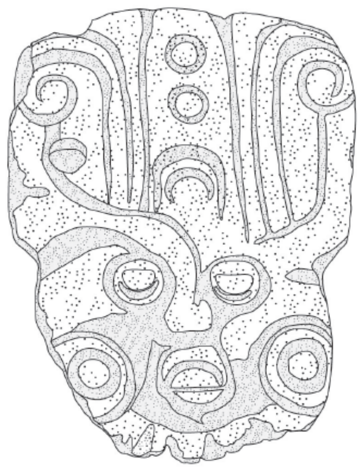
Investigations of the Belize River East Archaeology Project:

A Report of the 2024 Field Season



Marieka Brouwer Burg and Eleanor Harrison-Buck, Editors

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Preface and Acknowledgements

Marieka Brouwer Burg and Eleanor Harrison-Buck

Initiated in 2011, the Belize River East Archaeology (BREA) project kicked off its fourteenth year of archaeological research in the lower reaches of the Belize River Watershed in 2024. Our work continues to uncover evidence of the deep history—upwards of 8000 years—in the BREA study area. With a surface area of nearly 2000 km^2, the project has documented abundant data to confirm that people occupied this watershed from as long ago as the Paleoindian period (earlier than 8000 BCE) up through the Archaic, Maya, Contact, Colonial, Historic, and present times. Since 2016, we have focused our research in and around the Crooked Tree Wildlife Sanctuary, a location with plentiful resources, access to the ocean and uplands, as well as a rich social web. As we have shown with our research, the lower Belize Watershed was and continues to be an abundant area teeming with biodiversity and cultural life.

This report details research carried out by the BREA team over the course of two 2024 seasons conducted in January and May-July. We are fortunate to have amassed an amazing team of interdisciplinary scholars on the BREA team, including Drs. Adam Kaeding, Samantha Krause, Astrid Runggaldier, Tawny Tibbits, and associates Mark Willis and Mr. Jack Biggs. We were again joined by wonderful staff who kept field and laboratory research going, including Katie Shelhamer, Fiona Haverland, Cormac Day, and Marie White. We welcomed graduate students Katilin Murphy, Bridgette Degnan, and Alexandra Bazarsky to the project to assist in excavation, laboratory upkeep, and artifact analysis.

Field and laboratory work was carried out from our home base at Tillett's Village Lodge on Crooked Tree Island. As always, we could not have accomplished our research goals without the help and support of the Tillett family, most especially Ms. Judy Tillett, Mr. Walter Perriott, Ms. Delma Tillet, Ms. Delia Tillett, and Mr. Bruce Tillett. These folks make our stays comfortable and enjoyable and they are a big part of the reason we keep returning! Our deep gratitude goes out to the entire Tillett family for always welcoming us into the fold and helping us feel connected to the Crooked Tree community. We look forward to seeing our kids grow and play together, attending family parties, and, of course, participating in or watching pick-up basketball games.

We are grateful for the support and input from many local Belizeans collaborators. Helping in the field, we thank Cardinal Baptist, Rubin Crawford, Melvin Quilter, Boland Tillett, Bruce Tillett, Simon Tillett, and Emmanuel Williams. In the lab, Ms. Icilme Crawford deftly led artifact washing. We thank Mr. Juan Lopez and Ms. Brenda Lopez for granting us permission to excavate on their land adjacent to Altun Ha, and for providing much information and hours of friendly conversation about the area, the farm, and the sawmill. We also thank Mr. Persh and Mr. Enoch Morales for allowing us to investigate at the Morales Sand Quarry and to the employees of the quarry, including Mr. Luke Cox, for their knowledge of the area and for showing us the artifacts they had found. We are indebted to the Crooked Tree Village council, especially chairman Mr. George Tillett, for their support and encouragement of our work. Not least, we are grateful to our mechanic, Mr. Karim Swasey, for saving us on the side of the highway on more than one occasion.

We also extend our gratitude to all those at Birds Eye View Lodge, including but not limited to Ms. Verna Samuels, Mr. Denvour Gillett, Mr. Lenny Gillett, Ms. Kim Samuels, Ms. Lenicia Gillett, and Ms. Lorena Martinez. Thank you for taking care of our additional family when they visit us in the field, and for maintaining a wonderful pool for occasional field work breaks.

We thank our families for their forbearance in tolerating our long stints away from home, especially our partners David Buck and Jonathan Burg who deftly juggle our home lives during our absences. And to the youngest BREA team members, Natalie Buck and Viggo Brouwer Burg, for eagerly accompanying us to the field to see what their eccentric moms are up to, but also for embracing life in Crooked Tree among the Tillett clan.

BREA research has been made possible by generous support from the Alphawood Foundation and from the National Science Foundation. We also thank our universities and academic departments for supporting us in running the archaeological program, most especially our administrative coordinators: at UNH, Anne Torres and at UVM, Trevor Link. We again thank Dr. Meghan Howey at UNH for use of her Top Con total station.

Our permit to conduct archaeological research was granted by the Belize Institute of Archaeology, as part of the National Institute for Culture and History, and we thank all those who make those enterprises run smoothly. In particular, our thanks go out to Dr. Melissa Badillo, Mr. Josue Ramos, Mrs. Joyce Tun, Mr. Paul Smith, Ms. Rumari Ku, and Ms. Akirah August.

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Chapter 1

Overview of BREA Field Investigations of the 2024 Season

Marieka Brouwer Burg and Eleanor Harrison-Buck

The Belize River East Archaeology (BREA) project spans the mid-to-lower reaches of the Belize River Watershed, an area of ~2000 km^2 (**Figure 1.1**). In the last nine years, we have focused on the lower reaches with the goal of expanding understandings of human-environment interactions over time, spanning the Archaic (c. 8000–2000/1200 BCE) through ancient Maya (c. 1200 BCE–contact) periods. Additionally, we have been attendant to how lifeways of the distant past continue to shape the present-day landscape and inform modern decision-making practices, specifically in the area around the Crooked Tree Wildlife Sanctuary (CTWS). This UNESCO Ramsar wetland (Pinelo 2000), the only such protected wetland in Belize, provides many important ecosystem services, including groundwater recharge, storm water catchment, flood mitigation, and biodiversity promotion. Surrounding the CTWS lie at least six unique microenvironments, including various types of lowland tropical forests, pine-oak savanna, shrublands, broken ridge, and mangrove swamps in addition to the freshwater and saltwater lagoons and coastal estuaries and shoreline (see Brouwer Burg and Harrison-Buck 2024). We have documented a wide range of different adaptive strategies over time in these microenvironments (**Figure 1.2**).

The 2024 research program was particularly exciting as it marked the revival of active archaeological research at the Maya center of Altun Ha after a hiatus of 50+ years. Dr. David Pendergast and team conducted 40 months of excavation in the civic-ceremonial core of the site beginning in 1964 and ending in 1970 (Pendergast 1979, 1983, 1990). Since that time, no further research has been carried out, despite Altun Ha's central role in Classic period trade, exchange, and politics in this part of northern Belize. With permission from the Institute of Archaeology, the BREA project carried out two field programs in 2024: one in January and one in May-July. Co-director Dr. Marieka Brouwer Burg and Dr. Adam Kaeding met with landowners on January 1, 2024, to secure permissions to excavate in an area of Altun Ha located on private land outside the area developed for tourism. Kaeding led the excavation of Op. 72 in January 2024 in an area we refer to as Lopez Plaza (named after the landowner) just southwest of the main site center where intensive ancient Maya marine shell production took place. In this same plaza area, BREA Project Director Dr. Eleanor Harrison-Buck led Op. 74 excavations on Str. E-66 where evidence of shell bead-making was identified. Brouwer Burg focused on the Op. 73 excavations along with additional Archaic research during the January season. This field work was assisted by Jack A. Biggs (M.A., Michigan State University), Katherine Shelhamer (B.A., University of New Hampshire), Cormac Day (B.A., University of New Hampshire), and Fiona Haverland (B.A., University of Vermont). Kaitlin Murphy (B.A., Texas Tech University) undertook daily laboratory operations, overseen by Brouwer Burg.

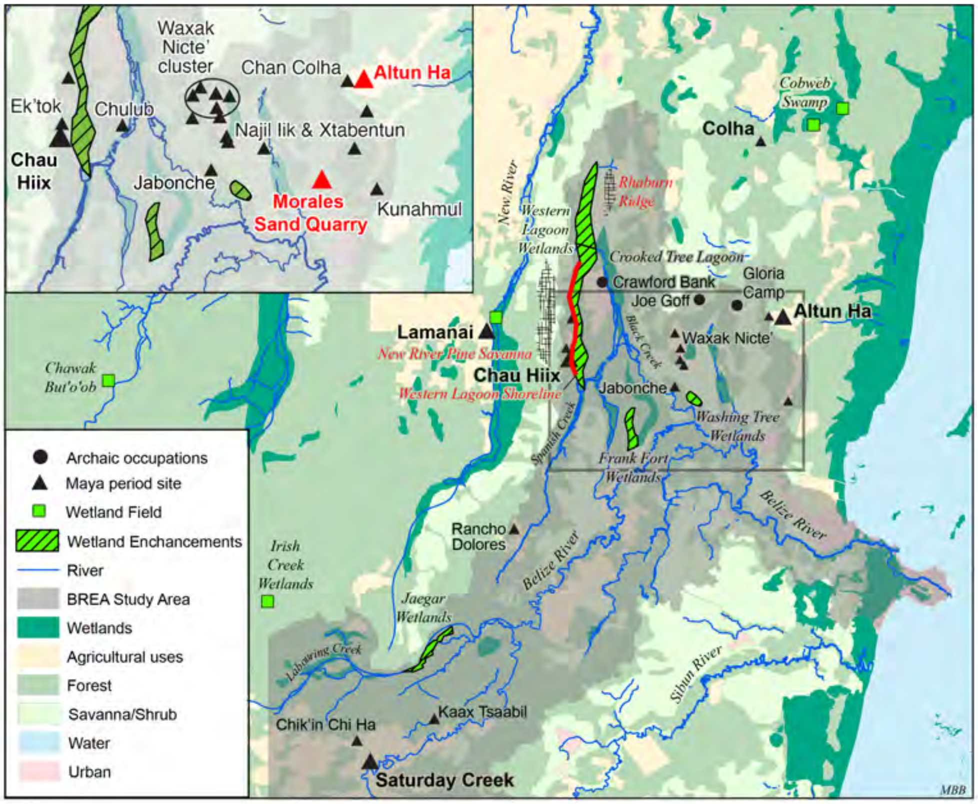

Figure 1.1 Belize River East Archaeology (BREA) project area with sites discussed in text (map by M. Brouwer Burg).

In May 2024, Dr. Samantha Krause (Texas State University) joined the team to conduct geoarchaeological research with Brouwer Burg, and was accompanied by graduate student Marie White (M.A., Texas State University). During this summer season, Harrison-Buck oversaw further excavations at Altun Ha, including Op. 75, Op. 80, and Op. 81 all located in the same area southwest of the Altun Ha site center in what Pendergast (1979) referred to as Zones C and E. Biggs led a shallow excavation of a possible monument fragment (Op. 75) while Harrison-Buck led a larger horizontal exposure of another stone marker found nearby in the center alleyway of a large ballcourt (Strs. C-1 and C-2) identified at Altun Ha (Op. 80). Bridgette Degnan (M.A., University of California Santa Barbara) joined the team to lead the investigation of Op. 81 under Harrison-Buck's guidance, which focused on a nearby range structure (Str. C-3) at Altun Ha in Plaza C, which is identified as an ancient Maya marketplace. Biggs and Murphy assisted in these excavations. Degnan and Murphy also assisted in the laboratory and were overseen by Dr. Astrid Runggaldier (University of Texas–Austin) and Brouwer Burg. During the summer session, we were also joined by Dr. Geoffrey Braswell (University of California-San Diego) for several days and his master's student Alexandra Bazarsky (B.A., Brandeis); they analyzed a large fraction of the obsidian specimens collected over the last thirteen years by the BREA project. Finally, Dr. Tawny Tibbits (University of Iowa) joined Brouwer Burg in July 2024 to conduct a granite collection trip in the Hummingbird and Cockscomb Mountains.

This report details the reconnaissance, survey, mapping, and excavation work that was carried out during these two field seasons. Additionally, we include analytical chapters in the second portion of the report, focusing on XRF-based sourcing work on granite ground stone tools and obsidian specimens.

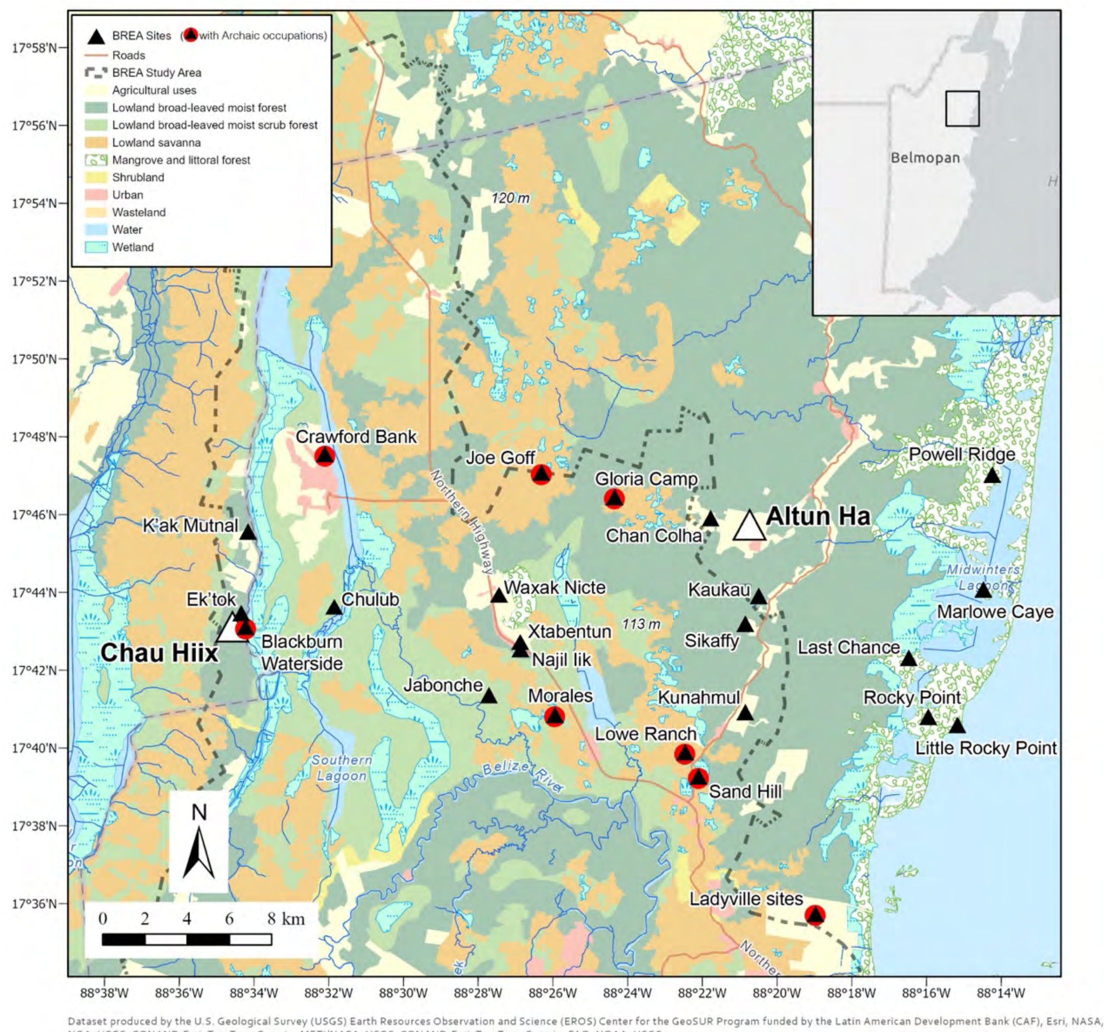

Figure 1.2 Crooked Tree Wildlife Sanctuary (CTWS) with BREA sites depicted within modern-day microenvironments (map by M. Brouwer Burg).

Background to the Research

Our previous archaeological surveys and test excavations carried out in 2022 and 2023 suggest that both Archaic and ancient Maya peoples relied heavily on so-called ‘marginal areas’—including wetlands and savannas—for procuring important resources for everyday life. For instance, in the large expanses of savanna we have found evidence that suggests raw materials for stone tools were quarried here by both Archaic and Maya peoples. The pine ridge savanna transitions to broken ridge where our preliminary surveys have exposed what we believe are Archaic habitation sites, containing fragments of stone bowls that may have been used for processing tubers. Such root crops grow in these sandy soils and are known to have been a staple food source during the Late Archaic, as well as the early Maya occupation. Where we find the largest ancient Maya sites, like Chau Hiix and Altun Ha, the terrain is a broken ridge environment mixed with broadleaved moist forest, the latter providing ideal soils for cultivating what are considered the three staples of ancient Maya diet—corn, beans, and squash. Yet, given the relatively limited pockets of broadleaved moist forest that grow in the low-lying coastal zone especially around Chau Hiix (see **Figure 1.2**), we suspect that these cultigens represent a minor role in the diet of those living in this area. Instead, we propose that most inhabitants relied more heavily on the mass harvesting of aquatic resources as their primary food source (Harrison-Buck et al. 2024). Additionally, we have documented the presence of salt production in the area (see Murata et al. 2023), indicating that all nutrients necessary to sustain human life existed in this region of northern Belize.

In our preliminary reconnaissance around the site center of Altun Ha, we were granted permission to access a part of site just to the west-southwest of the center that has been developed for tourism (**Figure 1.3**). This area of the site, referred to by Pendergast as Zones C and E is now privately owned but was included in David Pendergast's (1979) original map of the site. Here, one of the biggest discoveries made by the BREA team in Zone C was a ballcourt consisting of a pair of buildings (Structures C-1 and C-2) oriented north-south parallel with one another (**Figure 1.3**). The east (rear) side of Str. C-1 was the focus of previous investigations by Pendergast's team (Pendergast 1982:148). While he noted it was paired with Str. C-2 to the west, he did not identify this set of buildings as a ballcourt and it has long been presumed that no ballcourt existed at Altun Ha. So, this was an especially exciting discovery during the summer 2024 season for the BREA project.

In addition to the ballcourt, several sizeable range structures, and multiple elite plaza groups exist in this area of the site on private land, which is currently not developed for tourism. Using a LiDAR-equipped drone, the BREA project was permitted to fly over the site and produced a much more detailed topographic map of the Altun Ha site center and its surrounding settlement (**Figure 1.3**). The privately-owned area of the site was recently subjected to forest clearing and a number of the mounds have been damaged, including one in a modern field that revealed thousands of whole marine shell strewn upon the surface. The landowners (Mr. Juan and Ms. Brenda Lopez) indicated that they would be receptive to our excavating on their land. Therefore, with their permission and that of the Institute of Archaeology, we returned to this part of the site during the 2024 field season to perform the excavations described herein.

Altun Ha is roughly 10 km (more than 6 miles) from the Caribbean coast (**Figure 1.2**). With no pack animals, the transport of this quantity of shell would have involved substantial effort and was likely an ongoing affair, rather than a singular event. Excavation was necessary to clarify why and how so much marine shell was procured and how it was being used in the site core. The surface finds suggest that many of the shells are unworked, indicating that food may have been one of the primary reasons for its mass harvesting. However, a number of shell do display signs of cutting and perforating, indicating that secondary uses were also important. Altun Ha is located within an expanse of broadleaved moist forest, which could have translated to more arable land in the past, but many of the lagoons around this site are brackish. Given much of the surrounding land around the site today is not under cultivation, it seems questionable whether large-scale maize agriculture was a viable means of supporting the large Maya population that once inhabited this area.

2024 Field Work

This report is divided into three main sections detailing the fieldwork conducted during the January 2024 and May–July 2024 field seasons. The chapters in "Section I" discuss fieldwork involving our archaeological survey, mapping, and reconnaissance efforts. Chapters in "Section II" report on our site excavations carried out at sites in the lower Belize River Watershed. Chapters in "Section III" detail a number of the analytical studies our team has carried out in the past year. Below, we provide an overview of each of these sections and the chapter contributions included therein.

Section I: Survey, Mapping, and Reconnaissance

Reconnaissance and Survey

Reconnaissance and survey work conducted during the 2024 field seasons was geared toward exploring a) additional settlement beyond the site core of Altun Ha; and b) Archaic occupation in and around the Crooked Tree Wildlife Sanctuary. We also conducted intensive pedestrian survey and shovel tested in the northwest quadrant of the Morales site (**Figures 1.1** and **1.2**). Here, an Archaic Lowe point fragment was identified by the co-directors in January 2024 (see **Brouwer Burg and Harrison-Buck, Chapter 2**) and other Archaic-like tools have been unearthed through industrial quarrying excavation. In May 2024, Krause led a coring campaign in Tinas Lagoon, located west of this site in order to gather paleoecological data (see **Krause et al., Chapter 3**). Samples of sand were also collected from some of the previously dug pits at the site with the aim of future analysis using optically stimulated luminescence (OSL) dating.

Mapping

Multiple drone-mounted LiDAR flights were conducted over the site of Altun Ha and the satellite lithic production site of Chan Colha in January 2024 (see **Willis and Murata, Chapter 4**). The purpose of these flights was to collect settlement data on a wider area around the Altun Ha site than was originally surveyed by Pendergast and his team in the 1960s and 70s. Additionally, drone-mounted LiDAR technology has improved exponentially with every passing year, so the results of the 2022 fly over surveys were reflown for improved survey results during the 2024 field season.

The results of these LiDAR surveys revealed that the structures, plazas, and neighborhoods (or zones) of Altun Ha are connected by a series of raised pathways. We believe the features are similar to *callejuelas,* defined as streets measuring 3–4 m wide by Dahlin and Ardren (2002:257). At Chunchucmil, *callejuelas* "wind around residential units or clusters of residential units in the site center, but few of them radiate out for long distances to the site's hinterlands", suggesting that some of them were intended "to organize traffic between the heart of the city and destinations beyond the urban core" (Dahlin and Ardren 2002: 257). The location of the raised pathways at Altun Ha display a similar web-like shape and their distribution appears to connect areas 1-2 km from the site to the site core (see **Figure 1.3**). The *callejuelas* differ from *sacbeob*, which manifest as more formalized long and linear raised roadways. The LiDAR data also reveal many low spots within the landscape, which today are seasonally wet. It seems plausible that the *callejuelas* also functioned to raise pedestrian traffic above these depressed wet areas.

Geoarchaeological Survey

To further pursue our investigations of the hydrology of the Crooked Tree Wildlife Sanctuary and surrounds, we conducted three weeks of geoarchaeological investigations, led by project geoarchaeologist Dr. Samantha Krause. The goals of these investigations were two-fold. The first was to conduct further coring, shovel tests, and excavations in the linear channels of Western Lagoon. As we have reported on in Harrison-Buck et al. (2024), the initial construction of these channels date far earlier than expected, to the Late Archaic period (see also details of initial excavations in Krause et al. 2020). The second goal was to gather broader scale data on the hydrology of the CTWS. To accomplish this goal, we returned to areas in the Western Lagoon where Anne Pyburn (2003) had noted what she thought were ancient Maya wetland modifications. These areas included a large berm that borders the southern end of Western Lagoon as well as an area identified by Pyburn (2003) as a dam structure at the confluence of Blackburn and Spanish Creek, at the far southern tip of Crooked Tree Island. We found evidence in the latter indicating that an artificial berm was constructed here during Maya times although concrete evidence of a dam is still lacking (see **Krause et al., Chapter 3** for further details).

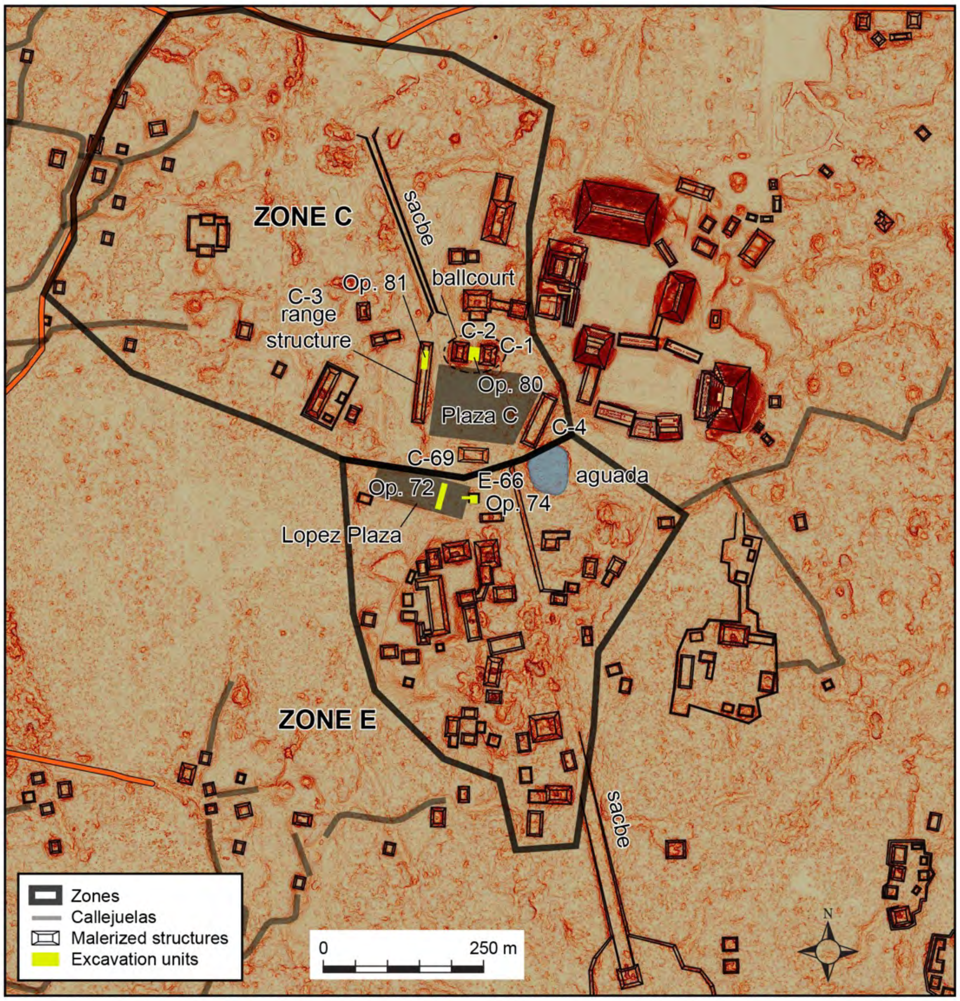

Figure 1.3 Areas of Altun Ha focused upon by the BREA team in 2024 (LiDAR image by M. Willis; digitization by S. Murata and L. Edmonston; compilation by M. Brouwer Burg).

Section II: Site Investigations

Test excavations were carried out at four main site locations during the 2024 field seasons, including: 1) the greater Altun Ha area, 2) the Morales site, 3) Western Lagoon, and 4) at a Lowe point find spot near Blackburn Creek in the New River Pine Savanna. The findings from these excavations are presented in the chapters in this report and are summarized below.

Greater Altun Ha Area

A shovel test campaign was carried out in the Lopez Plaza at Altun Ha to determine the extent of a marine shell scatter, the results of which were sufficient to warrant in depth investigation through excavation (see **Kaeding et al., Chapter 5**). Based on these results combined with a pedestrian survey and visual assessment of the extent of this large marine shell scatter, we opened two excavation units in January 2024, Operation 72 (see **Kaeding et al., Chapter 5**) and Operation 74 (see **Harrison-Buck et al., Chapter 7**). The former focused on delimiting the horizontal distribution of the shell scatter but was also geared toward elucidating the depth and chronology of the deposit and any evidence of earlier occupation in this area. The land in question is owned by Ms. Brenda Lopez, co-owner of the Lopez Sawmill and Farm with her husband Mr. Juan Lopez. The majority of the land lying to the west and southwest of the Altun Ha archaeological park is owned by this family. According to the landowners, the area in question was plowed in early 2022 for agricultural development, at which time the marine shells became apparent and were noted by BREA team member Satoru Murata. Since then, the land had not been re-plowed although four rows of fruit trees were subsequently planted in the tilled plot and surficial irrigation pipes were laid.

Operation (Op.) 72 was laid out as a 1-x-30 m grid-oriented N-S bisecting the Lopez Plaza. 72 was laid out as a 1-x-30 m grid-oriented N-S bisecting the Lopez Plaza. Of the 15 squares, B, E, F, K, and O were opened during the 2024 field seasons to provide visibility into different components of the plaza. Squares B, E, F and O revealed that the marine shell layer was associated with the final occupational phase of the Lopez Plaza likely dating to the Terminal Classic period. In Squares B, E, and F, excavations below the shell scatter revealed evidence of several earlier occupational phases that likely date no later than the Early Classic. In Square F, fragments of a stucco mask and other associated plaster with traces of red paint were found associated with one of the earlier construction phases along with the presence of flanged vessels suggesting an Early Classic date. In Square F, fragments of a stucco mask and other associated plaster with traces of red paint were found associated with one of the earlier construction phases along with the presence of flanged vessels suggesting an Early Classic date. Square K, located just off the plaza, yielded little in the way of useful data, Square O exposed facing stones of a low platform associated with an earthen surface, which represents the final phase of the Lopez Plaza. This square was intended to help clarify the context of the thick marine shell deposit, which was found to be sitting directly on top of low platform and informally prepared packed earthen floor of the Lopez Plaza.

During some of the first few days of visiting the site in January 2024, landowner Juan Lopez took Brouwer Burg several kilometers west of the Altun Ha site center to his family ranch, where he showed her a number of lithic scatters visible on the ground surface. At one such scatter, a number of “orange peel” flakes were identified and the production area, referred to as Chan Colha, was presumed to be a tranchet bit adze production locale (see **Brouwer Burg et al., Chapter 6**). Excavations at the famous chert production center of Colha, which lies roughly 20 km due north of here, recovered many of these tool types (Gibson 1991; Shafer 1983), which are diagnostic of the Middle to Late Preclassic, although were sometimes produced into the Late Classic. During the January season, the BREA team opened a 1-x-8 m trench (Op. 73) crosscutting this production mound in order to investigate similarities between this mound and those excavated by the Colha project. The goals were a) to investigate the relationship between these two production locations and whether they producing materials at the same volume and according to the same morphological templates; and b) to determine if any connection could be observed between Late Preclassic production and possibly earlier, Late Archaic lithic production as was found at Colha. The latter goal was based on an observation of Gibson's (1991), in which a number of constricted adzes were found below Preclassic Maya production contexts at Colha. Op. 73 excavations yielded a tremendous number of lithic tools and production debris, such that we had to subsample artifacts to collect and take back to our field lab. Ultimately, no evidence of earlier constricted adzes was recovered although the assemblage will be useful in helping us to study the relationship between Late Archaic hard-hammer percussion techniques and Middle-Late Preclassic techniques (for further discussion see **Brouwer Burg et al., Chapter 6**).

Op. 74 was opened on a small masonry structure due east of Op. 72 in the Lopez Plaza. This structure, which was not mapped in Pendergast's original surveys, was designated Structure E-66 (using the next available structure number in Pendergast's established sequence for Zone E). While not more than 2 m in height, the structure's proximity to the marine shell deposit in the Lopez Plaza was aimed at testing for the presence of shell craft production presumed to occur on or adjacent to the nearest mounded architecture in this plaza area (see **Figure 1.3**, **Harrison-Buck et al., Chapter 7**). Initially, the BREA team opened a 1-x-6 m trench (Squares A–C) exposing western side of Structure E-66 and a portion of the associated plaza area to the west. After this process revealed evidence of a polishing stone and numerous carved and perforated shell ornaments, including beads and clothing fasteners, we opened four 2-x-2 m units on top of the structure (Squares D–G) in an effort to better understand the building and its occupants associated with the shell crafting. In the northwest corner of Structure E-66, we encountered human remains within the building wall suggestive of a corner "cache" burial (see **Biggs, Chapter 17**). This simple interment was associated with a small greenstone axe, an artifact type frequently found in other burials in Zone E dating to the Terminal Classic period (see Pendergast 1990). As we were excavating the top of Structure E-66, attempting to identify an interior floor of a room, we removed the interior fill of the building and at the bottom uncovered a very large, thick cut stone measuring roughly 25 cm thick and 1 m around. It sat directly on a poorly preserved limestone surface that showed evidence of a cut that appeared to run partially underneath the stone. Given the large size of the roughly hewn, boulder-size stone, we thought it may represent a broken and repositioned monument. A concentration of chert debitage that had been burned was identified on the top of the stone. However, time did not permit a full excavation in January. With IA's permission we partially backfilled the unit and, with the landowner's permission, we constructed a wood and barbed wire fence around the unit so that a) the cattle would not tamper with it and b) we could return and complete the excavation in the summer. During the summer 2024 season, we reopened the excavation and were able to remove the stone and expose the plaster floor beneath it. However, other than a shallow but empty pit feature, nothing was recovered beneath the stone and excavations ceased at this stage.

In our summer 2024 season, when BREA returned to Altun Ha, the team continue investigations on the southwestern portion of the site not currently within the archaeological park boundaries. We focused on a few key areas that piqued our interest during the January season. We reopened Op. 74 and also investigated another possible monument (Operation 75) at the end of a sacbe running roughly N-S from Rock Stone Pond in Zone F of the site toward Zone C (see **Figure 1.3**). Until this research, only one carved monument had been documented at Altun Ha, which Pendergast referred to as the "Turtle Monument" (Pendergast 1990), which was found in Zone F at the southern terminus of the sacbe. A site as large and significant as Altun Ha is generally expected to have more than one carved monument. In email communication with Pendergast, BREA co-directors learned that he recalled seeing a possible monument in the vicinity of Zone E and instructed us approximately where to look. The results of this work are reported in **Biggs, Chapter 8**.

We opened two additional operations at Altun Ha in Summer 2024. The first (Op. 80) focused on the ballcourt that lies just southwest of the archaeological park in Zone C, described above (see **Figure 1.3**). We opened a 3.75-x-7 m unit in the playing alley between the western and eastern ballcourt buildings (C-2 and C-1, respectively). In addition to finding the ballcourt marker in the approximate middle of the architectural arrangement, the excavation also yielded important information about construction and refurbishment of the ballcourt along with a final desecration event that resulted in the smashing of the sizeable stone marker and defacement of the ballcourt structure facing stones on the lowest sloping terrace walls (for further discussion see **Harrison-Buck et al., Chapter 10**).

The second area of investigation during the Summer 2024 was a long, range structure (C-3) that bounds Plaza C, which has been identified by BREA as a likely marketplace at Altun Ha (see **Figure 1.3**). Excavated as Op. 81, we hoped to gain insight into the activities that took place in Plaza C by understanding the construction and configuration of Structure C-3, a long gallery-style range structure that bounds the west side of this enormous open plaza area. While we speculated initially that this structure may have housed market stalls, findings from excavation were inconclusive (for details, see **Degnan et al., Chapter 11**).

The Morales Site

The co-directors initially visited the Morales Sand Quarry in January 2024 and recovered a medial fragment of a Lowe point and were shown a number of other Archaic artifacts that had been excavated through industrial processes (see **Brouwer Burg and Harrison-Buck, Chapter 2**). Following this visit, the BREA team returned to the area in May 2024 to further investigate the northwest quadrant of the site. We conducted pedestrian and shovel test survey around the Lowe point find spot, which elucidated the stratigraphy of the area, consisting of loose forest soils underlain by lightening fine sand deposits that eventually graded into a dense clay. The sand deposits appear to be part of anchored dunes lying atop basal clay.

We collected samples for starch grain analysis from a ground stone bowl fragment in order to determine what types of seeds or plants may have been processed with this tool. As elaborated upon in **Brouwer Burg and Harrison-Buck, Chapter 2**, we also collected samples with permission from the owner of several unprovenienced but similar-looking, complete hemispherical ground stone bowls in a private collection at Crystal Auto Rental in Belize City. Testing is planned in the future to analyze the samples for starch grains, which may provide further evidence of Archaic food processing and subsistence.

Western Lagoon

Previous excavations in the Western Lagoon carried out by Krause et al. (2020) yielded paleoenvironmental samples and stratigraphic information supporting our hypothesis that the long, linear channels visible from satellite imagery were, in fact, anthropogenic. A series of 26 radiocarbon dates collected during previous work in 2019 (as summarized in Krause et al. 2020 and Krause et al. 2024) indicated that these channels were initiated during the Late Archaic period, c. 3400–1800 BCE (for a full reporting of these results see Harrison-Buck et al. 2024). Further, recently analyzed pollen data from cores collected during the 2023 field season (see Krause et al. 2024) revealed negligible traces of maize pollen (Perrotti pers. comm.), suggesting maize agriculture was not practiced in this area of wetlands. As we posit in Harrison-Buck et al. (2024), we believe these linear channels in the Western Lagoon were fish-trapping, used to corral fish into holding ponds for storage and later consumption.

To cross-examine these findings, we attempted to conduct further excavations in the linear channels but in May 2024, Western Lagoon was still too wet to permit such work. Additional planned work along the western edge of the Western Lagoon shoreline was also not possible on account of the submersion of the western causeway (noted as red line along the shoreline of the Western Lagoon in **Figure 1.1**). Instead, we focused our efforts on another area of the Western Lagoon that we had previously not been able to access—the far southern tip of Crooked Tree Island. Tracing one of the largest linear channels (where Op. 47 had been previously conducted [see Harrison-Buck et al. 2024]) that runs from Chau Hiix westward, we carried out a shovel test campaign where the channel met Crooked Tree Island on the eastern side of the lagoon (see **Krause et al., Chapter 9**). We also opened a small 1-x-1 m unit along the edge of this channel (Op. 76), although no concrete indications of channel construction were visible in this excavation like we found in Op. 47.

We also trekked on foot to the southern end of the island where Pyburn (2003) had excavated a purported dam feature, located where Blackburn Creek—which drains Western Lagoon—and Spanish Creek—which feeds into Crooked Tree Lagoon—converge. We opened Op. 77 in roughly the same location and in this 1 x 2 m test unit recorded a stratigraphic sequence roughly resembling the one outlined in previous investigations carried out by Pyburn (2003:Figure 5). We collected charcoal and soil samples for radiocarbon and geoarchaeological analysis for future analysis. The excavation revealed that basket-load construction was carried out in this location to increase the height of an artificial berm on the north side of Blackburn Creek. No evidence of a human-constructed dam was recovered (see further discussion in **Krause et al., Chapter 9**).

Lowe Point Find Spot near Blackburn Creek

While working for Mennonites from Shipyard to extend a road south into the New River Pine Savanna, local BREA collaborator and team member Melvin Quilter spotted a complete Lowe Point on the ground surface in recently bulldozed sand. He reported this find to Brouwer Burg and in July 2024, they revisited the area to investigate and carried out operation 86, a 2-x-2 m test excavation (see **Brouwer Burg and Quilter, Chapter 12**). The goal of this work was to determine if associated artifacts could be found on the surface or *in situ*. Both pedestrian and shovel test surveys were conducted, along with the 2-x-2 m excavation. However, no conclusive evidence of further Archaic occupation was encountered and the Lowe point appears to be an isolated surface find.

Section III: Analytical Investigations

We had two visiting scholars working in the BREA lab in June-July 2024: Dr. Tawny Tibbits and Ms. Alexandra Bazarsky. Tibbits (University of Iowa) and Brouwer Burg conducted a four-day driving expedition down the Hummingbird, Coastal, and Southern Highways to resample granite from the Hummingbird Ridge and Cockscomb Basin plutons (see **Tibbits and Brouwer Burg, Chapter 13**). These geologic samples were also sourced with the pXRF in the BREA field lab, resulting in a revised set of geoarchaeological signatures for the three granite plutons in Belize, an important reference for sourcing existing and future granite ground stone tools. Brouwer Burg and Tibbits also completed morphological and distributional analysis of all ground stone artifacts collected by the BREA team to date (see **Brouwer Burg and Tibbits, Chapter 16**).

Bazarsky, a graduate student at the University of California-San Diego, analyzed the BREA obsidian collection with the goal of understanding technological and typological characteristics. Guided by Brouwer Burg and Tibbits, she also collected pXRF readings on most of this collection. The results of this joint work are reported in **Brouwer Burg et al., Chapter 14**.

In the lab during summer 2024, Jack Biggs (M.A. Michigan State) spent time analyzing the human remains from Altun Ha Structure E-66 burial, which are reported in **Biggs, Chapter 17**. Additional lithic analysis was carried out by Dr. W. James Stemp in his lab at Keene State University on the assemblage from Crawford Bank, and those results are reported in **Stemp, Chapter 15**.

Conclusions

This report provides detailed information about the three main types of field work—mapping, excavation, and analytical investigations—conducted by the BREA team during the January and May-July field seasons of 2024. As an interdisciplinary team, we have many different specialists who also contribute to the findings reported herein. During 2024, we were joined by our LiDAR drone specialist Mr. Mark Willis, geoarchaeology specialist, Dr. Samantha Krause, and geologist, Dr. Tawny Tibbits. The expertise that these contributors offer, in addition to the wide range of research foci brought to the research by our talented BREA team members, provides the project with a rich, multiproxy set of data. With this growing body of information, we are continuing to add nuance and detail to our understandings of how humans interacted with their landscape in this area over an ~8000-year period. This 2024 report reflects the ongoing work of the BREA team as we continue to study the deep history of the Crooked Tree Wildlife Sanctuary and its neighboring environs in low-lying coastal zone of northern Belize. In the final chapter of this report, we discuss both near and long-term research plans of the BREA project.

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Chapter 2

Reconnaissance of Archaic Occupation at the Morales Site near Tinas Lagoon, Gardenia

Marieka Brouwer Burg and Eleanor Harrison-Buck

The ephemeral nature of preceramic occupations in Lowland Mesoamerica has impeded easy identification or clear patterns of land use. These occupations are often either deeply buried below many meters of sediment, on account of their age (>3000 years), or they are eroding out of the surface because of deflationary post-depositional processes, like wind action. Apart from the few rockshelters that have been found to contain preceramic deposits in Southern Belize (e.g., Mayahak Cab Pek, Saki Tzul, and Tzib Te Yux [Prufer et al. 2017]) we have little data to go on and must use other proxies to learn about subsistence and settlement behaviors.

In northern Belize, Rosenswig et al. (2015) have identified an orange-hued sediment that dates around 4.2 kya, a time during which a large-scale global drying event appears to have occurred (Booth et al. 2005; Thompson e al. 2002; Weiss 2016; Weiss and Bradley 2001). Some preceramic tools have been found in association with this sediment and may indicate a key distinguishing horizon. However, preceramic tools have also been found above and below this sediment, so further research is needed before we can definitively link the orange sediment with preceramic occupation.

Preceramic tools and debitage have been found along the eastern shoreline of Crooked Tree Island in a protected lagoonal system known as the Crooked Tree Wildlife Sanctuary (see **Figures 1.1** and **1.2** in **Brouwer Burg and Harrison-Buck, Chapter 1**; Boles 2018; Pinelo 2000; RAMSAR 2014); it appears that these artifacts are eroding out of their shallow contexts and are being transported by lagoonal infilling/draining activities to new locations along the shoreline (see Brouwer Burg 2022; 2023; Brouwer Burg et al. 2023). The lack of sealed stratigraphy, associated radiocarbon dates, or other preserved organic materials, is another example of the challenges in conducting research on this period.

To circumvent some of these challenges, we conducted a multi-criteria site suitability model to help guide our research (see Brouwer Burg and Harrison-Buck 2024 for details; all modeling was carried out in ESRI ArcGIS Pro). Input parameters included geospatial shapefiles depicting modern-day land cover, extent of ecozones (edge zones between ecosystems), location of freshwater, soil type, and elevation. We also included important resources like toolstone (Northern Belize chert in this region), as well as logwood for wooden tools, armatures, supports, and other building material. We modeled where preceramic peoples were likely to have utilized different resources during different seasons given a particular set of decision-making criteria (e.g., elevated location, close to ecotones, near water and chert), drawing upon information from ethnographic and ethnohistoric accounts from tropical and neo-tropical foragers, as well as

Traditional Ecological Knowledge (TEK) gathered from the local community of Crooked Tree Island and surrounds. **Figure 2.1** indicates the abundance of certain food resources by season.

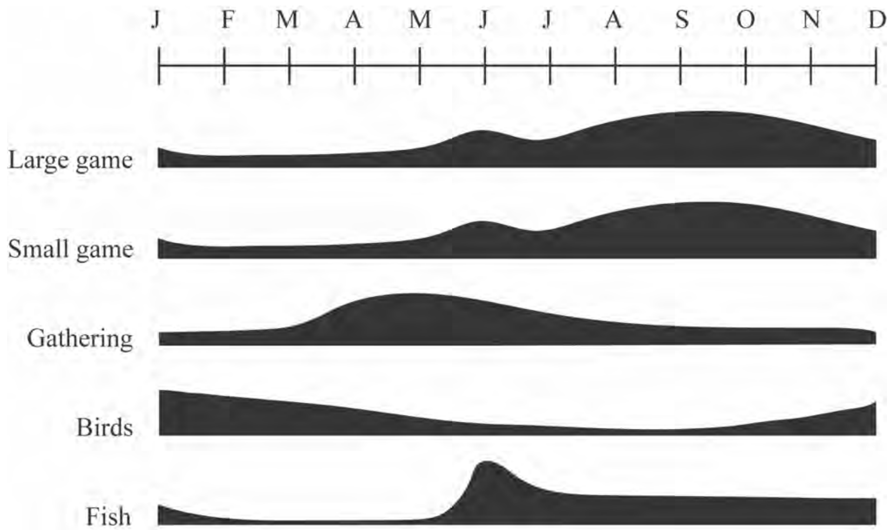

Figure 2.1 Food resources by season (image by M. Brouwer Burg).

In this process, we collated a list of some of the resources available in each of the ecosystems surrounding the CTWS and were struck by the diversity available in so-called marginal landscapes (or *terra nullius* -- no man's land; see Brouwer Burg and Harrison-Buck 2024: Table 2). We wanted to focus more specifically on lowland savannas as we have large tracts of savanna in our study area, and because Archaic artifacts are often found serendipitously by, for example, people excavating sand in contemporary quarries. Additionally, savannas are places with abundant resources, including game, woody tree species (e.g., calabash, craboo, plum, and palmetto), and hardy cereals like amaranth. The latter is a plant that likes acidic sandy soils, can tolerate heat and drought, and which supplies a good source of dietary protein (in the seeds) and nutrients (in the leafy greens).

The results of this site suitability modeling (**Figure 2.2**) provided us with a number of heuristic surfaces that can be used to direct field research by indicating where to focus efforts. We were, in particular, intrigued by the spatial results of the map in the upper right-hand corner, which depicts a land use decision weighted as follows: savanna (40%), chert (20%), hardwood (20%), water (20%; see also **Figure 2.3**).

In January 2024, we conducted a preliminary ground truth of this site suitability surface, targeting an area located just west of the Philip Goldson Highway in Gardenia (see black box in **Figure 2.2**). The area is covered today by lowland savanna vegetation (interspersed pine, oak, grasses, palmetto) and proximate to a sizeable wetland (Tinas Lagoon; **Figure 2.3**). While the area has been under sand mining for the last 20 years, there are still relics of the landscape that appear undisturbed – we refer to them as stable "forest islands" where older growth pine and oak persist and have not been impacted by deflationary processes, likely related to the root structure remaining intact. **Figure 2.3** (bottom) shows the difference between these forest islands and adjacent areas of sand "blow outs", where the removal of vegetative cover by industrial machinery has led to a continuing cycle of erosion. In these erosive areas, lithic artifacts are found on the sandy surface, probably exposed from the margins and then subsequently moved around by wind and water action. As will be discussed below, shovel test pits carried out in both the sandy area and forest islands indicated that the potential for soil development and intact stratigraphy was still possible in the latter contexts.

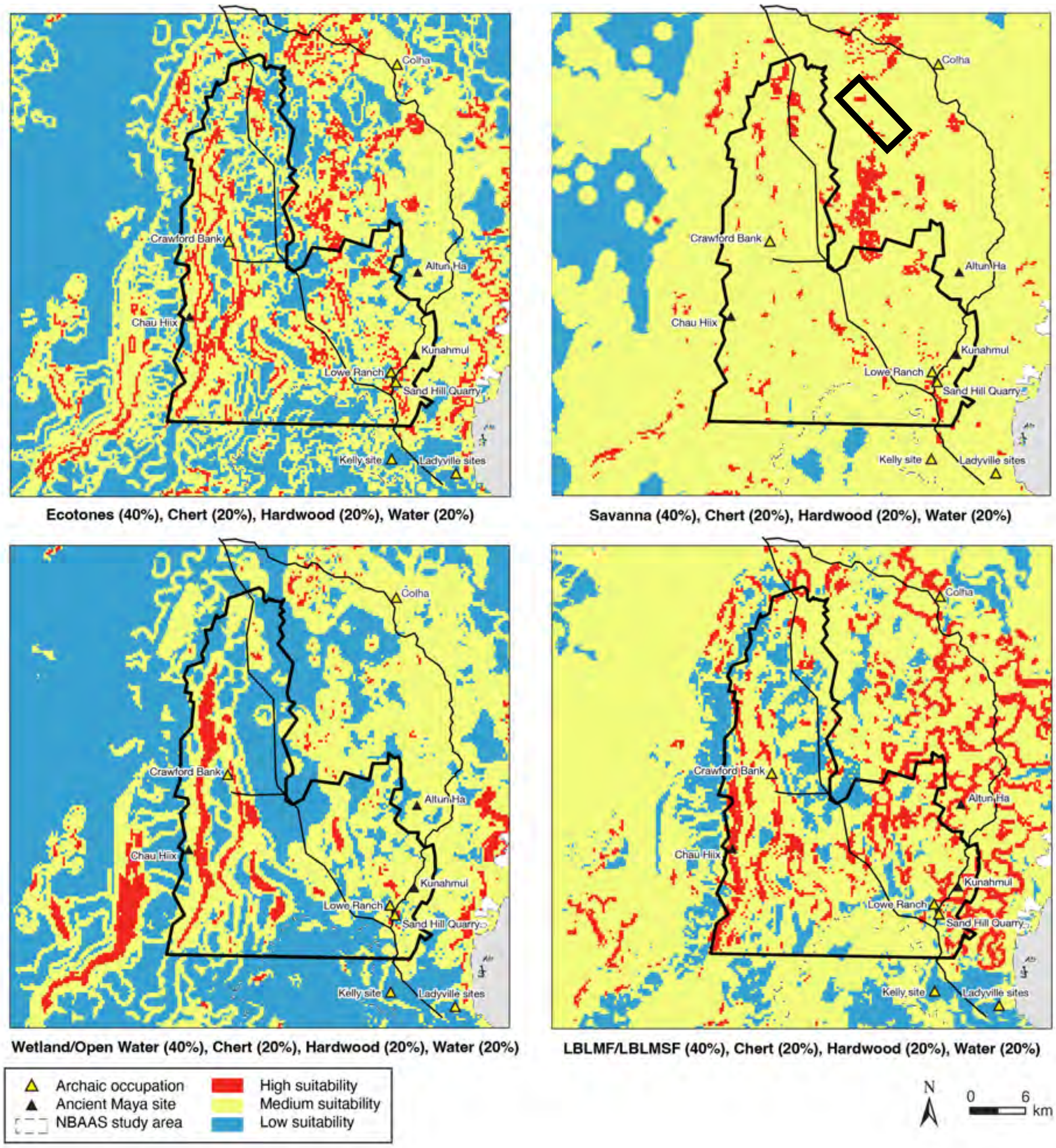

Figure 2.2 Site suitability models for the NBAAS study area given variable decision-making criteria (from Brouwer Burg and Harrison-Buck 2024: Figure 10. LBLMF = lowland broadleaf moist forest; LBLMSF = lowland broadleaf moist scrub forest).

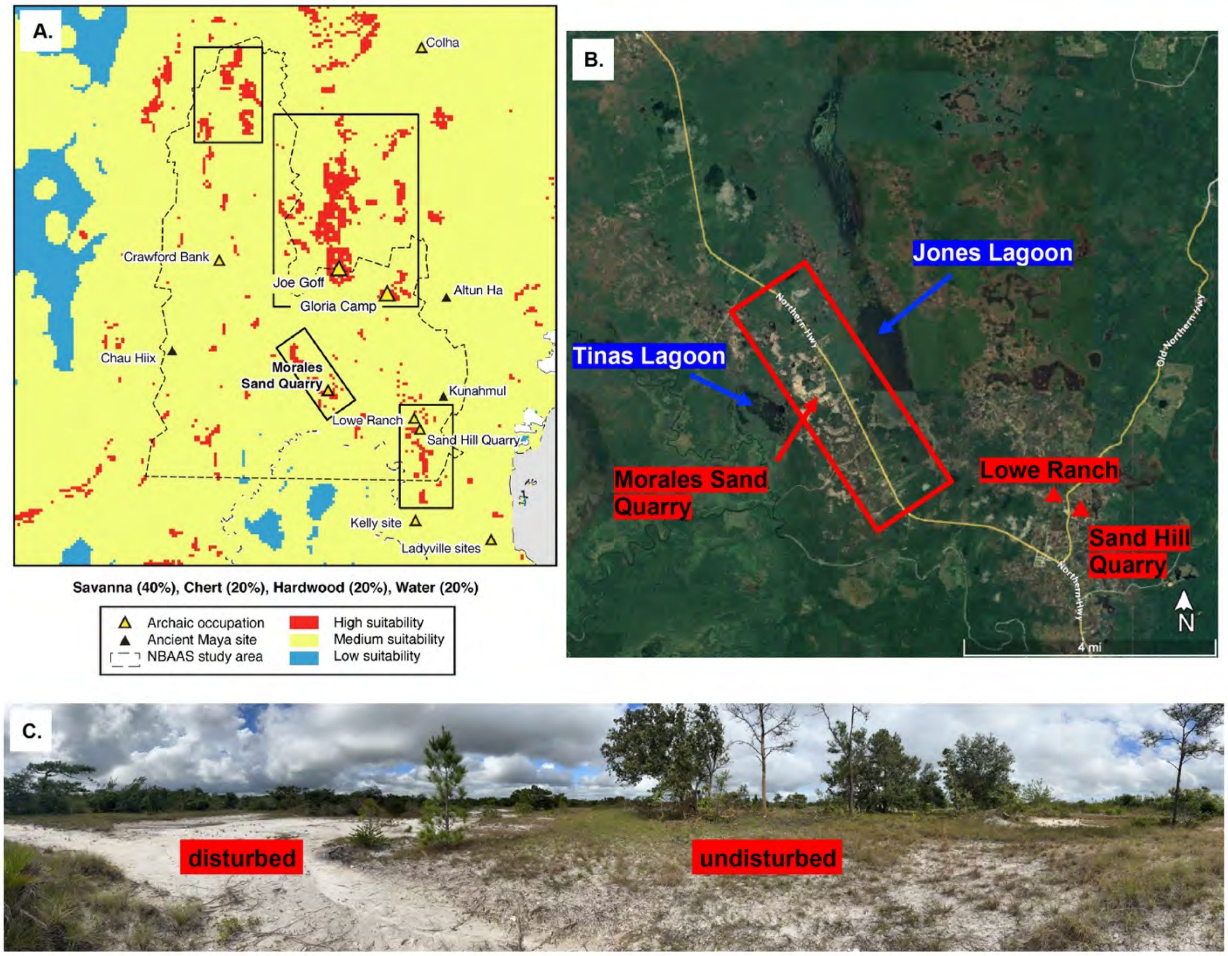

Figure 2.3 A: Overview of NBAAS project and areas of high savanna suitability indicated in red; B: Location of Morales Sand Quarry; C: Panoramic photo of Morales Sand Quarry with disturbed and undisturbed locations indicated (image by M. Brouwer Burg).

On January 17, 2024, the authors visited the Morales Sand Quarry (see **Figure 2.4**). We met and talked with a few employees and were immediately informed about the variety of Maya and Pre-Maya tools that have been recovered in the area. These included round sandstone bowls, manos and metates, chert bifaces, constricted adzes, and Lowe points. The employees detailed their process: they use an industrial excavator in pristine areas to remove topsoil, which is discarded in large heaps. When the underlying sand layer is exposed (between 5-15 cm below surface), the sand is placed in a dump truck and shipped over to the processing area where the sand is washed in an old metal truck bed that has been pierced with holes (**Figure 2.4**). This screening process removes all debris (including artifacts) larger than about 10cm, and the clean sand is washed into a holding pond where it is then be loaded into more dump trucks and carted away for sale. The operation is owned by Mr. Persh Morales of Biscayne and according to Mr. Morales, he has been digging in the area for over 20 years. They began digging in the vicinity of the office and have been expanding outward since then (see **Figure 2.4**). Most of the employees are from the Biscayne or Crooked Tree area and are generally quite knowledgeable about the local landscape. Many of them have fished in Tinas Lagoon or hunted in the sandy savanna. Mr. Morales shared that in future years, he is planning to shift from sand extraction to raising tilapia, converting some of the large sand-holding ponds into fishponds and linking to Tinas lagoon with a large canal.

Unfortunately, while many intact Archaic artifacts have been recovered from the area of Morales Sand Quarry, employees rarely know exactly where they come from. The men who work the excavators report that they cannot see artifacts as they are removing sand and it is only when the sand is washed in the screen that anyone has a sense of what came from where. Thus, we have only been able to get vague descriptions of where artifacts derive.

After having spoken with Morales employees, the authors obtained permission to conduct surface reconnaissance of the northern part of the site. During this reconnaissance, we noted the presence of many heavily patinated chert artifacts (now white) on the ground surface, but only in disturbed sandy areas (see **Figure 2.3**). In the undisturbed forest islands, only a few artifacts were observed. As described above, we assume that the vegetation in the forest islands is holding together the subsurface, including artifacts. Those found on the surface of the forest islands were likely deposited there by machinery or other modern processes. After walking a circuitous path around some of the areas excavated at least 10 years ago, we identified a medial fragment of a Lowe point on the edge of a forest island (**Figure 2.5**). While also patinated, this artifact looked substantially different than most of the others that have a white patina, but with dark honey brown chert still visible in breakage cross-sections; by contrast, the Lowe point fragment was a dull, matte gray with a rind on the edges of the tool. While we provisionally called this a Lowe point because of its bifacial working, corner notching, and beveled edges, it is substantially longer and thinner than many other Lowe points. Further research and more artifacts are required to better understand how the Morales point relates to the typological standard.

Figure 2.4 Top: a sample of artifacts recovered in sand extraction including (l-r) a Lowe point, a pounder/pestle, and a sandstone bowl fragment. Middle: map showing areas and years of sand extraction and Lowe point found during reconnaissance. Bottom left: excavator dumping sand on industrial "screen"; right: artifact pile next to screen (images by M. Brouwer Burg and E. Harrison-Buck).

Figure 2.5 Broken Lowe point found at the Morales site (photo by M. Brouwer Burg).

In May 2024, we returned to the Morales site to conduct further investigations. Our project geoarchaeologist, Samantha Krause extracted a core from Tinas Lagoon which is currently undergoing isotope, microcharcoal, water chemistry, and pollen analysis (**Figure 2.6**; see **Krause, et al., Chapter 3**).

Figure 2.6 Extracting geological core sample with Livingston push corer (photos by S. Krause).

We also returned to the forest island where the Lowe point was found in January. To gain a better understanding of artifact distribution and post-depositional processes, we conducted a two-tiered survey. The first component involved a walk-over survey intended to get an idea of horizontal artifact scatter. We laid out nine N-S transects with pin flags (see **Figure 2.7**). Walking from the north to the south end of the transect, we collected all lithic artifacts within reach every 10 m. The densities are indicated in **Figure 2.7** and **Table 2.1**.

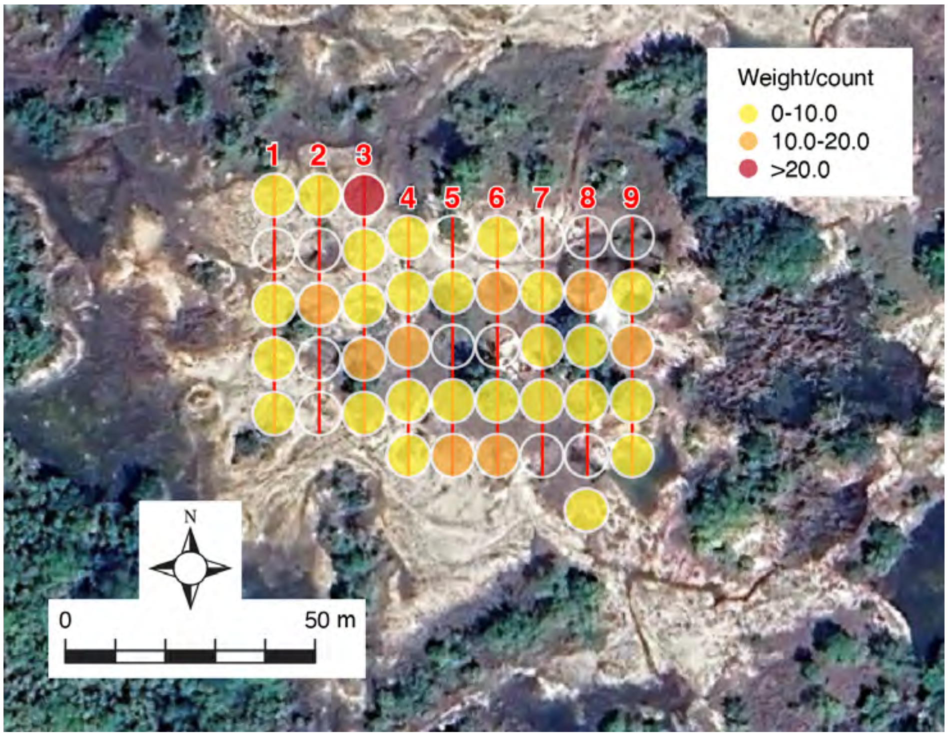

Figure 2.7 Heat map of walk-over survey indicating artifact density (weight-by-count) from each 10 m segment (image by M. Brouwer Burg).

