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Multi-Aspect Analysis of Flint Materials from Suchodółka, Site 3, the Świętokrzyskie Voivodeship

1. Introduction

The objective of the presented work is to characterise technological processes of lithic production on the basis of flint material obtained from Suchodółka, Site 3 located on the north edge of the Sandomierz Upland. The applied research methodology is a combination of debitage refitting (used for the technology reconstruction) with the microscopic analysis of traces on the surface of waste material produced during the lithic reduction. Accordingly, we shall tackle the problem of identifying specific types of raw material utilised at the site in relation to its treatment in prehistory. The spatial distribution analysis was employed to reveal the organisation of the site in respect to various functional areas.

The analysed assemblage was excavated from two trenches (26 m^2) where the lithic concentration originating from the Late Palaeolithic Period was discovered. The most numerous group of excavated products was composed of debitage – 2850 pieces. The material consisted mostly of blades, flakes from preparation, platform spalls, crested blades and cores. A few tool forms were noted. The tool forms were limited to a dihedral burin, a tanged point, a fragment of a perforator (**Fig. 1:1–3**) and single retouched blades. The majority of these materials are characteristic for the Swiderian Culture (Schild 1975; Szymczak 2000). The flint material was deposited in a fallow sand soil, from 50 to 70 cm below the ground. The relics were found in a concentrated form despite the geological conditions, which impeded their deposition in an intact space arrangement.

2. Raw material

The structure of lithics assemblage is characterised by the presence of mined raw material. Most forms that were excavated were made from the local Turonian flint of homogenous structure and good knappability. These forms may be roughly divided into two categories. The first category (2683 pieces) is distinguished by a greenish grey, glossy internal surface and a clear transition between the cortex and the silex. The second variety (61 fragments) is characterised by a grey, mat colour with lightly white dapples and a brown layer which divides the exterior part of raw material. The excavated artefacts had a cortex in a very good shape. They even contained clearly visible fossils sunk in its surface. Despite such a high occurrence of described raw material at the site only one tool was made from this flint, while the rest was represented in the inventory by debitage wastes.

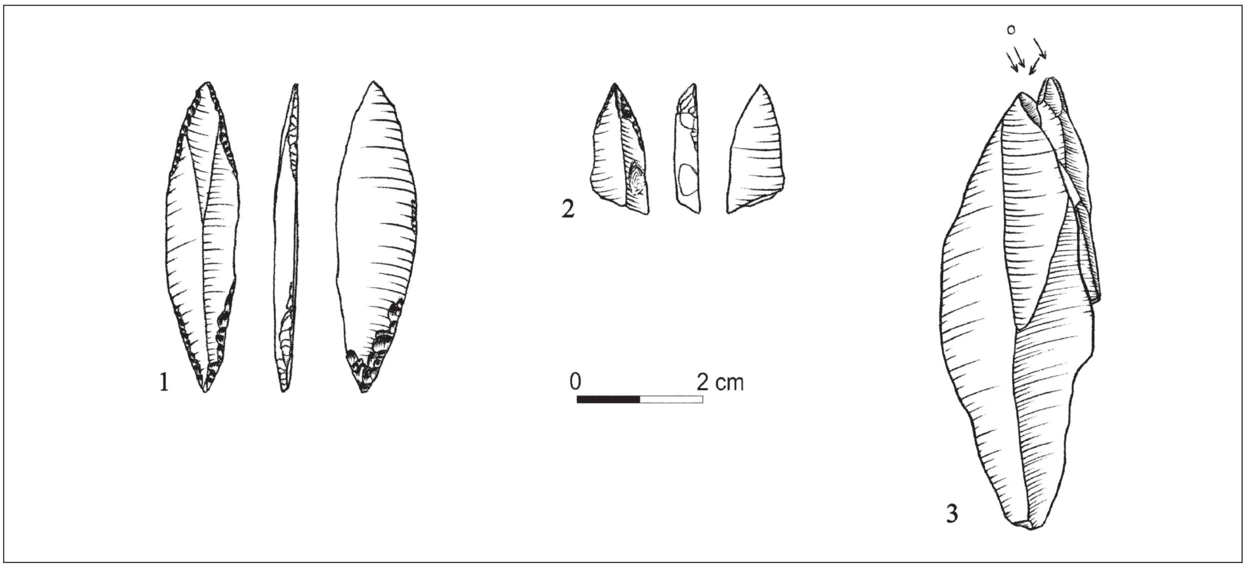

Fig. 1. Suchodółka, Site 3. 1 – tanged point; 2 – perforator; 3 – burin refitting (Drawing Ł. Kamiński).
Ryc. 1. Suchodółka, st. 3. 1 – liściak; 2 – przekłuwacz; 3 – składanka rylca.

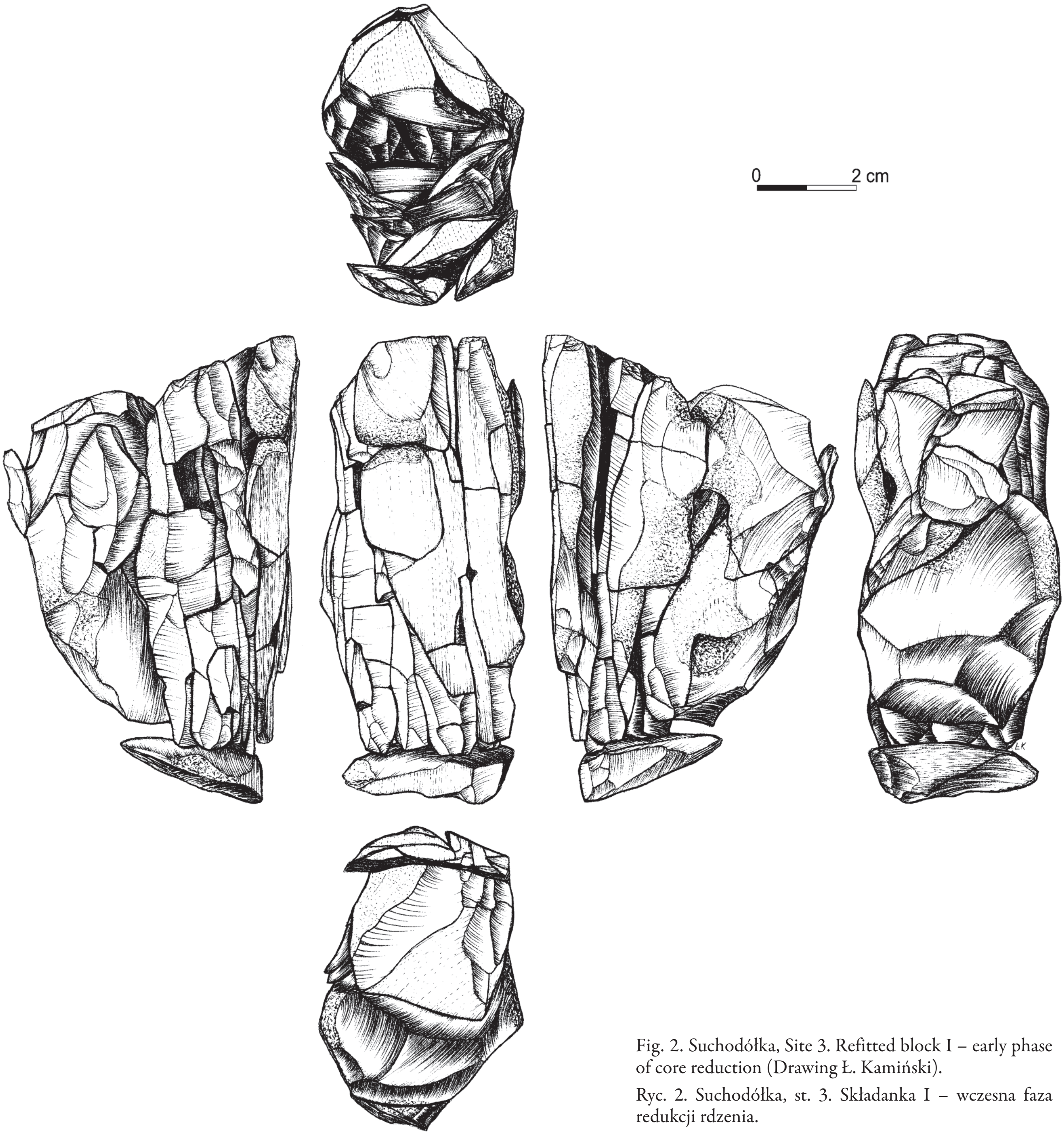

Fig. 2. Suchodółka, Site 3. Refitted block I – early phase of core reduction (Drawing Ł. Kamiński).

