AN ANALYSIS OF DEBITAGE AT KOSAPSOM PARK SITE (DCRU 4)

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ABSTRACT

In this paper, lithic debitage from the Kosapsom Park site (DcRu-4) in Victoria, British Columbia is analyzed in order to investigate the use of local raw materials and stone tool manufacturing methods over the past 3000 years in the area around the Gorge waterway. An analysis of broken flakes and shatter produced strong evidence for late stages of tool manufacture and retouch. An analysis of cortex cover and dorsal flake scars revealed the presence of early, middle, and late stages of lithic reduction. Therefore, the debitage from Kosapsom reveals an entire sequence of tool manufacture, from core reduction to eventual retouch.

Introduction

KOSAPSOM PARK SITE (DcRu 4)

In 1994 and 1995, excavations at Kosapsom Park (DcRu 4) uncovered the material remains of an ancestral village of the Songhees and Esquimalt First Nations (Mitchell 1995:2). These excavations were undertaken over two field seasons by Archaeological Society of British Columbia (ASBC) volunteers as well as a number of field school participants from the University of Victoria. The site is located along the Gorge waterway in Saanich, on the heritage grounds of the old Craigflower Schoolhouse (Mitchell 1995:2). While the upper layers of the site were disturbed by historical events relating to the activities at the nearby schoolhouse and the more recent Gorge Waterway Beautification Project, the site represents around 3000 years of continuous occupation (Mitchell 1994:3). While historic materials relating to the schoolhouse were also excavated and documented, the material remains of pre-contact occupation at the Songhees and Esquimalt First Nations ancestral village are the focus of this study.

Among the roughly 3500 artifacts uncovered, 1300 were found in pre-contact contexts. Many of these artifacts were lithic tools associated with both Gulf of Georgia (1800-250 BP) and Locarno Beach Culture Type phases (4000-2200 BP). In addition to tools, a large amount of lithic debitage (stone flakes that are the by-product of stone tool-making) was also collected across many different parts of the site. Since this debitage represents a significant portion of the excavated material, it provides a suitable sample size for analysis. This project will attempt to use certain diagnostic characteristics of debitage flakes in order to identify different stages of stone tool production, also known as the "lithic reduction process."

EXCAVATION HISTORY

In 1994, during the first of two field seasons at Kosapsom, a total of 23 units were excavated along the site of a proposed walkway (Mitchell 1994:4). In 1995, during the second season of excavations, nine of these units were reopened and 15 additional units were excavated. Due to time constraints, excavations did not expose the full extent of cultural deposits within these units (Mitchell 1994:3). Initial excavation units were 1x1 m in size and excavated in 5 cm arbitrary levels, although several larger amalgamated units were created during the 1995 field season (Mitchell 1995:4). All artifacts found in situ were recorded through the use of three dimensional point records. Faunal material was also recorded and collected by level (Mitchell 1995:4). All excavated cultural material was waterscreened through aluminum fly-screen and brought back to the University of Victoria for further analysis (Mitchell 1995:4).

DEBITAGE ANALYSIS

Broadly speaking, retouched stone tools (tools that have been re-sharpened or altered along the working edge through flaking) only make up around 3-5% of an entire lithic assemblage at a prehistoric habitation site, although this percentage fluctuates depending on the type of screening that is undertaken during excavation (Odell 2003:118). The vast majority of an assemblage falls into the category of lithic debitage. This term refers to any flake or flake fragment that has not been retouched or formed into a tool (Odell 2003:118). Since debitage constitutes such a large portion of the lithic assemblage at many archaeological sites, including Kosapsom, it represents a critical source of information relating to the activities of a site's inhabitants. The process of creating a flaked stone tool can be broken up into several stages that are associated with various activities including core reduction (primary reduction stage) and tool retouch (tertiary reduction stage). It can therefore be used to reconstruct the process of creating and maintaining a lithic tool (Kooyman 2000:51). Lithic material goes through a series of reduction stages that produce debitage with particular characteristics (Kooyman 2000:51). The way in which these stages are defined and identified is discussed below. By analyzing the characteristics of debitage, both on an individual and mass scale, researchers can gain insight into the stages of production that occurred at a site or an area within a site.

