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ARTICLE

Obsidian Tool Function and Maya Lithic Economy at Terminal Classic Pook's Hill, Belize: Subsistence, Domestic Activities, and Craft Production

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Abstract
The typological, technological, and use-wear analyses of obsidian artifacts from Terminal Classic Pook's Hill (AD 830–950+) provide opportunities to better reconstruct socioeconomic activities in this *plazuela* group, including long-distance trade, tool production, subsistence practices, domestic tasks, and the organization of craft production. Based on visual sourcing, most of the obsidian originated from highland Guatemala, specifically El Chayal. The majority of obsidian artifacts were prismatic blades, although both casual and bipolar reduction of blade cores and the recycling of blades from earlier occupations occurred at the site. Use-wear analysis reveals that obsidian tools were mainly used for subsistence and domestic household activities; however, the concentrations of tools with specific wear patterns (bone, ceramic, plants, and shell) at some locations in the *plazuela* provide evidence for local craft production among the population. Further support for craft production is provided by comparable use-wear on chert/chalcedony tools from these same locations. The products of low-level craft production were used within Pook's Hill itself and may have been distributed to neighboring communities within the Roaring Creek and Upper Belize River Valleys. Despite the sociopolitical and socioeconomic disruptions to lifeways that accompanied the Terminal Classic period, the Pook's Hill Maya seem to have experienced minimal upheaval in their daily lives and continued local low-level craft production. However, one important change in the Terminal Classic appears to be the increased difficulty in obtaining obsidian at Pook's Hill and the growing need for tool recycling and raw material conservation.

Resumen
Los análisis tipológicos, tecnológicos y de huellas de uso de los artefactos de obsidiana del Clásico Terminal de Pook's Hill (830–950+ dC), brindan oportunidades para reconstruir mejor las actividades socioeconómicas en este grupo plazuela, incluyendo el comercio a larga distancia, la producción de herramientas, las prácticas de subsistencia, las tareas domésticas y la organización de la producción artesanal. Según el identificación visual, la mayor parte de la obsidiana procedía de las tierras altas de Guatemala, específicamente del yacimiento de El Chayal. La mayoría de los artefactos de obsidiana eran navajas prismáticas, aunque en el sitio se encuentran tanto la reducción casual como la bipolar de los núcleos de obsidiana y las navajas recicladas de ocupaciones anteriores. El análisis de huellas de uso revela que las herramientas de obsidiana se utilizaron principalmente para actividades domésticas y de subsistencia. Sin embargo, las concentraciones de herramientas con patrones de uso específicos (hueso, cerámica, plantas y concha) en algunos lugares de la plazuela, evidencian la producción artesanal local entre la población. Las huellas de uso comparables de las herramientas de pedernal/calcedonia de estos mismos lugares corroboran la producción artesanal. Los productos de la elaboración artesanal se usaron dentro de Pook's Hill, mientras que otros probablemente se distribuyeron a las comunidades vecinas de Roaring Creek y la cuenca superior de Río Belice. A pesar de las perturbaciones sociopolíticas y socioeconómicas en los modos de vida que acompañaron al Clásico Terminal, los mayas de Pook's Hill parecen haber experimentado un trastorno mínimo en su vida diaria y

continuaron la producción artesanal local de bajo rendimiento. Sin embargo, un cambio importante en el Clásico Terminal parece ser la mayor dificultad para obtener obsidiana en Pook's Hill y la creciente necesidad de reciclar herramientas y conservar materias primas.

Keywords: obsidian; Maya; use-wear; craft production; household archaeology

Palabras clave: obsidiana; maya; huellas de uso; producción artesanal; arqueología doméstica

Despite the allure of Maya elites, the grandeur of their monumental architecture, and the chronicles of their written texts, the people from the lower echelons of society provide the best glimpses into the everyday lives of the ancient Maya (e.g., Lohse and Valdez 2004; Robin 2012; Webster and Gonlin 1988). In a world essentially devoid of metal implements, their stone tools provided them with the means to undertake the daily tasks necessary for their successful existence. The study of these stone tools, particularly those produced from chert and obsidian, enables reconstructions of their quotidian lifeways in terms of subsistence, domestic tasks, and craft production. Where and how they acquired their chert and obsidian tools, who used them, where they used them, and what exactly they did with them are key questions for reconstructing Maya socioeconomics on an intrasite level. Such studies may also assist in identifying possible connections between the lithic economies at individual sites and regional networks of exchange. These connections are of particular interest when considering periods of significant change for the ancient Maya, such as during the Terminal Classic (about AD 800–1050).

To better understand the lithic economy of lower-status Maya, notably commoners and lesser nobles, we conducted typological, technological, and use-wear analyses of 354 obsidian artifacts from Terminal Classic Pook's Hill (AD 830–950+), a *plazuela* group in the Roaring Creek Valley of central Belize (Figure 1). These analyses reveal that most of the obsidian at Pook's Hill originated from highland Guatemala, specifically from El Chayal; however, the presence of a small quantity of Ucareo prismatic blades from Central Mexico also provides evidence for links to Caribbean coastal trade networks. The main tool type at the site was the third-series prismatic blade. In addition to

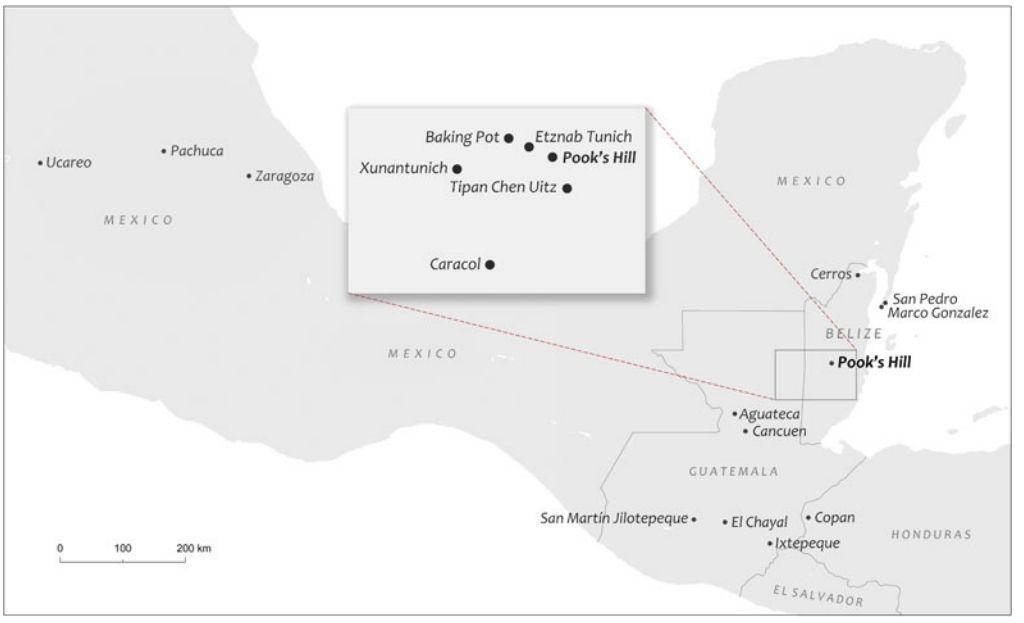

Figure 1. Map of Mesoamerica showing the location of Pook's Hill and other sites mentioned in the text (map by Christophe Helmke).

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the blades, which are rather small and narrow, exhausted polyhedral cores, flakes, and chunks resulting from casual and bipolar percussion all reveal obsidian conservation strategies used by the ancient inhabitants of Pook's Hill. Other indicators of obsidian conservation include the heavy use of blades and the recycling of some artifacts from earlier periods of occupation.

