MICROWEAR ANALYSIS IN THE SOUTHEAST MAYA LOWLANDS: TWO CASE STUDIES AT COPAN, HONDURAS

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Based on the results of 267 replication experiments with obsidian, chalcedony, and agate tools conducted with a range of working materials, I have classified use-wear patterns using Keeley's high-resolution approach to establish a framework for interpretation of stone-tool use. This paper describes the results of microwear analysis of two assemblages of lithic artifacts from the late Late Classic period (A.D. 763–850) at Copán, western Honduras, and shows how the use-wear data can be interpreted within the archaeological contexts and help to investigate how ancient complex societies functioned as well as how and why they changed. Microwear analysis of chipped-stone artifacts collected in front of Structure 10L-16 and artifacts from Structure 10L-22A show clear differences between the two assemblages. In accordance with the archaeological, epigraphic, and iconographic evidence, the low use-intensity of chipped stone from the first structure could have originated from special use such as ritual, production of marine shell ornaments, etc., during the reign of Yax Pac. Marine shell craft production may have been carried out by members of the royal family or attached specialists serving the ruler. The relatively high use-intensity observable in the second assemblage may reinforce the hypothesis that the building was a Classic Maya popol na *(council house) in which feasts or banquets were prepared. If this was the case, use-wear data might support epigraphic and iconographic evidence that suggests the weakening and eventual demise of centralized political authority at Copán in the ninth century.*

A base de los resultados de 267 experimentos con herramientas de obsidiana, calcedonia, y ágata conducidos con varios materiales de trabajo, he clasificado los patrones de huellas de uso según el método de gran alcance desarrollado por Keeley (1980) con el fin de establecer un marco para interpretar las funciones de herramientas líticas. Este artículo presenta los resultados del análisis de microhuellas de dos colecciones de artefactos líticos pertenecientes al final del Clásico Tardío (763–850 D.C.) procedentes de Copán, en el occidente de Honduras, y demuestra como los datos sobre microhuellas pueden interpretarse en los contextos arqueológicos y ayudar a investigar cómo antiguas sociedades complejas funcionaron y por qué cambiaron. El análisis de microhuellas de los artefactos líticos encontrados en frente de la Estructura 10L-16 y los artefactos procedentes de la Estructura 10L-22A demuestra claras diferencias entre los dos agrupamientos. Junto con la evidencia arqueológica, epigráfica, e iconográfica, la baja intensidad de uso de la lítica menor procedente de la Estructura 10L-16 puede indicar algún uso especial, tal como ritos, producción de ornamentos de conchas marítimas, etc. durante la soberanía de Yax Pac. La producción de ornamentos de concha marina pudo haber sido llevada a cabo por miembros de la familia real, o especialistas que servían al gobernante. Por otra parte, puede ser que la relativamente alta intensidad de uso del grupo de lítica menor procedente de la Estructura 10L-22A fortalezca la hipótesis de que el edificio sirvió como un popol na, *o sea casa de consejo, donde se prepararon festines o banquetes. Si éste fuera el caso, los datos de huellas de uso podrían apoyar la evidencia epigráfica e iconográfica que sugiere la debilitación y disminución eventual de la autoridad política central en Copán durante el siglo nueve.*

This paper describes the results of a microwear analysis on two assemblages of lithic artifacts from the late Late Classic period (A.D. 763–850) at Copán (Figure 1), western Honduras, and shows how use-wear data can be interpreted in their full archaeological contexts and help to collect the necessary information to investigate how ancient complex societies functioned as well as how and why they changed. In 1987 staff members of the La Entrada Archaeological Project, Honduras, began an intensive experimental study of use-wear on obsidian, chalcedony, and agate in order to establish a framework for interpretation of Maya stone-tool use. The results of 267 replication experiments con-

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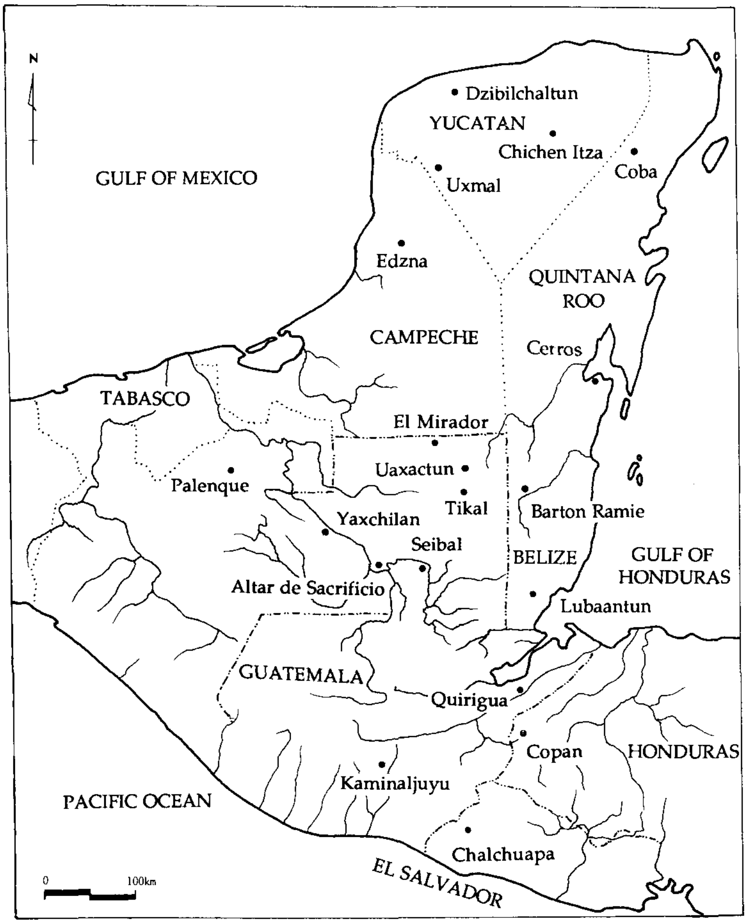

Figure 1. Location of Copán.

ducted with a range of worked materials permitted identification of use-wear patterns based on the high-power microscopy approach (Aoyama 1989, 1991, 1993). The framework defined at La Entrada was used as the basis for the Copán study. In Mesoamerican archaeology, the detailed analysis of stone-tool function is still in its infancy despite its great importance. Work to date has included interpretation of major aspects of stone-tool use through morphological and ethnographic studies, as well as use-wear analysis with a low-resolution microscope (e.g., Clark 1988; Fowler 1987; Hay 1978; Hester 1975; Lewenstein 1981; Michels 1979; Mallory 1984; Parry 1987; Shafer 1979, 1982, 1983; Sheets 1978, 1983; Wilk 1976, 1978). A limited number of microwear studies of Maya chert and obsidian artifacts undertaken recently employ the high-resolution approach established by Keeley (1980) and offer considerable potential for investigating a number of important problems in the evolution of complex societies (Aldenderfer 1991; Aldenderfer et al. 1989; Lewenstein 1987, 1991; Sievert 1992). These include the relation between craft specialization and the development of sociopolitical complexity, the spatial distribution and structure of political control over craft specialties, the relation between production and consumption of lithic materials, the extent of nonsubsistence production, and the role of lithic materials in nonfunctional contexts.

