REPORTS

Raw Material Selection and Stone Tool Production: Limestone Bifaces in the Mopan Valley, Belize

Rachel A. Horowitz, Bernadette Cap, Jason Yaeger, Meaghan Peuramaki-Brown and Mark Eli

Stone tool producers in the Maya Lowlands had several types of raw materials from which to choose. Limestone, chert, and obsidian are the most naturally abundant, whereas chert and obsidian outnumber limestone in archaeological contexts. The presence of flaked-stone tools made of limestone is typically attributed to the scarcity of more suitable raw materials. Nevertheless, in chert-rich areas, such as the upper Belize River valley, limestone bifaces and production debitage are present. To understand their presence, we examine limestone biface production and use at Buenavista del Cayo.

Keywords: raw material choice; lithic artifacts; Maya; limestone

A lo largo de las tierras bajas mayas en Mesoamérica los productores de utensilios líticos contaban con distintas materias primas para la elaboración de artefactos. Entre éstas, la piedra caliza, el pedernal y la obsidiana son las más abundantes en la naturaleza. En las colecciones arqueológicas los artefactos de pedernal y de obsidiana, en general, son más abundantes que los de piedra caliza. Cuando hay la presencia de estos últimos es típicamente atribuida a la escasez de materias primas más convenientes. Sin embargo, en áreas ricas en pedernal, como en el valle superior del Río Belice, están presentes tanto bifaces de caliza como el desecho de su producción. Para comprender esto, se examinará la producción y uso de bifaces de caliza procedentes de Buenavista del Cayo, Belice.

Palabras clave: materias primas; utensilios líticos; Maya; piedra caliza

Several factors shaped ancient Maya flintknappers' raw material choices, including material properties and abundance, and socioeconomic or political restrictions. In terms of the former, archaeologists have long recognized that raw material choices are driven by material properties. Generally, flintknappers preferentially work materials such as fine-grained cherts when making bifaces. More rarely, bifaces were fashioned from coarse-grained material that may not fracture as predictably (i.e., Nami 2015). In areas in which flintknappers had access to a variety of raw materials, we can consider factors contributing to raw material selection.

In the Maya Lowlands, the primary stone materials available were chert, limestone, and obsidian; limestone is the most naturally abundant but has the least documented evidence of use. Historically, limestone has been considered a less-desirable raw material for flaked-tool production because its physical properties do not result in predictable conchoidal fractures, which are found in brittle, elastic, and homogeneous materials (Andrefsky 2005; Whittaker 1994).

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Our research at Buenavista del Cayo, Belize (hereafter Buenavista) has caused us to rethink assumptions about raw material preferences for limestone. At Buenavista, we recovered 42 limestone bifaces and evidence for limestone biface production in the site's marketplace (Cap 2015a). These data suggest limestone bifaces were distributed through marketplaces and they were more common than previously thought.

Limestone Tools in the Maya Lowlands

Limestone tools are most often reported from chert-poor regions with locally available limestone. Within the southern Maya Lowlands, chert's uneven distribution results in localized chert-poor regions with relatively high percentages of limestone artifacts (Andrieu and Roche 2015; Rivero Torres 1987). In the chert-poor north coast region of the northern Maya Lowlands, archaeologists have noted the presence of limestone bifaces and debitage (Dahlin et al. 2011; Hearth and Fedick 2011). The low reported frequency of flaked limestone artifacts may be due to limestone's friability and its propensity to weather, which complicate its identification (Braswell 1998; Dahlin et al. 2011; Hearth and Fedick 2011).

Limestone use is not restricted to chert-poor regions. In the upper Belize River valley (UBRV), chert occurs ubiquitously, if irregularly (Horowitz 2017; VandenBosch 1999; Yaeger 2000), whereas limestone tools and flakes are found throughout the region (Supplemental Table 1). Most of the reported limestone tools are general utility bifaces (GUBs): large, chunky bifaces with rounded ends (Kidder 1947). Limestone GUBs have been found in households (Braswell 1998; Peuramaki-Brown 2012; Yaeger 2000), agricultural terraces (Wyatt 2008), and chert quarries (Horowitz 2017; VandenBosch 1999). Limestone debitage from flaked-stone tool production has also been reported but with little information about its quantity or characteristics (Supplemental Table 1).

The Buenavista sample provides an opportunity to begin systematic examinations of limestone biface production. We discovered evidence for limestone biface production early in our research at Buenavista, heightening our awareness of its potential presence.