Ryc. 2. Suchodółka, st. 3. Składanka I – wczesna faza redukcji rdzenia.

The second most frequently appearing material at the site was the Świeciechów flint (32 pieces) – also known as "the grey, whitely spotted." The artefacts made of it were limited to flakes and blades.

Thirteen artefacts made of chocolate flint were registered in the inventory. No conjoined lithics were found, except of the refittings of a burin (**Fig. 1:3**). The typologically-technological character of the findings implies that they were most probably brought to the site. The rare occurrence of waste products as opposite to blades and tools also supports this conclusion. The discussed forms have clearly the Late Palaeolithic character.

In addition to three types of material described above, small amounts of erratic flint (4 pieces) and striped flint of the Krzemionki type (2 fragments) were also found at the site. The latter mentioned flint was found in a Neolithic feature of the Funnel Beaker Culture. The feature was located on the peripheries of lithics concentration.

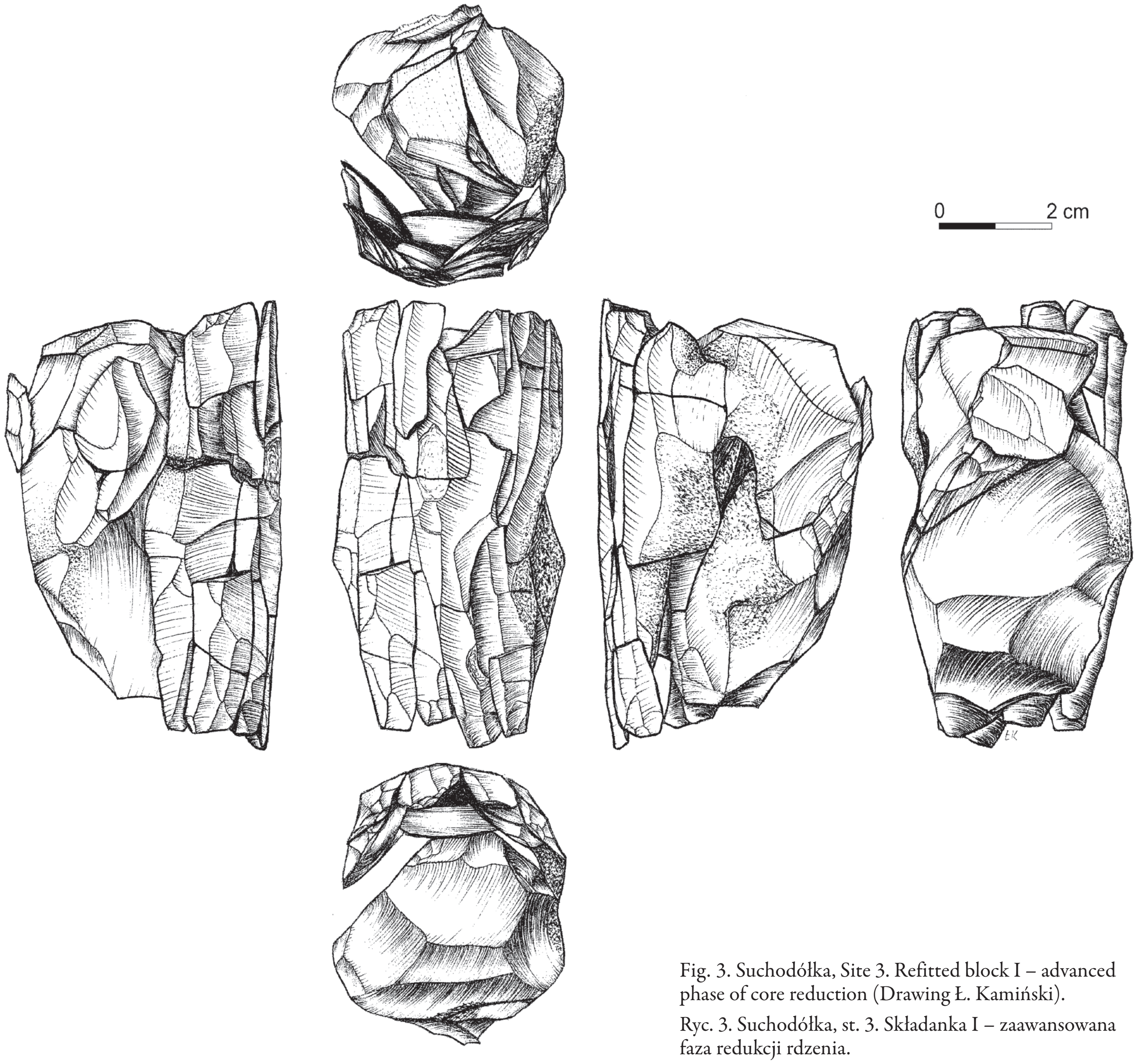

Fig. 3. Suchodółka, Site 3. Refitted block I – advanced phase of core reduction (Drawing Ł. Kamiński).

Ryc. 3. Suchodółka, st. 3. Składanka I – zaawansowana faza redukcji rdzenia.

3. Blade technology

The presented reduction sequence is based on the results of lithics refitting applied to the excavated flint material. Obtained tens of blocks represented particular phases of the flint production. Almost all of the cores in this group, except two, were the opposed-platform forms. The analysed cores were made from both varieties of the local Turonian flint.

The process of a single core blade production could be captured only on one refitting example. These single platform forms might occur due to small sizes of the raw material picked for debitage. As a result, crossed flaking could not be performed.

The characteristics of the opposed platform technology are described in the following chapter.

3.1. Raw material acquisition and preform preparation

The initial preparation of the opposed-platform core was strongly influenced by natural shapes of nodules. The reduction of a flint preform was usually more significant in case of thick, irregular nodules in comparison to flatter, tabular pieces which were not strongly transformed during that phase. Generally, if morphology of a flint block allowed a maker for it, the process was conducted by annexing natural straight, long, narrow surfaces for the working face of a core (**Figs. 2, 6:2**). In other cases the pre-core was thinned down from bifacial or unifacial prepared ridges created in front of a form (**Fig. 7:2**). Frequently the back of the core and later the striking platforms were also crested in the same manner. The main purpose of reduction on this