In order to conduct an effective analysis, flakes are broken down into several diagnostic features that can be examined on an individual basis. Information about each of these diagnostic features can be taken together and used to classify a piece of debitage as being the result of a particular activity or set of activities. Pokotylo (1978) and Magne and Pokotylo (1981) identify that an examination of the width of striking platforms (the area where a flake is struck in order to remove it from the original core) provides important information for identifying the stage of reduction that is represented by a flake. This is an example of one of the many examinable diagnostic features of a flake (Figure 1). Andrefsky (1998:20) identifies a number of diagnostic characteristics relating to the distal end of a detached flake. This type of analysis is concerned with identifying feathered terminations, step fractures, hinge fractures, and plunging terminations, all of which are used to determine specific manufacturing techniques. For example, while a feathered termination means that the distal end of a flake tapers off into a sharp edge, a step fracture happens when breakage occurs perpendicular to the original direction of force, leaving a squared bottom edge, rather than a tapered one. Lithic debitage has been an important source for analysis at a variety of sites in British Columbia. Magne (1985) as well as Sullivan and Rozen (1985) each devise systems by which debitage can be classified into early, middle and late stages of reduction. As elements of both of these systems are incorporated into my research, it is necessary to provide a brief overview of each method.

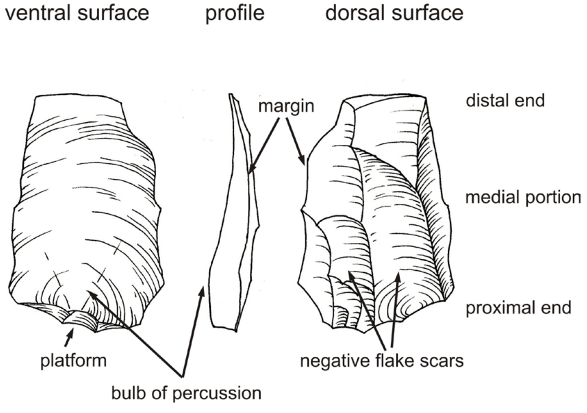

Figure 1. Schematic of a flake showing features discussed in the study. Illustration by Jenny Cohen.

Magne's (1985) system accounts for the amount of cortex (the unworked raw outer surface of lithic material, produced by chemical and mechanical weathering), and the number of flake scars on the dorsal surface of a flake. Magne (1985) also outlines a number of other characteristics, such as weight, platform scar count, and platform width, although none of these diagnostic features were used within the confines of this study. Previous studies have utilized a quantitative analysis of dorsal cortex cover in order to shed light on lithic reduction stages (Morrow 1984; Sanders 1992). These stages are commonly conceptualized through the categories of primary, secondary, and tertiary lithic reduction. The idea behind this method is that flakes that are the result of core reduction or other primary stages of lithic reduction are more likely to have cortex cover on the dorsal surface (Andrefsky 1998: 115). Secondary flakes will have less cortex than primary flakes, and tertiary flakes will have less cortex than secondary flakes (Andrefsky 1998:115). Flakes with a greater number of scars on the dorsal surface are also associated with later stages of lithic reduction, including tool manufacture (Magne 1985:113). Since the completeness of a flake is such a contributing factor in terms of how many flake scars will be present on the dorsal surface, only complete flakes may be used for this sort of analysis. Although the use of these categories for debitage analysis is widespread, there are some issues with this approach. Some researchers have pointed out that cortex may be removed at any stage of reduction, not just earlier ones (Jelinek et al. 1971:199). Therefore, there is no definitive package of traits that is representative of a particular stage of reduction. Rather, identifying a particular set of flake characteristics simply suggests that a certain stage of reduction is more likely.

Sullivan and Rozen's (1985) analysis of debitage from an Archaic Period site in east-central Arizona focuses on examining debitage on a more macro scale. Rather than looking at the various diagnostic characteristics of individual flakes, they instead categorize the flakes very broadly as either complete or broken (Sullivan and Rozen 1985:759). In this case, all debitage is taken into account, as are cores and core fragments. The idea that Sullivan and Rozen (1985:759) present is that complete flakes and cores are more associated with earlier stages of reduction, while broken flakes and non-orientable lithic debris (shatter) is more likely the by-product of later stages of reduction, including tool manufacture. This is because the larger primary flakes produced by primary stage core reduction are less likely to break or be classified as shatter. As the manufacturing sequence continues, and more precise shaping of lithic material is required, smaller and thinner flakes are produced (Sullivan and Rozen 1985:764).

