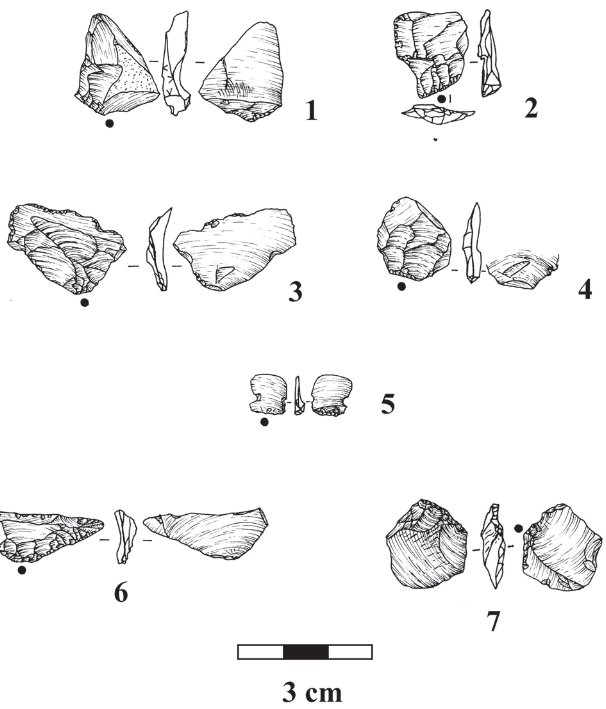

FIGURE 4. Siuren-I rock-shelter, Units H and G, modified after Demidenko 2000: 1, bifacial initial treatment chip of sub-type "1A"; 2, bifacial thinning chip of sub-type "1B"; 3–4, common retouch chips of both bifacial and unifacial tools of sub-type "2A"; 5, "Janus / Kombewa" chip from basal ventral thinning of a unifacial tool of sub-type "2D"; 6, rejuvenation chip on resharpening of unifacial convergent tool's tip of sub-type "3A"; 7, rejuvenation chip on resharpening of bifacial convergent tool's tip of sub-type "3B". 1, 3, 6–7, Siuren-I rock-shelter, Unit H; 2, Siuren-I rock-shelter, level Gc1–Gc2 of Unit G; 4–5, Siuren-I rock-shelter, level Gd of Unit G.

2004, Demidenko 2004b, 2004d). There are also differences in the frequencies of simple lateral and transverse side-scrapers within the two sets of unifacial side-scrapers: 35.3% and 16.9% respectively for Kiik-Koba and 30.5% and 20.1% respectively for the Buran-Kaya III tool kit. The higher value of simple lateral scrapers at Kiik-Koba may be explained by the manufacture of many these tools on large-sized chips (54.1%) and thin flakes, and thus unsuitable for further reduction; their higher frequency results in a lower proportion of transverse scrapers at the site. The supposedly most heavily reduced convergent items (39.7% for Kiik-Koba and 39.6% for Buran-Kaya III), as well as the least represented double pieces (8.1% for Kiik-Koba and 9.8% for Buran-Kaya III), have almost identical total percentages as the two sets of unifacial side-scrapers. Thus, the increased presence of simple lateral scrapers at Kiik-Koba can be understood not as a lesser degree in tool reduction intensity and duration, but rather as the selection of many small and/or thin pieces for tool production due to the lack of flint, given the site’s greater distance from high quality outcrops in the Eastern Crimea. In addition the unifacial side-scrapers at Kiik-Koba and Buran-Kaya III show a very similar dominance of all "simple" side-scraper types (simple lateral, transverse and double) over convergent side-scrapers: 1.52 : 1 for Kiik-Koba and 1.5 : 1 for Buran-Kaya III.