Use-wear analysis of the obsidian artifacts indicates that they were primarily used for subsistence and domestic household activities (Aoyama 1999, 2009; Lewenstein 1987; Stemp 2001, 2016; Stemp et al. 2010; Walton 2022, 2023). Higher frequencies of blades, flakes, and chunks with specific use-wear patterns at certain locations at the site provide evidence for concentrated activities that are likely the result of craft production. Locations for weaving and the production of bone and shell ornaments have been identified based on the use-wear on obsidian artifacts, in combination with other artifact classes. Use-wear data from 1,444 chipped chert and chalcedony tools (see Stemp et al. 2010, 2021) provide additional support for the subsistence and domestic activities at Terminal Classic Pook's Hill and reinforce evidence for craft production.

Based on site size, architecture, and limited signs of affluence, the craft producers at Pook's Hill were most likely commoners and perhaps lesser nobles, some of whom may have had economic ties to elites. Production was on a small scale—conducted as part-time work at the household level, generating only a small surplus—and it seems that the finished products were primarily intended for the residents of Pook's Hill, where some of these items were recovered. Some finished objects of bone, shell, and textiles may have also been locally traded to neighboring communities in the Roaring Creek Valley and possibly to other more distant sites in the Upper Belize River Valley (Awe and Helmke 2007). The lithic use-wear data indicate continued small-scale craft production by lower-status Pook's Hill Maya in the Terminal Classic. This suggests that some regional socioeconomic activities and exchange relationships involving small communities of primarily low-status Maya may have continued to some degree independently of the centralized economies of larger sites in the area, such as Xunantunich, Baking Pot, and Tipan Chen Uitz (Andres et al. 2014; Hoggarth et al. 2021; LeCount et al. 2002), which were greatly affected by the Maya collapse.

The Terminal Classic in the Maya Lowlands

The Terminal Classic, about AD 800–1050, was a period of transition and transformation in the central Maya Lowlands. Commonly considered the period of the Maya "collapse" and often misconstrued as the time of the complete failure of Maya civilization, the Terminal Classic witnessed the culmination of both external and internal changes. These changes began earlier in the Late Classic period and led to significant sociopolitical and socioeconomic reorganization that affected cities and communities in different ways. As a protracted process that spanned centuries, the Maya "collapse" was characterized by the disintegration of divine rulership and dynastic rule at many, but not all, Maya kingdoms (Morris et al. 2007:6; Rice et al. 2004:8). At some sites, there was a rapid transition from the Late to Terminal Classic associated with the decline of centralized authority, whereas at others, it seems to have been a slower process (Demarest et al. 2004; Rice et al. 2004; Webster 2002). Invariably, the "collapse" had a cumulative macroregional effect on the Lowland Maya.

The demise of centralized authority resulted in the cessation of construction of monumental architecture, such as temples, palaces, and ballcourts; the disappearance of carved stelae and elaborate royal tombs; and the disruption of economic systems for the production and exchange of prestige and elite ceremonial items (Chase and Chase 2004; Culbert 1988; Demarest et al. 2004; Martin and Grube 2000; Rice and Rice 2004; Webster 2002). Many of these changes reflected a general decentralization of power and the disintegration of Classic period political alliances and economic relationships among elites. Accompanying decentralization at many cities were site abandonment and significant population migration to other regions, notably to the northern lowlands of the Yucatan peninsula. Various causes of these sociopolitical and socioeconomic changes have been proposed and include deforestation, drought, failed governance, and warfare, among others (Demarest et al. 2004; Gill et al. 2007; Golden and Scherer 2013; Lucero 2002; Shaw 2003). No single cause can account for the changes in all regions (Morris et al. 2007; Rice et al. 2004).

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The Site of Pook's Hill

Pook's Hill is a medium-sized, single patio or *plazuela* group located in the karstic foothills of the Roaring Creek Valley within the Upper Belize River Valley of central Belize. Based on ceramic evidence, the earliest Maya presence at Pook's Hill dates to the Late Formative period (about 300–100 BC); however, it was primarily inhabited in the Late Classic (about AD 700–830) and Terminal Classic (about AD 830–950) periods, with a continued presence into the beginning of the Early Postclassic (AD 950+) based on the recovery of early facet New Town Complex pottery mixed into the terminal phase of occupation (Stemp et al. 2010:218–219). The *plazuela* group consists of nine building platforms surrounding a small patio (Figure 2). Most of the structures are "range structures" based on their rectangular plan, except for a special function "ancestor shrine" along the eastern perimeter of the patio. An apsidal room with a partially preserved domed vault, located in the northwestern corner of the *plazuela*, has been identified as a sweatbath, or *pibnaah* (Awe and Helmke 2007:31–32; Helmke 2006:53–68; Helmke and Awe 2005). Based on Pook Hill's architecture, configuration, and the material culture recovered there—including exotic items, such as greenstone pendants and beads, marine shell *adornos*, jadeite tooth inlays, and polychrome serving vessels—the site was most likely inhabited by an autonomous kin group or lineage. This social group consisted primarily of commoners and lesser nobles who had access to imported goods and sumptuary items (Stemp et al. 2010). Evidence for affluence, status, and connections to elites at other sites is also provided by the recovery of highly decorated Terminal Classic molded-carved vases with glyphic texts mentioning a nonroyal elite individual (Helmke and Reents-Budet 2008).

The Obsidian Assemblage from Terminal Classic Pook's Hill

This analysis includes 354 obsidian artifacts recovered from Terminal Classic nonceremonial deposits at Pook's Hill. The assemblage consisted of 258 (72.9%) blades and blade segments, 57 (16.1%) flakes, 36 (10.2%) chunks, one (0.3%) bifacial thinning flake, one (0.3%) exhausted polyhedral core, and one

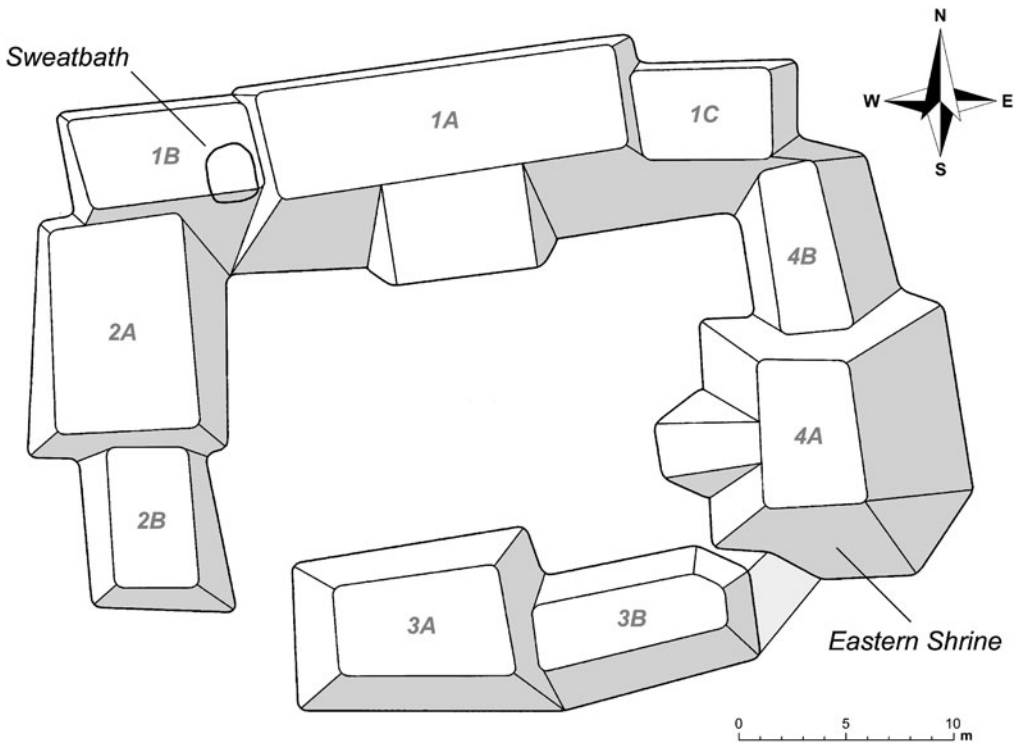

Figure 2. Plan of Pook's Hill 1 *plazuela* (plan by Christophe Helmke).