Research Question

This project is aimed at providing a comprehensive analysis of the debitage at the Kosapsom Park site (DcRu-4) in order to shed light on the use of local raw materials and the subsequent manufacture of stone tools in the area around the Gorge waterway over the course of the past 3000 years. An analysis of this material will determine whether the inhabitants of the Kosapsom site were bringing large amounts of raw material to the site to engage in core reduction, or whether large cores were more often reduced elsewhere and brought to the site. More generally, this research is aimed at determining whether the debitage assemblage at Kosapsom represents the by-products of earlier stages of core reduction, or the later stages of tool manufacture and retouch (tool repair or resharpening). If the lithic assemblage at Kosapsom reflects earlier stages of manufacture, one would expect to find a large number of cores and complete flakes with significant cortex cover on the dorsal surface. Alternatively, if the assemblage was dominated by smaller broken flakes with complex patterns of flake scars on the dorsal surfaces, this would indicate more secondary and tertiary stages of stone tool manufacture.

Methodology

THE SAMPLE

In order to conduct this analysis, efforts were taken to make the sample of debitage as inclusive as possible. For this reason, I examined flakes with and without remnant platforms. Following Sullivan and Rozen's (1985) quantitative analysis of lithic material, cores were also examined within the confines of this study. Any retouched material that was found during the course of cataloguing and recording was removed from the sample. Evidence of bipolar reduction was also found during the cataloguing process. These flakes are marked by two points of percussion. Bipolar flakes and cores have certain diagnostic characteristics that differ in comparison with the bulk of flakes at the site, which were marked by a single point of percussion. It is therefore problematic to combine multiple methods of reduction within the same quantitative analysis. Due to time constraints, I was unable to conduct a separate analysis for flakes that were reduced using bipolar technology. For this reason, best efforts were made to remove the products of bipolar reduction from the sample. However, since these characteristics have varying degrees of expression within debitage assemblages, it is likely that some less obvious examples of bipolar reduction remain in the sample. In order to limit error due to small sample size, material from various excavation units, levels, and layers were combined and analyzed together. As a result, this study represents a general analysis of lithic debitage and cores at the Kosapsom site as a whole, rather than a comparison of different areas of the site or different time periods.

The sample consisted mainly of basalt flakes. Dacite was also present in significant numbers. Chert, andesite, and quartzite were present within the sample in very limited quantities. The abundance of basalt suggests that there was a nearby source. There were a number of flakes that showed evidence of having been burned, which suggests that they may have been found in association with a hearth feature. While length and width measurements were not taken, the flakes were qualitatively noted as being quite variable in size.

CLASSIFICATION OF DEBITAGE

In order to facilitate the quantitative analysis of lithic material at Kosapsom, debitage was classified and recorded using the hierarchical scheme outlined in Figure 2. Sullivan and Rozen (1985:769) and Jelinek (1976:19) suggest that lithic assemblages with higher proportions of complete flakes represent the by-products of core reduction and earlier stages of lithic reduction. In contrast, they suggest that assemblages with a higher proportion of broken flakes and shatter signify later stages of lithic reduction and tool manufacture. The classification scheme illustrated in Figure 1 identifies flakes as complete or broken, while further differentiating incomplete flakes into the more specific categories of: proximal, split platform, crushed platform, medial, medial/distal, flake fragment, and shatter.

