6 LOCAL CHERT REDUCTION, MAINTENANCE, AND TOOLMAKING: TERMINAL CLASSIC CHERT USE AT NOHMUL, BELIZE

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Stone tools and debitage recovered from Terminal Classic Period contexts at the site of Nohmul, Belize were collected in 1978 and 1979 as part of a dissertation project. Our analysis of this Nohmul chert assemblage has found evidence for local reduction of cobbles and core maintenance, as well as the production and maintenance of tools. Nohmul is situated roughly 30 kilometers from the Northern Belize Chert Bearing Zone, and the site of Colha, Belize – the argued center of lithic production in the region during the Terminal Classic. Consequently, these chert artifacts from Nohmul (1) broaden our understanding of chert consumption and production in the region and (2) provide researchers an additional dataset (via tDAR) for comparison to other Terminal Classic assemblages within and outside the Northern Belize Chert Bearing Zone.

Introduction

The traditional narrative of Classic Period lithic technology in northern Belize is characterized by a producer-consumer model, wherein tool production is performed largely by a small number of specialists in specific sites, and these tools are then exported, exchanged, and used by other sites in the region (Buttles 2004; Dockall and Shafer 1993; McAnany 1989). However, this model has faced some challenges (see Moholy-Nagy 1990 but also Healen 1992; Hester and Shafer 1992). Chert provenience often remains unclear as does the degree of tool manufacture occurring outside the context of these production centers. In addition, evidence suggests that the chert economy changed over time (Shafer and Hester 1983:529-531; Speal 2009).

Among the primary challenges to better understanding the chert economy in northern Belize are assumptions about the origin and distribution of chert, the difficulty of access and use of previously excavated material, and the difficulty of characterizing chert in forms differing from the producer-consumer model. Many of these excavations occurred decades ago and while many relevant sites have seen excavation, time has made accessing some of these datasets difficult. As in other parts of the Americas, even fully analyzed and well publicized data may not be accompanied by their original datasets (sensu McManamon, et al. 2017). In some cases, the sites themselves have been damaged or destroyed (Vasquez 2013). This destruction of the archaeological record makes investigations of artifacts from prior excavation at sites even more pertinent, because additional excavation cannot be conducted on the destroyed mounds. The curation of excavated material for future analysis has the potential to provide new results and add to prior interpretations.

The Producer Consumer Model

Chert has played an important role in archaeological interpretations of the economic relationships between settlements, particularly in northern Belize; shedding light on production, trade, and exchange of materials. More specifically, tool production and use are argued to be best characterized by a producer-consumer model, in which knappers at the site of Colha, and then later at Altun Ha, produced the tools that were then exchanged with other sites in the region (Shafer 1981; Shafer and Hester 1983:540). These two settlements are in the Northern Belize Chert Bearing Zone (NBCBZ), which provided easy access to high quality chert resources (Figure 1).

Colha is a small settlement with a population of around 600 people (Eaton 1982; Shafer and Hester 1991:87). But, despite that small population, Colha bears extremely dense deposits of lithic debitage. The density of deposits for a site with such a small population – and the lack of similar such deposits at sites outside the NBCBZ – suggest a strong tool-producing economy. The presence of finished tools and little evidence for the local manufacture of these kinds of “formal” tools at other sites has been used to argue for chert from Colha at sites outside the NBCBZ zone, such as

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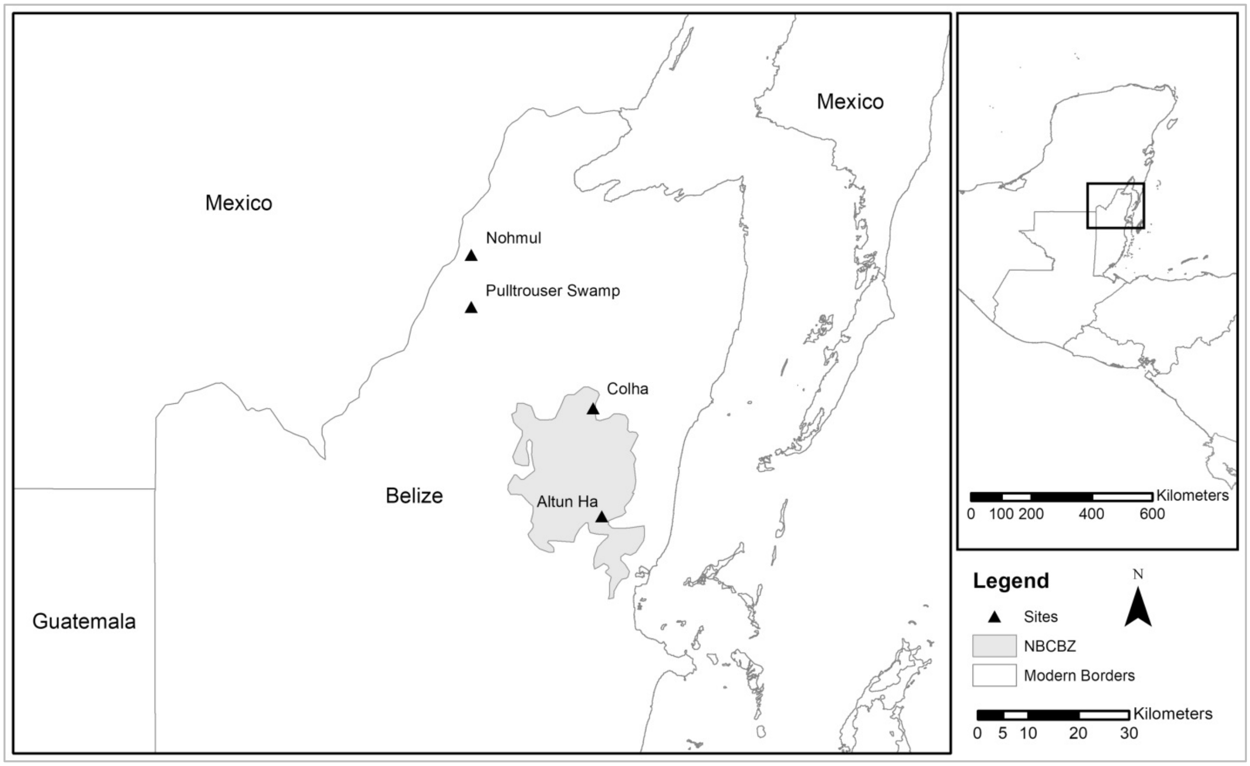

Figure 1. A map showing the locations of Nohmul, Colha, and the Northern Belize Chert Bearing Zone (NBCBZ) along with modern national borders in northern Belize (modeled after McAnany 1989: Figure 1).