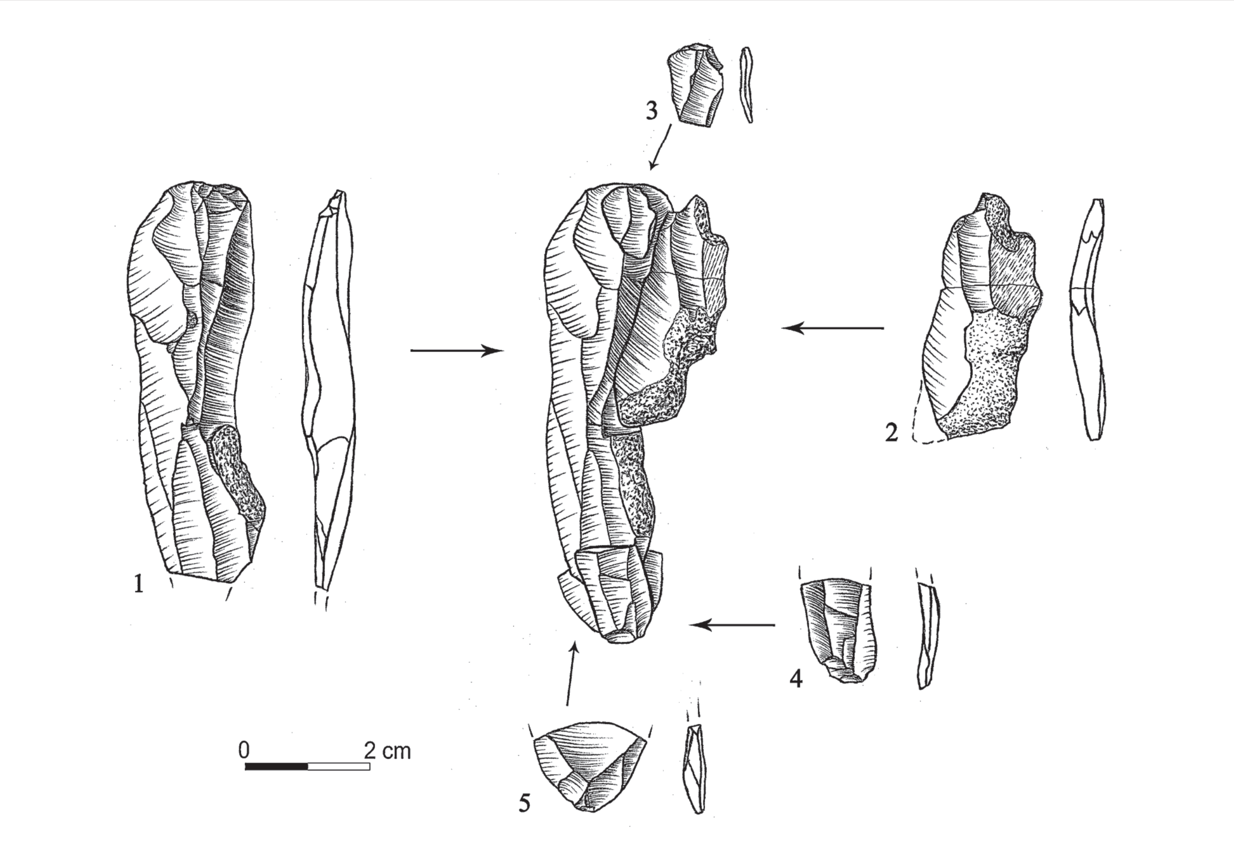

Fig. 4. Suchodółka, Site 3. Refitted block I – preparation of blade and its by-products: 1 – the "intended blade" (blank shaped in the intended manner, but discarded due to its irregularity?); 2 – ridge-straightened blade; 3 – edge-preparation bladelet detached to isolate the platform; 4 – ridge-straightened bladelet obtained to shape the distal part of the blade; 5 – ridge-straightened flake also known as the "upsilon blade" (Ataman 1989) or "correction blade" (Dziewanowski 2006) (Drawing Ł. Kamiński).

Ryc. 4. Suchodółka, st. 3. Składanka I – wiór i produkty z jego przygotowania: 1 – „wiór preferencyjny/predeterminowany" (wiór przygotowany wcześniejszymi odbiciami formującymi jego kształt, być może porzucony z powodu nieregularności?); 2 – wiór kształtujący odłupnię; 3 – wiórki izolujące piętę rdzenia przed uderzeniem; 4 – wiórki kształtujące dystalną część „wióra preferencyjnego"; 5 – wiór korekcyjny.

stage was narrowing the flaking surface, making symmetrical sides and providing morphology that would enable platform preparation.

3.2. Initial blade detachment

The next stage involved the preparation of platforms on the opposite parts of a core. There were cases when a natural side could be adopted for the striking surface but usually it was prepared by detaching few flakes or by removing platform spalls.[1] The analysed refitted blocks show that most of the cores with removed platform spalls were crested. These forms were detached from one of the striking surfaces (**Fig. 7:1,2**) rather than from both sides of the preforms (**Fig. 6:2**), and a flaking angle on this stage was almost always sharp. The subsequent phase was focused on shaping of the working face of the core. It was achieved by detachment of crested or cortical blades. If cortical blades were obtained from the flaking surface, they were usually massive with thick bulbs and big butts. These blades were carefully prepared before detachment, which

[1] Most of the nomenclature used in the work was based on categories proposed by J. Wilke and A. Quintero (1994) for the Naviforms Core-and-Blade Technology.

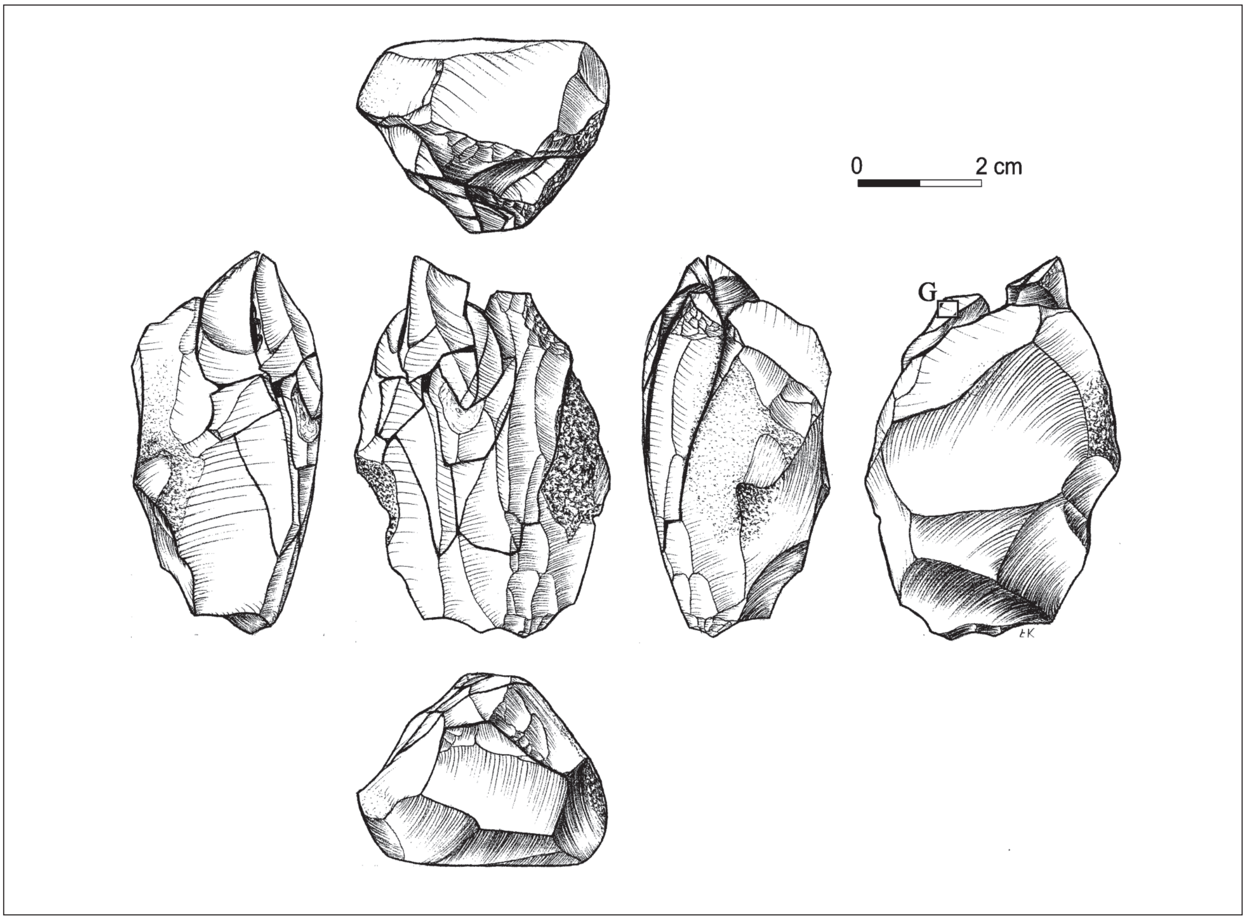

Fig. 5. Suchodółka, Site 3. Refitted block I – final phase of core reduction (Drawing Ł. Kamiński).
Ryc. 5. Suchodółka, st. 3. Składanka I – końcowa faza redukcji rdzenia.

can be observed on the refitted material. This process required a removal of existing overhangs and moving the margin of the platform back from the ridge from which a knapper wanted to obtain the blade (**Fig. 2**). The blades that were prepared this way had a curvature in their proximal part. This procedure was conducted to avoid the *outre-passé* effect which could destroy the platform opposed to the one being used. It should be also noted that the blades were intensely abraded before detachment.