The average weight/count for the sample is 9.3 g/specimen with a min of 0.8 g/specimen and a max of 97.09 g/specimen. The single very heavy segment (transect 3, 0-10 m) is considered an outlier and is directly related to the collection of a large macroflake. What is also interesting is that most of the orange segments lie along the margins of the forest island, which suggests that these are the areas where active disturbance is occurring and where artifacts are clustering as they weather out of the subsurface.

Table 2.1 Distribution of lithic debitage and tools across northwest section of the Morales site. Count followed by weight in grams. "Deb" = debitage.

Transect	1	2	3	4	5	6	7	8	9
0-10 m	Deb: 3/12.6	Deb: 7/57.8	Deb: 3/291.2	Deb: 16/64.7		Deb: 1/1.8			Deb: 7/46.5
10-20 m			Deb: 18/149.2	Deb: 11/21.2	Deb: 1/0.8	Deb: 11/208.3	Deb: 39/139.9 Tool: 1/20.6	Deb: 9/157.5	Deb: 16/160.6 Tool: 1/542.2
20-30 m	Deb: 1/6.2		Deb: 36/136 Tool: 2/148.4	Deb: 6/66.4				Deb: 11/24.9	Deb: 5/23.3
30-40 m	Deb: 16/63.2 Tool: 1/71.5	Deb: 12/135.5	Deb: 6/83.5 Tool: 1/235.3	Deb: 29/67.6 Tool: 1/88.2	Deb: 31/86.2 Tool: 1/50.4	Deb: 8/41.1 Tool: 1/71.3	Deb: 75/308.2 Tool: 2/30.2	Deb: 6/31.5 Tool: 1/48.8	Deb: 7/54.7 Tool: 1/170.1
40-50 m	Deb: 93/354.0 Tool: 4/144.3		Deb: 50/195.8	Deb: 3/2.4	Deb: 100/1229.3 Other rock: 1/37.6	Deb: 29/326.4	Deb: 15/139.5		
50-60 m								Deb: 10/75.7	

The second step involved a shovel test campaign (STP survey 058; **Figure 2.8**; **Table 2.2**). Roughly half of the STPs were negative and those that were positive contained mostly microdebitage in the upper strata. The main exception was STP 7, which yielded a large macroflake (415.7 g) 40 cm below ground surface. This STP was just on the edge of the forest island, suggesting intact stratigraphy lies underneath. Also interesting, as described in Table 2.2, is the burn lens found in STP 13 and 15, between 5-18 cm below ground surface. Both STPs were located in disturbed areas, so further research is needed to determine whether these burn layers are recent or buried.

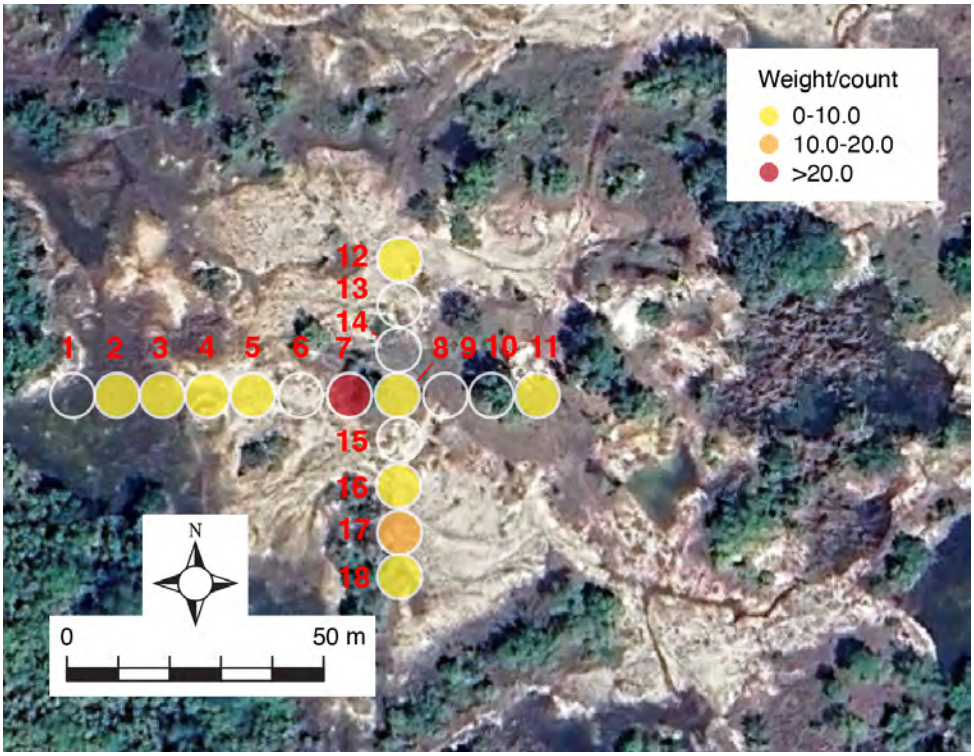

Figure 2.8 Distribution of artifact density from STP series 058.

Table 2.2 Results of STP series 058 at the Morales site.

STP #	Positive or negative	Ending elevation (cm BGS)	Stopping point of STP/other comments
1	Negative	80	0-12 cm many fine and thick roots with fine sand, few limestone pebbles (<1%), 7.5YR8/1 12-40 cm lighter fine sand, 7.5YR8/1 40-80 cm fine sand becomes wetter and thus darker in color (2.5YR8/2); ended at a thick, hard red sandy clay (10YR6/8 and 10YR5/8 mottling)
2	Positive	80	Same as STP 1 with a few chert flakes
3	Positive	75	Same as STP 2
4	Positive	66	Same as STP 2
5	Positive	54	Same as STP 2
6	Positive	84	Same as STP 2
7	Positive	80	Same as STP 2, very large chert flake found ~40 cm
8	Positive	109	6-50 cm is a white sand

			>105 cm limestone chunks
9	Negative	105	Same as STP 1 but no clay encountered
10	Negative	90	Same as STP 1
11	Positive	90	Same as STP 2
12	Positive	63	Same as STP 2
13	Negative	60	5-8 cm burned lens of microcharcoal and organics (10YR5/1)
14	Negative	84	Same as STP 1
15	Negative	88	13-18 cm black charcoal-rich burn layer
16	Positive	87	Same as STP 2
17	Positive	80	Same as STP 2
18	Positive	57	Same as STP 2
19	Negative	37	Same as STP 1

Grinding Stone Analysis

The ground stone bowl fragment recovered during industrial excavations at Morales and observed by the authors in January 2024, along with the pestle and an oblong bowl fragment, were reminiscent of artifacts observed by MacNeish and colleagues and reported in the BAAR reports. MacNeish referred to these shapes as "Tecomate", "Hemispherical", and "Oblong", and dated these specimens by association with their hypothesized chipped stone chronology to the "Belize Complex", sometimes also referred to as the "Stone Bowl Complex", roughly 5,500–4200 BCE (MacNeish et al. 1980: 61-63). We note that secure radiocarbon dates were not used to anchor this chronology, which was instead based on technological and morphological changes MacNeish observed in the chipped tools and has been questioned in the literature (see Stemp et al. 2021).

MacNeish and colleagues hypothesized that these bowls were likely used to process seeds and plants based on evidence of "areas of grinding on [them]" (MacNeish et al. 1982:59), although what these areas of grinding looked like was not elaborated on. To test this hypothesis, we collected starch grain samples by scraping the insides of the ground stone tools with clean toothbrushes and deionized water. We had observed similar sandstone bowls with a hemispherical shape while picking up a rental car at the Crystal Auto Rental headquarters in Belize City. While the owner could not recall or did not know from where the artifacts derived, their similar morphology to the fragment found at the Morales site indicated there were of similar age. With the owner's permission, we also sampled these two specimens (**Figure 2.9**).

Figure 2.9 Ground stone bowls from Crystal Auto Rental in Belize City (photo by M. Brouwer Burg).

Interpretations and Conclusions

This reconnaissance and survey revealed some important insights about the Morales site. First, it was an important ground truthing exercise that confirmed our site suitability model preferencing savanna habitats for seasonal behaviors like hunting and perhaps collection of aquatic resources from Tinas Lagoon. We might expect that hunter-gatherers were in this area during the wet season, when game were concentrated in the remaining high spots. Alternatively, the area proximate to Tinas Lagoon may have been targeted during the dry season as a repository of aquatic species. We will continue to ground truth the site suitability model preferencing savanna ecosystems in future research.

Second, while the area is characterized by lowland savanna, not all savanna is prone to aeolian wind disturbance and, in fact, it seems that modern human disturbance might be one of the main causes for deflating Archaic archaeological contexts in this area. What we saw in the stable forest island landscape is that vegetation has acted to keep the subsurface intact. This finding is critical; knowing that stratified deposits are present in the subsurface will help us plan future research in the area.

Third, the variety of artifacts recovered from the area suggests that lowland savanna was a key ecosystem over a long period of time, not just a marginal landscape people tended to avoid or only use infrequently. Based on dating elsewhere (Prufer et al. 2017), the presence of Lowe Points from the Morales site suggests the area may have been used as early as the early Preceramic period (c. 10,000–8000 BCE). It is possible that the stone bowls also date to this time, as similar implements were also recovered in dated contexts in southern Belize (Prufer et al. 2017). However, MacNeish and colleagues (1980, 1980, 1982, 1983) have argued that stone bowls, in particular date to the "Belize Phase," c. 5000 BCE. Additionally, constricted adzes have been found from the site and these tend to date to the late Archaic (c. 3400–1200/900 BCE; Iceland 1997; Lohse et al. 2006; Stemp et al. 2021). The presence of both preceramic hunting and processing implements indicates that in addition to wild game and plants, cereals like amaranth may also have been collected and processed in these areas, and perhaps also important structural material like palmetto. Finally, various Maya artifacts have been found at the Morales site, including general utility bifaces and manos and metates. The presence of these Maya artifacts suggests that even once maize became the staple of the Mesoamerican diet, wild plants and animals and other important non-food resources were obtained from the savannas.

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Chapter 3

Reconstructing Wetlands in the Crooked Tree Wildlife Sanctuary: Results from the May 2024 Season

Samantha Krause, Marieka Brouwer Burg, and Marie White

Introduction

During the May 2024 field season, we focused on targeted survey and excavation in three key locations across the BREA/NBAAS survey area in order to obtain a geomorphic/ecology record to support our ongoing research on the Preceramic period. We first conducted pedestrian survey in a sawgrass wetland called Tinas Lagoon west of the Morales site, as well as wetland coring via a modified piston corer (**Figure 3.1**). We then surveyed and tested human modified features on the landscape in the southern sections of the Western Lagoon, specifically near the confluence of Poor Hall, Blackburn, and Spanish Creeks (expanded on in **Krause, et al., Chapter 9**). Finally, in addition to the wetland coring and survey that we have been conducting for the past several previous seasons, we also turned our attention to dune geomorphology. Sand dunes are a key formation in the local geomorphology of coastal Belize, and so we surveyed and described dunes around the Morales site in order to better understand local aeolian processes on a geologic time scale. This chapter details the wetland survey efforts conducted in the May 2024 season.

The geomorphological and geoarchaeological team consisted of Samantha Krause, Marieka Brouwer Burg, Marie White, as well as local researchers Rubin Crawford, Bruce Tillett, Cardinal Baptist, and Melvin Quilter. Our team was joined briefly by Kaitlin Murphy and Jack Biggs for additional coring assistance.

Environmental Framework and Background

The geological bedrock and varied geomorphology of coastal Belize provides the foundation upon which past peoples built their societies, from the Paleoindian period to the ancient Maya, through the present. This chapter continues the work conducted in our previous report (see Krause et al. 2024). By surveying the soils and geomorphology of the BREA study area, we can better reconstruct both natural and human-influenced landscapes and generate clearer understandings of soil/sediment change along our transect through the varied microenvironments of the coastal landscape.

Coastal Belize is low-lying, with an elevation range from sea level to only 10-20 m above sea level (masl). This area consists of many complex microenvironments of alluvial dune deposits, lagoons, and tidal systems. The geological framework in this region is predominantly limestone and dolomitic limestone ranging in age from 56 to ~2.6 million years ago, from the Eocene to the Pliocene (Perry et al. 2009; Beach et al., 2009). There are some pockets of chert within these limestone layers, and the chert bearing zone is roughly aligned with the Middle Eocene Doubloon Bank formation (King et al., 2004). These formations are overlain by various coastal sediments, from carbonate and silicate sources (High 1975) dating throughout the Quaternary, the youngest being Holocene in age. The general wetland types in coastal Belize consist of herbaceous depression freshwater marshes, seasonally wet/dry savannas, riparian and lagoonal hardwood swamps, and mangrove dominated brackish to saline wetlands.

The wetlands of coastal Belize are complex and varied, and only a handful of scholars have collected ecological data within these systems. One such study occurred in Cobweb Swamp near the site of Colha in the 1990s, a depression wetland north and east of our study area (Alcala-Herrera et al., 1994). Here, researchers extracted cores from the Cobweb sawgrass marsh using a vibracore. Core sequences revealed ~7,000 years of wetland deposition that indicated multiple flooding events, fluctuations in gastropod and foraminifera populations, and different sediment accumulation periods over time. Jacobs and Hallmark (1993) report two other coring ventures in Northern Belize that resulted in similar stratigraphy to the Cobweb Swamp core: one from Laguna de Cocos on Albion Island (Bradbury et al 1991; Alcala-Herrera et al., 1994) and the other from Northern River Lagoon (High 1975). All three of these cores provided stratigraphic sequences that captured geomorphological evidence from the late Pleistocene into the Holocene, and suggest changing patterns of sediment deposition, wetland ecology, and hydrology over recent geologic history, but before the Maya and their predecessors began to dramatically change the hydrology and vegetation within the region.

Objectives

The objectives for the geomorphological team during the May 2024 field season are similar to the objectives of the January and May 2023 field seasons (Krause et al., 2024) and consisted of the following:

1. Expand understandings of soil geomorphology in the study area, focusing especially on how soils relate to the various microenvironments on the landscape.
2. Collect deeply buried sediments from seasonal and perennial wetlands within the study area to enhance understandings of past climate regimes through the use of multiproxy study.
3. Connect deeply buried sediment deposits with pre-Maya time periods, as well as later cultural shifts and transitions.
4. Collect OSL samples from exposed dune sequences around the Morales site, with the goal of constraining aeolian processes on the landscape.

Description of the Research and Methods Used

Lake and wetland sediment deposits are important archives of both natural and anthropogenic environmental changes. These archives can provide continuous or semicontinuous records of climate and environmental change over timescales of thousands of years. To collect sediment records from wetlands and lagoons, we used a modified piston corer. The modified piston corer was designed by Dr. Jason Curtis at the Land Use Environmental Change Institute, University of Florida. The design of the modified piston corer is based on the original design detailed in Livingstone (1955), and the benefit of using this system is that it is lightweight and transportable across rugged terrain. Before beginning a sampling drive, the piston and attached cable is brought to the lower end of the sampling tube (see images in Krause et al. 2024:50). The sampling tube is lowered to the surface of the lagoon/wetland bottom so that the side of the tube with the piston is flush with the sediment surface. The tube is depressed around the piston by pushing on the extension rod, and typically 2-3 team members are needed for this step. As it descends, the tube fills with lagoon sediment; the piston prevents compression of the sample during the drive. In addition, the piston prevents the sample from falling out while the sample is being lifted up after a successful collection. After the tube is pushed down as far as possible, the entire device is hoisted back up, and the tube is removed, capped, labeled with identifying information and directional arrows, and replaced by an empty collection tube. The operation is then repeated until the team can longer successfully collect material, or until basal/geologic material is reached.

Tinas Lagoon is located west of the town of Gardinia, off the Northern Highway, and west of the Morales site (**Figure 3.1**). Some of the lagoon is seasonally inundated logwood and calabash swampland, and sawgrass swamp fringes the standing perennial water of the main part of the lagoon. Tinas Lagoon is seasonally fed by Black Creek, which drains into the Belize River south of the system. Our team conducted a pedestrian survey from the Morales site westward toward the sawgrass swamp of Tinas Lagoon. We walked the perimeter of the ecological transition zone from low-lying hardwoods to sawgrass swamp to determine the best access point into the wetland. We entered the system from the east, cut/cleared the brush until we were able to survey out into an organic, slightly inundated area. We eventually cleared an area for coring and constructed a small platform to stand on as the swamp contained a few inches of standing water, and the ground surface was wet enough that the research team would sink into the mud if stationary for too long. We were able to extrude two cores located 5 m apart.

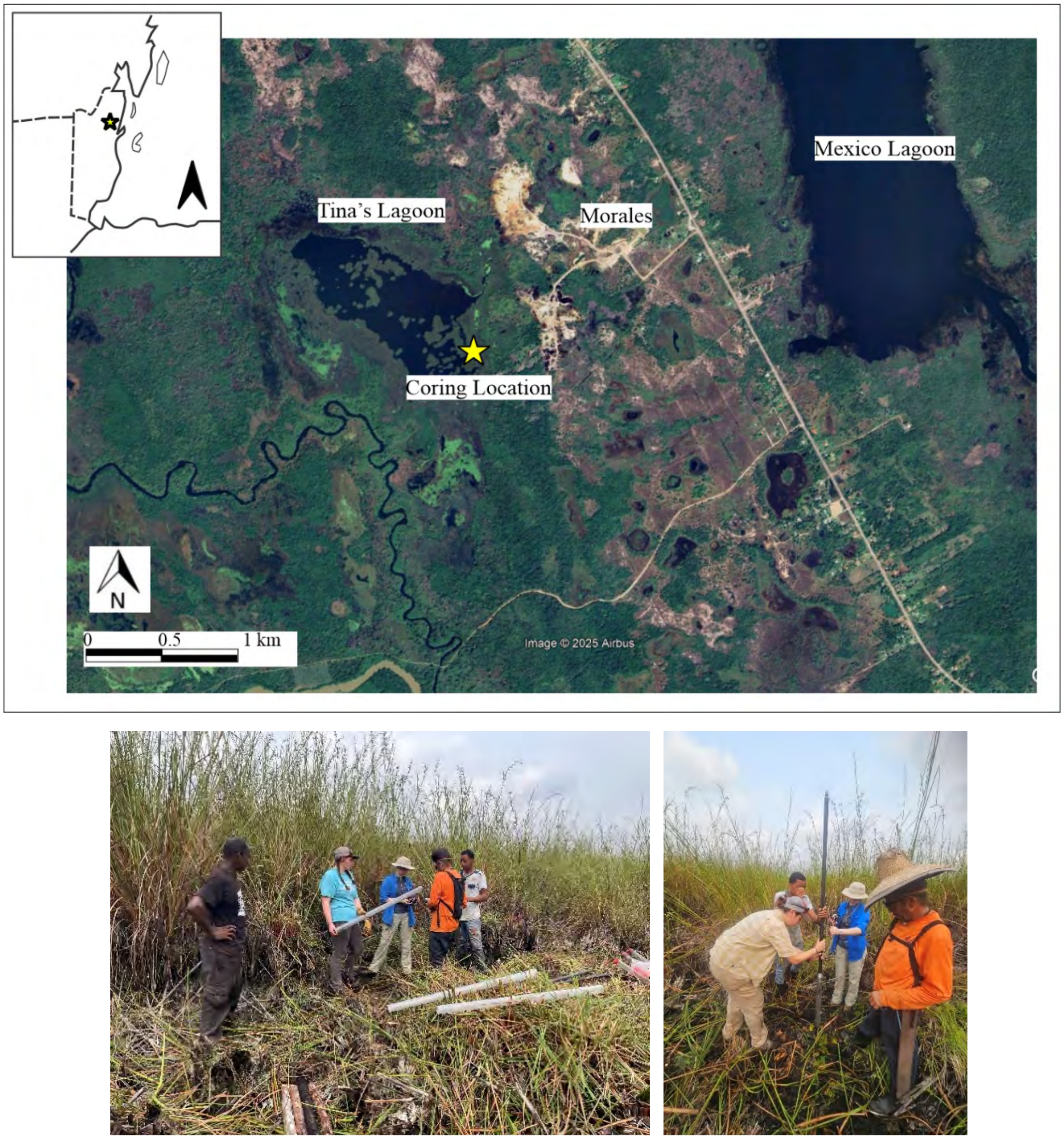

Figure 3.1 Top: Location of Tinas Lagoon in Gardenia; Bottom: The field team prepares the coring location and begins a core sequence (image and photos by S. Krause).

In addition to coring at Tinas Lagoon, we also surveyed the nearby sand dunes around the area. The Morales site has been in operation for over two decades and has engaged in sand extraction operations in the area (for more, see **Brouwer Burg and Harrison-Buck, Chapter 2**). Some of the sand dunes have already been excavated by modern quarrying, but on the fringes of the dug pits, some dunes remain intact. These recently exposed dune profiles provide an excellent opportunity to better understand the geomorphology of these sequences, especially since Archaic materials are often found in sandy areas in the Belize coastal plain. We opportunistically located dunes that had recently been cleared/partially excavated and then cleaned the faces of these sequences to observe the stratigraphy. We inserted PVC pipe into the base of the dunes to collect material for future OSL dating.

Interpretations and Conclusions

The two core sequences from Tinas Lagoon were extremely similar in stratigraphy and structure (**Figure 3.2**). We were able to recover about 140 cm of material at each coring location (in a total of 3 core tubes each) in the sawgrass swamp. Our team extruded these cores at the BREA laboratory facility and collected representative samples of the various sediment layers for additional geochemical analysis and radiocarbon dating.

From the surface to ~10 cm below the surface (cmbs), the topsoil was a saturated peat (10YR2/1 black) with many roots. At ~10 cm, the sediment transitions to a gytta, (2.5Y4/1), which is a black and gel-like mud formed from the partial decay of peat. Here, clay begins to increase with depth. By 30 cmbs, the basal clay sharply transitions to a much darker Gley 1 2.5/N (black) clay. There are some shells within the matrix from ~40-62 cmbs, but otherwise the material is quite homogenous. There is another sharp transition to a sandy peat (Gley 1 6/10Y) below this layer at ~123 cmbs. This next zone had quartz crystals throughout the matrix. Finally, at the bottom of the sequence, starting ~136 cmbs, was a sandy clay with large gypsum crystals precipitating throughout. Large (1-2 mm) gypsum crystals can form in these kinds of wetland soils when water evaporates in mineral-rich environments, leading to the recrystallization of dissolved calcium sulfate. This is typical in seasonal wetlands that are influenced by a fluctuating water table. We were unable to core much farther into this sandy clay and suspect that we were nearing basal material.

Figure 3.2 Three cores from the first sampling area in Tinas Lagoon (photos by S. Krause)

In addition to the cores from Tinas Lagoon, we described and photographed exposed sand dunes around the Morales site, and excavated into a few of these to collect potential OSL dates. These dunes are mostly anchored under low tropical forest today, but when exposed by the sand mining operation, about 1.5 m of quartz sand with weak pedogenic features is revealed.

Within the dune sequence, we observed a similar stratigraphy across the sand quarry. In general, there is about 10-20 cm of mixed O/A topsoil, which is mostly comprised of pine duff, some organics and charcoal, and mixed sand. This decends sharply to a pure white quartz sand matrix. In some of the dunes, a potential weakly developed E decending into a B horizon is visible at around 50-60 cmbs. Usually, an E horizon is white, but in this case, we posit that organic matter and iron oxides are accumulating in the E horizon, leading to more gray coloration. The underlying B horizon is more orange due to the increase of iron and clay. Redoximorphic features increase with depth, and the basal material (typically encountered around 1 m in depth) is a sticky sandy clay that is bright orange due to iron concentrations. These dunes are pedogenically different than the dunes observed and recorded around Joe Goff and along the causeway leading into Crooked Tree island from the northern highway.

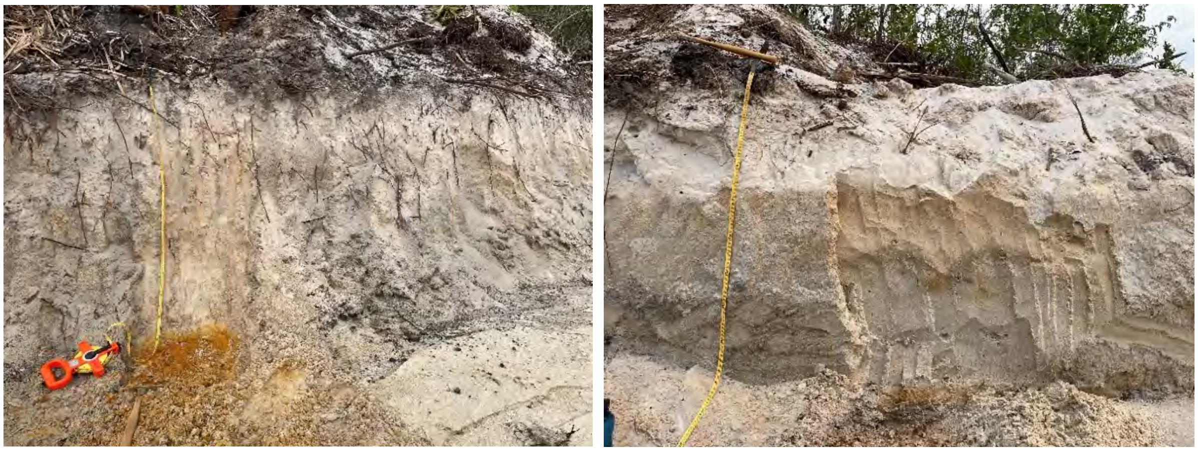

Figure 3.3 Two examples of dune sequences with weak pedogensesis. The base of the dune on the left is an extremely oxidized sandy clay (photos by S. Krause).

Further study should be undertaken to continue to map the stratigraphy of coastal Belize, and to constrain the timing of geomorphic events such as dune formation and anchoring, as well as wetland formation throughout the late Pleistocene and into the early Holocene. Future field seasons should include additional coring efforts in the BREA study area. Subsequent laboratory efforts, such as C14 and OSL dating, as well as additional geochemical research, should be undertaken to fully reconstruct the paleoenvironments of the area.

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Chapter 4

LiDAR Mapping of Areas in the Vicinity of Biscayne and Rock Stone Pond

Mark D. Willis and Satoru Murata

Introduction

Our Unmanned Aerial Systems (UAS) work for the BREA project took place under permit 11/241 from January 21 to 28, 2024. We focused on refining the Light Detection and Ranging (LiDAR) data collection methods from 2022 and improving the techniques used at Chan Chich in 2023 (Willis and Murata 2022; Willis 2023). In 2022, we collected LiDAR data at several locations, but at Jabonche, we missed significant mound locations that had been identified in previous total station data (**Figure 4.1**). In addition to remapping Jabonche, we aimed to fly over unmapped areas around Biscayne, Altun Ha, and nearby regions. The four areas we worked in were Altun Ha, Chan Colha, Jabonche, and Xtabentun (**Figure 4.2**).

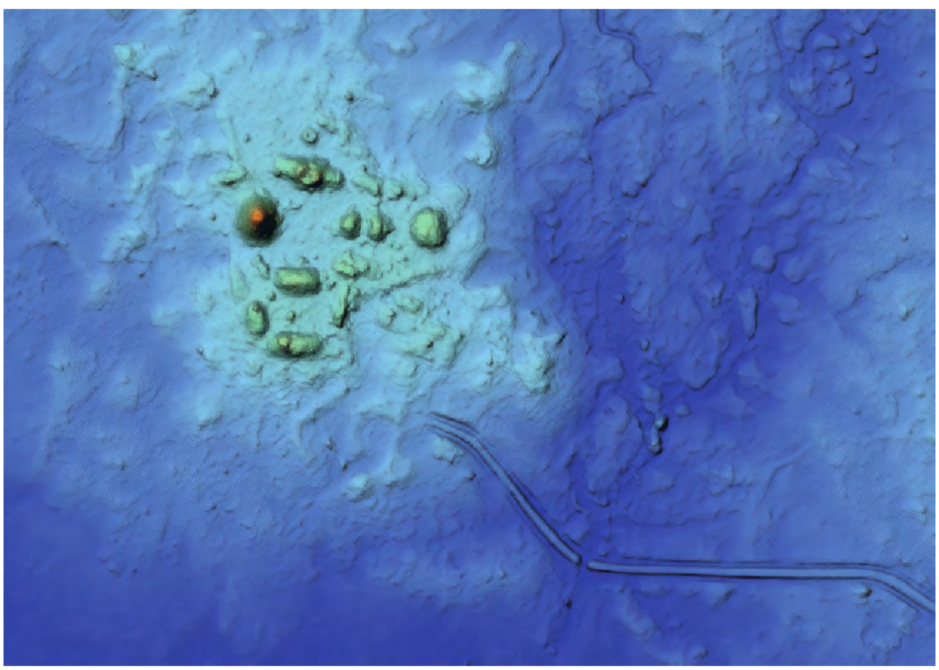

Figure 4.1 Digital elevation model (DEM) of Jabonche (image by M. Willis).

LiDAR is a remote sensing method that uses pulsed laser light to map an environment (NOAA 2022). Traditionally, LiDAR surveys have been conducted with multi-million-dollar equipment attached to airplanes or helicopters. The combined UAS and LiDAR unit we used are "affordable" equipment that costs under $50,000 USD and that can be easily deployed in several challenging scenarios and is being used around the world (Calderone et al. 2024; Roberts Thompson and Finch 2023; Lu et al. 2023; VanValkenburg et al. 2020; Vilbiga et al. 2020).

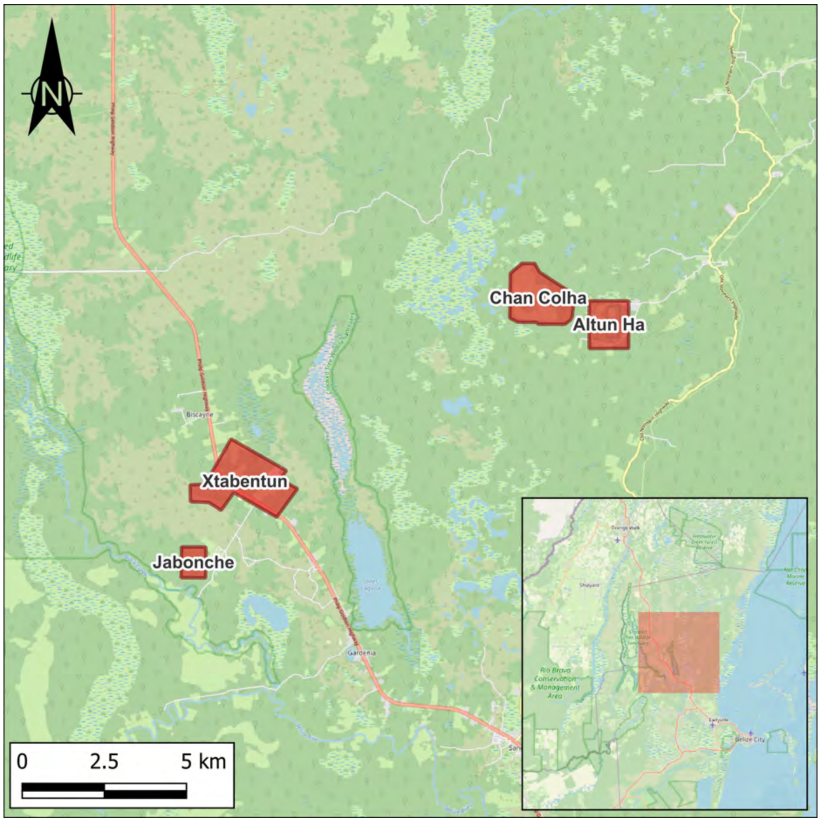

Figure 4.2 Study areas in the BREA permit area (image by M. Willis).

Equipment

We used the same equipment as in 2022—a DJI M300 UAS, more commonly called a drone, with a DJI-RTK2 Global Navigation Satellite System (GNSS; **Figure 4.3**). We also used Emlid RS2 and RS3 GNSS units to maintain coordinate control across the study areas. The Emlid RS2 also served as a post-processing kinematic (PPK) unit in case we lost the signal between the M300 and DJI-RTK2.

Figure 4.3 Drone equipment at the site of Coquericot in 2022 (photo by S. Murata).

Two new pieces of equipment were added this year: a larger DJI RC Plus controller, which provided a bigger screen for maneuvering the drone and allowed better real-time LiDAR data processing, and the upgraded DJI Zenmuse L2 LiDAR sensor. The L2 sensor introduced several improvements over the L1 that used in 2022, making it more powerful for aerial surveying and mapping

Accuracy and Range

The L2 sensor offers better accuracy, with 4 cm vertical and 5 cm horizontal accuracy compared to the L1's 5 cm vertical and 10 cm horizontal. It also improves range detection, reaching up to 500 meters under optimal conditions, whereas the L1 reached only 450 meters.

Point Cloud and Returns

The L2 generates denser point clouds, supporting up to five returns compared to the L1's three returns. This ability allows the L2 to penetrate vegetation more effectively, capturing more detailed ground-level data in complex environments.

Operational Efficiency

The L2 is more efficient, covering up to 2.5 km^2 in a single flight, compared to the L1's 2 km^2. It also offers faster flight speeds, further increasing its efficiency.

Overall, the L2 sensor provides substantial improvements over the L1, offering better accuracy, faster flight speeds, and more efficient data collection. These advancements allow us to map larger areas more precisely and, in less time, making the L2 a crucial upgrade for complex survey environments.

Data Collection

Before fieldwork, we digitized the LiDAR data collection locations into Google Earth's KMZ format polygon files. We selected these areas based on factors such as distance from basecamp, vegetation type, known sites, and areas of future research interest. We imported the polygons into the drone's controller and set mission parameters, including flight height, transect distance, and laser pulse types.

Flying the mission followed a process similar to previous years on the BREA project (Harrison-Buck et al. 2015). We selected launch locations that were free of obstacles like electric poles and trees, and away from people.

We transported the M300 in a large protective case, which also served as a platform for assembly and launch. At the site, we unfolded the drone, attached the L2 LiDAR payload, and powered everything on. One difference this year was that the L2 did not need to warm up for several minutes before each flight. In addition to a DJI-RTK2 GNSS base station, we set up an Emlid RS2 base station as a backup. While the Emlid RS2 does not communicate directly with the drone, its longer battery life (18-20 hours compared to the DJI's two hours) provided a backup source of positional data.

If the DJI RTK-2 lost communication, the Emlid RS2 data was used for post-processing corrections through a method called PPK. After setting up the DJI RTK-2 and the Emlid RS2, we reviewed the mission's flight plan to ensure that everything matched the real-world field conditions.

Once the DJI RTK-2 acquired its position, we began data collection. The M300 autonomously flew to its pre-programmed altitude and followed the first line of transects. Like a lawnmower, the drone moved back and forth, collecting data along the transects. During this time, the L2 broadcasted millions of laser beams below the aircraft, recording when they were reflected back. The system used positional data from the DJI RTK-2 and the IMU to triangulate the three-dimensional location of each point with high accuracy. A single flight collected hundreds of millions of points, and a multi-mission project could easily gather over a trillion points. Depending on the study area size, multiple flights and launch locations were sometimes necessary to optimize battery use.

We had enough batteries to complete three consecutive flights. For longer missions, we recharged the batteries with an inverter connected to a running vehicle, which required a vehicle that would not overheat while idling in the Central American heat (**Figure 4.4**).

In total, we mapped four discrete areas within the BREA permit area (see **Figure 4.2**), ranging from the tourist site of Altun Ha to locations near Biscayne.

Figure 4.4 Invertor running off of truck to charge drone batteries (photo by M. Willis).

Data Processing

The first step in data processing was downloading the data from the L2 memory cards and preprocessing it in DJI Terra software. This software aligned individual transects and unified multiple flight datasets into a single file. The files were several gigabytes in size, testing the limits of modern laptops' processing capabilities. We processed each day's data in the evenings using DJI Terra, which took between two to eight hours. The software then exported a unified dataset in LAS format, an industry-standard ASCII format.

Next, we post-processed the LAS data using third-party software to classify each of the billions of points in the LiDAR point cloud. The software analyzed whether each point represented bare earth, vegetation, water, buildings, or other features (**Figures 4.5** and **4.6**). In our case, we primarily extracted bare earth models to visualize the ground beneath the vegetation. The post-processing software was complex, with dozens of adjustable parameters that could significantly alter the output quality. We spent a considerable amount of time re-running the software on the same datasets to optimize the results.

We used Terra Scan and Terra Model software (TerraSolid 2024) for post-processing.

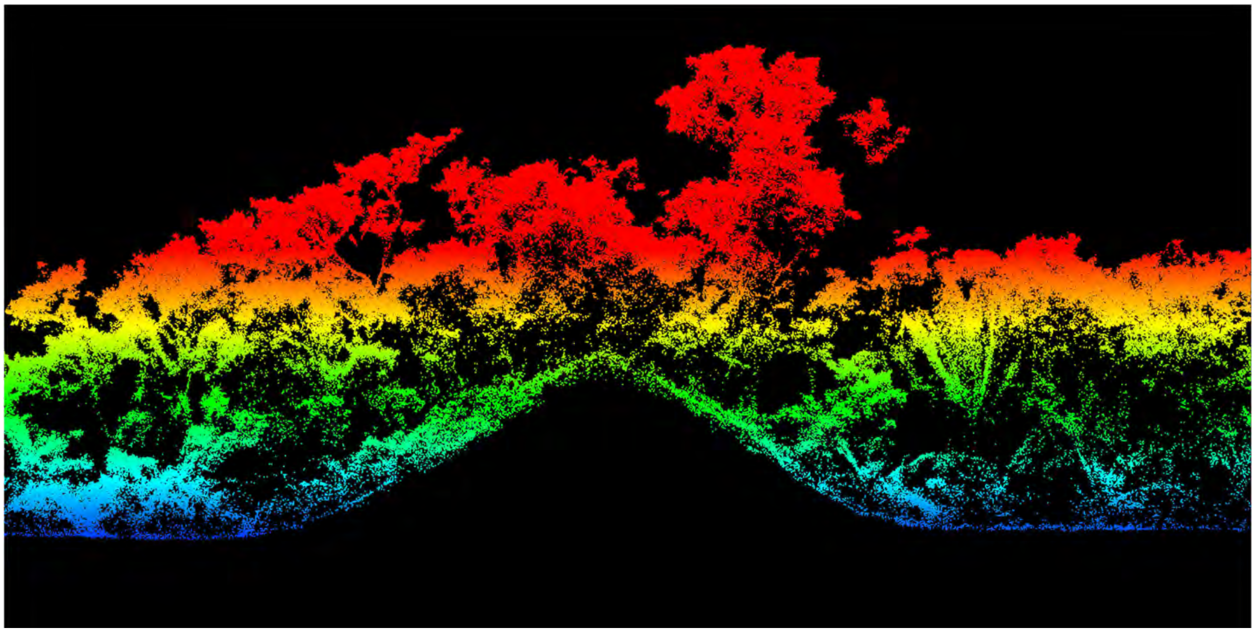

Figure 4.5 Example profile of LiDAR data showing overstory and prehistoric mound below (image by M. Willis).

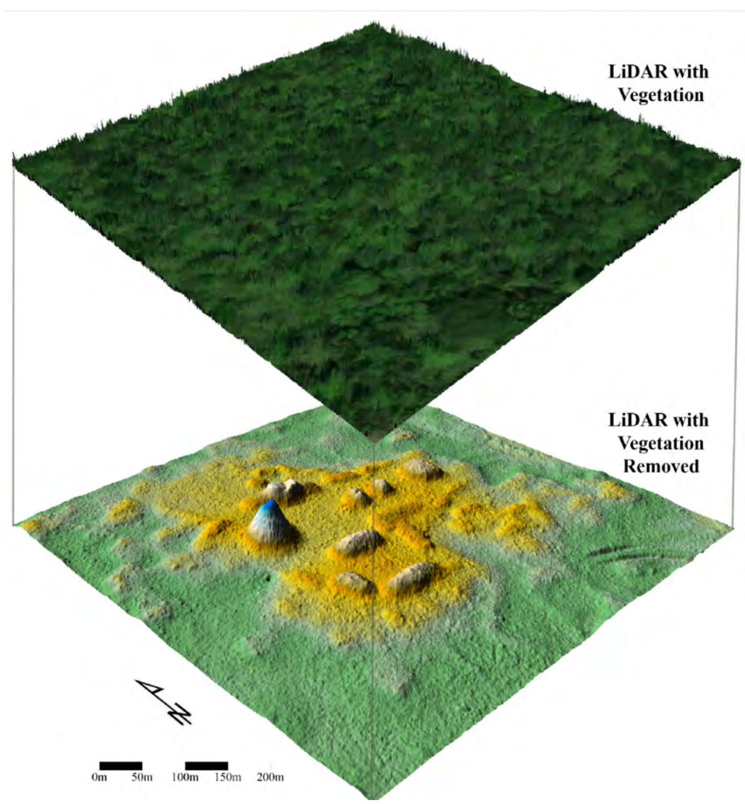

Figure 4.6 Example of vegetation removal from LiDAR data (image by M. Willis).

Results

The results consist mainly of maps and a brief discussion of each. The maps show the bare earth models in the Simple Red Relief style, which highlights subtle archaeological features (Auld-Thomas 2024). We have not yet ground-truthed the data to verify whether all identified features are prehistoric or cultural in nature. Most visible features resemble those seen in other plane-based LiDAR datasets and are recognizable to experienced analysts (Inomata et al. 2021). The Digital Terrain Models (DTMs) were extracted from the point cloud data, with resolutions ranging from one point every 3 cm to one point every 50 cm, depending on vegetation density. We visualized the DTMs using QGIS 3.34 GIS software.

Jabonche Study Area

We initially focused our efforts at Jabonche for several reasons. First, we noticed that our 2022 LiDAR data did not clearly identify all the mounds that had been ground-truthed and mapped by earlier BREA fieldwork (Murata and Robinson 2015). Jabonche was a known site where we had both LiDAR and total station mapping data, allowing us to conduct multiple missions over the site core using different flight parameters to compare results with a site that had been mapped traditionally and with LiDAR. As seen in **Figure 4.7**, the 2024 data is clearly much better, but this might only be because the 2022 data did not fully cover the mound complex. Being at the edge of coverage meant that much less data was collected there in 2022 and this may be why significant mounds are missing. It may be that a combination of adjusting the flight parameters and the use of an L2 sensor on the drone for the 2024 mission helped to improve the post-processing results and accuracy of the map (see further below).

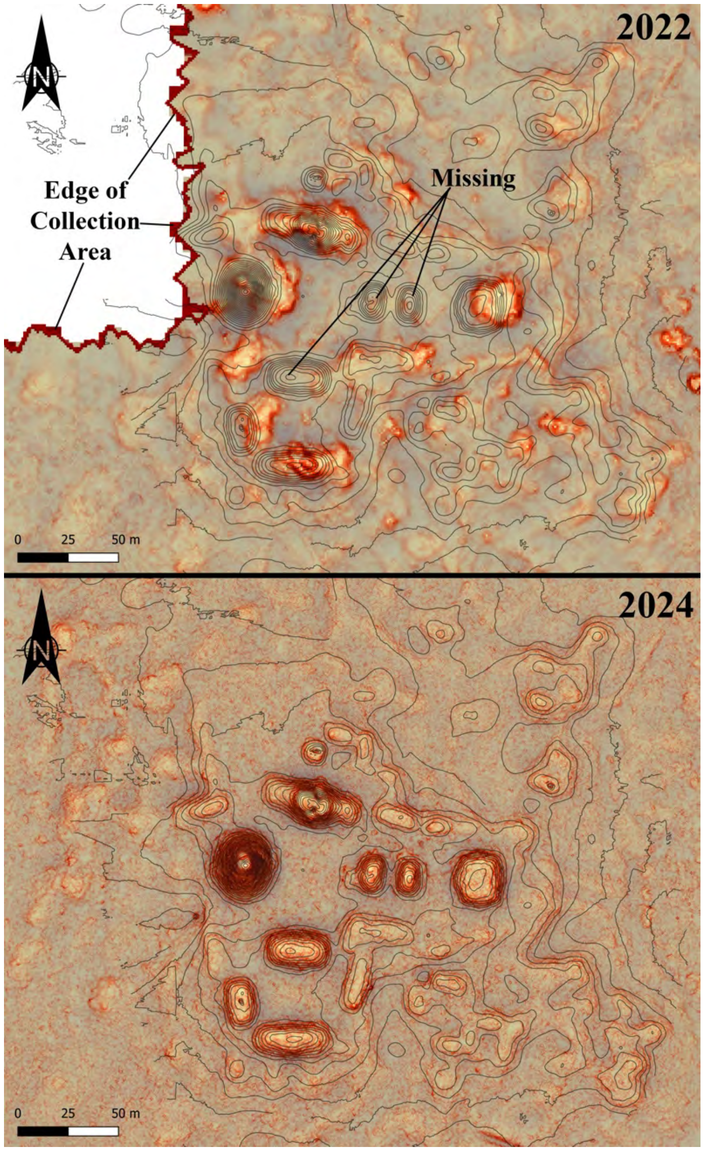

Figure 4.7 Comparison of the 2022 and 2024 LiDAR data a Jabonche. Contours from Murata and Robinson (2015; image by M. Willis).

We flew three separate missions at Jabonche, each with varying flight parameters. The speed of the drone and its altitude determined how many pulses of laser light returned to the sensor from the bare earth during each flight. The slower the drone flew, the more opportunities the LiDAR had to capture reflections. Similarly, flying closer to the ground increased the likelihood of receiving returned reflections. Another variable we adjusted was the sidelap between transects. Sidelap is essentially the amount of overlap of data collection between each transect. Reducing the sidelap increased the reflection-to-return ratio but also required more flight time. However, flying too low made it harder to maintain a good signal because the jungle vegetation absorbed the signal. The challenge was to balance good data collection with efficient flight time. We found in previous tests outside Belize that flying additional perpendicular transects to the original flight path greatly reduced data quality due to how the LiDAR software processes data in strips. This outcome contrasts with photogrammetric methods more commonly used with camera-based drone mapping. If perpendicular transects are collected, it is advised to only process those parallel to each other together. Keep it in two separate datasets. Merging will only introduce noise to both sets of data.

We flew the first mission 80 meters above ground level (AGL) and at 8 meters per second with a 20% sidelap. The second mission was flown at 70 meters AGL at 6 meters per second with the same sidelap, and the final mission was flown at 90 meters AGL at 10 meters per second with a 50% sidelap. These three missions took place over two separate days, with a rainstorm occurring between the second and third missions. Since the L2's laser cannot collect data through standing water, some lower ground features were obscured in the final dataset.

Comparing the results of all three datasets, we found that the data collected at 70 meters AGL and 6 meters per second produced the best results. All three datasets revealed the missing mounds from the 2022 LiDAR data. It remains unclear whether the improvement is due to the L2 being a better sensor or the fact that the missing mounds were at the very edge of the 2022 collection area.

Based on the data quality, we determined that the best flight configuration for mapping sites within one kilometer of the launch site was 70 meters AGL at 6 meters per second with a 20% sidelap (**Figure 4.8**). We mapped an area of 3.37 km², with numerous albarradas (perhaps more appropriately referred to as *callejuelas* or ancient Maya pathways) and mounds clearly visible. Interestingly, a fallow pasture with thick grasses in the northeast of the study area did not resolve well and appears as blobby noise.

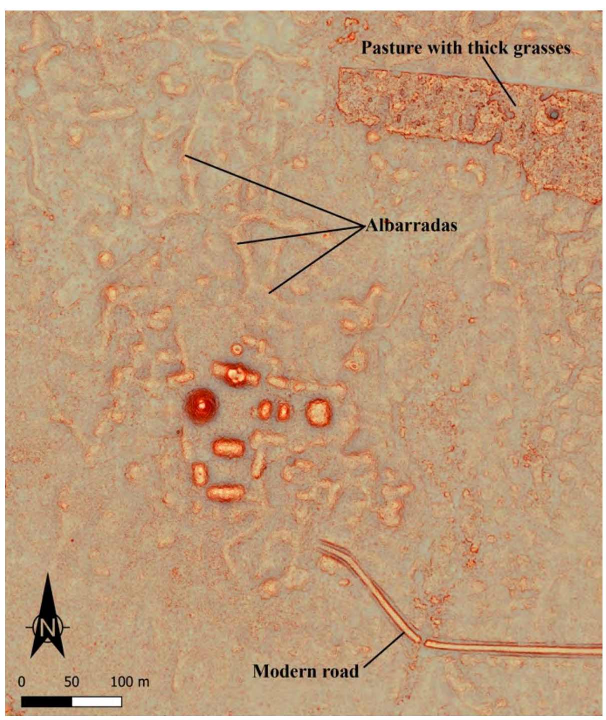

Figure 4.8 2024 Jabonche dataset that collected at 70 m agl and 7 m/s (image by M. Willis).

Xtabentun Study Area

We also focused on an area near the town of Biscayne, which we called Xtabentun for mapping purposes. To map this large area, we conducted a total of eleven missions from various locations along the edge of the highway. We mapped 9.67 km^2 using the LiDAR. The canopy across the study area ranged from dense jungle to open areas, including spaces with homes and fields. At least two clusters of mounds were visible in the data, including an E Group on the north side of the highway (**Figure 4.9**). There were also scattered single mounds across the data.

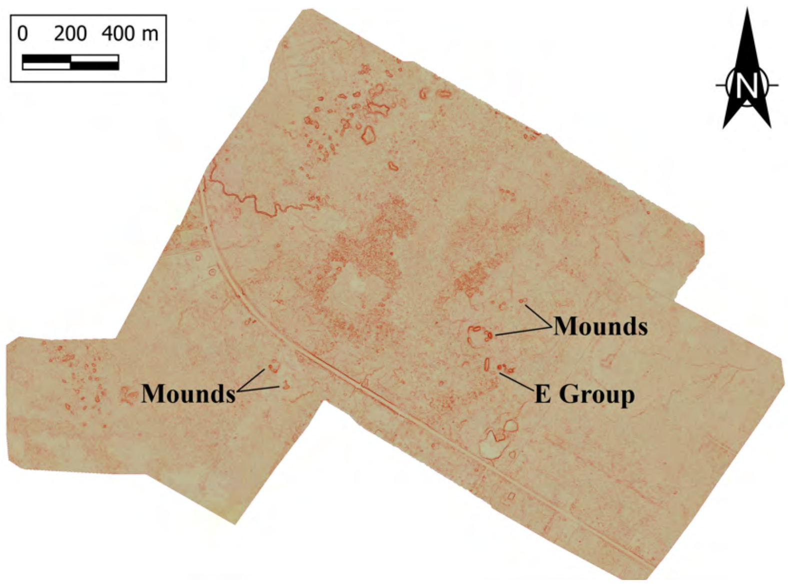

Figure 4.9 Simple red relief model of the Xtabentun study area (image by M. Willis).

Chan Colha Study Area

This project area is located north and west of the Altun Ha Study area. Heavy rains the night before our flights had left the area very wet. A generous landowner provided one of his mill workers to transport us to the site using an old tractor. We also used the tractor's battery to recharge the drone equipment while we were in the field. The landowner's son Julio, who is also a drone pilot, accompanied us (**Figure 4.10**).

Figure 4.10 Left: riding to Chan Colha; Right: drone operation (image by M. Willis).

We conducted five missions in this study area. Much of the land had reduced vegetation due to farming, but some areas still had dense jungle. The sparser vegetation and better drone communication signal allowed us to fly all missions from a single location, which saved us from relocating in muddy conditions. Additionally, we flew the drone higher, at 80 meters AGL, and faster, at 7 meters per second, to take advantage of the open terrain and speed up the survey. We flew one extra mission over the core of the BREA excavations at a lower altitude of 50 meters AGL and 4 meters per second to collect more detailed data. We mapped a total area of 6.46 km^2.

Most of the mounds identified in the LiDAR data were concentrated in the southeast of the study area, with numerous callejuelas (referred to in the map as albarradas) crisscrossing the landscape (**Figure 4.11**). Upon reviewing the LiDAR data and others collected in 2022, we noticed that some areas looked like in the DEMs were actually recent brush-clearing activities. Similar signatures to callejuelas appeared in this data, but these linear features were push piles of vegetation from land clearing (see **Figure 4.11**). It is purely speculative at this point, but we wonder whether the callejuelas we see today could have originated from prehistoric land clearing. Decades of clearing fields and moving debris to the sides of fields might have created these raised linear features. Alternatively, they could have been intentionally raised as walkways, or a combination of both processes may have created these unusual features. Detailed information about callejuelas in the region can be found in Guderjan et al. (2020) and Hutson and Magnoni (2017).

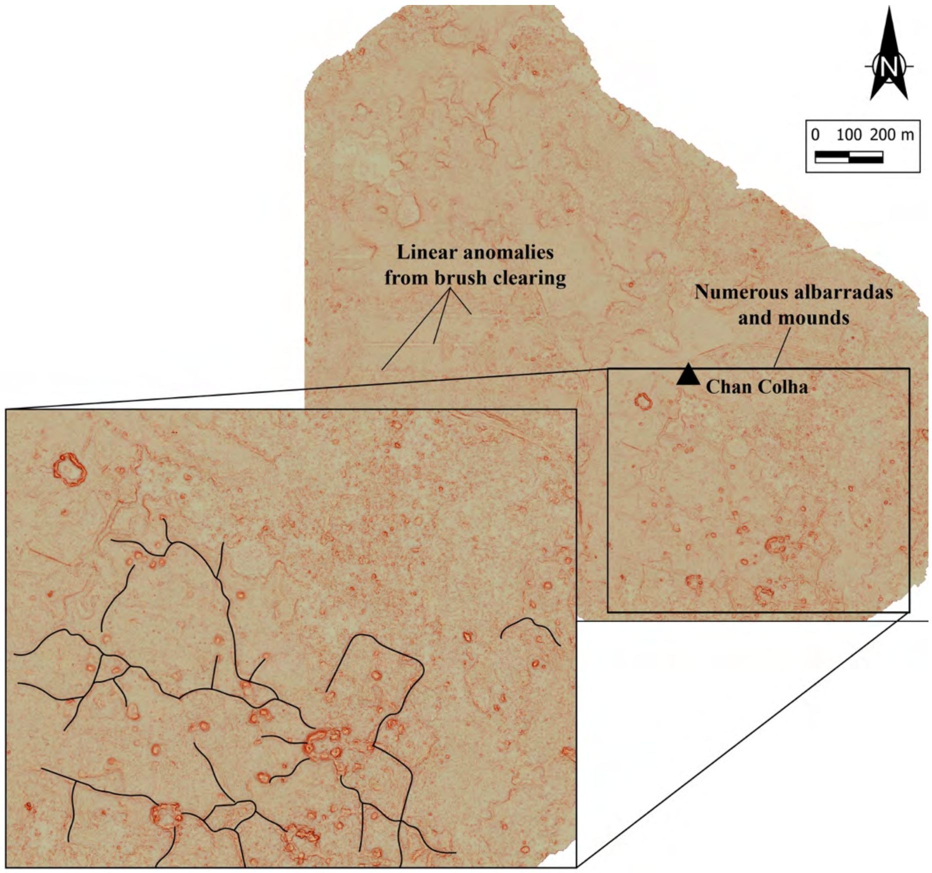

Figure 4.11 Simple red relief model of the Chan Colha study area. Note: callejuelas indicated in black on inset (image by M. Willis).

Altun Ha Study Area

In 2022, we collected high-quality LiDAR data from the core of Altun Ha. This year, we returned to collect additional data, mainly to compare the L1 and L2 sensors. Although we expected the L2 to outperform the L1, the L2 provided much crisper details of reconstructed pyramids and better clarity in heavily forested areas. The L2 data also showed looting sites more clearly than the L1 data (**Figure 4.12**).

We conducted four missions at Altun Ha at 70 meters AGL and 6 meters per second, using the default 20% sidelap. We mapped 5.31 km² using the L2 (**Figure 4.13**).

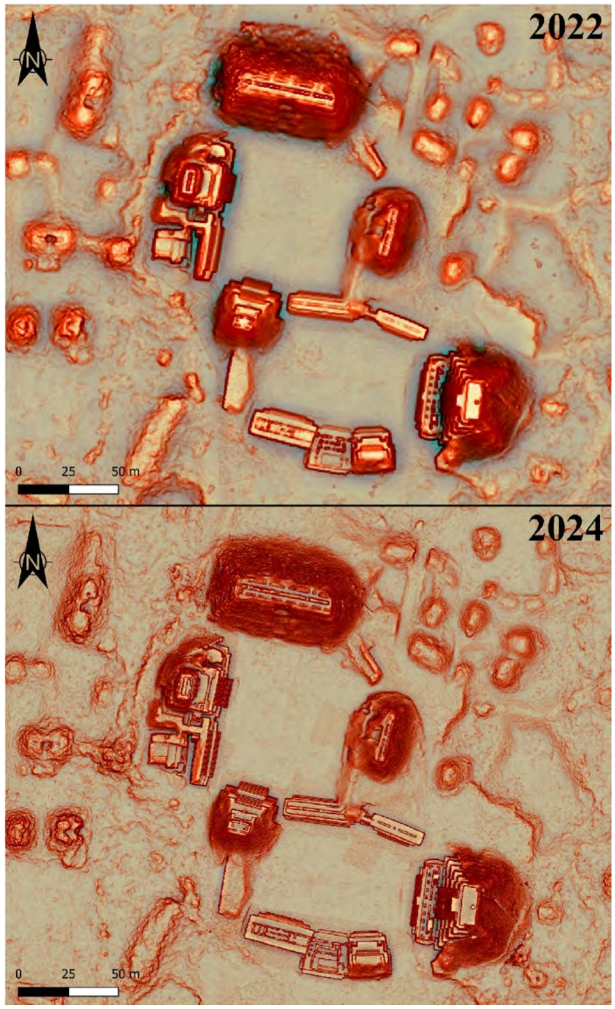

Figure 4.12 Comparison of the site core of Altun Ha from 2022 and 2024 LiDAR data (image by M. Willis).

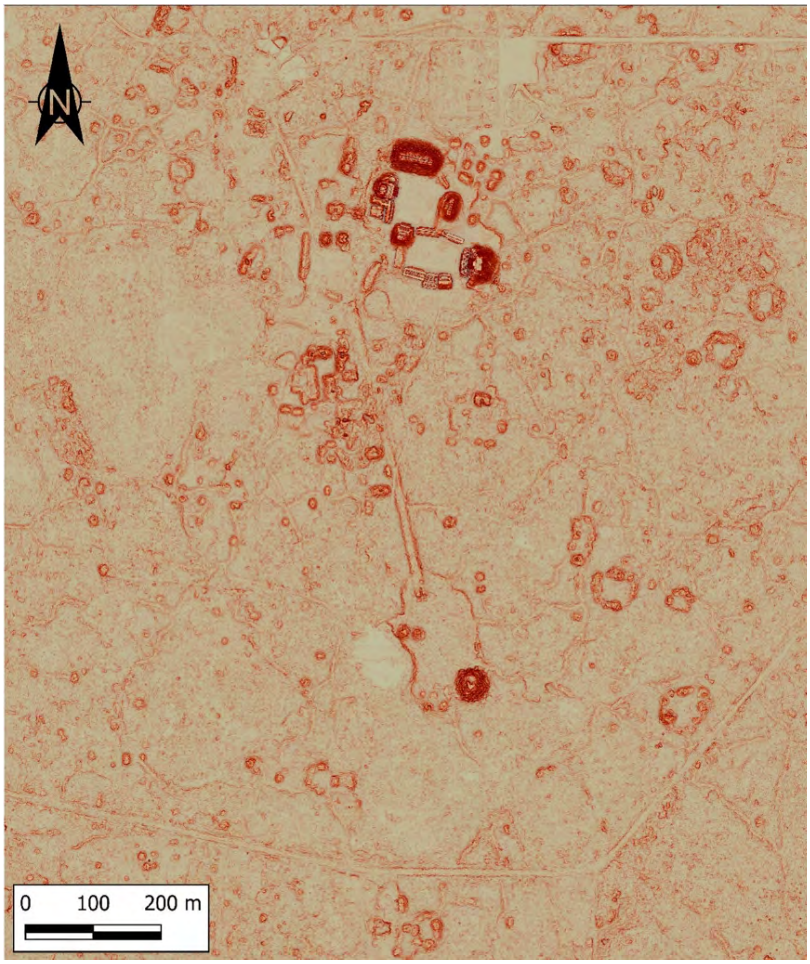

Figure 4.13 Simple red relief model of the Altun Ha study area (image by M. Willis).

Discussion

The 2024 LiDAR mapping project was highly successful. We managed to collect data every day the drone was deployed, despite occasional rain and high winds. We identified the optimal settings for flying the L2 sensor in jungle environments—70 m AGL, 6 m/s, with 20% sidelap and parallel transects. We discovered that flying perpendicular transects introduced noise and reduced data quality when processed together. We advise to only process transects that are parallel in any given dataset.

In addition to refining our collection settings, we successfully mapped two new areas: Chan Colha and Xtabentun. The datasets revealed several previously unknown mound complexes. The Xtabentun data, in particular, indicated large areas without significant architecture, which may guide future research.

As Belize and much of the Maya area continue to be developed, much of its rich archaeological landscape faces an uncertain future from agriculture and construction. Drone-based LiDAR offers an efficient way to document these landscapes at the most minimum level, and as the technology improves, we hope its use for archaeological mapping becomes more widespread.