Nohmul, Pulltrouser Swamp, and Santa Rita (Buttles 2004; Dockall and Shafer 1993; McAnany 1989). Pulltrouser Swamp, for example, has abundant evidence suggesting that this site consumed, and even relied on, the products produced at sites like Colha (Hester and Shafer 1984; Masson 2001; Shafer and Hester 1983; 1991:87 see also Speal 2009).

However, this economic system shifted over time. Shafer and Hester (1983:524-529) demonstrate the existence of centralized workshops producing primarily oval bifaces in the Early Classic period. Lithic production continues to be important at Colha in the Late Classic with a shift towards less centralized production (Shafer and Hester 1983:529-531). This is contextualized in the Late Classic with Altun Ha potentially assuming the role as the primary producer of lithic material for export from the NBCBZ (Shafer 1981; Shafer and Hester 1983:540). Finally, in the Early Postclassic Period reduction patterns change. Shafer and Hester (1983:537) argue that there is a 50 to 100-year hiatus in settlement and production at Colha between the end of the Classic Period and the start of the Postclassic Period. This discontinuity in settlement is suggested to be accompanied by a shift toward more Yucatec influenced material culture at the site on reoccupation (Buttles 2004:286-288), in addition there is a shift from oval biface production to laurel leaf production (Shafer and Hester 1983:figure 4). However, the production of laurel leaf points is not specifically a Postclassic marker at other centers; for example, Late Classic laurel leaf points were found from Structure A3 at Caracol (Figure 2; AF Chase and Chase 1987:15).

The producer consumer-model outlined above has some challenges. It has been argued that the identification criteria for workshops at Colha may be too lax and can be confused with workshop refuse dumps (see Moholy-Nagy 1990 and replies by Healen 1992; Hester and Shafer 1992), and that chert nodules within and outside the NBCBZ cannot be easily distinguished through chemical analysis (Cackler, et al. 1999:389-391,394-385). In many cases the

Figure 2. Laurel leaf points, associated with later dates in northern Belize, have been found in the Late Classic Period at Caracol in Structure A3. (Photo by Arlen and Diane Chase; see AF Chase and Chase 1987:15).

color of the chert is thought to be an important way to distinguish the source (Speal 2009:93); however, some colorations simply result from weathering processes (Cackler, et al. 1999:396). Even so, fine grained, deep-brown to banded-tan chert is often attributed to sources near Colha (Hester and Shafer 1984:164; McAnany 1989:334-335; Shafer and Hester 1983:521).

The extent of tool production at sites outside the NBCBZ is also not as well understood, and it may be underestimated by the producer-consumer model. Recently, work has highlighted tool production at sites outside the NBCBZ, and characterized variation in tool production across the Maya Lowlands over time (Speal 2009). Even sites with strong evidence for dependence on Colha chert, show some evidence of local production of tools (though often more expedient in nature), and some amount of cortex and evidence of early stage reduction in NCBCZ chert (Speal 2009). It is similarly unclear how consumer sites would have reacted to the proposed Colha hiatus.

Legacy collections, like this one from Nohmul, provide potentially rich sources of information that have not yet been fully tapped. Our research goals are threefold. First, to analyze an existing dataset and make our results generally available for future comparative work. Second, to explore potential differences in activities between two contemporaneous structures with different architectural forms. Third, to identify the extent of tool production or early stage core reduction in the assemblages. As future research unlocks or creates additional legacy datasets; we hope that this dataset will be useful, possibly leading to new interpretations of the chert economy in northern Belize.

Nohmul

Here we report on an analysis of 381 chert artifacts recovered during excavations at Nohmul in 1978 and 1979 during Corozal Postclassic Project excavations – conducted by Diane Chase for her dissertation research (DZ Chase 1982:489-491). Nohmul is located in northern Belize, east of Belize's border with Mexico (Figure 1). The site was occupied from roughly 300 to 1000 CE and was subsequently abandoned (Hammond, et al. 1987:279-280).

Excavations at Nohmul began at the turn of the 20th century under Thomas and Mary Gann (DZ Chase 1982:27-28; Gann 1911; Gann and Gann 1939). Excavations continued in the 1940s through work undertaken by Anderson and Cook (Anderson and Cook 1944; DZ Chase 1982:28-29). More recent excavation occurred under the auspices of the Corozal Project, which ran from 1973 to 1976 under the direction of Norman Hammond (DZ Chase 1982:29-30; Hammond 1973, 1974, 1975, 1977). Diane Chase excavated Structure 20 in 1978 and Structure 9 in 1979 as part of the Corozal Postclassic Project (DZ Chase 1982:18-19; DZ Chase and Chase 1982:596-598,601-593). Finally, from 1982 to 1986 Norman Hammond returned to the site for four additional field seasons (Hammond 1983; Hammond, et al. 1985; Hammond, et al. 1987; Hammond, et al. 1988). No further archaeological excavation has occurred at Nohmul. However, in May 2013 the northern part of central Nohmul was destroyed (Figure 3) by a contractor to provide fill for road construction (Vasquez 2013). The site had also been used in the 1940s for construction fill (see Anderson 1954:entry #1-2 cited in Hammond 1983:247).

Similar to Colha's more Yucatec material culture shift, Nohmul saw a shift to more Yucatec architectural features, though at the slightly earlier date of 800 CE (Hammond, et al. 1988:12). In particular, the architectural forms

Figure 3. The destruction of Nohmul in 2013 for construction fill. (Photos by Jaime Awe).