3.3. Advanced blade detachment

The debitage process was precisely planned to maintain the flaking surface with right proportions and convexities. The goal was to form ridges that would enable detachment of blades having a desired morphology.[2] Lithic products obtained with this technology have sharp tips, parallel edges and regular ridges. The length of these blades is usually a little bit shorter than the size of the core from which they were separated. Before starting a detachment process a knapper was frequently forming the flaking surface by removing chips, bladelets, flakes and blades. This was done to prepare prominent and regular ridge, isolate a platform and move back the point of impact (**Fig. 4:2,3**). If needed, the opposed platform was also used for a ridge formation. It helped to avoid overshooting during core reduction and to shape the distal part of the future blade (**Fig. 4:4**).

[2] In literature related to double platform core technologies there are few corresponding terms describing these blades: "intended blades" (Wilke, Quintero 1994), "preferential blades" (Migal 2007) or a result of predetermined debitage (Dziewanowski 2006).

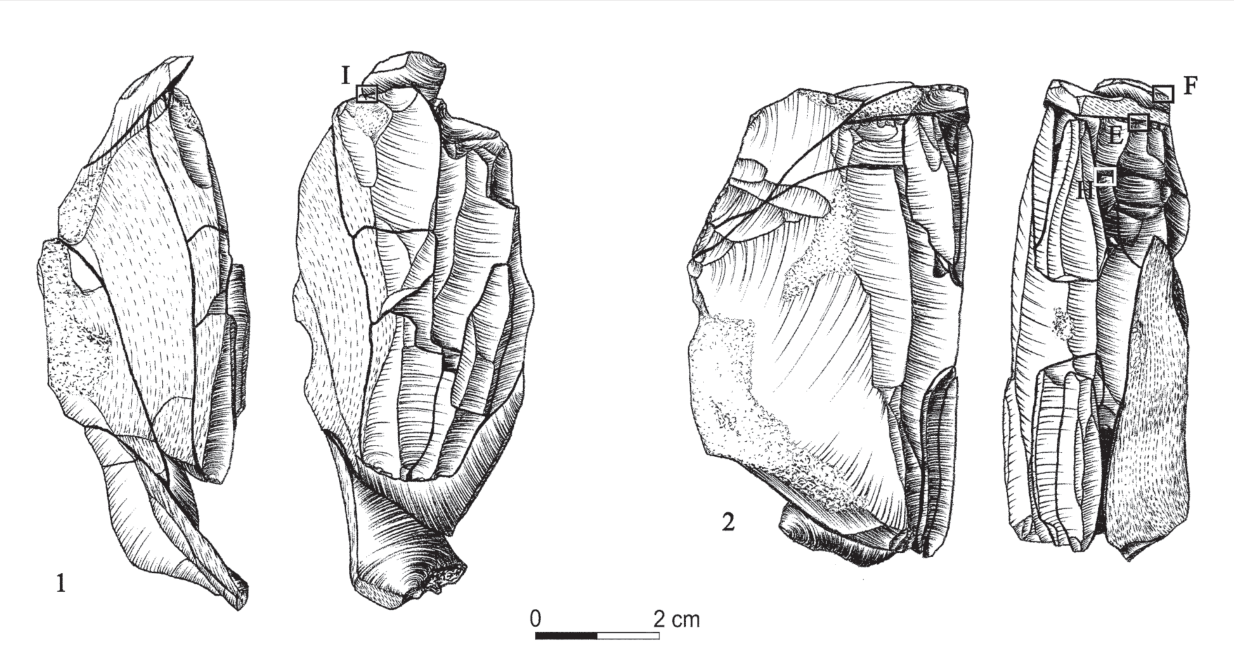

Fig. 6. Suchodółka, Site 3. 1 – refitted block III; 2 – refitted block IV (Drawing Ł. Kamiński).
Ryc. 6. Suchodółka, st. 3. 1 – składanka III; 2 – składanka IV.

Traces of that process can be found in the refitted material which contained high amounts of waste products.

The refitting process revealed by-products that made the flaking surface narrower – the so-called "side blades" and occasional split forms connected with the removal of core deformation. Part of these were secondary crested blades (created when a core became too irregular) or reparation flakes, blades produced to remove step terminations and hinged fractures. Blades from this phase were obtained from a sharp flaking angle and have usually punctiform or linear butts that were intensely abraded with a small or diffused bulb (**Figs. 3, 4**).

Both of the platforms were repaired by detaching corrective platform spalls or faceting flakes if needed. Corrective platform spalls were flat (**Figs. 6:1, 8:1**), crested (**Figs. 3, 6:2**) and faced (**Figs. 5, 6:1, 7:3, 8**).

3.4. Core exhaustion

The last phase of core reduction is represented in lithics assemblage by two categories. The first group consists of cores discarded due to errors made during the debitage which did not allow to progress with the blade removal process. Most of these forms had hinged fracture on the flaking surface (**Figs. 6:2, 7:1, 8**) or were destroyed by the *outre-passé* effect (**Fig. 7:3**). The second group is represented by the cores that were exploited and further obtaining of blades from their flaking surface was impossible. This happened usually when the flaking surface became too flat. Final products detached from this kind of cores could have a morphology of blades from the advanced stage (**Fig. 6:1**) or could take a form of massive and thick flakes (**Fig. 5**). A flaking angle may become almost straight on this stage of reduction. Usually in this situation only one striking platform is used for obtaining of a blade (the one with a straight angle) and the opposite one tends to have a corrective character.

4. Debitage techniques used for obtaining blades

In this chapter we shall present the verification of debitage methods used for flint production on materials from Suchodółka, Site 3. The verification was first performed by macroscopic and later microscopic use-wear traces analysis. We examined flint form surfaces that originated from application of various techniques of obtaining blades. The interpretation of the results was made by their methodical comparison with the traces registered on the experimental forms. The presented method can be considered as an alternative or an addition to experimentally-technological study of flint materials represented, i.a., by J. Pelegrin (2000), M.L. Inizan, H. Roche, J. Tixier (1992), and W. Migal (2007).

4.1. Macroscopic analysis

Macro-scale features observed on the individual series of blades from the opposite platform cores are an evidence of using a direct soft hammer stone percussion technique in the debitage process. Sharp flaking angles are also characteristic for this type of hammer. In this percussion