Analytical Procedures and Experimental Program

Description of chipped-stone artifact form uses the criteria and terminology proposed by Sheets (1975, 1978, 1983) and Clark (1988;

Clark and Lee 1979). I defined the final operating classification, which consists of 13 taxa (Aoyama 1988, 1991, 1994). Among the taxa, "general debitage" is a broad category that comprises refuse from a variety of manufacturing techniques, including unidentified shatter and other miscellany (Sheets 1983: 200).

We cleaned all specimens, both experimental and archaeological, prior to determination of use-wear under the microscope. We carefully hand-washed each specimen with soap and water, and then wiped it with absorbent cotton and alcohol. Finally, we immersed each piece in warm HCL (10 percent solution) for 10 minutes. The instrument used in the study was a metallurgical microscope of 50–800× magnification with an incident-light attachment (Olympus BHM). We applied magnifications of 100×, 200×, and 500× for the observation of use-wear. Magnification of 200× was the most frequently used; 100× served primarily to permit identification of use-wear locations, whereas observation of use-wear details in specific areas of artifacts required 500× magnification.

We documented use-wear patterns with microphotos taken on Fuji Neopan 35mm black-and-white films and Fujichrome with an Olympus photomicrographic system camera PM-10M attached to an Olympus EMM-7 photomicrographic exposure meter. We generally took microphotos after use-experiments, but in some cases we also documented the transition of microwear according to the number of strokes of tool use during an experiment.

We conducted 267 experiments on obsidian (151 experiments) and chalcedony and agate (116 experiments) tools, based on the methods of Keeley (1980) and the Tohoku University Microwear Research Team in Japan (Kajiwara and Akoshima 1981), in order to establish a framework for interpretation of Maya stone-tool use. Another objective of the experiments was the investigation of difference in use-wear patterns in obsidian from several major Precolumbian sources. We utilized natural nodules of not only chalcedony and agate from the La Entrada region but also obsidian from Ixtepeque, El Chayal, San Martín Jilotepeque in Guatemala, and La Esperanza and Guinope in Honduras for the experimental work. Replica percussion flakes produced with a stone hammer were hand-held rather than hafted. We retouched replicas before some experiments, but undertook no edge rejuvenation during experiments.

We performed experiments on Gramineae, composite plants, wood, bamboo, bottle gourd, cornstalk, chili, squash, avocado, pineapple, papaya, coconut, yucca, meat, hide (fresh and dry), leather, bone, antler (dry and soaked), *jute* snail (*Pachychilus* sp.), soil, and stone (obsidian, chert, and volcanic tuff). We coated several hides with soil, and soaked some antlers for one day. Actions undertaken included sawing, cutting, grooving, scraping, whittling, chopping, and boring. Experiments involved varying numbers of strokes of each action, some up to 5,000 strokes.

Use-Wear on Siliceous Sedimentary Rocks

According to Keeley (1980), there is a correlation between polish type on flint and the material worked (e.g., bone polish, hide polish, wood polish). Recent studies indicate, however, that the correlation between polish type and material worked is not absolute; that is, both the type of action and number of strokes can influence the formation of polish (Aldenderfer et al. 1989; Kajiwara and Akoshima 1981; Vaughan 1985). Similar polishes produced by both the same worked material and the same action developed at different rates during different experiments. The appearance of similarity in polishes produced by different materials and different actions is created if distinguishable polishes are undeveloped. In the face of such difficulties, the Tohoku University Microwear Research Team (Kajiwara and Akoshima 1981:10–15) identified 11 basic types of polish on shale that are principally the result of the material worked. Because different polish types are frequently observable on the same edge, a complex of different polish types is described by a combination of a principal type and a secondary type, such as BF1, D2C, ElF2, etc. (Kajiwara and Akoshima 1981:16). This classification can also be applied to chert artifacts (Serizawa et al. 1982). The results of microwear analysis of 116 experimental chalcedony and agate specimens in the present study confirm that the classification set forth by the Tohoku University Microwear Research Team can also be applied to chalcedony and agate artifacts (Aoyama 1989, 1991). In our experiments, polish types A, B, C, D, and E became distinguishable after 500 strokes.

Type A

The polish is the same as sickle gloss or corn gloss (Witthoft 1967). The characteristics of Type A polish include: (a) a very smooth, rounded and reflective surface, (b) a fluid appearance, and (c) filled-in striations. Type A results from cutting of Gramineae.

Type B

Although the edge of the polish surface is rounded like that of Type A, it never develops as extensively as Type A. Type B is produced by work on wood and other plants.

Type C

The polish surface is rough, with numerous tiny pits and striations. Type C appears principally with sawing and cutting bone and antler, but is also produced by the working of *jute* snail.

Type D1

The polish surface is smooth and flat, but its area is limited to near the edge of the lithic. Type D1 develops with the working of soaked bone or antler.

Type D2

Although similar to Type D1, the polish surface appears more concave or convex in section than that of D1 owing to the presence of clear striations. Type D2 results from working of dry bone or antler and *jute* snail.

Type E1

Type El polish does not extend very far from the working edge, and the edge of the polish surface is slightly rounded. It is produced by the processing of meat and fresh hide.

Type E2

The edge of the polish surface is rounded and rough, with numerous tiny pits. Type E2 results from the processing of dry hide and leather.