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(0.3%) exhausted medial polyhedral core fragment (Figure 3). Almost all the obsidian artifacts (332, or 93.8%) were visually sourced to El Chayal in highland Guatemala. Another 16 (4.5%) are consistent with the Ixtepeque source, and one (0.3%) is identified as originating from San Martin Jilotepeque, both in highland Guatemala. The remaining five (1.4%) artifacts are visually consistent with obsidian from Ucareo or possibly Zaragoza in central Mexico (Braswell 2007; see Braswell et al. 2000).

Obsidian Analysis Methods

Studies of obsidian artifacts that include typological, technological, and use-wear analyses are relatively rare for Maya sites, especially when considering the immense quantity of obsidian blades, flakes, and cores recovered from excavations throughout the Maya Lowlands (e.g., Aoyama 1999, 2007, 2009; Aoyama et al. 2017; Cadalen et al. 2023; Clark 1988; Emery and Aoyama 2007; Lewenstein 1987; Mallory 1984; Sharpe and Aoyama 2023; Stemp 2016; Stemp and Awe 2014; Stemp et al. 2018; Stemp, Braswell, et al. 2019; Stemp, Peuramaki-Brown, and Awe 2019). When such studies have been undertaken, they have produced valuable information about ancient Maya socioeconomic activities, including details about raw material procurement, tool production, trade patterns, subsistence practices, domestic tasks, and the organization of craft production.

Typological and Technological Analyses

In a previous study, Braswell (2007) provided typological and technological analyses of 266 obsidian artifacts from contexts dated to the Terminal Classic at Pook's Hill. An abridged summary of these findings is presented in this section.[1] The artifacts were classified into types belonging to four fundamental operational chains of production: (1) prismatic blade, (2) retouch (i.e., biface or uniface production), (3) casual percussion, and (4) bipolar percussion industries (Figure 4). Lithic artifacts often began their use life as the product of one industry and were later modified, recycled, or even scavenged and repurposed through further reduction. For this reason, a single piece can be ascribed to more than one type or even industry. Some artifacts, notably nondiagnostic chunks or shatter, could not be assigned to a particular percussion industry.

Cleaning Protocols and Equipment for Use-Wear Analysis

Cleaning of the obsidian artifacts from Pook's Hill was minimal. Although, in the past, cleaning protocols for wear analysis on chipped stone tools included acidic and basic chemical solutions (e.g.,

Figure 3. Obsidian artifacts from Pook's Hill: (*top row*) prismatic blade segments; (*bottom row*) an exhausted polyhedral blade core, blade core fragments, and casual percussion flakes produced from exhausted blade cores (photograph by W. James Stemp). (Color online)

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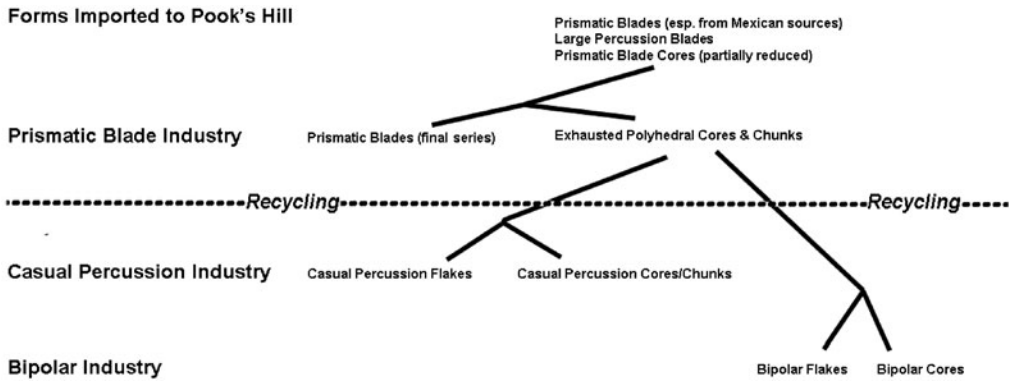

Figure 4. Obsidian industries and artifacts represented at Pook's Hill. One flake from the Retouch Industry, perhaps from resharpening a biface made elsewhere, is not included (diagram by Geoffrey Braswell).

Stemp 2001, 2016), concern about the potential recovery of organic and inorganic residues adhering to the lithic artifacts has recently altered the cleaning method (Stemp, Braswell, et al. 2019:Online Supplement 3; see Croft 2021). The obsidian artifacts discussed in this analysis were rinsed in warm water and left to air dry, thereby providing an opportunity for future research on residues.

For the use-wear analysis, a metallurgical microscope (Unitron MS-2BD) was used to locate and identify use-wear features at both low- and high-power (40×, 100×, 200×, 400×; 0.10, 0.25, 0.40, 0.65 NA) magnification with bright- and dark-field illumination. The purpose of 40× magnification was primarily to observe edge microchipping. The 100×, 200×, and 400× magnifications were used first to locate used tool surfaces and then identify and describe the use-related wear features, such as abrasion, polish, and striations. Photomicrographs of the tools were taken using a Moticam X3 (4.0 MPX) Wi-Fi-enabled digital camera mounted onto the microscope.

Comparative Database for Obsidian Use-Wear

Use-wear on the obsidian artifacts was identified by Stemp using a comparative database consisting of 155 obsidian replicates—prismatic pressure/punch blades, larger hard-hammer blades, and hard-hammer flakes—used in controlled experiments to perform a variety of tasks on materials like those used by the ancient Maya (Stemp 2016; see Lewenstein 1987). The analysis included observation and documentation of edge microflaking, abrasion, polish, and striations on the obsidian artifacts. The locations of the used surfaces on the lithic artifacts were recorded using the independent use zone (IUZ) system previously employed by Stemp (2016; Stemp et al. 2010, 2021; see Aoyama 1999).

Obsidian Analysis Results from Terminal Classic Pook's Hill

Tool Production and Procurement

Typological information aggregated by lithic industry for obsidian is displayed in Table 1. Overall, third-series prismatic blades and segments account for 75.4% of the obsidian artifacts from Pook's Hill and 66.2% of all the typological assignments; again, a single piece may be assigned to more than one type. The narrow width of the blades (mean = 10.3 mm), blade thickness (mean = 2.8 mm), high cutting-edge-to-mass ratio (mean = 90.5 mm/g), and the complete lack of cortex on any artifact recovered from Pook's Hill suggest that obsidian, specifically polyhedral blade cores, arrived at the site in an already considerably reduced state when compared to the metrics from experimental blade production and those from sites with better or earlier access to obsidian (cf. Fowler et al. 1987; McKillop 1995, 1996; Sheets and Muto 1972; Sidrys 1979). Pook's Hill seems to have been the end of the line for nearly exhausted prismatic blade cores.

Limited access to prismatic blades and blade-production technology, which is not surprising given the location and social status of the inhabitants of the site and the disruption of procurement systems

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Table 1. Obsidian Industries Represented at Pook's Hill, Belize.

Period	Prismatic Blade[a]	Retouch	Bipolar Percussion	Casual Percussion	Unidentified Percussion
AD 950+ ($N = 205$) *(secondary, mixed contexts)*	184 (89.8%)	1 (0.5%)	31 (15.1%)[b]	18 (8.8%)[c]	8 (3.9%)[d]
AD 830–950 ($N = 61$) *(primary, unmixed contexts)*	56 (91.8%)	—	5 (8.2%)[e]	10 (16.4%)[f]	1 (1.6%)

Note: Data presented as counts and percentages; some lines sum to more than artifact totals because of multiple assignments.
[a] Blade segments that could be refit were counted as a single artifact.
[b] Includes 25 artifacts also classified as exhausted polyhedral core fragments.
[c] Includes seven artifacts also classified as exhausted polyhedral core fragments.
[d] Include five artifacts also classified as exhausted polyhedral core fragments.
[e] Includes four artifacts also classified as exhausted polyhedral core fragments.
[f] Includes seven artifacts also classified as exhausted polyhedral core fragments.

caused by political fragmentation and demographic decline, led to the scavenging of obsidian artifacts at Pook's Hill during the Terminal Classic period. Produced during earlier periods, these artifacts were either reused as is or recycled using expedient percussion techniques. The preferred artifacts for recycling were exhausted polyhedral cores and core fragments, which were further broken into flakes using freehand or bipolar percussion. Bipolar percussion is used most frequently to produce flakes from very small cores.