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Chapter 5

Investigations of a Marine Shell Working Area at Altun Ha in the Lopez Plaza (Op. 72)

Adam Kaeding, Eleanor Harrison-Buck, Jack A. Biggs, and Cormac Day

Objectives

During reconnaissance efforts in the January 2022 season, BREA team members were guided to a location that we refer to as the Lopez Plaza, named for the current owner Mrs. Brenda Lopez. This area is located southwest of Groups A and B just beyond the fenced boundary of Altun Ha in a part of the site core that is privately owned and has not been developed for tourism (**Figure 5.1**). Though the primary objective at the time was to gather wide ranging LiDAR data, the BREA surveyors were struck by the surface archaeology they encountered during field reconnaissance. The Lopez Plaza is a relatively small, cleared pasture area which was also previously used for other agricultural pursuits. At the time of the BREA survey visit, the area had just been tilled and in the process of being converted into a small orchard. This ground disturbance revealed a dense and expansive deposit of marine shells (identified as *Melongena melongena*) over a large area of the Lopez Plaza (**Figure 5.2**). At this time, with the limited information available, the number of shells was estimated to be in the thousands, representing a type of deposit unlike any so far discovered by the BREA team. Operation (Op.) 72 was a comprehensive excavation program designed to investigate the nature and extent of this shell deposit. A visual assessment and program of shovel testing (STP Series 056), described below, were carried out prior to laying out Op. 72 to isolate the highest density area of the shell deposit.

Description of Research Methods

The first step in determining an investigation strategy was to better identify the extent of the marine shell feature. In order to refine our understanding of the distribution of shells to better inform the placement of excavation units, BREA team members investigated the area using visual assessment and shovel testing methods (see Kaeding et al. 2022). The visual assessment involved a semi-systematic walkover of the enclosed pasture area in which the shells had been identified with BREA team members spread out at approximately 1 m intervals. During this walkover BREA team members noted where shells were visible on the surface and where they appeared to be absent. During this walkover, BREA team members also assessed and shared any observations regarding topography, architectural modification, vegetation patterns, soil characteristics, and the distribution of any non-shell surface artifacts.

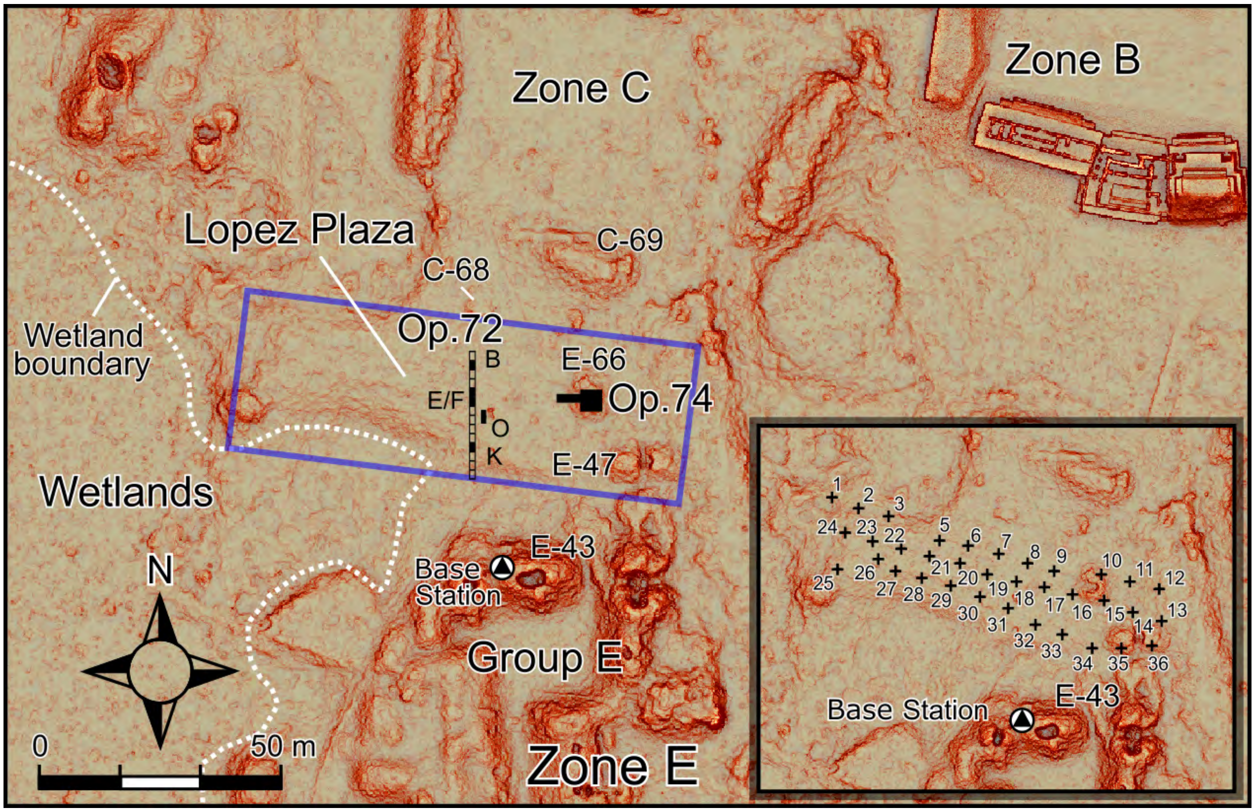

Figure 5.1 LiDAR map showing location of Op. 72 with area of shell scatter investigated in the Lopez Plaza demarcated with blue rectangle; inset shows locations of shovel test pits (map by M. Willis; annotated by M. Brouwer Burg and J. Biggs).

Once the distribution of marine shell was very generally characterized by the semi-systematic visual assessment walkover, BREA team members investigated the subsurface characteristics of the deposit via shovel testing (STP Series 056; **Figures 5.1** and **5.2; Table 5.1**). Shovel testing included the systematic distribution of small circular excavations measuring approximately 30–40 cm in diameter. Tests were laid out on a cardinally oriented grid at a 10 m interval using tape and compass. The extent of the testing grid was informed by the distribution of marine shell observed on the surface as well as topography of the Lopez Plaza and any associated platform(s) upon which the shell seemed to be concentrated. The test pits extended to the southern and western edges of the Lopez Plaza, which forms a narrow "peninsula" circumscribed by a low-lying wetland area (see **Figure 5.1**). The northern extent of the testing was delimited by an east-west fence line to the south of Structure C-69 and extended east until reaching the fence demarcating the official site boundary of the Altun Ha tourist area.

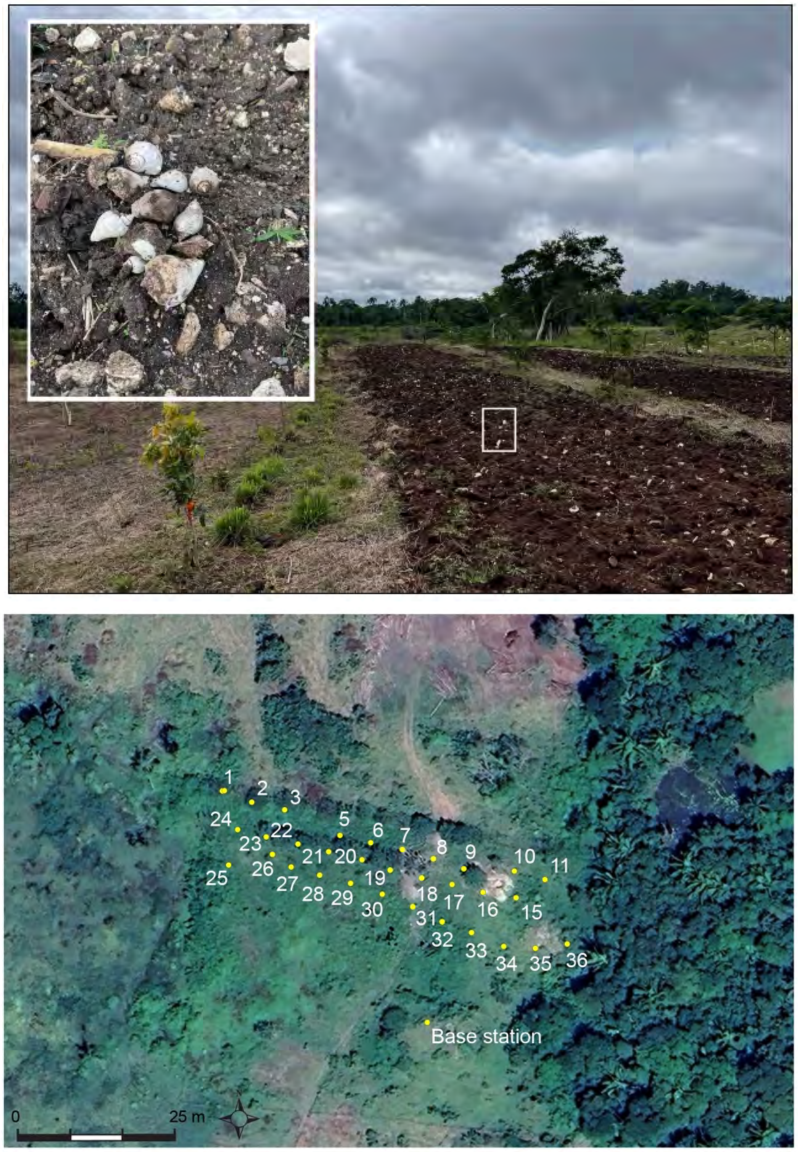

Figure 5.2 Top: Marine shell concentration in tilled field southwest of Altun Ha site center in the Lopez Plaza visible in January 2022 (photos by S. Murata); Bottom: Same area showing distribution of shovel tests in survey 056 and Op. 72 overlaid on Google Earth satellite image (map by M. Brouwer Burg).

When possible, these STPs were excavated using a hand shovel, but due to the density of the materials in this area, almost all of these tests required the use of a post hole digger. All excavated materials were passed through a ¼-inch screen to ensure the consistent recovery of artifacts. General elevations of particularly unique, significant, or diagnostic artifacts were noted during the excavation according to depth from the surface. Once excavation reached archaeologically sterile soils, subsurface impasse, water table, or the physical limit of the excavation tools (shovel or post hole digger), the shovel tests were terminated. The soil profiles of each shovel test were documented by descriptions of soil strata including measured thickness; soil characteristics including type, color, and density; and content.

Table 5.1 Results of shovel test series 056 at Altun Ha in the Lopez Plaza.

Shovel Tests	Soil Strata			Contents
	Approx. Depth (cmbs)	Color	Texture	
1 -5	0-15	10YR 3/2	Loamy clay	Lithics, pottery sherds, marine shell
	15-30	10 YR 3/3	Silty clay loam	
	30-80	10 YR 3/3	Clay loam	
6	0-22	10 YR 3/3	Clayey loam	Pottery
	22-70	10 YR 5/4	Silty coarse sand	
7	0-10	10 YR 3/2	Loamy clay	Much marine shell, chert flake
8	0-5	10 YR 3/2	Clayey loam	Marine shells, ceramics, chert flakes
	5-43	10 YR 3/2	Clayey loam w/ limestone	
9	0-41	10 YR 3/2	Loamy clay	Ceramics, lithics
	42-53	10 YR 4/2	Silty clay	
10	0-10	10 YR 3/2	Clayey loam w/ limestone incl.	(terminated early due to limestone)
11	0-10	10 YR 3/2	Loamy clay w/ limestone incl.	Ceramics, chert (terminated early due to limestone)
12	0-10	10 YR 3/2	Clayey loam w limestone incl.	(terminated early due to limestone)
13	Not excavated			
14	0-19	10 YR 3/2	Clayey loam w limestone incl.	Ceramic, chert flakes (terminated early due to limestone)
15	0-17	10 YR 3/2	Loamy clay w limestone incl.	Chert, ceramics (terminated early due to limestone)
16	0-9	10 YR 3/2	Clayey loam	Marine shell
17	0-40	10 YR 3/2	Clayey loam w limestone incl.	Ceramics, chert flakes
18	0-57	10 YR 5/2	Clayey loam w limestone incl	Ceramics, chert
	57-70	10 YR 5/2	Silty loam	
19	0-10	10 YR 3/2	Clayey loam	Much marine shell, ceramics
	10-39	10 YR 3/2	Clayey loam w limestone incl.	
	39-50	10 YR 5/2	Silty loam	
20	0-53	10 YR 3/3	Fine sandy loam	Ceramics, chert flakes, marine shell
	53-70	7.5 YR 4/6	Sandy loam	
21	0-36	2.5 YR 3/2	Sandy clay loam	Ceramics, chert flakes
	36-90	2.5 YR 4/4	Silty sand w ceramic incl.	

22	0-30	10 YR 5/2	Clayey loam w ceramic incl.	Ceramic, chert flakes
	30-75	7.5 YR 3/3	Sandy loam	
23	0-19	10 YR 3/2	Clayey loam	Marine shell, ceramics (terminated early due to limestone)
24	0-38	10 YR 3/2	Clayey loam w limestone incl.	Ceramics, lithics, large, incised sherd
	38-98	7.5 YR 3/4	Silty clay	
25	0-7	10 YR 3/2	Clayey loam	Ceramics, chert flakes
	7-24	7.5 YR 3/3	Clayey loam w cobbles	
	24-80	7.5 YR 3/3	Clayey loam	
	81-89	10 YR 4/1	Silty clay w limestone incl.	
26	0-29	10 YR 3/3	Silty loam w ceramic incl.	Ceramics, chert flakes
	29-80	2.5 YR 4/8	Silty sand w ceramic incl.	
27	0-44	10 YR 3/3	Sandy loam w ceramic incl.	Ceramics, lithics
	44-67	7.5 YR 3/3	Sandy clay	
	67-90	7.5 YR 4/4	Silty sand w ceramic incl.	
	90-108	7.5 YR 3/3	Silty clay	
28	0-38	7.5 YR 3/2	Clayey loam w ceramic incl.	Chert, ceramics, marine shell
	38-61	7.5 YR 5/2	Clayey loam	
	62-114	5 YR 3/3	Sandy loam	
29	0-29	10 YR 3/3	Sandy clay loam w ceramic incl.	Chert flakes, ceramics, marine shell
	29-83	5 YR 5/6	Silty sand w ceramic incl	
30	0-35	10 YR 3/2	Sandy clay	Much marine shell, ceramics, lithics (high volume)
31	0-7	10 YR 3/2	Loamy clay w limestone incl.	Ceramics
32-36	0-13	10 YR 3/2	Silty clay loam	Marine shell, ceramics, chert flakes

Based on the data recovered from the visual assessment and shovel testing, Op. 72 was laid out in the area with the highest potential to provide the most insight into the nature of the marine shell deposit (**Figure 5.1**). A 30-x-1 m trench was laid out north-south traversing the Lopez Plaza in the area where shovel testing yielded the highest density of marine shells. The layout of the trench reflected the needs of our research strategy—because a deposit of this nature had not yet been investigated in BREA research, the approach included the flexibility to expand as needed in whichever direction results might suggest. With this in mind, it was never intended that the entire 30 m trench would be excavated. Instead, it was divided into 15 squares, each 2-x-1 m in area (see below). Squares (Sqs.) B and F were selected for initial excavation, and the results of observations of those efforts were to determine which additional squares might warrant further investigation. Results from within Sqs. B and F discussed below motivated expansion into Sq. E. Excavation was also initiated in Sq. K which was located at edge of the topographic rise and therefore potentially well suited to inform the nature of the construction of the platform upon which the shells were distributed. Excavations of this square, however, did not show any clear evidence of faced stone and was aborted early on in the excavation.

During the following summer (2024) season, Sq. O measuring 1 m (east-west) x 3 m (north-south) was laid out roughly 50 cm to the east of the north-south line of Op. 72, with its northwest corner located roughly 1 m from the southeast corner of Sq. F. This additional square was opened up after modern disturbance from heavy machinery scraped the ground surface and exposed a well-preserved east-west line of facing stones running across the Lopez Plaza. The stones mark the northern edge of a low platform that lines the southern side of the Lopez Plaza and appears to connect with the northwestern corner of Str. E-47. Excavation of Sq. O aimed to further expose this low platform running along the southern side of the Lopez Plaza and the associated context of the shell deposit (described further below).

Units were excavated in a mix of natural and 20 cm arbitrary levels with shovels and picks as much as possible. Because the focus of this operation was often relatively fragile marine shells, much of the excavation was conducted with trowels and smaller hand picks. Similarly, because of the distribution of shells in particular, few levels reached the full 20 cm thickness before switching. All excavated soils were passed through ¼-inch screen for the consistent recovery of artifacts. Excavation levels were documented with standardized zone and excavation forms.

Results

Visual Assessment

Since the initial discovery of the shell feature in the recently tilled field, the location has continued to host an orchard/garden and pasture, but the ground has not been tilled since 2022 according to the landowners. This land use meant that the area was generally very clear, but that some low vegetation growth had returned and also serves as pasture for cattle, meaning the deposit of shell was periodically trampled by grazing cows. Marine shells were still identifiable on the surface, but the density, volume, and horizontal extent of the overall feature was no longer as visible as it was in 2022. As a result, the first step in characterizing this area – the visual assessment – was only mildly successful in identifying the extent of the deposit. Effectively the result of the visual assessment was the confirmation of the initial observation that the majority of the pasture area was characterized by a flat plaza area extending east from the border with the Altun Ha tourist site. Structure C-69 is a large structure associated with Zone C that marks the interface between the Lopez Plaza and Plaza C to the north (see **Figure 5.1**). To the east, closest to the fence line of the Altun Ha tourist site, several small structures (Structures E-47 and E-66) that are visible on the surface sit on and are associated with this area we refer to as Lopez Plaza. Another small structure (Structure E-67) also is visible on the western edge of the Lopez Plaza, abutting a lower wetland area. This elongated plaza area drops down to a narrow, wet area on its south side – possibly a water management channel or canoe slip (some of the wetland remains a year-round lagoon) – leaving a small space to the north of a very large elite residential compound (Group E). Visual assessment suggested that the shells were almost exclusively distributed across the Lopez Plaza. Other artifact types were also identified across the surface including ceramics and chert lithic tools and appears to represent the debris from intensive shell production in this area.

Shovel Testing

Shovel testing confirmed observations from visual assessment and added clarity to exactly where across the area of the Lopez Plaza the shells were found in the highest concentration. In total, 36 shovel tests were distributed throughout the Lopez Plaza – both where shells were observed during visual assessment, and in areas where no shells were seen on the surface (**Figures 5.1** and **5.2**). The profiles exposed by shovel testing provide further insight beyond the distribution of shells. Generally speaking, there was a fairly uniform profile across the plaza, with shovel tests reaching greater depths further to the west and ending shallower to the east. To the eastern side, nearing the Altun Ha site center, shovel tests usually terminated after only 10 cm or so of excavation due to encountering compact construction fill. Though initial survey and visual assessment indicated that the plaza was a fairly flat, contiguous surface from east to west, in fact, shovel testing suggested that the eastern end was comprised of more substantial masonry architecture while the western half was built of primarily earthen fill. Along with soil characteristics, artifact recovery was recorded for each shovel test with particular attention paid to the shell content (both by count of individual intact shells and by volume of fragments; **Table 5.1**). Incidentally, shells were identified in the eastern end both on the surface during visual assessment and in shovel tests, but because the testing was so shallow in this area, the volume of shells was necessarily reduced. As a result, while the relative density of shells in this eastern part of the plaza may actually be similar to the western side, the information potential – particularly through excavation – was dramatically lower.

Overview of Op. 72 Excavation

As mentioned above, the Op. 72 excavation unit was laid out cardinally so that it crosscut the Lopez Plaza in a north-south orientation, straddling the line of shovel tests that yielded the highest volume of marine shells (STPs 007, 019, and 030, each with over 90 g of shell, see **Figure 5.1**). The excavation unit was initially laid out during the January 2024 season as a 1 m wide (east-west) x 30 m long (north-south) trench. The unit was divided into 15 individual squares, each 2-x-1 m (**Figure 5.1**). The squares were designated A through N, with A as the northernmost square of the trench, and N at the southern end. Excavation was initiated in Sq. B and Sq. F. Results from Sq. F prompted the excavation of the southern half of Sq. E. Excavation was also initiated within Sq. K where a cluster of larger limestone cobbles were visible on the ground surface near the edge of the Lopez Plaza where it sloped down to the south. The aim of Sq. K was to expose the construction of the exterior edge of the plaza, but excavations ceased when no facing stones were identified, only what looked like collapsed stone, perhaps serving as the construction of the canal or canoe slip along the edge of the wetland-lagoon. During the January 2024 season, only Sqs. B, E, F, and K were excavated. During the following summer 2024 season, as noted above, an additional square (Sq. O) measuring 1-x-3 m was opened up to the east of this line to capture the edge of an east-west platform wall associated with the southern edge of the Lopez Plaza.

The marine shell and associated artifacts that were deposited over time resemble a dense midden deposit measuring roughly 30 cm thick, which appears to date to the Terminal Classic period (ca. AD 780-900). Excavations in Sq. O provided more architectural context for the midden, indicating that this dense deposit overlay the latest phase of the Lopez Plaza, which consists of a packed earthen floor surface (Zone 22). A low, one course high platform oriented roughly east-west sat on the earthen surface. The low platform borders the southern edge of the Lopez Plaza and may connect with the west side of Str. E-47 (refer to **Figure 5.1**). The Zone 22 surface appears to run underneath this platform suggesting that it predates it. A mix of Terminal Classic material overlies the surface and Early Classic flanged vessel fragments lay flat on the surface of this packed earthen floor, suggesting that the Terminal Classic shell deposit likely post-dates the construction of the Zone 22 earthen surface.

Table 5.2 presents the possible zone equivalencies between Sqs. B, E, F, and O. The vertical exposure in Sqs. B and E revealed that the fill of this packed earthen surface was roughly 30 cm thick and overlay several earlier phases of construction all of which appear to date no later than the Early Classic period (ca. AD 250-600), including at least two plaster floors (Zones 9 and 10 in Sq. B), which overlay several lines of stone with remnants of lime plaster (Zone 12 in Sq. B) and fill in and below these stones. In Sqs. E and F, fragments of stucco mask were recovered, including a large, worked fragment found at the bottom of Zn. 7 that appears to be lying flat at the interface with Zone 13 around 68cmbs. The elevation suggests that the top of Zn. 13 may be equivalent to the top of the Zone 10 floor in Sq. B. At the bottom of Zone 13 in Sq. E a concentration of limestone cobbles and boulders may represent construction fill that is coeval with the Zones 12/17 construction found in Sq. B. For the most part, the excavation approach offered vertical depth, but a relatively narrow horizontal excavation and limited exposure of any associated architectural features and other variations that might be visible in plan view. This limited horizontal exposure inhibits a fuller reconstruction of the Early Classic construction, but reflects the overall aim of the excavation, which was to expose the (Terminal Classic) marine shell deposit visible on the surface.

The earthen surface of the Lopez Plaza upon which this deposit sits was not a formally prepared floor. It lacks any clear plaster or construction fill that is common elsewhere at the site where more development, construction, partitioning of space, and variety of activities has left a clearer delineation in the archaeological record. As a result, this surface was not readily identifiable in Sqs. B, E and F. In Sq. O, the bottom of the large facing stones of the low east-west platform served as a guide for discerning the level of this plaza surface. There were some deposits and observations that were excavated as discrete zones, but in many cases the zones were removed in arbitrary levels throughout the unit. Each zone is discussed below in reference to their specific squares, but for the most part distinguishing between zones was a means of maintaining vertical control either arbitrarily or to capture potentially significant changes in the characteristics of the matrix.

Table 5.2 Zone equivalencies between squares in Op. 72.

Deposit Type	Elev. Below Ground Surface	Square B	Square E	Square F	Square O
Shell midden	~0-35/40 cm	Zones 1/2/3	Zones 1/2/3/4	Zones 1/2/3/4	Zones 1/20/21
Earthen Surface/Fill	~35/40-60 cm	Zones 4/5/8	Zones 4/5	Zones 4/5	Zone 22
Plaster Floor #1	~60-68 cm	Zone 9	Zone 7	Zone 7	unexcavated
Plaster Floor #2	~68-85 cm	Zone 10	Zone 13	unexcavated	unexcavated
Plaster-covered limestone	~85-93 cm	Zone 12/17	Zone 13	unexcavated	unexcavated

Square B

As mentioned above, the intention was to excavate this deposit rather aggressively with the standard arbitrary level thickness at 20 cm. However, it was rarely the case that a full 20 cm was removed before observations warranted a zone switch. This is certainly true of Sq. B where the average thickness of excavation levels was 9.75 cm (**Figure 5.3)**. The first three excavation levels likely represent a single archaeological zone that are representative of the shell midden. They were all the same soil color, texture, general compactness, and yielded a very similar collection of artifacts including marine shells, pottery sherds, high volumes of obsidian, and uncharacteristically high volumes of red-painted-plaster fragments, among other artifact types. The collection in this upper area, which extended to approximately 25.9 cm below surface (cmbs) and did include disturbance at the top associated with recent agricultural activities, was full of marine shell, both broken and whole specimens the majority of which were *Melongena melongena* (see discussion further below).

Switching zones was largely driven by slight changes in compactness or, more often, changes in the density of limestone inclusions within the soil that was interpreted as a possible early indicator that the excavation was reaching a floor level. Although no packed earthen floor was readily identifiable, it likely was represented by Zone 4 (see below and **Table 5.2**). Another factor that drove zone changes was the distribution of the marine shells themselves that were recovered at a fairly consistent, moderate density but occasionally manifested as higher concentrations or clusters, as is the case with Sq. B, Zn. 2 (**Figure 5.4**).

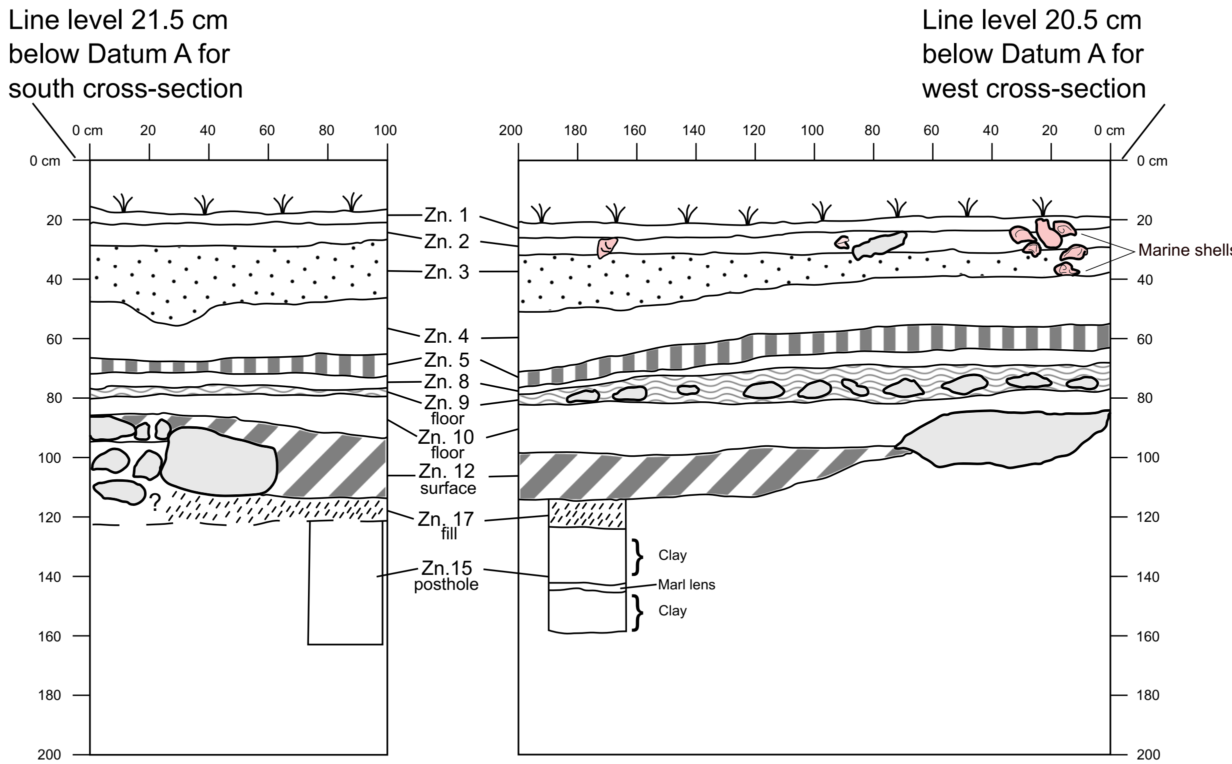

Figure 5.3 Cross-sections of the south and west walls of Op. 72, Sq. B (maps drawn by E. Harrison-Buck, digitized by J. A. Biggs).

Figure 5.4 Cluster of marine shell found in Op. 72 Sq. B Zn. 2 (photos by J. A. Biggs).

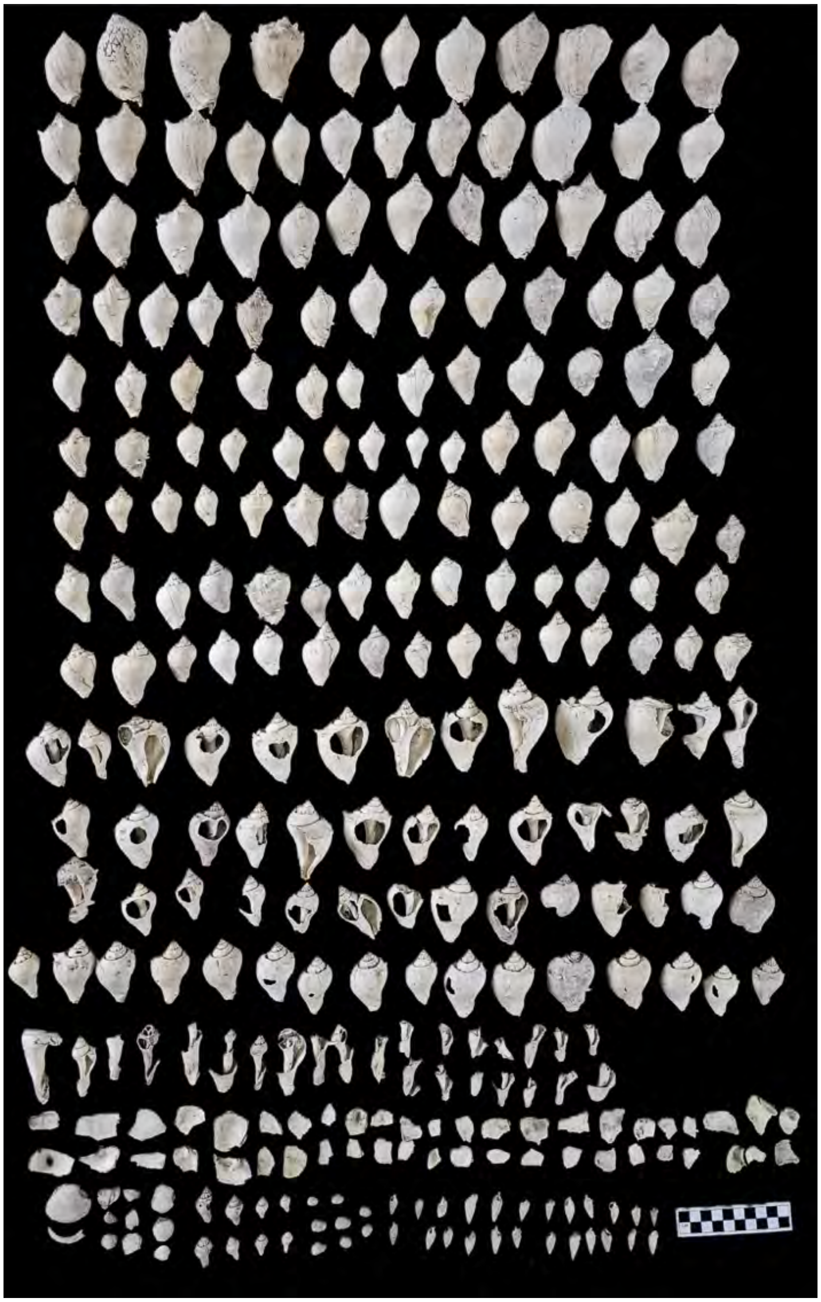

Figure 5.5 Marine shells and shell fragments found within Sq. B, Zn. 2 (photo by J. A. Biggs).

The first ~25-30 cm of excavation was characterized by a very high density of marine shells, both broken and intact (**Table 5.3, Figure 5.5**). Towards the bottom of Zone 3 (henceforth "Zn.") the density of these shells declined dramatically, and in Zn 4 no complete shells were recovered, only a lighter density of broken fragments, and almost none were recovered from deeper levels. In fact, only one deeper zone (Zn. 6) in Sq. B included marine shell and this was a potentially intrusive pit feature initially identified as a posthole due to its very roughly circular (17-x-22 cm) appearance and very loosely consolidated soils. This feature cut into Zn. 4, which as noted above appears to be the earthen surface equivalent to Zn. 22 in Sq. O (**Table 5.2**). This is based on comparative elevations and similar characteristics of the matrix.

Table 5.3 Results of Op. 72, Sq. B.

Zone	Soil Matrix			Contents
	Color	Texture	Avg. Thickness (cm)	
1	10 YR 3/2	Silty clay loam	8.8	Chert debitage, marine shell, obsidian, pottery sherds
2	10 YR 3/2	Silty clay loam	5.2	Charcoal, animal bone, chipped stone tool, debitage, marine shell, obsidian, pottery sherds
3	10 YR 3/2	Silty clay loam	11.9	Animal bone, debitage, freshwater shell, human bone, marine shell, obsidian, pottery sherds, plaster/mortar
4	10 YR 4/2	Sandy loam	19.9	Large (queen) conch frags, animal bone, debitage, freshwater shell, marine shell, obsidian, spondylus bead (?), pottery sherds
5	10 YR 4/2	Sandy clay loam	6.4	Animal bone, debitage, freshwater shell, obsidian, pottery sherds,
6	10 YR 2/2	Fine sandy loam	12	Marine shell,
8	7.5 YR 5.3	Silty sandy loam	3.8	Animal bone, debitage, obsidian, pottery sherds
9	10 YR 5/4 2.5 YR 8/2	Plaster	6.9	Charcoal, burned limestone, chipped stone tool, debitage, pottery sherds
10	10 YR 5/3 2.5 YR 8/3	Plaster/sascab	13	Animal bone, chipped stone tool, freshwater shell, obsidian, pottery sherds, plaster/mortar
11	10 YR 4/3	Sandy clay loam	6	Debitage, pottery sherds
12	7.5 YR 8/3	Plaster/Silty sand	12.1	Animal bone, debitage, freshwater shell, pottery sherds
15	10 YR 3/2 10 YR 8/3	Silty clay Clay marl Sandy clay	65	Animal bone, shipped stone tool, debitage, freshwater shell, marine shell, pottery sherd (deep test posthole)
17	10 YR 3/2	Silty clay loam	11	Pottery sherds

Excavation ultimately revealed that Zn. 6 was probably not a posthole due to its shallowness. This one instance of deeper recovery of marine shell is likely related to some kind of intrusive behavior and suggests that the Zn. 6 pit feature is likely a product of the Terminal Classic activities taking place on the earthen surface. The Zn. 4 surface slopes down to the south and may have been subject to a series of enigmatic pit features relating to the shell production activity (see **Figure 5.3**). A high density of large sherd fragments was reported lying flat on the Zn. 4 surface in Sq. B. Similar deposits of large sherds were also noted in Sq. F and also in Sq. O, also lying flat on the Zone 22 earthen surface (see below). Ceramic analysis for Op. 72 is ongoing, but a preliminary analysis of material suggests that much of the diagnostic material is Terminal Classic debris overlying the earthen floor. However, flanges diagnostic of the Early Classic period were also reported lying flat on the surface of Zone 22 in Sq. O, suggesting a mix of material. The midden debris overlying the Zn. 4 earthen surface in Sq. B is particularly dense, more so than in other squares excavated in Op. 72. While the shell midden appears to be entirely filled with Terminal Classic ceramics, it is possible that the earthen floor was constructed earlier. Reports of flanges were noted further below in Zone 7 in Sqs. E and F, suggesting that the earlier phases of architecture probably date no later than the Early Classic period.

Aside from the intrusive Zn. 6 pit, there are no clear architectural features associated with the shell concentration within Sq. B (nor in Sqs. E and F). Excavation of the upper levels identified no clear floors or surfaces; no stones representing fill, ballast, or retaining walls; nothing providing particularly strong differentiation between any portions of the shell deposit; and no real insight into the nature or method of plaza construction. It was only once Sq. O was excavated that the Zn. 4 matrix in Sq. B was identified as a possible correlate with the Zn. 22 earthen floor in Sq. O. The matrix of this earthen surface measures roughly 25-30 cm thick and encapsulates both Zns. 4, 5, and 8 in Sq. B (and Zones 4 and 5 in Sqs. E and F), all of which are virtually indistinguishable and together represent the fill of this packed earthen plaza floor (refer to **Table 5.2**).

At deeper levels, more architectural clarity was present with Zn. 9 in Sq. B where, at about 60 cmbs, an intact plaster floor was encountered (with a thin lens of terminal debris overlying the floor that was removed as Zone 8 directly above it). Below the Zn. 9 floor a second plaster surface was identified as Zn. 10 at approximately 8 cm deeper (**Figure 5.6**). The deposits associated with these, both directly above and below, continued to yield debitage and pottery among other artifacts, but the obsidian volume seems to have decreased significantly, and the marine shell is absent altogether. Some larger stones were identified near the bottom of the excavation (Zn. 12) in Sq. B, consisting of two parallel lines of roughly hewn stone that were partially covered with plaster (**Figure 5.7**). These may have served a structural or retaining function but unfortunately not enough of these stones were exposed to fully understand their orientation or relationships. However, they may be associated with the cluster of limestone identified at the bottom of the excavation in Sq. E defined as Zn. 13 (**Table 5.2**). We suspect that these stones represent a layer of core fill underlying the plaster seen on the surface of Zn. 12 in Sq. B (**Figures 5.3** and **5.7**). Given the sequence of discovery and exposure of these various elements alongside different zones within other squares, the recovery of materials from that core fill was collected separately as Zn. 17 in Sq. B. Excavation within the entirety of Sq. B was terminated at this point as both the shell feature and the underlying platform construction had been sufficiently investigated.

Figure 5.6 Mid-excavation of the Zn. 9 plaster floor in Sq. B with the Zn. 10 plaster floor partially exposed to the south (photo by J. A. Biggs).

Following the termination of general excavation in Sq. B, a posthole was extended to get an overview of the profile to greater depths. This posthole (Zn. 15) was excavated in the southwest corner of Sq. B down to an elevation of 146 cmbs and the matrix continued to yield a moderate volume of pottery sherds from silty clay soils that then transitioned to a clayey marl, terminating with compact limestone (possibly bedrock; see **Figure 5.7**).

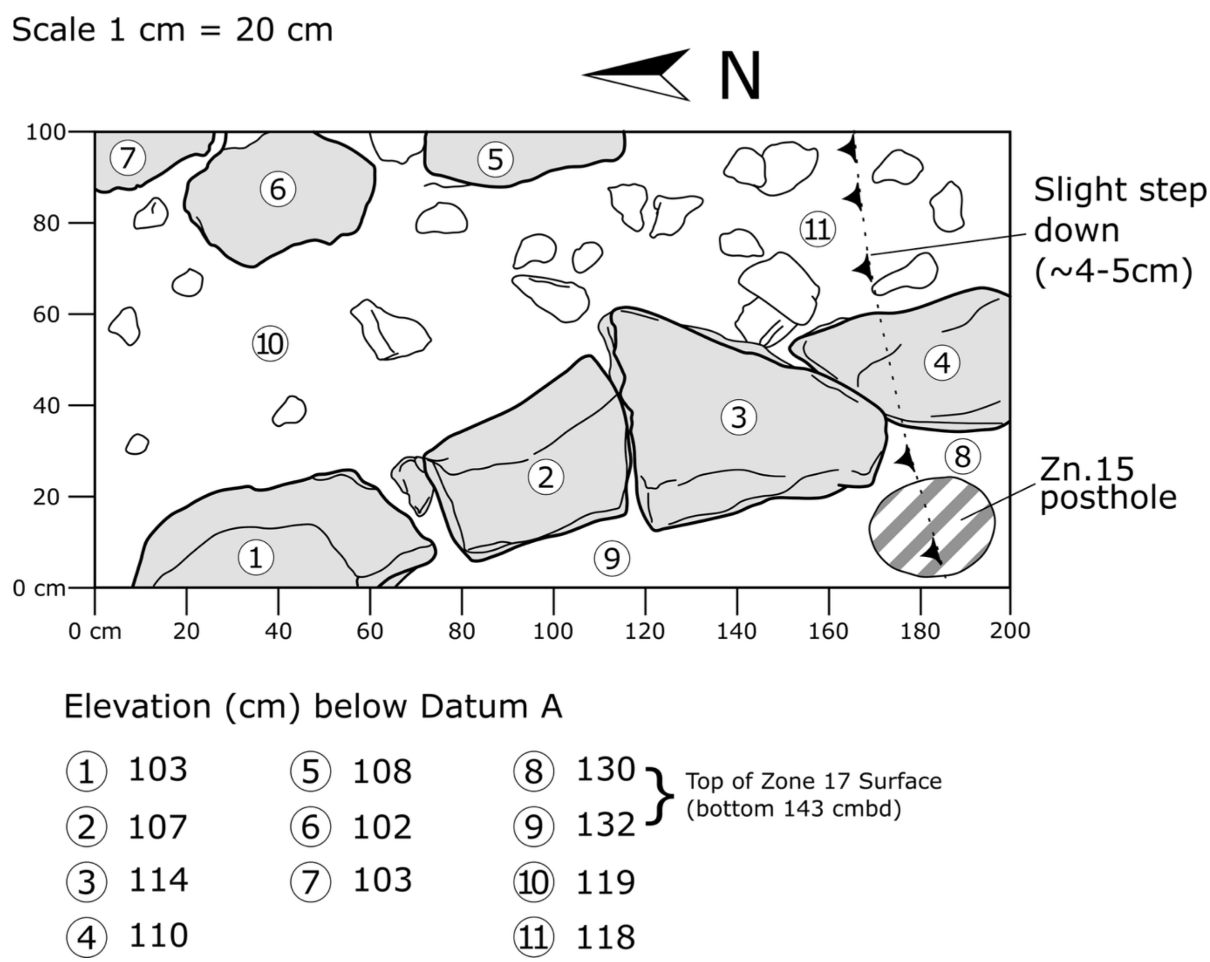

Figure 5.7 Final planview of Op. 72, Sq. B showing top of Zone 12 and the Zone 15 posthole (map by E. Harrison-Buck, digitized by J. A. Biggs).

Square F

Sq. F was excavated concurrently with Sq. B, with Sqs. C, D, and E initially left unexcavated. As is discussed below, Sq. E was eventually opened based on observations in Sq. F (see below). As this narrative is being presented chronologically, these two squares, F and E, are presented out of alphabetical order. Because Sq. B was slightly 'ahead' of Sq. F, excavation in Sq. F was able to proceed a bit more rapidly – with a better understanding of the nature of the overall deposit, fewer observations warranted zone/level switching. However, although the average zone thickness in Sq. F was slightly higher than Sq. B at 11.7 cm (**Table 5.4**), the bottom of Zn. 3 in Sq. F did not extend quite as deep as Sq. B and therefore portions of Zn 4 in Sq. F continued to yield evidence of the marine shell midden deposit well into this zone, probably indicative of a gradual slope of the earthen plaza surface in this area (**Figure 5.8**).

Table 5.4 Results from Op. 72, Sq. F.

Zone	Soil Matrix			Contents
	Color	Texture	Avg. Thickness (cm)	
1	10 YR 3/2	Silty clay loam	3.6	Chert debitage, marine shell, obsidian, pottery sherds
2	10 YR 3/2	Silty clay loam	11.3	Animal bone, debitage, marine shell, pottery sherds
3	10 YR 3/2	Silty clay loam	7.1	Animal bone, debitage, obsidian, pottery sherds
4	10 YR 3/2	Silty clay loam	19.9	Animal bone, debitage, freshwater shell, marine shell, obsidian, pottery sherds
5	10 YR 3/2 10 YR 4/2	Silty clay loam	18.5	Chert debitage, marine shell, obsidian, pottery sherds
7	10 YR 3/2 10 YR 4/2	Silty clay loam	9.7	Debitage, marine shell, human bone, obsidian, pottery sherds, decorated stucco mask

Overall, Sq. F had both a substantially lower volume of artifacts and significantly lighter density of marine shells, even from the uppermost excavation levels. It does seem like the zone followed a similar density trajectory, markedly decreasing after the first 25-30 cm. Interestingly, marine shell continued to be recovered throughout the excavation of Sq. F, unlike in Sq. B where shells effectively disappeared after a certain depth. This may indicate that the earthen surface of the plaza slopes downward to the south or is the result of more intrusive pit disturbance, perhaps visible in the north profile of Sq. E (**Figure 5.9**).

Because Sq. F did not yield as much information about the marine shell deposit or provide clarity about the nature or sequence of plaza construction, it was terminated at about 100 cm below datum around the bottom of Zone 7. However, during the excavation of the final zone (Zn. 7) in Sq. F, a fragment of a decorated plaster stucco mask fragment was found lying face-down at the bottom of Zone 7 marking the interface with Zone 13. Presumably, the stucco fragment was resting on an earlier surface and although there was no floor readily apparent in either Sqs. F or E, the elevation of Zn. 13 ~68 cmbs is roughly equivalent to the level of Zone 10 Plaster Floor #2 in Sq. B (see **Table 5.2**). While reconstructions of this and other stucco fragments found in excavations are ongoing, we wonder if this is a portion of a Maya Venus (*Lamat*) sign that was part of a stucco façade similar to one found encircling the El Diablo Pyramid at the Maya Peten site of El Zotz dating to the Early Classic period (**Figure 5.10**).

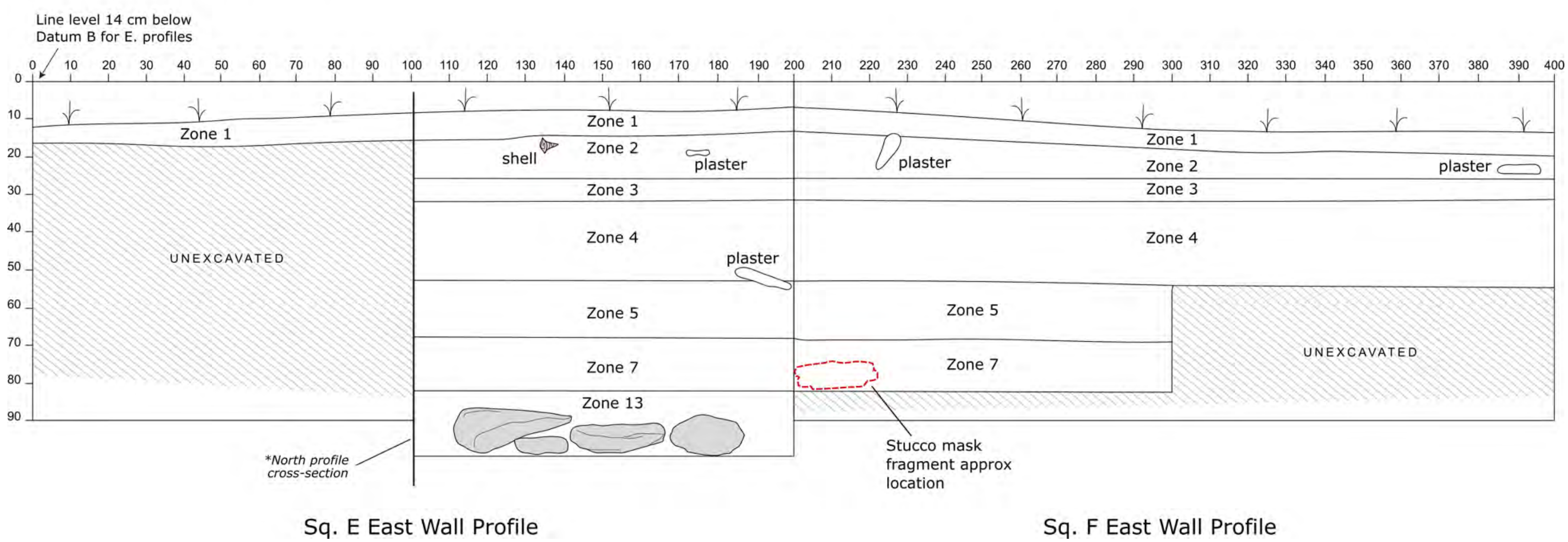

Figure 5.8 East wall profile of Op. 72 Sqs. E and F (drawn by C. Day, digitized by M. Brouwer Burg and J. Biggs).

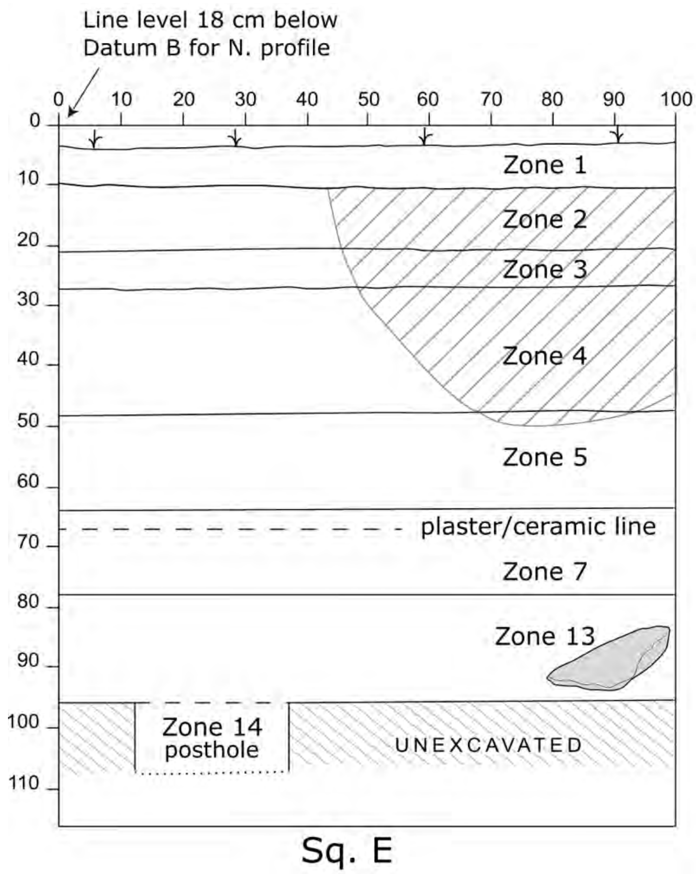

Figure 5.9 North wall profile of Op. 72 in the middle of Sq. E (drawn by C. Day, digitized by M. Brouwer Burg and J. Biggs).

Square E

The decorated stucco mask found within Sq. F was located directly at the square's northern edge of the unit wall abutting the southern edge of Sq. E. There were indications that more of the stucco mask might extend farther north. As this particular artifact seemed like it might represent a different type of activity or event from the marine shell – and potentially one from an earlier stage in the site's development – it warranted further investigation in Sq. E. Since the interest at this point was specifically the investigation of that deeper potential feature, only the southern half of Sq. E was opened. Similar to Sq. F, and in comparison to Sq. B, Sq. E yielded a lower density of marine shells, but the presence of marine shell continued throughout the entire vertical deposit, albeit in relatively low numbers (**Table 5.5**). Again, this may be the result of intrusive pits cutting into the earthen surface upon which the shell midden was overlying (**Figure 5.9**). Other recorded characteristics with regard to soil type, density, and general archaeological assemblage were also, unsurprisingly, quite similar to Sq. F. Like Sq. F, no architectural elements or intact floors were readily identifiable within Sq. E, namely the presence of Plaster Floors #1 and #2 (Zones 9 and 10) found in Sq. B. However, after careful study and comparisons of the zones in terms of the matrix and elevations, the feature denoted as a plaster/sherd line in the north wall cross-section of Zone 7 in Sq. E is likely the remnants of Plaster Floor #1, referred to as Zone 9 in Sq. B (see **Figure 5.9** and **Table 5.2**).

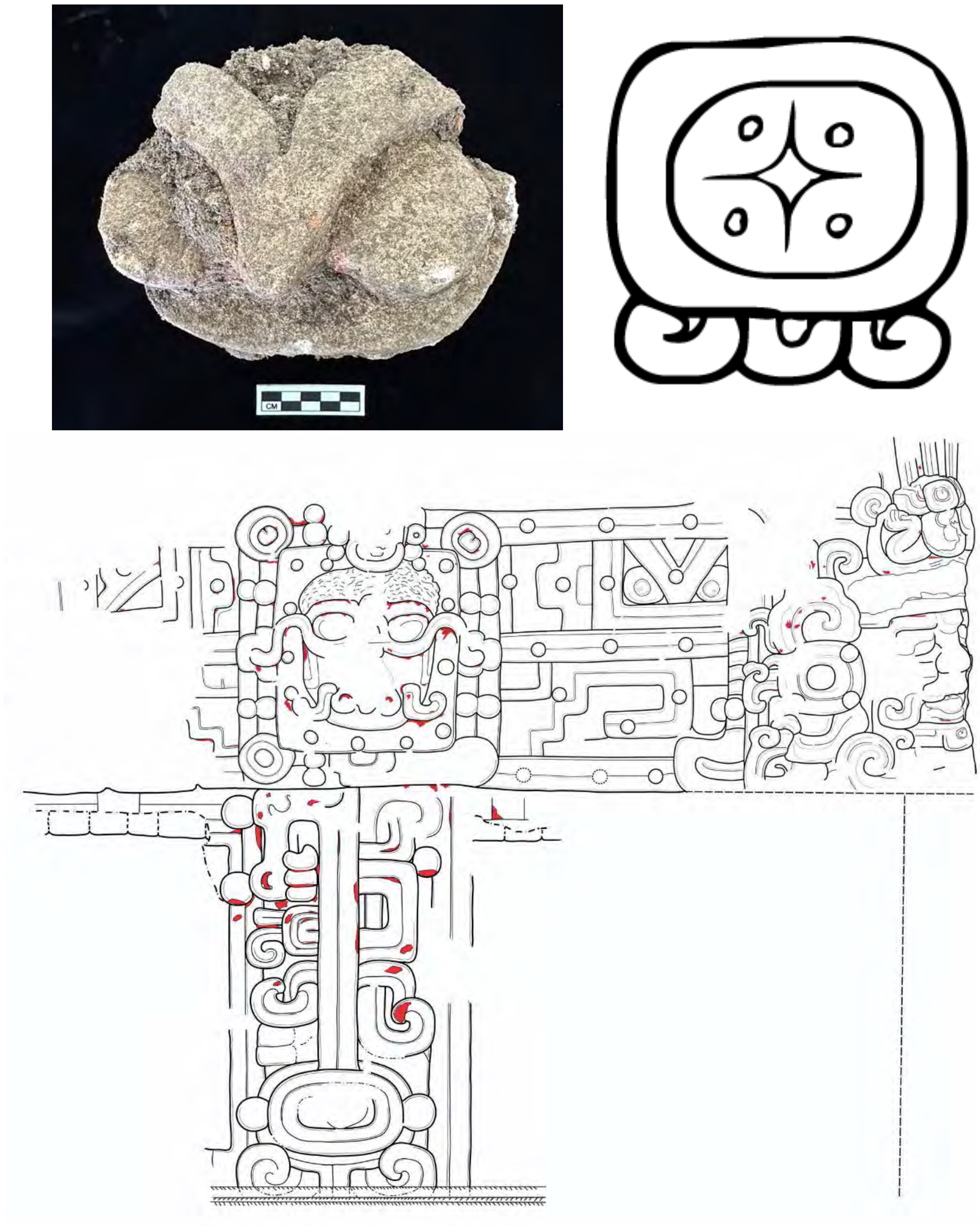

Figure 5.10 Top left: stucco mask fragment with remnants of red paint found in Sq. F, Zn. 7 (photo by M. Brouwer Burg); Top right: image of Maya Venus (Lamat) sign (Creative Commons); Bottom: Stucco mask showing Venus or star sign in sculpted band encircling the El Diablo Temple at El Zotz (after Taube and Houston 2015: Fig. 5.6).

Excavation of Sq. E reached the target depth for the recovery of the decorated stucco mask defined at the northern edge of Sq. F. The fragment of stucco was also removed as Zn. 7, although it likely rested face-down on the surface of Zn 13, which as noted above is likely equivalent to Plaster Floor #2 (Zn 10) in Sq. B (**Table 5.2**). Additional fragments of the stucco mask were recovered from Sq. E, though these were smaller and less elaborately decorated. The distribution of the stucco fragments showed no pattern indicative of any particular event or behavior, although presumably they represent the remains of a building façade that was dismantled in antiquity. Excavation continued in Sq. E beyond the depth of the stucco fragments in an effort to gather more information about the overall chronology and construction sequence of the plaza area. A cluster of limestone cobbles and boulders concentrated on the east side of Sq. E was exposed at the bottom of Zone 13 (**Figure 5.11**). Based on the elevations and configuration of stone, it is likely that this cluster of limestone is coeval with the two lines of stone found in Zn 12 in Sq. B, perhaps representing associated construction fill (**Figures 5.7** and **5.8**; **Table 5.2**). The limited horizontal exposure inhibits a fuller reconstruction for this earlier building phase. At the base of Zone 13, a posthole excavation (Zn. 14) was dug down to an elevation of 157 cmbd similar in depth to the Zn. 15 posthole in Sq. B. This posthole helped to tie in the sequence to Sq. B, as it yielded pottery sherds from silty clay that transitioned to clay, marl, and ultimately to solid limestone between 123-130 cm below surface.

Table 5.5 Results of Op. 72, Sq. E.

Zone	Soil Matrix			Contents
	Color	Texture	Avg. Thickness (cm)	
1	10 YR 3/2	Silty clay loam	6.6	Chert debitage, marine shell, obsidian, pottery sherds
2	10 YR 3/2	Silty clay loam	9.8	Animal bone, debitage, marine shell, pottery sherds
3	10 YR 3/2 10 YR 4/2	Silty clay loam	11.9	Chert debitage, marine shell, obsidian, pottery sherds
4	10 YR 3/2	Silty clay loam	22.1	Debitage, marine shell, human bone, obsidian, pottery sherds
5	10 YR 3/2 10 YR 3/3	Silty clay loam	15.3	Animal bone, debitage, human bone, marine shell, obsidian, pottery sherds
7	10 YR 3/2 10 YR 2/1	Silty clay loam	10.34	Stucco mask fragments, painted plaster
13	10 YR 3/2 10 YR 5/3	Silty clay loam	12.2	Animal bone, debitage, marine shell, pottery sherds
14	10 YR 3/2 10 YR 8/2 10 YR 8/3	Clay loam	43	Pottery sherds (deep test posthole)

Figure 5.11 Bottom of Zone 13 showing cluster of limestone (photo by C. Day).

Square K

The excavation of Sq. K was a minimal, exploratory effort to try and better understand the nature of the plaza construction underlying the shell deposit. As the overall Op. 72 trench ran north to south, Sq. K was quite a bit farther to the south from the focus of activity where the shells were most densely deposited. This square was selected as it marked the southernmost edge of the Lopez Plaza and might provide insight into the architectural feature and context of the shell deposit. There was also some exposed stone here on the surface that appeared as though it might represent an *in situ* retaining wall (**Figure 5.12**). Based on visual assessment and shovel testing, there was no reason to think this square would yield any useful information regarding the shell deposit itself. The aim of the excavation was to systematically clean that area up enough to explore whether, in fact, it was likely to yield any information regarding construction.

Only two zones/levels were excavated in Sq. K – the top zone which yielded the same assemblage seen elsewhere (including some marine shell but not a high density), and then some excavation into what may be simply collapse debris that was excavated as Zn. 16 (**Table 5.6**). This effort did not yield any particularly valuable information regarding the site or the plaza construction, and certainly not the shell feature. Once these two zones were excavated, the Sq. K excavation was terminated after no facing stones were identified in the jumble of stone. The heap of stone resembles collapse debris sloping off the plaza's edge but could represent part of a roughly hewn barrier retaining wall seen elsewhere lining the edges of the low-lying, wetland-lagoon area to the south and west of Lopez Plaza (see **Figure. 5.1**).

Figure 5.12 End of Zn. 1 in Sq. K with arrows indicating possible architectural stones for a platform retaining wall (photo by J. A. Biggs).

Table 5.6 Results of Op. 72, Sq. K.

Zone	Soil Matrix			Contents
	Color	Texture	Avg. Thickness (cm)	
1	10 YR 2/2	Sandy loam	6.7	Chipped stone tool, debitage, ground stone tool, marine shell, pottery sherds
16	10 YR 3/2	Silty clay loam	15.3	Pottery sherds

Square O

Only Sqs. B, E, F, and K were excavated during the January 2024 field season. However, during the following summer season in 2024, Sq. O was opened up. This 1-x-3 m unit is located around a 50 cm east of where the original Op. 72 trench was laid out, east of Sq. G with its northwest corner located roughly 1 m from the southeast corner of Sq. F (see **Fig. 5.1**). During the summer season, fires raged around the site of Altun Ha and heavy machinery was brought in by the landowners to create a fire barrier by scrapping the surface and removing any vegetation that might fuel the spread of fire. During this process, members of the BREA team observed a line of facing stones oriented roughly east-west and extend to the west of Str. E-47. This line of stone marks the northern edge of a low platform running along the south side of the Lopez Plaza.

Most of the 1 x 3 m unit encompassed the low, one course high platform structure (**Figure 5.13**). Of the 3 m long unit, 120 cm of the platform was exposed and the last 80 cm on the northern end of Square O exposed a portion of the earthen plaza floor (Zn. 22). The shell midden was concentrated in the northern end of the square directly overlying the Zn. 22 plaza floor area and almost completely covered the front facing stones of the platform. Whole shells and Terminal Classic ceramic sherds were found throughout Zns. 1, 20, and 21 (see **Table 5.7**). Zn. 21 is fairly level and contained many chunks of plaster and sherds that appeared to be lying flat, suggesting this may be a floor surface associated with the platform (although it may be simply a compact lens of debris that accumulated and should be considered part of the midden). Zn. 21 was filled with Terminal Classic ceramics, lithic materials, and marine shells. The collapse and terminal debris overlying the platform (Zn. 19) and the fill of the platform itself (Zns. 24 and 25) also contained evidence of whole and fragmentary shell, suggesting its construction is coeval with the shell midden (**Table 5.7**).