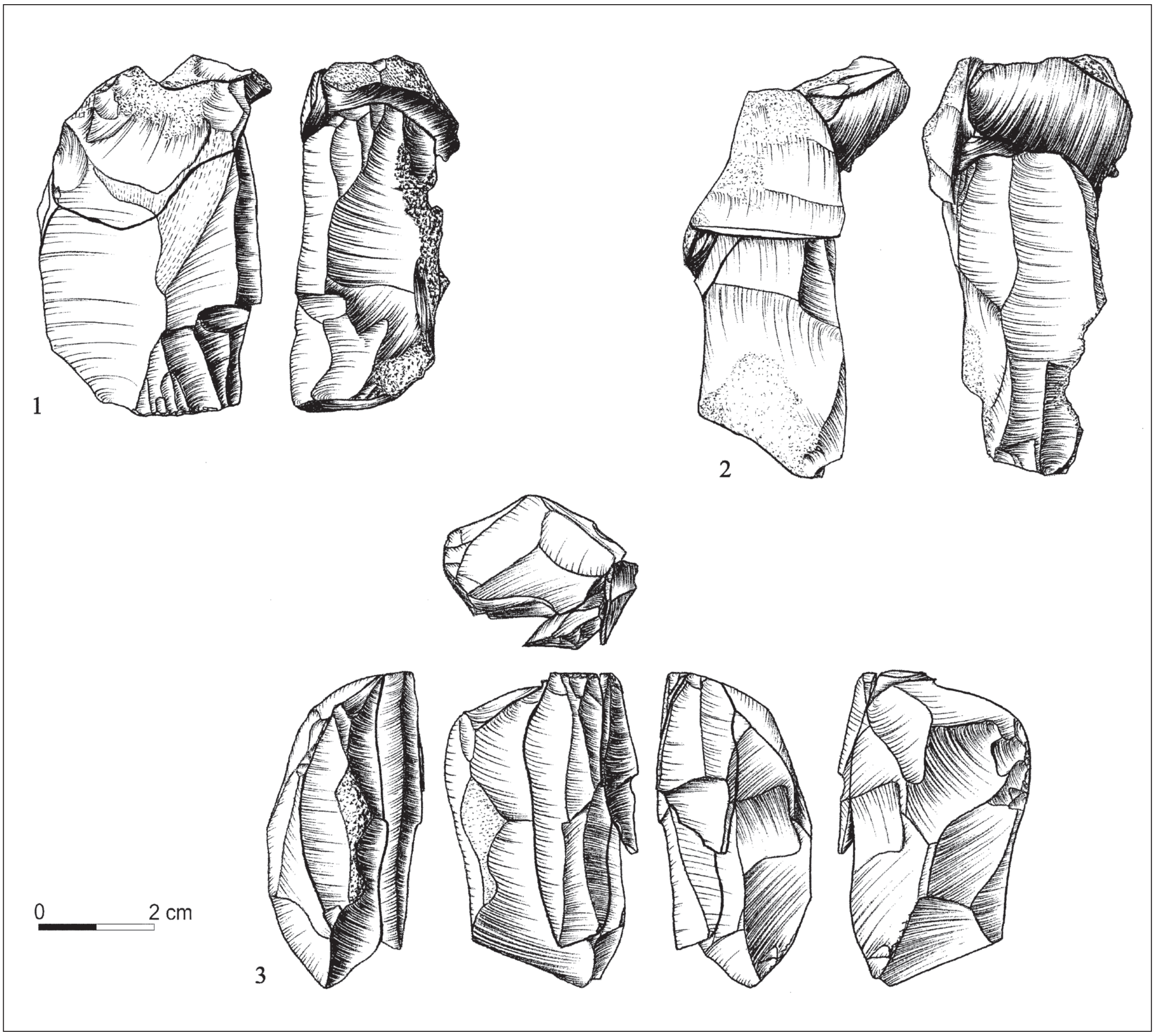

Fig. 7. Suchodółka, Site 3. 1 – refitted block V; 2 – refitted block VI; 3 – refitted block VII (Drawing Ł. Kamiński).
Ryc. 7. Suchodółka, st. 3. 1 – składanka V; 2 – składanka VI; 3 – składanka VII.

technique two ways of striking can be differentiated. Both of them were recognised in the materials from Suchodółka. The traces indicate they were used repeatedly and exchangeably.

The first striking method leaves distinctive traces in the morphology. Marks are similar to the remainders from the debitage while using a hard hammer stone. Blades obtained with this technique are relatively massive. Surfaces of bulbs have almost always visible scares. If they do not occur, it is as a result of a faulty directed strike causing crushes. Butts resulting from this type of debitage are wide, but their shape can be modified using abrasion of ridges between the flaking surface and the striking platform (Pelegrin 2000).

The other debitage technique resembles the application of an organic billet. The impact point is smaller, which implies more delicate rotation of a blow. A resulting lip is most frequently located on a punctiform butt. Bulbs are usually thin or even diffused with visible concentration lines (Pelegrin 2000).

4.2. Microscopic analysis

The research examined both existing concepts of the blade debitage gaining in the Swiderian Culture. The first developed concept was an indirect percussion with an antler punch (i.a. Schild 1969: 4; Ginter 1974: 29; Ginter, Kozłowski 1975: 59). Roughly thirty years later a direct percussion with a soft stone hammer was introduced (i.a. Przeździecki 2002: 75; Dziewanowski 2006: 151; Migal 2007: 187). Following the requirements of these methods replicas of cores with blades and flakes were produced. The flakes were obtained by striking with a hard and soft stone hammer or an antler tool. These series were made of the same raw materials as registered at the site. They

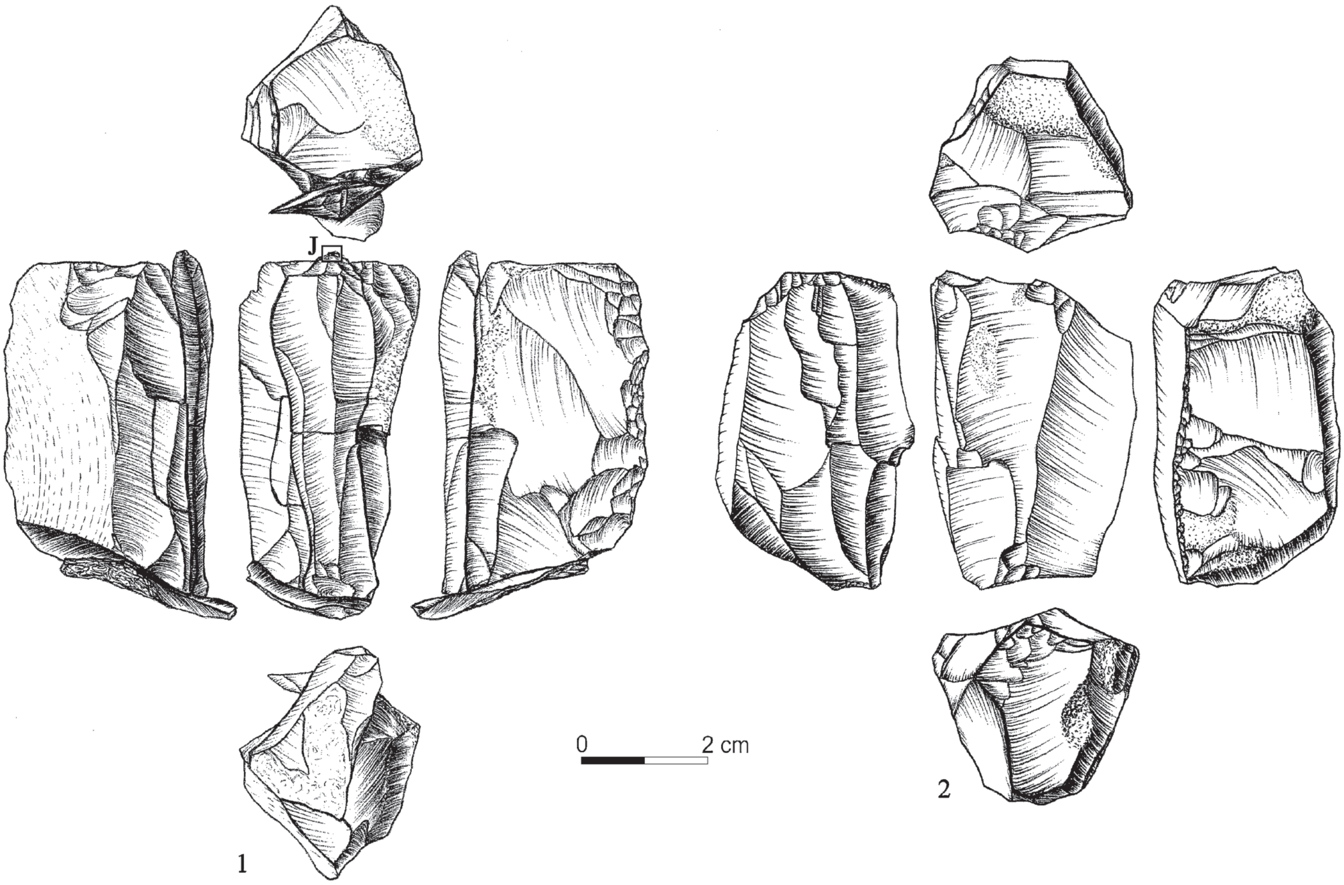

Fig. 8. Suchodółka, Site 3. 1 – refitted block II; 2 – opposed platform core (Drawing Ł. Kamiński).
Ryc. 8. Suchodółka, st. 3. 1 – składanka II; 2 – rdzeń dwupiętowy.

were all various kinds of the local Turonian flint. At the subsequent research phases, selected forms were analysed under the microscope. A set of characteristic microscopic features was found (mainly linear traces and polishes) that determined particular flint debitage techniques. It enabled to compare obtained data with microscopic analysis outcomes performed on the original material. Results of this analysis are presented below in this chapter.