Analyses of the Kiik-Koba and Buran-Kaya III unifacial convergent tools (convergent scrapers and points) show the general prevalence of points over convergent scrapers for both sites, but with some differences. At Kiik-Koba frequencies are: 64.5% points and 35.5% convergent scrapers, whereas at Buran-Kaya III there are fewer points (56.4%) and so a higher frequency of convergent scrapers (43.6%). The higher frequency of points among unifacial convergent tools may also serve as another indicator of multiple tool treatments, and the same explanation may account for percentage comparisons between all unifacial convergent tools and "simple" unifacial side-scrapers (Kiik-Koba 1.85:1 ratio and Buran-Kaya III 1.5 : 1 ratio of unifacial convergent tools over "simple" unifacial side-scrapers).

We identified two basic models for the secondary reduction of unifacial tools. The first is based on the use of "regular" debitage pieces (length > width) and has two variants: 1) simple straight and convex side-scrapers – sub-triangular / semi-crescent side-scrapers and points – triangular / sub-crescent and crescent / leaf shaped / hook-like side-scrapers and points; and 2) simple / transverse side-scrapers – elongated semi-trapezoidal side-scrapers and points – semi-crescent side-scrapers and points – sub-crescent and crescent side-scrapers and points / hook-like points.

The second model uses debitage pieces with shortened, transverse proportions (length < width) and has one basic secondary treatment sequence: simple / transverse side-scrapers – semi-trapezoidal side-scrapers, points and denticulates – sub-trapezoidal and trapezoidal / leaf shaped side-scrapers, points, denticulates and perforators and/or sub-crescent and crescent / triangular side-scrapers and points – hook-like points.

From the size of tools and unretouched debitage products we also observed a pattern for the production of the most heavily reduced tools ("convergent" types, including convergent denticulates and perforators) on the largest debitage pieces. The key metric parameter was blank thickness, enabling multiple retouching and rejuvenation phases. Additionally, the presence of many flakes and large-sized chips with shortened, transversal proportions that mainly originated from bifacial tool shaping and thinning treatment led to development of the two models for the reduction sequence of unifacial tools.

Some unifacial tool reduction differences between Kiik-Koba and Buran-Kaya III are also related to blank form, with varying importance for chip-blank occurrence. At Buran-Kaya III, chip blanks account for 10–20 or 25% of the tools. At Kiik-Koba, the percentage of chip blanks is much higher with, however, a twofold subdivision: the higher chip ranks (47–57%) are related to different side-scraper types (simple, transverse, double and convergent); lower (although still appreciable) chip ranks, (37.5 and 33.3%), are for points and denticulates. This may reflect advance planning by Neanderthal flint knappers, initially selecting larger and thicker blanks for tools that are expected to be more heavily retouched.

Other important observations can be made from the unifacial tool reduction models and the chip blank data. Many convergent scrapers and especially points in Kiik-Koba industry type assemblages are associated with more intensive flint treatment and rejuvenation