Types Fl and F2

Both have poorly developed and dull polish. Type Fl polish is "greasy" in appearance, whereas Type F2 is extremely dull. The two types result from the working of yucca, and also appear with limited processing of Gramineae, avocado, chili, bottle gourd, dry antler, bone and *jute* snail. They also occur when a hard material is worked with a portion of the tool not frequently utilized. Types Fl and F2 often appear at early stages of work that culminates in polish Types A, B, C, D, or E.

Type X

The polish is dull with a matte texture, and develops from soil abrasion.

Type Y

Some parts of the polish surface are smooth, and others are rough, with numerous tiny pits of various forms and sizes as well as irregular striations. It is produced by the working of stone.

Use-Wear on Obsidian

Because the surface of obsidian is usually more vulnerable than that of siliceous sedimentary rocks (SSR), striations form more readily on the surface of obsidian than on SSR. Furthermore, not all types of obsidian polish are very similar to those on SSR (e.g., Hurcombe 1985, 1992; Kajiwara 1982; Lewenstein 1987; Midojima 1986; Vaughan 1981). Consequently, I classify use-wear on the obsidian tools utilized in this study into 11 patterns that correlate with the material worked, based on combined observation of the striations, polish, and tiny pits in the polish surface. When different use-wear patterns are observable on the same edge, I identify a complex of different patterns of use-wear by

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a principal pattern and a secondary pattern such as ah, ef, dh, etc. It should be noted that no differences in use-wear patterns were observed in obsidian from the several sources in Guatemala and Honduras (Aoyama 1989, 1991, 1993). These results indicate a great potential for the determination of the materials worked with Maya obsidian tools. The following is a description of the 11 use-wear patterns on obsidian identified in this study. Figures 5 and 8 illustrate representative examples of analyzed artifacts, and Figures 6 and 9 present several use-wear patterns.

Pattern a

An authentic polish (like sickle gloss or corn gloss [Witthoft 1967]) is characterized by (1) a very smooth and reflective surface, (2) a fluid appearance, and (3) filled-in striations. The polish, which is similar to that of Type A on SSR, results from the processing of Gramineae.

Pattern b

The polish surface is bright and very smooth, but not as bright or smooth as pattern a. In spite of the very developed polish, the surface of pattern b is relatively flat. Associated striations are generally thin and long. A relatively large number of tiny pits are observable in the polish surface. This polish is similar to Type B on SSR, but the extent of the polish is greater on the obsidian surface. Pattern b results from the working of wood and other plants.

Pattern c

The polish surface is bright and flat, but rough and pitted and marked by clear striations. Pattern c is produced principally by sawing and cutting of bone and antler, as well as less frequently by the working of *jute* snail.

Pattern d

The polish surface is bright, smooth, and flat, with slightly rounded extreme margins. Infrequent thin striations and a few tiny pits are observable in the polish surface. Pattern d is produced by actions that involve motion transverse to the tool edge, such as the scraping and whittling of bone or antler.

Pattern e

The polish surface has an extensively matted texture and is generally rough, with numerous tiny surface pits and striations. It is limited in area to near the edge of the tool. It results from the working of hide.

Pattern f

The polish is poorly developed, with short striations and numerous tiny pits observable on a limited area near the edge of the implement. With continued implement use, Pattern f transforms into e. Pattern f is produced by the cutting of hide and meat.

Pattern g

The polish surface is bright and very flat, but not as rough as pattern c; it consists of tiny pits of various sizes, with numerous striations in the polish surface. Pattern g results from the working of *jute* snail.

Pattern h

The polish is weak and dull, with relatively long striations and tiny pits of various forms and sizes in the polish surface. The polish is produced by the working of yucca, and also appears during initial use of implements on Gramineae, other native plants (avocado, chili, and bottle gourd), dry antler, bone, and *jute* snail. It also occurs when a hard material is worked with a portion of the tool not frequently utilized. Pattern h is an initial step in developing use-wear patterns a, b, c, d, or g.

Pattern i

The polish is weakly developed, rounded, and smooth, and it is limited to a small portion of the implement's edge. Neither striations nor tiny pits are observable. The polish is produced by the cutting of meat.

Pattern x

The polish surface is dull with a matte texture and very rough, with tiny pits varying in size and form as well as many striations. The polish is produced by excavating soil, either alone or mixed with hide.