The analysis was performed on a type XTST ZOOM stereoscopic microscope. The microscope allows for smoothly regulated zooming; from 21× to 135×. Detailed determination of the character of the traces that covered the flint surfaces was carried out with a metallographic microscope – Nikon LV150. This type of microscope is designed to work in reflex light (with an opportunity to change light intensity). It supports zooming of 50× to 500×. The microscope was attached to a digital camera to transfer the images directly to a computer. The images were processed in GIMP software. The flint tools were cleaned off contaminations on their surfaces with warm water and detergent as well as pure acetone.

Tens of experimental forms were microscopically analysed. Special attention was paid to the surfaces of blades and flakes butts as well as the striking platforms of cores. The observed traces (primarily the linear traces and polishes) clearly differ depending on the technique applied in the debitage. The distinction in the character of microscopic traces was not noticed due to the differences in flint materials used for blade production.

In the following chapters we shall present the microscopic characteristic of diagnostics features for every particular technique used (cf. Keeley 1980: 28; Vaughan 1985: 41–42; Ibáñez et al. 1990; Byrne, Olle, Vergès 2006; Méry et al. 2007).

4.2.1 The forms produced using a mineral stone hammer (Fig. 9: A,B)

Clear linear traces were observed on the surfaces of butts and cores striking platforms. They appeared in the forms of shorter or longer straight fissures going deep inside the flint structures. The described strias are marked by a more or less irregular course of the lateral edges. These linear traces, running in parallel to each other, are arranged in groups of a few to dozens of lines. They are aligned orthogonally or diagonally in relation to the front edge of a core or a butt. Individual groups of fissures often cross in some sections. In the cases of debitage butts, the strias start in the ventral parts of butts.

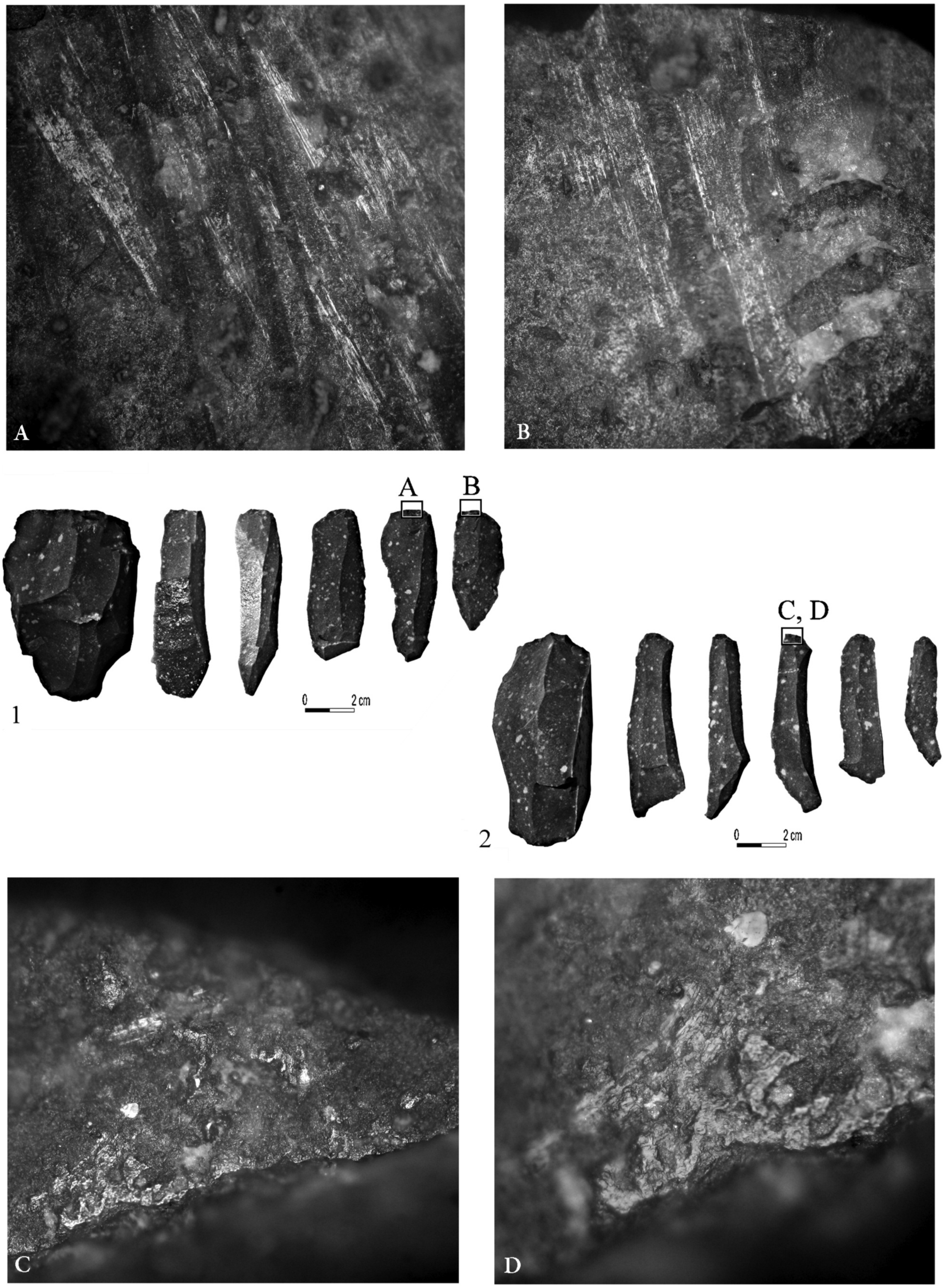

Fig. 9. Experimental forms. Technological microwear traces: A, D – 200×; B, C – 100× (Photo K. Pyżewicz).

Ryc. 9. Okazy eksperymentalne. Technologiczne ślady mikroskopowe: A, D – 200×; B, C – 100×.

The linear traces usually occur together with the intensive, shiny, "metallic" polishes. They are located in the same places as the fissures. However, they do not penetrate the linear traces. The polishes appear as strips of various width. They abrase the microrelief of flint. Their direction aligns with the linear traces.

Curved cracks alongside the striking platforms or butts of the flint surfaces were sporadically detected.

Even after the flint form is carefully cleaned, the traces preserve their characteristics.

4.2.2 The forms produced using antler billets by indirect or direct percussion (Fig. 9:C,D)

The diagnostic feature of blades, flakes and cores that were knapped with an antler billet is an occurrence of characteristic polishes. The polishes are a result of frictions between a flint structure and a fragment of an antler. The traces appear as quite long strips, singular (in this case they are parallel to each other) or grouped. They are endemically spotted. The polishes are usually slightly foggy, superficial and locally disappearing. They do not penetrate the flints' structures. They are oriented orthogonally or diagonally to the edge of a core or a butt front. Particular strips may cross in the striking platform area.

No other traces on the surfaces were observed. If they do appear, they form thin, delicate and smooth lines that align with the polishes strips.

A careful cleaning of a form decreased the intensity of the traces, but did not change their character.

4.3. Results of microscopic analysis of original materials (Fig. 10)

The initial selection of the Suchodółka, Site 3 flint material is followed by detailed microscopic analysis. Tens of forms originating from diverse stages of debitage were selected for this study. They include cores, blades, flakes, crested blades and platform spalls.