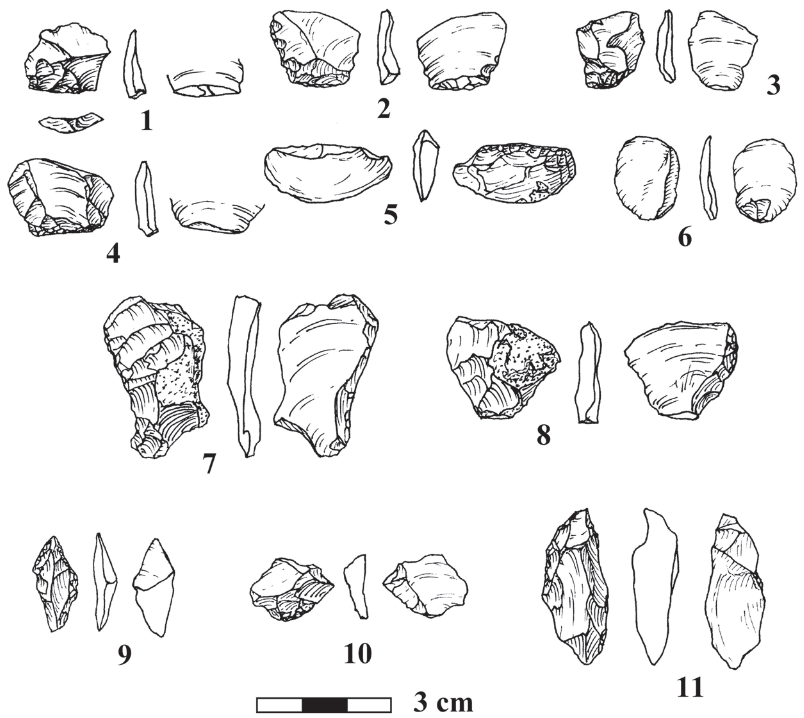

FIGURE 5. Kiik-Koba grotto, Layer IV, modified after Demidenko 2013c: 1–2, bifacial thinning chips of sub-type "1B"; 3, common retouch chip of both bifacial and unifacial tools of sub-type "2A"; 4, retouch chip from fine resharpening of tool's lateral edge of sub-type "2B"; 5, retouch chip from radical resharpening of tool's lateral edge of sub-type "2C"; 6, "Janus / Kombewa" chip from basal ventral thinning of a unifacial tool of sub-type "2D"; 7–8, pseudo-Prondnik spalls of sub-type "2E"; 9, rejuvenation chip on resharpening of unifacial convergent tool's tip of sub-type "3A"; 10–11, rejuvenation pieces on resharpening of bifacial convergent tools' tips of sub-type "3B".

processes, also influenced by the long distances between sites and high quality flint sources. Accordingly, we cannot state that the prevalence of convergent tools over "simple" tool types is a culturally determined feature of CMT assemblages. In addition, the higher percentage of "convergent" over "simple" tools among the Kiik-Koba unifacial tools (1.85 : 1) compared with Buran-Kaya III (1.5 : 1 – see above) once again underlines the greater distance of Kiik-Koba from high quality flint sources, and longer times of activity, resulting in an even more intensive flint exploitation at Kiik-Koba compared with Buran-Kaya III.

Of course, not all unifacial tools on chip blanks were initially produced on original chips – some tools have undergone severe retouching and size reduction so meeting the chip definition of < 3 cm maximum dimension. But the appearance of 47–57% of chip blanks among "simple" side-scraper types once again strengthens our hypothesis (Demidenko2013c, Uthmeier 2013, Demidenko, Uthmeier 2013a) that "simple" unifacial tools are present in greater numbers in the Kiik-Koba tool-kit because Neanderthals had to use imported flint much more intensively, thus selecting more chips as blanks for unifacial tool manufacture. This also explains why the highest percentage of chip blanks is found for "simple" types – further retouch of such tools was not planned, with the tools instead being used for *ad hoc*/daily needs.

The bifacial tools also differ in frequency: 38 complete and/or re-utilized bifacial tools at Kiik-Koba compared with 23 at Buran-Kaya III. The former site's tools show much less variability, with a notable absence of preforms and double side-scrapers in the Kiik-Koba sample. Whereas at Kiik-Koba there is a dominance of points, with a fairly high percentage of convergent pieces, together totalling 92.1% of bifacial tools, at Buran-Kaya III points and convergent tools account 69.6% of bifacial tools. The higher convergent tool index at Kiik-Koba indicates a higher level of retouch intensity and duration of use for the bifacial tools here compared with those at Buran-Kaya III. Moreover, it is surely not accidental that all Kiik-Koba bifacial tool groups are smaller in size than those at Buran-Kaya III.

Thus, both unifacial and bifacial tools at Kiik-Koba reveal more intensive secondary reduction compared with those at Buran-Kaya III. At the same time, it is worth recalling that bifacial tool reduction at both sites is acknowledged as more intensive than that of unifacial tool reduction. Given the focus of the present paper it is worth examining in detail the by-products of the sites' unifacial and bifacial tool reduction processes, and the indicators of intensity and duration for the multiple phases associated with the tools' secondary treatment. These are as follows for all the large-sized (> 1.5–2.9 cm) chips at Buran-Kaya III (4817) and Kiik-Koba (1478) and their 5 types and 9 sub-types.