Buenavista

Buenavista, located on the east bank of the Mopan River in the UBRV (Figure 1), was a major political center during the Early Classic and the early Late Classic periods (AD 300–700), with occupation extending from the Middle Preclassic (950–300 BC) through the Terminal Classic period (AD 780–1000; Ball and Taschek 2004; LeCount and Yaeger 2010; Peuramaki-Brown 2012). This sample derives from investigations by the Mopan Valley Archaeological Project (MVAP) that, under the direction of Jason Yaeger, has worked at and around Buenavista since 2005. MVAP investigations of relevance include excavations in the monumental core (Cap 2015a), survey and excavations of surrounding settlement zones (Eli 2014, 2015; Peuramaki-Brown 2012), and excavations of the minor center of Callar Creek (Kurnick 2013) and Callar Creek Quarry (Horowitz 2017).

Limestone Acquisition

The UBRV bedrock consists of Cretaceous and Tertiary period limestone beds and alluvial deposits containing limestone and chert cobbles. Cretaceous beds consist of dolomite and crystalline limestone. Tertiary beds consist of soft limestone, chert, marl, and gypsum (Smith 1998). Although a survey of limestone outcrops has not been conducted, the ancient Maya used both hard and soft limestone, suggesting their accessibility. The latter were preferred for masonry (Braswell 1998; Keller 2006), whereas the former were more suitable for knapping.

Limestone Biface Production and Exchange

Excavations in Buenavista's Late Classic marketplace (Cap 2015a) recovered evidence of limestone biface production, the largest reported concentration of limestone debitage in the UBRV (Supplemental Table 1), and the first time limestone tool production has been identified in a marketplace. Limestone bifaces were produced in two areas (Figure 2): the western and eastern zones, with maximum limestone

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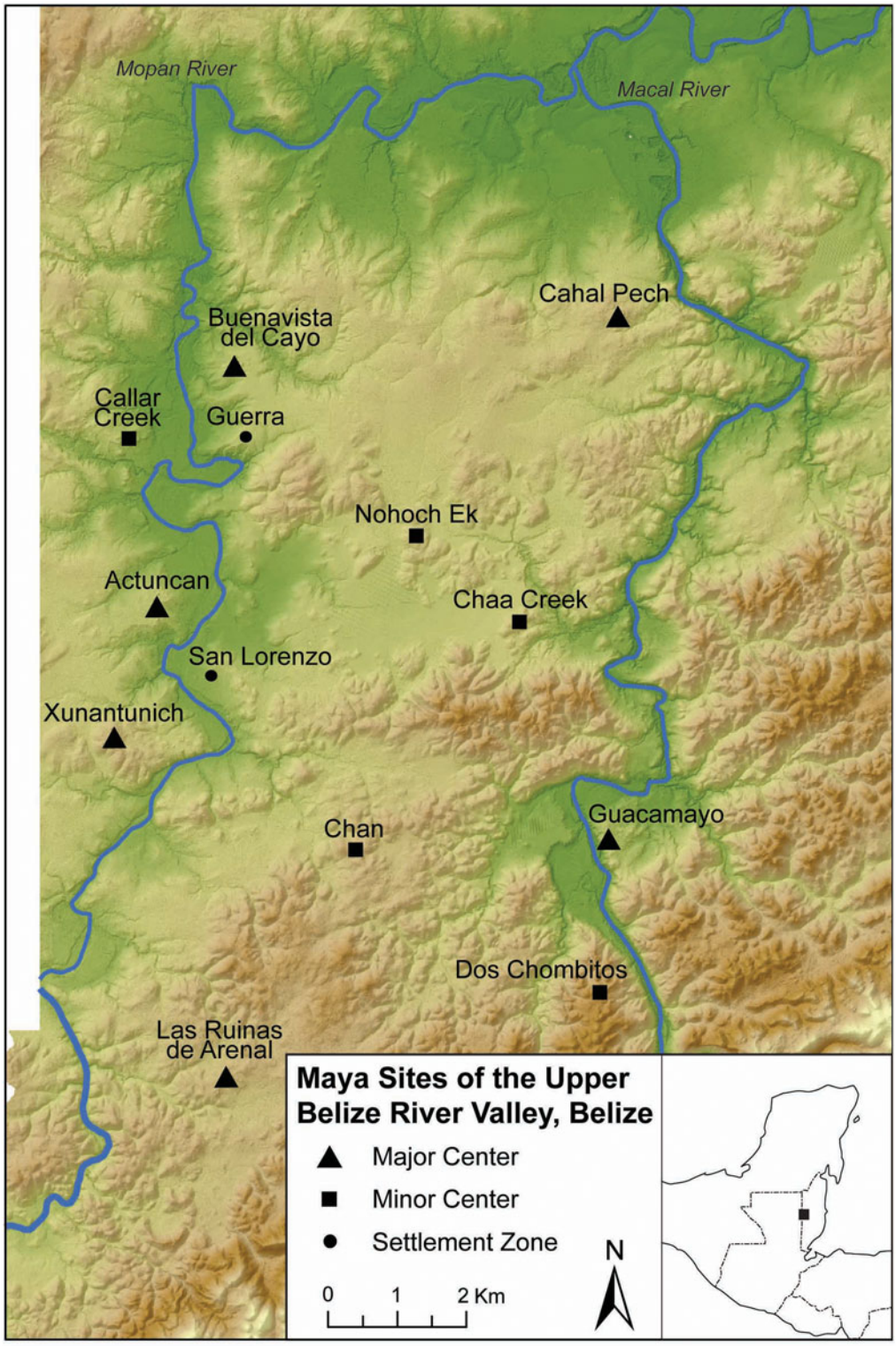