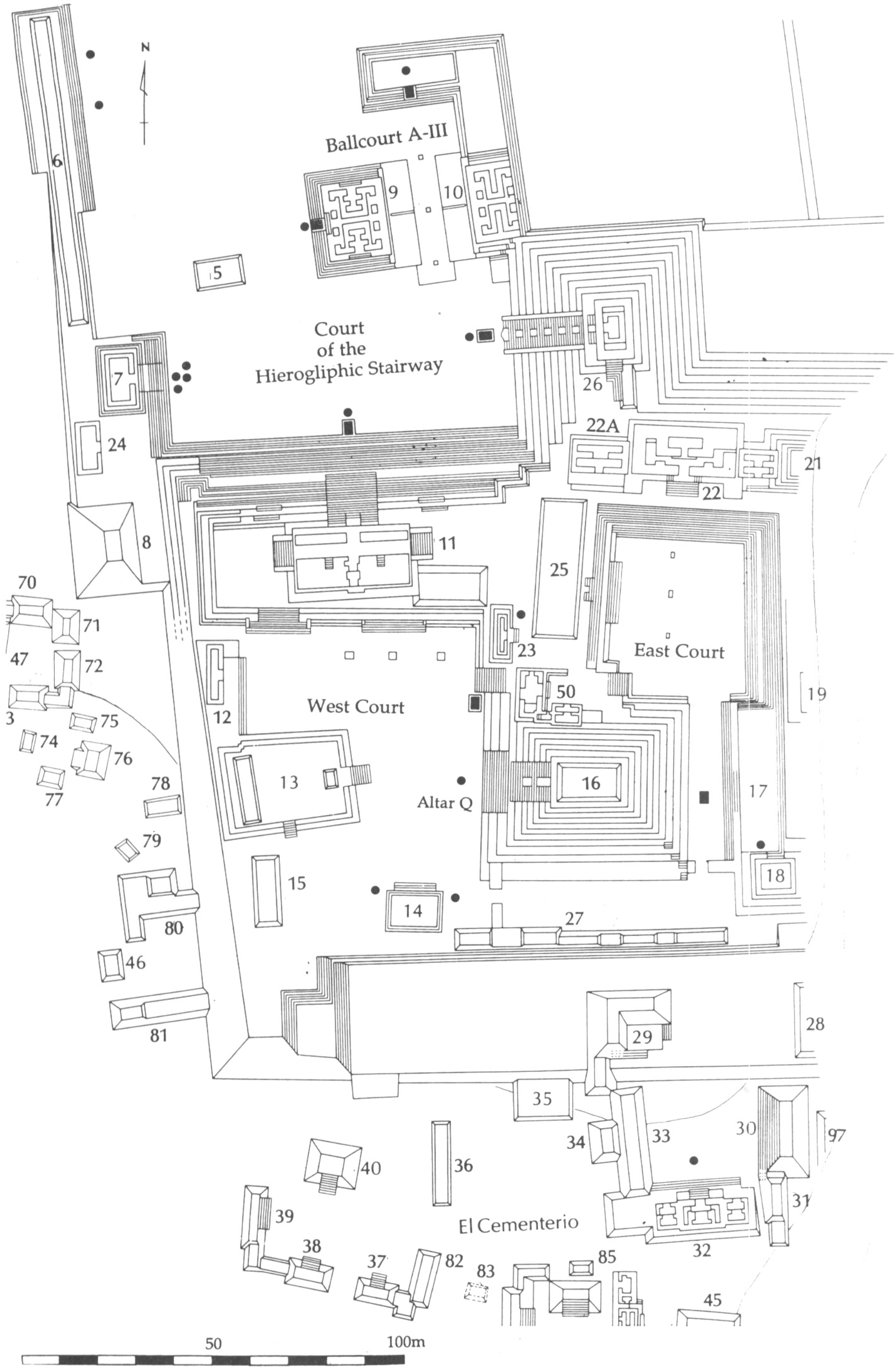

Figure 2. Plan of the Acropolis at Copán, Honduras, showing location of Structures 10L-16 and 10L-22A (after Fash and Long 1983:Map 12).

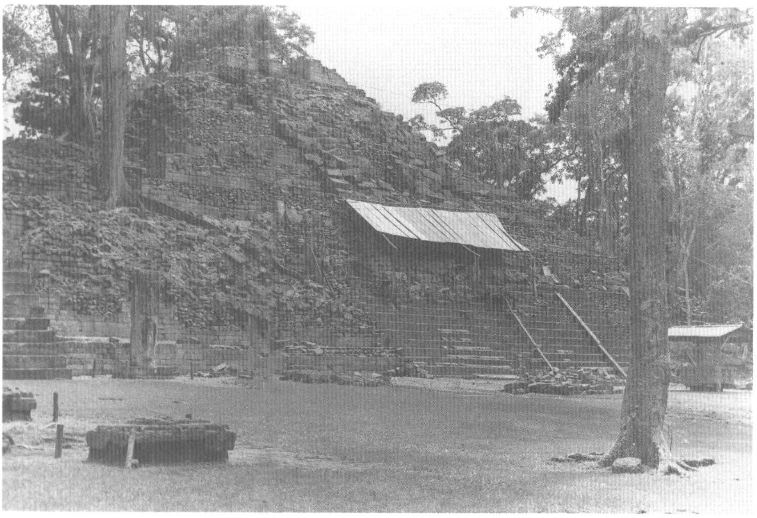

Figure 3. View of west facade of Structure 10L-16 and the West Court, Copán.

Pattern y

The polish surface is weak with a matte texture, but not as rough as pattern x; it is characterized by tiny pits that are not clearly visible. Striations are observable without a microscope. Pattern y appears with the working of stone.

Case Study 1: In Front of Structure 10L-16

Structure 10L-16 is the tallest pyramid in the final construction of the Acropolis that divides the East and West Courts at Copán (Figures 2 and 3). The stone sculptures associated with the structure include six different types of Jaguar Tlaloc war images as well as grisly skulls, ropes for binding captives, and warriors complete with shield and lance (Fash and Fash 1990:35). The imagery relates strongly to death and warfare, and the temple may be a shrine dedicated to the founder of the Copán dynasty, Yax K'uk Mo' (Fash 1992: 101). According to Schele and Miller (1986: 113), the south facade of Structure 10L-11 (Figure 4) and the West Court fronting it were symbolically defined as the underworld and as a place of sacrificial death, whereas the lower terraces and the West Court were the underworld to which messengers were dispatched through sacrifice. Glyphic texts indicate that in dedicating Altar Q, Yax Pac,

Figure 4. View of south facade of Structure 10L-11 and the West Court, Copán.

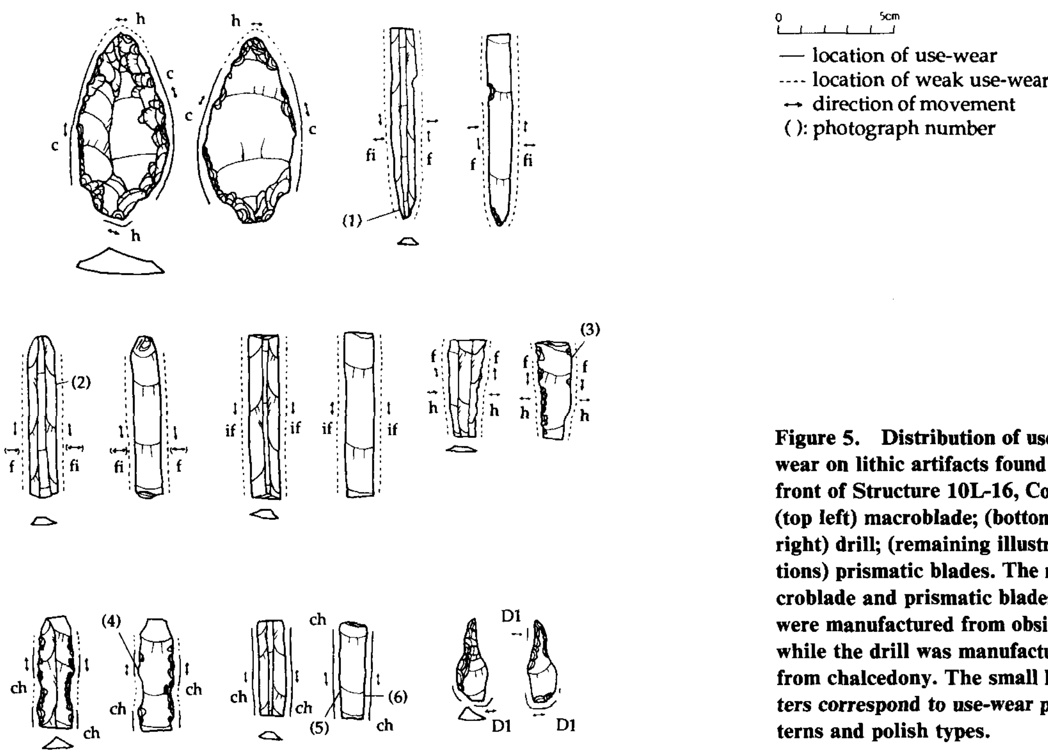

Figure 5. Distribution of use-wear on lithic artifacts found in front of Structure 10L-16, Copán: (top left) macroblade; (bottom right) drill; (remaining illustrations) prismatic blades. The macroblade and prismatic blades were manufactured from obsidian while the drill was manufactured from chalcedony. The small letters correspond to use-wear patterns and polish types.