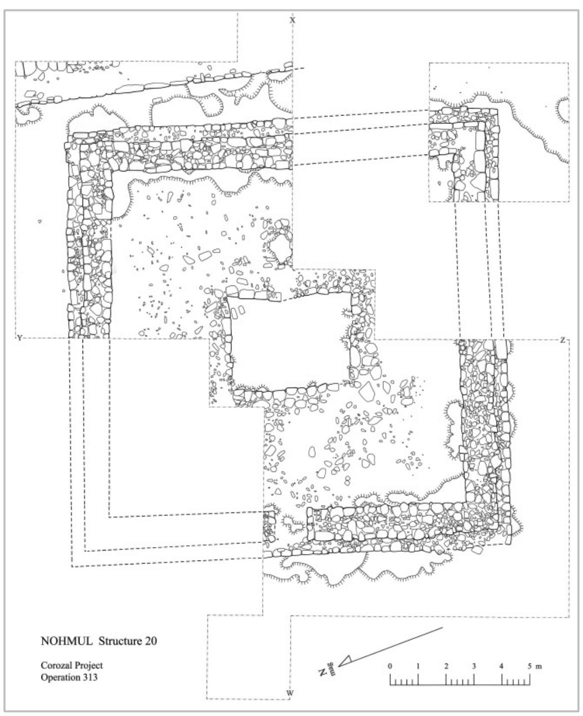

Figure 4. Structure 20 excavation plan (reproduced from DZ Chase 1982:Figure 3-4).

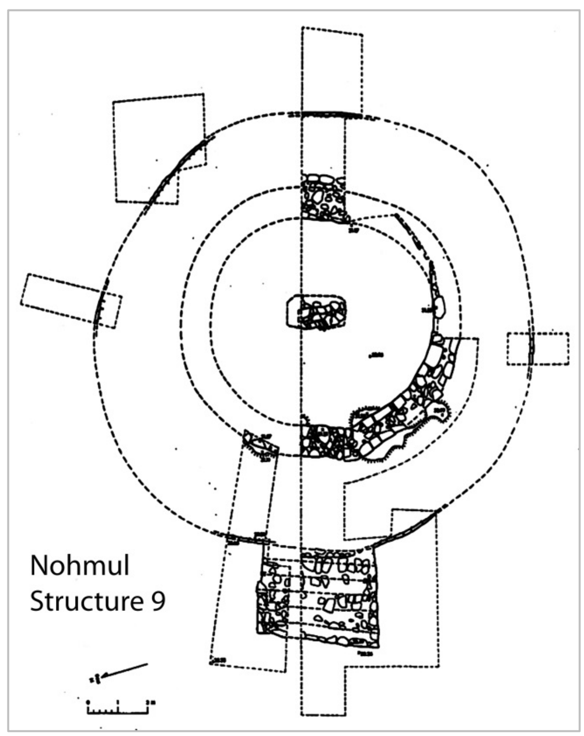

Figure 5. Structure 9 excavation plan (reproduced from DZ Chase 1982:Figure 3-9).

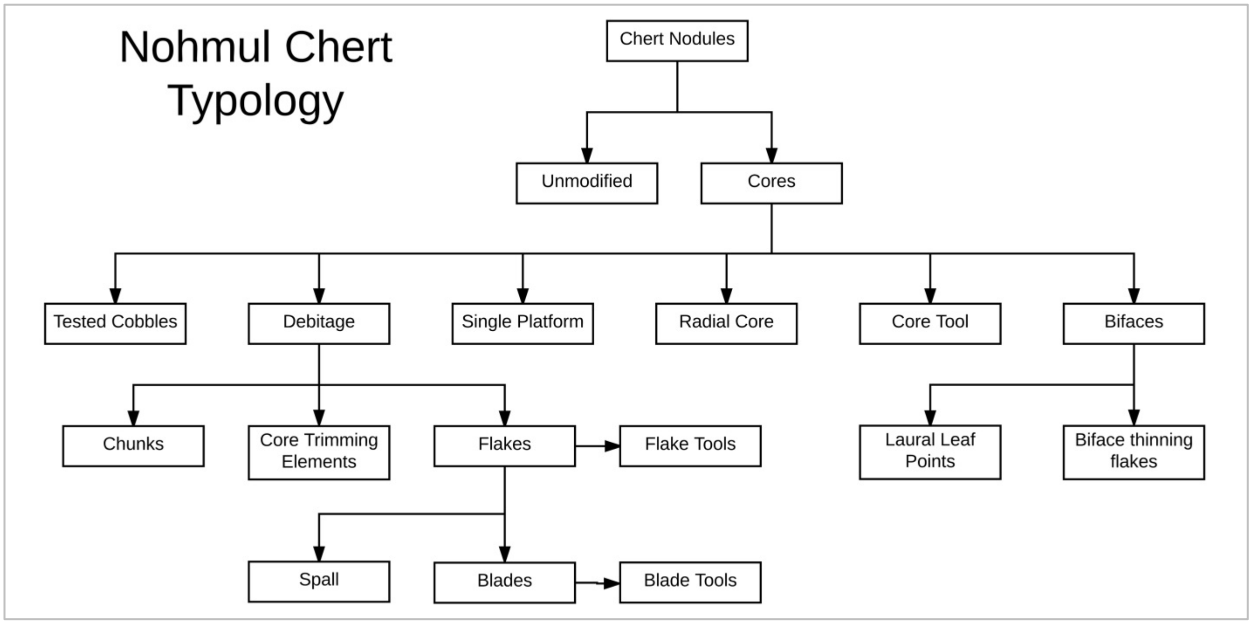

Figure 6. The Nohmul chert typology employed in this research.

exhibited by Structures 20 and 9 in Nohmul's epicenter highlight this influence through Structure 20's patio-quad form, Structure 9's circular form akin to El Caracol – the round structure at Chichén Itzá – and the 17-degree orientation for both structures (DZ Chase and Chase 1982:599-601,605-597).

The lithic sample from Nohmul may date to a period during which Colha's production waned. The sample was recovered from contexts associated with Structures 20, and 9. Both Structure 20 and Structure 9 were erected within the central plaza at Nohmul during the Terminal Classic (DZ Chase and Chase 1982:599,605). This provides a narrow window for artifact use of about 100 years for both structures. A radiocarbon date from an activity undertaken immediately prior to the start of Structure 9's construction dates to the late eighth century (P-3977, 1300±40; CRD-1σ: 615-785 CE; Hurst and Lawn 1984:235).