Figure 1. Location of Buenavista.

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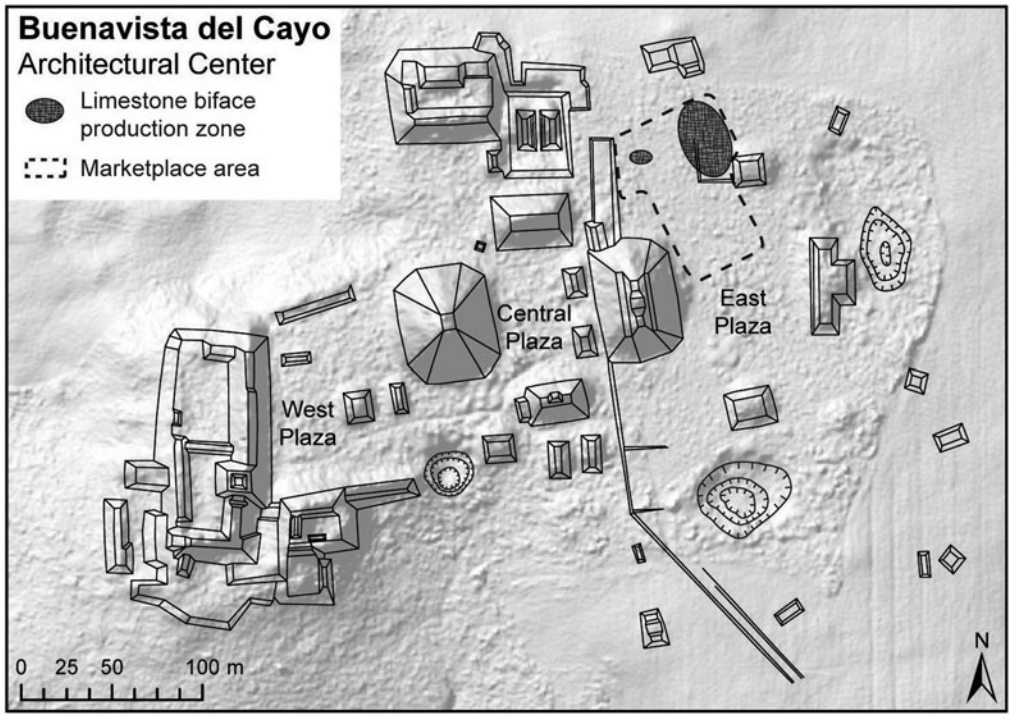

Figure 2. Limestone debitage concentrations in Buenavista's marketplace.

Table 1. Biface Metrics, Breakage Patterns, and Macroscopic Use-Wear.