Table 1. Obsidian Chipped-stone Artifacts Collected in Front of Structure 10L-16.

	n	%
Prismatic blades	269	95.7
Macroblades	2	.7
Prismatic blade points	3	1.1
Bifacial points	1	.4
General debitage	6	2.1
Total	281	100.0

who acceded to power on July 2, A.D. 763, as the sixteenth ruler of Copán, sacrificed 15 jaguars, one for each of his royal ancestors; the bones of 15 jaguars were collected during the excavations (Fash and Fash 1990:35).

In 1989 Ricardo Agurcia and David Kluth uncovered a midden in the West Court in front of Structure 10L-16. Based on stratigraphy as well as associated ceramics and glyphic texts, this midden is dated to the reign of Yax Pac (A.D. 763–820). The 20-cm-thick layer contained numerous marine-shell ornaments representing at least four species, together with some chipped-stone tools, a small number of sherds, *jute* snails, and animal bone. The inference that the materials were deposited near their original use location may be supported by the excellent preservation of use-wear on the chipped-stone artifacts, although this evidence obviously bears primarily on the elapsed time between use and deposition. The midden deposit yielded neither metates nor manos. Examination of shell ornaments and fragments indicates that the actions performed on the artifacts include cutting, grooving, whittling, and boring. It is possible that the chipped-stone artifacts found in the midden were used for production of marine-shell ornaments.

Of the 313 pieces of chipped-stone artifacts collected from the midden, 89.8 percent (N = 281) are imported obsidian, and 10.2 percent (N = 32) are local chalcedony in the form of 30 pieces of unretouched flakes and two drills. Table 1 lists the obsidian artifacts, none of which had cortex present. Prismatic blades comprise 95.7 percent of the obsidian artifacts; no retouched flake artifacts were encountered. All obsidian artifacts were presumably manufactured elsewhere in Copán and brought into the West Court as finished artifacts.

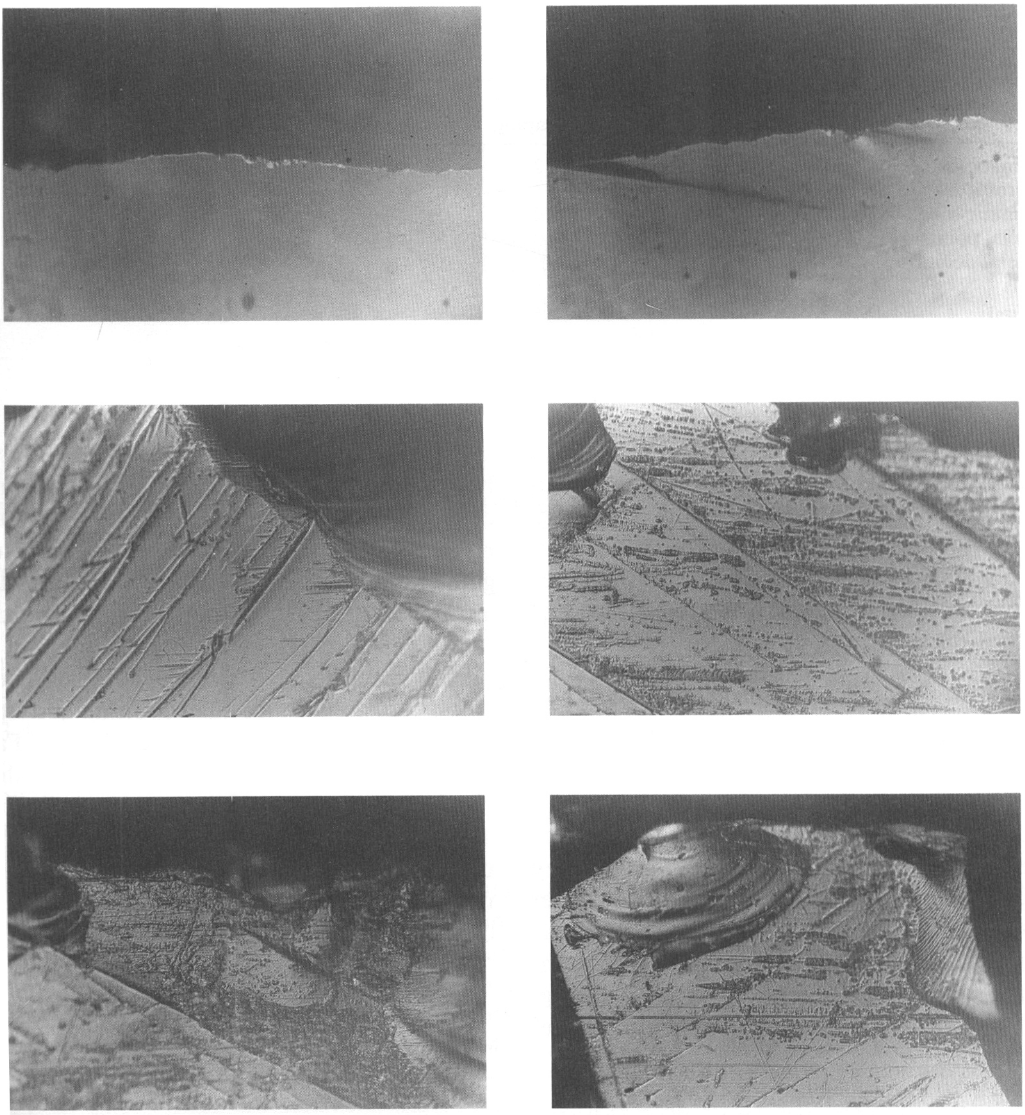

Figure 6. Examples of use-wear on lithic artifacts found in front of Structure 10L-16, Copán: (top left) Item 2, pattern i; (top right) Item 3, pattern i; (middle left) Item 5, pattern f; (middle right) Item 6, pattern c; (bottom left) Item 7, pattern c; (bottom right) Item 7, pattern ch.