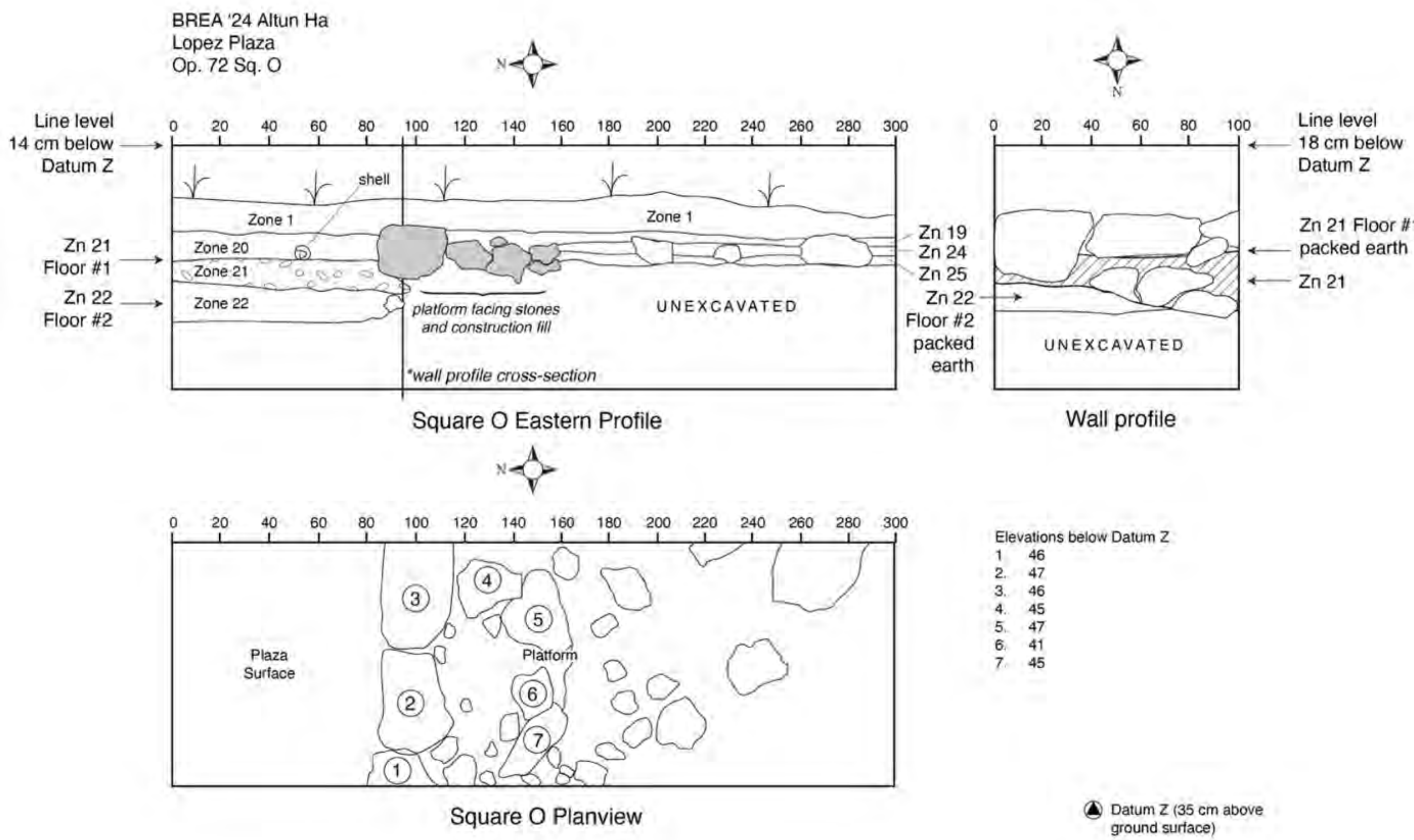

Figure 5.13 Profile and cross-section drawings of Op. 72 Sq. O (drawn by E. Harrison-Buck digitized by M. Brouwer Burg).

Table 5.7 Results from Op. 72, Sq. O.

Zone	Deposit Type	Soil Matrix			Contents
		Color	Texture	Avg. Thickness (cm)	
1	Topzone/Midden	10 YR 2/2	Silty clay loam	13.8	Med.-high density: Chert debitage, chert tool fragment, marine shell, obsidian, pottery sherds
19	Collapse/Terminal debris on Platform	10 YR 2/2	Silty clay	4.0	Med. density: Animal bone (fish vertebrae), debitage, marine shell, pottery sherds
20	Midden	10 YR 3/2	clayey	7.8	Med. density: debitage, marine shell, pottery sherds
21	Midden/surface?	10 YR 3/3	clayey	15.8	Med. density: debitage, marine shell, and pottery sherds
22	Plaza surface	10 YR 3/2	Silty clay	14.2	Med. density: Animal bone, debitage, chipped tool, freshwater shell, pottery sherds
23	Platform facing stones	unexcavated	unexcavated	unexcavated	
24	Platform construction fill	10 YR 3/2	clayey	4.6	Light density: debitage, chipped tool, marine shell, pottery sherds, plaster/mortar
25	Platform construction fill	10 YR 4/2	clayey	9.4	Light density: debitage, chipped tool, marine shell, pottery sherds

Large ceramic sherds were found lying flat on the surface of Zn. 22. This earthen floor surface also contained chunks of plaster and had a high density of artifacts (many that appear to date to the Late-Terminal Classic), but most of the shell lay heaped over top and the Zn. 22 floor appears to run underneath the facing stones of the one-course high platform (see cross-sections in **Figure 5.13**). This suggests that the Zone 22 surface pre-dates the shell deposit and the platform construction. Excavations on the platform yielded additional marine shell with not only the terminal debris on the surface (Zns. 1 and 19), but also from in the construction fill of the platform itself (Zns. 24 and 25). Although few diagnostic sherds were recovered from the fill contexts, a total of 13 shells were collected from the Zn. 24 fill, suggesting that the low platform dates to at least the Terminal Classic period.

Table 5.2 presents the zone equivalencies between Sq. O and the other units of excavation. As noted above, the vertical exposure in Sqs. B and E revealed that the fill of the packed earthen surface below the shell layer was roughly 30 cm thick and overlay several earlier phases of construction all of which appear to date no later than the Early Classic period (ca. AD

250-600). This is corroborated by the portion of Zone 22 that was excavated to roughly 50 cmbs. At the bottom of this zone, a number of Early Classic flanged vessel fragments were recovered suggesting an earlier phase of occupation/construction below the Terminal Classic shell deposit. Excavations in Sq. O stopped at this level once the association of the shell deposit and latest architectural features (earthen floor and platform) were clarified.

Interpretations and Conclusions

The objective of the visual assessment, shovel testing, and Op. 72 excavation were to investigate the nature of the marine shell deposit originally identified during reconnaissance in 2022. These efforts characterized the deposit's horizontal and vertical distribution, its relationship with the Lopez Plaza on which it was found, and its context with regard to the surrounding Altun Ha site architectural components. This includes the low, one-course high platform feature discovered during excavation of Sq. O, which was built directly on top of the Zn. 22 earthen surface of the Lopez Plaza. The earthen floor of the plaza that was roughly 30 cm thick was not formally prepared as a plastered floor surface with ballast, but in this part of the Lopez Plaza it appeared as a more informal packed surface that served as a production locale primarily for shell-working.

Excavation and surface collection recovered evidence of the artifact assemblage associated with the marine shells. This roughly 30 cm thick deposit of marine shell and associated artifacts appears to represent a dense midden built up over top of the packed earthen floor of the Lopez Plaza. Nearly all of the ceramics associated with the shell midden appear to date to the Terminal Classic period (ca. AD 780-900). The construction of the Zn. 22 earthen surface of the Lopez Plaza may pre-date this latest phase of occupation as a mix of Terminal Classic material and Early Classic flanged vessel fragments were found associated with this packed earthen floor.

Deeper levels of the Op. 72 excavation units provide insight into the development of this part of Altun Ha, prior to the activities that deposited the shells. A full understanding of the chronology requires additional analysis of the data collected, but some initial observations are worth noting here. The architecture exposed underneath the earthen plaza, including two plaster floors and the lines of stone at the lowest levels of Op. 72, suggest they likely date to at least the Early Classic period based on the presence of flanged vessels. Additional support for this date also includes evidence of small and large fragments of painted stucco, which suggests that during this time buildings decorated with red painted stucco masks were dismantled and the fragments were scattered in these early levels. At least one of the stucco buildings targeted for destruction was a ceremonial structure with Venus or star imagery. An example of such iconography is found on an Early Classic stucco mask encircling the façade of the Temple of the Night Sun at the Peten site of El Zotz (Taube and Houston 2015). Earlier examples of stucco masks are found in the Late Preclassic at numerous Maya sites, such as El Mirador in Peten, Guatemala and

Cerros and Lamanai in northern Belize. While the general concept of Venus as the morning and evening star appears in Preclassic contexts elsewhere in Mesoamerica, the form of the Venus (star) sign like the one found at Altun Ha and also seen in the stucco mask at El Zotz makes its first appearance in the Maya area during the Early Classic period (see **Figure 5.10**). Further analysis is necessary, but it seems likely that the example from Altun Ha may be roughly coeval in date to the example from El Zotz.

A Word on Shell Identification

While we did not have access to a faunal specialist during the field research, we have since confirmed that the species found throughout the shell deposit described here is *Melongena melongena*, a species of marine gastropod mollusk that prefers shallow and brackish, estuarine conditions during development, often in mangrove swamps, and can transition to full marine conditions upon reaching adulthood. *M. melongena* is related to crown conch and is typically brownish in coloration while living (**Figure 5.14**). All of the shell recovered in this fieldwork had been bleached to a shade of white, indicating that the shell had been exposed to much sun prior to burial.

Figure 5.14 Left: *Melongena melongena* shells before bleaching (source: https://en.wikipedia.org/wiki/Melongena#/media/File:Melongena_melongena_01.JPG). Right: Some of the sun-bleached shells found in Zone 2 of Sq. B (photo by C. Day).

Chronology

The data recovered from all of the methods described above, but particularly the controlled unit excavation, sheds light on the chronology of site development in this portion of Altun Ha. The distribution of the shells themselves, concentrated very clearly within the uppermost levels of excavation, strongly indicates that the activities that resulted in this shell feature took place during a later stage of site use. Preliminary analysis of the ceramics within the shell layers tentatively suggests a Terminal Classic date. The presence of flanged vessels in lower levels beginning in Sq. O around 50 cmbs at the bottom of the Zn. 22 earthen plaza fill suggests an Early Classic occupation in the lower levels. This sequence suggests that there may be a break in occupation during the Late Classic period (ca. AD 600-750). A more refined understanding of the chronological sequence will have to await a comprehensive analysis of the recovered artifacts from each zone, in particular the ceramics directly associated with the shells compared to those from deeper levels.

At this point, this is evidently true of the large earthen plaza floor on which shells are distributed; the shells were deposited late into or after its construction and toward the end of its use. However, some questions remain. For example, what is the relationship between the shell feature and the plaza area itself? We know the activities that deposited the shells occurred after the construction of the latest plaza surface, but we do not yet know whether it was immediately after – suggesting possibly that the plaza was built up (perhaps with some recycled Early Classic materials) specifically as an activity area for working shell. Alternately, this plaza may have existed in this location for a long time and was only selected as a suitable activity area for shell working much later than its construction. A better understanding of the ceramics recovered through the vertical profile will shed light on this question and help explain how the presence of the decorated stucco mask fragments fit into the site development.

Similarly, we do not currently know the exact chronological relationship between the plaza and the other architectural elements immediately surrounding it. For instance, when precisely was the low platform that lines the southern edge of the Lopez Plaza constructed and how does it relate to the history of shell production in this locale? While it seems that it does not pre-date this activity, is it coeval or does it post-date it? We do know from the visual assessment and shovel testing – and from Op. 74 (see **Harrison-Buck et al., Chapter 7**) – that the distribution of marine shells is not exclusive to the area investigated in Op. 72. Shells were found across the entirety of the Lopez Plaza, albeit in varying concentrations continuing to the east all the way to the Altun Ha site center fence line.

Given that at least at the time of the investigations presented here, the shell feature was a surface and near-surface manifestation, it is possible that other factors are responsible for the wider distribution of the shells. For instance, we do know that the area was modified in recent years as part of its use in various agricultural endeavors including as a garden, an orchard, and a pasture. It is possible that the marine shell feature was initially far more concentrated and contained and that the spread across the site is due to the post-depositional impacts of this modern farming activity. Some modern push piles around Str. E-66 that contained several marine shells were noted in the excavation of Op. 74. However, the stratigraphic excavations in Op. 74 that exposed a portion of the Lopez Plaza area on the west side of Str. E-66 did not show nearly the concentration of whole or partial marine shell that was found to the west in Op. 72. Here, evidence of shell bead production was a more prominent activity (see **Harrison-Buck et al., Chapter 7** for further discussion).

The shovel testing indicated that in moving to the east and south across the Lopez Plaza, the architectural modification changes from the earthen construction of the plaza hosting the highest concentration of marine shells, to a much more consolidated stone construction fill that is basically impenetrable through standard shovel testing excavation methods. For instance, STPs 31-36 running along the southern edge of the Lopez Plaza encountered compact stone and as a result were shallow in depth (average depth 12.5 cmbs [see **Table 5.1** and **Figure 5.1**]). This is probably because STPs encountered the low, one course high platform that was exposed in Sq. O and observed on the surface along the southern edge of the Lopez Plaza running east to where it met up with the west side of Str. E-47.

The only other area of STPs that encountered a similar fill and were equally shallow (average depth 12 cmbs) were STPs 10-16 in the far eastern part of the Lopez Plaza where investigations also encountered a core fill of stone (see **Table 5.1**). The limestone fill that was noted in these STPs is likely the remains of an elevated basal platform that underlies Strs. E-47 and E-66, which together form a small plazuela group on the east side of the Lopez Plaza (see **Figure 5.1**). A portion of this basal platform was exposed in excavations of Str. E-66 investigated by Op. 74 (**Harrison-Buck et al, Chapter 7**). Here, the initial construction of this building sat on a one course-high basal platform (see Terrace II in **Figure 7.4**), which steps down to an earlier surface of the plaza floor on the west side of the structure. If the edge of this basal platform extended to the south and met up with Str. E-47, then it is possible that it cornered with the long, one-course high platform running east-west along the southern border of the Lopez Plaza (exposed in Sq. O and observed on the surface). This would have effectively created a "sunken" plaza space of mostly packed earthen fill that contained the shell-working activity and served to separate this production space from the elevated plazuela group to the east.

Associated Artifact Assemblage

During visual assessment, shovel testing, and excavation of the upper levels of Op. 72, non-shell artifacts were also recovered within the shell deposit, which shares some characteristics of a midden. A more thorough characterization of this associated assemblage awaits ongoing inventory and analysis. However, if observations documented during the field investigation hold, then there are certain patterns with possible implications. For example, while there were a variety of artifact types intermixed with the marine shells in this feature, it did not appear to include either the diversity or relative volumes of what might otherwise be associated with a generic household midden or other standard type of occupation. The volume and density of shells compared to other artifact categories strongly supports the interpretation of this site upon its discovery – that it represents a different, specific type of activity area centered on the processing of the marine shells themselves.

Based on observations during fieldwork, it does seem that another artifact type is represented in what might be considered higher-than-expected abundance among the shell feature: lithic tools. Several large, complete or partial chert blades were identified immediately – on the surface during the visual assessment. This tool type continued to be seemingly overrepresented throughout excavation. The same is true of obsidian blades and blade fragments in Op. 72 as well as Op. 74 (see **Harrison-Buck et al., Chapter 7**). Again, confirmation of this observation, and any deeper understanding of its potential significance, must await ongoing quantification and analysis, but the initial simple inference is that the feature represents a specific activity area in which shells were being worked to whatever end using a toolkit of various lithic blades and blade types for piercing and cutting activities, also evident in the modification of some of the marine shells, as described below.

Marine Shells

The key element of the feature investigated by the Op. 72 excavation and associated assessment and testing was, of course, the marine shells themselves. As with all topics introduced above, these will be better understood following the completion of future analyses. Again, similar to above, some patterns and observations from the field and initial processing may provide insight. For example, shells were inspected for any patterns of modification that might suggest how they were used or processed prior to deposition. Certain characteristics, such as angled cuts on the distal end or spire might suggest use of the shells as materials for tool manufacture. Small holes or slits around the crown of the shells could be indications of meat extraction – particularly extraction of the raw marine meat. In fact, it appears that both of these modifications, and others, are represented among the collection. However, none of the modifications appear in a great enough density to confidentially suggest that they represent the primary activity or intention underlying the feature.

There are observably different types of marine shell in the collection, distinguishable among specific characteristics including the presence and prominence of spines versus smoothed exteriors. Further analysis is necessary to confidently confirm whether the different characteristics represent age, sex, environment, species, subspecies, or other distinctions. Once those categories are better understood, quantification can help suggest whether a selection bias might be represented in the collection. Preliminary observations of the assemblage (e.g., **Figure 5.5**) suggest the most of shells collected are overwhelmingly a single marine species—*Melongena melongena*—indicative of a clear selective preference. Initial observations suggest some variation in size, which notably includes very tiny shells that would not have been useful as either food or shell bead production. What this reveals is that shells were likely harvested in bulk at the source along the coast and sorted once back at the production site in the Lopez Plaza.

While there is a considerable range of shell sizes represented in the collection, there appears to be a likely statistically significant overrepresentation of what might be called small-to-mid sized shells in this deposit. Almost all of the shells recovered whole are roughly the same size (both length and circumference). It cannot be stated with confidence at this stage, but it appears that most collected broken shell fragments would also match this size sorting. This might reflect the location from which the shells were harvested, preference for marine shells of a certain age, harvesting technologies, or any other array of explanations. However, it is also worth noting that the shells in this deposit are those that we can confidently assert were *not* used for any other purpose than that reflected here. In other words, the fact that these mid-sized shells seem statistically overrepresented in this deposit may not indicate that they were preferred. In fact, the exact opposite may be true, that the mid-sized shells are here explicitly because they were not selected for other uses (i.e., the deposit represents the reject pile). In that sense the notable absence of any large varieties of whole marine shell, such as Queen Conch – which were only represented in the Op. 72 collection by sparse, small fragments – may be a particularly important point of evidence for the interpretation of site and feature development.

Potential Activities

The patterns discussed above in this section all point to potential explanations of the source of this archaeological feature unique among BREA excavation results to date. Further analysis is clearly necessary, but there are some important possibilities to consider. The first among these interpretations is that that this shell deposit is the equivalent of shell middens found essentially all over the world wherever aquatic resources are relatively accessible. Such shell middens are almost universally understood to represent the harvesting and consumption of meat, in this case, *Melongena melongena*. As noted above, some characteristics of the shells may provide evidence of meat-extraction methods. Similarly, the great abundance of shells would likely be a necessary byproduct of the harvesting of a relatively smaller amount of meat. On the other hand, a couple of factors observed during fieldwork may argue against this. First, the characteristics that may indicate extraction are not particularly well represented among the shells. If that was the primary activity here, it would seem likely that those markings would be more ubiquitous. Also, very generally, it does seem that most shell middens manifest very close to the underwater location from which the shells themselves would have been gathered. As far as our current understanding suggests, the source of these shells would have been the shallow saline estuaries along the Caribbean coastline, approximately 10-12 kilometers (km) away from the Lopez Plaza.

Another possible use for a substantial collection of shells might be the production of construction materials. Burning shells and then mixing them with water creates lime which can then be used in the creation of plaster and mortar. A massive site like Altun Ha would likely have required an enormous and consistent supply of these building materials even for maintenance, much less expansion. If site maintenance requires a massive supply of plaster and mortar, and creation of these materials might involve a massive amount of marine shell, then this could certainly explain the presence of this large concentration of marine shell. However, there are two factors that might refute this interpretation as well. First, the shells have very clearly not been burned in the process of plaster or mortar manufacture. Second, there is very little evidence of any burning at all in the area explored by the methods discussed above. Assessment, testing, and excavation yielded minimal charcoal and no fire or kiln features were observed within this area or either operation (Op. 72 or Op. 74). So, it would appear that if mortar or plaster production was taking place, it was not happening anywhere nearby. If this feature does represent a material stockpile for that production process, then it seems odd that it would be at a considerable distance from where the rest of the process was conducted. Incidentally, crushed marine shell could also be used as temper in ceramic production – all considerations in support of and opposition to their potential use in mortar/plaster production would apply exactly to the ceramic temper hypothesis.

One explanation with relatively robust support from the data so far collected is that the shells were harvested in order to use the shells in the production of jewelry or other art and ornamentation. There is direct evidence to this effect as several shell beads were recovered during the excavation of Sq. B in Op. 72. The strongest evidence for this interpretation comes from only meters away, during the excavation of the nearest structure in Op. 74 (see **Harrison-Buck et al., Chapter 7**).

Other direct evidence comes from the preliminary lab analyses that showed a more discernible pattern to the marine shells than was identified in the field. While complete marine shells were found, the incomplete, broken, and fragmented pieces gave a more nuanced view. Many of the shells had a seemingly uniform cut or punched out area near the opening of the shell (**Figure 5.15**). Some of the cut-out edges show clear evidence of filing resulting in a straight line and some nearly squared angles. This was possibly for targeting a desirable portion of the shell for making preforms or blanks that could then be modified further into the desired shell bead or ornamentation. These possible blanks were also found throughout the upper zones in Op.72. Additionally, shell spirals were a common find in these layers and suggest these may have been "spent shell cores" such that all useable parts of the shell had been extracted for bead or ornamentation production, leaving behind the innermost spiral of the shell.

Indirect evidence can be extrapolated from patterns observed in other excavations and other sites. When lapidary work areas have been discovered, they have frequently been identified in high-status, elite contexts (Aoyama 2007; Emery and Aoyama 2007; Isaza and McAnany 2001). The shell feature investigated by Op. 72 is directly north of Group E, an enclosed elite plaza group. This was a particularly high-status area – a Terminal Classic royal residential complex – as evidenced from the elite and royal artifact assemblage found within residential structures with restricted access (Pendergast 1990).

So, the logic here, though again admittedly indirect, is as follows: shell beadwork seems to have been an elite activity and we find a uniquely high-volume deposit of shells only meters away from the presumed focal point of elite daily life at Altun Ha. Like the other suggestions presented above, there are points of evidence that work against this interpretation. One of these has been described with reference to potential meat extraction. Despite the presence of the complete shells, those with the targeted shell extraction, possible shell blanks, and “spent’ shell cores, there is no direct evidence of the final stages of the shell ornamentation production such as shell bead/ornament “mistakes” or broken examples, shell debitage, or objects used to finely work the shells like stone perforators. Thus, it is possible that this area was purely used for the production or the refuse of the early stages of shell ornament creation. The latter stages of the process may have taken place in a separate area.

Figure 5.15 Left: Some of the marine shells from Zn. 2, Op. 72, Sq. B showing the similarly located “holes” possibly the result of targeted extraction; Top right: Shell with the cut/punched out area with straight edges; Bottom right: Close-up of a possible shell blank with a filed straight edge (photos by J. A. Biggs).

One final interpretation suggested here is that the shell feature represents a material stockpile for any combination of the activities mentioned above; and/or any number of possibilities not yet suggested. The section above provides some counterarguments along the way. For example, why transport all the extra bulk of shells if the meat is the target? Why store the shells here if they were intended for burning into lime somewhere else? These considerations are still valid, but if the shells are considered more of a multi-value, multi-function resource, then potentially a stockpile explanation makes more sense. For example, a scenario could be envisioned where resources were gathered from the coastal waters in bulk. The entirety of that collection of marine resources could then be transported to this location (and hypothetically other locations that have avoided detection due to their liminal position directly adjacent to, but not within site centers and formal plaza groups). And then particular objects were sorted and selected out of this stockpile as needed for any particular purpose: meat was extracted from the shells of the appropriate size, age, sex or whatever other attribute guided that choice; the best shells for jewelry-making were taken to the bead working areas; a basket of nondescript shells was hauled to the masons' fires for lime or crushed into temper for the potters. This scenario is highly speculative, but it aligns relatively well with general and specific observations from fieldwork. For example, this could explain the conspicuous absence of larger conch shells – they would have presumably had higher value to artists and so would have been picked out of the stockpile early. It might also explain the handful of small non-melongena seashells recovered during excavation – these are somewhat out of place in a melongena-shell deposit, but not if that deposit represents a more comprehensive, bulk collection of marine resources. And it may help explain the abundance of shells here lacking any evidence for any other specific use or intention – these are the 'leftovers' or reject pile, the unremarkable shells that were not selected for any particular purpose and over time accumulated as a trash deposit in this area .

Economic Differentiation

Regardless of the various reasons for which the shells may have been collected, and regardless of the processes and behaviors that led to their mass deposit in this particular location, the existence of this shell feature has implications for the understanding of the local economy. As mentioned above, the closest source for these shells – given our current understanding of the landscape – would have been the coastal estuaries located approximately 10-12 km away. By no means is this an insurmountable distance to travel on foot; there and back would be well under a day's walk. Furthermore, there are existing waterways that connect this area directly to the coast that, if not necessarily today, can be reasonably imagined to have been navigable by canoe in times past. So, the source of the shells is certainly, almost easily, accessible. But this accumulated shell midden does not seem to represent a day trip to the coast for an individual or a family. The sheer number and volume of shell strongly suggests that there is a higher level of economic planning and organization at play. Take the elite lapidary discussion from above, for example. Shell bead working activity areas have been identified in particularly high-status locations and so the beadwork itself has been reasonably attributed to high status elites. These elites were almost certainly not traveling to the coast to capture and return with their selected shells. Neither was this likely an activity of the farmers, dispersed more widely beyond these large ceremonial centers – that majority of the population likely did not spend much time or have much uninhibited access to a location like this, in the "backyard" of the royal residential compound.

We propose that this shell feature in this location may represent a component of the economic system that involved a sector of the population who were not farmers, but specialized craft producers. They were likely supported by elite processes and functions of society but were probably not member of the noble family. This group may have been part of an elite merchant class who were also specialized craft producers. Though not as prominent as the nobility, they are certainly not invisible to archaeology. Not only are they directly represented in Maya art (referenced by the so-called “merchant god”), but many investigations have also recovered, analyzed, and presented the archaeological signatures left behind by these merchant-craft producers (Aoyama 2007; Fash 1991; Inomata et al 2002). This feature, however, speaks not only of the merchant class within the elite compound of Zone E at Altun Ha, but in fact may provide a glimpse into a potentially greater division of labor that involved a larger social network. The quantity of debris and the location and extent of the feature suggest a cottage industry that far exceeded production activity normally carried out at the household level.

This initial report on our investigations of this feature, the characterization of its distribution across an otherwise unremarkable portion of the site of Altun Ha, and the investigation of its vertical profile and associated assemblage has all shed light on an archaeological signature that is unique within the BREA survey dataset to date. The ultimate takeaway is one that has characterized and underpins a lot of this project’s research—that there is a great deal of valuable data to be found in places that might otherwise be dismissed. The investigation of the marine shell feature presented here has raised many interesting questions that hopefully will be cross-examined and more fully addressed with future lab analysis.

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Chapter 6

Exploration of a Chert Lithic Tool Production Mound at Chan Colha (Op. 73), West of Altun Ha

Marieka Brouwer Burg, Fiona Haverland, and Melvin Quilter

In January 2024, while surveying an area southwest of the Altun Ha Archaeological Reserve, landownder Juan Lopez took the authors out to a "rock cutting" area on his ranch. Three mounds with lithic material scattered on the ground surface were visited (**Figure 6.1**). One in particular was intriguing due to the high number of "orange peel" flakes present (**Figure 6.2**). As will be described below, orange peel flakes are a distinctive byproduct of trancet bit adze production. Most tranchet bit adzes found at Colha derive from Middle and Late Preclassic occupations (Shafer 1983). Thus, we opened Operation (Op.) 73 to investigate the second chert production mound, which we affectionately referred to as "Lee Colha" ('lee' is Kriol for little). Later, we officially named the site Chan Colha ('chan' means small in Yucatec Maya).

Mr. Lopez reported that the entire area around Op. 73 was high bush when his family cleared it 35 years ago (~1989). They used the standard procedure of pushing down trees with a bulldozer, harvesting the useable lumber, and then burning the brush and leveling the area. Thus, we expected that there would be remnants of recent anthropogenic burning and disturbance in the topsoil, in addition to artificial depressions from tree push and infill.

It is possible that this mound was originally identified by Thomas R. Kelly in the 1980s as part of the Colha Regional Archaic project, although it is not clear from Kelly's 1981/1982 report chapters (Kelly 1980; 1982). As no other lithic production mound has been thoroughly investigated in the Northern Belize Chert Bearing Zone (NBCZ) since the Colha Project in the 1980s and 90s, we felt that Op. 73 had the potential to provide a comparative study of lithic production, but also the opportunity to investigate technological changes between Middle and Late Preclassic lithic tools and possibly even older tools (e.g., from the Preceramic Maya).

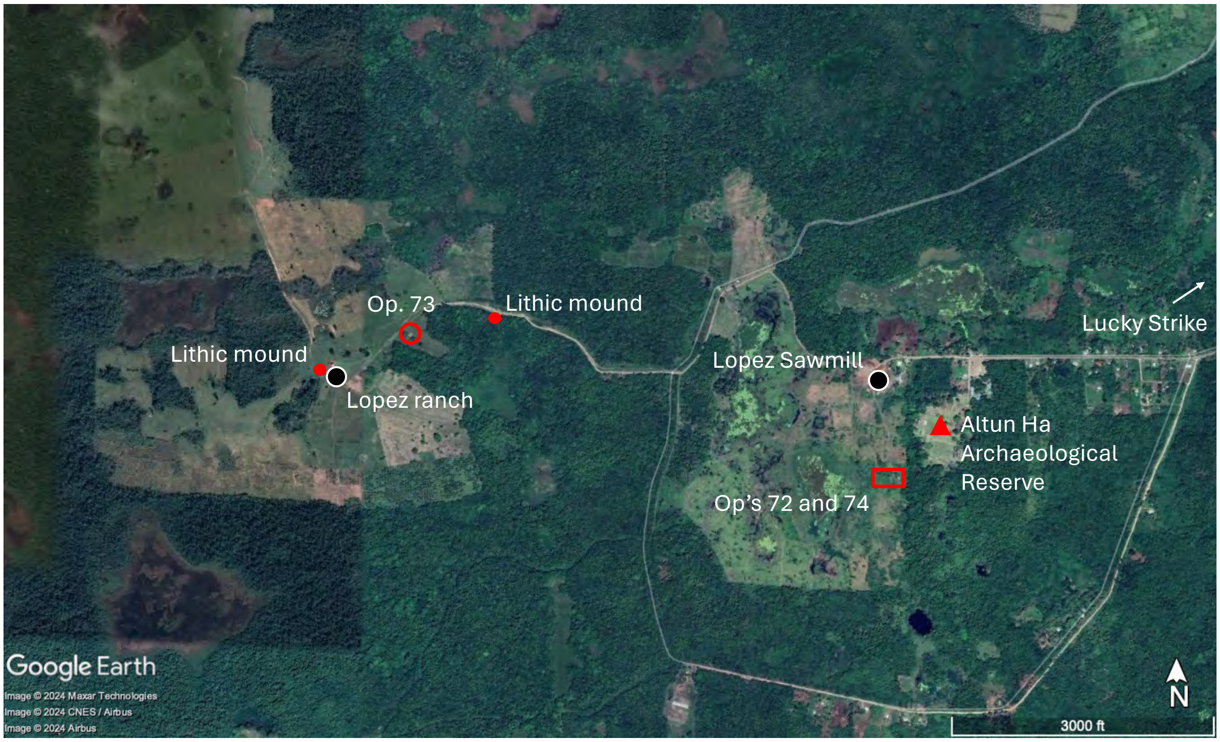

Figure 6.1 Overview map of excavations undertaken in the vicinity of Altun Ha (map by M. Brouwer Burg).

Figure 6.2 Left: orange peel flakes on surface at Op. 73; Right: ventral and dorsal sides of two specimens (photos by M. Brouwer Burg).

Constricted unifaces or adzes are diagnostic to the Late Archaic Period (c. 5000–2000 BCE; **Figure 6.3**). They have been recovered primarily at preceramic sites in Northern Belize (e.g., Sand Hill, Lowe Ranch, and Ladyville; Hester et al. 1980; Kelly 1982; MacNeish 1981; MacNeish et al. 1980; Shafer et al. 1980), although some were recovered in Late Preclassic and Late Classic occupations at Colha (Gibson 1991:229). However, Gibson (1991:235) notes "the fact that so many of these tools are found in redeposited contexts at Colha suggests that localities occupied by the sedentary Maya were also occupied earlier by Archaic groups who midden components were later disturbed by the land modification and construction activities of the Maya." These tools were fashioned out of thick macroflakes using direct, hard hammer percussion. The constricted shape was achieved via heavy stepped thinning along the lateral edges. A steep dorsal ridge is most often present. Also important to note is that the bulb of percussion tends to be located near the distal or "bit" end. Gibson (1991:232) observed 19 specimens and concluded from evidence of edge grinding that these tools were hafted. Furthermore, he writes that it is "clear that the overall convex shape was an important functional attribute" (Gibson 1991:232).

Figure 6.3 Left: Constricted adze found west of Altun Ha, collected by BREA team in January 2022; Middle: Constricted adze found north of Sand Hill, collected by M. Brouwer Burg in January 2022. Right: Constricted adze from Sand Hill (originally published in Shafer et al. 1980: Figure 6; photos by M. Brouwer Burg).

By contrast, there is a related and well-known adze shape dating to the Middle and Late Preclassic called the tranchet bit adze (**Figure 6.4)**. The bit end of this tool was also constructed on the bulbar/distal end and, while they do not have the same convexity of constricted adzes, there is clearly a similarity in the overall dimensions and possibly the production sequence (see **Figure 6.4**). To produce the sharp cutting edge of this adze, a characteristic "orange peel flake" was removed transversely from the wide bit end of the tool. This term was coined by John

Masson (reported in Shafer 1976; Wilk 1976), one of the landowners of Colha, who found thousands of these pieces scattered on the surface near lithic production mounds (Shafer 1983:57). While originally these pieces were a source of confusion for archaeologists in terms of their function, Hester and Shafer quickly intuited their role as a byproduct of the tranchet bit production sequence. Shafer notes that this was a technique used elsewhere in the Old World to create "cleavers", and cites Bordes, who defines similar tools as "having a straight cutting-edge cause by the removal of a flake parallel with the cutting edge" (Bordes 1968:249). The tool itself was likely multi-purpose and utilitarian, used for chopping wood and clearing brush, the Preclassic equivalent of the machete.

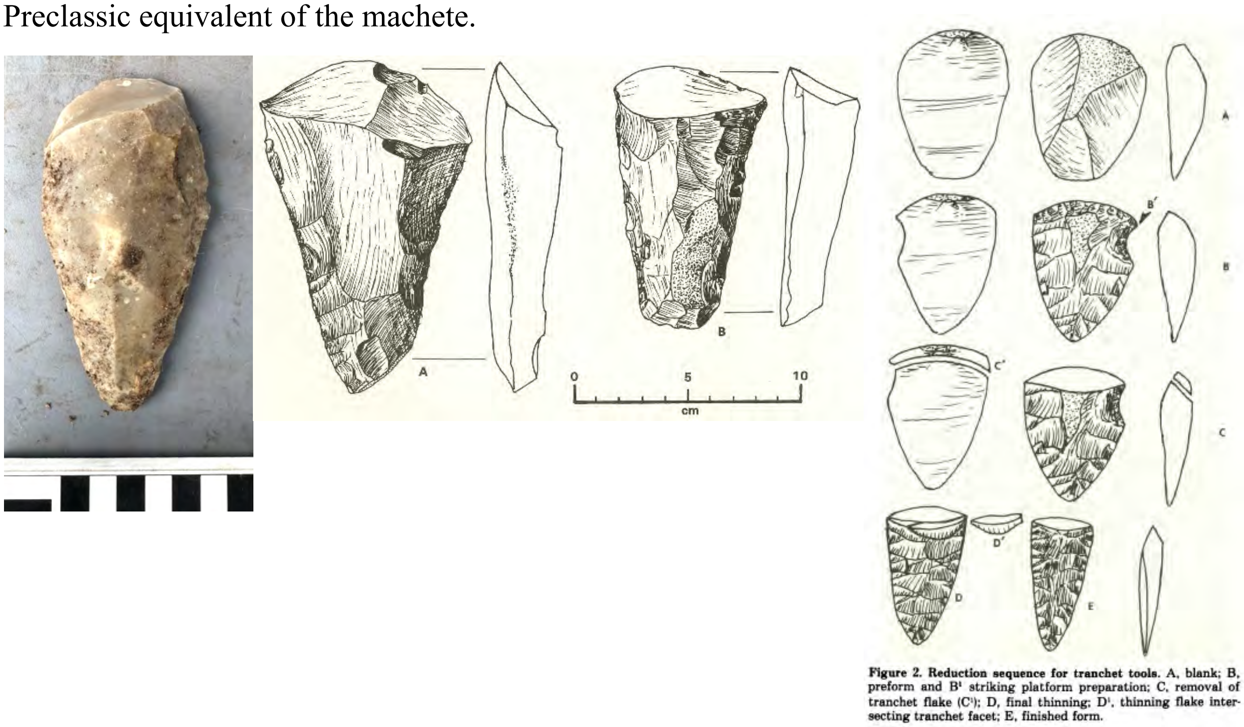

Figure 6.4 Left: Tranchet bit adze excavated at Op. 73, Zone 2, Square D; Middle: Tranchet bit tools from Shafer 1983:Figure 7. Specimen A from Kokeal and Specimen B from Colha Operation 2030 (photo by M. Brouwer Burg); Right: Shafer's (1983) schematic sequence for tranchet tool production.

Objectives

1. Investigate the stratigraphy of a Middle-Late Preclassic lithic production area.
2. Generate a Preclassic lithic assemblage that can be used for comparative study with existing BREA Preceramic lithic assemblages.
3. Explore the connection between Preclassic and Preceramic tools, specifically the connection between constricted adzes and tranchet bit adzes.
4. Probe for occupation/use of the area prior to the Preclassic.

Description of Research and Methods

A shovel test survey (series 057) was initially carried out over the area in order to determine the best location to place an excavation unit. We followed standard BREA procedure for this survey (see Kaeding 2022:99-100), placing the STPs every 10 m (see **Figure 6.5**). Due to time constraints, we excavated every other STP. All but one of the STPs was positive, indicating that the entire area is rich with chert artifacts (**Table 6.1**). Also worth noting is that none of these STPs yielded ceramics.

Table 6.1 Results of STP series 057 at Chan Colha.

STP #	Positive or negative	Ending elevation (cm BGS)	Stopping point of STP/other comments
1	Positive	76	0-25 cm fine sandy loam (10YR6/4) 25-76 cm white (7.5YR8/1) marl with clay chunks (7.5YR6/6 and 7.5YR5/1)
3	Positive	65	Same as STP 1, chert artifacts from 0-11 cm
5	Positive	44	Same as STP 1, chert artifacts from 0-28 cm
7	Positive	45	Same as STP 1, chert artifacts from 0-20 cm
9	Positive	50	Same as STP 1, chert artifacts from 0-26 cm
11	Positive	55	Same as STP 1, chert artifacts from 0-30 cm
13	Positive	49	Same as STP 1, chert artifacts from 0-6 cm
15	Positive	44	Same as STP 1, chert artifacts from 0-13 cm
17	Positive	40	Same as STP 1, chert artifacts from 0-6 cm
19	Positive	49	Same as STP 1, chert artifacts from 0-6 cm
21	Negative	26	Same as STP 1

This excavation challenged the BREA team in new and interesting ways. This was our first experience in dealing with such a large volume of chipped stone debitage and, while we began by screening 100% of what was excavated, we switched to screening every fourth bucket by Zone 4, on account of the staggering volume of material. In consultation with W. James Stemp, we collected only diagnostic artifacts, which included lithic tool forms, performs, and bifacial thinning flakes. This required the lead author to provide a quick-and-dirty tutorial on identifying such artifacts. Furthermore, due to excavation restrictions at the neighboring and ongoing excavations at Altun Ha-Brenda Lopez (see **Kaeding et al., Chapter 5**), the entire team was relocated to Chan Colha for two days. During this time, we focused on removing much of the volume of the unit, but that also required the devising of a workflow that could handle the volume of artifacts while also screening the artifacts which, at that point, were encased in a thick, sticky clay matrix.

This excavation began as a 1-x-2 m unit laid out at the base of the lithic production mound (Square A; **Figure 6.5**). The unit was oriented with the long side-oriented E-W. As investigations continued, we expanded the unit another 2 m east (Square B). Finally, we opened one additional 1-x-2 m unit on top of the mound (Square D).

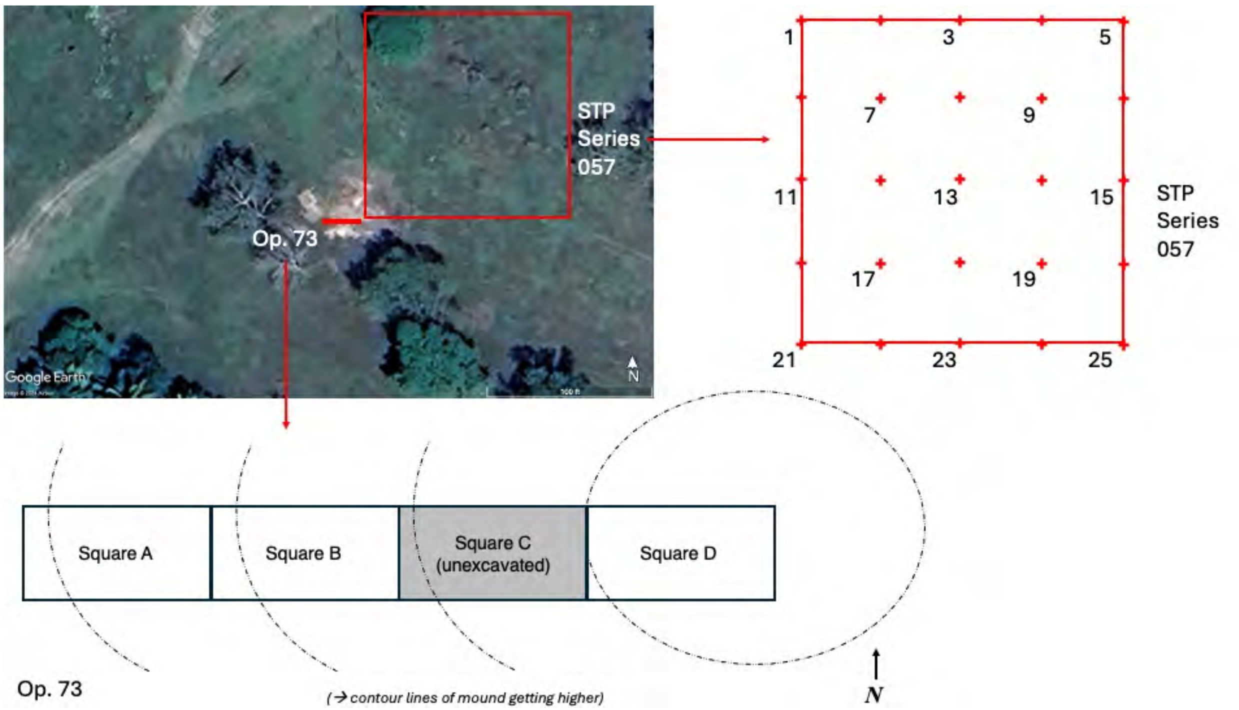

Figure 6.5 Satellite image of Op. 73 (note that this image was taken in February 2024 after our excavations, which are still visible) with schematic of unit and STP series 057 layout (image by M. Brouwer Burg).

Operation 73

Zone 1 (topsoil)

Zone 1 was taken down 5 cm in order to remove topsoil in all three squares (**Figure 6.6**). The zone was full of lithic tools, debitage, and—to a lesser extent—ceramic sherds. Orange peel flakes were observed throughout in Square A and B (**Figure 6.2**), although the sherds were concentrated in the eastern ½ of Square A, as were formal tools and tool fragments. The density of the soil matrix was a loose silty sand. The sand itself was fine in texture. The color was a dark grayish brown (10YR4/2) in Square A, brown in Square B (10YR4/3), and grayish brown in Square D (10YR5/2).

Figure 6.6 Opening shots of Square A (left), Square B (middle), and Square D (right; photos by M. Brouwer Burg).

As we continued downwards, tools and debitage were so thick that there was almost no soil in either Square A or B (**Figure 6.7**). Screening was very time consuming, and we decided to focus only on sherds, blades, bifacial thinning flakes, and recognizable tool forms. Tool forms were less abundant in Square D, where very fine microdebitage, spall, and flakes dominated the artifacts.

Figure 6.7 Left: high lithics-to-soil ratio in the unit; Center: Quilter and Haverland screening; Right: high density of lithic debitage from one bucket of dirt (photos by M. Brouwer Burg).

Zone 2 (lithic debitage layer)

This zone was a darker matrix— very dark grayish brown (10YR3/2)— that appeared at the bottom of Zone 1 in Squares A, C, and D. In Square A, the zone only appeared in the eastern half of the unit (**Figure 6.8**), but it was continuous throughout Squares B and D. Similar to Zone 1, Zone 2 was characterized by lots of lithic debitage of all sizes, from tiny flake spall to full tools. In Square A, there appeared to be a concentration of tools and tool fragments in this zone. Again, there was little sediment present although what was there was a loose silty sand. In Square A and B, the zone was thin—only 5 cm in thickness before coming down on a stickier and darker clay. In Square D, the layer was thicker—about 15 cm—with a slightly darker patch adjacent to the western wall. We assumed this darker sediment was the result of sub-recent clearing and burning of the land reported by Mr. Lopez.

About 5-6 tested chert nodules (ranging in size from 10-30 cm) were observed in the western half of Square D (see **Figure 6.8**). These nodules suggest that primary through tertiary lithic production was carried out at the site. However, we doubt that these nodules are in situ given the recent disturbance described above. Further, a chunk of possible plaster was found in the western wall of Square D. As no other similar pieces were recovered and thus, we assume that this chunk may be natural or may have been pushed by heavy machinery from an adjacent, unexcavated area.

A charcoal sample was collected in a clayey lens found at 48 cm below datum, at the same elevation and adjacent to a pointed biface, blade fragments and a large, broken rim sherd. However, this sample will most likely be recent in age. Another interesting find came from Square D, where a failed tranchet adze was recovered (see **Figure 6.3**), displaying an overshot mistake in its production.

Figure 6.8 Opening shots of Zone 2/3 in Squares A (left), B (center), and D (right) (photos by M. Brouwer Burg).

Zone 3 (lithic debitage layer)

This zone was located only in the western half of Square A (see **Figure 6.8**). It was characterized by a slightly greater sediment-to-lithic ratio and more roots. The sediment was a semi-compact, silty clay. It was black in color (10YR2/1). A few chunks of charcoal were recovered about 100 cm from the western wall and hugging the southern wall of the zone, at an elevation of 51 cm BD. Also notable is that a large general utility biface fragment was found in association with this charcoal sample, directly atop a compact and dense clay layer (Zone 4).

Zone 4 (clay lens)

Zone 4 constitutes a compact and dense clay layer that was dark in color (10YR2/2, very dark brown and 10YR3/2 very dark grayish brown). It appeared in two discontinuous areas of the unit (see **Figure 6.9**). It contained fewer lithics than the surrounding Zone 5, which continued to be chock full of lithics and was looser in texture. Zone 4 sloped downward at the western edge of Square A. As Square A was located less than 5 m from a wet depression of hog wallow/gilgai hummocks, we speculated that Zone 4 might represent vertic clay hummocks at the edge of the lithic production mound.

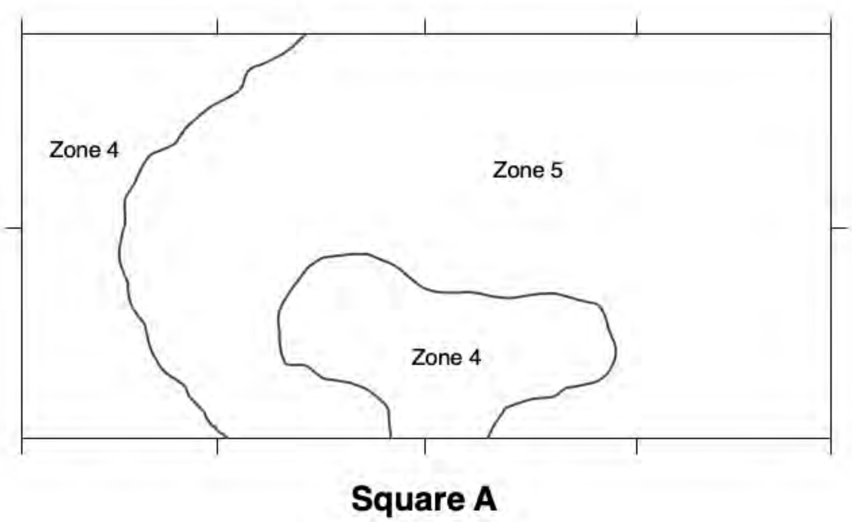

Figure 6.9 Zones 4 and 5 in Square A (north is up; image by M. Brouwer Burg).

Zone 5 (lithic debitage layer)

Zone 5 was characterized in juxtaposition to the Zone 4 compact clayey humps in Square A (**Figure 6.9**). It was encountered at the same depth below datum as Zone 4, between 48 and 65 cm BD. Zone 5 was looser in density than Zone 4, and was characterized as a semi-compact, silty clay. It was slightly darker in some places than Zone 4 (very dark grayish brown, 10YR3/2). Unlike Zone 4, it continued to be full of lithics, especially microdebitage. It was also found to run underneath Zone 4 (see **Figure 6.10**). A cluster of tools was noted along the northern wall, about 100 cm from the western wall of the unit. These tools included a biface, stemmed microblade fragment, multiple orange peel flakes, and a microblade uniface (**Figure 6.10**). They would be removed as part of Zone 6.

When Square B was opened, we came down on Zone 5 directly after Zone 2. The zone was thicker in Square B than in Square A, about 23 cm. A massive amount of large debitage was found, as well as some ceramic rims that suggest Late Preclassic activity.

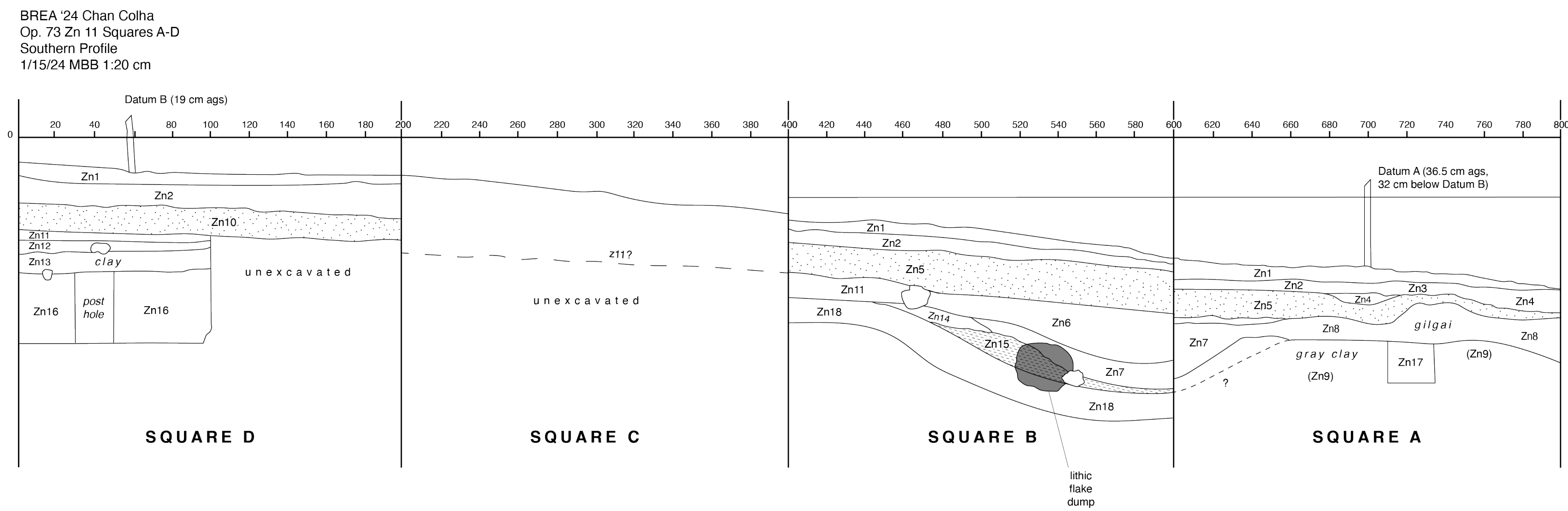

Figure 6.10 Square A South Profile (drawn and digitized by M. Brouwer Burg).

Zone 6 (pit fill)

Zone 6 comprised a cluster of tools in the northeast corner of Square A (see **Figure 6.11**). The soil matrix here was a semi-compact, sandy clay (black 10YR2/1) with lots of tools and debitage, similar to Zone 5. However, the higher density of tools suggests a pit feature where materials collected naturally or were intentionally placed.

When Square B was opened, we found that Zone 6 continued across a large portion (3/4) of the unit (**Figure 6.12**). At its maximum thickness, Zone 6 was 15 cm deep and lipped up to the west and east (see **Figure 6.10**). At this point, we began to screen every fourth bucket. Artifact counts remained extremely high.

Figure 6.11 Left: Concentration of lithic tools in eastern portion of Square A, Zone 6 (photo oriented north, scale 1 cm = 10 cm); Right: Some of the tools from Square A, Zone 6 (photos by M. Brouwer Burg).

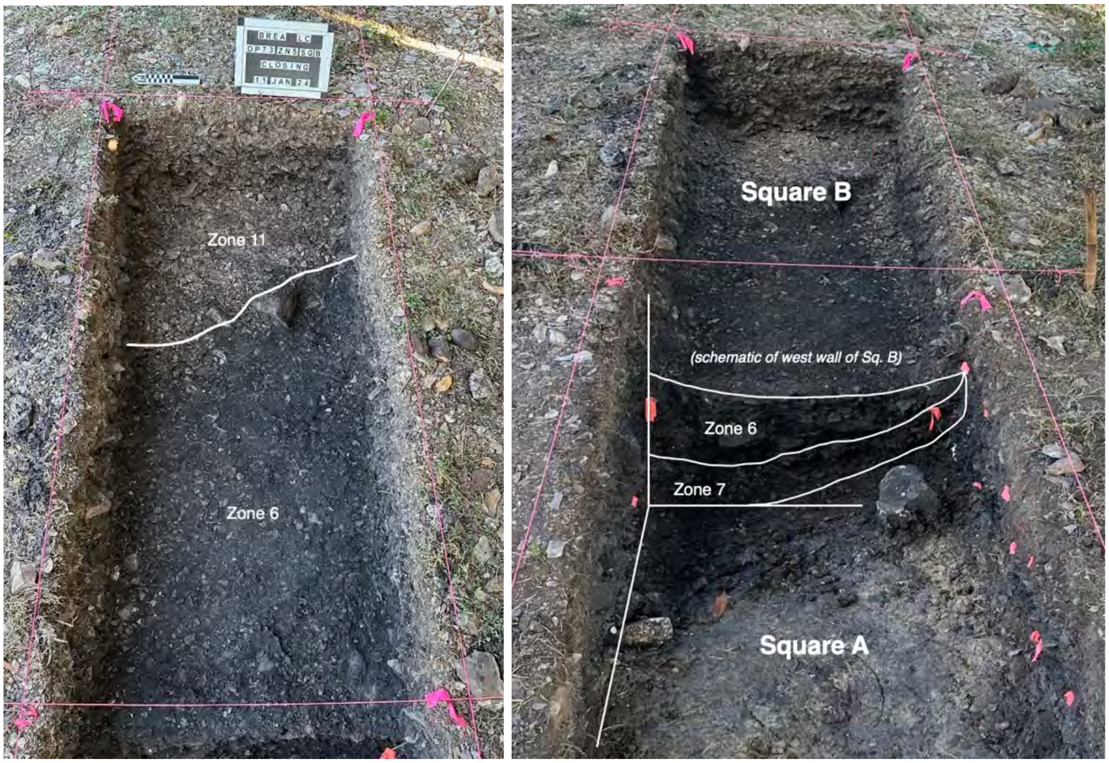

Figure 6.12 Left: top of Zones 6 and 11 in Square B; Right: schematic drawing of relationship between Zones 6 and 7 (photos by M. Brouwer Burg).

Zone 7 (pit fill)

Zone 7 was removed in Squares A and B as additional pit fill below Zone 6. These two zones may have been one deposit that became darker (10YR4/1 dark gray) and wetter with depth (**Figure 6.13**). Like Zone 6, Zone 7 comprised a compact, silty clay. Zone 7 was roughly 10 cm in thickness but, like Zone 6, lipped up to the west and east. Many tools were recovered from within it, including three large macroblades. At the bottom, it became very wet and the lithic debitage became so small it was akin to a gravel (Zone 15; see **Figure 6.13**).

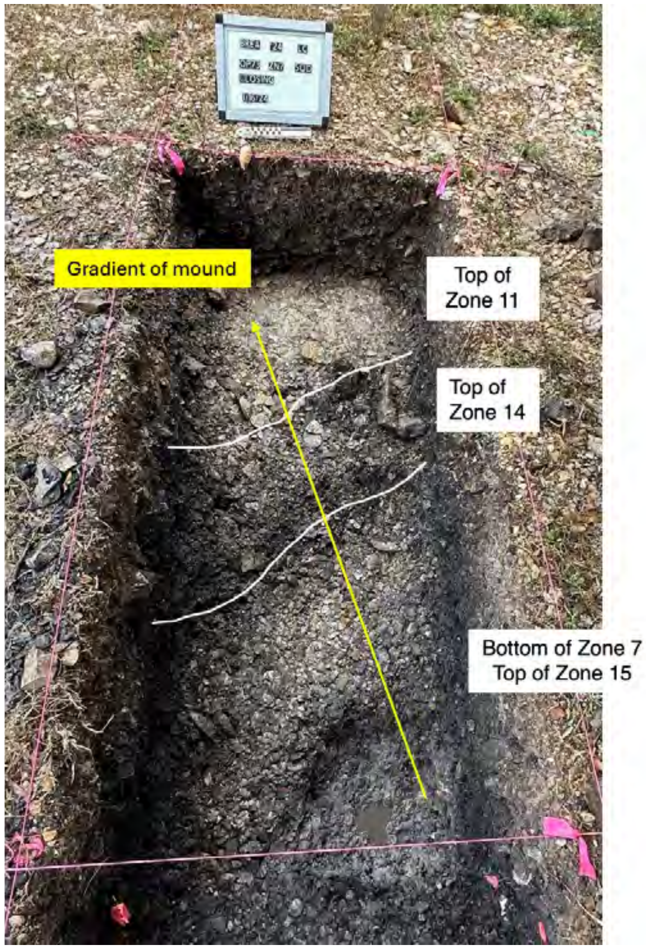

Figure 6.13 Bottom of Zone 7 in Square B, and associated discard layers. Note the gradient of the mound (photo by M. Brouwer Burg).

Zone 8 (clay surface)

This zone lay directly underneath Zone 7 in Square A. It was a compact, sandy clay, dark brown in color (10YR3/2). The main difference between Zones 7 and 8 was that there are hardly any lithics in it, just a few small flakes that may have fallen in from the unit walls, leading us to believe we had come to the natural surface on which lithic production activities were initiated upon. In profile, Zone 8 appears to be a large mound of clay or hummock in the middle of Zone 8 (see **Figure 6.10**). We picked through the zone to see if it was underlain by cultural layers, but it continued for 25 cm with no notable artifacts.

Zone 9 (natural basal clay)

This zone lay directly below Zone 8 and comprised a compact sandy gray clay (10YR6/1) with orange flecking (10YR6/8 brownish yellow). We did not excavate this zone apart from exposing its surface at the bottom of Zone 8 (**Figures 6.10** and **6.14**).

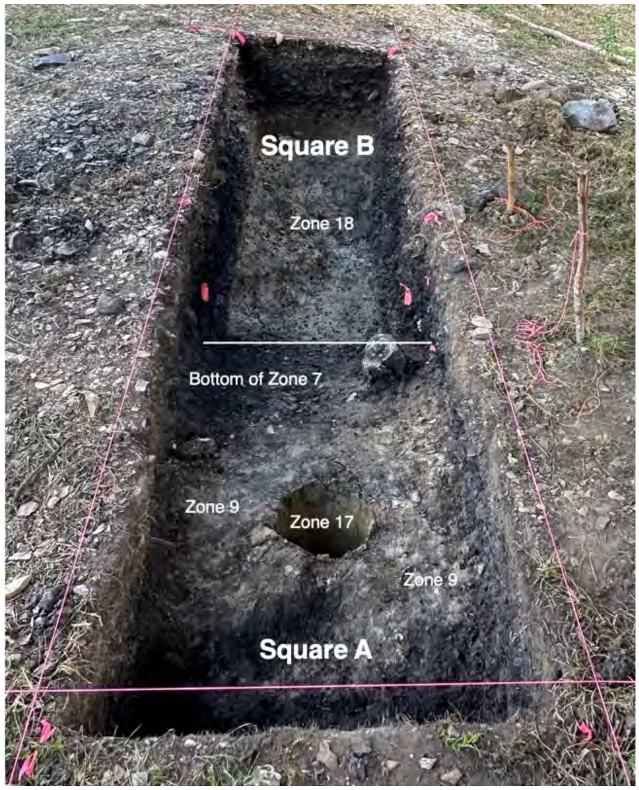

Figure 6.14 Bottom of Zones 7, 9, 17, and 18 in Squares A and B (photo by M. Brouwer Burg).