Throughout the Maya area, the Terminal Classic-to-Postclassic transition was marked by shifting procurement patterns. Mexican obsidian—especially from the sources of Ucareo, Pachuca, and Zaragoza—became increasingly important during the tenth century. By the middle of the Postclassic period, obsidian from the Guatemalan source of Ixtepeque replaced virtually all materials from other sources, including El Chayal (Braswell 2000, 2003; Braswell and Glascock 2007; Escamilla Ojeda 2004; Nelson 1985).

At Pook's Hill, Ixtepeque obsidian began to appear in the early Terminal Classic period but still constituted a relatively small portion of the sample (Table 2). A few pieces of dark, blue-black Mexican obsidian—likely from Ucareo but perhaps also from the Zaragoza source—are limited to the latest contexts. Instead, the vast majority of obsidian found in Terminal Classic and even later contexts came from the El Chayal source. This implies that local scavenging, rather than the arrival of new obsidian, was a significant procurement pattern during and after the Terminal Classic.

Procurement patterns and tool production processes involving chert were considerably different from those documented for obsidian in the Terminal Classic at Pook's Hill. Almost all the chert and chalcedony were readily available as local resources in the vicinity of the site or in the form of finished tools that were likely acquired from workshop locations, such as Etz'nab Tunich that was roughly 10–20 km away (Stemp et al. 2010, 2021; Sullivan et al. 2016, 2015). Where chert ranging in quality from low to high could be locally procured in reasonably high abundance, as at Pook's Hill, reduction was frequently organized within commoner household groups for their own provisioning. Although production of chert tools beyond the requirements of household use or for exchange in

Table 2. Obsidian Sources at Pook's Hill, Belize.

Period	El Chayal	Ixtepeque	San Martin Jilotepeque	Ucareo
AD 950+ *(secondary, mixed contexts)*	188 (91.7%)	11 (5.4%)	1 (0.5%)	5 (2.4%)
AD 830–950 *(primary, unmixed contexts)*	58 (95.1%)	3 (4.9%)	—	—

Note: Blade segments that could be refit were counted as a single artifact.

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marketplaces did occur at some other Maya sites, this does not appear to have been the case for Terminal Classic Pook's Hill (see Cap 2021; Connell 2000; Hearth 2012; Heindel et al. 2012; Horowitz 2018a, 2018b, 2022; Horowitz et al. 2019; VandenBosch 1999; Yaeger 2000).

Production of chert tools for intra-household use mainly included informal/expedient flakes and minimally retouched flake tools, as well as small quantities of blades and bifaces based on the recovery of a blade core fragment, biface preforms, and cortical thinning flakes at the site (e.g., Ford and Olson 1989; Horowitz 2018a, 2018b; see Horowitz 2022 for skill). This production appears to have been done on a part-time basis, was undertaken by the household members themselves (see Connell 2000; Chase and Paige 2020; Hearth 2012; Horowitz 2018a, 2018b; VandenBosch 1999), and seems to have regularly occurred alongside other daily activities that involved making items of necessity from various types of materials (see Hearth 2012; Robin 2004, 2012; Stemp 2001; VandenBosch 1999; VandenBosch et al. 2010). Given the availability of local chert cobbles/nodules and access to finished tools from nearby workshops, there is minimal evidence for tool curation (Stemp et al. 2010).

Microscopic Use-Wear

All 354 obsidian artifacts from Terminal Classic nonceremonial contexts at Pook's Hill were subjected to microscopic use-wear analysis. The identification of IUZs on the artifacts revealed that 319 (90.1%) possessed some evidence of use. Thirty-two (9.0%) artifacts did not demonstrate any use-related wear, and three (0.8%) could not be reliably analyzed because of postdepositional damage. The 32 artifacts with no traces of use include 17 chunks, seven flakes, six blade segments, one exhausted polyhedral core, and one polyhedral core fragment.

In terms of tool type, almost all blades and blade segments (250 of 258, or 96.9%) have wear traces consistent with use, whereas fewer flakes (51 of 57, or 89.5%) or chunks (17 of 36, or 47.2%) were used. Based on these percentages, clearly the Maya were using almost all the blades/blade segments they acquired and relied heavily on obsidian debitage as tools. A total of 566 IUZs were identified on the 319 used obsidian artifacts (Table 3). Overall, most actions (81.8% of IUZs) are longitudinal motions (i.e., cutting, sawing). Given the relatively low edge angles of obsidian prismatic blades and their sharpness, the fact that most were used to cut or saw is not surprising. An emphasis on longitudinal motions is also consistent with use-wear analysis data on obsidian blades from other Maya sites (e.g., Aoyama 1999, 2009; Cadalen et al. 2023; Lewenstein 1987; Stemp 2016; Stemp and Awe 2014). Although most tools were used for cutting or sawing, some were used in transverse motions (i.e., scrape, plane, whittle; 6.2% of IUZs).

Roughly one-quarter (26.0%) of the 566 IUZs on the obsidian artifacts possess wear consistent with wood contact (Figure 5a–b). Yet, other hard materials (16.6% of IUZs), indeterminate materials (11.1% of IUZs), plants (9.9% of IUZs; Figure 5c), other soft materials (7.8% of IUZs), meat / skin / fresh hide (7.6% of IUZs; Figure 5d), and bone (6.7% of IUZs) were also commonly worked. Based on use-wear analysis, the use of obsidian to work wood, plants, meat / skin / fresh hide, and bone is well demonstrated at other Maya sites (e.g., Aoyama 1999, 2009; Cadalen et al. 2023; Lewenstein 1987; Stemp 2016; Stemp and Awe 2014). Overall, the range of activities represented by the pattern of obsidian tool use at Pook's Hill is consistent with subsistence and daily domestic activities expected within Maya households based on previous chert and obsidian use-wear studies (Lewenstein 1987; Stemp 2001, 2016; Stemp et al. 2010), as well as those from elsewhere in Mesoamerica (Walton 2022, 2023). These activities included butchering animals; skinning and hide-processing; making wooden handles for tools; producing tools, containers, and other objects from various perishable and nonperishable materials; weaving basketry and cloth; and preparing plant food (e.g., Lewenstein 1987; Palka 2005; Tozzer 1941). Although obsidian tool use in and around different structures at the site varied, the same range of subsistence and domestic activities appears to have occurred in the patio and at the structures (Table 3). The lithic use-wear data from Terminal Classic contexts indicate that obsidian and chert/chalcedony artifacts were used to work most of the same contact materials but not necessarily with the same frequencies (Figure 6).

Percentages of IUZs for woodworking on obsidian tools are quite high and vary somewhat by location. Because evidence for working wood is widely distributed throughout the site, craft-related

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Table 3. IUZs on Obsidian Artifacts from Separate Locations at Pook's Hill, Belize.