The flints were produced by direct percussion with the hammer stone technique – the only one registered in the analysed group of artefacts. The characteristic traces were clearly left on the cores (**Fig. 10:H**). They covered the striking platform and the flaking surface. They exposed individual directions of the hammer stone trajectory. The surfaces of blade butts or flakes (also the ones partially covered with cortex) had analogous deformations as those which appeared in striking platforms. Particular linear traces origin at the point of force application. It is possible that the same technique was used both in the initial stage of knapping (**Fig. 10:E,F**) and in the actual blade debitage process (**Fig. 10:G,I,J**). A mineral hammer was also used to make corrections or reparations of the cores. This is indicated, e.g., by the existence of characteristic traces on the surface of rejuvenation forms or hinge removal flakes.

It is worth noting that some cores or blades exploited with a stone hammer have specific microscopic deformations of flint structure which are results of abrading or working with a stone edge on the flaking surfaces and striking platforms (i.a., **Fig. 10:I**). These forms differ from the features created when applying a hammer stone for lithic reduction. The differences are in direction, placement, and a lack of coverage with the point of force application. Linear traces are aligned almost in parallel to the edge separating a striking platform from a flaking surface. Sometimes they are arranged in the forms of small, grouped scratches on the edge that divides: 1) a butt and a blade front, or 2) a striking platform and a working face of a core. Additionally, they may be present in the different fragments of debitage. Although in this situation we cannot exclude that they are remains of previous blade detachment. There were also cases in which it was impossible to differentiate between micro-traces coming from the blade detachment and the abrasion.

5. Planigraphy (Fig. 11)

The dispersion of the flint material indicates that there was almost no post-deposition perturbation at the site. The visible concentration of the finds in the centre of the site area supports this hypothesis. It is most probably the place where the blades were produced. This is signified by the large amounts of fine material like chips and small flakes. The area located approximately a meter to the north from this place was the storage of exploited cores. The results of refitting seem to confirm this conclusion. The burin assemblage on the horizontal and vertical axes ideally aligns with the former debitage place – an evidence of creating it on a working spot.

6. Conclusions

Reconstructed sequences of core reduction show that debitage was probably focused on detachment of intended blades. The majority of forms left at the site were by-products of this process. Advanced phase of blade detachment was captured only on one refitted block. It was possible to conjoin it probably due to mistakes made while flint knapping. They caused the breakage of blade and further reparation of the flaking surface. The study also supports the existing hypothesis stating that the soft hammer stone technique was applied for blade detachment in the Swiderian Culture.

The uniqueness of Suchodółka, Site 3 comes from the selection of the local Turonian flint used for blade production. The application of this raw material has not been noted at the nearby Swiderian settlements. Few tools were found at the site, but only one of them was made from the local flint (**Fig. 1:2**). Others were from different raw materials and were probably brought to the working place. These tools were made from blades and differed significantly in respect to the technological process advancement and

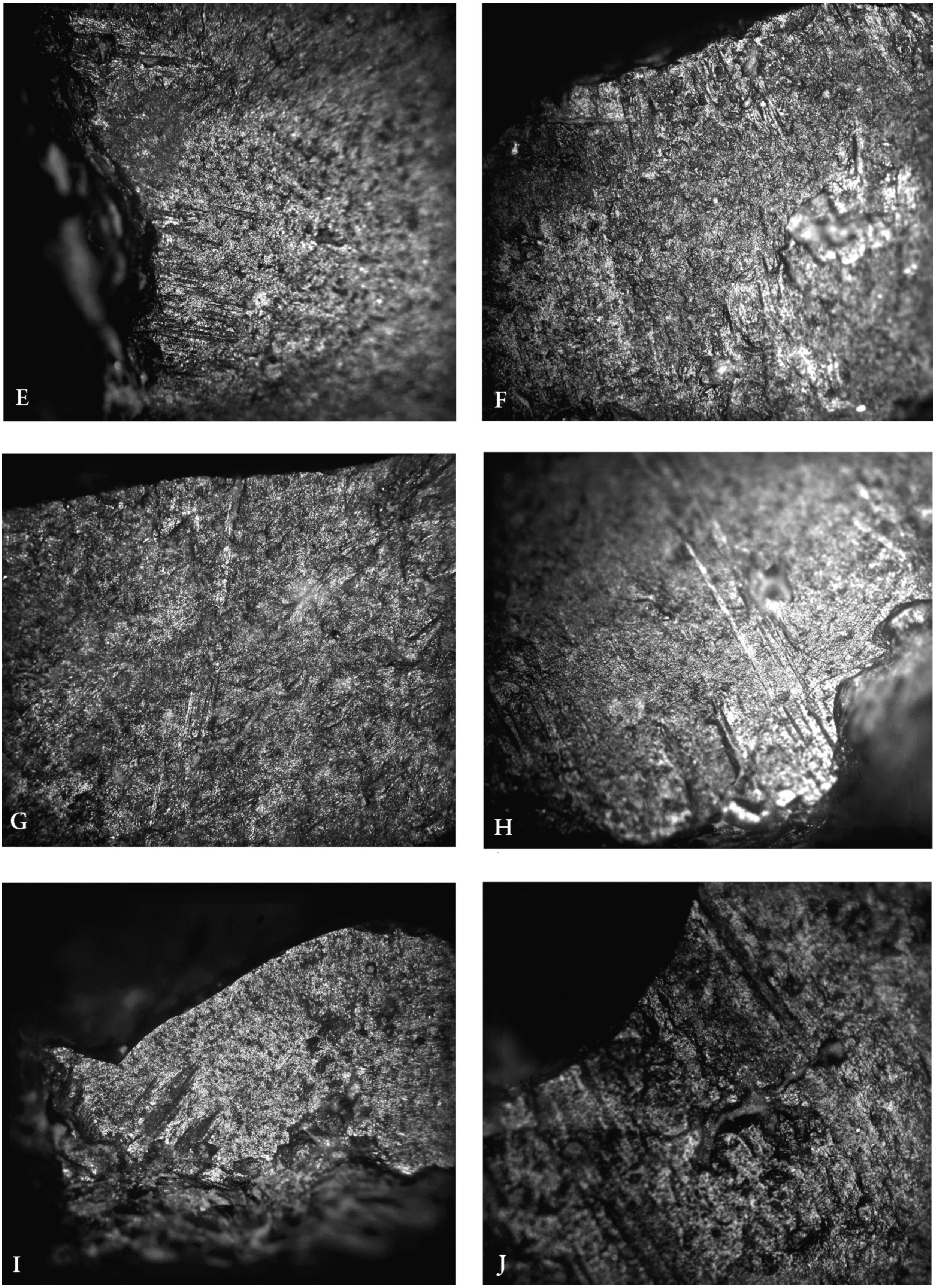

Fig. 10. Suchodółka, Site 3. Technological microwear traces: E–H, J – 100×; I – 50× (Photo K. Pyżewicz).

Ryc. 10. Suchodółka, st. 3. Technologiczne ślady mikroskopowe: E–H, J – 100×; I – 50×.