We randomly selected 40 artifacts, 33 of obsidian and 7 of chalcedony, for microwear analysis. We observed use-wear on all analyzed obsidian artifacts, but on only 5 of the chalcedony artifacts. Figure 5 shows some representative examples of analyzed artifacts, and Figure 6 presents several representative use-wear patterns. Table 2 presents the relationship between artifact type and motion-of-use, and Table 3 relates artifact type and the material worked. Both tables present counts of used edges, and hence the totals exceed the number of artifacts analyzed.

The most common action associated with these lithic tools was cutting or sawing, followed in order by scraping, whittling, piercing, grooving, drilling, and unknown action. Meat or hide was the most common material worked, followed by shell, bone or antler, unknown materials, and plant or wood. Table 4 shows the relationship between the type of material worked and motion-of-use; the ac-

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Table 2. Correlation between Artifact Type and Motion-of-Use on Chipped-stone Artifacts Collected in Front of Structure 10L-16.

Motion of Use Type	Cutting or Sawing	Grooving	Scraping	Whittling	Piercing	Drilling	Unknown	Total
Prismatic blades	49	0	12	4	0	0	0	65
Macroblades	2	0	1	0	0	0	0	3
Prismatic blade points	4	0	0	0	2	0	0	6
Bifacial points	2	1	0	0	0	0	0	3
General debitage	5	0	0	1	0	0	1	7
Drills	0	0	0	0	0	1	0	1
Total	62	1	13	5	2	1	1	85
%	72.9	1.2	15.3	5.9	2.4	1.2	1.2	100.0

Note: If an artifact has several used edges, the number of actions was registered by each edge; if several actions were observed in an edge, each action was counted.

tivities performed with the analyzed artifacts were as follows: cutting, scraping, and piercing meat or hide; cutting or sawing, grooving, whittling, and drilling shell, bone, or antler; cutting or sawing and whittling wood or other plants; cutting or sawing and whittling unknown material.

Case Study 2: Floor of Structure 10L-22A

Structure 10L-22A (Figures 2 and 7) served as a *popol na*, or council house, during the eighth century and continued in use for at least 75 years, up to the death of Yax Pac (Fash et al. 1992:437). A 3-x-6-m midden deposit, consisting of a 30–40-cm-thick layer with considerable carbon and other organic remains, was uncovered in 1988 at the southeast corner of the structure. Based on stratigraphy as well as associated ceramics and related glyphic texts, this midden could have been laid down in the first half of the ninth century, either in the last years of Yax Pac's reign or after his death. Mixed with the organic remains, which included *jute* shells and animal bone, were numerous types of utilitarian ceramic vessels (some represented by partial specimens), as well as some chipped-stone tools, evidence that cooking activities probably took place there (Fash and Fash 1990:32; Fash and Sharer 1991:35; Fash et al. 1992:426). As in the case of the Structure 10L-16 deposit, the excellent preservation of use-wear on the chipped-stone artifacts may indicate that the implements were disposed of close to their use location.

The 114 pieces of chipped stone collected

Table 3. Correlation between Lithic Type and Worked Material on Chipped-stone Artifacts Collected in Front of Structure 10L-16.

Worked Material Type	Meat or Hide	Shell, Bone, or Antler	Wood or Other Plants	Unknown	Total
Prismatic blades	34	10	5	12	61
Macroblades	1	2	0	0	3
Prismatic blade points	4	2	0	0	6
Bifacial points	0	3	0	0	3
General debitage	0	0	0	7	7
Drills	0	1	0	0	1
Total	39	18	5	19	81
%	48.1	22.2	6.2	23.5	100.0

Note: If several worked materials were observed in an edge, each material worked was registered.

Table 4. Correlation between Worked Material and Motion-of-use on Chipped-stone Artifacts Collected in Front of Structure 10L-16.

Worked Material Motion-of-use	Meat or Hide	Shell, Bone, or Antler	Wood or Other Plants	Unknown	Total
Cutting or sawing	27	16	4	15	62
Grooving	0	1	0	0	1
Scraping	13	0	0	0	13
Whittling	0	1	1	3	5
Piercing	2	0	0	0	2
Drilling	0	1	0	0	1
Unknown	0	0	0	1	1
Total	42	19	5	19	85

Note: If an artifact has several used edges, the number of actions was registered by each edge; if several actions were observed in an edge, each action was counted; if several worked materials were observed in an edge, each material worked was registered.

Figure 7. View of south facade of Structure 10L-22A, Copán.

from the midden comprised 98.2 percent (N = 112) obsidian (Table 8) and 1.8 percent (N = 2) chalcedony. Table 5 shows the assemblage of obsidian artifacts, none of which had cortex present. Prismatic blades constitute 63.4 percent of the obsidian artifacts. The unusually high percentage of bifacial points and the lack of whole exhausted cores suggest that the artifacts were manufactured elsewhere and brought to the structure as finished objects. Moreover, microwear analysis showed that a fragment of polyhedral core had been recycled to whittle wood or other plants. It is possible, however, that the edges of some bifacial points and other implements were rejuvenated at or near this structure.

We randomly selected 23 chipped obsidian artifacts for microwear analysis, which revealed use-wear on 95.7 percent of the sample. Figure 8 shows some representative examples of analyzed artifacts, and Figure 9

Table 5. Chipped Stone Artifacts from Structure 10L-22A.

	n	%
Prismatic blades	71	63.4
Macroblades	2	1.8
Fragments of polyhedral core	3	2.7
Bifacial points	20	17.9
General debitage	12	10.7
Scrapers	2	1.8
Denticulates	2	1.8
Total	112	100.0

Table 6. Correlation between Artifact Type and Motion-of-use on Chipped-stone Artifacts from Structure 10L-22A.