Structure 20 (Figure 4) was erected in front of earlier architecture at Nohmul creating an alley. This alley contains a temporary refuse pile behind the northeast corner of the structure, and both interior and exterior deposits contain ceramic refits between each other indicating a short time horizon to their deposition (AF Chase and Chase 2013:52-53). Chert cores were identified in situ in front of the building's entrance (DZ Chase 1982:96), indicating some direct evidence for local production of tools. However, the ceramic material and other artifacts strongly suggest a more domestic and household use for this structure (AF Chase and Chase 2013:54). In contrast, Structure 9 (Figure 5) is a circular structure (DZ Chase and Chase 1982:601-607) with material culture that suggests non-residential use (DZ Chase 1982:123). Finally, both Structure 9 and Structure 20 possess the same construction angle while situated across the plaza from each other, and their construction would have limited mobility across this space (Hammond 1983:figure 2).

Results

We performed a techno-typological analysis of 381 chert artifacts recovered from Structures 20 and 9. For our analysis, we utilized the following lithic typology (Figure 6) and collected data on striking platforms, platform damage, cortex, dorsal scar orientation, length, width, thickness, and weight; we also used the original laboratory identification numbers still visible on the artifacts to organize our data and appended a record of context, operation, and current storage box to the dataset

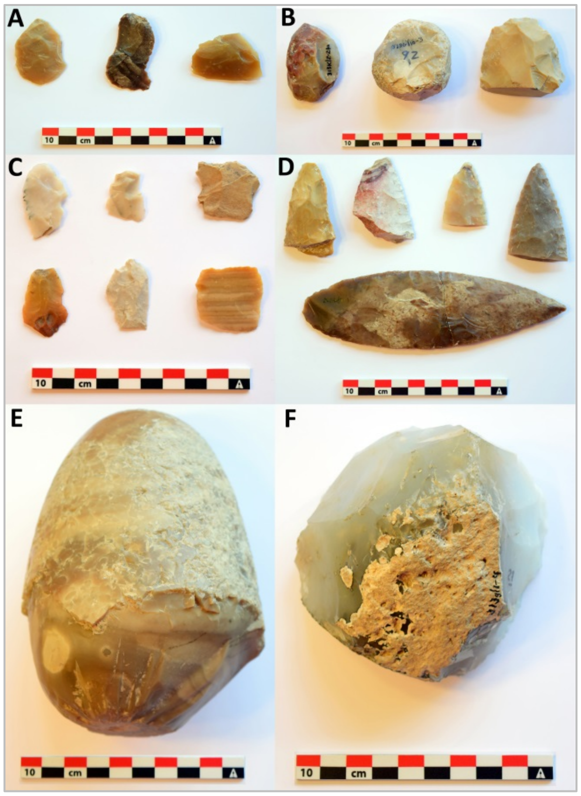

Figure 7. Sample chert from this dataset including: (A) biface thinning flakes, (B) core tools, (C) flakes, (D) laurel leaf points, (E) a mano, and (F) a unifacial core. The complete laurel leaf point and the mano are "NBCBZ-like" (i.e. "Colha-like") honey-brown chert excavated from Nohmul Structure 20.

(see Chase and Paige 2019). This preliminary analysis focuses on identifying whether or not there are signs of early stage reduction of cores, including the presence of cortical pieces, evidence of core preparation, rejuvenation, and initial shaping of tools. We also identified whether there may be differences in the treatment of brown-tan chert, some of which could potentially have come from the Colha area, and other kinds of chert that may be more indicative of local usage.

The Nohmul debitage (Figure 7) consists largely of flakes, cores, bifaces, biface thinning flakes (64.2%), and flaking debris (25.5%) (Table 1). Debris included burnt shatter, and chunks (elements without a platform, or a ventral surface). Less common are core trimming elements (4.8%). These include pieces like core tablets, which are removed from the top of single platform cores, and flakes that removed high areas of the core face with dense stacking, or repeated instances of flakes that terminated in step fractures. These core trimming elements often bear evidence of small flakes removed from the dorsal margin of the platform, consistent with overhang removal, and one instance of an abraded platform. Blade fragments are also present (5.3%). These have parallel lateral margins, unidirectional dorsal scars, and some with retained platforms exhibit careful platform preparation, through abrasion, microchipping of the dorsal surface.

Cores with evidence for both flake and blade production are in the assemblage. Most of the cores are either radial flake cores, or flake cores with multiple changes in orientation. Two of these multidirectional cores show some evidence of blade or bladelet removals. More formal blade cores are less common, though they are present (N=3). They are unidirectional, single platform pyramidal cores which is consistent with the unidirectional nature of blade fragments present in the assemblage. Each are made from a fine blue-gray chert.

There are some differences in the kinds of debitage elements, and products in terms of raw material. Among the brown chert pieces, some types are overrepresented. For example, 13% of brown chert pieces are biface thinning flakes, while they only make up 4.6% of non-brown chert. Similarly, bifaces make up 15.7% of the brown chert, and 7.2% of the non-brown chert (Table 2). This points to a slightly greater emphasis on biface thinning on fine, brown chert. Cores, in large part radial and multidirectional cores, are also more common on non-brown chert, and single platform blade cores are only found on non-brown chert.

The tools present in the assemblage are largely bifaces. This includes non-thinned bifaces, which make up ~25.8% of the assemblage, and appear to be made by reducing chert cobbles (Table 3). Thinned laurel leaf bifaces make up 10.3% of the assemblage; the original blank is not clear on these pieces given how heavily they have been reduced. Hammerstones, typically made from repurposed radial chert cores, make up 19.6% of the tool assemblage. These cores were battered, and show extensive use-wear along their arc-length and a smoother, polished side in a shape resembling a hockey puck. Some of these

Table 1. Nohmul debitage consists largely of flakes, cores, bifaces, and biface thinning flakes.