1. Bifacial tool treatment chips:

Buran-Kaya III – 104 items / 3.4%; Kiik-Koba – 50 items / 4.7%.

1A. *Bifacial initial treatment chips*:

Buran-Kaya III – 39 items / 1.3%; Kiik-Koba – 14 items / 1.3%.

1B. *Bifacial thinning chips from rejuvenation processes of upper "convex" surface of bifacial "plano-convex" tools*:

Buran-Kaya III – 65 items / 2.1%; KiikKoba – 36 items / 3.4% (*Figure 5: 1–2*).

2. Retouch chips of both bifacial and unifacial tools:

Buran-Kaya III – 1 395 items / 45.5%; Kiik-Koba – 532 items / 50.3%.

2A. *Common retouch chips*:

Buran-Kaya III – 1294 items / 42.2%; Kiik-Koba – 495 items / 46.7% (*Figure 5: 3*).

2B. *Retouch chips from fine re-sharpening of lateral edges*:

Buran-Kaya III – 65 items / 2.1%; Kiik-Koba – 21 items / 2.0% (*Figure 5: 4*).

2C. *Retouch chips from radical re-sharpening of lateral edges*:

Buran-Kaya III – 20 items / 0.7%; Kiik-Koba – 8 items / 0.8% (*Figure 5: 5*).

2D. *"Janus/Kombewa" chips from basal and terminal ventral thinning of unifacial tools*:

Buran-Kaya III – 16 items / 0.5%; Kiik-Koba – 5 items / 0.5% (*Figure 5: 6*).

2E. *Pseudo-Prondnik spalls*:

Buran-Kaya III – 0; Kiik-Koba – 3 items / 0.3% (*Figure 5: 7–8*).

3. Rejuvenation chips on resharpening of unifacial and bifacial convergent tools' tips:

Buran-Kaya III – 134 items / 4.4%; KiikKoba – 47 items / 4.5%.

3A. *Rejuvenation chips on resharpening of unifacial convergent tools' tips*:

Buran-Kaya III – 88 items / 2.9%; Kiik-Koba – 22 items / 2.1% (*Figure 5: 9*).

3B. *Rejuvenation chips on resharpening of bifacial convergent tools' tips*:

Buran-Kaya III – 46 items / 1.5%; Kiik-Koba – 25 items / 2.4% (*Figure 5: 10–11*).

4. "Regular" chips (from any possible reduction, including core reduction):

Buran-Kaya III – 1433 items / 46.7%; Kiik-Koba – 429 items / 40.5%.

5. Undiagnostic chips:

Buran-Kaya III – 1885 items / –; Kiik-Koba – 420 items / –.

The data point to almost equal indicators of tool treatment intensity at the two sites, with slightly higher values for Kiik-Koba. The different proportions of chip occurrence are not of themselves sufficient to account for the different secondary treatment and re-treatment processes, although some comparisons are possible.

Regarding the type 1 chips, it is clear that bifacial shaping / thinning chips from the rejuvenation processes of the upper convex surface of bifacial plano-convex tools (1B) occur more often at Kiik-Koba, indicating a more systematic reshaping / thinning for the tools there, while bifacial initial treatment chips (1A) are of similar importance for the two samples, indicating just a few bifacial tools produced at the sites. Looking at the retouch chips of both bifacial and unifacial tools (2), there are rather more (c. 5%) of such pieces from Kiik-Koba compared with Buran-Kaya III whereas so-called "regular" chips (4) show the reverse order with a difference of c. 6%. The internal structure of type 2 chips for both sites is very similar except of the notable presence of 3 pseudo-Prondnik spalls (2E) in the Kiik-Koba sample and their total absence at Buran-Kaya III. It seems that such pieces, while morphologically very similar to para-burin lateral spalls originating from the terminal rejuvenation of Central European Micoquian Prondnik bifacial backed knives, reflect more intensive reshaping and rejuvenation of Kiik-Koba type bifacial tools, as Prondnik knives are virtually absent among the Kiik-Koba tool kit. Instead the spalls demonstrate multiple reshaping of bifacial tools at Kiik-Koba which at some stage(s) in their reduction sequence(s), result in the removal of chips like the para-burins, here called pseudo-Prondnik spalls.