Zone 10 (lithic debitage layer)

This zone was found just below Zone 2 in Square B and was ~11 cm in thickness (**Figure 6.10**). In hindsight, it was very similar in composition to Zone 5 in Squares A and B and probably could have been labeled as such. The zone was almost devoid of sediment—there was not enough to characterize its texture or color—and contained innumerable chert artifacts, mostly loose microdebitage. Notable artifacts included a pointed biface, an oval biface, ~10 ceramics, a chunk of plaster with possible red paint or burn marks, and a few *pomacea* shell in the NE corner. The latter were collected although they were very friable. No nodules were found in this zone, although those found in Zone 1 and 2 might once have been more deeply buried. A lso important to note was that there were fewer complete tools or even tool fragments in this zone than we saw in Zone 5 in Squares A and B. This preponderance of production debris suggests the area was used as a lithic production area and that complete or broken tools were removed from the immediate vicinity (and/or perhaps fell or were swept over the side of the mound, into Squares A and B).

Zone 11 (discard pile)

Zone 11 was found in the eastern ¼ of Square B and was characterized by a darker matrix (10YR6/4 light yellowish brown) than Zone 5 above (**Figure 6.10**). The texture/density of this matrix was a semi-compact, slightly moist clayey sand. Many tools were found within this moist layer (~7 cm thick) although there seemed to be less debitage than in Zone 5. We initially interpreted the layer as a pit feature, but Zone 6 was found to lip up over top of this layer. Our current theory is that Zone 11 represents a discrete discard event, which was then covered by Zone 6, another separate discard event.

We also recognized a corollary of Zone 11 in Square D (~5 cm thick; **Figure 6.15**). Here, Zone 11 was full of lithic debitage with somewhat more sediment matrix than overlying Zone 10. The matrix was less moist in Square D and was thus somewhat lighter (10YR4/4 dark yellowish brown), but maintained the same texture and density. Due to time limitations, we only continued to excavate Square D in the eastern half of the unit (1-x-1 m). A charcoal sample was collected along the southern wall at 80 cm west of the eastern wall.

Figure 6.15 Top of Zone 11 in Square D (photo by M. Brouwer Burg).

Zone 12 (lithic debitage layer)

Zone 12 was identified in Square D only. It was more clayey than Zone 11, and had more matrix between lithics (~6 cm thick). Overall, there were fewer microdebitage pieces here and more large debitage flakes, blades, tool fragments, and tools. While the color of the matrix was generally grayish brown (10YR5/2), some purer gray (10YR5/1) streaks were also observed. An incomplete tranchet bit adze was found in this layer and its resemblance to a constricted adze was striking. The specimen was unifacially worked, slightly waisted, with steep cutting edges on the proximal end (**Figure 6.16**).

Figure 6.16 Left: Top of Zone 12 in Square D; Right: Tranchet bit adze (photos by M. Brouwer Burg).

Zone 13 (clay layer)

Zone 13 was characterized as a compact clay layer in Square D with just a few lithics artifacts embedded in the top of the zone (**Figure 6.17**). The layer was taken down ~10 cm in order to determine if it was sterile underneath the interface with Zone 12. The clay is likely a vertisol, displaying some slickensides due to periodic wetting/drying. It was a brownish yellow color (10YR6/6).

Figure 6.17 Top of Zone 13 in Square D (photo by M. Brouwer Burg).

Zone 14 (discard pile)

This zone was characterized by a semi-compact, sandy clay that was very dark gray in color (10YR3/1). It was notably darker than Zone 11 above it. Much lithic debris was present but notably, no more ceramic material was found in this layer. The layer was found to lip up onto Zone 11, suggesting it was a separate discard event that occurred after the Zone 11 material was discarded (see **Figure 6.10**).

Zone 15 (discard pile)

Zone 15 was very similar to Zone 10 in Square B—pure lithics with very little matrix and very loose in density. As we progressed downward in the zone, it became slightly darker (10YR4/1 dark gray) and wetter but remained a silty clay. The layer was approximately 13 cm in thickness (**Figure 6.10**). In addition to the many lithic artifacts, there were a few ceramics recovered as well.

Zone 16 (clay with lithics)

This zone began as a post hole excavated into the bottom of Zone 13 to determine if we had hit sterile sediment/basal clay. A patinated lithic (macroflake) was found at 99 cm BD, near the interface with marly limestone/sascab (likely basal material). Thus, the zone was excavated to the full 1-x-1 m extent (see **Figures 6.10** and **6.18**). We screened 100% of this material in the event that additional artifacts could be recovered; however, there were no additional finds other than a few small flakes that probably came from wall fall. The matrix was a light gray (10YR7/2), compact silty clay. It exhibited redoxomorphic features in the form of black and red mottles (10YR3/1 very dark gray; 7.5YR6/8 reddish yellow). This indicates that the clay is a vertisol that formed atop the limestone bedrock and experienced drying and wetting, similar to Zones 8, 9, 13, 15, and 18. At the very bottom of the zone, in the SW corner, we exposed some limestone fragments that appear to have been flaked. It is unclear whether this was intentionally done, to test the quality of the interior stone, or if the breakage was the result of natural processes.

Figure 6.18 Bottom of Zone 16 in eastern half of Square D (photo by M. Brouwer Burg).

Zone 17 (post hole)

Zone 17 was dug from the interface of Zone 8 and 9 (**Figure 6.14**). The goal was to determine if any cultural layers lie within or below Zone 9. This post hole punched down to 105 cm below datum. Only a few tiny pieces of lithic were found in this clay, and all from the top of the column. At the bottom of the column, marly limestone was encountered, suggesting that this clay is, indeed, basal.

Zone 18 (basal clay)

Zone 18 was found underneath Zone 15 in Square B (**Figure 6.19**). It was sterile apart from a few lithics found at the interface with Zone 15. It graded from a sandy clay into a gray clay (10YR6/1) with redoximorphic mottling features (10YR6/4 light yellowish brown, 10YR6/6 brownish yellow, and 2.5Y4/1 dark gray). After 10 cm, the layer was found to contain no additional artifacts and was deemed sterile basal clay, similar to Zone 9 in Square A and Zone 16 in Square D. We assume that this was the natural surface upon which Archaic or Preclassic Maya began their knapping.

Figure 6.19 Bottom of Zone 18 in Square B (north arrow should point left; photo by M. Brouwer Burg).

Interpretations and Conclusions

The unique contours of the Op. 73 mound, and its staggered layers of discard, strongly suggest that the area was used over a period of time for craft specialization activities, specifically the production of tranchet bit adzes and stemmed macroblades. Based on the stratigraphy and contents of each layer's artifact assemblage, we posit the following sequence of events.

First, a somewhat elevated area next to a low, often wet depression was chosen for knapping. Chert does not outcrop at the surface here, nor is there any indication of chert quarrying. Scattered chert nodules may have been present in the underlying basal limestone bedrock;

however, it seems more likely that flint nodules were brought to this location from elsewhere, perhaps from an area ~3 km SW where we identified chert bearing soils outcropping at the ground surface (see **Brouwer Burg and Harrison-Buck, Chapter 2**).

Next, chert knappers sat at the top of the elevated area (Square D) and began to knap chert nodules, producing large volumes of small chert debitage. Failed tools (due to human error or stone impurities) were discarded downslope and some were likely pushed or washed into the depression between Squares A and B. Periodically, knappers probably cleaned their working area by scraping lithic debris downslope as well. This led to sequential discard episodes with slightly different densities of artifacts and differing soil matrices based on the amount of time they were exposed before soil development began. This is most clearly represented by the staggered layers of artifacts in Square B (Zones 6, 7, 11, 14, and 15). While we initially thought Zone 6 and 7 were pit fill, considering the broader extent of the area, it seems more likely that Zone 6 and 7 were discard layers. The undulating layers in Square A seem less a product of intentional human layer and more likely the result of the natural settling of lithic debris downslope over time.

If we had more time to investigate this area, we would assume that we may have found more primary lithic production spots, high areas where knappers sat and created tools and lots of debitage. When we look at the subtle elevational differences of the area, we can see there are some contiguous high areas (e.g., the fan belt).

Chan Colha, lying less than 2 km from Altun Ha's site core, was very likely an important production location for both utilitarian tools used by nearly every household in the city, as well as weaponry. Hafted tranchet bit adzes were as important to the ancient Maya as the machete is to contemporary Belizeans. The former could be used for clearing brush, felling trees, chopping wood, preparing foodstuffs, and even as a weapon in a pinch. The stemmed macroblades—likely hafted onto substantial spear shafts—were used primarily as weapons. They could have been issued to armed guards and/or a civil militia when necessary.

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Chapter 7

Bead-Making at Structure E-66 in the Lopez Plaza at Altun Ha (Op. 74)

Eleanor Harrison-Buck, Jack A. Biggs, Katherine Shelhamer, and Cormac Day

Introduction

Excavations of Operation 74 targeted Structure E-66, a small masonry structure that was previously not identified when Altun Ha was first mapped by David Pendergast between 1964-1970 (Pendergast 1979, 1982, 1990). Structure E-66 (henceforth Str. E-66) is small mound located in what we have named the Lopez Plaza, named after the current landowner, which is part of what Pendergast referred to as Zone E at Altun Ha. This structure appears to be associated with Structure E-47 which together form a small patio group on the east side of the Lopez Plaza (see (**Figure 7.1**). Structure E-47 bounds the southern side of the patio group and was excavated by Pendergast's team, who interpreted the building as a non-elite residential structure dating to the ninth century Terminal Classic period or what he refers to as the Pax phase (Pendergast 1990:201). Str. E-66 borders the west side of this same patio group and is slightly smaller in scale. The final phase of this building also appears to date to the Terminal Classic period, but we also identified an earlier phase of construction. Ceramic analysis is ongoing, but it may correspond to an Early Classic occupation identified elsewhere in the Lopez Plaza (see **Kaeding et al., Chapter 5**). Another small structure with a possible monument fragment was investigated on the east side of this same patio group associated with a small mound (Str. E-67) and a long intersite sacbe that runs from Zone F north past Zone E to where it enters Plaza C just to north (see **Biggs, Chapter 8**).

Excavation of Operation 74 commenced during the January 2024 season and continued into the summer 2024 season. During these two field seasons, BREA also was investigating a dense marine shell scatter identified on the surface of the Lopez Plaza to the west of Str. E-66 (see **Kaeding et al., Chapter 5**). It was theorized that if shell production was the focus of activity in this plaza then shell bead production may also have occurred on the nearby mounds. Finds of a large number of shell beads in the plaza area just west of Str. E-66 in Squares seemingly confirmed this hypothesis (**Figure 7.2**). Other evidence of shell bead production was found, including a polishing stone and lithics that may have functioned as micro-drills or burins for shell perforation (see **Figure 7.2**). It is worth noting that the polishing stone and all of the shell beads were found in Zones 1-4 in Squares A, B, and G that are located in the plaza area west of the structure. Diagnostics suggest that these contexts date to the ninth century and are coeval with the period when massive quantities of marine shell were deposited on the west side of Lopez Plaza and exposed in Op. 74 (see **Kaeding et al., Chapter 5**).

Objectives of the Operation 74 Excavations

The primary objectives of the two field seasons conducted at Str. E-66 were to:

1. Understand the structure's association with the large quantities of melongena melongena shell found on the west side of the Lopez Plaza.
2. Obtain ceramic and/or carbon samples to determine the chronology of any shell production along with dates for each construction phase of the structure to reconstruct the building's use-life;
3. Collect artifacts (including any special deposits) to understand the relationship of the site to larger site center of Altun Ha.

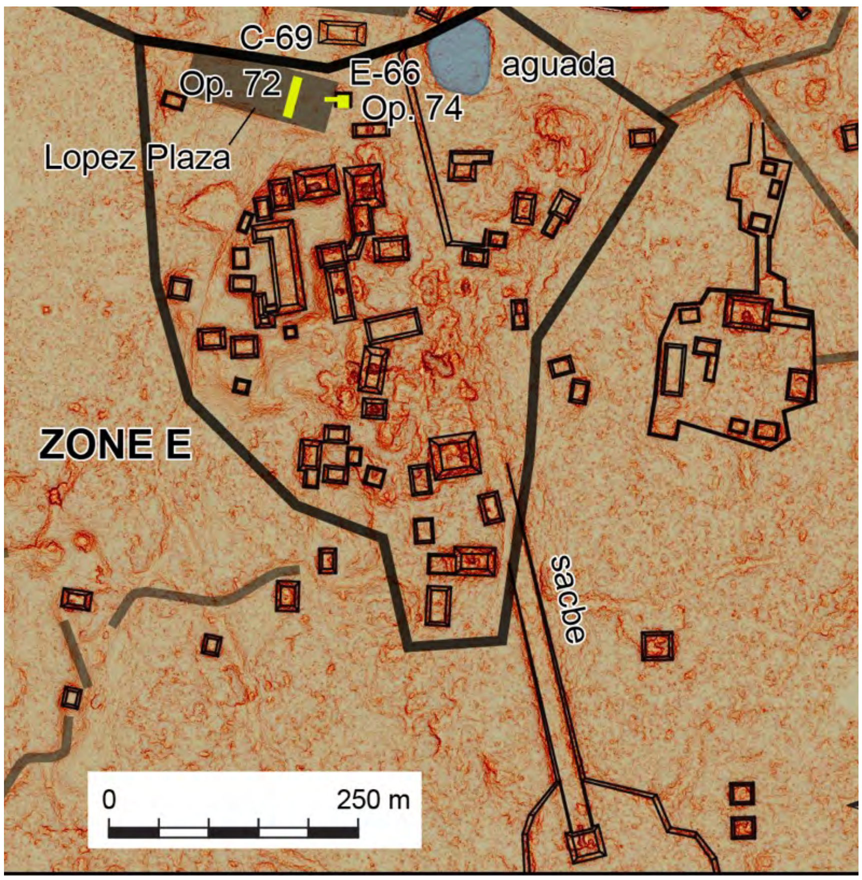

Figure 7.1 Mahlerized overview map of Zone E, showing Str. E-66 and location of excavations units (LiDAR image by M. Willis, map by S. Murata).

Figure 7.2 Artifacts from Operation 74 found in the plaza proximate to Str. E-66 (from top, left to right) shell beads, a stone polisher, a series of micro-drills used for shell production (photos by E. Harrison-Buck).

Description of the Research and Methods Used

Operation 74 consisted of seven squares (A-G). Squares G, A, and B were 1 m (north-south) x 2 m (east-west) (**Figure 7.3**). Two phases of architecture (Phase I and II) were defined in Operation 74. Squares G and A exposed two consecutive plaza floors and Square B exposed two phases of a stepped terrace construction on the west side of Str. E-66. Squares C-F were each 2-x-2 m and together exposed 4 x 4 m of the summit of the structure. This all-stone building also contained two discrete phases of construction visible in excavations of the platform super structure.

Although ceramic analysis is still ongoing, preliminary results indicate that both phases of construction date to the ninth century Terminal Classic period. However, there appears to be an earlier phase in Lopez Plaza that dates to the Early Classic period, identified by a wall with a different orientation than Str. E-66m a portion of which was identified underneath Floor 2, which was defined at the bottom of in Squares A and B, but not excavated (see **Figure 7.3**).

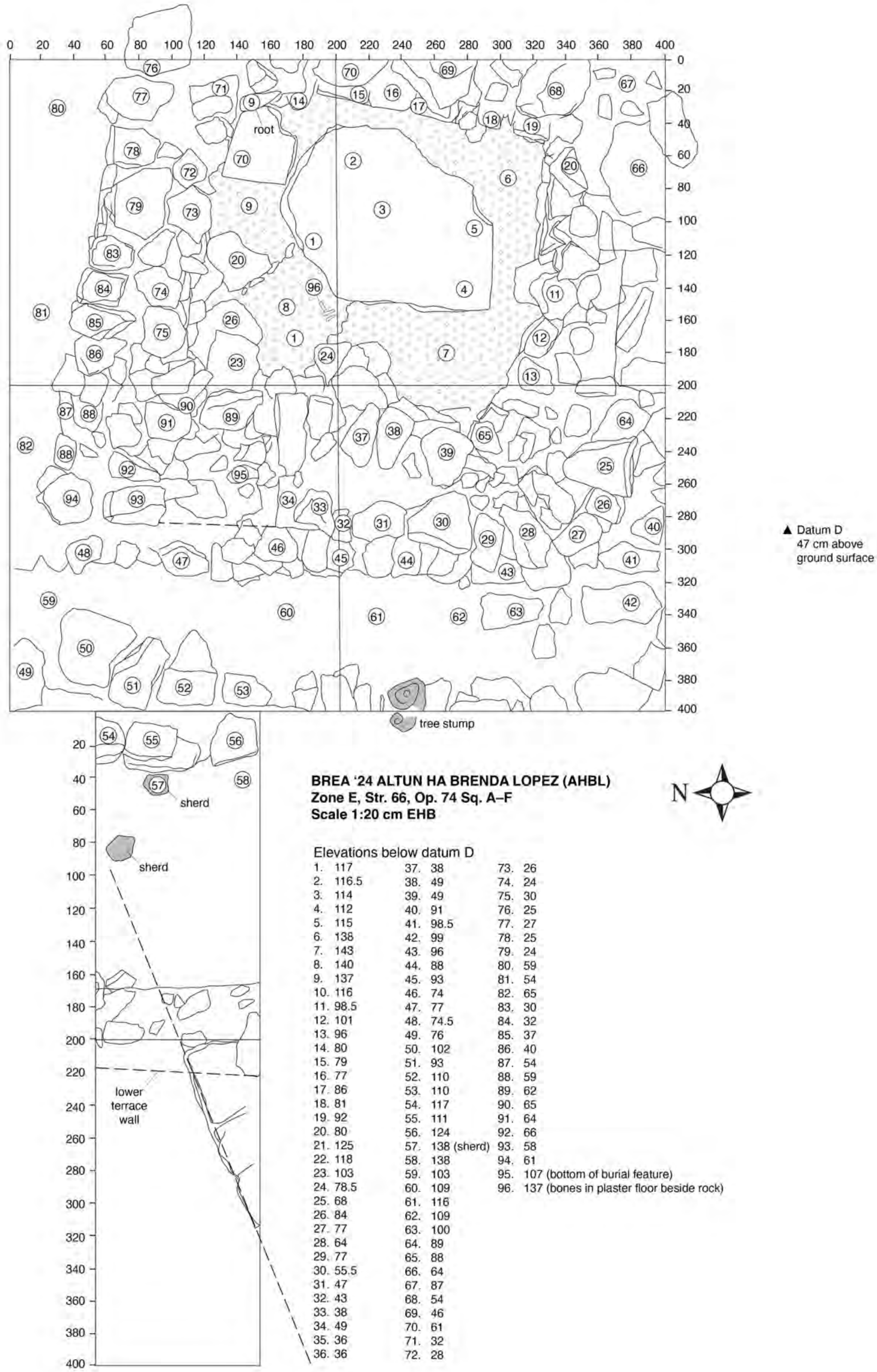

Figure 7.3 Planview map of Operation 74 (drawn by E. Harrison-Buck, digitized by M. Brouwer Burg).

Excavation Methods

All vertical measurements throughout the excavations were taken from four temporary datum points (Datums A, B, C, and D). Due to the overall height of the mound, and excavations spanning two separate field seasons, it became necessary to use multiple datums to ensure vertical control. Datums A, B, and C were used during the January 2024 season and Datum D was used in the Summer 2024 season. For excavation, 5-gallon buckets were used to remove all materials from the units. Zones were separated arbitrarily (10 or 20 cm depths) or when a texture and/or color change was evident in the matrix. Most of the dirt was screened using ¼-inch mesh screen. Picks and shovels were used to remove overburden. Trowels were used to define *in situ* artifacts and intact architecture and small wooden tools were used to define and excavate around *in situ* human remains within the one burial that was idenfied in the northwest corner of Str. E-66 during the January 2024 season. The subsequent sections detail the findings of our excavations, broken down by zone, our smallest unit of excavation. The following sections are divided by the phases of architecture encountered in Str. E-66, such that the latest phase is discussed first (Phase 1) and the earliest detected phase is discussed last (Phase II).

Phase I – Final Building Phase

Zone 1 (topzone)

Zone 1 is topzone soil that includes many roots and some modern debris, including what appears to be some modern disturbance as a result of farming with several "push" piles on the northwest and southwest corners of the structure. Zone 1 ended in Square C when a lighter gray, compact matrix was encountered, which represents a portion of the later terrace surface. Some whole and fragmentary *Melongena melongena* shells were identified in the push piles, but generally-speaking we found relatively few whole or partial marine shell in this location in the Lopez Plaza to the west where Operaton 72 was carried out. Artifact density was moderate. In addition to the marine shell, artifacts included fresh water snail shell, animal bone, chert debitage, obsidian, and pottery sherds.

The matrix of Zone 1 consists of dark loamy topsoil and the squares on the platform (namely Squares D-F) include a high density of collapsed boulder and cobbles visible on the surface. Off-mound in Squares A, B, and G there were less large collapsed stone and all three squares yielded worked shell beads in Zone 1. In Square A, there were four small circular beads recovered and one oblong bead with two drilled holes and two incised lines on the edge on one end (see **Figure 7.2**). In addition, a squat tubular hematite bead was recovered. In Zone 1 Square B, five beads were found including two circular, two oblong, and a small shell that resembles an olivelia with a large single perforation. In Square G, two small circular shell beads were also recovered, along with a broken half of a hematite bead identical to the one found in Zone 1 Square A.

Zone 2 (collapse)

Zones 2 and 5 were directly below Zone 1 and represent the collapse debris of stone on and around Str. E-66. Collapsed stone was present across the unit with the exception of Square G, which is located in the plaza area fartherest west from the structure. Zone 1 in Squares C-F that are on mound removed collapsed stone from around the exterior of Str. E-66. Unfortunately, Zone 2 in Square C removed a portion of the later terrace surface, which was not immediately identified due to poor preservation but was recorded in the cross-section (**Figure 7.4**). There is an additional step down from this terrace identified at the interface of Squares B and C and there is another small step down at the interface of Squares A and B before it reaches the plaza floor, which appears to have also served as the plaza floor (Zone 3) for an earlier phase of architecture (see Phase II below).

The bottom of Zone 2 in Squares A and G removed the collapse above the Zone 3 plaza surface. Zone 2 in these squares was slightly lighter soil, but still dark and loamy. In Square B, Zone 2 is collapse debris above Zone 9, which was thought to represent collapse above the Zone 3 surface but appears to have been the fill of a secondary floor surface that steps up to a terrace surface in Square C, visible in the north wall cross-section (see **Figure 7.4**). Like Square B, disturbance due to a push pile obscured the latest phase of construction, which in Square C was a terrace wall. Therefore, a portion of the latest phase of terrace construction was removed as Zones 2 and 9 (see below). The same mixing of contexts occurred in Square E where Zones 2 and 9 removed some collapse debris and defined the surface of the terrace. Artifacts recovered from this mixed context included animal bone, debitage, and ceramics.

Zone 9 (lower and upper terrace/surface)

This is a mixed context as it sought to remove what was thought to be collapse overlying the upper terrace in Squares C and E and also overlying the Zone 3 plaza surface that was exposed in Square A moving east into Square B toward the edge and over top of upper terrace of Str. E-66. Zone 9 in Square B removed less than 10 cm of matrix which turned out to be a later (lower terrace) surface covering the Zone 3 floor only in Square B (see **Figure 7.4**). The Zone 9 lower terrace surface steps up at the interface of Squares A and B and was added when the final phase of upper terrace was added to the west side of Str. E-66. Roughly 5-10 cm of this latest upper terrace in Squares C and E was also removed as Zone 9 and was switched arbitrarily to Zone 14.

Zone 14 (upper terrace/surface)

Zone 14 was unexcavated and is the remains of the latest terrace construction fill below Zone 9 that was exposed in Squares C and E. The top portion of the upper terrace construction fill was excavated as part of Zone 9 in Squares C and E and revealed an earlier terrace construction. The upper terrace was disturbed and obscured due to poor preservation and limited exposure. This later upper terrace was drawn in the northern profile drawing (see **Figure 7.4**).

Zone 3 (plaza surface)

Zone 3 is a floor surface in Squares G, A, and B that appears to be the plaza floor, which may have been used during both Phases I and II construction. The Zone 3 floor surface is a poorly preserved plaster consisting of a lighter grey, speckled matrix. Zone 3 was only excavated in Squares G and A and extended roughly 20 cm where it ended when an earlier surface (Zone 4) was encountered. Zone 3 in Square A revealed 14 small circular shell beads, one oblong, and a small shell that resembles an olivelia with a large single perforation. In addition, a single well-preserved copper bell was recovered from Zone 3 in Square A.

The Zone 3 floor steps up slightly at the interace of Squares A and B. During Phase II, the Zone 3 floor was partially covered in Square B with the Zone 9 lower terrace surface that abutted the latest upper terrace facing stones of Str. E-66 (see **Figure 7.4**). This slightly elevated surface was exposed at the base of Zone 9 in Square B and runs underneath the latest upper terrace and was found , but was not excavated during the 2024 season. Large sherds were found lying flat on the Zone 3 surface here. Based on the finds in Zone 3 Square A it is likely that this matrix had it been excavated would have yielded an equally high density of shell beads.

Zone 5 (collapse)

Zone 5 is the collapse debris directly below Zone 1 just over top of the final phase of the Str. E-66 platform exposed in Squares D, E and F (see **Figure 7.3**). The collapse consisted of lots of large uncut boulders and cobbles. The matrix contains many voids and the matrix is slightly lighter in color than Zone 1.

Zone 6 (burial inside the wall of Str. E-66)

Initially, it was theorized that Str. E-66 consisted of a low, two-to-three course high free-standing wall measuring roughly 70-80 m thick circumscribing a small interior room. During the course of defining this wall a burial defined as Zone 6 was identified in the northwest corner of Str. E-66 (see **Figure 7.3**). As we excavated the deposit and further tested the idea of a free-standing wall, we noticed what looked like a break in the northwest corner of the wall. One possibility is that this break represents a narrow doorway in the freestanding wall providing access from an interior room to the upper terrace on the west side of Str. E-66 (**Figure 7.4**). Conceiveably, this doorway may have been sealed off in a final phase of construction at which time the burial was interred in the fill that blocked up the doorway. The burial deposit was not contained in a discrete pit but appears to be floating in the fill in Squares C and D and was interred during the final construction event of Str. E-66. Cranial fragments were found spilling outside of the wall to the west. Feet were found within the wall but just within Square D, suggesting the body was oriented with the feet to the east and head to the west (see **Biggs, Chapter 17** for further discussion).

Grave goods included a single polished greenstone celt that was directly associated with the bones (see **Figure 17.4**). Part of Zone 6 included removing the fill inside the proposed doorway/threshold area Excavations revealed that the bones were deposited right on core fill, although some fragments had falled deeper into voids within the fill of the wall. The burial bottoms out on a plastery matrix found at 84 cm below Datum D, which is the same elevation as the plaster concentration exposed on the other side of the wall that marks a possible interior floor or platform surface for the earlier Platform II (see Zone 8 below).

Zone 8 (construction fill inside the walls of Str. E-66)

Zone 8 is a thick layer of construction fill comprising boulders and cobbles directly below the Zone 5 collapse debris. This fill is associated with the latest phase of Str. E-66. Zone 8 was removed in Squares D and F which encompass the majority of the interior fill of the structure (see **Figure 7.3**). As noted above, initially it was theorized that Str. E-66 consisted of a low, two-to-three course high free-standing wall measuring roughly 70-80 m thick circumscribing a small interior room. While the top two-to-three courses do look somewhat faced on either side of this low wall, there is very little convincing evidence of an interior plaster floor with the exception of a white plaster concentration on the west edge produced by a termite nest and some noted in the vicinity of the Zone 6 burial deposit in the northwest corner of the wall (described above). Toward the bottom of Zone 8, the matrix becomes denser and more clayey with less voids. This compact earthen layer does not resemble a formally prepared floor, but may represent the surface of an earlier platform (Phase II). However, the surface is rather uneven and not clear from the cross-section. Some of this earthen "floor" appears to have been removed as part of Zone 8. At the bottom of Zone 8, the zone was changed to Zone 11 where there is a change in the construction of the interior walls that demarcate the earlier Platform II construction.

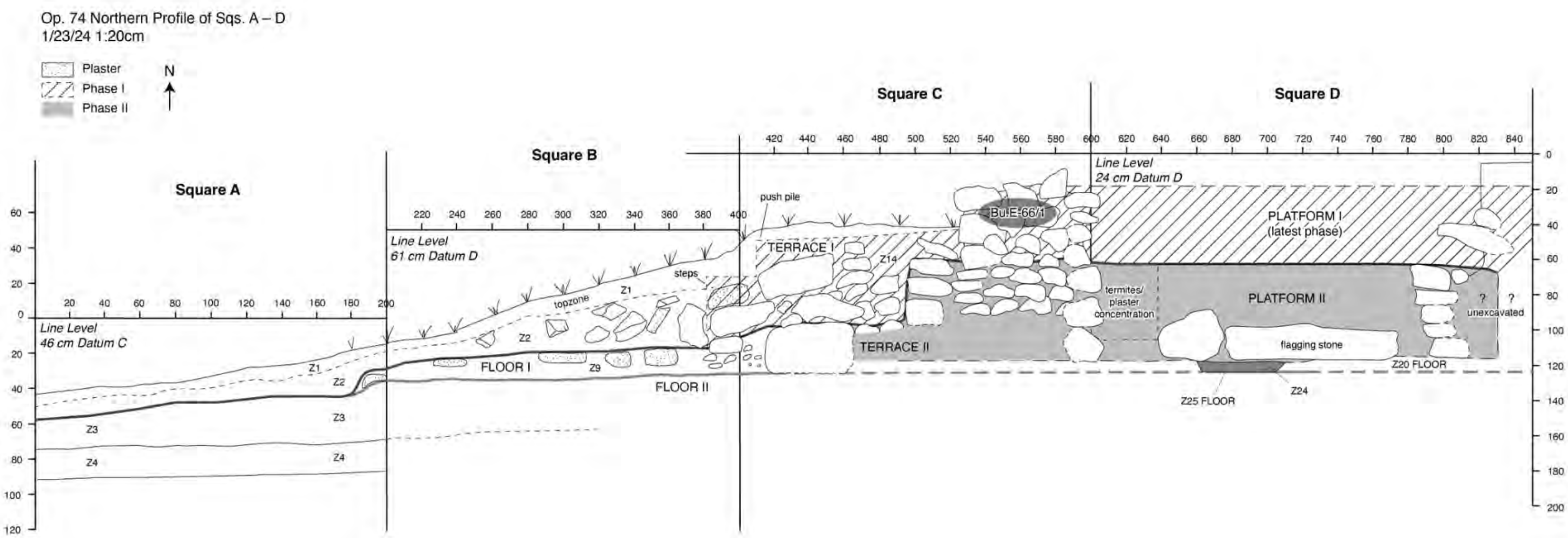

Figure 7.4 North wall profile of Operation 74 (drawn by E. Harrison-Buck, digitized by M. Brouwer Burg).

Zone 16 (construction fill on south side of Str. E-66)

Zone 16 is fill on the south side of Str. E-66 and is restricted to Squares E and F. Zone 16 is directly below Zone 1 and is roughly the same elevation as the collapse and fill of Zones 5 and 8, respectively, which were excavated just to the north inside the structure in Squares E and F. The aim of Zone 16 was to further define the presence of a southern wall and to test the area to determine if a doorway existed on this side of the building where possible doorjambs and a void in stones along the southern edge of the wall was visible. Due to the poor preservation and the southern limits of the excavation this was inconclusive. This zone ended at the level where the earlier platform is thought to begin. Small amounts of plaster were visible at this level around the same elevation of the termite plaster concentration thought to represent the surface of the earlier (Phase II) platform construction.

Zone 19 (western wall)

Zone 19 excavated a section of the western wall of Str. E-66 in Squares C and E just south of the Zone 6 burial. The aim was to further assess the possibility of a free-standing wall and to expose the earlier phase of construction below. Excavations determined that the latest phase was more likely a retaining wall rather than a free-standing wall. Wall stones on the exterior were faced but less well faced on the interior. The outer retaining wall was perched on top of what appeared to be another outer wall of rough construction comprising stacked stones that would have been covered by the upper terrace(s).

Zone 21 (western wall)

Zone 21 was a continuation of the western wall excavation below Zone 19 in Squares C and E of Str. E-66. The zone deconstructed the wall that was perched on top of what appeared to be another outer wall of rough construction comprising stacked stones that would have been covered by the upper terrace(s).

Zone 22 (western wall)

Zone 22 was a continuation of the western wall excavation below Zone 21 in Squares C and E of Str. E-66. The zone deconstructed the wall that was perched on top of what appeared to be another outer wall of rough construction comprising stacked stones that would have been covered by the upper terrace(s).

Phase II

Zone 11 (construction fill)

Zone 11 is the fill associated with the earlier Phase II platform inside Str. E-66. The zone is directly below Zone 8 in Squares D and F. The matrix consists of significantly larger boulder fill that marks a break between the later and earlier platform construction. A nicely faced eastern wall was exposed at the top of Zone 11, which represents an earlier phase of construction that could not be fully defined given the eastern limits of the excavation. It was tentatively defined as part of the earlier construction of Phase II, but it is possible this construction is associated with an earlier building phase associated with the plaster floor (Zone 20) that runs underneath Str. E-66 (see below). All other interior walls at this elevation to the north, west, and south consist of roughly hewn stacked stones suggesting the earlier phase of the building was a basal platform comprising bin construction with loose cobble and boulder interior fill. Zone 11 terminated when a large flat stone was encountered at the botton of the zone.

Zone 15 (construction fill surrounding large stone)

Zn. 15 in Squares D and F is a final layer of construction fill inside Str. E-66 surrounding a large stone slab that sits directly on a plaster floor. On the large flat stone a "special deposit" of very friable, burned chert was found in a small concentration. A small amount of carbon was also recovered from this deposit and was sampled for radiocarbon dating.

Zone 17 (large stone)

Zone 17 is the large flagstone that spans in Squares D and F. It was left *in situ* until the summer 2024 season when the landowner, Mr. Juan Lopez, assisted us with his mechanical equipment and pulled the stone out of the unit. A shallow pit feature with some evidence of burning and animal remains (Zone 24) was found underneath, partially covered by this large “flagging” stone (see below).

Zone 18 (construction fill)

Zone 18 is the matrix surrounding the large stone defined as Zone 17.

Zone 20 (plaster floor)

Zone 20 is a well-preserved plaster floor that was not excavated, but was exposed below the large Zone 17 stone and the surrounding Zone 18 construction fill inside the walls of Str. E-66. This floor is at the same elevation as the earlier floor surface (Zone 3) found underneath Zone 9. This similar elevation suggests that this Zone 3 floor may run underneath the Phase II upper terrace and predate the construction of Str. E-66. The Phase II walls exposed inside the building sit directly on top of the Zone 20 floor.

Zone 24 (shallow pit feature)

Zone 24 was defined as a cut into the Zone 20 plaster floor surface (see **Figure 7.3**). The full extent of the cut was exposed when the large stone (Zone 17) was removed from the unit. The cut lies in the southwest corner of Square D and the northwest corner of Square F. A large dome-shaped rock made up the southwest corner of the cut and appears to have been cut directly into the Zone 20 plaster floor. Upon excavation of the cut, another plaster floor (Zone 25) was encountered about 5-6cm below the surface of the Zone 24 floor. The matrix of Zone 24 is a sandy clay with a light density of small inclusions and highly eroded sherds that were small and poorly preserved. The archaeological evidence suggests that some burning occurred in the area of the cut. Charcoal and some charcoal staining were present throughout the matrix as were burned sherds and a few pieces of burned limestone. Some small faunal remains, including fish, possibly bird and another unidentified animal were recovered in the Zone 24 matrix, mainly in the northern area of the cut. Notably, the animal remains do not show evidence of burning. The evidence may point to a termination event involving the animal remains and a burning event.

Zone 25 (plaster floor)

Zone 25 is another plaster floor surface underlying the Zone 20 floor. This surface was not excavated during the 2024 field seasons.

Phase III

Zone 4 (earthen layer)

Zone 4 is an earthen layer excavated in Squares G and A that encompasses what is an even earlier packed earthen floor surface. This zone starts slightly above the surface level and continued down roughly 10-15 cm. At the bottom of the zone, a line of stone was defined that represents an earlier wall construction that runs at a different orientation than Str. E-66. In Square A, the stones are associated with an extremely compact soil that is slightly lighter in color.

Zone 7 (construction fill)

Zone 7 appears to be a fill layer underlying the Zone 4 earthen surface that was found in Squares A and G. The matrix contains cobbles and a low wall was further exposed that relates to an earlier phase of occupation that predates Str. E-66 (see **Figure 7.3**). It is possible this phase overlays with the Early Classic occupation documented elsewhere in the Lopez Plaza in Operation 74 (see **Kaeding et al., Chapter 5**).

Zones 10, 12, and 13 (pit feature)

Zones 10, 12, and 13 represent what appears to be a single pit feature cutting into the Zone 4 earthen surface in the northwest corner of Square G. Once excavated down to Zone 12, the pit appeared as a dark circular stained area with a diameter of ~20 cm. It is thought to represent an old tree disturbance rather than an intrusive feature associated with Zone 4.

Interpretations and Conclusions

Str. E-66 consists of at least three phases of construction. A preliminary study of the diagnostic material in Operation 74 suggest that the final two phases may date to the Terminal Classic period (ca. AD 780-900/1000). Str. E-66 seems to have been built and used entirely in the Terminal Classic period, while the earlier phase has not been securely dated. According to David Pendergast (1990), the elite residential area in Zone E, located immediately south of the Lopez Plaza, also reflects a predominantly Terminal Classic occupation. Yet, our excavation in other areas of the Lopez Plaza exposed in Operation 72, suggest that this late occupation overlies an earlier component of the site that likely dates to the Early Classic period. Portions of stone walls exposed in both Operations 72 and 74 have a distinctive orientation that does not align with the Terminal Classic architecture and lend support to the notion of a chronological break, skipping over the Late Classic period in this particular part of the site. Ceramic analysis is forthcoming and will aid in our understanding of the chronology and function of Str. E-66, but the small size of the building would be unusual for a residential structure.

The excavation of Operation 74 highlights the importance of investigating plaza areas as places of craft production, rather than just focusing exclusively on the buildings and associated terraces of buildings. Morevoer, preferencing the more monumental elite buildings to the exclusion of more isolated, smaller buildings like Str. E-66 produces a "blind spot" for a large portion of the ancient Maya economic production. The discoveries in the Lopez Plaza of Zone E show that smaller buildings associated with large expanses of "vacant terrain" may hold a rich repository of untapped production activity areas. In the case of the Lopez Plaza, this "vacant terrain" is particularly intriguing as it sits at the interface between a Terminal Classic elite residential zone and Plaza C to the north, a large open plaza that may represent an ancient Maya marketplace (see **Degnan et al., Chapter 11**). The presence of shell beads and tools for shell production along side an abundance of marine shell found on the west side of Lopez Plaza suggest that the inhabitants of Str. E-66 at Altun Ha were involved in shell bead production, possibly servicing a marketplace economy at Altun Ha. Another possibility that is not mutually exclusive is that the shell production was servicing the elite living just to the south during the Terminal Classic in Zone E. Further excavation is planned in the Lopez Plaza and the adjacent Plaza C in future seasons and will hopefully shed further light on shell production at Altun Ha and its possible relationship with the elite economy and marketplace activity.

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Chapter 8

Investigation of a Possible Monument at Altun Ha (Op. 75)

Jack A. Biggs

Introduction

Continued excavations at Altun Ha during the summer 2024 season included Operation 75. This excavation was instigated by an email communication between Dr. David Pendergast, who excavated Altun Ha from 1964-1970, and BREA co-Directors Dr. Eleanor Harrison-Buck and Dr. Marieka Brouwer Burg. In these emails, Dr. Pendergast stated he believed that a possible carved monument was located somewhere within Zone E of Altun Ha, southwest of a seasonal aguada (**Figure 8.1**). This would have been a significant discovery as there is only one other known carved monument from Altun Ha – the "Turtle Monument" which was found near the southern terminus of the north-south sacbe leading from the Plaza C to Rockstone Pond in Zone F (**Figure 8.2**; Pendergast 1990).

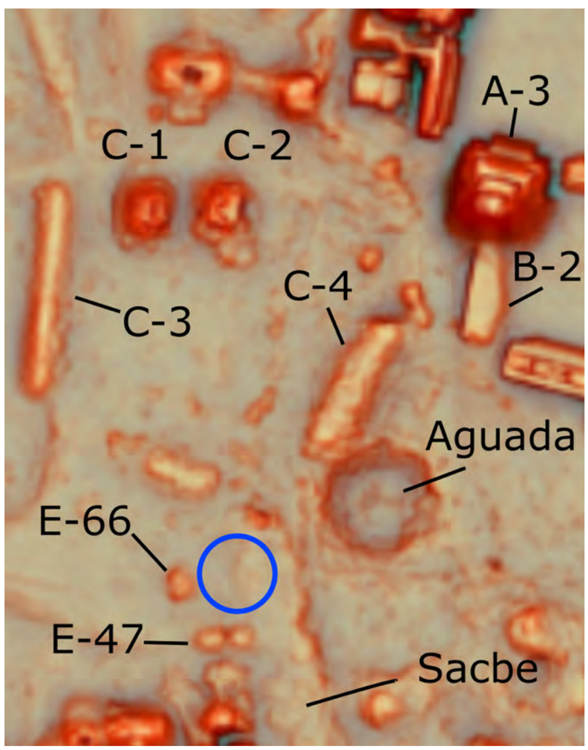

Figure 8.1 LiDAR map of Altun Ha indicating area where Pendergast recalls observing a possible monument (map by M. Willis; modified by J. A. Biggs).

Figure 8.2 The "Turtle Monument" found by Pendergast at the terminus of the sacbe leading from the site core to Zone F. Photo edited to emphasize the eroded carving (photo by J. A. Biggs).

Most of the Zone E area where this possible monument was located had been cleared and was occasionally used by the current landowners for cattle grazing. Members of the BREA team conducted a pedestrian survey and located what could be a possible monument lying flat on ground surface, about 20 m east and 4 m north of Str. E-66 (see **Kaeding et al., Chapter 5**) and along the western edge of a sacbe. This possible monument was the only large cut stone (measuring roughly 75-x-75 cm) in the area. Thus, Operation 75 was placed in this location to further investigate this large stone slab.

Objectives

Excavations were conducted in order to:

1. Investigate the possibility of a carved monument within Zone E of Altun Ha.
2. Determine if this was the original location of the possible monument.
3. Investigate this possible monument's association with Str. E-66 to the west, the sacbe immediately to the east, and possibly the aguada to the northeast.

Description of Operation 75

Operation 75 is a cardinally oriented unit measuring 2-x-2 m and designated as Square A. This square was placed so that the possible monument fragment was in the center and fully encompassed by the unit boundaries. Further, just east of the monument lies the western edge of a large sacbe that runs roughly NW-SE and commences in the southeast corner of Plaza C, terminating at a large platform (Zone F) that abuts Rockstone Pond (**Figure 8.3**).

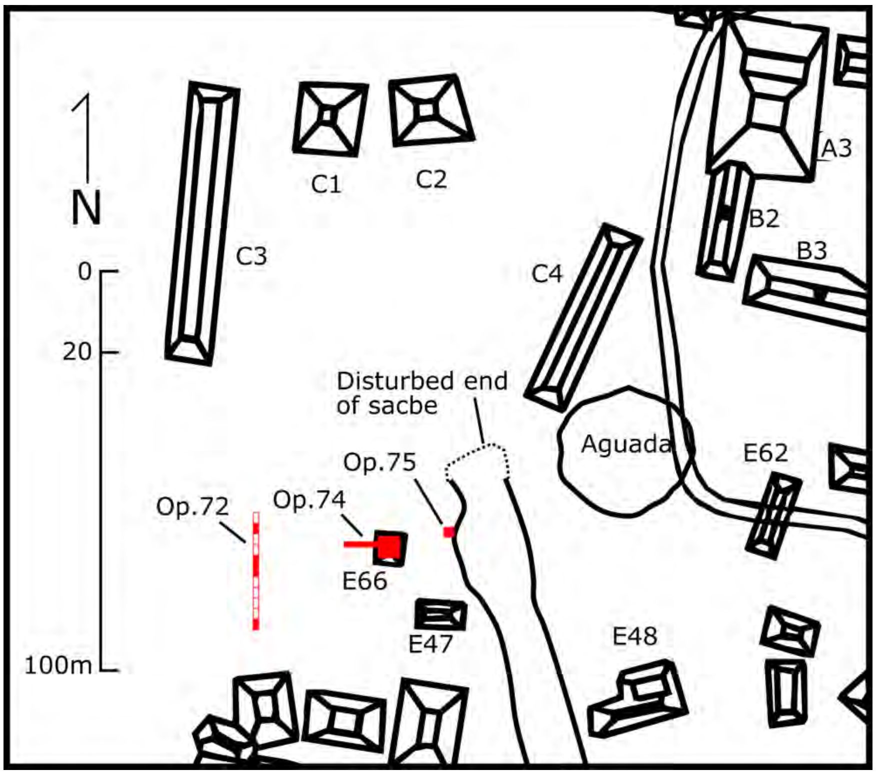

Figure 8.3 Map of Operations 72, 74, and 75 and the surrounding structures southwest of the Altun Ha site core (original map by D. Pendergast, 1979; modified by J. A. Biggs).

While the southern half of this long sacbe is well-preserved, the northern portion that includes Op.75 is much more poorly preserved. Land-clearing efforts for cattle and possibly logging in the recent past extend up to the fence line that separates the Altun Ha Archaeological Reserve from the private land where these excavations took place. Bulldozer activity has clearly damaged the entire northern terminus of the sacbe based on the presence of very large limestone boulders, downed trees, and loose dirt seen during the 2024 summer season. Additionally, bulldozer scraping on top of the sacbe created an undulating surface that extends slightly south of the location of Op.75. Thus, it is unknown if this was the original location of the possible monument or if it was displaced.

Excavation Methods

All vertical measurements during the excavation of Op.75 were taken from a temporary datum (Datums A). For excavation, 5-gallon buckets were used to remove all materials from the units. Zones were separated arbitrarily (10 or 20 cm depths) or when a texture and/or color change was evident in the matrix. The dirt was screened using ¼-in mesh screen and trowels were used to define *in situ* artifacts and intact architecture. The subsequent sections detail the findings of our excavations, broken down by zones, our smallest unit of excavation.

Excavation of Operation 75

Zone 1 Humic Layer (Squares A and B)

Zone 1 is a thin humic layer across Square A, ranging from about 2-6 cm in depth (**Figure 8.4**). This zone did not extend throughout the entire square and was only located in the NW and SE areas of the square. The matrix consists of a compact slightly sandy loam and was very dark gray (10YR3/1) in color. Due to the very dry conditions of the 2024 summer season, little to no moisture remained in the uppermost centimeters of the soil. This resulted in a very compact and granular matrix that was difficult to break apart. Few artifacts came out of this zone and included lithic debitage and ceramic vessel sherds.

Rocks ranging from about fist-size to 40 cm in length were present throughout the zone with most of them visible before excavation began. These were mostly located to the south, east, and northeast of the possible monument (given its own zone designation of Zone 3). Based on the size and location of these large stones, it was thought these might be fragments of a collapsed stela/altar base that the monument rested on, or possibly some of the exposed sacbe. A downward slope in Zone 1, especially to the west of the monument, could indicate that the monument was originally located on the western edge of the sacbe. However, another downward slope, but in the southeast corner of the square did not fully support this hypothesis. Thus, Zone 1 was ended once the matrix changed consistency and to investigate what the surrounding rocks represented.

Figure 8.4 Zone 1 of Op.75, Square A (photo by J. A. Biggs).

Zone 3 Possible Monument (Square A)

Zone 3 is discussed before Zone 2, as Zone 3 is the actual possible monument fragment and sat directly atop Zone 2 and was also higher in elevation than Zone 1 throughout most of the square. This monument was a clearly worked, large piece of limestone based on the overall flatness of the sides, the right angles between the sides, and its overall rectangular shape. As mentioned previously, it measures about 75-x-75-x-22 cm. After moving the stone, it was clear that it was likely facing up when found as the exposed side was very flat and more worked than the underside which had a rougher texture and was much more undulating. It appears that the top and left sides of the monument are intact, but the bottom and possibly the right side were fractured off. It is likely these sides broke off long ago, and not from recent bulldozer activity, due to the dullness of the fracture lines. Thus, it is possible that this worked stone was both taller and wider than its current condition.

A photogrammetric model of the monument was made by the author using 171 photos taken in the field of all sides of the monument. This was done both as a method of digital preservation, but also to observe the texture of the monument without distraction by the color and lighting seen in the field. The model was created using Agisoft Metashape, generating a textured and colored 3D model. However, subtracting the color from the dense cloud of points was the most informative step. A straight incised line can be seen running parallel to the top edge of the monument, possible demarcating the boundary for markings below (**Figure 8.5**). A very small portion of a parallel incised line can also be seen near the base of the likely fractured bottom end. It is unknown if this would have run the entire width of the monument like the upper incised line. There is also a border on the left side of the monument, running parallel to the upper line, possibly framing the subject of the monument; however, this left border is not as cleanly defined as with the upper incised line.

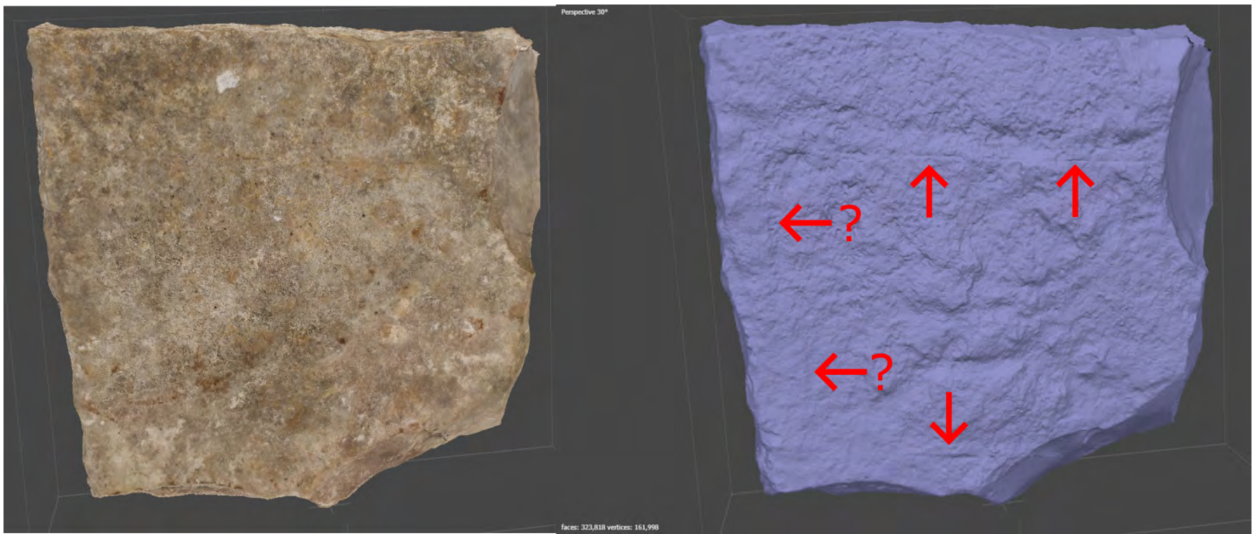

Figure 8.5 Photogrammetric model with color (left) and without (right) of the monument with incised lines indicated by red arrows (model and photos by J. A. Biggs).

The overall erosion of the stone, likely the result of being exposed to the elements for hundreds, if not thousands, of years has mostly obliterated any detail that may have once have adorned the surface of the monument. Using the photogrammetric model without any color revealed further remnants of possible stylistic details. There is a possible profile of a human face with the nose, lips, and chin preserved (**Figure 8.6A**). No other features of the possible individual could be discerned. However, rotating the 3D model to a different angle reveals that the human profile might instead represent the outline/general "shape" of a highly eroded glyph (**Figure 8.6B**).

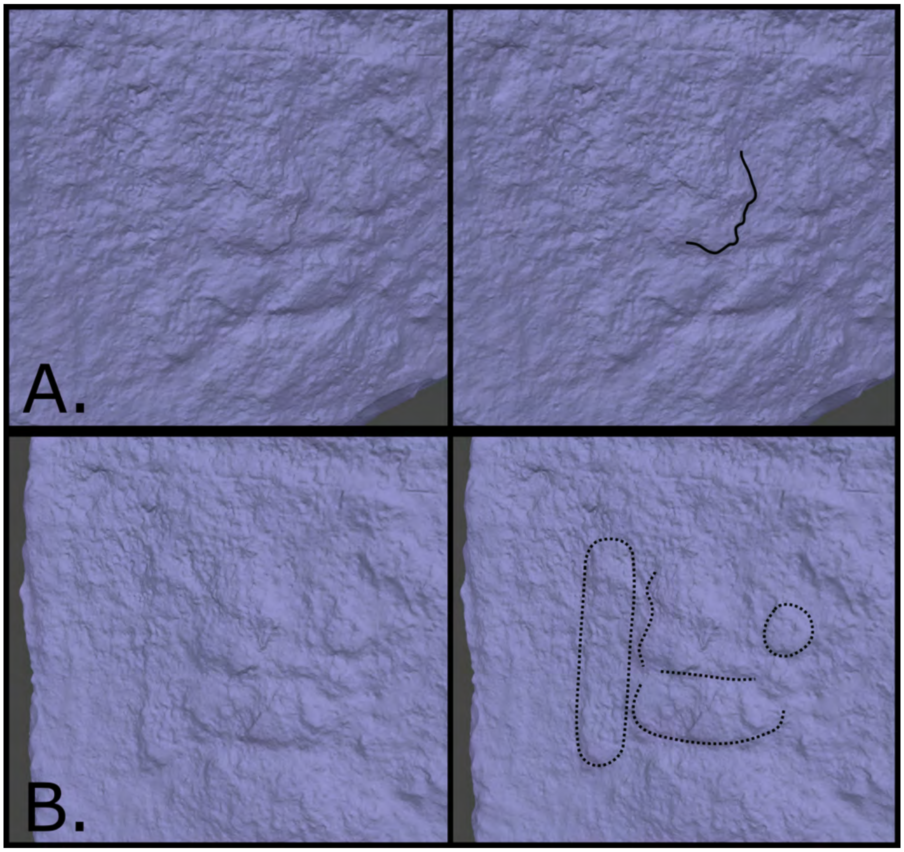

Figure 8.6 A: Photogrammetric model of the monument showing the possible profile of a human (nose, mouth, and chin looking down to the right); B: Image of the same model from a different angle depicting a possible glyph (photos by J. A. Biggs).

Whatever the case, the shape of this high-quality limestone slab clearly shows it was modified in antiquity and was not architectural in function. The stones that flanked the monument on all but the west and northwest sides were analyzed to determine if they were fragments of the monument. Unfortunately, none of the types, textures, or shapes indicated that they were originally part of the monument. After documentation, the monument was removed to expose Zone 2 lying underneath and extending throughout the rest of the square.

Zone 2 Possible Structure/Plinth Collapse (Square A)

Zone 2 was located directly below Zone 1 in the northwest and southeast areas of Square A, directly underneath the monument fragment (Zone 3), and was already exposed throughout the rest of the square when excavation of Op.75 began. With the area around (and some within) Square A undulating, and the area directly under and around the monument at a slightly higher elevation, it was hypothesized that the monument may have been set within a small plinth, just outside the west side of the sacbe. Thus, Zone 2 represents the collapse and highly eroded surface of a possible plinth or small structure housing the monument. The matrix within Zone 2 was a compact and slightly clayish silt with a dark grayish brown color (10YR4/2). It had a very granular and gritty texture with white flecks throughout, possibly remnant plaster. Some larger areas of this possible remnant plaster surface were located just under the monument fragment (**Figure 8.7**). Inclusions in Zone 2 consisted of limestone ranging in size from pebbles to larger-than-fist sized rocks. No discernible shape or outlines of a possible plinth were identified during the excavation of Zone 2. Few artifacts were found within this lens but those present included lithic debitage, ceramic body sherds, and a few small marine shells similar to those found in Operations 72 and 74. Zone 2 ended in the southern central portion due to the discovery of a likely tree pit (Zone 5) and throughout the rest of Square A once the possible plaster remnant layer was removed and exposed more limestone rocks underneath.

Figure 8.7 Zone 2 in Square A after the removal of the monument fragment (photo by J. A. Biggs).

Zone 4 Possible Structure Fill (Square A)

Zone 4 was located only in the northern half of Square A, delineated by the southern edge of the monument and extending to the northern border of Square A. This zone is the possible construction fill for the plinth/small structure, operating under the assumption that one existed there at one time. The matrix is similar in color to Zone 2 – a dark grayish brown (10YR4/2).

However, there was a change in matrix texture to a compact sandy clay silt. As with the previous zones, few artifacts were found and included lithic debitage and ceramic vessel sherds. Unfortunately, this zone was not fully excavated due to time constraints and the need to shift research focus to other areas of the site.

Zone 5 Tree Pit (Square A)

Zone 5 was a likely tree pit located in the southern central area of Square A. It was found directly under Zone 2 and some of the larger stones possibly associated with the plinth collapse. The soil was loose and very dark brown (10YR2/2) in color with a slightly clayish silt texture, a stark contrast to the surrounding matrices of Zones 2 and 4. Like with Zone 4, Zone 5 was not fully excavated. It was defined, documented, and then excavation efforts were shifted elsewhere at the site.

Interpretations and Conclusions

Operation 75 represented a unique opportunity to understand a possible carved monument fragment from Altun Ha. During excavation, it became clear that the extent of disturbance in the area was far greater than originally thought. The area around Square A and much of the sacbe (from Op.75 up to the possible sacbe terminus) were cleared of debris by BREA team members to try and understand the placement of the possible monument fragment in relation to the surrounding features. This was because its placement was somewhat "odd" as it was not located at the actual northern terminus of the sacbe and appears to have been offset from the sacbe, and not actually connected. The nearest structure (Str. E-66, located about 20 m west and 4 m south of the monument) is not large, but was more likely a small platform in its final phase, making the placement of a carved monument unlikely. Moreover, the landowner informed us that he used a bulldozer to move very large limestone boulders found elsewhere on the property and place them near the end of the sacbe while simultaneously pushing up and disturbing its northern end (**Figure 8.8**). It was also clear that areas flanking the sacbe just north of Op.75 were scraped by the bulldozer in order to flatten out the area. This, coupled with the very undulating nature of the ground surface within and surrounding Op.75, suggests that the entire northern portion of the sacbe down to Op.75 were disturbed and displaced.

Figure 8.8 The disturbed northern end of the sacbe showing the large limestone boulders, treefall, and loose and undulating soil mixed with old irrigation lines resulting from bulldozer activity; both photos are facing north (photos by J. A. Biggs).

However, no other cut or modified limestone blocks were found in the immediate area. An argument can also be made that – though disturbed – the monument may have been part of a small plaza group bordered by Str. E-66 to the west, Str. E-44 to the south, and the sacbe to the east. Only the western side of Str. E-66 (facing away from the sacbe) has been excavated and is probably the back side of the structure, making the eastern side the front of the structure facing the small plaza and monument (**Figure 8.9**).

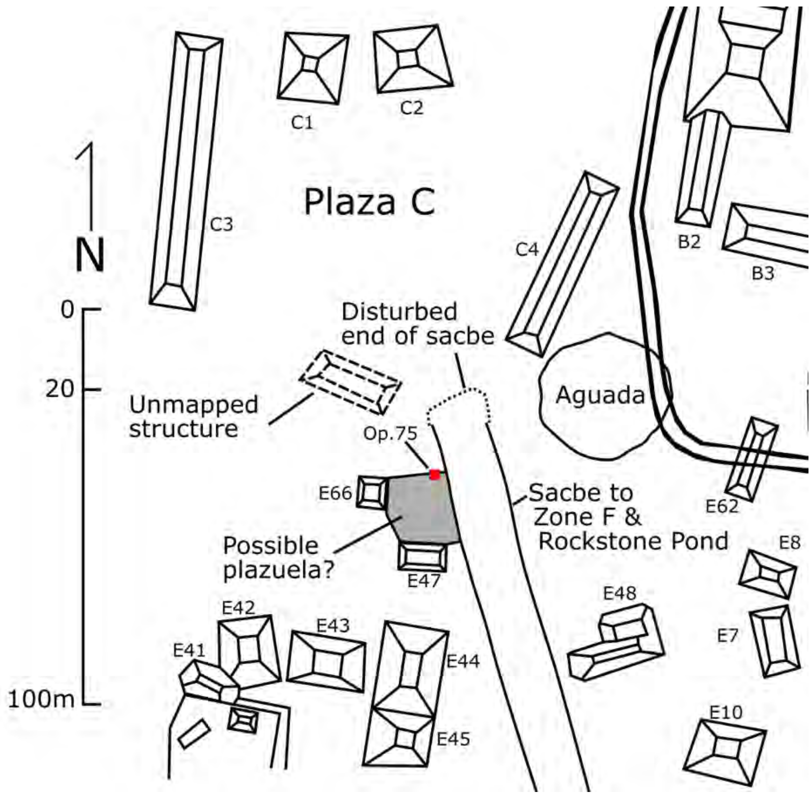

Figure 8.9 Map containing portions of Zones C and E of Altun Ha (southwest of the site core) showing a possible plazuela bounded by Str. E-66, Str. E-47, and the monument and sacbe (map from Pendergast 1979; modified by J. A. Biggs).