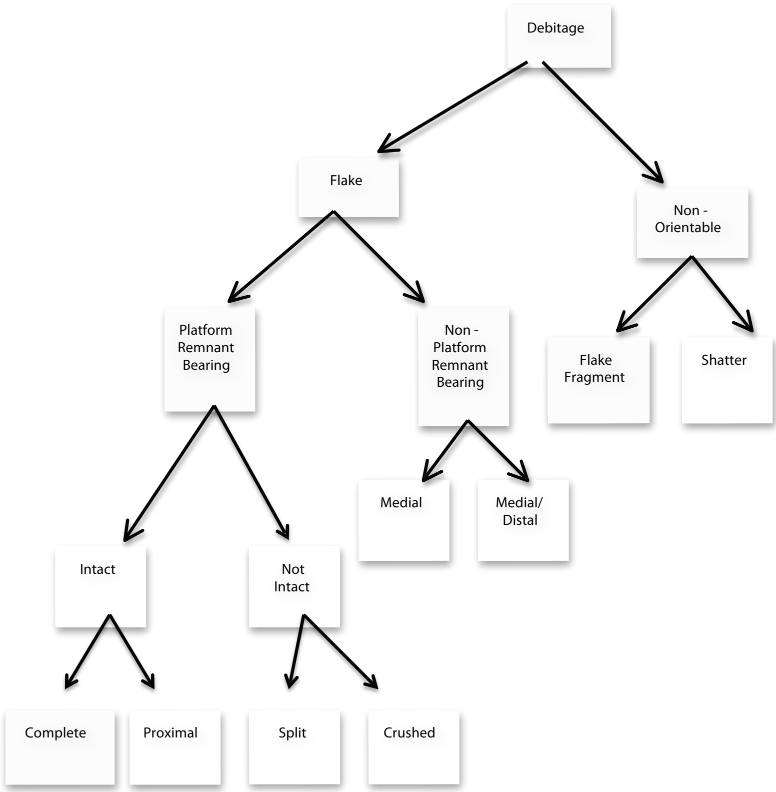

Figure 2. Debitage Classification Scheme.

While non-orientable flakes are often classified as shatter (Shott 1994:70), they have been split into two categories for the purposes of this study. The 'shatter' category refers to lithic material that is not orientable and lacks diagnostic flake characteristics like a visible conchoidal fracture or bulb of percussion. The category of 'flake fragments' refers to material that I was unable to orient, but appears to have diagnostic characteristics that someone with more experience may be able to use to identify the portion of the flake. Any broken flake that could be oriented was categorized as proximal, medial, medial/distal, or split. While the categories in Figure 2 are much more specific than the ones used in the actual analysis, the sorting and recording of debitage in this way creates a more comprehensive pool of data that makes future inter-site comparisons more viable. It also facilitates future analyses of the Kosapsom material that are beyond the scope of this research project. For the purposes of analyzing the proportions of complete flakes and cores in comparison with broken flakes and shatter, the categories of split, proximal, medial, and medial/distal were combined into a single 'broken flake' category. Flakes with crushed platforms could fall into the 'complete flake' or 'broken flake' category, depending on their completeness. Cores were also counted and classified, but no further analysis was undertaken on them.

ANALYSIS OF COMPLETE FLAKES

During the classification stage of analysis, complete flakes were set aside for further analysis based on Magne's (1985) diagnostic criteria for analyzing debitage. Here, a number of quantitative secondary flake characteristics can be used to identify the stage of reduction that a particular flake represents. These categories include: weight, dorsal scar count, dorsal scar complexity, platform scar count, platform angle and cortex cover (Magne 1985). Due to project constraints, only the weight, dorsal scar count, and cortex cover categories were recorded for each flake, with a dorsal scar count and cortex cover analysis being the focus of this second stage of analysis. The thickness of each complete flake was also measured, but as with the weight category, this information was not used for the purposes of this study. The amount of information collected during the cataloguing stage of analysis went beyond that necessary for the purpose of this study; this was done, however, in the interest of facilitating further research on this material.

There are a number of different methods for recording the amount of dorsal cortex within a debitage assemblage. Andrefsky's (1998:115) method of recording the presence or absence of cortex does not account for the varying degrees of cortex that tend to be present at different stages of lithic reduction. For example, an assemblage of ten spalls (flakes with 100% cortex cover on the dorsal surface) would be statistically indistinguishable from an assemblage of ten flakes with less than 10% cortex cover on each. For this reason, Magne's (1985) method of creating four categories that represent increments of 25% as well as two independent categories for 0 and 100 percent cortex cover was utilized. This system employs categories that are specific enough to allow for a reasonable estimation of cortex cover in the assemblage while not being so specific as to create a large amount of error relating to the estimation of cortex cover on an individual flake.