Motion-of-use Type	Cutting or Sawing	Scraping	Whittling	Piercing	Total
Prismatic blades	27	5	2	0	34
Fragment of polyhedral core	0	0	2	0	2
Bifacial points	13	3	2	2	20
Scrapers	4	2	1	0	7
Denticulates	2	1	0	0	3
Total	46	11	7	2	66
%	69.7	16.7	10.6	3.0	100.0

Note: If an artifact has several used edges, the number of actions was registered by each edge; if several actions were observed in an edge, each action was counted.

Table 7. Correlation between Lithic Type and Worked Material on Chipped-stone Artifacts from Structure 10L-22A.

Worked Material Type	Wood or Other Plants	Meat or Hide	Bone, Shell, or Antler	Total
Prismatic blades	18	9	2	29
Fragment of polyhedral core	2	0	0	2
Bifacial points	9	6	0	15
Scrapers	2	2	0	4
Denticulates	0	2	0	2
Total	31	19	2	52
%	59.6	36.5	3.8	100.0

Note: If several worked materials were observed in an edge, each material worked was registered.

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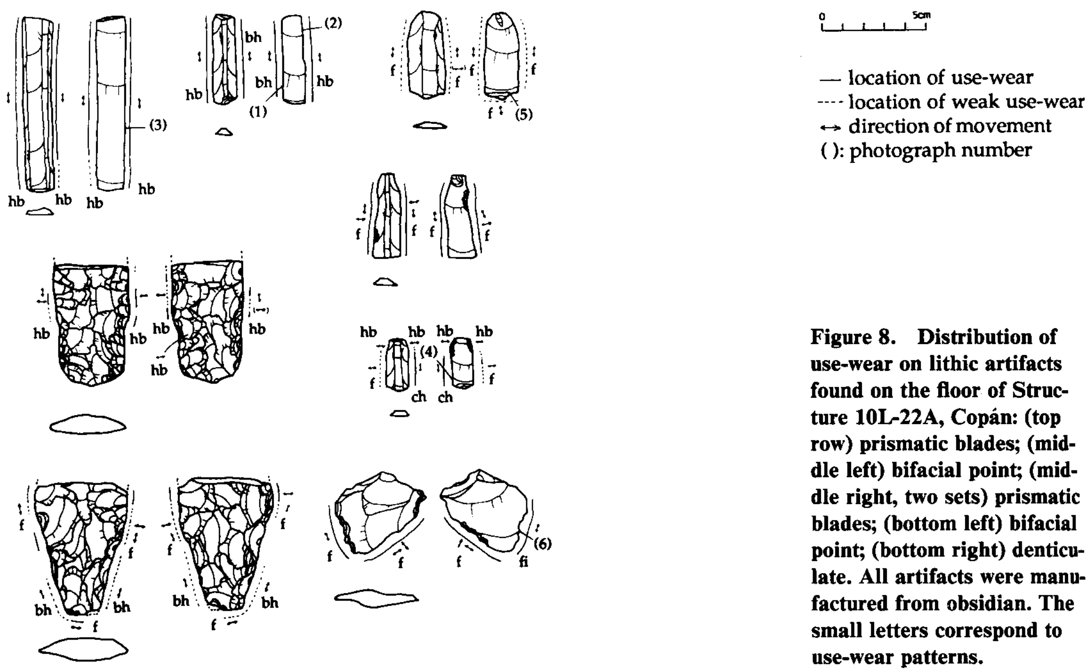

Figure 8. Distribution of use-wear on lithic artifacts found on the floor of Structure 10L-22A, Copán: (top row) prismatic blades; (middle left) bifacial point; (middle right, two sets) prismatic blades; (bottom left) bifacial point; (bottom right) denticulate. All artifacts were manufactured from obsidian. The small letters correspond to use-wear patterns.

presents several representative use-wear patterns. Tables 6 and 7 show the relationships between artifact type and motion-of-use, and artifact type and material worked. As with Tables 2 and 3, counts are of utilized edges rather than artifacts.

The most common action was cutting or sawing, followed in order by scraping, whittling, and piercing. Plant or wood was the most common material worked, followed by meat or hide, and bone or antler. The activities performed were as follows: cutting or sawing, whittling, and drilling wood or other plants; cutting, scraping, and piercing meat or hide; and cutting or sawing shell, bone, or antler (Table 8).

Table 8. Correlation between Worked Material and Motion-of-use on Chipped-stone Artifacts from Structure 10L-22A.

Worked Material Motion-of-use	Wood or Other Plants	Meat or Hide	Bone, Shell, or Antler	Total
Cutting or sawing	27	17	2	46
Scraping	0	11	0	11
Whittling	7	0	0	7
Piercing	1	1	0	2
Total	35	29	2	66

Note: If an artifact has several used edges, the number of actions was registered by each edge; if several actions were observed in an edge, each action was counted; if several worked materials were observed in an edge, each material worked was registered.

Summary and Discussions

Comparisons of the results of microwear analysis of Structure 10L-16 and Structure 10L-22A chipped-stone artifacts show clear differences between the two samples. Specialized activities such as ritual and craft specialization, i.e., production of marine shell ornaments, seem to have been undertaken in front of Structure 10L-16 during the reign of Yax Pac. Marine shell craft production may have been carried out by members of the royal family or attached specialists serving the ruler (e.g., Brumfiel and Earle 1987; Earle

Table 9. Percentage of Worked Material on Chipped-stone Artifacts Collected in front of Structure 10L-16 and from Structure 10L-22A.

	Context	
Worked Material	In Front of Structure 10L-16	Floor of Structure 10L-22A
Meat or hide	49.4	43.9
Shell, bone, or antler	22.4	3.0
Wood or other plants	5.9	53.0
Unknown	22.4	0