Further investigation is needed in order to fully understand this highly disturbed area. The overall lack of architectural features surrounding the monument fragment, as well as the absence of other monument pieces from this clearly broken but worked limestone block indicates the fragment is not in its original position.

Surface survey in a mostly inaccessible but nearby area revealed another much larger and longer cut limestone block that is now believed to be the monument Pendergast originally referenced (**Figure 8.10**). Investigation of this new monument has not been yet conducted, yet it is clear that the possible monument fragment from Op.75 does not belong to this one as they are different sizes, dimensions, and of differing limestone quality and texture. Future investigations in this area, particularly for deciphering a possible connection between these two monuments, would reveal more information about this more poorly understood area of Altun Ha.

Figure 8.10 Oblique view/screenshot of a photogrammetric model with detailed images of the other possible monument believed to have been the one found and mentioned by Dr. Pendergast. Outset photos detail the worked edges of the monument (model and photos by J. A. Biggs).

References Cited

Pendergast, David M. 1990. *Excavations at Altun Ha, Belize, 1964-1970. Vol. 3.* Publications in Archaeology. Royal Ontario Museum, Toronto.

Chapter 9

Revisiting the Hydrology of Chau Hiix: Geoarchaeological Investigations of the Canals and Dams of the Western Lagoon Wetlands (STP Series 059 and 060, Ops. 76 and 77)

Samantha Krause, Marieka Brouwer Burg, and Marie White

Introduction

In May 2024, the geoarchaeological team excavated one 1-x-1 m test unit (Op. 76) and a 1-x-1.5 m test unit (Op. 77) along the southern edge of the Western Lagoon. The team included Samantha Krause, Marieka Brouwer Burg, Marie White, and local researchers Rubin Crawford, Cardinal Baptist, Melvin Quilter, and Simon Tillett. These excavations were part of ongoing investigation of Archaic occupations in the Crooked Tree area, within the Northern Belize Archaic Adaptive Strategies (NBAAS) subproject. This area was chosen as a target site because previous excavations by the team in 2019 and coring efforts in 2023 revealed the potential for deeply buried deposits related to Archaic occupations in the study area (Krause et al. 2020; Krause et al. 2023). Additionally, research by Dr. K. Anne Pyburn in the early 2000s (Pyburn 2003) suggested the presence of an earthen water management feature at the confluence of Poor Haul Creek and Spanish Creek, at the southern end of the Western Lagoon in Crooked Tree, Belize (**Figure 9.1**). The primary goal of this research was to test the areas originally surveyed by Pyburn to determine whether large earthworks influenced flood regimes and stream flow in this part of the Crooked Tree Wetlands, and, if possible, to establish the cultural period to which these earthworks belong.

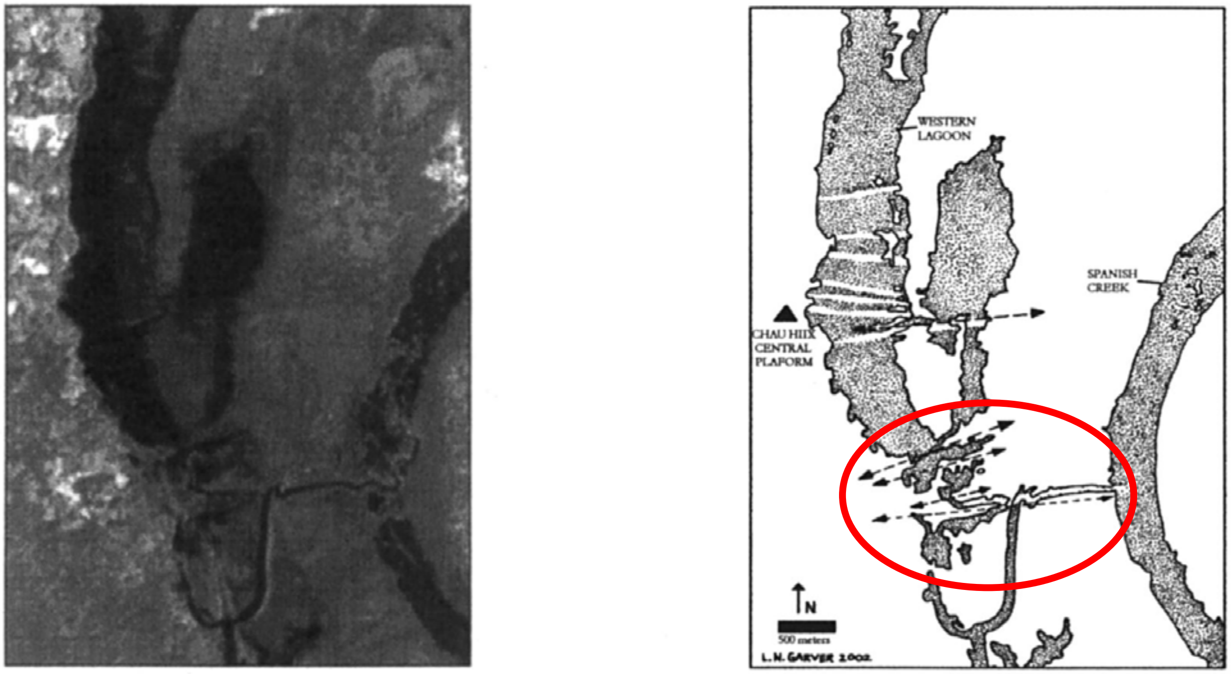

Figure 9.1 Image from Pyburn (2003:Figure 4) showing water features including dams and canals. Red oval indicates area of interest.

Environmental Background

The Western Lagoon, located in the Crooked Tree Wildlife Sanctuary (CTWS) in coastal Belize (a Ramsar Wetland of International Importance), is part of an interconnected system of low depressions, lagoons, and backswamps that make up a complex drainage system (Pinelo 2001; RAMSAR 2014). Revenge Lagoon, Western Lagoon, Spanish Creek, Poor Hall Creek[1], Black Creek, and Southern Lagoon all drain into the Belize River, located to the south. The region's geological framework is predominantly Eocene, Miocene, and Pliocene limestone and dolomitic limestone (Perry et al. 2009; Beach et al. 2009), overlaid by discontinuous Holocene coastal sediments and marls (High 1975). Depression and floodplain wetlands can consist of either noncalcareous, sulfate-poor, sand-based materials or calcareous, sulfate-rich marl deposits (Kim & Rejmánková 2002). The Western Lagoon was first surveyed by archaeologists when Dr. K. Anne Pyburn and colleagues conducted research in the 1990s and 2000s (Pyburn 2003), primarily at the site of Chau Hiix. Further excavations and surveys were carried out at Ek'tok (Harrison-Buck 2020) and a few other locations in this vicinity (Buck and Murata 2020). Additionally, we have conducted geoarchaeological excavations on wetland features that cut

[1] "Poor Hall" Creek appears on Google Earth imagery although the location was described to us by locals familiar with the area as "Po' Haul" Creek, referring to a poor catch of fish in Belizean Kriol.

across the Western Lagoon, dating to the Late Archaic and Early-Middle Formative periods (Harrison-Buck et al. 2024).

Satellite imagery (via Google Earth) shows the large berm that Pyburn documented in previous research as the southernmost dam feature in the Western Lagoon. This topographic feature has controlled the lateral movement of Spanish Creek where it connects with Poor Hall Creek. Here, Spanish Creek has meandered across its floodplain; meanders like this, and subsequent cutoffs, can be triggered by various factors, including high water flow, erosion, or sediment accumulation. Satellite imagery from 1969, 2012, and 2025 (**Figure 9.2**) reveals subtle channel adjustments and changes to the local hydrology at the southern end of the Western Lagoon over the past several decades, though the berm remains intact.

Cultural Framework: Dams and other water management features in the Maya world

Dams and other related water management features are key aspects on landscapes of the ancient Maya world, though relatively few have been excavated and dated using ceramic chronologies or radiocarbon assays. Dams and canals, which are usually associated with *aguadas* (reservoirs), are often mapped by researchers as a component of the larger archaeological landscape. Many site maps and survey reports contain mention of these features, but there is often little time or funding set aside for further study and excavation and subsequent publication in journals.

A particularly high density of Maya water features have been excavated in the southern Maya Lowlands, including locations in northwestern Belize and the Peten in Guatemala. Probably the most famously well studied dams and water management systems are located at the site of Tikal, and this complex system includes not only water control features (dams and reservoirs) but also channels and systems of distribution throughout the urban center (Scarborough et al. 2012). At Tikal, the onset of the late Preclassic drought and reduction of precipitation over the greater region coincides with the construction of interconnected canals, reservoirs, and other management structures. Likely this was a collective societal effort to distribute spring and rainwater throughout the site center (Scarborough and Sierra 2015). One of the more prominent large earthen dam and associated reservoir was located and excavated at the site of El Zotz, also in the Peten region (Luzzadder Beach et al. 2017). At a smaller, more residential scale, a drainage/check dam reservoir system of the site of Dos Hombres was recorded and is thought to be used by individual households (Lohse and Findlay 2000). These smaller check dams represent a more local-scale water management system, likely for non-elite residents.

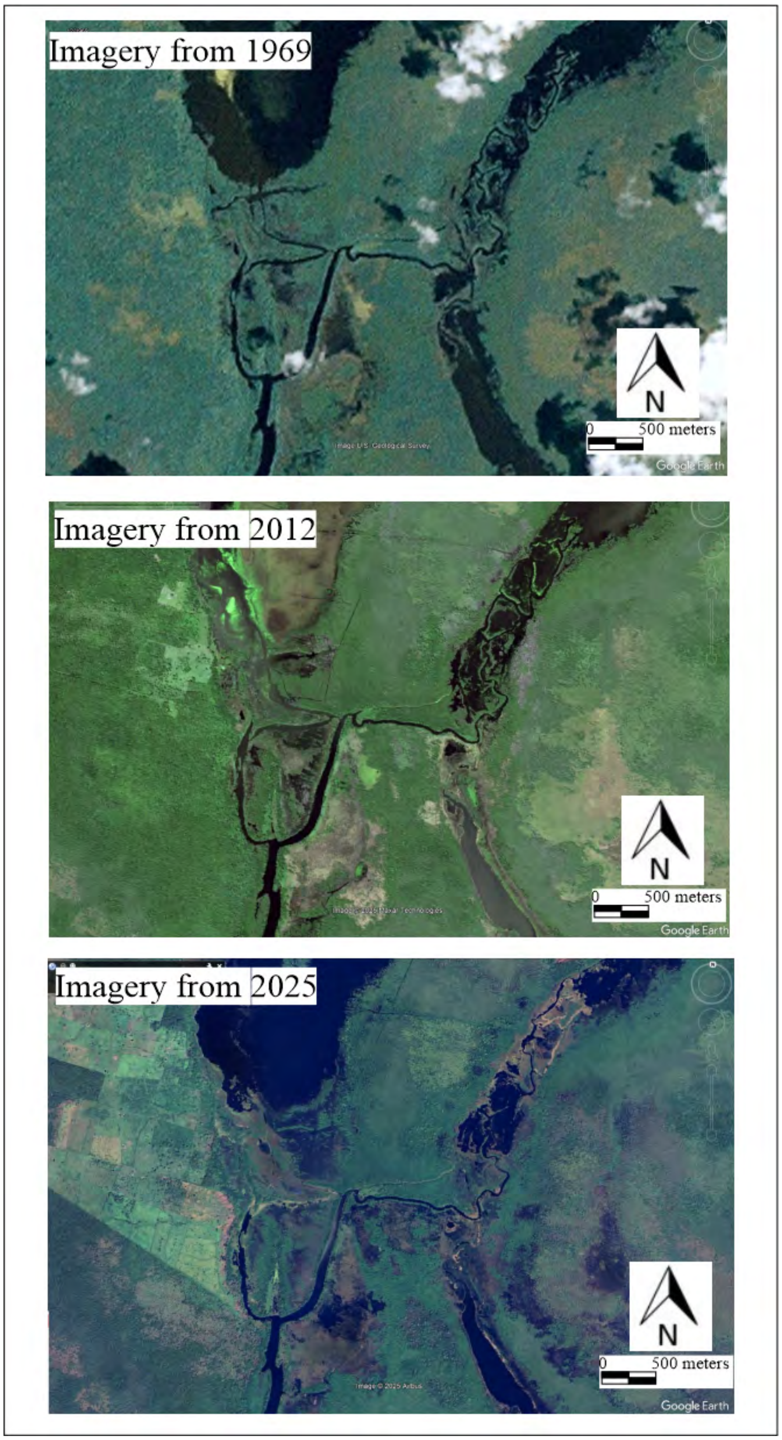

Figure 9.2 Satellite imagery of the study area from 1969 to 2025 (image by S. Krause).

What is noteworthy about many of the dams that have been excavated/dated in the Maya region is their location: many of these water control systems are situated in higher elevation areas, either in the Elevated Interior of Guatemala or along the escarpments of the Belize/Guatemala border. These systems all date to the Preclassic or Classic periods.

Geographically, all of these systems were likely used to control and manage only rainwater at various scales. However, the dam recorded by Pyburn in the Western Lagoon, located along the Belize coastal wetlands and within a dynamic floodplain system, likely served a similar, but hydrologically different purpose. This system would have needed to manage water from a unique hydrological perspective; here, perennially wet systems are controlled not only by seasonal flood pulses driven by rainfall coming from higher elevations, but also due to the inundation of coastal wetlands and rivers during hurricane season. It is well known in the BREA project area that for most of the year, water flows from Spanish Creek into Black Creek and into the Belize River. However, during peak flood events at the height of the wet season, Black Creek flows north from the Belize River. This natural reversal of flow would have been a seasonal challenge for early residents on the landscape during fishing seasons, and likely there would have been an increasingly sophisticated need to manage the hydrology of the area as populations grew.

In the Western Lagoon, Pyburn documented not only a potential series of dams but other water management features as well, including the canals that the BREA and NBAAS teams have studied since 2019. In Pyburn's (2003) original report, published in the journal *Ancient Mesoamerica*, she reports that her team conducted field survey and excavation of canals and dams in the Western Lagoon. In this original research, Pyburn states "Two dams were built at the inlet from Spanish Creek into the lagoons around Chau Hiix that may have regulated the influx of water at the start of the wet season. Huge dikes (.5–.6 km in length) were constructed perpendicular to stream flow and parallel to the largest canals in Western Lagoon" (Pyburn 2003:125; see **Figure 9.3**). Without radiocarbon dating, Pyburn posited that the earthen dam feature and canals were likely constructed by the Maya and associated with the nearby site of Chau Hiix. Since our previous findings determined that at least some of the canals in the Western Lagoon were constructed before the nearby site of Chau Hiix was occupied, our team hypothesized that perhaps the dam system that Pyburn originally recorded was also constructed earlier than previously expected. Based on the unique hydrology of Western Lagoon and construction of the dam, as well as its close proximity to much earlier canal systems, it is possible that at least the beginning of construction of the Western Lagoon dam occurred during a different cultural period than the dams we see in the Elevated Interior.

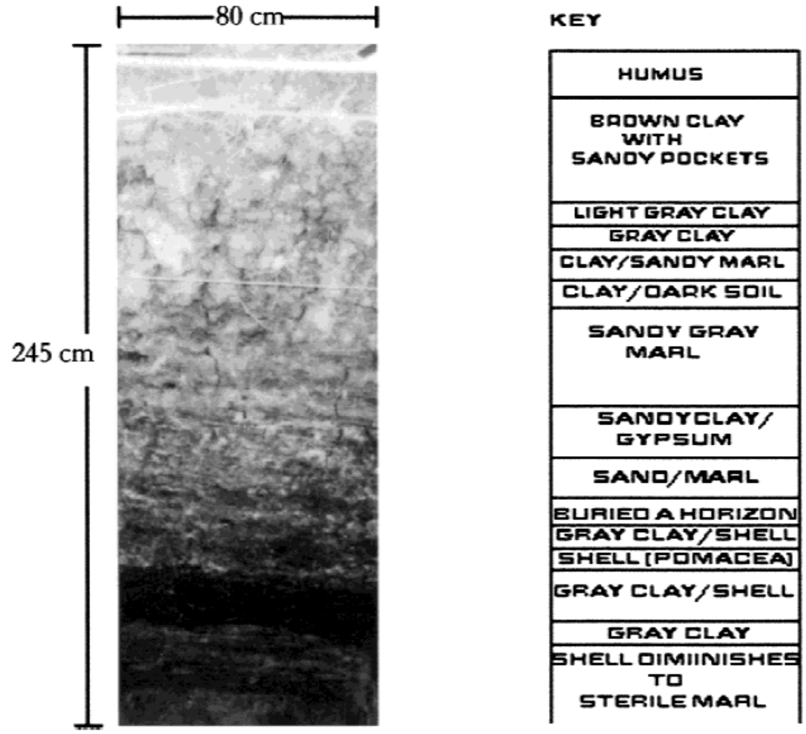

Figure 9.3 Image from Pyburn (2003:Figure 5) describing the strata of the dam.

Objectives

The objectives for this research were as follows:

1. Conduct pedestrian and shovel test surveys across the southern area in the Western Lagoon highlighted in Pyburn's 2003 research report with the purpose of ground validating features associated with water control and to examine underlying stratigraphy.
2. Document and excavate a test unit in the potential earthen dam.
3. Map the stratigraphy and collect sediment samples from the earthen dam for further radiocarbon dating and geochemical analysis.
4. Recover diagnostic lithic artifacts from excavations either within the dam fill or beneath the dam construction
5. Connect deeply buried sediment deposits with pre-Maya time periods, as well as later cultural shifts and transitions.

Description of the Research

For shovel test survey, we followed the procedure laid out in Kaeding (2022:96) and for excavation, we followed the standard procedure for geoarchaeological trenching, outlined by Krause et al. (2020:118). Two shovel test surveys were conducted—STP series 059 along the edges of the Poor Hall Creek berm and STP series 060 cross-cutting an ancient canal on the eastern side of Western Lagoon (**Figure 9.4**). Two excavations were conducted: Operation 76 was a 1-x-1 m unit placed along the northern side of the main branch of the canal that extends eastward across Western Lagoon from Chau Hiix. Operation 77 was a 1-x-2 m unit located along the edge of the northern side of the berm, at the confluence of Blackburn and Spanish Creeks, where we believe Pyburn excavated in the late 90s/early 2000s.

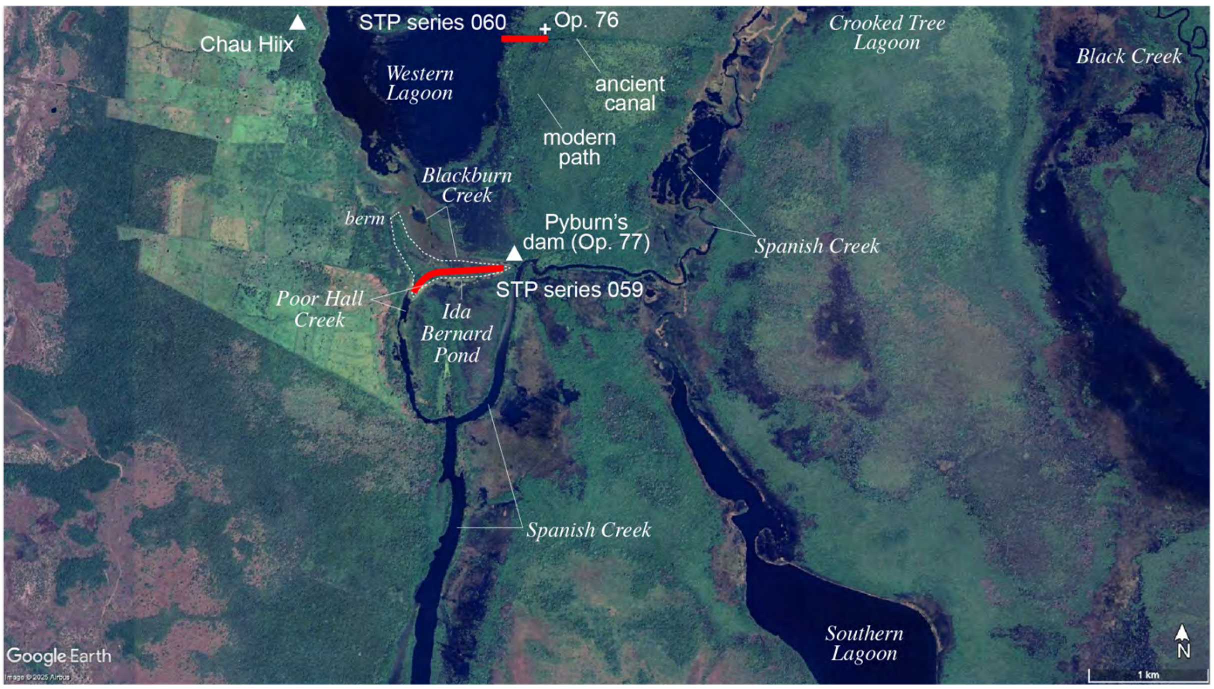

Figure 9.4 Map indicating key features in area. Red lines represent STP series (image by M. Brouwer Burg).

STP series 059 ran along the edges and sides of the berm lying just north of Poor Hall Creek (**Figure 9.5**). We accessed this area by parking on the land of Mr. Glenn Crawford on the western shore of Western Lagoon. We hiked toward the creek and crossed an area with ~2 m of standing water to reach the berm (see pink track in **Figure 9.5**). We traversed the rest of the berm, conducting STPs 1 and 2 along the western thumb, then running four STPs (3-6) perpendicular across the berm farther east. We pushed through dense vegetation all the way to the Blackburn confluence, where we encountered a natural stream and sandy deposits (see bottom image in **Figure 9.5**). On our return, we conducted a few more STPs across the thumb (8-11) and another (STP 7) on a higher area across from the thumb. The results of these tests are reported in **Table 9.1**.

Figure 9.5 Top left: Rubin Crawford crossing Poor Hall Creek; Top right: Sam Krause and Melvin Quilter demonstrate height of berm; Middle: map of STP series 059 survey and excavation in vicinity; Bottom: Krause and Quilter at the natural spring (map and photos by M. Brouwer Burg).

While May 2024 was a dry, hot month, there was still some standing water in the creek and in Ida Bernard Pond (see **Figure 9.5**). The berm itself rises about 2-3 m above the low-lying creek bed and one of our main objectives was to determine if the berm displayed indications of human modification. The berm is covered in lowland broadleaf moist scrub forest and southward lies a mix of wetland grasses and logwood swamp. Rubin Crawford recalled that the little backwater of Ida Bernard Pond was named after a local woman who used to camp there. Both Blackburn and Poor Hall Creek appear to drain into Spanish Creek. On the far eastern side of the berm, near the confluence with Blackburn and Spanish Creeks, we encountered the decomposing remains of a boardwalk. Again, Rubin Crawford recalled that these structures had been built by Birds Eye View Lodge as a place to bring tourists during bird tours.

The STP series 059 units were uniformly comprised of dark vertic clay that lightened with depth and contained high levels of redoximorphic features and gypsum threads and crystals. The presence of manganese nodules in STP 4 suggests that the area is stable and that pedogenesis is ongoing. Some charcoal was encountered in STP 2 and collected. No artifacts were recovered but there was also a notable lack of shells or pebbles, which would be expected in a natural deposit. At the bottom of STP 1, we encountered hard clods of pure clay that we initially thought were rocks but might be the result of basket-load construction. The overall impression is one of a seasonally wet-dry environment but the lack of features like shell or rock may indicate that these sediments were brought in and deposited by human agents, perhaps a by-product of the fish canal cleaning that likely occurred on a frequent basis farther north in the lagoon.

Table 9.1 Results of STP series 059 along Poor Hall Creek.

STP #	Positive or negative	Ending elevation (cm BGS)	Stopping point of STP/other comments
1	Negative	74	0-50 cm reddish black clay with roots (2.5Y2.5/1) with iron flecking (7.5YR4/6) and gypsum threads, descends gradually into: 50-74 cm gray clay (GLEY1 5/N) with iron (10YR5/6)
2	Negative	95	Similar to STP 1 but wetter and more gypsum ~90 cm charcoal sample recovered, in same gray clay and notable lack of shells with hard clods of clay
3	Negative	82	0-1 cm duffy/loamy detritus 1-40 cm thick, homogenous, vertic clay, dark grayish brown (2.5Y4/2) with mottles of 2.5Y4/1 gray and 7.5Y4/6 strong brown

			40-82 cm becoming more reduced (GLEY1 4/N), strong brown streaks, flecks of charcoal, soft gypsum masses and slickensides increase with depth
4	Negative	105	Same as STP 3, pockets of manganese streaks, clay becomes lighter with depth, from bluish gray (GLEY2 5/PB) to yellowish brown (10YR5/6) with red (2.5Y4/6)
5	Negative	62	Same as STP 2
6	Negative	63	Same as STP 5
7	Negative	75	Same as STP 5
8	Negative	70	Same as STP 5
9	Negative	82	Same as STP 5, more charcoal and less duff
10	Negative	70	Same as STP 5, water table
11	Negative	70	Same as STP 5, water table

Since we were unsuccessful in identifying Pyburn's dam area from the west and south, we attempted to reach the farthest southern point of Crooked Tree Island by driving south from the village (see yellow route in **Figure 9.5**). The dryness of the season made conditions favorable and we were able to drive due south along the eastern access road of the Island that extends to Hole in the Wall (i.e., Chulub; for more on BREA investigations of Chulub, see Murata et al. 2018). We then cut SW across the island through lowland savanna to the Western Lagoon side. From a parking spot about 1 mile north of Pyburn's Dam, we loaded our equipment and pushed south on foot. The ~1 hour trek was difficult -- across uneven, heavily cracked earth and through low-lying scrub vegetation that tore at our clothing and equipment. Nevertheless, we reached the confluence of Blackburn, Poor Hall, and Spanish Creeks and found a raised terrace overlooking the water with shade and a lush breeze (**Figure 9.6**). It was not a wonder that many others had been here before us, as the remains of a fishing camp indicated.

We laid out a continuation of STP series 059, although in the first STP dug (12), we uncovered what looked like a buried paleosol. Knowing that Pyburn had also encountered a similar layer (which she termed a "buried A horizon"), we decided to lay out an excavation unit – Operation 77. The paleosol was deeply buried and so a 1-x-2 m unit was laid out.

We excavated this unit based on sediment horizons rather than arbitrary 10 cm levels (**Figure 9.7**). Due to the high clay content within the sediment, screening was assisted by manually breaking apart sediment peds. Since we were so close to nearby Spanish Creek, we would test the depth to water table regularly during excavations with a posthole digger, so that our unit did not run the risk of flooding before excavations were complete. We halted excavations once we reached a basal clay and water table around 220 cm below the surface (cmbs).

Figure 9.6 Confluence of Spanish and Blackburn Creeks (photo by M. Brouwer Burg).

We described soil horizons, mapped features, and collected a soil sample from representative horizons down profile in Op. 77. Each sample was collected using a cleaned trowel and bagged in a plastic zip-lock bag and was subsequently weighed and shipped to the Soils and Geoarchaeology lab at the University of Texas for analysis.

Figure 9.7 Left: excavation in progress at Op. 77; Center: excavation unit continuing to be probed with the post hole digger; Right: Sandy/platey non-artifacts (photos by S. Krause and M. Brouwer Burg).

The stratigraphy of Op. 77 Square A was as follows (see **Figure 9.8**).

Zone 1 (topzone)

This zone extended from 0-17 cmbs and consisted of a mixed O/A horizon (10YR4/3, dark yellowish brown). This O/A horizon was over 50% root material (small and large), layered quartz sandy silt, as well as compacted silty material that we mistook for undifferentiated body sherds at first glance (**Figure 9.7**). We later realized that these were likely not ceramics but instead were sand inclusions with a platy structure (meaning the sand aggregates were wider than they were tall, forming plate-like units that were horizontally oriented) likely deposited due to repeated high energy flood events. No diagnostic artifacts were recovered in this mixed O/A horizon, which we classified as topsoil.

Zone 2 (A1 horizon, earthen)

This zone extended from 17-42 cmbs and consisted of a well-developed A1 horizon of clay vertisol that appears to lie atop cultural soils (Zone 3). with many fine roots (10YR 3/2, very dark grayish brown). The zone was characterized by increasingly compact clay with massive to prismatic structure and cracks/slickensides present. There is a rapid increase of iron staining (up to 15% on some peds) as well as a few dark stains of Mn (4%) which indicate that this soil has been stable for quite some time. Gypsum threads and Fe stains increased with depth, indicating repeated wetting and drying across this horizon. There was a distinct lack of shell or $CaCO_3$ concretions.

Zone 3 (A2 Horizon, cultural burning/anthropomorphic layer)

This zone extended from 42-67cmbs and represents a potential anthropogenic activity layer as part of the A2 horizon. The soil matrix (Gley 1 5/N, gray) is mostly clay with increased gypsum crystals (sugary texture). There are also increased mottles (10YR 6/4, light yellowish brown). In addition, there are at least four, 1-cm thick charcoal-rich burn layers at 42cm, 51cm, 59cm and 64cm. These burn events could represent some anthropogenic activity throughout this layer, and we collected a sample for C14 dating at 42 cm.

Zone 4 (B Horizon)

This zone extended from 67-135 cmbs. The soil structure and overall soil matrix color (Gley 1 5/N, gray) did not change, but there are increased iron stains (to 50%) and evidence of accumulation of clay, iron, and aluminum with depth (illuviation), indicating the development of a B horizon. There are some additional anthropogenic features in this horizon, including an undulating white band of about 1 cm thickness at 77 cm, as well as two additional charcoal-rich burn layers at 100 and 115 cm. The very white undulating band could also represent a burn event, potentially from a slash and burn event across the landscape, as is seen in the Maya agricultural fields from the Birds of Paradise system in northwestern Belize (Beach et al 2019). The other two burn layers were dark and contained large, burned fragments of wood, which could represent burning at a different scale. C14 samples were collected at 74 cmbs, 115 cmbs, and 130-140 cmbs.

Zone 5 (Cgyy Horizon)

At 135 cmbs, there is an abrupt sediment change to a Cgyy horizon (a gley C horizon with much gypsum and slickensides). Extending to 174 cmbs, this horizon was made up of pure gray vertic clay (Gley 1 4/N, dark gray) and soft, massive gypsum deposits. Slickensides increase, and there is some evidence of charcoal staining. There is much less Fe staining in this horizon, but a few streaks of Fe were noted sporadically, mostly associated with old root channels where water infiltrates. Gypsum increases with depth to make up over 50% of the soil matrix towards the bottom of this horizon. A C14 sample was collected at 170 cmbs.

Zone 6 (Paleosol 1, Ab1 Horizon)

This zone extended from 175-185 cmbs. An abrupt change to an undulating buried A horizon (Ab1) occurred at 175 cmbs. This sediment was dark in color (Gley 1 3/N, very dark gray), organic rich, with a few iron stains. Within the clay matrix of this paleosol, we encountered a discontinuous sandy silty clay (2.5Y 5/4 and 4/4, light olive brown and olive brown). This brownish material appeared in pockets throughout the paleosol and could potentially represent materials thrown onto the old surface, or perhaps small pockets of flood materials. Samples of both the paleosol and the sandy silty clay were collected for further laboratory analysis. A C14 sample was collected at 174-185 cmbs.

Zone 7 (flood layer)

This zone extended from 185 to ~197/200 cmbs. The abrupt change at 185 cm was to a 10-15 cm thick layer composed completely of small terrestrial snails and a few larger bivalves and even larger apple snails. This layer contained no soil matrix, and likely represents a flood layer, because the shells are similar to what we have encountered in layers excavated at Crawford Bank and the canals of Western Lagoon. This layer also looks extremely similar to the modern bed of Spanish Creek, which indicates that perhaps this area was at one point under flowing water before the berm was built up.

Zone 8 (Paleosol 2, Ab2 Horizon)

This zone extended from 200-233 cmbs. It was marked by an abrupt transition to an Ab2 horizon, which we hypothesize was a previous surface. The sediment is organic and dark (Gley 1 2.5N, black and 2.5Y2.5/1, black), with a more granular structure than previous horizons. There are a few large apple snail shells embedded within the top few centimeters of this horizon, and a few pockets of sandy silty material, similar to the Ab1. This soil horizon lightens with depth. We recovered charcoal from ~233cmbs, right before the next transition to the basal clay. A chert/chalcedony core/nodule (blackened) was recovered at 210 cm.

Zone 9 (Cg2 Horizon, basal clay)

This zone extended from 233-235 cmbs and was marked by a sharp transition to a bluish basal gray Cg2 horizon (Gley 2 5/5 and Gley 2 6/10).

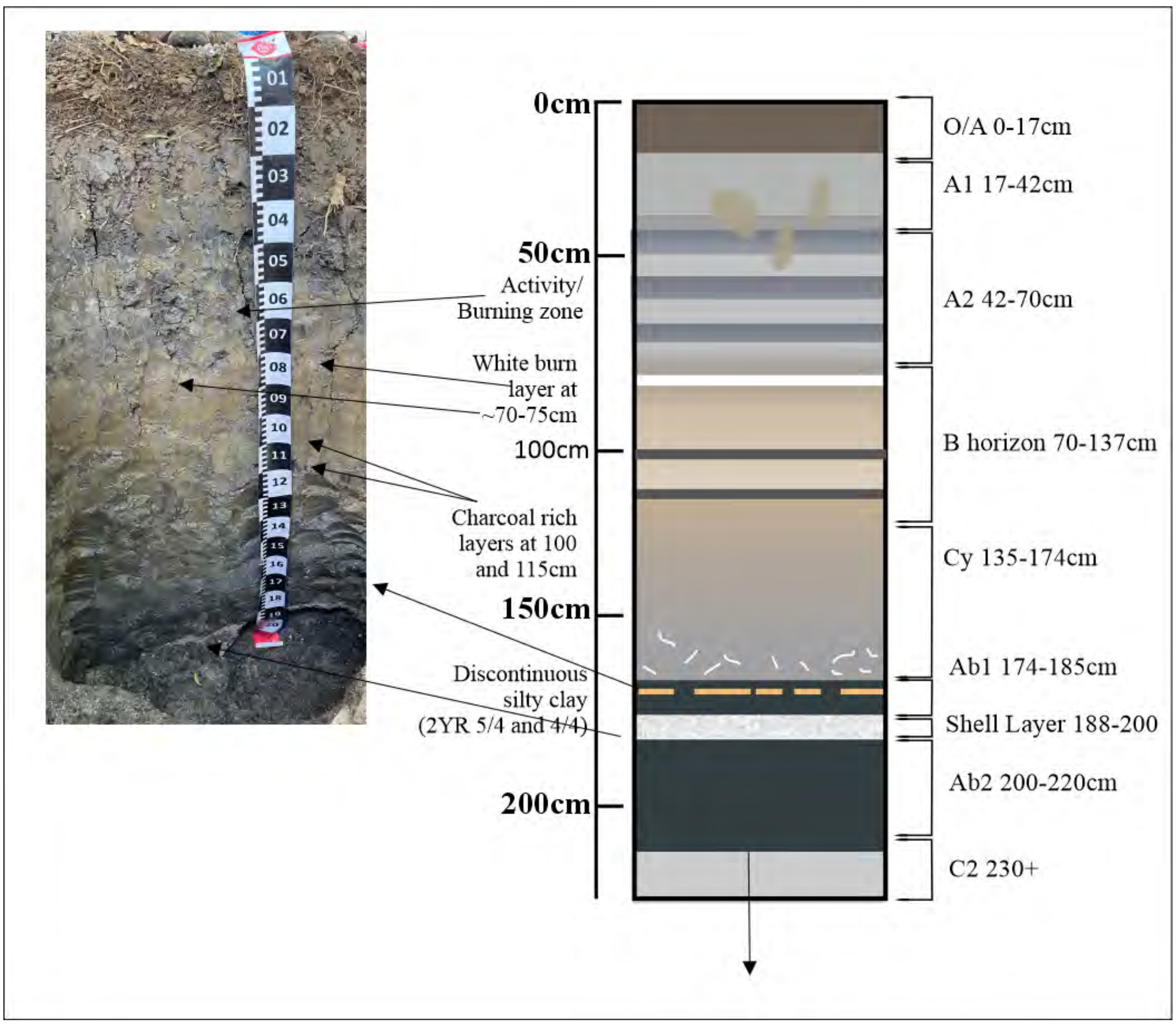

Figure 9.8 Op. 77 profile with sediment descriptions (image by S. Krause).

The second major initiative of the research described here was to get a fuller understanding of the cluster of canal features that extend across Western Lagoon from Chau Hiix. These features are visible in satellite imagery (see **Figure 9.9**). In summer 2017, the BREA team conducted a 1.5-x-2 m unit in a circular depression thought to be an ancient fish weir located due east of Chau Hiix in Western Lagoon (Op. 34; Craig and Harrison-Buck 2018:191-193). The excavation yielded no obvious evidence to suggest the depression was used for fish trapping although the excavators realized that without a geoarchaeologist, they were unsure what to look for in the sediment profile. The present authors had also successfully gathered core sediments from Sip-Your-Key Bight in a previous season (see Krause et al. 2023). For these reasons, we wanted to revisit the location where the Chau Hiix canal system exited Western Lagoon and to investigate whether it continued across Crooked Tree Island. Additionally, we hoped to collect diagnostic artifacts and C14 dates.

Figure 9.9 Map of Western Lagoon during dry season of 2017 showing canal network extending eastward across lagoon from Chau Hiix toward Crooked Tree Island (image by M. Brouwer Burg).

STP series 060 was initiated with the goal of bisecting one of the canals (**Figure 9.9; Table 9.2**). STP 1, dug in the canal, looked stratigraphically like Operation 78 dug by Krause in 2018, and which yielded C14 dates ranging from 5930-5770 cal BCE (middle Archaic) to 1000-

830 cal BCE (early/middle Preclassic; Harrison-Buck et al. 2024). Similar to what we saw in STP series 059, there was a conspicuous lack of shell in the subsurface, although many were present on the surface.

STP 2 was dug in an area between canals, slightly raised, drier, and with more established vegetation. This STP yielded more redoximorphic features, indicative of wet/dry cycling.

Table 9.2 Results of STP series 060 on eastern edge of Western Lagoon.

STP #	Positive or negative	Ending elevation (cm BGS)	Stopping point of STP/other comments
1	Positive	120	0-60 cm pure vertic clay, dark gray (7.5YR4/1), pop grass roots at top 60-120 cm clay lightens in color (GLEY1 8/N), iron inclusions (7.5YR5/6), gypsum crystals and Mn masses 100 cm water table *Chalcedony cobble (untested) found ~40 cm **C14 sample collected ~51 cm
2	Negative	82	0-5 cm O horizon (10YR2/1, black) 5-35 cm gray vertisol clay (GLEY13/N, very dark gray); iron staining around root holes and gypsum precipitating 35-50 cm vertic clay darkens (GLEY1 2/5N, black) 50-82 cm vertic clay lightens (GLEY1 7/N, light gray; GLEY17/10Y, light greenish gray) with yellow mottles (7.5YR5/6, 5/8, and 6/6); gypsum crystals throughout and increasing with depth; yellow dominates profile (70%)
3	Negative	73	0-2 cm O horizon 2-30 cm A1 horizon (10YR3/1, very dark gray), clay 30-40 cm A2 horizon (10YR4/2, dark grayish brown), clay 40-73 cm C horizon (?) composed of light-colored clay (GLEY1 7/N) and iron streaking (10YR4/6) *C14 sample at 72 cm **two surface finds nearby: one chert flake and one marine shell

STP 3, located in the middle of the large canal about 100 m further east on Crooked Tree Island, resembled STP 1. This seems to support the hypothesis that this artificial canal was dug across Western Lagoon and potentially across Crooked Tree Island as well, perhaps in an effort to provide a more direct route for the ancient Maya to reach Spanish Creek. Today, Spanish Creek empties into Black Creek in the dry season and Black Creek connects Crooked Tree Lagoon to the Belize River. Thus, it is possible that, if the drainages were more or less in the same position in prehistory, people could have traveled by watercraft from Chau Hiix to the Belize River and beyond via the Chau Hiix canal, Spanish Creek, and Black Creek (**Figure 9.10**).

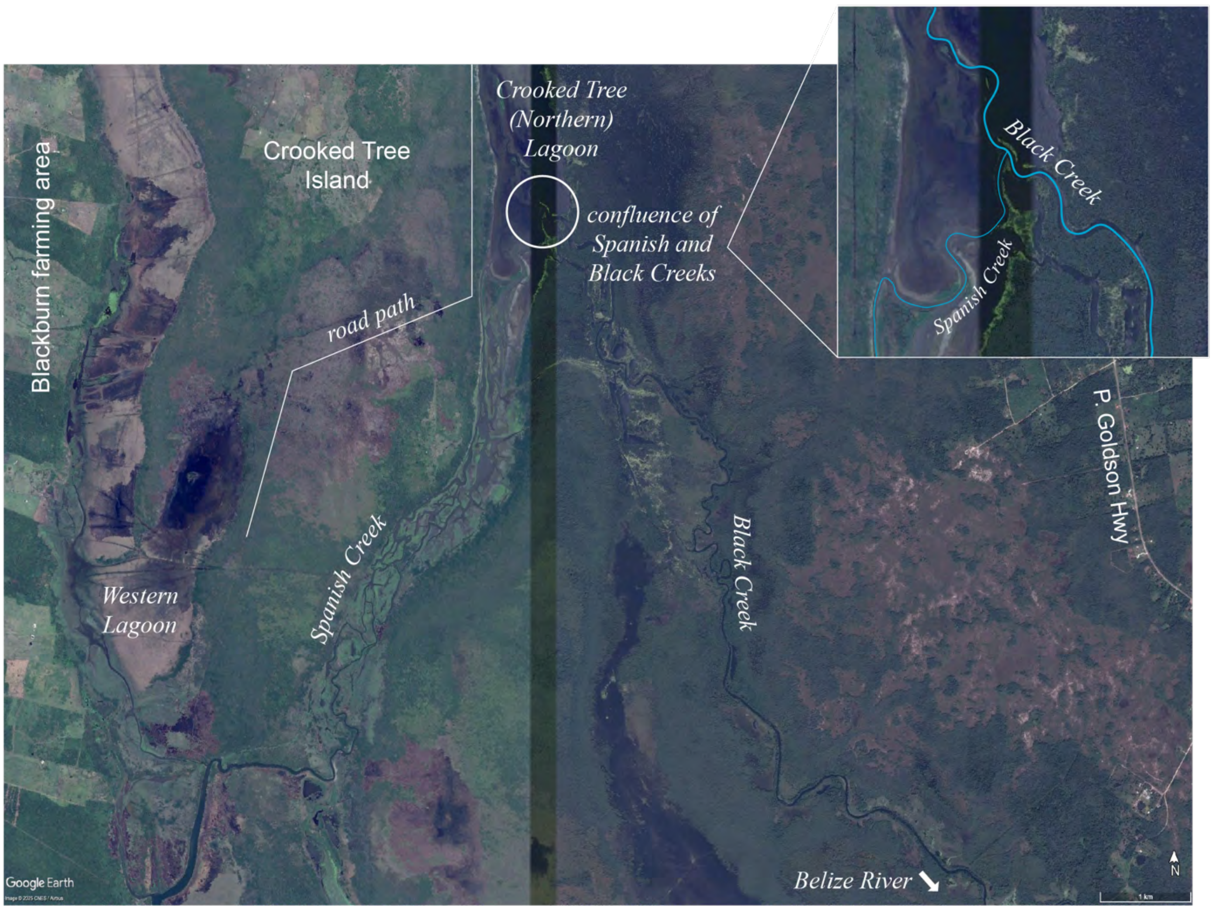

Figure 9.10 Hydrological map of Crooked Tree Wildlife Sanctuary indicating relationship between Spanish and Black Creeks (image by M. Brouwer Burg).

We opened operation 76 just north of STP 3 from the series 060 (**Figures 9.9** and **9.11**). This 1-x-1 m unit was placed along the edge of the main canal, in a logwood, seasonally inundated swamp forest. Like Operation 77, we excavated this unit by sediment horizons. The four zones are described below.

Zone 1 (topzone)

This 5 cm thick silty loam layer was very dark in color (10YR3/1, very dark gray). We designated it an O horizon with many fine roots. No artifacts were recovered from this zone.

Zone 2 (earthen)

This ~25 cm thick zone is marked by a sharp transition to an A1 horizon. This clay vertisol is a dark gray (GLEY1 4/N) in color with a prismatic structure and slickensides. Brown (7.5YR4/4) mottles increase with depth. Two artifacts were recovered from this zone: one lithic (chalcedony) flake found at 10 cm, which could be natural, and a core fragment found at 26 cm.

Zone 3 (earthen)

This ~20 cm zone was a clay vertisol that we designated an A2 horizon. It was gray (GLEY1 5/N) in color and displayed fewer cracks that Zone 2 A1 horizon. The brown (7.5YR5/6) mottling comprised about 50% of matrix in this zone.

Zone 4 (earthen)

The last zone in this column was ~40 cm in thickness and represents a possible C horizon consisting of almost pure white gypsum (GLEY1 8/N), with bluish black (GLEY2 2.5/5PB) Manganese streaks, as well as iron oxide in the matrix.

Figure 9.11 Excavation underway at Operation 76, depicting (L-R) Simon Tillett, Rubin Crawford, Cardinal Baptist, and Sam Krause (photo by M. Brouwer Burg).

This profile indicates a homogenous and likely old soil with no evidence of human modification present. If there were human modification, we would expect to see layers of sand, mud, or muddy streaks throughout.

Interpretations and Conclusions

With this research, we identified the feature that Pyburn called a "dam" although we are inclined to call it a berm. As shown in **Figure 9.8**, the feature appears to have been artificially raised by human activity. The two buried paleosols, separated by the shell layer, suggests the area was lived on for a time before a massive flood event (the shell layer) and then people returned to the spot. The interspersed burn layers higher in the profile also seem to point to anthropogenic burning events. We will be able to say more about the sequence of events once we receive the C14 dates. What seems clear is that humans were here and doing things (living, burning, building) for a significant amount of time. We suspect that the area was a key pinch point in the hydrological flow of the area and while we disagree with Pyburn about the Op. 77 berm being a dam, we do believe that this berm paired with the southern berm investigated in STP series 059 created the necessary water restriction for effective dam construction. The dam itself—perhaps a check dam made of perishable material—could have been located just south of Op. 77, functioning to close off flow from Blackburn Creek into Spanish Creek. Traditionally, check dams need not be elaborate and may consist of perishable materials like fiber, wood, sandbags, or rocks (**Figure 9.11**).

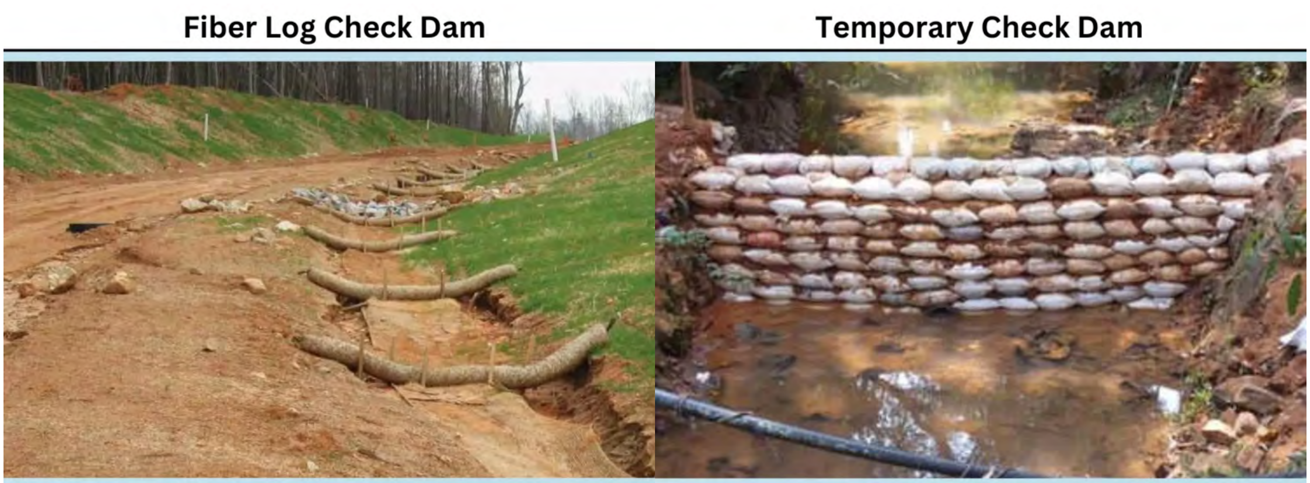

Figure 9.11 Simple check dams made of fiber, wood, and sand (from www.dreamcivil.com).

The next steps for understanding the construction of this earthen dam feature will be through soil and sediment testing in the laboratory facilities at the University of Texas at Austin.

C14 dates have already been sent out and will be published in subsequent reports and peer-reviewed journals. Laboratory work during the 2025-2026 calendar year will carry out a suite of soil tests including but not limited to: pollen (Jones 1994), geochemical analysis via XRF to understand enrichment/depletion patterns of key elements as an indicator of past human activity, (Hutson et al. 2009, Cook et al. 2006), particle size analysis and percentage of organic matter to elucidate sediment origin and geomorphic processes, (Dean 1974), and micro and macro charcoal analysis to understand fire regime and possible drought patterns (Anderson and Wahl 2016). The results of these tests will be published in subsequent reports and peer-reviewed journal articles.

As for the canals cutting across Western Lagoon from Chau Hiix, their density and relatively straight courses strongly suggest they are not natural features, and we have shown in Harrison-Buck et al. (2024) that they do appear to have been dug into the surrounding sediment. However, there is an overall lack of expected anthropogenic characteristics, such as layers of artifacts, sand, stone, or packed clay. One potential explanation is that all traces of human use have been scoured away in recent years, perhaps an unintended consequence of the road causeways built in the 1990s that bridge the Western and Crooked Tree Lagoons. Neither causeway was constructed with sufficient culverts to permit water to flow between the northern and southern portions. Subsequently, the northern portions of both lagoons have experienced far more silting and vegetative growth. We suspect that the southern portions of the lagoons have experienced far more erosion and sediment transport as the volume of water through the system has been confined to a smaller containment area. With increasingly volatile, climate-change induced storms, we expect that the lagoons will experience further hydrological change as they adapt to new precipitation regimes. Continuing to study and monitor these hydrological systems will be important for understanding post-depositional processes as well as for anticipating the impacts of future flood events.

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Chapter 10

Investigating the Ballcourt at Altun Ha (Op. 80)

Eleanor Harrison-Buck, Jack A. Biggs, and Kaitlin Murphy

Introduction

Structures C-1 and C-2 at Altun Ha are two parallel structures that were first mapped by David Pendergast between 1964-1970 (Pendergast 1979, 1982, 1990). Pendergast (1982:148) conducted excavations in 1963 and 1969 of Structure C-1 on the east (rear) side of the building and noted that it was paired with Structue C-2 to the west (**Figure 10.1**). However, he did not register that these two structures formed a ballcourt assemblage. He also identified what he suggested were two ballgame handstones in Structures E-1 and E-44, but concluded that this assemblage was an "oddity, because Altun Ha does not boast a single ball court" (Pendergast 1990:21). Pendergast may have been dissuaded from identifying Structures C-1 and C-2 as a ballcourt because their summits are considerably steep and taller in height than other examples found in Belize, such as the ballcourts at Chau Hiix and Lamanai. However, BREA excavations during the summer 2024 field season were able to confirm that Structures C-1 and C-2 do indeed form a ballcourt with a central alleyway between them. Operation 80 exposed the sloping upper and lower terrace walls on the west side of Structure C-1 and a large pit feature in the center of the alleyway that contained a stone marker, which is a characteristic feature of ballcourts in the Maya area. The sizeable circular stone marker contained a single incised line encircling the outer edge of the stone, but it was evidently smashed in antiquity and only a portion of the marker was found, thrown back into the pit feature along with numerous broken fragments of the stone monument.

The plain stone marker with the incised line resembles the stone marker found in the ballcourt at Lamanai (Helmke, personal comm. July 2024). The alleyway measures roughly 4 m in width and the length of the alleyway created by the pair of parallel structures measure roughly 18 m in length. The ballcourt delimits the northern side of Plaza C, an enormous open plaza space that is thought to represent a marketplace. Ballcourts have been identified in association with marketplaces elsewhere, such as Tikal's East Plaza and Coba's Plaza A (Coronel et al. 2015; Jones 2015). Plaza C is bound to the west and east by two low elongated platforms, Structures C-3 and C-4, respectively and to the south by Structure C-69. Structure C-3, a 60 m long platform, was the focus of another excavation in summer 2024 (see Degnan et al. Chapter 12). While the ballcourt shares the same near cardinal orientation as Structure C-3, the other two buildings share a different orientation, which is roughly 20 degrees east of north (see **Figure 10.1**). While Plazas A and B to the east are more tightly enclosed by monumental architecture, the configuration of Plaza C is more open and accessible to the public. There are multiple openings to this large plaza and more recent mapping shows two of the largest sacbeob entering on the northwest and southeast corners of this plaza, effectively linking two of the main elite residential zones to the north (Zone C) and to the south (Zone E).

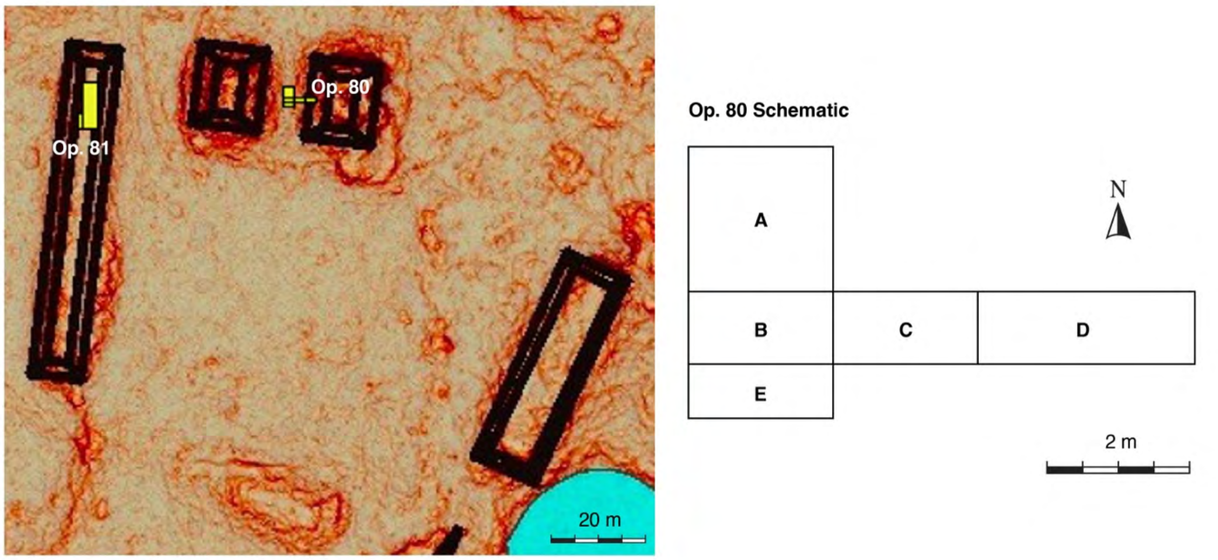

Figure 10.1 Mahlerized Overview Map of Zone C, showing the ballcourt (Strs. C-1 and C-2) and location of excavations units (LiDAR image by M. Willis, map by S. Murata).

Objectives of the Operation 80 Excavations

The primary objectives for Operation 80 were to:

1. Confirm this pair of buildings served a ballcourt function;
2. Obtain ceramic and/or carbon samples to determine the chronology of the ballcourt and any earlier construction phases;
3. Search for a stone marker and any associated cache deposit to understand the chronological relationship of Structures C-1 and C-2 with the larger site center of Altun Ha.

Description of the Excavation and Methods Used

Operation 80 consisted of five squares (A-E). Square A is a 2-x-2 m excavation unit positioned roughly in the center of the ballcourt alley. Operation 80 was expanded with the addition of Squares B (1-x-2 m) to the south of Square A. To the east of Square B, two additional squares extend up the slope of the eastern ballcourt structure (Structure C-1)—Squares C (1 -x-2 m) and D (1-x-3 m; **Figure 10.2**). Finally, Square E (.75-x-2 m) was added to the south of Square

B to capture the southern edge of a large pit feature idetified in the center point of the ballcourt alley (**Figure 10.3**).

Figure 10.2 Opening Shot of Operation 80, Squares B-D, looking east toward Structure C-1 (photo by E. Harrison-Buck)

All vertical measurements throughout the excavations were taken from two temporary datum points (Datums A and B). Datum A was generally used for measurements in Squares A, B and E. Due to the overall height of the mound, it became necessary to use multiple datums to ensure vertical control. Datum B was located farther up the slope of the mound (25 cm above ground surface) and was generally used for measurements in Squares C and D. For excavation, 5-gallon buckets were used to remove all materials from the units. Zones were separated arbitrarily (10 or 20 cm depths) or when a texture and/or color change was evident in the matrix. Most of the dirt was screened using ¼-inch mesh screen. Picks and shovels were used to remove overburden. Trowels were used to define *in situ* artifacts and intact architecture and small wooden tools were used to define more delicate finds. The subsequent sections detail the findings of our excavations, broken down by zone, our smallest unit of excavation.

Description of the Excavation

Two phases of the ballcourt were defined in Operation 80 (**Figure 10.3**). There is evidence of an earlier alleyway floor (Zone 11) that was found underneath the final plaster floor surface (Zone 4) of the ballcourt alleyway. There is also some evidence of an earlier wall found underneath the sloping western wall of Structure C-1 that was partially exposed in Square D. Although ceramic analysis is still ongoing, preliminary results indicate that both phases of construction date to the ninth century Terminal Classic period. The date of the desecration of the ballcourt marker is not all together clear, but further artifact analysis may help to refine the dates of this event.

Zone 1 (Topzone)

Zone 1 is topzone soil that comprises mostly thick cattle grass. The matrix includes many roots and is a very compact, dark soil that has the occasional cow patty, suggesting the area has been trampled over the years by cows that graze periodically in this part of the Lopez farm. When excavations began the topsoil was hard and sun baked, but as the rainy season commenced the soil became much looser and easier to dig. The overall artifact density is light but consisted of pottery sherds, lithic debitage, plaster chunks (some with red paint), at least one obsidian blade (in Square C), and a few *Melongena melongena* marine shells (in Squares A and B) that resemble those recovered in Operations 72 and 74, carried out in the Lopez Plaza (see **Kaeding et al., Chapter 5**; **Harrison-Buck et al., Chapter 7**).

Zone 1 in all squares consisted of a humic layer and scattered larger boulders and cobble collapse debris. Zone 1 ended when a higher density of plaster and limestone chunks were encountered (Zone 2). This was encountered across all the units of the alleyway (Squares A, B, C, and E) at the bottom of Zone 1. Extending east of Squares B and C is Square D which runs upward along the slope of Structure C-1. A large boulder sat on the surface of Zone 1 in Square C and several large roots of a cedar tree cut across the eastern side of the unit. The large boulders removed from the surface of Operation 80 likely represent collapse as well as looter's backdirt. In Square D, a shallow pit intruded into the west side of Structure C-1 and had partially exposed the western sloping ballcourt wall that was further exposed at the bottom of Zone 1. The dark soil of Zone 1 in Square D resembled the topsoil found in other squares, but this area of the excavation also contained a higher density of large tumbled boulders and smaller loose cobbles that were removed as part of Zone 1. The collapse that continued under Zone 1 was found across all squares of the excavation.

Zone 2 (Collapse)

Zone 2 was directly below Zone 1 and represents the collapse debris of stone on and around the alleyway and east side of Str. C-1. Zone 2 was characterized by the presence of limestone rocks and plaster chunks throughout Squares A, B and E. Initially, it was thought that Zone 2 might represent the remains of a plaster surface in the alleyway, but ultimately it was deemed collapse. The matrix (prior to rain) was compact and dark in color like in Zone 1 and contained collapse falling from both Structures C-1 and C-2.

In Squares A, B, C, and E, the zone was taken down approximately 15-20 cm at which point the zone was ended arbitrarily and switched to Zone 3. In Square D, Zone 2 held a higher density of larger cobbles, comprsing the collapse of core fill that was falling from the west side of Str.C-1. A nicely preserved slopping wall was exposed in the eastern end of Square D. Here, a nicely preserved plaster surface was exposed at the bottom of Zone 2 (Zone 6). It was thought that this represented a platform terrace, but it petered out aout 80 cm to the west of the sloping wall. Here, Zone 5 was defined—a thin layer of collapse debris which was removed to further define the Zone 6 construction, a small step feature visible on the east end of Square D abutting the west wall of Structure C-1. All other squares Zone 2 ended arbitrarily and continued to be removed as Zone 3 collapse (see below).