	Plaza	Str. 1A	Str. 1B	Str. 1C	Str. 2A	Str. 2B	Str. 4A	Str. 4B	Total
Bone									
cut/slice	1 (2.3%)	—	2 (1.5%)	—	1 (1.2%)	—	—	—	4 (0.7%)
incise/grave	—	—	—	—	1 (1.2%)	—	—	—	1 (0.2%)
saw	4 (9.3%)	3 (4.5%)	1 (0.8%)	2 (1.9%)	16 (19.3%)	—	1 (2.7%)	3 (5.1%)	30 (5.3%)
scrape/plane	—	—	—	—	2 (2.4%)	—	1 (2.7%)	—	3 (0.5%)
Ceramic									
incise	—	2 (3%)	2 (1.5%)	—	—	—	—	—	4 (0.7%)
notch	—	—	1 (0.8%)	—	—	—	—	—	1 (0.2)
saw	—	5 (7.5%)	23 (17.7%)	—	—	—	—	—	28 (4.9%)
Dry hide									
cut/slice	—	1 (1.5%)	—	1 (0.9%)	—	—	—	—	2 (0.4%)
scrape/plane	—	—	—	—	—	—	1 (2.7%)	5 (8.5%)	6 (1.1%)
Meat/fresh hide									
cut/slice	4 (9.3%)	6 (9%)	11 (8.5%)	1 (0.9%)	12 (14.5%)	—	1 (2.7%)	7 (11.9%)	42 (7.4%)
scrape/plane	—	1 (1.5%)	—	—	—	—	—	—	1 (0.2%)
Meat and bone									
cut/slice	—	—	—	—	—	—	—	1 (1.7%)	1 (0.2%)
Plant									
cut/slice	3 (7%)	8 (11.9%)	20 (15.4%)	10 (9.4%)	2 (2.4%)	4 (9.8%)	3 (8.1%)	6 (10.2%)	56 (9.9%)
Plant (Reed)									
cut/slice	—	—	1 (0.8)	1 (0.9%)	—	—	—	—	2 (0.4%)
saw	3 (7%)	—	—	—	—	—	—	—	3 (0.5%)
Shell									
incise	—	—	—	—	—	1 (2.4%)	—	—	1 (0.2%)

(*Continued*)

Table 3. IUZs on Obsidian Artifacts from Separate Locations at Pook's Hill, Belize. (*Continued*)

	Plaza	Str. 1A	Str. 1B	Str. 1C	Str. 2A	Str. 2B	Str. 4A	Str. 4B	Total
saw	—	2 (3%)	1 (0.8%)	—	4 (4.8%)	9 (22%)	1 (2.7%)	1 (1.7%)	18 (3.2%)
Stone									
cut/slice	—	—	—	1 (0.9%)	1 (1.2%)	—	—	—	2 (0.4%)
saw	—	—	—	8 (7.5%)	2 (2.4%)	—	2 (5.4%)	—	12 (2.1%)
scrape/plane	—	—	—	—	—	1 (2.4%)	—	—	1 (0.2%)
Wood									
cut/slice	—	2 (3%)	4 (3.1%)	9 (8.5%)	1 (2.4%)	1 (2.4%)	1 (2.7%)	2 (3.4%)	20 (3.5%)
saw	12 (27.9%)	13 (19.4%)	19 (14.6%)	21 (19.8%)	14 (17.1%)	10 (24.4%)	4 (10.8%)	12 (20.3%)	105 (18.6%)
scrape/plane	3 (7%)	—	5 (3.8%)	—	—	—	1 (2.7%)	1 (1.7%)	10 (1.8%)
whittle	1 (2.3%)	3 (4.5%)	1 (0.8%)	3 (2.8%)	1 (2.4%)	1 (2.4%)	1 (2.7%)	—	11 (1.9%)
indeterminate	—	—	—	—	1 (2.4%)	—	—	—	1 (0.2%)
Soft									
cut/slice	4 (9.3%)	6 (9%)	9 (6.9%)	10 (9.4%)	2 (2.4%)	6 (14.6%)	5 (13.5%)	1 (1.7%)	43 (7.6%)
scrape/plane	—	—	—	—	—	—	—	1 (1.7%)	1 (0.2%)
Hard									
cut/slice	—	2 (3%)	—	—	3 (3.6%)	—	—	—	5 (0.9%)
incise/grave	—	—	1 (0.8%)	—	—	—	—	—	1 (0.2%)
saw	2 (4.7%)	5 (7.5%)	15 (11.5%)	18 (17%)	11 (13.3%)	3 (7.3%)	13 (35.1%)	15 (25.4%)	82 (14.5%)
scrape/plane	—	1 (1.5%)	—	—	2 (2.4%)	—	—	1 (1.7%)	4 (0.7%)
indeterminate	—	1 (1.5%)	—	1 (0.9%)	—	—	—	—	2 (0.4%)
Indeterminate									
cut/slice	—	1 (1.5%)	2 (1.5%)	1 (0.9%)	—	—	—	—	4 (0.7%)
saw	—	—	1 (0.8%)	—	—	—	—	1 (1.7%)	2 (0.4%)
scrape/plane	—	—	—	1 (0.9%)	—	—	—	—	1 (0.2%)
indeterminate	6 (14%)	5 (7.5%)	11 (8.5%)	18 (17%)	7 (8.4%)	5 (12.2%)	2 (5.4%)	2 (3.4%)	56 (9.9%)
Total	43	67	130	106	83	41	37	59	566

Note: The IUZ data do not include the obsidian artifacts from Cache 4A-2 or Burials 4A-3 and 4A-4 that were previously analyzed and published in Stemp et al. (2018) and Stemp, Braswell, et alia (2019).