A dorsal scar count was also undertaken with the view that flakes that are the by-product of later stages of tool manufacture (including retouch) would have a greater number of dorsal flake scars when compared to earlier stages of core reduction (Magne 1985:114). In many ways, this measurement is an extension of the idea behind measuring cortex cover. Flakes from early stages of reduction are much more likely to have some degree of cortex cover on the dorsal surface. As the sequence of tool manufacture continues into advanced stage of reduction, more cortex is removed as material is flaked away, creating a complex pattern of flake scars on the dorsal surface of each new flake that is removed. Within the confines of Magne's (1985) study, data from a series of experimental debitage assemblages was used to determine the number of flake scars that best fit the categories of primary, secondary, and tertiary reduction. Using this data, flakes with zero or one dorsal scar were categorized as representing early stages of reduction; flakes with two dorsal scars were categorized as representing a middle stage of reduction; and any flakes with three or more flake scars on the dorsal surface were categorized as the by-products of late stage reduction. As mentioned in the introduction, there is no inherent link between a specific number of dorsal flake scars and a specific stage of reduction. Rather, these categories simply represent the most likely stage of reduction, as illustrated by experimental flint-knapping studies (Magne 1985).

Results and Discussion

MASS ANALYSIS OF DEBITAGE

I utilized Sullivan and Rozen's (1985) framework for the categorization and subsequent analysis of debitage and cores for the first part of the analysis. The results of the first stage of analysis are presented in Table 1. The entire sample of lithic material is included in this table, and the percentage of material that falls into the categories of complete flakes, cores, broken flakes, and shatter/debris are listed. The shatter category is the largest of the four, representing approximately 40% of the entire sample. It should be noted that although best efforts were made to ensure the correct categorization of flakes and flake fragments, a conservative approach was taken in order to minimize error. Therefore, since the shatter category encompasses any non-orientable material, it is likely that the shatter category is overrepresented. However, the effects of this possible overrepresentation of shatter is minimal within the confines of this study because the first stage of analysis focuses on the combined numbers of complete flakes and cores versus the combined numbers of broken flakes and shatter/debris. It is much more likely that broken flakes as opposed to complete flakes would be incorrectly classified as shatter due to the possible absence of a platform or bulb of percussion.

Table 1. Classification of lithic material by general category

Lithic Category	%	Number of Flakes
Complete Flakes	22.04	95
Cores	9.51	41
Broken Flakes	28.54	123
Shatter/Debris	39.91	172
	Total	**431**

Together, broken flakes and shatter represent over 68% of the entire sample of 431 flakes. This is compared to just over 30% that is represented by complete flakes and cores. Viewed separately, shatter makes up almost 40% of the sample, while broken flakes account for 28.54%. Complete flakes represent 22.04% of the sample, while cores make up the smallest portion of the sample at less than 10%. A smaller number of cores are expected, as they are generally used to produce multiple flakes. These percentages are further illustrated in Figure 3. Following Sullivan and Rozen's (1985) debitage analysis, the large amount of material attributed to the broken flake and shatter categories suggests that the debitage material at Kosapsom, as a whole, is more indicative of advanced stages of tool manufacture and retouch, as opposed to early core reduction. However, the amounts of complete flakes and cores are still quantitatively significant, suggesting that in at least some cases, raw material was brought directly to the site, where the entire sequence of manufacture took place.

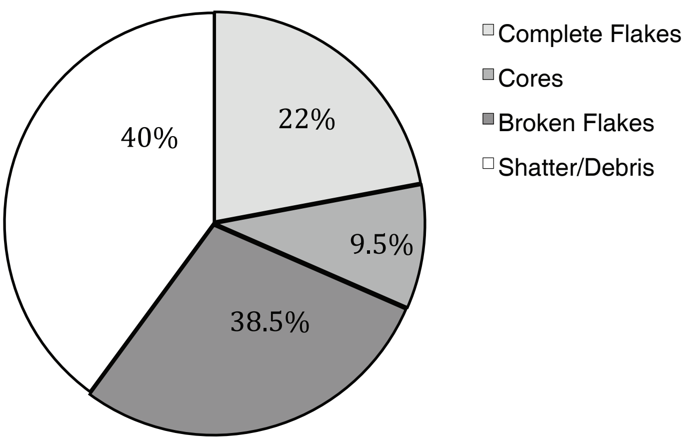

Figure 3. Percentages (%) of diagnostic categories within the sample.

DORSAL SCAR COUNT

The second part of the analysis more closely examined the complete flakes, which were identified during the first stage of analysis. The results of the dorsal scar count are displayed in Table 2. Out of the total 94 flakes, I identified 37 complete flakes with zero to one dorsal scars, 20 flakes with two dorsal scars, and 37 flakes with three or more dorsal scars.