Finally, the frequencies of rejuvenation chips from unifacial and bifacial convergent tools' tips (type 3) relative to the numbers of unifacial and bifacial convergent tools appear to provide the most accurate indicators for evaluating the intensity and duration of these tools' reshaping and rejuvenation which are considered among the most reduced tools in the assemblage. The Buran-Kaya III data show more evidence of rejuvenation: 142 unifacial convergent tools cf. 88 3A rejuvenation chips (1.6 : 1); 23 bifacial convergent tools cf. 46 3B rejuvenation chips (0.5 : 1). For Kiik-Koba: 149 unifacial convergent tools cf. 22 3A rejuvenation chips (6.8:1); and 40 bifacial convergent tools cf. 25 3B rejuvenation chips (1.6 : 1). The first important inference from these tool: chip ratios is that both sites show higher reduction intensities for bifacial tools than for unifacial ones. But why are the Kiik-Koba ratios lower, when, by all other indicators, tool intensity is higher for Kiik-Koba than Buran-Kaya III?

There are two possible explanations. First, keeping in mind that Bonch-Osmolowski did not use different sized screens for dry sieving during the 1920s excavations at Kiik-Koba, he might have partially screened sediments of lithological layers IV and VI (archaeological upper and lower layers), which could have led to the loss of some of these specific chips during excavations. Second, the use of a special reshaping technique, well-defined by Uthmeier – the so-called "technique 2" (see Uthmeier 2013), may also play a role. This is associated with lateral reshaping of some Kiik-Koba surface shaped tools, and is also recorded by the present author for 2B and 2C type chips at Buran-Kaya III and Kiik-Koba. The more important aspect is that Uthmeier observed this reshaping technique for more Kiik-Koba surface shaped tools than for such tools at Buran-Kaya III. Combining the two explanations, we may further suppose some differences between bifacial processes and some heavily retouched unifacial tools rejuvenation processes in the Buran-Kaya III and Kiik-Koba assemblages.

There may also be an additional explanation related to bone retouchers. Strangely enough, not a single bone retoucher was discovered in the Buran-Kaya III layer B fauna from the 1996 and 2001 excavations. This is unusual, given that CMT assemblages usually contain at least a few bone retouchers. In contrast, the Kiik-Koba Micoquian upper layer is famous not only for the numerous bone retouchers found, but also for their initial recognition as such by Bonch-Osmolowski (see Bonch-Osmolowski 1940: 116–123, Khlopachev 2013).

There are a minimum of 58 bone retouchers in the Kiik-Koba *in situ* Micoquian layer IV assemblage but none from Buran-Kaya III, layer B. The very recent study and discussion by A. P. Veselsky of >200 bone retouchers from Micoquian archaeological levels excavated in the early 2000s at the Kabazi V site (Crimea) are highly relevant here. His final considerations are: *"It is most likely that bone retouchers were the most important tools in bifacial tool production, their light weight and soft consistency making them particularly practical in the final stages of bifacial tool manufacture, e.g. for the retouching of working edges. It is also possible that bone retouchers were employed at crucial moments, for example when retouching the tip of points on bifacial tools, when excessive weight and hardness may have led inadvertently to the fragmentation of important tool parts"* (Veselsky 2008b: 452). Accordingly, the use of many bone retouchers for the rejuvenation of unifacial and bifacial convergent tool tips at Kiik-Koba may well have reduced accidental breakage, whereas the use of harder retouchers (probably sandstone pebbles with poorly preserved surfaces found during the 1996 Buran-Kaya III layer B excavations) may have resulted in much more frequent accidental breakage of convergent tools. If this third explanation is correct, it is possible to speculate that the Kiik-Koba Layer IV Micoquian Neanderthals treated relatively few flint artefacts overall (no more than 4000 pieces), but with great care, given the high quantity of bone retouchers present. Here again, there is a combination of two important factors: a deficit of flint items, caused by the considerable distances from high quality flint sources, and intensive flint treatment and re-treatment processes at the site and evident from the pieces recovered.