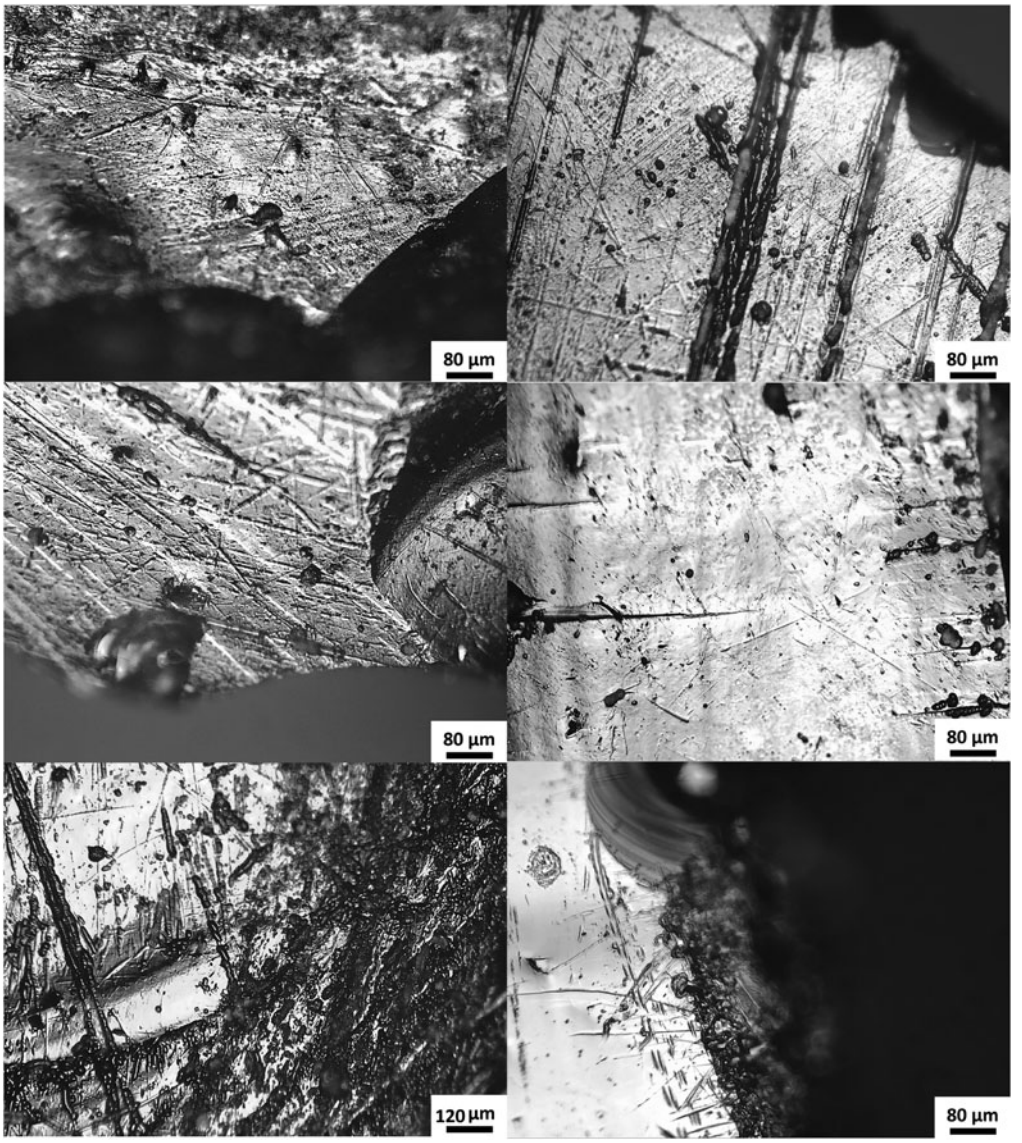

Figure 5. Photomicrographs of use-wear from Pook's Hill: (a) obsidian blade segment used to saw wood (200×); (b) obsidian blade segment used to whittle wood (200×); (c) obsidian blade segment used to cut/slice fibrous plants (200×); (d) obsidian blade segment used to cut/slice a soft contact material, possibly meat / skin / fresh hide (200×); note the residues adhering to the blade's edge; (e) obsidian flake used to saw ceramic (100×); (f) obsidian blade segment used to saw shell (200×) (photomicrographs by W. James Stemp).

activities are much more difficult to discriminate from subsistence-related and domestic tasks (Aldenderfer 1991a, 1991b). This is also true for the distribution of chert/chalcedony woodworking tools at Pook's Hill (Stemp et al. 2010). Why wood contact is so abundant and widespread in the use-wear data is no doubt due to the range of potential uses for this material, including for construction materials, tool handles, firewood, containers, and other utilitarian items. The widespread use of wood in various contexts at Maya sites has been noted based on other use-wear studies (e.g., Aoyama 1999, 2009; Cadalen et al. 2023; Clark 1988; Lewenstein 1987; Sharpe and Aoyama 2023; Stemp 2001, 2016).

In addition to daily subsistence and domestic activities, higher percentages of obsidian tools with IUZs consistent with certain motions and contact materials at different locations throughout the site strengthen previous suggestions for craft production that were based on use-wear analysis of the

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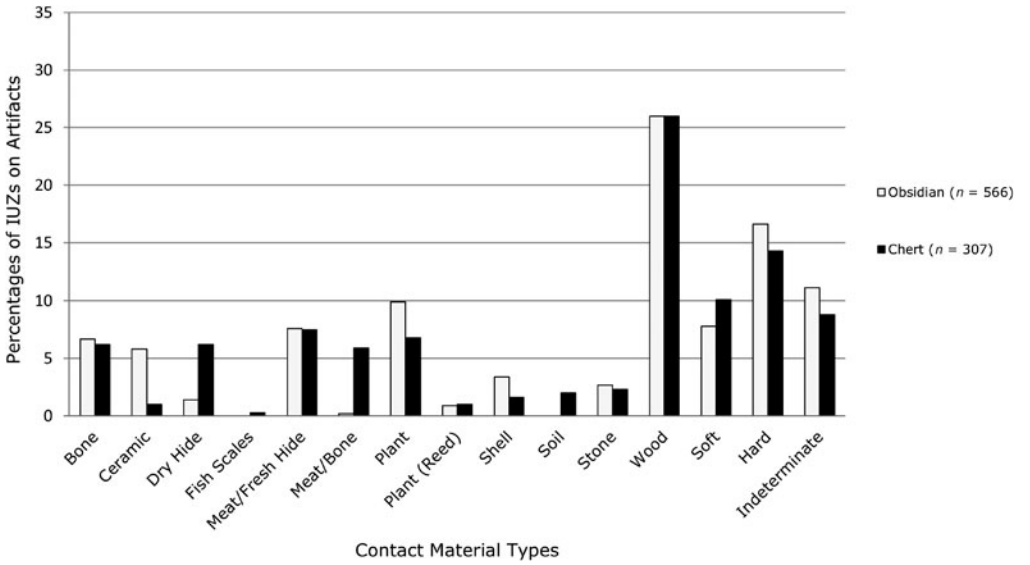

Figure 6. Percentages of IUZs on obsidian and chert/chalcedony artifacts by contact material type from nonceremonial contexts at Pook's Hill.

chert/chalcedony tools (Stemp et al. 2010). At Structure 1B, contact with ceramics constitutes a significant proportion of all obsidian tool use (20%; Figure 5e). More importantly, 78.8% of all IUZs for ceramics (26 of 33) at the site are on obsidian tools recovered at Structure 1B (Figure 7). The highest percentage of IUZs for chert/chalcedony tools with ceramic use-wear are found at Structure 1B; however, the number of tools is low (Stemp et al. 2010). The fact that 38.9% of the ceramic spindle whorls recovered from Pook's Hill come from the same deposits suggests that Structure 1B was a location associated with spindle whorl production and weaving activities (Figure 8). This interpretation is

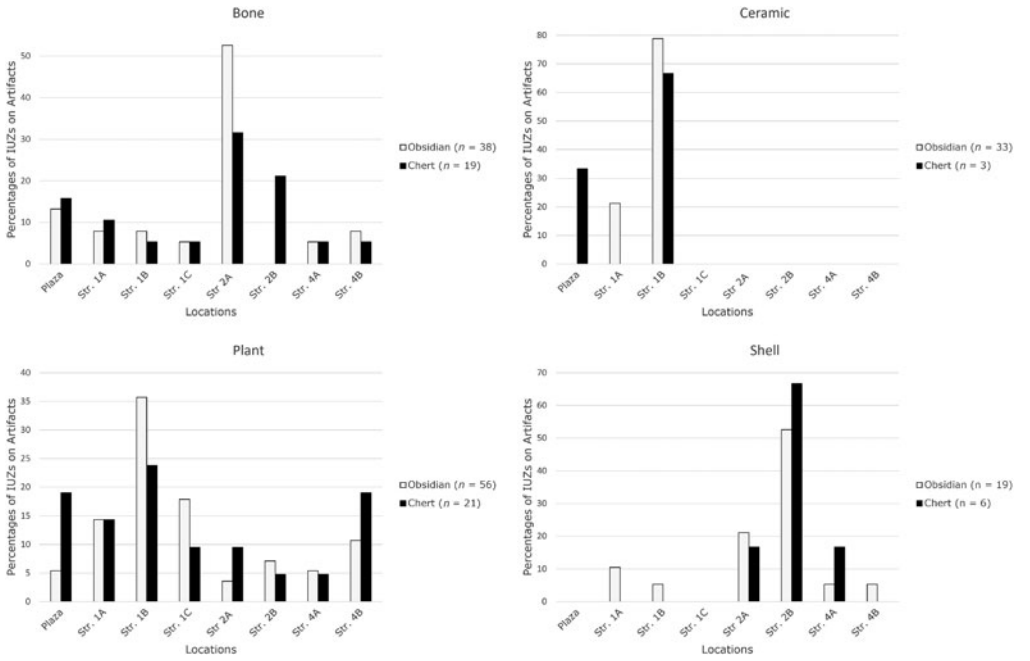

Figure 7. Percentages of IUZs for bone, ceramic, plant, and shell on obsidian and chert/chalcedony artifacts from nonceremonial contexts by location at Pook's Hill.