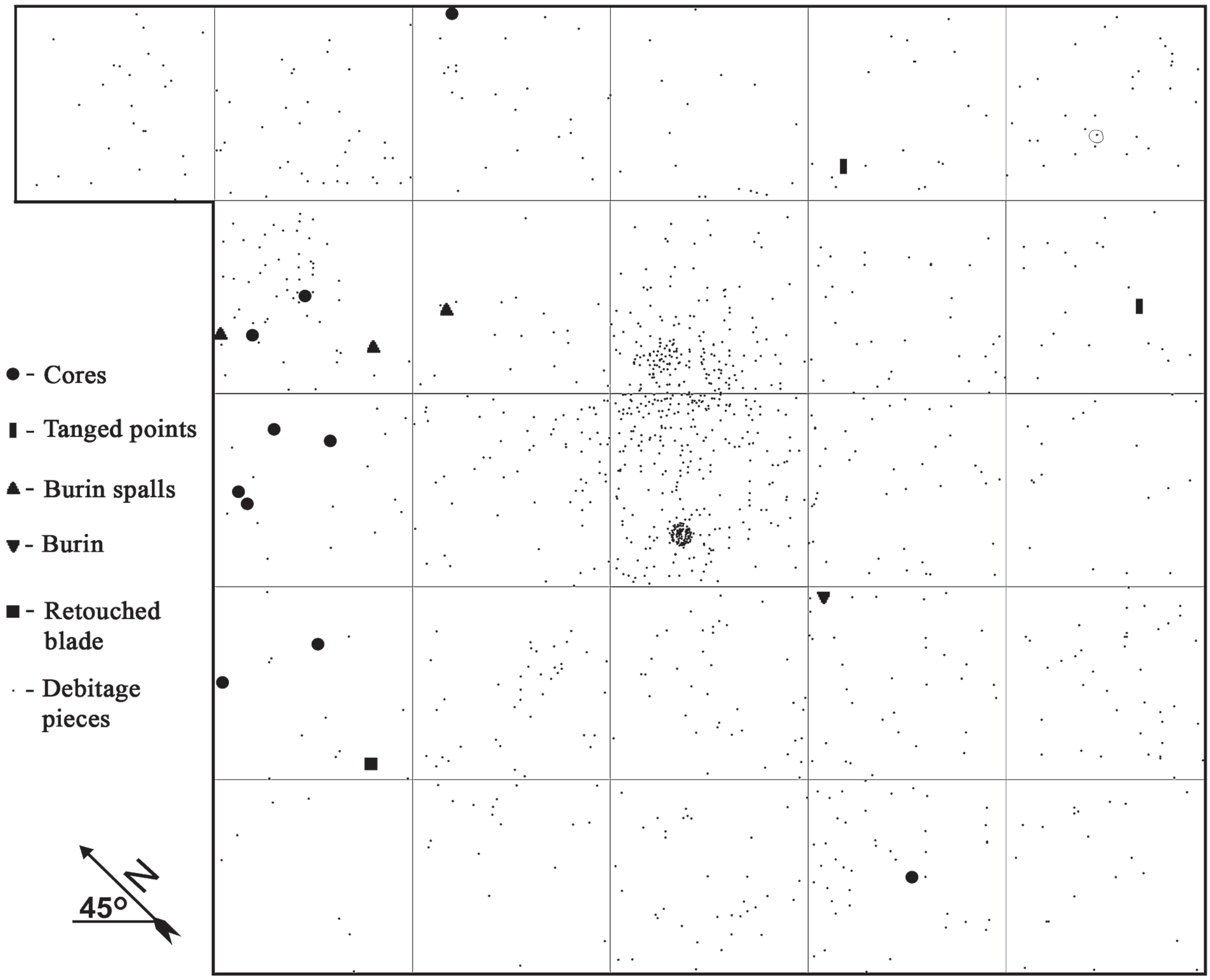

Fig. 11. Suchodółka, Site 3. Planigraphy of the artefacts from Trenches III and V (Drawing K. Pyżewicz).
Ryc. 11. Suchodółka, st. 3. Planigrafia zabytków krzemiennych w wykopach III i V.

their size. Some were originally intended to be blades while others were made from the "waste products". Drawing conclusions from the core reduction strategies without the context of production findings is associated with certain risks. Besides morphological criteria of an intended blade one must remember about the subjective need of a producer who could discard or approve irregular products in specific economic situations. A definitive example of a tool made from a large intended blade was the burin (**Fig. 1:3**) which shows analogies, among others, to the Swiderian assemblages from Całowanie, level VI (Fiedorczuk 2006), and Świdry Wielkie I (Schild 1975). The tanged point was formed from smaller and more fragile blade (**Fig. 1:1**). The perforator and the retouched blades may have been made of any debitage being a waste material recorded at the production site (**Fig. 8:2**).

Further investigations should be made in the area of: 1) selection of specific kinds of blades that result from different technological procedures, as well as 2) their transformation into tools. The materials from both the Suchodółka Site 3 assemblage and the nearby sites in the Sandomierz Upland should be extensively studied. The functional microwear analyses of those materials may be useful in gaining deeper understanding of prehistoric behaviour and flint production economy.

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WIELOASPEKTOWA ANALIZA MATERIAŁÓW KRZEMIENNYCH ZE STANOWISKA SUCHODÓŁKA 3, WOJ. ŚWIĘTOKRZYSKIE

W artykule podjęto próbę scharakteryzowania schyłkowopaleolitycznej technologii wiórowej, której elementy odnotowano na stanowisku Suchodółka 3 (woj. świętokrzyskie). Zabytki poddane szczegółowej analizie pochodziły z pracowni krzemieniarskiej, w której wytwarzano półsurowiec wiórowy pozyskany z rdzeni dwupiętowych. W wyniku przeprowadzonych badań ukazane zostały poszczególne etapy rdzeniowania; podjęto także próbę identyfikacji technik debitażu, które zastosowano do rozszczepiania poszczególnych brył.

W celu scharakteryzowania procesu redukcji rdzeni posłużono się metodą składanek, która umożliwiła zaobserwowanie poszczególnych stadiów produkcji oraz potwierdziła zwarty charakter zespołu. W wyniku podjętych badań stwierdzono m.in. znaczną ilość odpadów produkcyjnych, związanych zarówno z wczesnymi etapami formowania obłupni i produktów będących efektem odnawiania i świeżenia pięt, a także z korygowaniem kształtu odłupni.

Ponadto, w celu identyfikacji sposobów obróbki posłużono się analizami eksperymentalnymi i mikroskopowymi. Przeprowadzone doświadczenia polegały na odtworzeniu zaobserwowanych w składankach sekwencji przy zastosowaniu narzędzi z surowców mineralnych (tłuki z piaskowca) i organicznych (pośredniki z poroża). Porównując serie produktów debitażu eksperymentalnego i oryginalnego, wykorzystano analizy mikroskopowe. Na podstawie badań porównawczych stwierdzono, że sposobem, którym posłużono się podczas obróbki brył krzemiennych na stanowisku w Suchodółce, była najprawdopodobniej technika uderzenia bezpośredniego tłukiem kamiennym. W efekcie tych prac można było również skonfrontować pozyskane dane z tezami przedstawionymi w literaturze przedmiotu.

Wnioski z przeprowadzonych badań dobrze korespondują z danymi pozyskanymi na podstawie innych zespołów związanych z kręgiem kultur z liściakami, które to analizowano za pomocą metody składanek. Stosunkowo duży udział wiórów nie poddanych użytkowaniu, zarejestrowanych w Suchodółce, jak i na pozostałych schyłkowoplejstoceńskich stanowiskach, skłania do interpretacji, że półsurowiec wiórowy zapewne poddawany był przez wytwórców selekcji związanej z preferowaniem określonych parametrów morfologicznych. Na podstawie analizy nielicznie odnotowanych w pracowni krzemieniarskiej narzędzi można przypuszczać, że głównym celem produkcji było uzyskanie relatywnie dużych, prostych i regularnych wiórów o ostrym wierzchołku. Półsurowiec ten, niekiedy nazywany „preferencyjnym", zwykle przeznaczany był – jak się wydaje – do dalszego użytkowania poza miejscem jego produkcji. Większość badaczy skłania się ku interpretacji, według której opisany wyżej typ wiórów przekształcano w liściaki pełniące funkcję grotów strzał. Podczas badań zwrócono uwagę, że sposób zastosowania okazów spełniających opisane kryteria morfologiczne mógł zależeć od wielu czynników. W analizowanym zespole odnotowano wyłącznie jedną formę wykonaną z wióra „preferencyjnego", którą przekształcono w rylec klinowy. Jest to sytuacja odmienna niż w przypadku pozostałych narzędzi wiórowych, wykonanych z półsurowca właściwego dla zaawansowanego debitażu wiórowego, jednak będącego jednocześnie odpadem w badanych składankach.