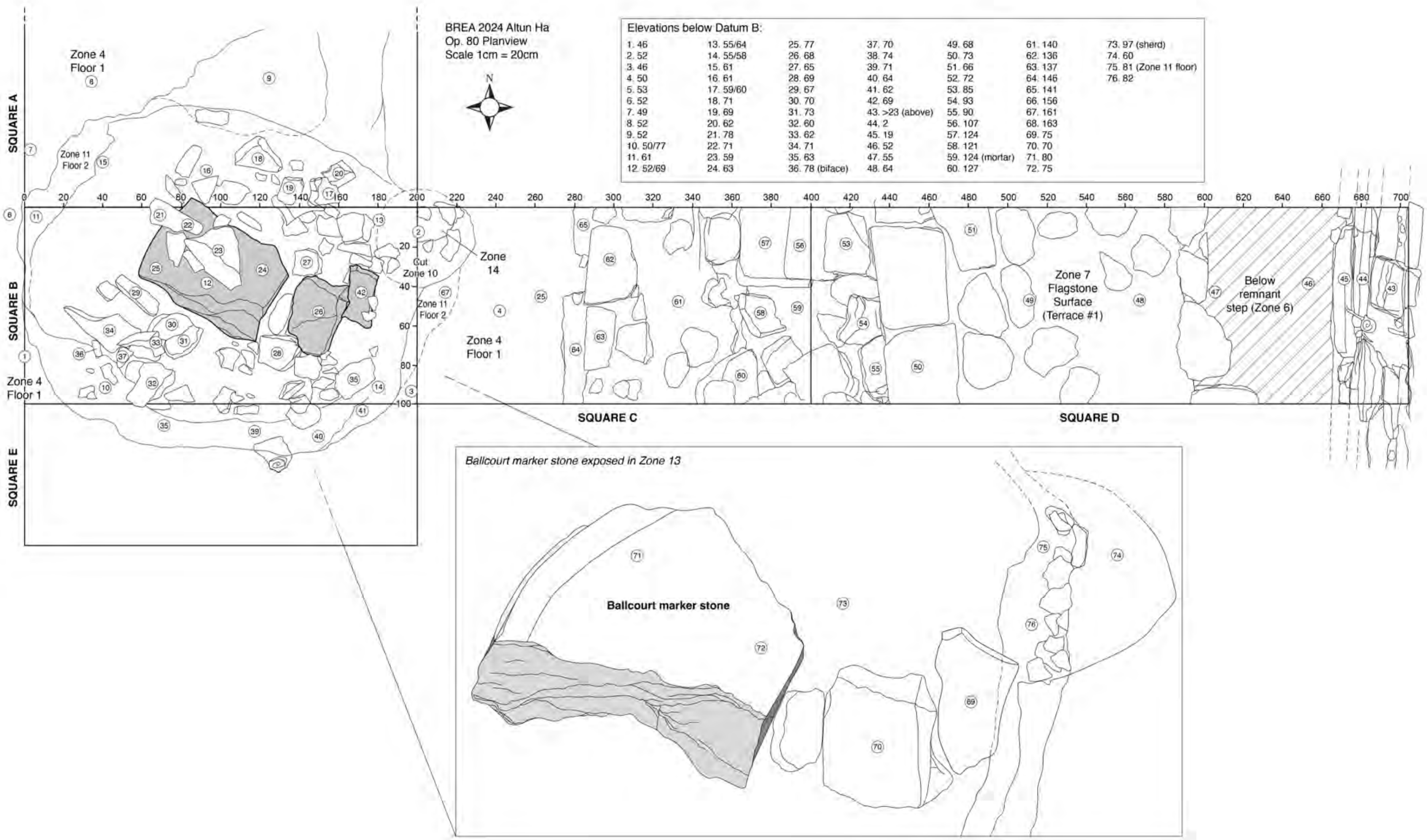

Figure 10.3 Planview map of Operation 80 (drawn by E. Harrison-Buck, digitized by M. Brouwer Burg).

Zone 3 (Collapse)

Zone 3 is a continuation of the Zone 2 collapse debris in Squares A, B, C, and E. The matrix consists of a dense, dark soil mixed with some limestone and plaster. This is the remaining collapse debris overlying the latest alleyway plaster floor (Zone 4) and the lowest terrace on the west side of Structure C-1 (Zone 12). In Squares A, B, and E, this remaining collapse debris measures roughly 10-15 cm thick. In Square C, the collapse is only 5-10 cm thick and the matrix in this area contains pockets of soft, dark soil along with much a more compact matrix filled with limestone and plaster chunks and large cobbles. Upon removal of the Zone 3 collapse in Square C, the lowest terrace of Structure C-1 was exposed. No facing stones on this lowest terrace were found intact and it appears to have been purposefully dismantled in antiquity. Only the core fill and mortar (Zone 12) of the lower terrace remained intact.

At the base of Zone 3 in Square C, the Zone 4 plaster surface was exposed, abutting the dismantled remains of the lower terrace of Structure C-1. The Zone 4 plaster floor was exposed in Squares C and E and in the northwestern portion of Square A. In most of Square B, a large circular pit (Zone 10) was exposed, cutting into the Zone 4 floor. Zone 10 represents the top portion of a pit feature associated with the remains of a ballcourt marker described further below. In addition, a long linear pit feature that included a posthole (Zone 9) cut into the surface of the Zone 4 floor and was defined along the eastern edge of Square A and continued south into Square B. Additionally, another posthole (Zone 14) was defined at the bottom of Zone 3 in the eastern edge of Square C, also cutting into the Zone 4 floor. These pit disturbances and partial dismantling of construction evident on the lowest terrace of Structure C-1 appear to be part of a larger desecratory event of the ballcourt. Artifacts in Zone 3 were light to medium in density. While ceramic analysis is ongoing, one sherd noted at the bottom of Zone 3 in Square E overlying the Zone 4 floor surface is a post-fired incised rim sherd (**Figure 10.4**), which may indicate a final date of the Middle to Late Postclassic.

Zone 4 (Alleyway Plaster Floor #1)

Zone 4 is the latest plaster floor found in the ballcourt alleyway. This 7-9 cm thick hard plaster surface was well-preserved in Square C where it may have been resurfaced in the area closest to the west side of Structure C-1. The Zone 4 floor was only removed in Square C. Very few artifacts were recovered from Zone 4. At the base of Zone 4, an associated ballast fill (Zone 15) waa exposed (see further below).

Figure 10.4 Post-fired incised red-slipped ceramic sherd identified at the interface of Zones 3 and 4 in Square E (photo by E. Harrison-Buck).

Throughout most of Square B, a huge circular pit (Zone 10) cuts into the Zone 4 plaster floor. This large circular pit feature extends slightly into Squares A, C, and E (refer to the planview in **Figure 10.3**). In the interior of the cut, large fragments of a smashed stone ballcourt marker were defined (see Zones 10 and 13 below). As noted above, a long linear cut with an associated posthole (Zone 9) was also defined at the base of Zone 3, cutting into the Zone 4 floor. Another circular posthole (Zone 14) was defined on the eastern edge of Square C that cut into the Zone 4 floor. It resembled the Zone 9 posthole and long linear cut identified along the eastern edge of Square A, which continues south into Square B (**Figure 10.3**).

Intact portions of the Zone 4 plaster floor was exposed in most of Squares A, C, and E with the large circular pit occupying most of Square B, measuring roughly 2 x 2 meter square and representing the center of the ballcourt alleyway. The Zone 4 floor was intact in Square C, as noted above, and was associated with the final phase of Structure C-1. As noted above, the lowest terrace of this structure was purposefully dismantled in antiquity and the facing stones were removed. The floor abutted where the facing stones once were (see **Figure 10.6**). The postholes and linear cut found along the eastern edge of Squares A, B, and E appear to be related to the partial dismantling of Structure C-1 and the descecration of the ballcourt marker.

Zone 5 (Collapse)

Zone 5 was defined in Square D only. The matrix consisted of a roughy 10 cm thick layer of rock-filled matrix directly underlying the Zone 2 collapse. It was removed separately from Zone 2 collapse because it was initially thought to possibly represent remnants of an upper terrace surface of Structure C-1. However, Zone 5 was ultimately defined as additional collapse debris similar to Zone 2. Removal of the Zone 5 collapse debris exposed a well-preserved upper terrace surface (Terrace #1) of Structure C-1. Terrace #1 (Zone 7) consists of large flagstone construction coated with lime plaster. A small concentration of plaster (Zone 6) was left intact in the far eastern end of Square D because it was thought to represent an architectural feature (see below). In Square D, a shallow looter's pit (visible in **Figure 10.2**) had partially exposed the faced retaining wall of Terrace #2, which appears to consist of two phases. These two phases of architecture were difficult to define based on their poor preservation and the limited exposure of Operation 80.

Zone 6 (Structure C-1 "Step" Feature)

Zone 6 consisted of an enigmatic plaster feature encountered below the collapse of Zone 2 in the eastern end of Square D (**Figure 10.5**). Zone 6 measured roughly 15-20 cm high and extended about 80 cm to the west of the Zone 8 sloping upper terrace retaining wall of Structure C-1 (see **Figure 10.5**). The surface of this feature resembled a small terrace or plaster step lipping up to the Zone 8 wall, but there was no evidence of faced retaining stones. It is possible the facing stones were ripped off during the same desecration event that dismantled the facing stones of the lower terrace wall. The matrix of Zone 6 consisted of thick chunks of sascab and eroding plaster that are visible in cross-section (see **Figure 10.7**).

Figure 10.5 Left: Overview of shot of Square D in Operation 80, showing Zone 6; Right: close-up of Zone 6 "step" feature (photos by E. Harrison-Buck).

The nature of the Zone 6 fill and lack of retaining stones made it initially seem like plaster "melt" from the structure that had collapsed in a thick deposit, rather than an architectural feature. However, once Zone 6 was removed, it became clear that this was more likely a constructed feature added when the sloping upper terrace wall (Zone 8) was added during its final phase of construction. The facing stones of Zone 8 rested on top of Zone 6 with no additional facing stones found below Zone 6 when it was removed (**Figure 10.7**). This indicated that the construction of Zones 6 and 8 were coeval as part of the final phase of the ballcourt terrace construction. Once removed, the nicely preserved surface of Terrace #1 (Zone 7) was exposed, running underneath Zone 6 and the Zone 8 wall, presumeably to an earlier phase of the upper terrace wall that is behind the Zone 8 wall (see **Figure 10.7**).

Zone 7 (Flagstone and Plaster Floor Surface of Terrace #1)

Zone 7 consists of the sloping plaster surface of Terrace #1 of Structure C-1, which represents the lowest terrace of the eastern ballcourt structure. The Zone 7 surface slopes downward to the west in the direction of the ballcourt alleyway with a difference of roughly 20 cm in depth from east to west (refer to **Figure 10.6**). The Zone 7 plaster and flagstone surface runs underneath the Zone 6 "step" and Zone 8 retaining wall. Both Zones 6 and 8 appear to post-date the Zone 7 lower terrace surface, as noted above. Once the Zone 6 "step" was removed, the Zone 7 terrace surface that was exposed during the summer 2024 measured roughly 2.3 m in depth if measuring from the western edge of Zone 7 to the interface with the sloping retaining wall of Zone 8. As noted above, Zone 7 appears to run underneath the Zone 8 wall. It was likely associated with an earlier terrace retaining wall hidden behind the Zone 8 wall, located perhaps another 30 cm to the east. This would mean the total original depth of the Zone 7 terrace may have been around 2.6 m (see **Figure 10.6**).

When the Zone 6 step and Zone 8 terrace wall were added, a portion of the Zone 7 terrace was covered. Only a portion of the Zone 7 terrace remained exposed during this final phase of construction for the ballcourt, measuring around 1.5 m in depth (see **Figure 10.5**). Zone 7 steps up from the alleyway rougly 60 cm in height but the retaining stones of the Zone 7 terrace were removed in antiquity and only the inner fill (Zone 12) remained intact (see **Figure 10.8**).

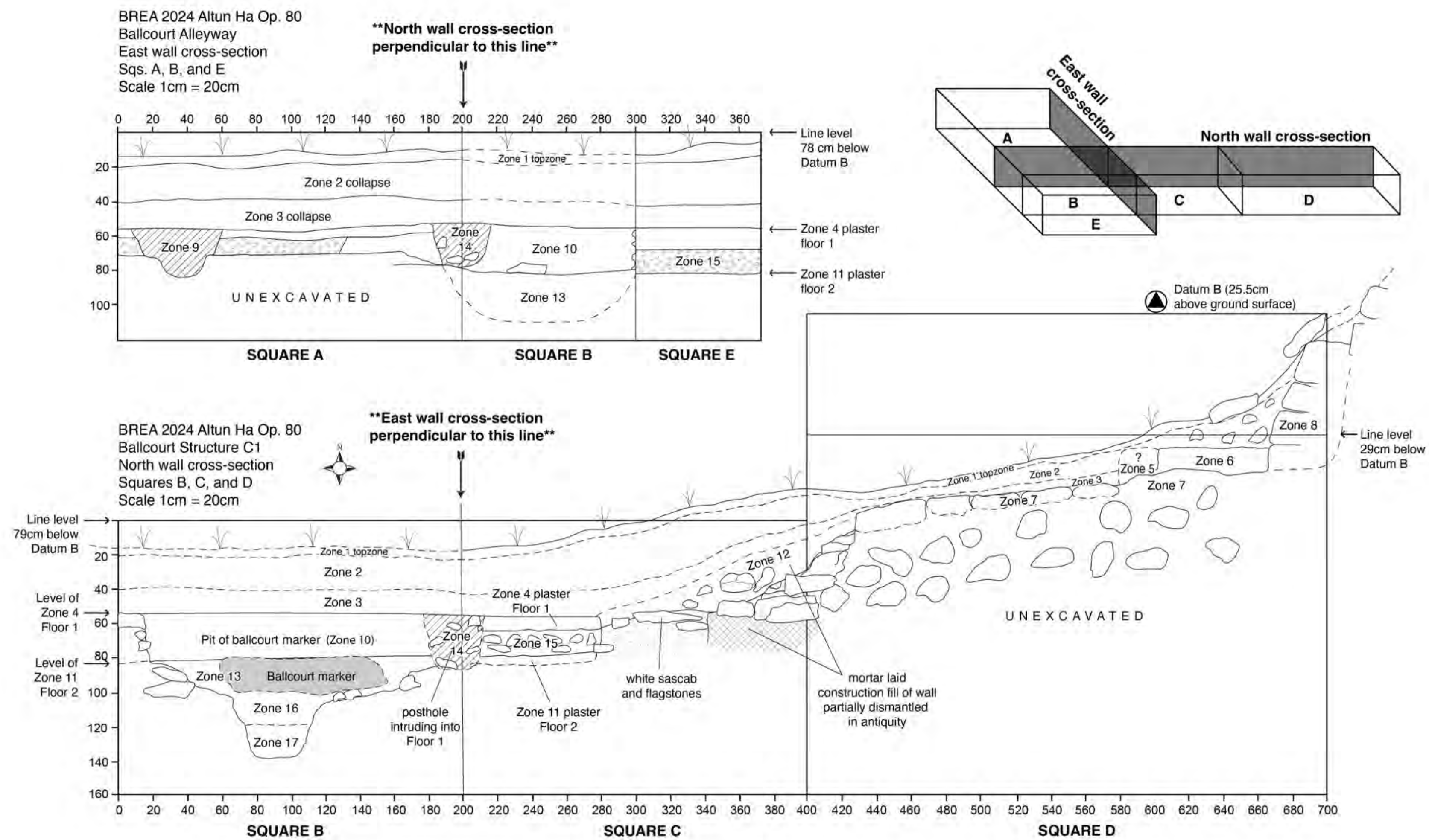

Figure 10.6 North wall profile of Squares B, C, and D in Operation 80 (drawn by E. Harrison-Buck, digitized by M. Brouwer Burg).

Figure 10.7 West wall of Upper Terrace #2 of Structure C-1 (Zone 8). Note white plaster lens of Zone 6 in the southern cross-section that appears to be lipping up to the Zone 8 west wall (photo by E. Harrison-Buck).

Zone 8 (Upper Western Terrace Retaining Wall of Structure C-1)

Zone 8 is the western sloping wall of the upper terrace of Structure C-1 that was exposed on the eastern edge of Square D in Operation 80. Zone 8 appears to be associated with the Zone 6 "step" feature defined above. Both Zones 6 and 8 mark the final phase of the ballcourt construction. Zone 7 runs underneath both of these zones and suggests there is likely an earlier phase of construction. The Zone 8 retaining wall was not excavated during the summer 2024, but it is suspected that another sloping terrace wall exists behind the Zone 8 wall that was associated with the initial construction of the Zone 7 terrace (see **Figure 10.6**).

Zone 9 (Posthole and Linear Pit Feature)

Zone 9 is a long linear pit feature defined along the eastern edge of Square A. The length of the pit feature was longer than originally thought and although separated by the balk of the excavation units, the feature appears to extend into Square C visible on the northwestern edge of this square. When excavations began, the Zone 9 feature was originally thought to be a possible burial pit. However, no evidence of human remains were identified and the elongated nature of the pit that was ultimately defined is not a configuration normally found with burials. The pit was also relatively shallow, except for an area in the northeast corner of Square A where the depth and configuration resembled a posthole feature (see Square A in **Figure 10.3**). The posthole was easily discernible due to its darker matrix compared with the rest of the Zone 9 pit fill which included a mix of broken bits of white plaster. Zone 9 ended when large (worked) chert cobbles were encountered at the base of the posthole feature. About 20 cm below the surface of the Zone 4 floor (where the original cut was defined) another earlier plaster floor (Zone 11) was identified in the cross-section, evidently cut into by the Zone 9 intrusive pit feature.

The Zone 9 post hole and long linear pit that cuts into the Zone 4 alleyway floor appears to be associated with the later desecration of the ballcourt at which time the facing stones of the Structure C-1 terrace were removed and the ballcourt stone marker was dug up (see Zone 10 below). Another small posthole feature (Zone 14) cutting into the Zone 4 alleyway floor surface in Square D may also be part of this later disturbance.

Figure 10.8 Overview shot of Squares C and D in Operation 80, showing in the foreground the edge of the Zone 10 pit cutting into the Zone 4 alleyway plaster floor. In the background is the Zone 12 terrace fill topped by the Zone 7 flagstone and plaster terrace (photo by E. Harrison-Buck).

Zone 10 (Fill of Large Circular Pit Feature)

Zone 10 was encountered at the bottom of Zone 3 in Squares A, B, and E. This zone is the top portion of fill from a large circular pit feature. The pit measured over 1.6 m in diameter and was found cutting into the surface of the Zone 4 alleyway floor. The Zone 10 fill consisted of a loose matrix filled with small gravel inclusions and a light density of artifacts, including a chipped tool, obsidian and several fragments of painted red plaster. This matrix extends roughly 10-15 cm in depth before encountering larger cobble inclusions. Zone 10 extended to a depth of about 20 cm and ended arbitrarily. At the base of Zone 10, a number of large broken fragments of stone with worked edges were exposed in the center of the pit, which appear to be the remains of a smashed stone monument (see **Figures 10.9** and **10.10**). The location of the pit with the monument fragments in the center of the ballcourt alleyway is a common location for ballcourt markers. The worked fragments of stone were ultimately removed as Zone 13 (see below).

In the southwest corner of Square B and along the edges of the large circular pit feature, a small portion of a second (earlier) floor (Zone 11) was exposed at the base of Zone 10. This appears to represent an earlier alleyway floor that had also been disturbed and cut into by the later intrusive pit feature (see Zone 11 below). While most of Square B contained the large pit feature, Square A to the north and Square E to the south exposed the northern and southern edges, respectively, of the large circular pit that intrudes into the latest (Zone 4) plaster floor.

Zone 11 (Alleyway Plaster Floor 2)

Zone 11 represents an earlier plaster floor of the ballcourt alleyway. The largest area of Zone 11 that was exposed was in Square C beneath the ballast (Zone 15) of the Zone 4 floor that was removed to expose the surface of Zone 11 (**Figure 10.6**). This earlier alleyway floor appears to mirror the extent of the Zone 4 floor, stopping at the western edge of where the lower terrace facing stones of Structure C-1 would have been had they not been removed in antiquity.

Elsewhere in Operation 80, the Zone 11 floor was partially exposed while excavating the Zone 9 post hole and linear pit feature running along the eastern edge of Squares A and B, which cut through a portion of both Floor 1 (Zone 4) and Floor 2 (Zone 11). As noted above, portions of the Zone 11 plaster floor were also exposed in cross-section along the edges of the large intrusive pit feature in Squares A, B, and E. The Zone 11 floor was not excavated in summer 2024, but was drawn in the cross-section (see **Figure 10.6**) and also photographed (see **Figure 10.9**). Floor 2 (Zone 11) appears to have been previously cut into by an earlier pit feature that did not precisely align with the later (Zone 10) pit feature. It may be that Floor 2 was in use at the time an earlier pit was dug for the ballcourt marker, when it was originally set in the center of the alleyway. The thickness and overall size of the stone ballcourt marker suggests that Zone 4 (Floor 1) may have been constructed when the monument was put in place and capped this earlier cut into Zone 11 (Floor 2). It was only later that the Zone 4 floor was subsequently cut into and the large circular pit (Zone 10) was dug into the alleyway at which time the ballcourt marker was dug up, smashed, and then partially reinterred back into this large intrusive pit. The sequence is difficult to reconstruct with precision due to this later disturbance, but the broken monument fragments and depth of the pit suggest that they did not rise above the surface level of Zone 4 (see **Figure 10.9**).

Figure 10.9 Relative locations of Floors 1 and 2 with largest smashed monument fragment. Note the incised line running along the worked edge of the monument (photo by E. Harrison-Buck).

Zone 12 (Core Fill of Terrace #1 of Structure C-1)

Zone 12 is a jumble of large limestone cobble fill mixed with mortar that appears to be the remnant of the lower terrace wall of the ballcourt (**Figure 10.8**). The wall lacks any facing stone, suggesting that the cut stones of the lower terrace were removed in antiquity. Although the cobbles resemble collapse debris, the presence of hard mortar suggests that this is the remains of intact interior core fill. This core fill underlies the Zone 7 terrace flagstone and plaster surface (described above). Ballcourts normally have sloping walls, which facilitated the movement of the ball during the game. While the facing stones of this terrace are gone, the slope of the Zone 12 core fill suggests that the lower terrace, which stood about 60 cm in height, sloped downward to the west at an angle to where it met with Floor #1 (Zone 4) of the ballcourt playing alley.

Figure 10.10 The large pit feature in the center of the ballcourt alleyway (above) with broken monument fragments removed as Zone 13 and (below) with the largest fragement exposed (photos by E. Harrison-Buck).

Excavations involved some probing of the core rubble on the east side of Zone 12 directly underneath the Zone 7 flagstone terrace surface, but when no facing stones were revealed under this surface, excavations were not continued any further here. However, about 10-15 cm of core fill was removed lower down on the slope along the western half of Zone 12 near the interface with the Zone 4 floor in search of an earlier phase. No artifacts were recovered from Zone 12. Although no earlier phase of architecture was identified, a sizeable gap between the Zone 4 plaster surface and the Zone 12 core fill appears to mark where the faced retaining stones of the terrace once stood before they were removed in antiquity (see **Figure 10.6**).

Zone 13 (Monument Fragments and Fill of Large Circular Pit)

Zone 13 is directly below the Zone 10 pit fill. This zone is the remains of the largest of the broken monument fragments that were found in the circular pit feature, which was located in the center of the ballcourt alleyway (**Figure 10.10**). The large pit feature cutting into the Zone 4 alleway floor measures roughly 1.6 m in diameter and (at the bottom of Zone 13) measures roughly 50 cm in depth. We estimate that when intact, the large circular stone monument may have measured somewhere between 1.15-1.3 m in diameter based on the size of the pit and the arc of the largest preserved fragment (shown in **Figure 10.9**). We suspect that the circular ballcourt marker was originally deposited intact and placed in a pit that was cut into Floor #2 (Zone 11) and capped by the later Floor #1 (Zone 4) in the center of the alleway. Only a single incised line runs around the outer circumference of the circular stone marker, which may have been painted but has since eroded.

At some point later, the large pit in the alleyway floor was dug and the sizeable and heavy stone ballcourt marker was located, pulled out of its original location, and then smashed with portions of the monument tossed haphazardly back into the large intrusive pit feature. The monument fragments do not appear to rise above the Zone 4 floor and were seemingly capped with the Zone 10 fill of the pit. The Zone 10 matrix appears to have filled in the pit to the level of the Zone 4 alleyway surface. This monument smashing was likely accompanied by the dismantling of the lower terrace facing stones and perhaps also the removal of the facing stones for Zone 6 associated with the upper terrace final phase.

Zone 13 ended when all of the fragments of the monument were removed, along with the surrounding darker pit fill. At the bottom of Zone 13, a lighter whitish gray fill was encountered beneath the pit fill, which represents the remnants of the Zone 11 earlier floor (described above).

Zone 14 (Posthole Feature)

Zone 14 is a small posthole feature measuring about 25-30 cm in diameter that was identified cutting into the surface of the Zone 4 alleyway floor in Square C. It was situated near the edge of the excavation unit around the northwest corner of Square C, right at the interface of Squares A, B and C, which made the excavation of this feature somewhat challenging. The northeast quadrant of this feature extended outside of the excavation unit but was capture in the northn wall cross-section (see **Figure 10.6**). We suspect that this intrusive posthole is associated with another posthole feature (Zone 9) of similar size that was identified less than 2 meters directly to the north within the northeast corner of Square A. These two posthole features may represent the remains of a perishable structure erected over the alleyway when the ballcourt marker was dug up and the facing stones on the terraces of Structure C-1 were dismantled in antiquity. The posthole measured 26 cm in depth and consisted of a loose silty clay soil and small lieston inclusions with a light density of artifacts.

Zone 15 (Ballast Fill of Floor #1)

Zone 15 is the ballast fill associated with the Zone 4 plaster floor that was only excavated in Square C down to the level of the second Floor 2 (Zone 11). The Zone 15 ballast directly beneath the Zone 4 plaster floor that was removed in Square C measured between 11-17 cm thick. The very compact matrix consisted of a high density of gravel and small cobble size inclusions, many of which were lithic debritage. A sample of this lithic debitage was collected during excavations. The bottom of this zone exposed the well-preserved plaster surface of Floor 2 (Zone 11) described above.

Zone 16 (Pit Feature)

Zone 16 was a small pit feature identified in the center bottom of the large circular pit feature once all of the fragments of broken monument stone and associated dark fill was removed in Zone 13. This small pit feature represented the deepest portion of the pit where the largest monument fragments had been found and was characterized by a gray, wet, sticky clay matrix. Zone 16 matrix was distinctive from the surrounding light whitish gray sascab matrix representing the earlier floor of Zone 11. The Zone 16 feature was not circular, but an amorphous shape with small limestone inclusions. Most of this small pit feature was in Square B, but a small area extended into the southern edge of Square A. This semi-compact matrix was excavated to confirm that no cache deposit existed underneath the monument. No special deposits were identified, but some animal bone, rim sherds, debitage, and plaster/mortar was recovered. The zone was ended artibitrarily around 20 cm and changed to Zone 17 (see below).

Zone 17 (Pit Feature)

Zone 17 was a continuation of the amorphous pit feature found at the bottom of the large intrusive pit feature containing the broken fragements of stone monument found in the center of the alleyway. Zone 17 continued to dig down roughly 25 cm underneath a rock that was found at the bottom of Zone 16. This amorphous shaped pit underneath the rock continued to the north into Square A, the edges of which were defined by a surrounding whitish gray matrix, which appears to represent the ballast fill of the earlier Zone 11 alleyway floor. The only artifacts in this zone were found directly beneath the rock, but toward the bottom of Zone 17 the matrix appeared to be sterile and constisted of more rock fill, perhaps indicating that a core rubble fill underlay the ballcourt. The limited exposure in Zone 17, however, inhibits a fuller reconstruction of this phase of construction and excavations of Operation 80 ended at this point.

Interpretations and Conclusions

There appears to be at least two phases of construction for the ballcourt at Altun Ha. Poor preservation and limited exposure in Square D inhibited a fuller understanding of the construction stages of Structure C-1, but the Zone 6 addition and Zone 8 wall suggests there is an earlier phase of the superstructure that remains underneath this phase of construction. However, no earlier terrace was identified beneath the Zone 7 terrace surface that was exposed in Squares C and D during the sumer of 2024. Nor did the earlier alleyway floor (Zone 11) appear to run underneath the Zone 7/12 terrace construction of Structure C-1. However, the presence of two alleyway floors (Zones 4 and 11) lend support to the notion that there were two separate construction phases for the ballcourt (see **Figure 10.6**). A preliminary study of the diagnostic material in Operation 80 suggest that both phases may date to the Late-to-Terminal Classic transition (ca. AD 780-900/1000), although ceramic analysis is still ongoing.

During the final occupation of the ballcourt at Altun Ha, the building underwent a purposeful termination event, which may have marked a violent end to at least this portion of the site in Zone C. The presence of two postholes that are aligned north-south suggest a perishable structure may have been erected over the area when a large intrusive pit was dug into the center of the alleyway. This pit was aimed at unearthing a large circular stone ballcourt marker that was likely put in place at least by the final (Zone 4) phase of the ballcourt construction. The dismantling of the facing stones on the outer terrace walls of Structure C-1 probably occurred at the same time as the unearthing and smashing of the circular stone marker. The smashed monument that was reinterred in the large pit feature represents only a portion of the monument, perhaps less than one half of its original extent.

It remains unclear where the rest of the ballcourt monument was deposited. There are examples from the Maya area during the Classic period where carved stone monuments were robbed in antiquity and "give a sense of the proclivity of victorious armies to forcibly acquire monuments of conquered states" (Helmke and Awe 2016:3). An example from the Late Classic period includes several carved panels that were originally part of a hieroglyphic stairway at Caracol that were forcibly removed and transported to several sites, including Xunantunich, Ucanal, and Naranjo, which are located some distance away from Caracol. In some cases the movement of monuments across the landscape are conducted as an expression of an allied relation, but the other possibility is that the removal of these panels was carried out as a result of a warring event and defeat of Caracol by Naranjo in AD 680 (Helmke and Awe 2016).

In the case of the Caracol panels, while they were removed and transported elsewhere, they were left intact. However, during the Terminal Classic period there are frequent occurences of monument destruction, which I have argued elsewhere is the result of widespread conflict and overthrow of the Classic Maya ruling elite. I have demonstrated that this purposeful destruction of monuments often was accompanied by the purposeful destruction of elite architecture, which occurred at nearly every major city center across the Maya Lowlands as part of a widespread collapse of dynastic power seen at the end of the Classic period (Harrison-Buck 2016:Table 3). Instead of the careful removal and curation of monuments, in many cases these carved stones were smashed and broken apart or in some cases those with kingly portraits were left standing but the faces of the final reigning kings were purposefully mutilated. Often, these acts of violence also targeted the elite residence and the ceremonial architecture of the final reigning kings (Harrison-Buck 2012). I suggest that the smashed ballcourt monument at Altun Ha along with the evidence of the desecration of the ballcourt ceremonial architecture at Altun Ha more closely resembles this kind of violent termination, which is suggestive of a targeted attack aimed at eradicating the ceremonial ballcourt at this site.

In many of his excavations, Pendergast (1979, 1982, 1990) noted evidence of "post-abandonment" activity dating to the Terminal Classic and subsequent Postclassic period. The presence of at least one Postclassic sherd (**Figure 10.4**) found at the interface of the collapse and the latest alleyway floor surface of Zone 4 suggest at least some later visitation to this area, although it is not enough evidence to definitively date this final desecration event. Further study of the artifacts from this investigation will help to shed further light on when exactly this desectratory event took place and whether it mirrors the events documented at other Classic Maya centers elsewhere in the Maya Lowlands.

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Chapter 11

Investigating Structure C-3 at Altun Ha (Op. 81)

Bridgette Degnan, Jack A. Biggs, Eleanor Harrison-Buck, and Kaitlin Murphy

In Summer 2024, the Belize River East Archaeology (BREA) project conducted excavations on Structure (Str.) C-3, a long-range structure west of the newly defined ballcourt that comprises Strs. C-1 and C-2 (See **Figure 11.1**). These three structures, along with Str. C-4 to the southeast and C-69 to the south, are located at the southern end of Altun Ha's Zone C, as defined by Dr. David Pendergast (Pendergast 1979). In his original zone designations, Pendergast admitted that the delineation of the Zone C boundaries was in some cases arbitrary and that at least a portion of Zone C structures had a fluid relationship with those of Zone A (Pendergast 1982). The identification of the ballcourt bolsters this idea, and Summer 2024 saw the first steps towards formally assessing the relationship of these southern Zone C structures both to one another—perhaps framing a previously unrecognized plaza—and to the original "Central Precinct" (Plazas A and B).

If these structures indeed frame a plaza, the layout of the new plaza (Plaza C) indicates that the space likely served public functions. Causeways lead into Plaza C from the north and the south, with the northern entrance between Strs. C-3 and C-1 and the southern entrance between Strs. C-4, C-69, and the *aguada*. The low-lying buildings that frame the plaza have wide gaps between them that markedly open the space, as opposed to the tall structures and tightly bound openings that demark Plazas A and B. In fact, Plaza C would be the largest plaza in the site core, measuring approximately 4,920 m^2, larger than both Plaza A (~4,210 m^2) and Plaza B (~3,880 m^2). These configurational characteristics align with attributes of plazas that hosted marketplaces in the Late Classic. Such attributes include a large, open space that can accommodate crowds, open entrances defined by causeways and gaps between buildings, a nearby water source (note the *aguada* directly to the southeast in **Figure 11.1**), and nearby structures that could have served administrative purposes (Cap 2015; King 2015).

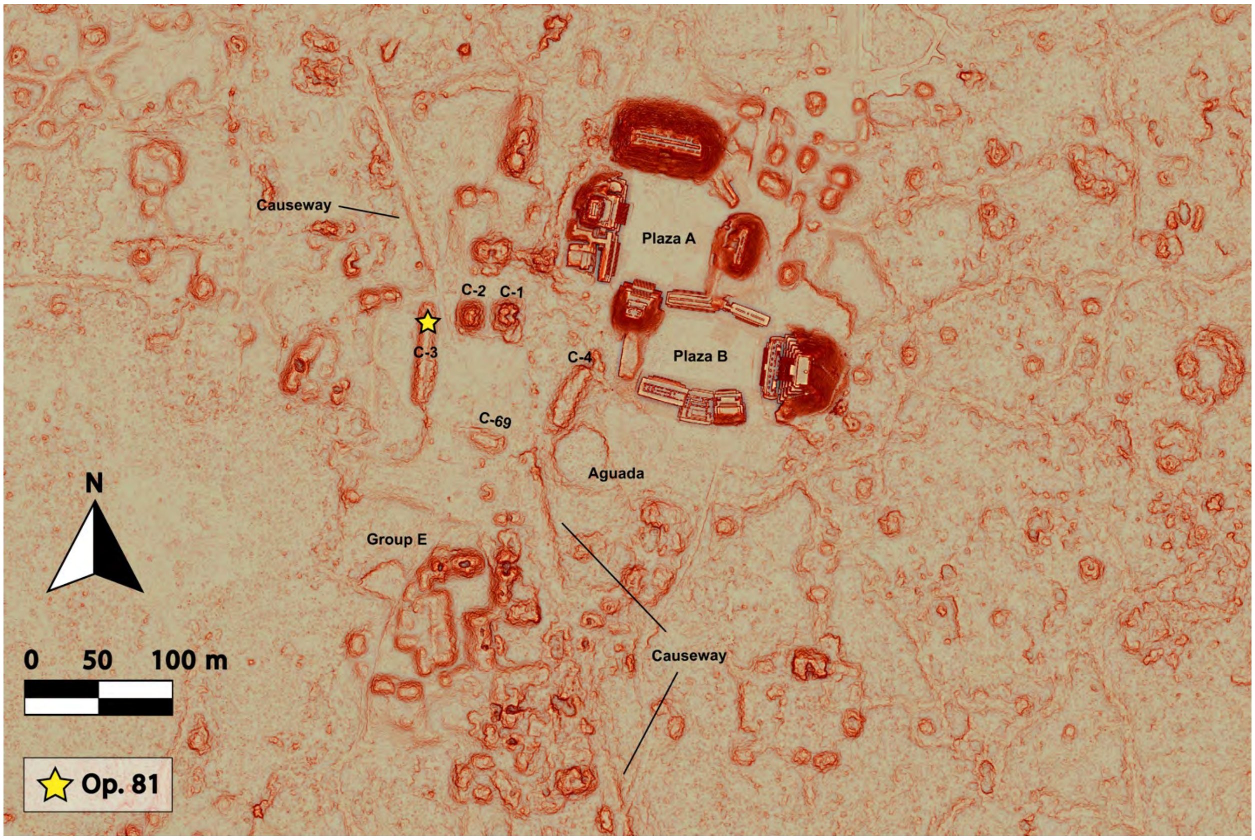

Figure 11.1 Map of Altun Ha site core (map by M. Willis; annotated by B. Degnan).

Objectives

Str. C-3 is approximately 72 m long. Due to its distinctive length, association with the ballcourt, and proximity to Altun Ha's Central Precinct, our excavations had the following objectives:

1. Determine the final architectural form and function of the structure. We aimed to ascertain whether Str. C-3 served primarily as a residence or if it held some other civic, ceremonial, or economic role.
2. Identify any earlier architectural phases. We aimed to understand if Str. C-3 had previous construction phases before its final form.
3. Establish a chronology for the use of Str. C-3. By recovering diagnostic pottery and collecting faunal and charcoal samples for radiocarbon dating, we aimed to develop a timeline for the use of both the terminal phase and earlier architectural stages of the structures.

Overview of the Excavation

Operation 81 was a 6-x-4.6 m excavation unit oriented cardinally and subdivided into six excavation squares (Sqs. A–E). Excavations took place over the course of approximately 3.5 weeks: June 30–July 4, 2024, and again July 12–August 1, 2024. Squares A, B, C, and D were each 2-x-2 m units, arranged in a grid pattern, while Sq. E extended 3-x-0.6 m off the western side of Sqs. D and A (**Figure 11.2**). Op. 81 was placed on the northern end of Str C-3, to the west of Str. C-2 and aligned with the entrance (or exit) where the northern causeway meets the plaza (see **Figure 11.1**).

Sq. A was a 2-x-2 m unit positioned at the top of the mound. The northwest corner of Sq. A was placed to capture a cut limestone block visible on the ground surface which we correctly assumed to be part of a wall feature. After beginning excavations, we determined there was sufficient time and reason to open adjacent squares. Sq. C was placed to the north and Sq. D to the south of Sq. A, both located fully on the top of the mound. Sqs. B and F were placed to the east of Sqs. A and C, where the mound begins to slope down towards the plaza center. Sq. E, opened last, was an extension to the west of Sq. D and Sq. A. It was opened to follow architecture present in Sqs. A and C.

Excavation Methods

We took vertical measurements from either Datum A or Datum B, both set at the same elevation. We established Datum A at the start of excavation using a stake in the ground directly north of Sq A. When we opened Sq. C to the north, we placed a new datum, Datum B, as a stake in the ground to the west of Sq. A. We set Datum B at the same elevation as Datum A, so no adjustments are needed to compare depths taken from different datums. We screened all dirt through a ¼-in mesh screen. We excavated each square in zones, which were split by cultural features or changes in soil and could extend across multiple squares. In cases where features extended vertically, we arbitrarily split zones to maintain vertical control.

Artifact processing and analysis for Op. 81 is ongoing and scheduled for completion in the 2025 season. Therefore, we include only preliminary observations on artifact recovery in the excavation results, and we defer chronological designations until the analyses are complete.

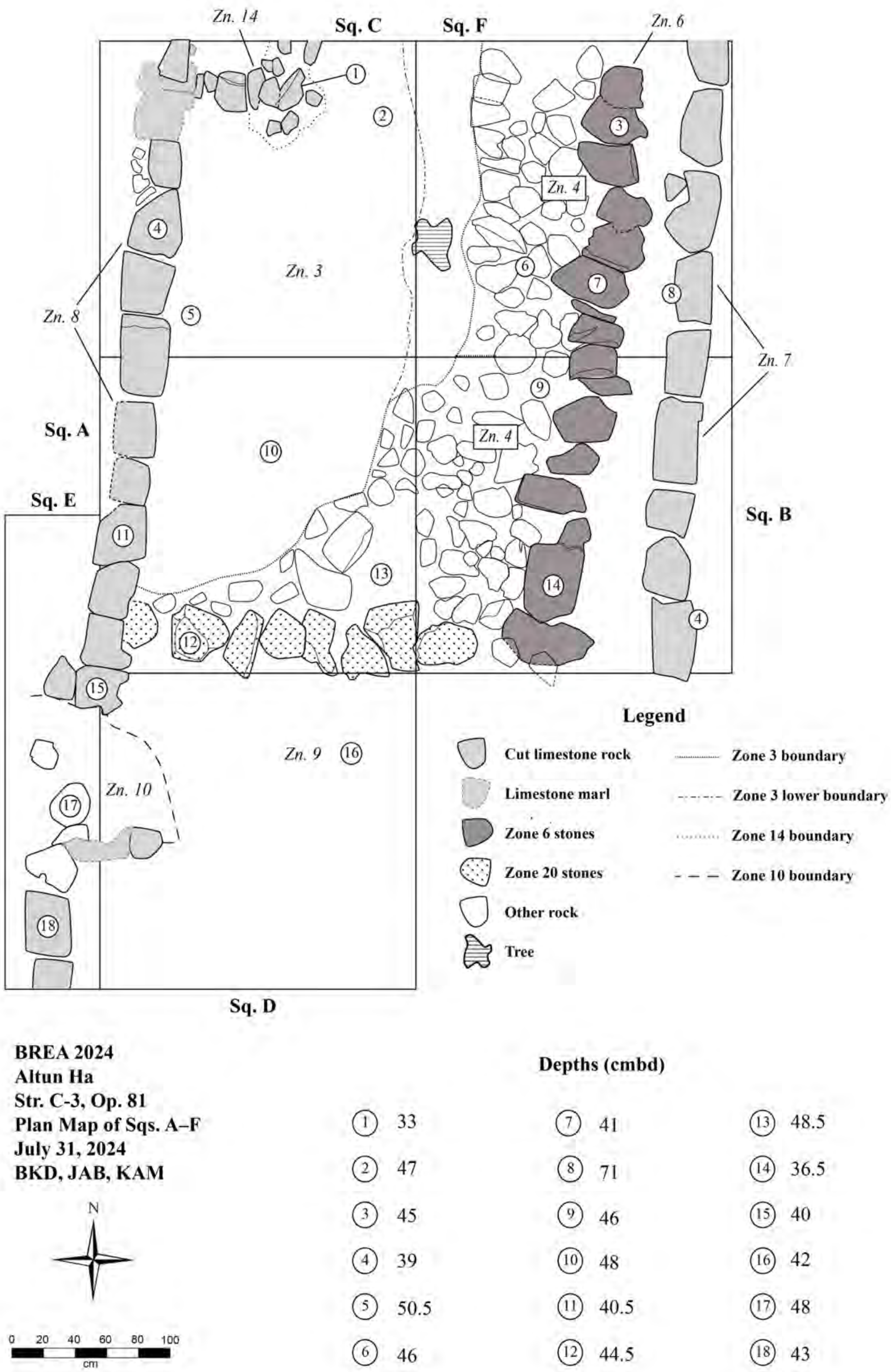

Figure 11.2 Plan view of Op. 81, Sqs. A–F, showing terminal architecture (drawn by B. Degnan, J. Biggs, and K. Murphy; digitized by B. Degnan).

Excavation Results

Zone 1 (topsoil)

Zone 1, the topsoil layer, is a loose, organic humic layer (10YR2/2) and was present in all excavation squares. In Sqs. A, C, D, and E this zone ranged in thickness from 6–13 cm, except for a notably thin layer covering the western wall of the structure (**Figure 11.3a**, Zone 8). In contrast, Zone 1 was thinner in Sqs. B and F, measuring between 1–7 cm. Some features and zones, including Zones 4, 6, 7, and 8, had portions visible on the ground surface (see **Figure 11.4**). The thinnest layer of topsoil was located above several Zone 7 stones that, while not visible before excavation, were sometimes less than a centimeter under the modern surface.

Zone 1 in Sqs. A, C, D, and E contained medium density artifactual material mixed with small and medium rocks. We recovered a significant number of large primary flakes and chert cores from this zone. The cores ranged from fist-sized and smaller, some exhausted, to small boulders with only a few testing flakes removed. Because of the sheer volume of these cores and their tendency to be quite large and heavy, we adopted a selective approach to collection, opting to collect only those cores made from fine-grained chert that exhibited flake scars on all or most sides.

Altun Ha is located within the Northern Belize chert-bearing zone (NBCZ), which likely explains why cores and chert cobbles are extremely common within collapse and construction fill (Hester and Shafer 1984; Shafer and Hester 1983). We found more cores in Zone 1 than other levels, however. We also recovered numerous stone tools throughout this zone, including general utility bifaces, scrapers, unifaces, and both unifacially and bifacially stemmed points (**Figure 11.5**). Excavators also recovered a fossilized coral fragment (**Figure 11.5**), diagnostic ceramics (**Figure 11.6a**), and noted the presence of burned chert and limestone throughout this zone. We also collected faunal bones, including some modern cow bone.

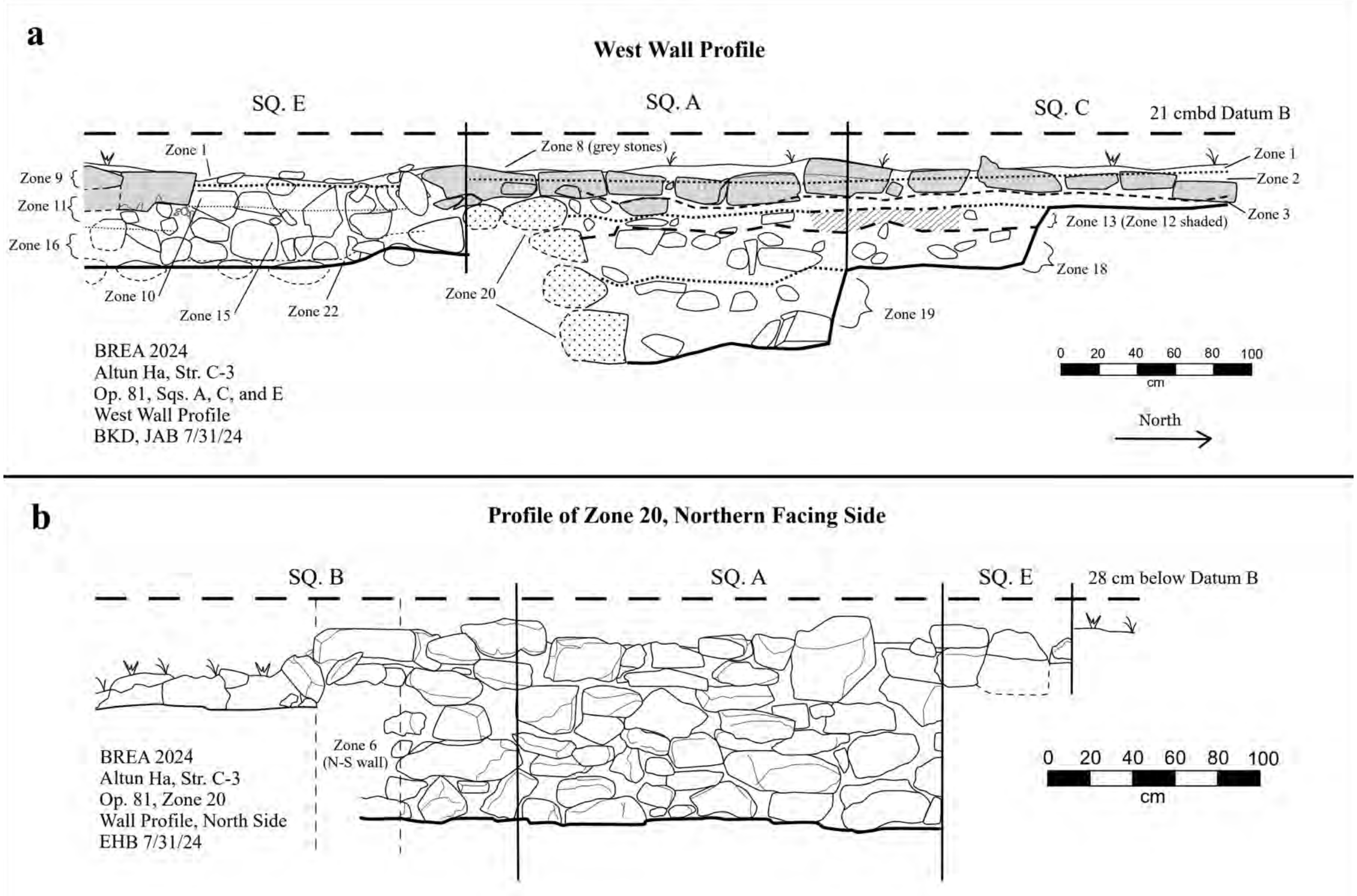

Figure 11.3 Op. 81 profiles: a) West wall profile, Sqs. A, C, and E (drawn by B. Degnan and J. Biggs; digitized by B. Degnan); b) Profile of northern-facing side of Zone 20 wall, Sqs. A, B, and E (drawn by E. Harrison-Buck and J. Biggs; digitized by B. Degnan).

Figure 11.4 Opening shot of Sq. A, facing north, showing Zone 4 (cobble fill) and Zone 8 (limestone wall) visible at surface (photo and editing by B. Degnan).

Figure 11.5 Sample of fossilized coral (a) and lithic artifacts (b-i) recovered from Zone 1 (photos and editing by B. Degnan).

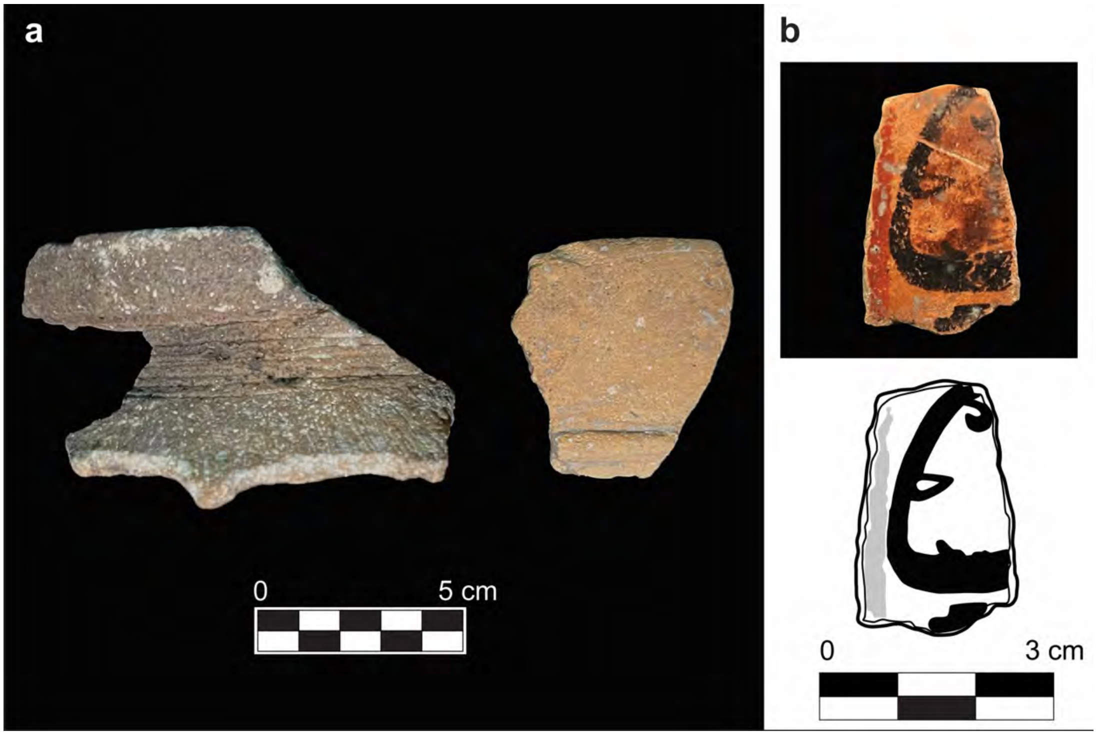

Figure 11.6 Sample of ceramic artifacts from Op. 81 showing (a) sample of diagnostic sherds from Zone 1, (b) photo and drawing of ceramic sherd with partial glyph from Zone 4 (photos, editing, and drawing by B. Degnan).

Zone 2

Zone 2 was a compact layer found partially preserved beneath Zone 1 in Sqs. A and C (10YR3/2, **Figure 11.3a**). The best-preserved areas of Zone 2 were in the northwestern corner of Sq. A and the southwestern area of Sq. C, particularly along the base of Zone 8. Despite variation in the preservation quality, Zone 2 was identifiable across the entirety of Sqs. A and C. Zone 2 had low-density inclusions of small to medium rocks peppering its matrix. In Sq. A, medium to large cobbles were present in the south and eastern areas, but none of these stones were removed as Zone 2, rather, they were removed with Zones 4 and 11. Zone 2 was thicker in the northern portion of Sq. C. This may have been due to collapse associated with Zone 14, described below. The matrix in Sq. C was also disturbed by a tree trunk along its eastern edge (partially in Sq. F) and roots that extended into this square (see tree in **Figure 11.2**). Zone 2 was 3–8 cm deep, and excavators soon encountered Zone 3 underneath, a better-preserved compact surface with patches of preserved plaster.

Zone 3

Zone 3 was a packed surface or floor extending across Sqs. A and C (10YR3/3) and onto the western edge of Sq. F. It was found at roughly 49 cm below datum (cmbd) in Sqs. A and C, though the surface was slightly undulating, ranging from 46–50.5 cmbd. In Sq. F, the undulation was more pronounced due to tree disturbance along the boundary of Sqs. C and F, causing the Zone 3 surface to range from 44–51 cmbd. Notably, plaster was preserved in several areas, particularly in Sq. A. The top of the Zone 3 surface was generally flush with the bottom of Zone 8 stones (see **Figure 11.3a**), suggesting that these features may collectively define the terminal phase architecture, with Zone 2 being a resurfacing of the Zone 3 floor.

The eastern edge of Zone 3 had largely eroded, leaving Zone 4, the construction fill under the floor, exposed. In the north, this boundary was visible at the eastern edge of Sqs. C and in Sq. F. The southern half of the boundary cuts nearly diagonally across Sq. A, forming a rounded shape where it intersects with the top of Zone 20, an interior wall (see **Figures 11.2** and **11.7**). The Zone 3 layer was thicker in Sqs. A and C than in Sq F., where the irregular surface of the Zone 4 construction fill was visible just a few centimeters below it. This is labeled in **Figure 11.2**, where 'Zone 3 boundary' outlines the entire area where some of Zone 3 was preserved, while the 'Zone 3 lower boundary' outlines the area where the layer was thickest. The architectural configuration that separates Zones 3 and 4 remains unclear; we are uncertain whether this boundary follows a pattern of some original architectural feature that was damaged during the Zone 2 resurfacing, or if Zone 3 once completely extended over Zone 4 but has since deteriorated. The matrix of Zone 3 consists of rocky fill made of fist-sized and smaller cobbles, varying from loose to semi-compact. Further excavation beneath Zone 3 (Zones 12, 13, 18) did not resolve the question of the Zone 3 and Zone 4 boundary.

Figure 11.7 Excavation photo of Zones 3, 4, and 8 in Sq. A (photo and notation by B. Degnan).

Zone 4 and Zone 17

Zone 4 consists of a rocky construction fill (10YR3/2) that extends roughly 0.8–1 m from the western side of the Zone 6 wall. This zone covers the western half of Sqs. B and F while also extending into the eastern portions of Sq. A (**Figure 11.2**). Initially, this fill was designated as Zone 17 in Sqs. C and F for horizontal control; however, upon confirmation that Zone 4 and Zone 17 described the same feature, all references to this feature are consolidated under Zone 4. The top of Zone 4 was roughly 48 cmbd. The southwest corner of Sq. A contained a patch with loose, dark soil and an absence of the rocky fill that defines the rest of the zone. The only result of investigation in this area was a charcoal sample taken at 65 cmbd, but no other artifacts. In total, excavation of Zone 4 continued to a depth of 91.5 cmbd.

The Zone 4 construction fill elevated the structure to its terminal height, and the Zone 3 surface lies above it. Although artifact cataloging is still in progress, excavators observed that thick chunks of preserved plaster were common throughout Zone 4. Many plaster fragments were painted red, like examples shown in **Figure 11.8**. Overall, Zone 4 contained medium artifact density, with collected artifacts including ceramic rims and sherds, lithics, obsidian, plaster, and C-14 samples. Of note is a ceramic sherd with a partial glyph, pictured and drawn in **Figure 11.6b**.

Figure 11.8 Sample of plaster fragments from Op. 81 (photos by B. Degnan).

Zone 5

Zone 5 was a thin, compact layer of collapse under the topsoil (Zone 1) and extending from the base of the Zone 6 wall and over the Zone 7 terrace (Sqs. B and F; 10YR2/1). The collapse was thickest at the base of Zone 6, hitting a maximum of 15 cm, and thinned towards the east. In some areas, less than a centimeter of Zone 5 covered the top of Zone 7. Artifacts recovered from this zone include lithic tools, debitage, ceramic rims, ceramic body sherds, and obsidian.

Zone 6

Zone 6 is a wall along the eastern side of Str. C-3 formed by a mix of unshaped chert cobbles and limestone blocks. The top course of stones was visible at the surface prior to excavation (**Figure 11.9**), and a walking survey of the structure indicates the wall extends across the entire structure. After we excavated Zones 1 and 5 to the east of Zone 6, we could see a second course of stones underneath. Some stones in this second course appear to be higher quality limestone, but others were chert cobbles like the first course. The height of the stones in the second course was inconsistent, with a third course peeking out under some of the thinner second course stones, while other second course stones extended deeper (see **Figure 11.10**).

Figure 11.9 Opening shot of Sq. F, facing west. The first course of Zone 6 stones is visible crossing through the middle of the unit. Exposed Zone 7 limestone visible in corner of Square B, to the left/south of Sq. F (photo by B. Degnan).

Figure 11.10 Excavation photo of Zones 6 and 7 in Sq. F, after clearing Zone 1 topsoil and Zone 5 collapse (photo by B. Degnan).

Zone 7

Zone 7 is a course of cut limestone running parallel to Zone 6, roughly 30 cm below and ~35 cm to the east (**Figures 11.2, 11.10**). Like Zone 6, Zone 7 is found in Sqs. B and F. This zone defines the upper terrace of Str. C-3, an intermediary step between the plaza floor and the interior of the superstructure delineated by the Zone 6 wall. The stones in Zone 7 are cut, plastered, limestone slabs that markedly differ from the chert cobbles that characterize Zone 6. Some of these stones were located just centimeters beneath the modern ground surface, and the limestone was delicate and easily crumbled.

Zone 8

Zone 8 is the western wall of the terminal structure, running slightly askew of a north-south orientation along Structure C-3 (see **Figure 11.2**). As with the Zone 6 eastern wall, an informal walking survey documented cut limestone blocks protruding from the ground surface every 8–10 m, confirming that Zone 8 extends across Str C-3. These stones are plastered, cut limestone, akin to those found in Zone 7.

The Zone 8 wall comprises a single course of stone that reaches a similar depth to that of Zone 3. It runs across Sqs. A, C, and E. Curiously, there is a break in the wall in the center of Sq. E (see **Figure 11.2**). In this area, two small limestone blocks were found out of alignment. At the northern end of the break, there is a smaller stone to the west of the main block, while at the southern end, a smaller stone lies to the east, connected to the presumed path of Zone 8 by a limestone marl. The cause of this gap is uncertain. While it may be an intentional gap left by the builders, our best guess is that it is a remnant of previous treefall or other natural disturbance. Indeed, the soil within this gap was looser and darker than the surrounding soil. We excavated matrix from the gap separately from other zones (**Figure 11.3a**, see Zones 10, 15, and 22).

Zone 9

Zone 9 was a surface extending across Sq. D and the southern end of Sq. E with patches of preserved plaster, particularly in the northeastern corner (**Figure 11.2**). In some areas without preserved plaster, the zone was traceable as a compact dirt surface (10YR2/2). In other areas, however, the surface had completely deteriorated to reveal the small cobbles comprising the ballast underneath (**Figure 11.11**). It is possible that Zone 2 and Zone 9 are the same surface: Zone 2 averages around 44 cmbd (Sqs. A and C), while Zone 9 averages 41 cmbd (Sq. D). We maintain distinct zone designations, however, due to the preservation differences and the fact that Sqs. A and C had two surfaces (Zones 2 and 3), while Sq. D only contained one. Excavators noted the recovery of various artifacts in Zone 9, including a botanical sample, faunal bone, lithic tools, debitage, plaster, ceramic rims, ceramic special sherds, and ceramic body sherds.

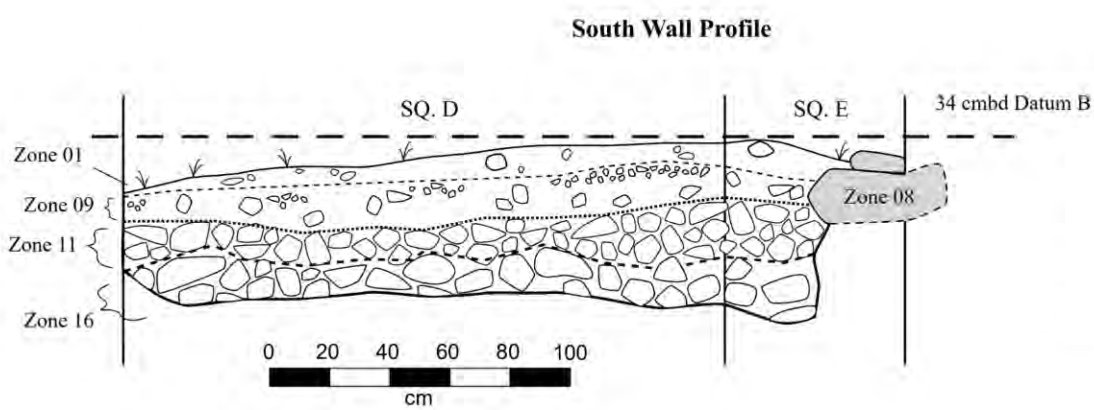

Figure 11.11 South wall profile of Op. 81, Sqs. D and E (drawn by B. Degnan and J. Biggs; digitized by B. Degnan).