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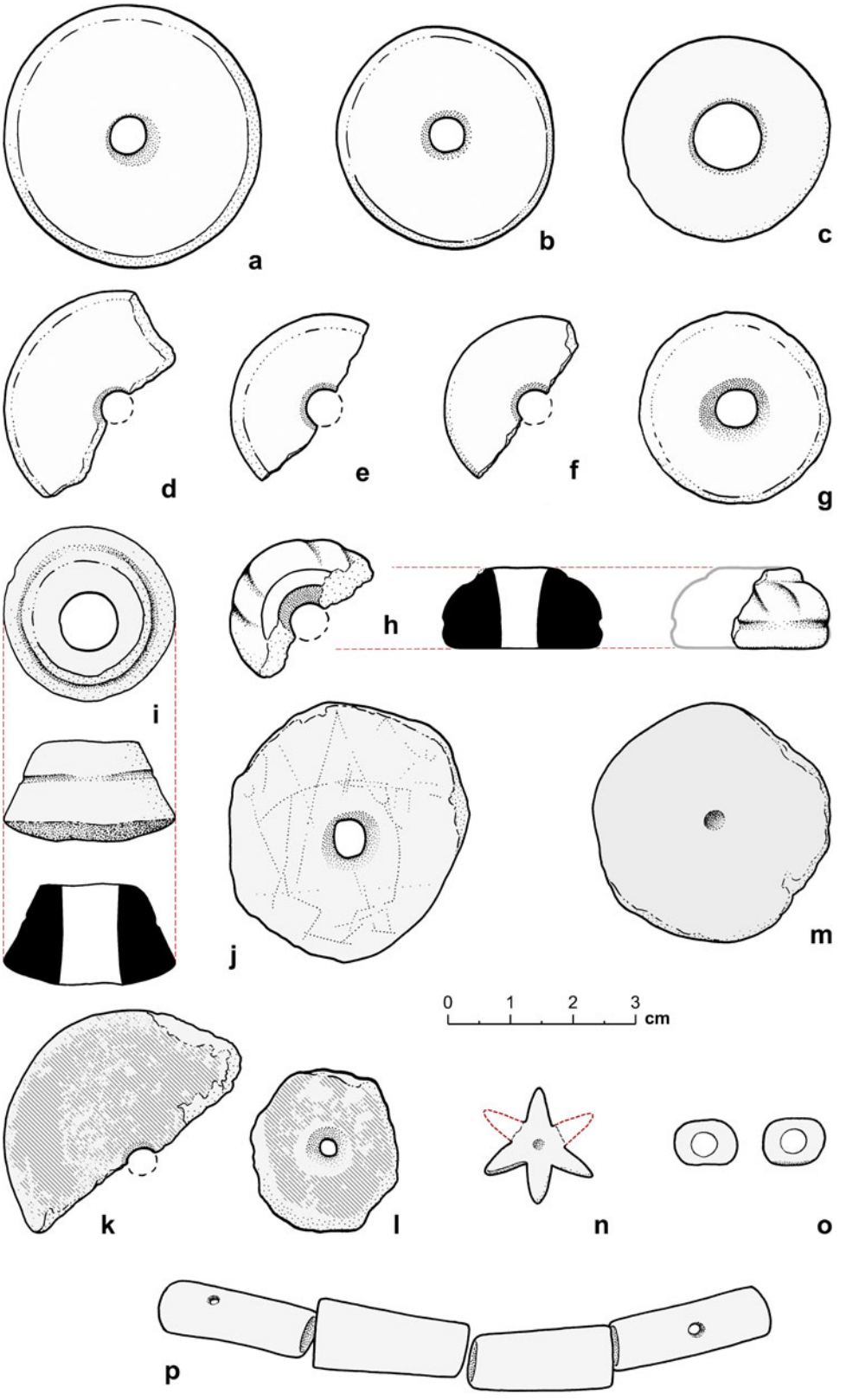

Figure 8. A selection of spindle whorls, shell *adornos*, and bone tubes from Pook's Hill: (a–i) limestone spindle whorls, (j–l) ceramic spindle whorls, (n–o) shell *adornos*, and (p) bone tubes (illustrations by Christophe Helmke).

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supported by the fact that 15.4% of the IUZs on obsidian tools at Structure 1B are the result of plant contact (35.7% of all plant IUZs at the site; Figure 7). A comparatively high percentage of IUZs for plants is also noted for the chert/chalcedony tools from this structure (Stemp et al. 2010).

At Structure 2A, there is strong evidence for the use of obsidian tools to work bone (24.1% of the IUZs at the structure and 52.6% of all bone IUZs at the site; Figure 7). Similarly, there is good use-wear evidence for bone working using chert/chalcedony tools at Structure 2A in the Late-to-Terminal Classic (Stemp et al. 2010). Significantly, animal bone recovered from Structure 2A provides evidence for various stages of production of bone tubes (Stanchly 2006:100–102). These tubes were variously used to produce rings, items of personal adornment, and possibly enema tubes (Figure 8). There is also use-wear evidence for cutting/slicing meat / skin / soft hide (14.5% of IUZs at Structure 2A), which may suggest that some contact with bone at this location is the result of animal butchery for subsistence. Nonetheless, cutting meat and hide could also be connected to removing soft tissue from bones for craft production purposes.

Finally, at Structure 2B, 22.4% of the IUZs on obsidian tools are the result of incising and sawing shell (Figure 5f). In terms of all IUZs for shell contact on obsidian tools excavated from Pook's Hill, 52.6% (10 of 19) are from this structure (Figure 7). Use-wear on chert/chalcedony tools reveals that contact with shell is more abundant at Structure 2B than at any other location at Pook's Hill (Stemp et al. 2010). Additionally, perforated marine shell *adornos* and halved shells used as inkwells were recovered at the site (Figure 8).

The obsidian and chert/chalcedony use-wear data reveal that craft production occurred in the same household areas of the site as other subsistence and domestic activities: there were no areas solely reserved for the production of craft items (Hearth 2012; Robin 2004, 2012; Stemp 2001; Stemp et al. 2010; VandenBosch 1999; VandenBosch et al., 2010). Given the combined percentages of obsidian and chert/chalcedony tools with use-wear consistent with crafting activities in particular locations at the site, the relatively small quantities of manufacturing debris, and the very few finished items recovered at the site, the scale of craft production at Pook's Hill appears to have been quite low. As such, it seems to have been primarily organized at the household level, likely on a part-time basis, with only one or two different types of objects or crafts being made in any one location. Given the scale of production, it is likely that the finished products were distributed within the Pook's Hill community itself. However, the types of items produced raise the possibility of exchange outside the corporate group, presumably to neighboring communities in the Roaring Creek and Upper Belize River Valleys (Clark 1986; Clark and Parry 1990:146; Costin 2001:275).

If we consider the locations for craft production, both bone working and shell working are associated with structures where individuals of lower or commoner status resided. Textile production or weaving activities may have been performed by individuals of somewhat higher status, given the location of the sweatbath in Structure 1C. The main indicators of higher status at Pook's Hill come from the eastern shrine structure and its burials. However, there is no lithic use-wear evidence suggesting any specialized craft production associated with this location.

Given that both Maya men and women were stone-tool users, the identities of the crafters at Pook's Hill are difficult to discern based on available lithic evidence. Possibly the strongest evidence for gendered labor at the site comes from Structure 1B, where ceramic and limestone spindle whorls, bone-weaving pins and sewing needles, chert/chalcedony tools with ceramic use-wear, and obsidian tools with higher frequencies of ceramic and plant use-wear were recovered. This combination of artifacts suggests textile spinning and possibly weaving of some sort, which are often depicted or described as women's work in Mayanist studies (Clark and Houston 1998; Clendinnen 1982; Halperin 2011; Hendon 1996, 2006; Joyce 1993, 2000; Robin 2002, 2004; Vail and Stone 2002). However, assigning weaving to women should not be assumed and may not be as straightforward at it seems. given the recovery of weaving paraphernalia from Maya male burials and the inclusion of the names of both men and women on inscribed examples (Dacus 2005; McCafferty and McCafferty 1996; Morehart and Helmke 2008; Welsh 1988). In terms of the production of other craft items, such as those made from bone and shell, it is possible that both men and women worked cooperatively using stone tools (see Robin 2002, 2004). This has been noted for elite and royal family households in the epicenter at Aguateca (Aoyama 2009:129).