	Structure 9		Structure 20		Total	
Element	**Number**	**%**	**Number**	**%**	**Number**	**%**
Flake	29	22.5	104	41.9	133	35.3
Blade	10	7.8	10	4.0	20	5.3
CTE	9	7.0	9	3.6	18	4.8
Biface thinning	8	6.2	19	7.7	27	7.2
Spall	0	0.0	1	0.4	1	0.3
Core	23	17.8	23	9.3	46	12.2
Biface	13	10.1	23	9.3	36	9.5
Chunk	10	7.8	37	14.9	47	12.5
Shatter	27	20.9	22	8.9	49	13.0
Total	*129*	*100.0*	*248*	*100.0*	*377*	*100.0*

Table 2. Differences in debitage and debris between raw material types.

	Tan-Brown Chert		Other Chert		Total	
Element	**Number**	**%**	**Number**	**%**	**Number**	**%**
Flake	38	33.0	95	36.1	133	35.2
Blade	8	7.0	12	4.6	20	5.3
CTE	8	7.0	10	3.8	18	4.8
Biface thinning	15	13.0	12	4.6	27	7.1
Spall	1	0.9	0	0.0	1	0.3
Core	9	7.8	37	14.1	46	12.2
Biface	18	15.7	19	7.2	37	9.8
Chunk	17	14.8	31	11.8	48	12.7
Shatter	1	0.9	47	17.9	48	12.7
Total	*115*	*100.0*	*263*	*100.0*	*378*	*100.0*

Table 3. Retouched tools are present in this Nohmul dataset.

	Structure 9		Structure 20		Total	
Tool	**Number**	**%**	**Number**	**%**	**Number**	**%**
Retouched flake	1	2.6	9	15.5	10	10.3
Retouched blade	4	10.3	2	3.4	6	6.2
Retouched core	1	2.6	0	0.0	1	1.0
Biface	11	28.2	14	24.1	25	25.8
Point	3	7.7	4	6.9	7	7.2
Laurel leaf	1	2.6	9	15.5	10	10.3
Scraper	1	2.6	0	0.0	1	1.0
Notch/denticulate	4	10.3	1	1.7	5	5.2
Perforator	3	7.7	8	13.8	11	11.3
Hammerstone	10	25.6	9	15.5	19	19.6
Polished tool	0	0.0	2	3.4	2	2.1
Total	*39*	*100*	*58*	*100.0*	*97*	*100*

Table 4. Amount of cortical cover present on debitage elements among assemblages.

	Structure 9		Structure 20		Total	
Cortex cover	**Number**	**%**	**Number**	**%**	**Number**	**%**
>%50	1	1.8	0	0.0	1	0.5
<%50	6	10.7	16	11.3	22	11.1
0	49	87.5	126	88.7	175	88.4
Total	*56*	*100.0*	*142*	*100.0*	*198*	*100.0*

Table 5. Amount of cortical cover present on debitage elements of tan-brown chert and other kinds of chert.

	Tan-Brown Chert		Other Chert		Total	
Cortex cover	**Number**	**%**	**Number**	**%**	**Number**	**%**
>%50	0	0.0	1	0.8	1	0.5
<%50	6	8.6	16	12.5	22	11.1
0	64	91.4	111	86.7	175	88.4
Total	*70*	*100.0*	*128*	*100.0*	*198*	*100.0*

exhausted cores in addition to serving as hammerstones, could have been used as some sort of polishing stone. Notched tools, perforators (including awls and drills), and scrapers make up 17.5% of the tool assemblage, while non-formal retouched flakes, and blades which together make up 16.5% of the assemblage.

Of the flakes in the assemblage, 13% have at least some cortex present, however there are very few pieces with greater than 50% of the dorsal surface bearing cortex (<1%) (Table 4). There are also relatively subtle differences in cortical cover between brown-tan chert pieces, which are often argued to be localized to the Colha area. 8.6% of the brown chert have some cortex present, as opposed to 13.3% in the rest of the assemblage (Table 5). This may indicate that more of this brown chert material was brought to the site in a relatively late stage of reduction compared to the rest of the material in the assemblage, however, the assemblage is too small to make a conclusion one way or another.

Overall, the number of cortical pieces across all raw material categories are below that observed among Lacandon Maya lithic workshops, but within ranges identified across the Southern Maya Lowlands (Clark 1991, Speal 2009). Neither of these structures at Nohmul shows evidence of being a lithic workshop with intensive reduction activities, or consistent evidence for the earliest stages of core preparation, or of biface making. Instead, the data suggests that more residential reduction, and rejuvenation was occurring (sensu Horowitz 2018:173-174,181; Speal 2009:111-112).

The Structure 9, and Structure 20 assemblages differ in the kinds of artifacts present. There are more laurel leaf bifaces in the Structure 20 assemblage. These (N=9) make up 15.5% of the tools in Structure 20, while there is only one case in the Structure 9 material. While a greater proportion of the Structure 20 debitage is made up of flakes, both structures show similar proportions of biface thinning flakes. Structure 9 includes more cores, including the larger formal single platform pyramidal cores, with some evidence for blade reduction. Additionally, Structure 9 has a greater proportion of core trimming elements, compared to the Structure 20 material.

The ancient Maya in Structure 20 produced flint knapping debitage and moved some of it to the temporary refuse pile behind the structure. In both cases, we also have few finished, complete tools and evidence of other kinds of tools no longer located at either structure agreeing with this interpretation of temporary trash deposits. Instead, the dataset primarily consists of some broken tools and other flakes with no clear refits. While some of the chert tools and nodules might have been procured elsewhere, there is clearly some local reduction and rejuvenation being carried out at the household level.

Data from Nohmul, but not our sample, indicate clear consumption of "honey-brown" chert including oval bifaces in the Early Classic (Hammond, et al. 1985:180; Hammond, et al. 1988:3-4), but our lithic sample from Nohmul's Terminal Classic Period, supposedly falls during Colha's hiatus in production. The laurel leaf points associated with Structure 20, share the same laurel leaf form that dominates Colha's Early Postclassic production (Shafer and Hester 1983:531), suggesting that they may have been produced there during the Terminal Classic. In addition, two chert artifacts in this dataset match the general description of NBCBZ-like: a chert nodule exhibiting heavy battering and grinding use-wear as a mano as well as a very thin laurel leaf (Figure 7d,e). Nohmul is close enough to Colha and Pulltrowser Swamp (Hammond, et al. 1985:178) that the site would have easily been able to exchange and participate in lithic trade with Colha.