All in all, indications of higher intensity and extended flint and tool exploitation at Kiik-Koba can be explained by the site's greater distance from high quality flint outcrops and, perhaps more importantly, its location in the first ridge of the Crimean Mountains, making Neanderthals' uphill trips to the grotto much more difficult. Flint nodules and finished unifacial and bifacial tools brought to Kiik-Koba were accordingly treated there more intensively, leading to higher convergent tool indices for both unifacial and bifacial tools. This was complemented by on-site unifacial tool production of small flakes and large-sized chips so that the form of the Kiik-Koba Micoquian artefacts represent a more exhausted state, and they are smaller in size compared with the Buran-Kaya III Micoquian flints.

Kiik-Koba industry type data for the CMT as a whole.

Although there are some incomplete data sets (e.g. for Prolom I), it is nonetheless possible to state that Kiik-Koba industry type assemblages provide maximal secondary treatment and re-treatment indicators for the CMT overall. In brief, the Kiik-Koba industry's tripartite typological data can be summarized as follows: unifacial simple tools (side-scrapers) are always < 40% – the lowest such index among CMT industry types. The proportion of unifacial convergent tools (side-scrapers and points) is always > 50% – a level similarly not observed for other CMT variants. While the identifiable bifacial tools index falls within a narrow band of c. 10–15% that is only matched by the Starosele industry type, Kiik-Koba bifacial tools are different from those at Starosele. The latter ones are mainly characterized by preforms and points, while the former also include side-scrapers and sometimes denticulates that are direct evidence of multiple reshaping and "exhaustion" of the bifacial tools.

Overall, the maximal degree of secondary treatment and re-treatment can be accounted for by distances from high quality flint outcrops; some particular processes associated with both the transportation of so-called "reduction objects; and the nature of the tools at the sites and their treatment there, with bifacial tool reduction serving as the main source of debitage blanks for the production of unifacial tools, as well as bifacial tools" manufacture and for extending their functional lives through multiple reshaping, re-utilization and rejuvenation. The sites' function as C2 butchery camps also heavily influenced flint tool characteristics during and after intensive primary, and especially secondary, butchering of ungulate carcasses. The marked "flint deficit" at these sites meant that Micoquian Neanderthals had to intensify as much as possible multiple retouching of already formed unifacial and bifacial tool edges, naturally resulting in multiple changes in tool form with heavily reduced items including triangular, trapezoidal and hook-like side-scrapers and points among the convergent tools. Accordingly, the abundance of convergent unifacial and bifacial tools is characteristic of the Kiik-Koba industry type Micoquian.

In the above sites the frequency of convergent bifacial tools is greater than for unifacial tools, leading to the following generalisation: *Within the CMT the greater the proportion of convergent scrapers and points, the greater is the intensity of tool reshaping and rejuvenation in a tool-kit* (Demidenko 2003b: 153, 2004b: 147, 2004c: 71, Demidenko 2013c: 127). At the same time, it should be emphasised that a flint deficit alone does not necessarily mean maximal exhaustion of artefacts, especially in other possible CMT tool kits comparable to the Kiik-Koba industry with high indices of convergent unifacial and bifacial tools. The best example of such an assemblage comes from the Karabi Tamchin buried rock-shelter situated, as with Kiik-Koba, in the highlands of the first ridge of the Crimean Mountains – c. 25–30 km away from high quality flint outcrops in the Eastern Crimean (Yevtushenko 2003, 2004). The site's Micoquian levels IV/2 and V assemblages belong to either "Starosele – Ak-Kaya" or "Ak-Kaya – Starosele" industry variants and the Micoquian levels probably represent a series of human occupations within each level, possibly *"short-term season hunting stations, dependent upon raw material importation, and oriented to non-selective, possibly encounter-based, hunting"* (Yevtushenko 2004: 340). Here occupations were of limited intensity and short duration, emphasising that a complex of behavioural and functional reasons, in addition to the proximity of raw materials, account for diversity within the CMT.