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Discussion

Although there has been significant research on stone tools in Classic period Maya household and political economies, including studies on quarrying, production workshops, trade and exchange, and marketplaces (e.g., Andrieu 2013; Andrieu and Cadalen 2024; Andrieu et al. 2014; Aoyama 2017; Braswell and Glascock 2002; Cap 2021; Golitko and Feinman 2015; Hearth 2012; Hester and Shafer 1984; Horowitz 2018a, 2018b, 2019; Horowitz et al. 2019, 2021; King 2012; Martindale Johnson 2014, 2016; Rice 1987; Roche Recinos 2021; Vandenbosch 1999; VandenBosch et al. 2010; Whittaker et al. 2009), very few studies incorporate detailed microscopic use-wear analyses. Research on chert and obsidian artifacts that incorporates use-wear as a primary method of analysis permits the identification of individual tool use in terms of motion and contact material type, as well as the quantities and distributions of used tools throughout a site over time. Moreover, it allows for intersite comparisons of stone tool use in terms of subsistence, domestic tasks, and craft production.

For example, at the small coastal site of Marco Gonzalez on Ambergris Caye, Belize, chert/chalcedony tools, including debitage, were primarily used for subsistence and domestic tasks, although low levels of craft production associated with the trade of marine resources, notably fish and shell, may have taken place in the Classic and Postclassic periods (Stemp 2001:158–160). Based on the distributions of obsidian and chert/chalcedony tools with use-wear, a similar pattern of mainly subsistence-oriented and domestic activities in households is also suggested for Late Postclassic–Early Spanish Colonial San Pedro, Ambergris Caye, another small site inhabited mostly by commoners (Stemp 2001, 2004, 2016). At both sites, subsistence and domestic tasks appear to have occurred in the same locations as crafting activity. At Cerros, a larger site in northern Belize, most evidence again points to the use of obsidian and chert/chalcedony for subsistence and domestic tasks. Although Lewenstein (1987:196) noted minor differences in tool use between nonresidential and residential structures, including elite residences, no evidence for large-scale craft specialization was found. If craft production occurred at Cerros, it was not organized as a spatially segregated economic activity (e.g., in *barrios*) and was likely variably dispersed throughout the site at some locations—for example, cotton-fiber working at the elite residence Feature 50D—where various other daily tasks were also performed.

At larger regional sites, such as Caracol in Belize, Aguateca and Cancuen in Guatemala, and Copan in Honduras, the pattern of craft specialization differs. At Caracol, chert drills and trimmed flakes with use-wear consistent with drilling and incising shell were recovered in nine residential groups of middle-status individuals; this find indicates craft production of jewelry and ornaments from imported marine shell (Pope Jones 1996). Pope Jones (1996) interprets the used tools—and associated shell debitage in some locations, such as the Mosquito group—as evidence for part-time production, most likely as a cottage industry controlled by a merchant class, a lineage, or elites.

At Aguateca, lithic use-wear evidence indicates that craft production of luxury items or artistic creations occurred in a variety of domestic contexts. However, part-time, low-volume production by elites, including both lower-status individuals and members of the royal household, was organized as both independent and attached-specialist crafting of luxury goods and weaponry, as well as utilitarian items (Aoyama 2007:24–25; Emery and Aoyama 2007:85–86; see Costin 2001:300; Inomata 2001; Inomata and Triadan 2000). Based on lithic use-wear and faunal remains, Emery and Aoyama (2007:84) argue that most of the residents in the site epicenter were involved in some stage of craft production involving bone and shell. Aoyama (2007:24) also notes that different households and individuals focused on different types of craft production and artistic creation. At Pook's Hill, low-level craft production may be considered a cottage industry primarily involving a local population of commoners and possibly lesser nobles; as such, it would differ from the elite- or merchant-controlled production of shell jewelry and ornaments at Caracol or the elite production of larger quantities of more prestigious and valuable sumptuary items described at larger sites like Aguateca, Copan, and Cancuen.

At Classic period Aguateca, Copan, and Cancuen, use-wear analysis has revealed that some locations were associated with multicrafting in which nonsubsistence craft items were made from a variety of raw materials, including bone, shell, stone, and wood (Aoyama 1999, 2007, 2009; Cadalen et al.

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2023; see Hirth 2009). Multicrafting of this type appears to have been done as early as the Middle Preclassic (1000–350 BC), based on the use-wear documented on chert and obsidian tools in middens with faunal remains at Ceibal, Guatemala (Sharpe and Aoyama 2023). At Pook's Hill, use-wear data do not support multicrafting. Small-scale craft production seems to be limited to the production of items from one material in one location. An argument for multicrafting at Pook's Hill might be possible, however, if the production of craft items was measured on the scale of the entire *plazuela* group as a single household.

Overall, lithic use-wear analysis indicates that Maya craft production frequently occurred in residential areas associated with individuals ranging from low to high status (Aoyama 1999, 2009; Cadalen et al. 2023; Pope Jones 1996; Stemp 2001, 2016; Stemp et al. 2010). However, lithic use-wear demonstrates that some craft production in residential areas, such as bone and shell work at Aguateca and the production of shell items at Copan, was clearly restricted to spaces controlled by elites, including royalty (Aoyama 1999, 2009; Emery and Aoyama 2007). Based on the contexts of recovery of chipped stone tools with use-wear and faunal remains at Ceibal, elite involvement in bone and shell craft production may have occurred as early as the Middle Preclassic (Sharpe and Aoyama 2023). Whether elites themselves made the items or specialists attached to royal courts or elite households did so is difficult to determine.

Conclusion

Despite the sociopolitical and socioeconomic disruptions to Maya lifeways that accompanied the Terminal Classic, it seems that Pook's Hill continued to remain occupied well into the end of this period. The obsidian tools provide evidence that the Maya at this site were still engaged in daily subsistence and domestic tasks, alongside local crafting of products they needed themselves and for possible exchange with others.

This argues for some persistence in socioeconomic activity among the inhabitants of Pook's Hill at a time when other sites were being abandoned.

Overall, the chert/chalcedony and obsidian tool use-wear data emphasize the economic contributions that smaller communities made to the production of nonsubsistence–based resources and other manufactured craft items. The obsidian data also support previous reconstructions showing that craft production using stone tools supplied items, such as textiles, bone tubes, and shell ornaments (Stemp et al. 2010). Although overall production volume seems to have been low and was likely organized on a part-time basis, lithic use-wear analysis of the stone tools clearly demonstrates the presence of craft production in a community of generally low-status Maya. These results also raise the possibility that production of this type may have linked small communities to local and perhaps regional exchange networks of the Roaring Creek and Upper Belize River Valleys in the Terminal Classic period. In sum, the inhabitants of Pook's Hill seem to have enjoyed economic independence, in addition to a degree of inclusivity, within a regional socioeconomic system.

As noted in other studies (Aoyama 1999, 2009; Cadalen et al. 2023; Lewenstein 1987; Stemp 2001, 2016), lithic use-wear analysis provides a means to determine the specific functions of individual tools. It is also a valuable approach for detecting craft production involving both perishable and nonperishable materials. Given the heavy reliance on stone tool technology by the Maya, understanding the functions of their tools based on use-wear analysis is important for reconstructing various aspects of their daily lives, including subsistence, domestic tasks, and craft production, that may be difficult to see in other ways.

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Data Availability Statement. All raw data are available on request from W. James Stemp (jstemp@keene.edu).

Competing Interests. The authors declare none.

Note

1. The difference in the number of artifacts previously analyzed by Braswell (2007) and those discussed in this article (354) is due to the following: (1) some artifacts were not available for the original typological and metric analyses, and (2) blade segments that could be refit were considered a single artifact by Braswell. However, for the use-wear analysis described in the article, each blade segment was counted as a separate artifact because of the possibility that individual segments that could be refit may have been used for different functions.

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