Most of our assemblage does not appear to be NBCBZ-like chert, but instead examples of local reduction and rejuvenation from unknown, likely local, sources. However, in no sense does either structure mimic the appearance of a chert workshop, focusing instead on residential and potentially ritual functions respectively (DZ Chase 1982; DZ Chase and Chase 1982). Thus, the data supports an economic system with not only producer-consumer workshops but also one with more localized production and retouching, especially during the possible decline in workshops at Colha. Additional analysis from Nohmul, and other sites and northern Belize when combined with this dataset, have the potential to shed more light on the larger-scale processes of the chert economy.

Discussion on Data Sharing and Future Use

Ideally the data obtained here, when combined with other datasets, will help to shed more light on the larger implications of production, consumption, and reduction of the Late Classic Maya. However, making datasets available can be difficult. While we will clearly share the digital dataset to interested parties, we want to facilitate future accessibility and long-term storage for other scholars (see Kintigh, et al. 2015). As such, the dataset for this project is accessible on tDAR, the Digital Archaeological Record, through this reference (see Chase and Paige 2019).

While physical artifact storage provides its own bespoke problems, digital storage creates new management issues. Archaeologists uploading their data files to tDAR is a common process among our colleagues in the US Southwest, but less common among Mayanists. This online platform provides long term file storage for archaeological datasets and guarantees free access to this data by charging only for initial data curation. Currently, two datasets are available from Belize (Fulton 2015; Horowitz 2015), and several datasets are available from Tikal including data from the University of Pennsylvania reports (Moholy-Nagy and Coe 2008a,b,c) and the original survey maps (for example Carr 2013). In addition to making the data accessible, tDAR provides a standard reference format for citing datasets, including the citations in the text above (see overview McManamon, et al. 2017:242). This online solution is well suited for Excel files and photographs; however, it is currently less well suited for larger data files – and currently unsupported – formats like LiDAR's LAS files.

While this file type is not currently supported by tDAR, uploading the raw LAS files from Caracol at current rates would cost more than another LiDAR aerial flight, over half the cost of the raw LiDAR data collection (see Table 6). For datasets of over 1 GB on tDAR, they now offer a special price of $500 per GB; however the initial cost is $10 per 10mb of data or per file or $5 per "file" for 100 or more files – treating both as "files" by definition (https://core.tdar.org/contribute and McManamon, et al. 2017:242). Both point cloud data sets are very large; the 2009 Caracol LiDAR is about 129 GB of raw point cloud data and the 2013 Belize LiDAR is about 767 GB of raw point cloud data (AF Chase, et al. 2014; AF Chase, et al. 2011). While on disk file sizes do not fit a strict one-to-one relationship with the prefixes – i.e. one gigabyte converts to 1024 megabytes of space within a computer's internal storage, while tDAR uses the SI convention of 1000 mb to one GB – after applying the $500 per GB, yields an estimated total cost for storing

Table 6. The costs of storing the 2009 and 2013 raw LiDAR point cloud data on tDAR would be around $450,000 USD. While it is more expensive for smaller files, tDAR has added a bulk file storage option for $500 per GB of data (see https://core.tdar.org/contribute and McManamon, et al. 2017:242 for more information).

LiDAR Project	Gigabytes	LiDAR Cost	Estimated tDAR Cost
2009 Caracol LiDAR	~129	$ 411,981.00	$ 64,500.00
2013 Western Belize LiDAR	~767	$ 360,265.00	$ 383,500.00
	Totals	*$ 772,246.00*	*$ 450,000.00*

both raw LiDAR datasets at $450,000. This price is far higher than the initial cost to fly either set of LiDAR data at $411,981 (2009 Caracol) and $360,265 (2013 Western Belize) respectively. Additionally, before the $500 per GB option existed, it would have cost four and a half million dollars to store these files. In any case, the high costs of storage lead directly into the primary difficulty in preserving digital data over time for any archaeological project.

Counterintuitively, physical paper copies which can be digitized and re-digitized as necessary are still an important part of the archaeological record. Digital files are prone to their own errors and issues. Magnetic storage mediums, like hard drives, degrade over time. Bits of data – the magnetic zeros and ones that code all computational information – can be flipped or rot over time corrupting entire files, file formats themselves can be updated and changed along with processing formats and programs of operating systems, and the average expected use-life of a computer and its constituent components is assumed to be about five years (see also McManamon, et al. 2017:239-240). Theoretically, tDAR protects against these issues and guarantees data accessibility in perpetuity by routinely checking and correcting datasets for bit rot errors and updating datasets to modern file formats as necessary through constant digital vigilance, and resulting in the high storage costs.

The difficulties of long-term digital data storage have created a market for magnetic tapes, essentially just giant cassette tapes, to store files securely for at least thirty years if properly managed (Woito, et al. 2019:35). This is another case of "zombie technology", like the resurgence of the Fortran computer language to handle high performance computing (see Jin, et al. 2011). At this time a single, current state of the art magnetic tape can store 330 terabytes of information (see Furrer, et al. 2018).

Long term storage of artifacts, data, and excavation records is an archaeological imperative; however, the issues of this long-term storage are not often discussed outside of library and museum contexts (but see Bauer-Clapp and Kirakosian 2017; Richards 2017). While paper records can last centuries, paper copies stored in a single location can also be lost due to fire or flood. Digital files are easier to share and copy, but much more prone to errors and data loss. The truth is that preserving datasets is a Sisyphean battle against the taphonomy of both digital and physical storage media, and this is an issue that is rarely discussed in archaeology.

Conclusion

The Nohmul assemblage bears evidence of local chert reduction with early stage reduction, flake and blade production, and rejuvenation of thinned bifaces similar to that found among other sites in the region. The project reported here took a sample of 381 chert artifacts from two excavated structures in Nohmul, Belize and identified slight differences between the artifacts present at Structures 20 and 9. Structure 20 differs mainly in the presence of more laurel leaf bifaces and more flakes. Structure 9 shows more evidence for reduction of cores and substantially more of the battered, repurposed core-tools.