CONCLUDING REMARKS

The approach to CMT tool, debitage pieces and chips described in this paper provides much specific data on individual site assemblages whilst also illuminating Neanderthals' distinctive flint treatment processes and life activities. It accordingly offers a livelier and more dynamic – and so more realistic – treatment of Palaeolithic assemblages as opposed to traditional so-called "statistically immobile" techno-typological indices of industry types. In other words, it allows us to widen both the directions and depth of investigations into Middle Palaeolithic variability.

The CMT tool treatment debitage pieces and chips, aside from their detailed classification, have been used as additional means for understanding the distinctive features of particular Micoquian industry types, and the specificity of Neanderthal activities at different sites. In particular, the 9 defined chip sub-types produced during tool treatment were used for the above, with proposals for their future possible use, to suggest, for example, that locations without preserved fauna remains and lacking 2B, 2C, 2D, 3A and 3B chips sub-types probably point to highly ephemeral sites with only primary butchery camp characteristics. Additionally, the proportions of different chip sub-types with various tool groups indicate the intensity and duration of tool treatment processes.

Studies of various tool treatment debitage pieces and chips increase our understanding of CMT sites, their archaeological layers / levels and find complexes, and the activities that contribute to their formation. A significant conclusion from the growing data set is that it undermines traditional explanations of Micoquian diversity based on "cultural" factors. Instead, the evidence points to a complex and, at the same time, flexible "radiating / logistic" life sustenance and adaptation model that allowed Crimean Neanderthals to successfully survive within different mountainous areas during the fluctuating climate and landscape conditions of the Upper Pleistocene. As such the model is characterized by varied and changeable subsistence activities at functionally differentiated sites resulting in turn, in diverse artefact assemblages left at the sites by their Neanderthal makers.

This model implies that as knowledge of a region's Palaeolithic sites and their detailed evidence accumulates, the "archaeological cultures" paradigm is progressively and unavoidably undermined in favour of more realistic reconstructions of Upper Pleistocene activities influenced by anthropogenic and natural factors. Moreover, studies of such seemingly unimportant small flint artefacts and tiny tool treatment pieces in the context of Palaeolithic functional activities demonstrate the value of "small data" and that no potential source of possible evidence should be ignored. The approach espoused here was pioneered and fittingly summarised by Bonch-Osmolowski for his Crimean Palaeolithic studies as early as the 1920s excavations at the Kiik-Koba grotto: *"There is no waste material in the Palaeolithic. Bone splinters and flint fragments, charcoal pieces, sediment samples, pebbles, etc. – all this can give us material for the reconstruction of production processes and life ways from these remote time periods"* (Bonch-Osmolowski 1940: 12).

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Appendix 1.

1. Bifacial tool treatment chips

1A. *Bifacial initial treatment chips* (*Figure 2: 1–3*) characterized by:

– faceted and dihedral butts with acute and rarer semi-acute angles in relation to the ventral surface, as well as with lipped / semi-lipped butts' back features; incurvate and/or twisted general profiles; – trapezoidal or generally expanding and ovoid shapes;

– some primary cortex often present on their dorsal surfaces. 39 items / 1.3%.