Table 2. Dorsal scar count by category.

	Stages of Lithic Reduction			
	Early (0-1 dorsal scars)	**Middle** (2 dorsal scars)	**Late** (3+ dorsal scars)	**Total**
Number of Flakes	37	20	37	94

It should be noted that the second category is the least inclusive in terms of the number of flake scars that are attributed to a particular stage of reduction. Therefore, the smaller number of flakes attributed to the second category may be partially explained by these categorical inequalities. Each category is represented by a significant amount of flakes, while the early and late reduction categories are especially evenly distributed. The results of the dorsal scar count, therefore, do not provide any strong indications that a specific stage of reduction dominated the manufacturing activities at Kosapsom. However, the relatively significant number of flakes with little or no evidence of dorsal scarring suggests that raw material was brought to the site and that core reduction did occur there. As with the results of the first stage of analysis, these results suggest that the entire sequence of stone tool manufacture is represented within the debitage assemblage at Kosapsom.

ANALYSIS OF DORSAL SURFACE CORTEX

The third part of the study involved the quantitative analysis of cortex on the dorsal surface of complete flakes. As stated earlier, the presence of cortex is generally associated with earlier stages of lithic reduction (Magne 1985:114). The results of this analysis are displayed in Table 3.

Table 3. Amount of cortex cover by category

	Percentage (%) of Cortex Cover on Dorsal Surface						
	0	**1-24.9**	**25-49.9**	**50-74.9**	**75-99.9**	**100**	**Total**
Number of Flakes	50	19	10	3	6	6	94

The majority of complete flakes did not have any cortex cover on the distal surface. It is important to remember, however, that there are a number of other possible variables that can affect the amount of cortex in a lithic assemblage. Quarried rock, for example, may not have as much cortex as a piece of river cobble. The size of the cobble can also affect cortex amounts. Nevertheless, the number of flakes with significant dorsal cortex cover is fairly low in comparison to flakes that have either very little or no cortex cover, suggesting that the assemblage is more representative of later stages of tool manufacture as opposed to core reduction. This is in line with the analysis of broken versus complete flakes, which also pointed to more advanced stages of manufacture. However, the presence of a significant amount of cortex on a number of flakes, including six spalls, suggests that all stages of lithic reduction occurred at the site. This evidence therefore also supports the conclusions drawn from the dorsal scar count portion of the study.

Summary and Conclusion

The results of this study highlight the complex nature of debitage analysis. While there are certain diagnostic flake characteristics that can be quantitatively analyzed, such as the amount of cortex or the number of flake scars on the dorsal surface, it is difficult to definitively characterize an assemblage as representing a particular stage of reduction. It is also important to consider that this project did not address the spatial or temporal aspects of lithic distribution at the Kosapsom Site. Further analysis of site material may result in the identification of different site activity areas, representing different stages of manufacture. In addition, the ongoing process of lithic reduction can often obscure evidence for the early stages of tool production, such as primary core reduction. In the future, a more complete debitage analysis that incorporates formed tools and bipolar technology would be a valuable source of data for the analysis of lithic technologies as well as manufacturing techniques at the site.

An analysis of the numbers of complete flakes and cores in relation to broken flakes and shatter produced strong evidence for late stages of tool manufacture and retouch. An analysis of cortex cover on complete flakes also produced evidence for late stages of lithic reduction. Alternatively, the analysis of dorsal flake scars revealed the presence of early, middle, and late stages of lithic reduction. The relatively large number of cores found at the site also points to earlier stages of reduction. Therefore, the analysis of debitage from Kosapsom reveals an entire sequence of tool manufacture, from core reduction to eventual retouch. It is likely that large amounts of local basalt were brought to the site in raw form and reduced on site. Due to the larger amount of material within the assemblage that is attributed to later stages of reduction, it is possible that only some of the raw material was reduced at the site, and the rest was reduced elsewhere and brought to the site for final shaping and eventual retouch.

Future Research

A large amount of data was collected that could not be analyzed within the scope of this research project, including weight and thickness measurements as well as information about the portions of broken flakes that remained (i.e. proximal, medial, distal). Information about the specific excavation units that material came from also was not utilized, and therefore future research could focus on whether or not specific areas of the site are linked to specific stages of tool manufacture.

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