In addition, the data created from this research has also been curated on tDAR, making the information publically and freely available. As such, this should aid in future research, especially as the results can be combined with other datasets. Hopefully, the increased accessibility of this data from these two excavations that occurred over 40 years ago will help shed more light on the chert economy of northern Belize.

In terms of the broader picture of lithic production in northern Belize, the Nohmul sample mirrors previously reported Colha patterns, but suggests that there was more continuity in production than had been recognized previously. While this Nohmul assemblage exhibits clear signs of local reduction, some of the chert was clearly imported from the NBCBZ region. Importantly, the Nohmul contextual data suggests that Colha-style laurel leaf points were being produced in the Terminal Classic Period, on an earlier timeframe than was previously identified by researchers at Colha. Both sites showcase increased Yucatec influence (pottery at Colha; pottery and architecture at Nohmul) during similar time periods and must have been responding to similar stresses and stimuli. The sites also exhibit a similar shift over time from oval bifaces to laurel leaf points. Yet, rather than being Postclassic in date, the Nohmul data place the laurel leaf form in the Terminal Classic era - and Caracol data suggest an even earlier dating for the production of this form at Colha. In summary, as new archaeological data from additional sites is acquired through future investigations, our understanding of the chert economy that was operational in northern Belize during the Terminal Classic Period will become better amplified.

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References

Anderson, A.H.
1954 Ancient Maya Antiquities and Archaeology, edited by Belize Department of Archaeology, A.C. File 61.

Anderson, A.H. and H.J. Cook
1944 *Archaeological Finds near Douglas, British Honduras*. Notes on Middle American Archaeology and Ethnology Publication 40. Carnegie Institution of Washington Division of Historical Research, Washington D.C.

Bauer-Clapp, Heidi and Katie Kirakosian
2017 Archaeologists and Archives: Revisiting an Old Challenge. *Advances in Archaeological Practice* 5(3):220-226.

Buttles, Palma
2004 The Importance of Colha in Belize Archaeology. *Research Reports in Belizean Archaeology* 1:281-294.

Cackler, Paul R., Michael D. Glascock, Hector Neff, Harry Iceland, K. Anne Pyburn, Dale Hudler, Thomas R. Hester and Beverly Mitchum Chiarulli
1999 Chipped Stone Artefacts, Source Areas, and Provenance Studies of the Northern Belize Chert-bearing Zone. *Journal of Archaeological Science* 26:389-397.

Carr, Christopher
2013 Tikal Report 11: Georeferenced Map- "Ruins of Tikal" (with border) (tDAR id: 391365); doi:10.6067/XCV8XK8GDP

Chase, Adrian S.Z. and Jonathan Paige
2019 Structure 20 and 9 chert data from Corozal Postclassic Project 1978 and 1979 excavations of Nohmul, Belize (tDAR id: 455196); doi:10.6067/XCV8455196

Chase, Arlen F. and Diane Z. Chase
1987 *Investigations at the Classic Maya City of Caracol, Belize, 1985-1987* 3. Pre-Columbian Art Research Institute, San Francisco, USA.

2013 Interpreting Form and Context: Ceramic Subcomplexes at Caracol, Nohmul, and Santa Rita Corozal, Belize. In *Ancient Maya Pottery: Classification, Analysis, and Interpretation*, edited by James J. Aimers, pp. 46-73. University Press of Florida, Gainesville.

Chase, Arlen F., Diane Z. Chase, Jaime J. Awe, John F. Weishampel, Gyles Iannone, Holley Moyes, Jason Yaeger, M. Kathryn Brown, Ramesh L. Shrestha and William E. Carter
2014 Ancient Maya Regional Settlement and Inter-Site Analysis: The 2013 West-Central Belize LiDAR Survey. *Remote Sensing* 6(9):8671-8695.

Chase, Arlen F., Diane Z. Chase, John F. Weishampel, Jason B. Drake, Ramesh L. Shrestha, K. Clint Slatton, Jaime J. Awe and William E. Carter
2011 Airborne LiDAR, archaeology, and the ancient Maya landscape at Caracol, Belize. *Journal of Archaeological Science* 38(2):387-398.

Chase, Diane Z.
1982 Spatial and Temporal Variability in Postclassic Northern Belize. PhD Dissertation, Department of Anthropology, University of Pennsylvania, Ann Arbor.

Chase, Diane Z. and Arlen F. Chase
1982 Yucatec Influence in Terminal Classic Northern Belize. *American Antiquity* 47(3):596-614.

Clark, John E.
1991 Modern Lacandon lithic technology and blade workshops. *In* Maya Stone Tools: Selected Papers from the Second Maya Lithic Conference, Prehistory Press, Monographs in World Archaeology No. 1, pp. 251-266.

Dockall, John E. and Harry J. Shafer
1993 Testing the Producer-Consumer Model for Santa Rita Corozal, Belize. *Latin American Antiquity* 4(2):158-179.

Eaton, J.D.
1982 Colha: An overview of architecture and settlement. In *Archaeology at Colha, Belize: the 1981 Interim Report*, edited by Thomas R. Hester, Harry J. Shafer and J.D. Eaton, pp. 11-20. Center for Archaeological Research The University of Texas at San Antonio, and Centro Studi Ricerche Ligabue, Venezia, San Antonio, TX.

Fulton, Kara A.
2015 Raw Artifact & Chemical Data - Community Identity and Social Practice during the Terminal Classic Period at Actuncan, Belize (tDAR id: 398973).

Furrer, S., M. A. Lantz, P. Reininger, A. Pantazi, H. E. Rothuizen, R. D. Cideciyan, G. Cherubini, W. Haeberle, E. Eleftheriou, J. Tachibana, N. Sekiguchi, T. Aizawa, T. Endo, T. Ozaki, T. Sai, R. Hiratsuka, S. Mitamura and A. Yamaguchi
2018 201 Gb/in2 Recording Areal Density on Sputtered Magnetic Tape. *IEEE Transactions on Magnetics* 54(2):1-8.

Gann, Thomas
1911 Explorations Carried on in British Honduras in 1908-9. *Liverpool Annals of Archaeology and Anthropology* 4:72-87.