1B. *Bifacial thinning chips from rejuvenation processes of upper "convex" surface of bifacial "plano-convex" tools* (*Figure 2: 4–6*) characterized by the same features as for 1A with two important additions: traces of butt abrasion and rather thin overall bodies. 65 items / 2.1%.

2. Retouch chips of both bifacial and unifacial tools

2A. *Common retouch chips* (*Figure 2: 7–9*) are similar to 1B chips but with plain, linear and punctiform butts with acute / semi-acute angle and lipped / semi-lipped butts' back features when a butt is either plain or linear, and in addition to the usual incurvate and twisted general profiles, there are also items with a flat general profile, having a feathered or hinged profile at the distal end. 1294 items / 42.2%.

2B. *Retouch chips from fine resharpening of tools' lateral edges* (*Figure 2: 10–11*):

– mainly wide (> 1 cm) linear butts with acute / semi-acute angle and lipped / semi-lipped butts' back characteristics; a line of intensive butt abrasion (a tool's already previously retouched edge) is nearly equal to a piece's proximal width that is wider than the distal end's width. 65 items / 2.1%.

2C. *Retouch chips from radical resharpening of tools' lateral edges* (*Figure 2: 12*) have: plain, faceted and dihedral butts with right and acute / semi-acute angles and not lipped butts' back characteristics; very intensive butt abrasion (a tool's already previously retouched edge) along a piece's quite thick proximal end where the width of the proximal end is wider than the distal end; usually definite features of hard hammer flaking mode seen through thick and diffuse bulb of percussion. 20 items / 0.7%.

2D. *"Janus / Kombewa" chips from basal ventral thinning of unifacial tools* (*Figure 2: 13–14*) are defined by their very distinct morphology: a dorsal-plain scar pattern accompanied by a remnant of a tool's blank (a flake or a blade) butt showing, as a result, an ovoid chip with "double-ventral" sides and two butts. These pieces are quite rare since when such a chip removes part of a tool's blank bulb from the interior (ventral) surface, it might disintegrate into fragments, even after a soft hammer blow. Therefore, even a single "Janus / Kombewa" chip in an assemblage is a definite indication of a ventral basal thinning approach to unifacial tools. 13 items / 0.4%.

2E. *Chips from terminal ventral thinning of unifacial tools* (*Figure 2: 15–16*), these are also characterized by a "double-ventral" surface for their dorsal and ventral sides but with ripples on their dorsal surfaces that clearly indicate the chips' detachment from tools' terminal ends on the ventral surfaces of their debitage blanks. 3 items / 0.1%

3. Rejuvenation chips of unifacial and bifacial convergent tools' tips

These pieces are morphologically characterised by an expanding overall shape, its shortened, transversal and almost rhomboid variant, where one of two transversal terminations contains a retouched pointed tool's tip and the second transversal termination has no tool retouch. Depending on retouch characteristics, rejuvenation pieces are classified as unifacial or bifacial tools.

3A. *Rejuvenation pieces on resharpening of unifacial convergent tools' tips* (*Figure 3: 1–4*) identified by retouch only on the dorsal surface of one of two triangular transversal terminations. 88 items / 2.9%.

3B. *Rejuvenation pieces on resharpening of bifacial convergent tools' tips* (*Figure 3: 5–7*), distinguished through the presence of rough treatment scars and retouch facet scars on both ventral and dorsal surfaces of one of two triangular terminations. 46 items / 1.5%.

4. 'Regular' chips comprise all remaining complete chips with the following features: no preference in morphological characteristics of butt types, general profiles, shapes and bodies;– absence of acute angle for butts, butt abrasion, any lipping and, at least, never a combination of all three of these indications on a single piece. Detachment of these chips could occur during any kind of flint primary and secondary reduction processes, including core reduction one. 1433 items / 46.7%.

5. Non-diagnostic chips are either items with missing (broken) and crushed proximal ends (butt areas) or heavily fragmented items which do not provide any real information. This chip type is unidentifiable in terms of reduction identification. 1885 items / –.

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