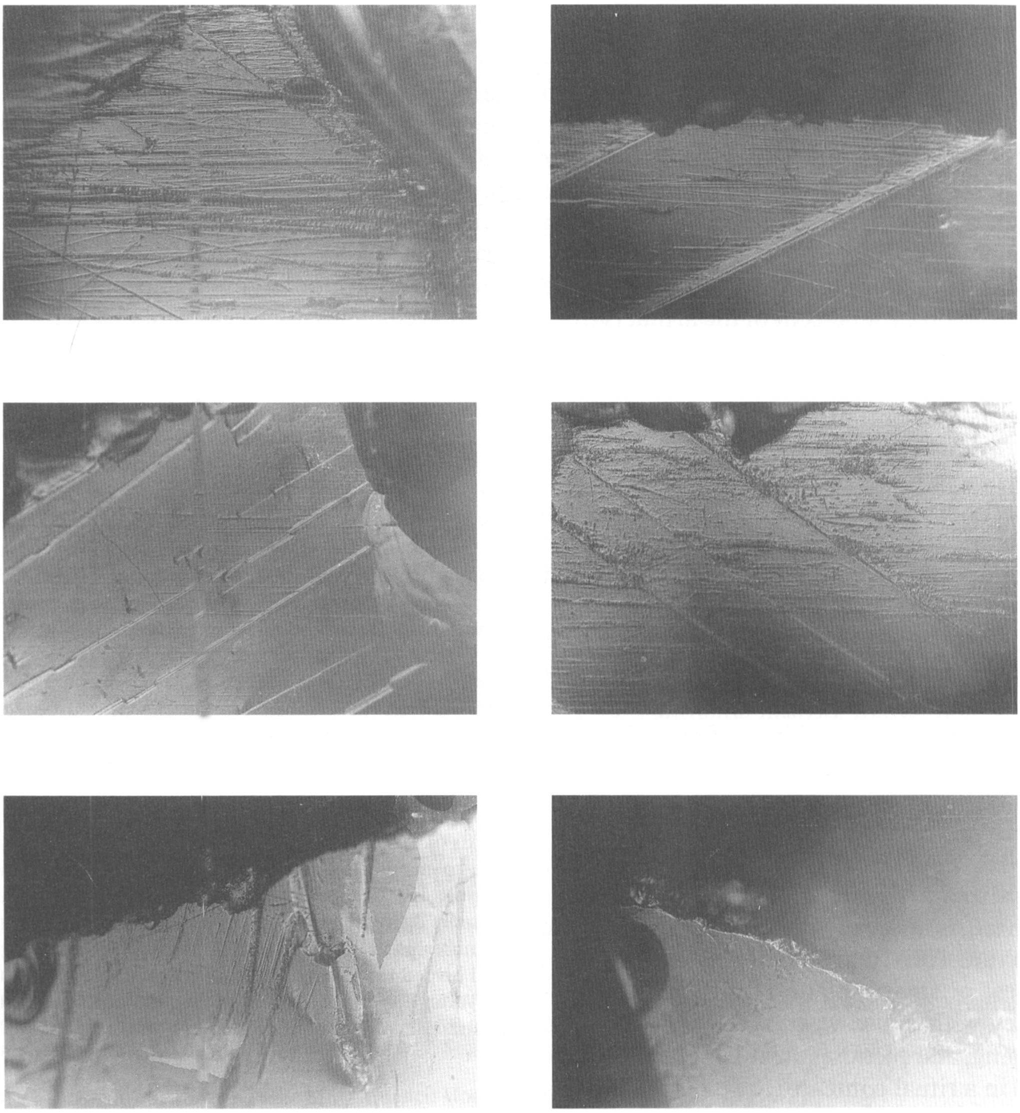

Figure 9. Examples of use-wear on lithic artifacts found on the floor of Structure 10L-22A, Copán: (top left) Item 2, pattern b; (top right) Item 2, pattern hb; (middle left) Item 1, pattern h; (middle right) Item 6, pattern c; (bottom left) Item 3, pattern f; (bottom right) Item 8, pattern i.

1981, 1987). Such marine shell craft specialists may have been of very high social status. On the other hand, the results of microwear analysis may reinforce the hypothesis proposed by Fash et al. (1992) that Structure 10L-22A was a Classic Maya *popol na* (council house) in which feasts or banquets were prepared. If this was the case, use-wear data might support epigraphic and iconographic evidence, which suggests the weakening and eventual demise of centralized political authority at Copán in the ninth century. Drilling and grooving of shell, bone, or antler were identifiable on the drill and bifacial point from 10L-16 but not on artifacts from 10L-22A. Moreover, a chi-square analysis showed that there is an extremely significant and very strong difference ($X^2 = 53.704$, $p < .0005$, $V = .635$) in the proportions of material worked with chipped-stone artifacts from both contexts. The material worked with lithic artifacts from 10L-16 was most often meat or hide, whereas the most common material from 10L-22A was plant or wood. The differences in percentage of shell, bone, or antler; wood or other plants; and unknown material worked in the two contexts are also striking (Table 9).

The tools from Structure 10L-16 appear not to have been as intensively used as those from Structure 10L-22A for the following reasons:

(1) The materials worked could not be identified on 22.4 percent of the artifacts from Structure 10L-16 owing to the high percentage of undeveloped polish and microwear patterns such as Fl, F2, and pattern h. In contrast, the materials could be identified on all artifacts from 10L-22A.

(2) 39.4 percent of prismatic blades from Structure 10L-22A were retouched from manufacture, in contrast to only 8.2 percent from Structure 10L-16.

(3) The individual artifacts from Structure 10L-22A were used more frequently for multiple functions than those from Structure 10L-16. That is to say, two kinds of material were worked with 18.2 percent of the individual artifacts from Structure 10L-22A compared to only 5.3 percent of those from Structure 10L-16. This may also relate to degrees of specialized activities.

There is a possibility that some of the Structure 10L-16 artifacts, such as prismatic blades, prismatic blade points, and macroblades with a use-wear pattern for cutting, scraping, and piercing meat or hide, were utilized in a ritual context. However, the results of microwear analysis (Table 4) perfectly match the actions performed on marine shell ornaments and support the hypothesis that some chipped-stone artifacts were indeed used for production of such ornaments. The archaeological, epigraphic, and iconographic evidence suggests that the low intensity of use of the Structure 10L-16 chipped-stone artifacts could have resulted from special uses such as ritual, production of marine shell ornaments, etc., possibly in the hands of Maya elites including the ruler, royal family, and attached specialists during the reign of Yax Pac. Moreover, the relatively high intensity of use of the Structure 10L-22A artifacts may reinforce the hypothesis that as a *popol na* the building was the site of feasts or banquets.

In sum, interpretation of the results of microwear analysis of the two Copán lithic assemblages in their full archaeological contexts assists in reconstructing the specific behavior and activities of the ancient Maya by providing valuable information regarding the function of structures associated with lithic artifacts. Collecting such functional data through conjunctive research remains a substantial challenge for archaeology, because this is the first step in investigating the direction and stimuli for long-term social, economic, and political change in ancient complex societies.

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