	N	Average	Maximum	Minimum	Std. Dev.
Length (mm)	17	108.1	160	60	30.6
Width (mm)	42	59.5	78	26	10.3
Thickness (mm)	42	33.7	50	20	7.1
Weight (g)	17	270.3	532.6	97.8	129.4
W/T (mm)	42	1.8	3.9	0.8	0.39
JTI (g/mm^2)	17	6	8.5	3.8	1.6
Breakage	Whole	Proximal	Distal	Medial	Total
Bending	0	4	3	1	8 (19%)
Impact	0	8	5	2	15 (35.7%)
None	17	2	0	1	19 (45.2%)
Use-Wear	Whole	Proximal	Distal	Medial	Total
Battering	14	9	7	0	30 (71.4%)
None	3	4	1	4	12 (28.6%)

densities of 644 and 58,062 debitage/m^3, respectively (Cap 2015a:253; Heindel 2010: Tables 10–13).

Whole and broken flakes were analyzed to determine production mechanisms and products. All flakes in the eastern zone and 87% of the flakes in the western zone are thinning flakes. No limestone bifaces were recovered, but the sample is consistent with end-stage biface production (Cap 2015a).

Limestone Bifaces

Excavations and pedestrian survey at Buenavista have thus far recovered 42 limestone bifaces contemporaneous with the site's marketplace[1,2]. Thirty-four were recovered from 19 households

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Figure 3. Limestone bifaces from Buenavista. A: Whole biface with flake removal; B, C: Whole biface; D: Biface with impact fracture.

(Eli 2014, 2015; Peuramaki-Brown 2012), 6 from a community structure (Peuramaki-Brown 2012), and 15 from the site's West Plaza (Cap 2015b). Of those recovered from households, 19 were recovered in excavations in Buenavista's South Settlement Zone (Peuramaki-Brown 2012) and 15 during surface collections in plowed fields in the settlement zones east and north of Buenavista (Eli 2014, 2015).

Biface analyses focused on metric, qualitative, and indexical analyses. Metric analyses provide information on size and form. Qualitative analyses examined completeness, breakage patterns, and use-wear. Breakage pattern analysis characterizes the nature and timing of breakage. We focused on impact fractures, caused when a biface strikes a hard surface; and bending fractures, caused by production errors and impact (Andrefsky 2005; Whittaker 1994:165). Macroscopic use-wear was assessed with the naked eye. Use-wear provides information on tool function and confirmation of breakage through use. Finally, the width/thickness (W/T) and Johnson thinning index (JTI; Johnson 1981), a ratio of biface surface area to mass, were calculated for whole bifaces to examine biface reduction and form.

The limestone bifaces are large, thick GUBs (Table 1; Figure 3). Twenty-eight bifaces were broken, of which 15 had impact fractures or impact-induced bending fractures, indicative of use-related breakage (Table 1). The fractures were visually similar (Figure 3), suggesting a similar cause. Macroscopic use-wear, predominately battering, was observed on the lateral margins of whole and broken bifaces, either from use or retouch for hafting (Table 1, Figure 3).

The bifaces had a high W/T ratio and low JTI (Table 1). These values illustrate that the limestone bifaces were finished but not thinned as is typical with biface production, although GUBs are thick. Thus, biface thickness was an intentional result of the production process.

Discussion

Evidence for limestone biface production and exchange in the Buenavista marketplace suggests that these tools were desired by householders, as they were incorporated into the site's marketplace exchange network. These findings also demonstrate that limestone was suitable/desirable for biface production.

The Buenavista limestone bifaces have use-wear and breakage patterns that indicate they were struck against hard materials. Comparisons with experimental quarrying, digging, and chopping found that thicker bifaces break less often than thinner ones (Clark and Woods 2014),

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bifaces accumulate feather and step fractures on lateral margins, and bending fractures predominate (Lewenstein 1987); these are all characteristics of this sample.

Given these patterns, we suggest the Buenavista limestone bifaces were likely used for heavy-duty tasks such as quarrying, chopping, and hoeing because the archaeological wear-patterns mimic those from experimental studies. Future experiments will be important for accessing these interpretations. Nevertheless, the presence of limestone bifaces and debitage in a chert-rich area indicates that for the ancient Maya these tools had utility and that the raw material quality did not dissuade knappers from using limestone to produce tools.

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Data Availability Statement. Discussed materials are housed in the MVAP laboratory with permission from the Institute of Archaeology.

Supplemental Materials. For supplementary material accompanying this paper, visit https://doi.org/10.1017/laq.2018.72

Supplemental Table 1. Table presenting data on the quantity of limestone bifaces and debitage in the Upper Belize River Valley.

Notes

1. Fifty-one chert bifaces were recovered from these locations.
2. The limestone is silicified; its friability, texture, and appearance are distinct from patinated and unpatinated chert.

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