Gann, Thomas and Mary Gann
1939 Archaeological Investigations in the Corozal District of British Honduras. *Bureau of American Ethnology Bulletin No.* 123:1-57.

Hammond, Norman (editor)
1973 *British Museum - Cambridge Unviersity Corozal Project 1973 Interim Report*. Centre of Latin American Studies, Cambridge University, Cambridge, UK.

1974 The distribution of Late Classic Maya major ceremonial centres in the central area. In *Mesoamerican Archaeology: New Approaches*, edited by Norman Hammond, pp. 313-334. University of Texas Press, Austin, TX.

1975 *Archaeology in Northern Belize, British Museum-Cambridge University Corozal Project 1974-1975*. Centre of Latin American Studies, Cambridge University, Cambridge, UK.

1977 Ex Oriente Lux: a view from Belize. In *The Origins of Maya Civilization*, edited by Richard E.W. Adams, pp. 45-47. School of American Research, University of New Mexico Press, Albuquerque, NM.

1983 Nohmul, Belize: 1982 Investigations. *Journal of Field Archaeology* 10(3):245-254.

Hammond, Norman, Catherine Clark, Mark Horton, Mark Hodges, Logan McNatt, Laura J. Kosakowsky and K. Anne Pyburn
1985 Excavation and Survey at Nohmul, Belize, 1983. *Journal of Field Archaeology* 12(2):177-200.

Hammond, Norman, Sara Donaghey, Colleen Gleason, J.C. Staneko, Dirk Van Tuerenhout and Laura J. Kosakowsky
1987 Excavations at Nohmul, Belize, 1985. *Journal of Field Archaeology* 14(3):257-281.

Hammond, Norman, K. Anne Pyburn, John Rose, J.C. Staneko and Deborah Muyskens
1988 Excavation and Survey at Nohmul, Belize, 1986. *Journal of Field Archaeology* 15(1):1-15.

Healen, Dan M.
1992 A Comment on Moholy-Nagy's "The Misidentification of Lithic Workshops". *Latin American Antiquity* 3(3):240-242.

Hester, Thomas R. and Harry J. Shafer
1984 Exploitation of chert resources by the ancient Maya of northern Belize, Central America. *World Archaeology* 16(2):157-173.

1992 Lithic Workshops Revisited: Comments on Moholy-Nagy. *Latin American Antiquity* 3(3):243-248.

Horowitz, Rachel A.
2015 Callar Creek Quarry, Belize Lithic Dataset (tDAR id: 399180); doi:10.6067/XCV8222W3F

2018 Technological Choice and Raw Material Availability: Lithic Production Implements in Western Belize. *Lithic Technology* 43(3):172-185.

Hurst, Barbara J and Barbara Lawn
1984 University of Pennsylvania Radiocarbon Dates XXII. *Radiocarbon* 26(2):212-240.

Jin, G., J. Mellor-Crummey, L. Adhianto, III W. N. Scherer and C. Yang
2011 Implementation and Performance Evaluation of the HPC Challenge Benchmarks in Coarray Fortran 2.0. *Proceedings of the 2011 IEEE International Parallel & Distributed Processing Symposium*:1089-1100.

Kintigh, Keith W., Jeffrey H. Altschul, Ann P. Kinzig, W. Fredrick Limp, William K. Michener, Jeremy A. Sabloff, Edward J. Hackett, Timothy A. Kohler, Bertram Ludäscher and Clifford A. Lynch
2015 Cultural Dynamics, Deep Time, and Data. *Advances in Archaeological Practice* 3(1):1-15.

Masson, Marilyn A.
2001 The Economic Organization of Late and Terminal Classic Period Maya Stone Tool Craft Specialist Workshops at Colha, Belize. *Lithic Technology* 26(1):29-49.

McAnany, Patricia A.
1989 Stone-Tool Production and Exchange in the Eastern Maya Lowlands: The Consumer Perspective from Pulltrouser Swamp, Belize. *American Antiquity* 54(2):332-346.

McManamon, Francis P., Keith W. Kintigh, Leigh Anne Ellison and Adam Brin
2017 tDAR: A Cultural Heritage Archive for Twenty-First-Century Public Outreach, Research, and Resource Management. *Advances in Archaeological Practice* 5(3):238-249.

Moholy-Nagy, Hattula
1990 The Misidentification of Mesoamerican Lithic Workshops. *Latin American Antiquity* 1(3):268-279.

Moholy-Nagy, Hattula and William R. Coe
2008a Appendix 3 (tDAR id: 377508); doi:10.6067/XCV818364V

2008b Appendix 4 (tDAR id: 377509); doi:10.6067/XCV8BR8RTC

2008c Appendix 5 (tDAR id: 377507); doi:10.6067/XCV84749H5

Richards, Julian D.
2017 Twenty Years Preserving Data: A View from the United Kingdom. *Advances in Archaeological Practice* 5(3):227-237.

Shafer, Harry J.
1981 Maya Lithic Craft Specialization in Northern Belize. Paper presented at the 80th Annual Meetings of the American Anthropological Association, Los Angeles, CA.

Shafer, Harry J. and Thomas R. Hester
1983 Ancient Maya Chert Workshops in Northern Belize, Central America. *American Antiquity* 48(3):519-543.

1991 Lithic craft specialization and product distribution at the Maya site of Colha, Belize. *World Archaeology* 23(1):79-97.

Speal, Scott C.
2009 The Economic Geography of Chert Lithic Production in the Southern Maya Lowlands: A Comparative Examination of Early-Stage Reduction Debris. *Latin American Antiquity* 20(1):91-119.

Vasquez, Jules
2013 No More Noh Mul? Contractor Bulldozes Mayan Temple. *7news*. Belize City, Belize.

Woito, Dave, Carlos Sandoval, Julio Hernandez, Sandra Peláez, Mark Hill, Turguy Goker, Molly Presley, Ryan Duffy, Richard Bickers, Carl Hoerger, Laura Loredo, Tom Wultich, Robert Raymond, Christine Rogers, Jon Benson, David Feller and Susan Merriman
2019 *2019 APPLICATIONS & SYSTEMS TAPE ROADMAP*. Information Storage Industry Consortium.