Zone 10

Zone 10 encompasses the area beneath the Zone 1 topsoil and within the gap in the Zone 8 stones (**Figure 11.3a**). Most of this zone lies in Sq. E, but it extends into the western side of Sq. D too (**Figure 11.2**). Zone 10 is characterized by dark organic soil that is loose and indicative of more recent disturbance than the surrounding matrix (10YR2/2). No preserved surface, such Zone 2, 3, or 9, is evident in this area. While it is possible that the gap in the Zone 8 wall was intentional, chunks of disintegrating limestone marl found crumbled within root mass and caked onto chert cobbles in this zone indicate the wall originally passed through this area. We hypothesize this area was previously disturbed by the growth of a tree or other bioturbation. After excavating down 12 cm, reaching roughly the same level as the bottom of Zone 8 stones, we transitioned to Zone 15 to maintain vertical control. However, no significant changes were noted between these zones, except that the cobbles in the fill were, on average, larger. Excavators noted lithic tools, debitage, and ceramic rims, special sherds, and body sherds present in Zone 10.

Zone 11

Zone 11 was the construction fill directly beneath the Zone 9 surface, covering nearly all of Sq. D, the southern end of Sq. E, and the sliver of Sq. A south of the Zone 20 stones (**Figures 11.3a, 11.11**). This zone begins at approximately 50 cmbd and extends to about 72 cmbd, at which point excavators transitioned to Zone 16 to maintain vertical control in our documentation. As excavation went deeper, the rocks comprising the construction fill gradually increased in size (represented in **Figure 11.11**), but we observed no other matrix changes. Zone 11 exhibited medium artifact density. Excavators recovered a variety of material, including C-14 samples, faunal bone, lithic tools, debitage, freshwater shell, marine shell, obsidian, plaster, and ceramics (rims, special sherds, and body sherds).

Zones 12 and Zone 13

Zones 12 and 13 were the construction fill beneath the Zone 3 floor, spanning Sqs. A and C (**Figure 11.3a**). After excavating Zone 3, we bisected Sq. C and only the southern portion was excavated (as depicted in **Figure 11.3a**). We recorded Zones 12 and 13 separately to distinguish between an area of compact, lighter dirt devoid of cobbles (Zone 12, 10YR4/2) that was surrounded by a slightly darker construction fill scattered with small to medium cobbles (Zone 13, 10YR4/3). We excavated Zone 12 to determine if this compact surface characterized some previous feature buried under the Zone 3 floor, but our investigations found no discernable feature. In total, Zone 12 was 14 cm deep, and excavators collected faunal bone, debitage, plaster, obsidian, and ceramic rims and body sherds. In Zone 13, totaling about 12 cm in depth, excavators collected a C-14 sample, chipped tools, debitage, obsidian, freshwater shell, and ceramic rims, special sherds, and body sherds. In Zone 13, particularly within Sq. A, excavators continued to seek an explanation for the boundary between Zones 3 and 4, perhaps, for example, a retaining wall defining Zone 3, although no clear indications were observed.

Zone 14

Zone 14 consisted of a cluster of cut and eroding limestone rocks located east of Zone 8 in Sq. C (**Figure 11.2**). Because the quality and material of these stones match the Zone 8 wall, when we first encountered the stones, we hypothesized that they could represent a wall running parallel to the Zone 8 wall, perhaps subdividing a room. When it became clear that the stones did not extend more than 80 cm from Zone 8, we investigated whether they were arranged in a circle, perhaps as a column. No such configuration was ultimately observed. In reality, these stones, heavily fragmented and diffused, were likely a product of collapse and disturbance from the Zone 8 wall. We collected debitage, marine shell, obsidian, and ceramic rims and body sherds from the fill around Zone 14.

Zone 15

Zone 15 was the construction fill directly beneath Zone 10 in Sq. E and some of Sq. D (10YR3/2). As mentioned above, we transitioned Zone 10 into Zone 15 to maintain vertical control, as it is possible that the disturbances that affected Zone 10 were minimized in Zone 15.

Zone 16

Zone 16 was the construction fill beneath Zone 11 in Sqs. D and E (**Figure 11.11**). As mentioned in Zone 11, the fill comprised medium to large stones. Excavators collected C-14 samples, faunal bone, debitage, marine shell, plaster, and ceramic sherds in this zone.

Zone 18

Zone 18 was the construction fill beneath Zones 12 and 13 (Sq. A and the southern half of Sq. C), separated to maintain vertical control (10YR4/4, **Figure 11.3a**). Zone 18 started at an average depth of 69 cmbd and extended to 91 cmbd. The fill consisted of small, medium, and large cobbles and light artifact density. The matrix had a higher density of rocks closer to the Zone 20 wall and Zone 4 border. We recovered faunal bone, debitage, plaster, and ceramic rims, special sherds, and body sherds from Zone 18.

Zone 19

Zone 19 is the final layer of construction fill excavated in Op. 81. At the starting depth (92.5 cmbd), we determined there was no longer a discernable difference between the Zone 4 construction fill in Sqs. B and F and the Zone 18 construction fill in Sqs. A and C. Therefore, Zone 19 comprises the construction fill across all four squares: A, B, C, and F, but only Sqs. A and B were excavated (**Figure 11.3a**). This zone is bounded by the Zone 20 wall (described below) to the south. We excavated this zone to an average depth of 133 cmbd, at which point we arbitrarily closed the zone and the 2024 investigations into Str. C-3 (**Figure 11.12**). We collected a C-14 sample, faunal bone, lithic tools, debitage, obsidian, plaster, and ceramic rims, special sherds, and body sherds from Zone 19.

Figure 11.12 Closing shot of Op. 81 excavations, facing south (photo by B. Degnan).

Zone 20

Zone 20 denotes an alignment of large stones running east-west under the terminal surface of Str. C-3 (**Figures 11.2, 11.3a, 11.3b**). It stands roughly 90 cm high, comprised of slightly irregular stones rather than standardized courses of cut limestone, and it likely extends deeper than our excavations. We have labeled this feature as a wall, though its form hints that it may have functioned as a retaining wall, or construction pen, used for structural integrity when raising the structure to its original height. It is possible, though unlikely, that the wall served as the northern wall in a previous construction phase of Structure C-3, and that Zones 19, 18, 13, 12, and 3 are part of an extension onto the building.

Interpretations and Conclusions

Our work on Op. 81 addressed all three of our stated objectives, though some aspects are only partially answered and require further investigation. To begin, we now better understand the final architectural form of Str. C-3. Two low walls extend across the entirety of the structure: one on the western side is composed of a single course of cut limestone blocks (Zone 8) and another on the eastern side made of a mix of uncut chert cobbles and limestone blocks (Zone 6). The eastern side drops down to a terrace (Zone 7), comprised of cut limestone blocks similar to those in the western wall (Zone 8). All three of these features lie just below the modern surface, with some portions poking out and visible without excavation.

The quality of the cut limestone that forms the western wall and front terrace (Zones 8, 7) stands in sharp contrast to the irregularity and mix of construction materials that comprise the front wall (Zone 6). This discrepancy suggests a chronological gap between the construction of these features, where Zones 8 and 7 may have originally belonged to an earlier building that was modified by adding Zone 6. Further analysis of diagnostic ceramics and radiocarbon dating of samples from the construction fill compared to materials on the terminal surface will help clarify this sequence.

Interestingly, we found no evidence of interior walls defining individual rooms. While it is possible our excavation units missed these features, the gallery buildings in Tikal's East Plaza marketplace are also missing interior walls (Jones 2015). These buildings had a thick spine wall and corbelled vaulted roofs that were supported by evenly spaced stone piers that formed doorways, or perhaps marketing stalls, along the front of the gallery buildings. At Altun Ha, similar doorway arrangements may be part of the perishable superstructure and thus beyond our reach, or they may be obscured under the later additions of Zone 6.

Due to time constraints, we ceased excavations before revealing definitive evidence of previous architectural phases in Str C-3 beyond the probable addition of the Zone 6 wall described above. At its maximum, our excavations extended 1.03 m below the modern ground surface, or 0.77 m into the construction fill below the Zone 3 surface. The lack of any previous architecture at this depth does not rule out a buried structure underneath. In his volumes on Altun Ha excavations, Dr. Pendergast commonly describes excavating over a meter and a half of construction fill between architectural phases (Pendergast 1979, 1982, 1990).

As for the function of the terminal structure, the density of utilitarian stone tools and cores found in Zones 1 and 2 suggests some form of specialized activity. In particular, the presence of stemmed blades (**Figure 11.5d–e, h–i**) may be of note. At nearby Colha, stemmed blades are found in higher concentration in the Terminal Classic period (Masson 2001). While some scholars have argued that stemmed blade production increased alongside violence in the

Terminal Classic period (Barrett and Scherer 2005), others have suggested the increased production may simply reflect shifting demand away from agricultural tasks and towards other activities (Masson 2001). For example, many stemmed blades found in domestic contexts at Colha were perhaps used in a secondary function, as cutting implements (Masson 2001).

Understanding the nature of activity on Str. C-3 and whether it occurred within a residential or non-residential space on Str. C-3 is important for understanding how this building articulates with Strs. C-1, C-2, C-4, E-66, and the open space between these buildings (tentatively designated Plaza C). In addition, it may be useful to investigate the central axis of Str. C-3 to confirm the presence of a staircase descending into Plaza C.

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Chapter 12

Searching for Additional Archaic Traces Around a Lowe Point Find Spot in Backlanding (STP Series 064 and Op. 86), and Further Investigation in the Vicinity (STP Series 065 and 066)

Marieka Brouwer Burg and Melvin Quilter

In June 2024, Mr. Melvin Quilter was driving a bulldozer in the New River Pine Savanna. From the driver's seat, he spotted a white colored rock on the ground and, having worked with the first author for over a year in the search for Archaic occupations, got down to have a closer look. The white rock turned out to be a complete Lowe Point lying on the sandy surface of the recently exposed ground (**Figure 12.1**).

At the time of this find, Quilter was employed by a Mennonite man from Shipyard. Rumors around Crooked Tree village suggest that a group of Mennonites from Shipyard have purchased land in Backlanding and are hoping to construct a road down the pine ridge, across the Western Causeway, and through Crooked Tree to get to the Northern Highway (**Figure 12.2**). According to one local informant, there have already been at least two town meetings held to discuss this possibility, one of which was attended by some of the male Mennonite elders.

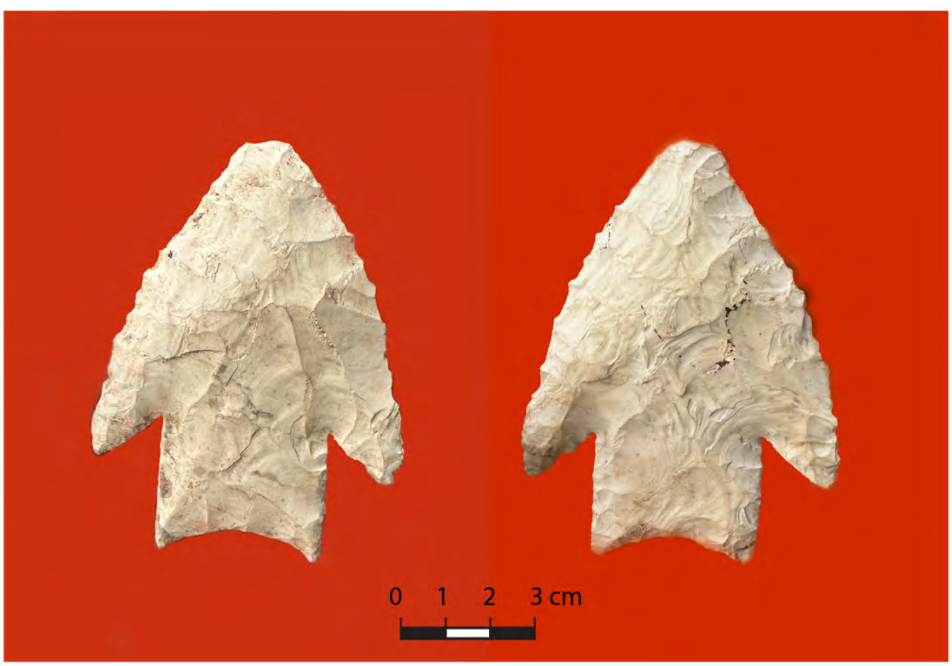

Figure 12.1 Lowe point found by Melvin Quilter at Backlanding (photos by M. Brouwer Burg).

Figure 12.2 Top: location of Lowe point find spot (Op. 86) and STP series 061; Bottom: locations discussed in the text including proposed "Mennonite" road in white (maps by M. Brouwer Burg).

On July 1-3, 2024, the authors returned to the spot where the Lowe point had been identified. After walking over the area and noticing the large number of lithics, heavily patinated, specifically in the road cuts, the authors decided to conduct a STP survey to get an understanding of the distribution of lithics in the subsurface (**Figure 12.2**). Unfortunately, it had rained the previous night and the ground was saturated with water and some of the surficial lithics sat in rills from groundwater runoff. During the pedestrian survey, we found the stem of a Maya macroblade, an Archaic looking macroblade, a possible piece of groundstone, a hammerstone/pounder, and the medial segment of a projectile point. The projectile point is bifacially worked and thin in cross-section. It has the appearance of a point we observed while visiting Jon Lohse project earlier in the summer in August Pine Ridge (**Figure 12.3**). Lohse is provisionally calling these "Pine Ridge" points (Lohse et al. 2024). It seems fitting that we may also have found such a point in the New River Pine Ridge, a very similar environment to August Pine Ridge.

Figure 12.3 Left: "Pine Ridge" point found in August Pine Ridge by Jon Lohse and team; Right: paisan-looking medial fragment found at Backlanding (photos by M. Brouwer Burg).

STP series 064 was laid out along a E-W trajectory (**Figure 12.2**). STP 1-6 were dug as 50-x-50 cm shovel test pits. Only three pieces of microdebitage were recovered from these units despite the fact that lithics lay strewn about on the surface (**Table 12.1**). To explore the relationship of lithic distribution between the road cuts and the undisturbed subsurface, we carried out 12 more STPs (7-18). This time, we used a posthole digger to quickly reveal depth to clay and artifact positivity. The first six (7-12) STPs were placed in the road cut and the second six (13-18) were in the undisturbed area. Unfortunately, we were not able to make any more significant conclusions, as all STPs (7-18) were negative. Additionally, the stratigraphy of all 18 STPs was incredibly similar, consisting of sand with roots and some redox features grading into basal clay.

Table 12.1 Results of STP series 064 at Backlanding.

STP #	Positive or negative	Ending elevation (cm BGS)	Stopping point of STP/other comments
1	Positive	29.5	0-10 cm thin O horizon descends into gravelly sand with some clay (2.5Y6/2 light brownish gray) 10-20 cm sand continues becoming slightly more clayey with concretions and redox features 20-30 cm basal clay at bottom, water table encountered *2 pcs microdebitage in 5-10 cm
2	Negative	71	Same as STP 1, end at water table
3	Negative	80	Same as STP 1 with more yellow/orange at bottom (yellow matrix = 2.5YR7/4 pale brown; orange = 2.5Y6/8 olive yellow)
4	Positive	83	Same as STP 1 but many red iron concretions at bottom making pale brown sand orangey in color *1 pc microdebitage in 5-10 cm
5	Negative	90	Same as STP 1
6	Negative	90	Same as STP 1
7	Negative	33	Same as STP 1
8	Negative	35	Same as STP 1
9	Negative	38	Same as STP 1
10	Negative	36	Same as STP 1
11	Negative	27	Same as STP 1
12	Negative	28	Same as STP 1
13	Negative	28	Same as STP 1
14	Negative	37	Same as STP 1
15	Negative	34	Same as STP 1
16	Negative	37	Same as STP 1
17	Negative	41	Same as STP 1
18	Negative	31	Same as STP 1

Clearly, the "peekaboo" view of a shovel test pit was not going to provide us with a better understanding of lithic distribution or answer the question of how much deflation had occurred over time. To get better horizontal exposure of lithics in situ, we opened a 2-x-2 m test excavation (Operation 86). Only one Square (A) was excavated (**Figure 12.4**).

Figure 12.4 Opening shot of Op. 86 (incorrectly identified as Op. 82; photo by M. Brouwer Burg).

Zone 1

This zone of topzone sediment consisted of sand interspersed with roots. It was semi-compact from the recent rains but easy to dig through. The sand varied in color from dark yellowish brown (10YR4/4) to yellowish brown (10YR5/6). We took this zone down an arbitrary 5 cm. While larger lithics were visible on the surface nearby, this zone yielded mostly small pieces of chert debitage (n = 24, 99.4 g) and one possible chipped tool fragment.

Zone 2

This zone represented the next ~5 cm of sediment from Op. 86 (**Figure 12.5**). The sand continued and the number of iron concretions increased. Pine tree roots were present throughout and seem to be responsible for the darker staining seen in **Figure 12.5**. Only one piece of debitage was recovered weighing 4.3 g. We did not continue down in Zone 2 because it began to rain and water was pooling in the unit. We did decide to carry out a posthole to determine how deeply the sand descended, although we had a good idea based on the previous STP survey described above.

Zone 3

Zone 3 represents a posthole excavated in the NW quadrant of Square A. It was 56 cm in depth from the bottom of zone 2 and contained one artifact at 30 cmbd.

Figure 11.5 Top of Zone 2, Op. 86 (incorrectly identified as Op. 82).

In short, Op. 86 did not reveal much in the way of a distinctive lithic scatter, as only small pieces of debitage were recovered. These pieces were not piece plotted as they did not appear to be flakes associated with the production of the Lowe point. Rather, these pieces of debitage were likely associated with retouching behaviors carried out in the vicinity, perhaps during a hunting foray.

Epilogue

After closing Operation 86 on July 2, the authors attempted to drive to the Dawson's Creek landing, a location where locals report a person can put in a canoe and cross New River Lagoon (**Figure 12.7**). However, on account of the rains described above, the ground was wet and squishy and we succeeded in getting our vehicle well and truly stuck in the mud. We walked a bit farther westward toward the Dawson Creek landing and encountered some highly eroded ceramics. These ceramics are the first to be recovered by these authors in the New River Pine Ridge. It was pushing four o'clock at that point and we decided to hike out to the top of the Western Causeway to await a pickup by a BREA team member. We took advantage of the hike (~one hour) to document the presence of lithics on the surface. Two areas in particular had large scatters, one at Santa Maria Caye, and another where Dawson's Creek crosses the main pine ridge road.

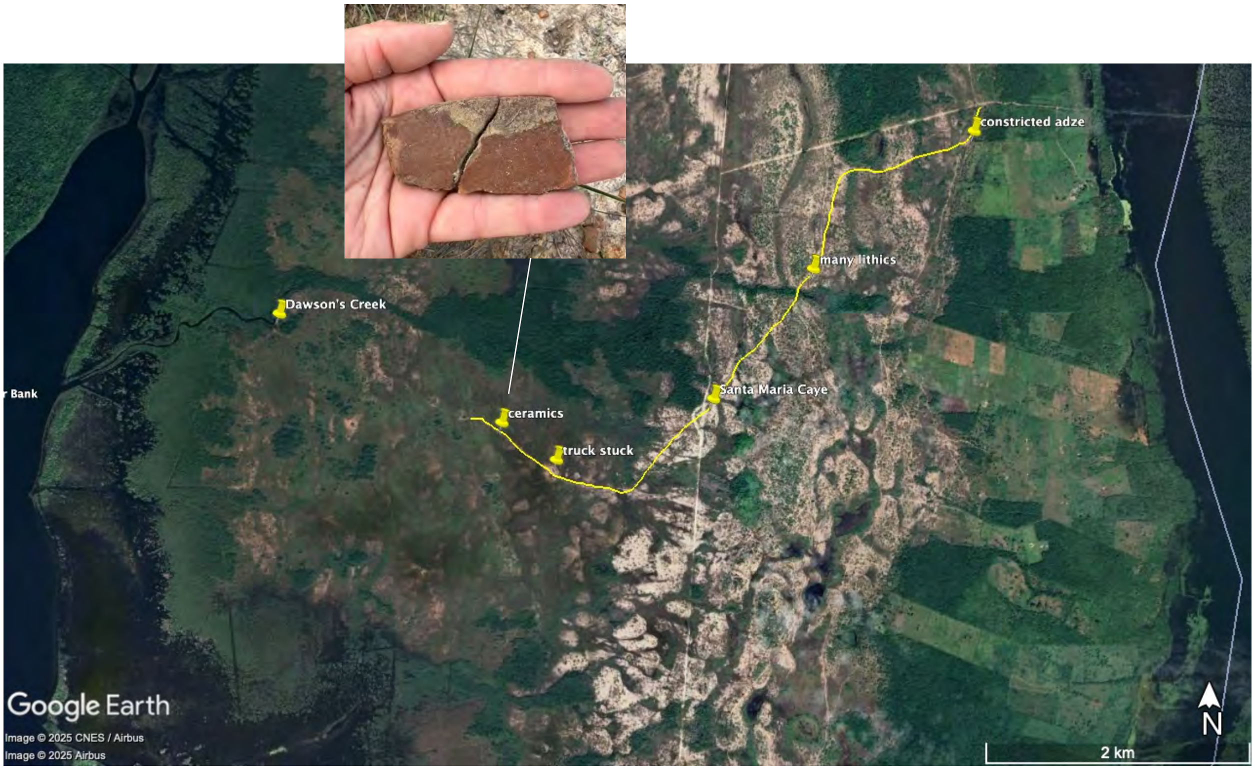

Figure 12.7 Overview of truck impasse and hike/surface survey on 7/2/2024; top: highly eroded ceramics, the first recovered from the New River Pine Savanna (map and photo by M. Brouwer Burg).

The following day, the authors returned by tractor and retrieved the stuck truck (**Figure 12.8**). Then, we went back to Santa Maria Caye and conducted further pedestrian survey and six STPs (STP survey series 065; **Table 12.2**).

Figure 12.8 Forty-five minute tractor ride out to (right) stuck truck near Dawson's Creek (photos by M. Brouwer Burg).

The pedestrian survey yielded a number of interesting findings. Most of the lithics were comprised of heavily patinated chert, rather than the chalcedony that is commonly found closer to Western Lagoon. However, the constricted adze recovered appeared to be made of a consolidated limestone (**Figure 12.9**).

Figure 12.9 Surface finds from Santa Maria Caye including left: constricted adze and right: pointed macroblade (photos by M. Brouwer Burg).

The subsurface of Santa Maria Caye was very similar to that of Backlanding. And, although there were numerous lithics strewn on the ground surface, none were recovered in shovel tests, indicating that aeolian compression has had a strong impact on these sandy sediments.

Table 12.2 Results of STP series 065 at Santa Maria Caye.

STP #	Positive or negative	Ending elevation (cm BGS)	Stopping point of STP/other comments
1	Negative	53	0-10 cm thin O horizon descends into pale brown (10YR6/3), gravelly sand 10-20 cm sand continues becoming slightly more clayey with concretions and redox features 20-30 cm basal clay at bottom
2	Negative	49	Same as STP 1
3	Negative	41	Same as STP 1, sand redder (2.5YR3/6, dark red)
4	Negative	42	Same as STP 1
5	Negative	45	Same as STP 1 *many lithics on surface
6	Negative	28	Same as STP 1, matrix is yellowish brown (10YR5/6) sandy clay

After returning the tractor to Mr. Luke Crawford, the authors made one last trip across the Western Causeway on July 3, 2024, this time to evaluate the impact of the last season's flooding on the site of Ek'tok, which was investigated by the BREA team in 2018-2019 (**Figure 12.10**). The land belonged to Mr. James Dawson, who died tragically in a car wreck in 2022; now the land is managed by his sister Ms. Lollette Flowers and her partner Mr. Roy Bradley (the latter also worked with K. Anne Pyburn at Chau Hiix in his youth). Ms. Lollette granted us permission to walk on the land and to dig a few shovel test pits. One of us (Quilter) used to help Mr. Dawson with his cows and was familiar with the property.

Figure 11.10 Location of past investigations at Chau Hiix, Ek'tok, and the STP series described here.

We found that some of the land, including ancient Maya mounds, have recently been cleared of vegetation (**Figure 12.11**). Already in 2018, Murata and Kaeding had identified a large looter's tunnel on structure 1 (see Murata and Kaeding 2020: Figure 3.2), but the amount of surficial clearance has expanded since then. Many pieces of sandstone and granite grinding stones, along with pottery and lithic debris, were observed strewn on the ground. The second author believes the disturbances were undertaken by bulldozer, ostensibly attempting to clear the land to facilitate movement of the cattle.

Figure 12.11 Left: Quilter standing in front of ancient Maya structure; Right: Looters pit in structure first identified in 2018 (photos by M. Brouwer Burg).

The goal of this reconnaissance was to identify relic shorelines of Western Lagoon that might have been inhabited by the Late Archaic groups who initiated the construction of the linear features we assume were used as fish weirs (see Harrison-Buck et al. 2024). Thus, we pushed as close to the lagoon as possible and were seeking any artifacts or traces of Archaic occupation in our STPs. It had been a very dry May-June and although the rains had recently begun, the lagoon levels were still quite low.

STP series 066 consisted of two units that we attempted to dig to a basal deposit (**Table 12.3**). In the first, we began to see powdery sand laminations interspersed with peat toward the bottom of the column, which is also what we found when we cored in this area in 2023 (see Krause et al. 2024). However, both STPs took quite a while to dig on account of the high clay content and no artifacts were recovered. We decided that to make this exercise more useful, we need to return and open at least a 1-x-2 m trench for added visibility and to increase our chances of recovering any artifacts.

Table 12.3 Results of STP series 066 at Ek'tok Waterside.

STP #	Positive or negative	Ending elevation (cm BGS)	Stopping point of STP/other comments
1	Negative	97	Next to lagoon 0-50 cm very dark (black) humic clay, slightly lighter with depth, a bit blue (gley)

			50-97 cm getting more powdery sand laminations and gypsum with black layers of peat interlaced.
2	Negative	72	Up higher, to the west Same as STP 1 but clay is even thicker and we didn't reach the powdery sand this time. Need a bigger unit.

Interpretations and Conclusions

These investigations were exciting but also disappointing. We felt tantalizingly close to finding an early Archaic occupation with the discovery of the Lowe point. However, projectile points such as these were likely hafted onto spear shafts and used in hunting large animals or in fishing. Therefore, most likely this Lowe point (like many others) was lost during the hunting activity itself. Thus, we would not expect to find complete Lowe points at a residential occupation unless the occupation doubled as a production locale. And in that case, we'd also expect to find more than one such point as well as abundant evidence of tertiary production. While at the Backlanding site there was lithic debris scattered about, much of it was large and contained cortex, indicating that this area may have been used over the millennia to fashion or resharpen various types of tools, including Maya tools.

The surficial nature of the lithic scatters at both Backlanding and Santa Maria Caye indicates that a good deal of aeolian deflation has occurred in the pine ridge, leading to the compression of materials deposited over thousands of years into a 5-10 cm topzone. The locations where these lithics become visible on the surface always seem to correspond to recent movement of vehicles, heavy machinery, or ground water runoff that expose and transport the shallowly buried artifacts. We feel that the prospects of finding stratified deposits in this pine ridge savanna is low. Notably, there seems to have been more deflation and compression of sandy layers in the New River Pine Savanna than in the lowland savanna of the Morales site (see **Brouwer Burg and Harrison-Buck, Chapter 2**). Perhaps this is related to the degree of ecotone and broken ridge/forest islands, which functions to anchor and stabilize soils.

In summary, while savannas are easier to excavate and yield more surficial artifacts than lowland broad leaf forest contexts, the research described above indicates that focusing on areas with greater soil aggradation is needed in order to identify stratified deposits. It is clear that savannas were used by Archaic period people for hunting purposes, and perhaps also collection and processing of cereal grasses (see **Brouwer Burg and Harrison-Buck, Chapter 2**). Further research will focus on edge zones between ecosystems as likely locations for occupation or more concerted residential use.

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Chapter 13

Resampling and Analyzing Granite from the Hummingbird Ridge and Cockscomb Basin

Tawny Tibbits and Marieka Brouwer Burg

Introduction

Granite was an important raw material for the production of ground stone tools in the Maya Lowlands. In particular, manos and metates were used for grinding a variety of materials from food stuffs to pigments (Searcy 2011). Being an igneous rock, granite is long-lived and durable, making it a desirable raw material with which to work. There are three chemically distinct and geographically restricted granitic plutons situated in the country of Belize: the Hummingbird Ridge, Cockscomb Ridge, and Mountain Pine Ridge (Bateson and Hall 1977, Dixon 1956; **Figure 13.1**). In her dissertation work, Tibbits (2016) collected hand samples from these three plutons and developed geochemical ranges for each. However, while these ranges have withstood multiple tests of validity, there remained a need to increase robusticity of the initial dataset by collecting more hand samples, especially from the Hummingbird and Cockscomb regions, and recording find coordinates with higher precision GPS. The authors planned a 4-day driving excursion along the Hummingbird Highway and the newly paved and improved Coastal Highway to meet this need.

Objectives

The research objectives for this excursion were as follows:

1. Sample riverways for granitic cobbles and/or pebbles in Hummingbird Ridge, along both the Hummingbird and Coastal Highways.
2. Sample riverways for granitic cobbles and/or pebbles in Cockscomb Basin, with special focus on attempting to (a) locate the Cabbage Haul Gap intrusion and (b) locate the Cockscomb Plug south of the pluton proper.
3. Update the outcrop database to improve robusticity of the chemical ranges.

Background

The three granite plutons within the Maya Mountains are visually very similar, making visual provenance difficult (Bateson and Hall 1977, Dixon 1956). Foundational work in the Maya Mountains determined that petrographic differentiation is possible using thin sections and analyzing mineral content with specific attention on minor mineral phases present (Bateson and Hall 1977). Shipley and Graham (1987) highlighted the importance of granite as a resource that was widely exploited by people in the Eastern Maya Lowlands over time. Work by Ward (2013) provided a leap forward in our understandings of how extensive this use may have been and revealed a large-scale mano production at the site of Pacbitun, located just north of the Mountain Pine Ridge.

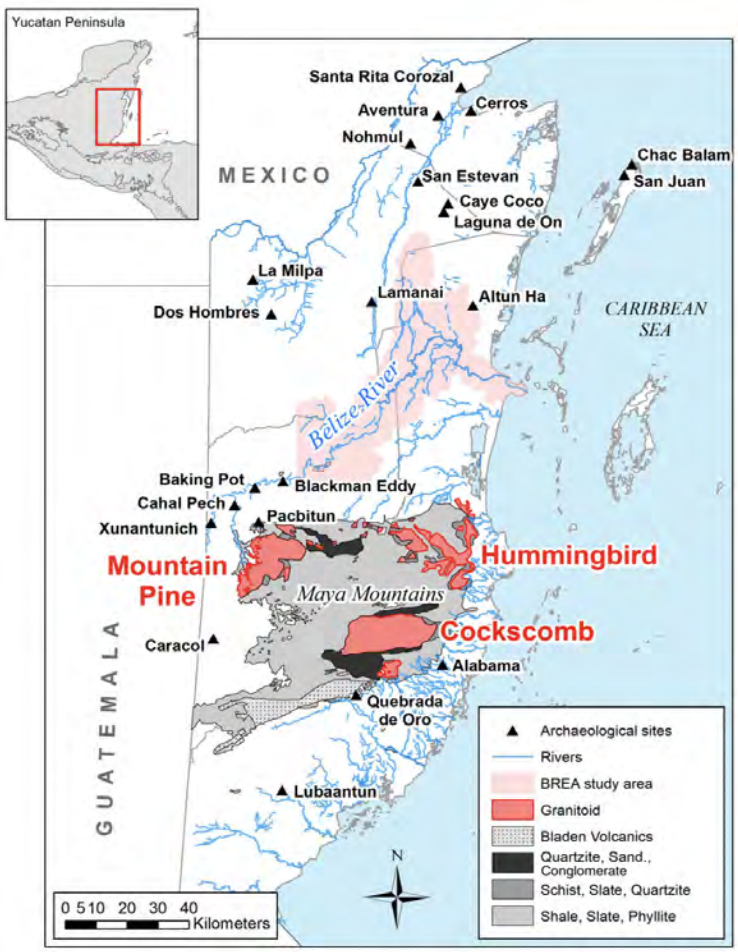


Figure 13.1 Map of Belize showing the three granitic plutons within the Maya Mountains (map by M. Brouwer Burg).

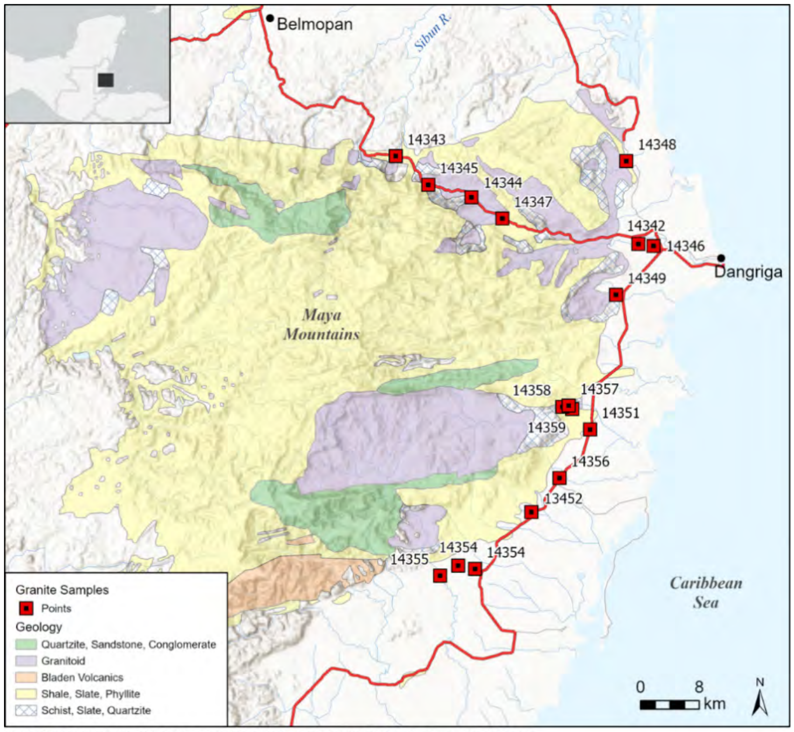
Tibbits (2016) encountered granite stone tools in sites ranging from La Milpa in the far north of Belize to Uxbenka in the south. These granite tools were almost exclusively manos and metates, with a few bowls present. Granite is pervasive in ancient Maya households (Searcy 2011). The ubiquity of granite tools, as well as their dense and bulky nature, has resulted in few research projects focusing exclusively on the extraction, production, exchange, and use of this artifact category, or even reporting in any regular manner on the types of ground stone tools found or their distributions within sites. This gap in the literature is disheartening but understandable and has motivated us to continue developing a geochemical database for analyzing procurement practices, leading to interesting questions about the production and exchange of granite across vast distances.

In Tibbits' (2016) sourcing research, hand samples were collected and geochemical signature ranges were developed for each pluton using a combination of petrographic thin sections and lab-based XRF on powdered samples. The experimental method of using XRF on whole rock samples in the field was compared to the lab-based XRF sampling using no fewer than five distinct datapoints to generate a geochemical signature. The results of this work indicated that this method of five data points was sufficient to generate a bulk geochemical signature that was statistically similar to that generated by powdering a sample for XRF analysis. From there, an initial dataset was developed showcasing the range of geochemical variation within and among the three plutons to be used as a comparison to understand where archaeological granite may have been extracted (Tibbits 2016, Tibbits et al. 2022).

Methods

To increase robusticity of the initial granite dataset, we set out to collect more hand samples from the Hummingbird and Cockscomb regions, using a more accurate GPS receiver (an EOS Arrow with sub-decimeter accuracy). Recent improvements to the Coastal Highway as well as new construction along the Hummingbird Highway and the Southern Highway have made access to the granitic areas.

During a 4-day driving excursion, Brouwer Burg and Tibbits drove the Hummingbird, Coastal, and Southern Highways in search of granite pebbles/cobbles along the roadsides. The find locations are shown in **Figure 13.2**. Great care was taken to ensure all samples were from easily accessible, public lands. The Hummingbird Ridge was examined from the Hummingbird and Coastal Highways. New construction on the Coastal Highway has both exposed new areas for analyzing creeks and created new difficulties in the form of introduced road fill. These samples were collected with the goal of improving source identification potential for granite ground stone tools recovered from the BREA project area.



Esri, NASA, NGA, USGS, CONANP, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, CONANP, Esri, TomTom, Garmin, FAO, NOAA, USGS

Figure 13.2 Map of the route taken by Brouwer Burg and Tibbits to collect samples (map by M. Brouwer Burg).

From the survey, 17 granite locations were sampled along the Hummingbird Ridge and Cockscomb Basin regions, with a total of 22 pieces analyzed during the 2024 season. Once all samples were cleaned in the field lab, it became evident that some of the supposed granite samples were not actually granite. For example, one pebble from Mullins Creek was identified as metamorphic after washing. Additionally, nine non-granite samples were purposefully collected to build a comparative reference collection for the BREA laboratory. These samples were identified as dacite, conglomerate, shale, mudstone, phyllite, smoky quartz, and a metamorphic cobble that could be easily confused for granite.

In addition to samples collected by the authors, Dr. Jon Spenard of the Rio Frio Regional Archaeology Project (RiFRAP) provided granite samples from recently discovered ancient quarry sites within Mountain Pine Ridge (n = 43). Granite samples from the RiFRAP area were collected from surface deposits largely on the western portion of the pluton during two seasons (see Spenard et al. 2025).

All samples were analyzed using an Olympus Vanta XRF on Geochem setting using three beams, at 20 seconds per beam. Each sample was analyzed five times in different locations in an effort to generate a composite geochemical signature, per the methodology established in Tibbits (2016). These five data points were then averaged to generate a single plottable data point for each rock. After analysis, the data was reviewed to determine if the roadside granites were truly local or likely to have been trucked in for construction. Four pieces were removed, as it was unclear if they were naturally tumbled from the local pluton or if they were brought in with an additional 2 removed as they were determined to not be granite (Table 13.1).

Table 13.1 Location of granite specimens collected during reconnaissance. Note: six geological samples were removed from the final dataset due to high variance in the chemical signatures, suggesting recent transport to the area.

	LCB	Sr/Y	Rb/Sr	Source
CCB Red Bank Rd	14354	12.18667	0.746171	Cockscomb
CCB Red Bank Rd	14354	15.09302	0.92604	Cockscomb
CCB Mayan World 1	in situ	8.856	4.97019	Cockscomb
CCB Mayan World 2	in situ	9.655172	4.628571	Cockscomb
CCB Santa Rosa	14344	16.05882	0.517705	Removed
CCB Maya Centre 1	14357	36.60	0.00	Removed
CCB Maya Centre 2	14358	32.92	0.01	Removed
CCB Maya Centre 3	14359	7.935484	0.684282	Removed
CCB Swasey River	14355	11.07042	0.783715	Cockscomb
CCB Cabbage Haul Kendal	14351	1.39	22.53	Removed
HBR Hurricane Rd	14352	3.630769	9.627119	Hummingbird
HBR HRQ	14342	3.227586	11.48718	Hummingbird
HBR St Margaret big	14343	2.279245	13.10596	Hummingbird
HBR St Maragret small	14343	2.590476	13.85294	Hummingbird
HBR N Stann Cr	14345	5.140496	1.16881	Hummingbird
HBR Pomona Field 1	14346	4.731707	9.139175	Hummingbird
HBR Pomona Field 2	14346	2.27	21.28	Hummingbird
HBR Sattva 1	14347	7.5	5.191111	Hummingbird
HBR Sattva 2	14347	5.8	6.53202	Hummingbird
HBR Mullins Cr	14348	4.9125	3.80916	Hummingbird
HBR Bocawina 3	14349	2.747826	8.71519	Hummingbird
HBR Bocawina 3	14349	6	7.847826	Hummingbird

Results

Earlier work successfully distinguished between the three plutons by following the magmatic differentiation of the chamber as it shifted through time (see Tibbits 2016; **Figure 13.3**).

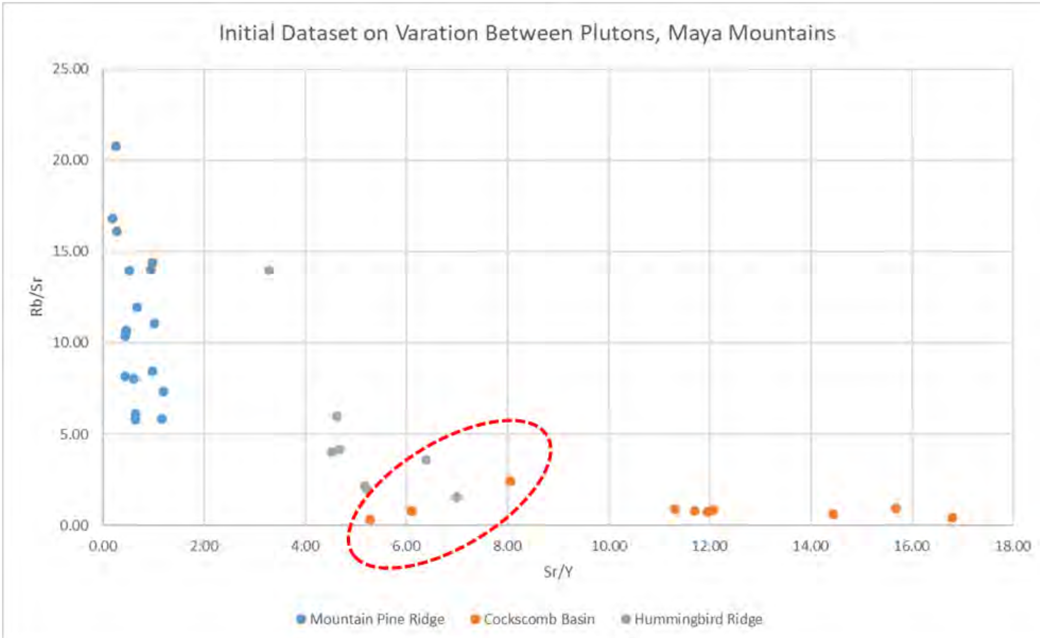


Figure 13.3 Dataset from Tibbits (2016) showing the separation of plutons using XRF on the initial set of outcrop samples collected (image by T. Tibbits).

Strontium, yttrium, and rubidium most successfully differentiated the plutons in a bivariate chart, likely related to the fact that they are generally resistant to weathering and transport by natural processes. There were areas of signature overlap where source certainty is lower, most notably between the signature range of Hummingbird Ridge and Cockscomb Basin (see red ellipse in **Figure 13.3**). In addition to this, the GPS coordinates collected for these points were low quality due to technical issues and in retrospect, some samples that were included in this initial dataset should not be considered "granite", but rather diorite or other crystalline varieties found in the Maya Mountains.

The new dataset (n = 71) is derived from the 17 sampling locations and geographically well-constrained samples from the initial 2016 dataset. As can be seen in **Figure 13.4**, when plotted in a bivariate chart, the new dataset displays a similar distribution of signatures from the three plutons. The signatures are more internally constrained and no longer show any clear overlaps. The overlaps between the Hummingbird Ridge and Cockscomb Basin signatures were deemed the most problematic in the initial data and this work has alleviated that problem area. However, while the Mountain Pine and Hummingbird Ridge appeared more distinctive in the initial dataset, the new dataset indicates that some pieces have similar signatures.

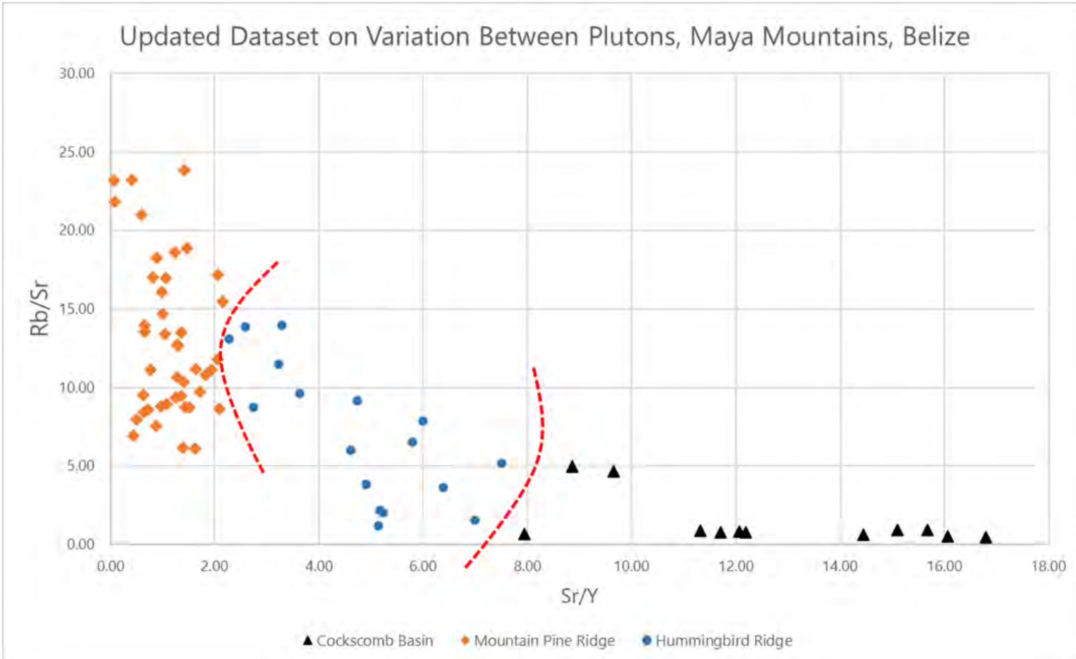


Figure 13.4 Bivariate distribution of Sr/Y and Rb/SR ratios for the new dataset to be used in future work sourcing granite from the Maya Mountains (image by T. Tibbits).

Three geological samples from Maya Centre (LCB #14357, #14358, and #14359) had unexpectedly high ratios of Rb/Sr, such that they were skewing the scale to accommodate the spacing. In light of this, they are noted but not included in Figure 13.4 as they are likely not sourced from the Maya Mountains. Another geological sample from Cabbage Haul Kendal (LCB #14351) revealed an anomalously high Sr/Y ratio, such that the authors concluded it was transported road fill and not naturally part of the landscape; it was also removed from the final dataset. Additionally, within the Hummingbird Ridge sample, two geological specimens from Santa Rosa (LCB #14344 and #14350) were determined not to be granite and were also therefore excluded from the dataset. These are accounted for in the six removed pieces mentioned above.

Interpretation and Conclusions

The expansion of the granite dataset by the authors in our 2024 driving excursion has increased our knowledge of the variation within and between plutons of the Maya Mountains. Our understanding of the range of variation for both the Cockscomb and the Hummingbird granites has been greatly increased. While there is some new uncertainty between the signatures of Mountain Pine Ridge and Hummingbird Ridge, the overlap between Cockscomb Basin and Hummingbird Ridge has been resolved for now, although additional specimens could add more specificity to our ranges.

Compared with Tibbits' (2016) study, we were highly successful in sampling the main pluton of the Cockscomb Basin. This was largely due to recent road improvements in the Stann Creek District, which have opened up new feeder roads into the mountains. Additionally, we were able to take advantage of recent high volume stormwater runoff that moved a large quantity of granite cobbles downstream into the coastal plain. Further, we were able to eliminate two problematic pieces from the earlier dataset, which were determined to be non-local to the Cockscomb Basin. These findings cleared up a zone of overlap between the Hummingbird and Cockscomb Basin granites.

Within the Hummingbird Ridge, we were equally successful at locating granite. The repaving of the Coastal Highway allowed us access to areas previously inaccessible, although this work also made clear that not much of this highway is near enough to the granitic portion of the mountains to be of much help in increasing our sample range. Along the Hummingbird Highway, new roadways also opened up previously inaccessible parts of the granite pluton.

When looking at these ranges, the zone of overlap between Cockscomb Basin and Hummingbird Ridge has generally been resolved; however, we now have the issue of an overlap between Hummingbird Ridge and Mountain Pine Ridge. These samples are not geographically near each other; the RiFRAP area is on the central western side of the Mountain Pine Ridge pluton. However, compared alongside the archaeological materials analyzed in 2016, very few fall into this zone of overlap. This had the added benefit of reinforcing the ability for XRF to be used in the field to accurately assess granite when using a tested methodology, despite the initial dataset being developed with a different model of Olympus handheld.

Returning to the original goals of this data collection excursion, we were successful in the majority of those objectives. We increased the size of our Hummingbird Ridge and Cockscomb Basin sample and were able to discard readings that were clearly erroneous or outside the range of variation. The only goals not met were the subgoals of #2. We were not able to locate either the Cabbage Haul Gap intrusion or the Cockscomb Plug south of the pluton proper. This was not for lack of trying, but rather related to the inaccessible location of these areas from main roads. In future work focused on these areas, we will need to spend time identifying landowners to gain proper permissions to access these more remote areas of the Maya Mountains.

In addition, we have learned a lot about the granite in the Maya Mountains and have increased our understanding of how this variation can be analyzed for use in asking questions about granite ground stone tool production and exchange. This research has also served to affirm and validate the framework from the Tibbits' 2016 work, which has been shown to withstand repeated testing. The results described here have refined the previous analysis and provided greater insight into the areas of geochemical overlap that exist within plutons. This also has the added benefit of underscoring that this XRF work is replicable using different instruments.

Granite variation within a single pluton is still largely beyond the grasp of field-based XRF work. However, we have made great strides in unraveling the story of how granite geochemistry varies from pluton to pluton within the Maya Mountains. With the introduction of this data, we have established a thoroughly provenanced database of granite from each of the plutons with accurate GPS locations collected for each sample. To our knowledge, the information presented here represents the most thorough survey of granite chemical signatures from the three plutons in Belize and in future work, we will continue to improve understandings through additional specimen collection and refinement of our models.

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Chapter 14

Production and Sourcing of Obsidian Artifacts from Sites in the Middle and Lower Belize River Watershed

Marieka Brouwer Burg, Alexandra F. Bazarsky, Tawny L. B. Tibbits, Vivian Burr, Geoffrey Braswell, and Eleanor Harrison-Buck[1]

Introduction

The BREA team has conducted systematic survey and excavation between 2011 and 2024 within the eastern catchment of the Belize River watershed (Brouwer Burg and Harrison-Buck 2023, 2024; Harrison-Buck 2011, 2013, 2015a, 2015b, 2018, 2020; Harrison-Buck and Brouwer Burg 2022). In total, the project has collected obsidian from 35 sites within the project study area, plus other unknown areas or GPS loci where obsidian was recovered through reconnaissance or pedestrian survey (**Figure 14.1**). While a few previous pilot studies have been conducted on this artifact category (Garland and Brouwer Burg 2013; Duff and Harrison-Buck 2015), we attempted in this study to analyze the entire assemblage of obsidian collected by the project, with the exception of specimens from an Archaic occupation and from recent excavations at Altun Ha. The assemblage we will discuss below comprised 864 obsidian specimens, which we analyzed with the goal of assessing typology, technology, and provenience.

Background

As a non-local and highly valued toolstone, obsidian in the Maya region is often considered a luxury good available mainly to elites and/or associated with ritual activity. However, it is also often found in more rural locations and commoner households. Most obsidian from lowland Maya contexts derives from geographically restricted areas in the Guatemalan Highlands: San Martin Jilotepeque, El Chayal, and Ixtepeque (**Figure 14.3**). These volcanic deposits are at least 350 km in linear distance from the BREA study area (see Braswell 2000:Figure 20.1). Occasionally, obsidian is imported from beyond the Maya region; for example, a distinctly green-colored Pachuca obsidian comes from central Mexico (Meissner

[1] Author contributions: Conceptualization: Harrison-Buck, Brouwer Burg, Braswell, Bazarsky, Tibbits; Methodology: Braswell, Tibbits, Brouwer Burg; Investigation: Bazarsky, Tibbits, Burr, Brouwer Burg; Analysis: Brouwer Burg, Tibbits, Bazarsky; Resources: Brouwer Burg and Harrison-Buck; Data Curation: Brouwer Burg, Tibbits, Harrison-Buck; Writing – original draft: Bazarsky, Brouwer Burg, Tibbits; Writing – review and editing – Brouwer Burg, Tibbits; Supervision: Brouwer Burg, Harrison-Buck, Braswell; Project administration: Brouwer Burg and Harrison-Buck; Funding acquisition: Harrison-Buck and Brouwer Burg.

2017:137). Ucareo obsidian, also from central Mexico, tends to contain distinctive striations and a blue hue, which can also help distinguish it (Aoyama 2014).

Within the archaeological record, the majority of obsidian recovered in field contexts tend to be blade fragments. Other products like flakes, bifaces, and cores are also sometimes found. Varying amounts of each functional type can reveal how obsidian was being transported, the kinds of production techniques used, and whether items were created *in situ* or distributed in their finished form. Obsidian specimens can also yield information about ritual behavior and—when found in association with human remains—social status. Obsidian tools, while used for everyday tasks like cutting and slicing, were also created for ritual importance. For example, bloodletters were important in religious and kingship rituals, obsidian eccentrics symbolized power and status, and large obsidian points/knives are thought to have represented authority (Stemp et al. 2019; Walton 2021).

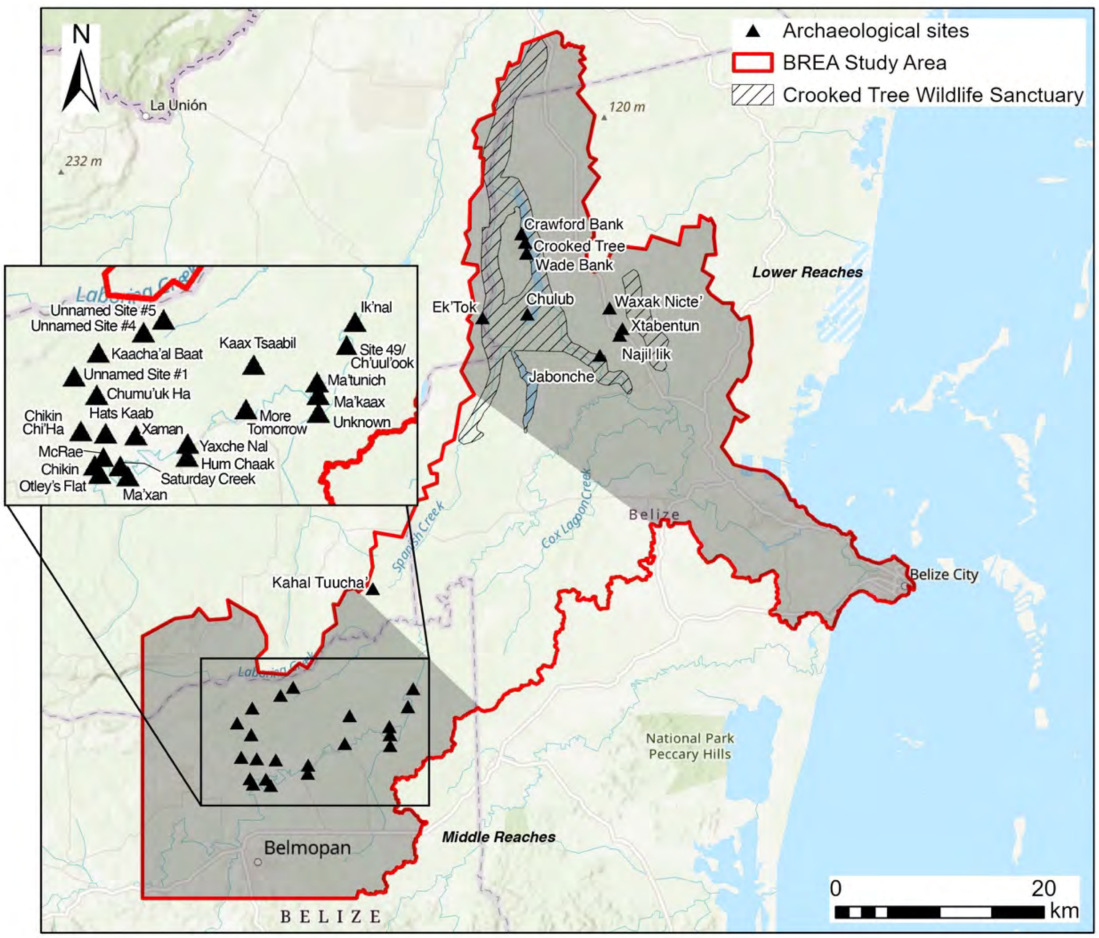

Figure 14.1 BREA study area showing ancient Maya sites and find spots yielding obsidian specimens in the middle and lower Belize River Watershed (map by M. Brouwer Burg).

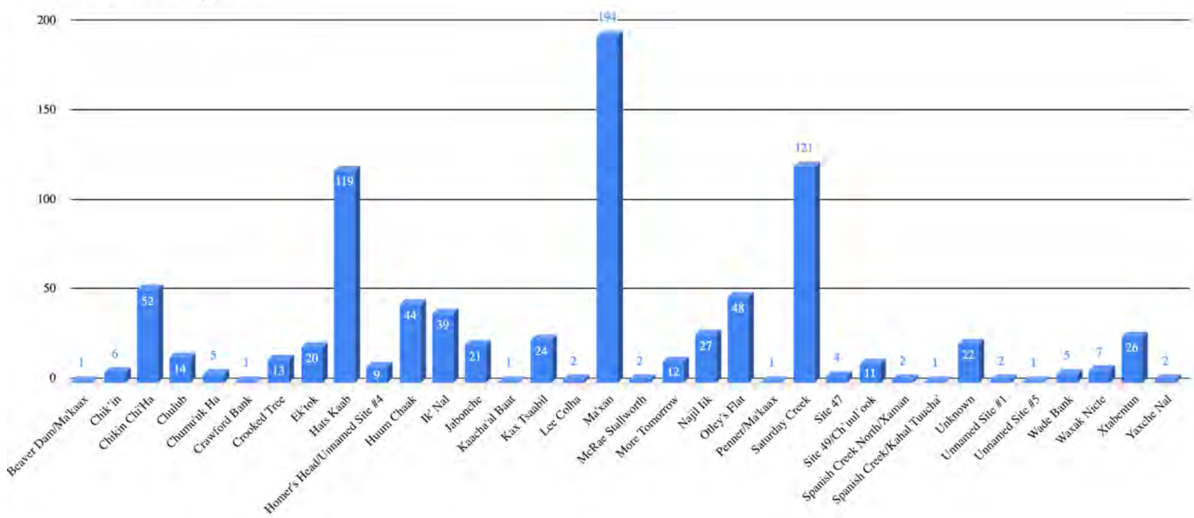

Figure 14.2 Find locations of the obsidian specimens analyzed in this study (image by A. Bazarsky).

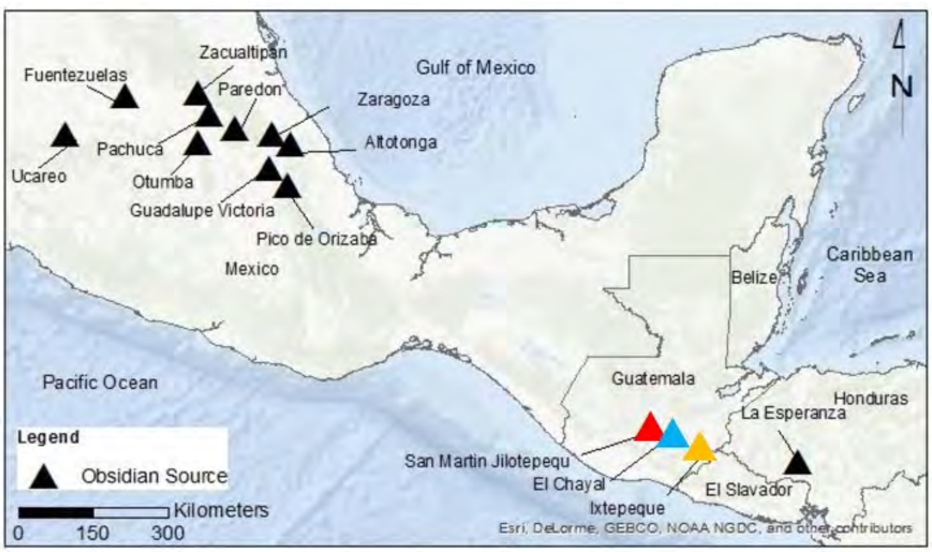

Figure 14.3 Map of the major obsidian sources in highland Guatemala and central Mexico (adapted from Seidita 2015).

To assess temporal trends in the data, it is important to set the stage regionally. McKillop (2004:136-138) outlines that San Martin Jilotepeque was a dominant source of obsidian during the Middle Preclassic, while in the Late Preclassic, El Chayal became the preferred source. She notes the latter trend might be related to the rise of the Kaminaljuyu kingdom, located near the El Chayal deposit (McKillop 2004:137). El Chayal remains the dominant obsidian source at most Classic Maya sites but is overshadowed by Ixtepeque obsidian in the Terminal Classic and Postclassic, likely indicating another shift in regional economic systems. In general, obsidian source diversity increases in the Postclassic. For example, McKillop notes that in Postclassic strata at Wild Cane Caye, obsidian from as many as six different sources were recovered, ranging from La Esperanza obsidian from Honduras to Pachuca and Ucareo obsidian from central Mexico (McKillop 2004:137).

Methods of Analysis

All obsidian specimens were analyzed for body/industry type, metric attributes, visual indicators, and XRF information. We note that the obsidian collected by the BREA project contains both excavated material and surface collection pieces. The lab collection bag (LCB) number was recorded for each specimen but in cases where a bag contained more than one piece of obsidian, a secondary number was assigned so as to track individual pieces within LCB bags.

For body and industry type, specimens were first roughly categorized as core, chunk, blade, flake, and biface. Then, where possible, an industry type was assigned: bipolar, free-hand/casual percussion, retouch, or prismatic blade (see **Figure 14.4**). If a specimen contained multiple attributes from within a category (e.g., a flake from a core that was worked with both prismatic blade and casual percussion industry), a note was made and the specimen was input as its final or most identifiable industry. Additionally, notes were made of the amount of cortex and visible retouch present. Specimens categorized as blades underwent further analysis indicating the portion of the blade present (i.e., proximal, medial, distal, or whole) as well as their sequence of production (i.e., first, second, final, or corrective). The number of *aristas* or arises (flake scars) were also recorded.

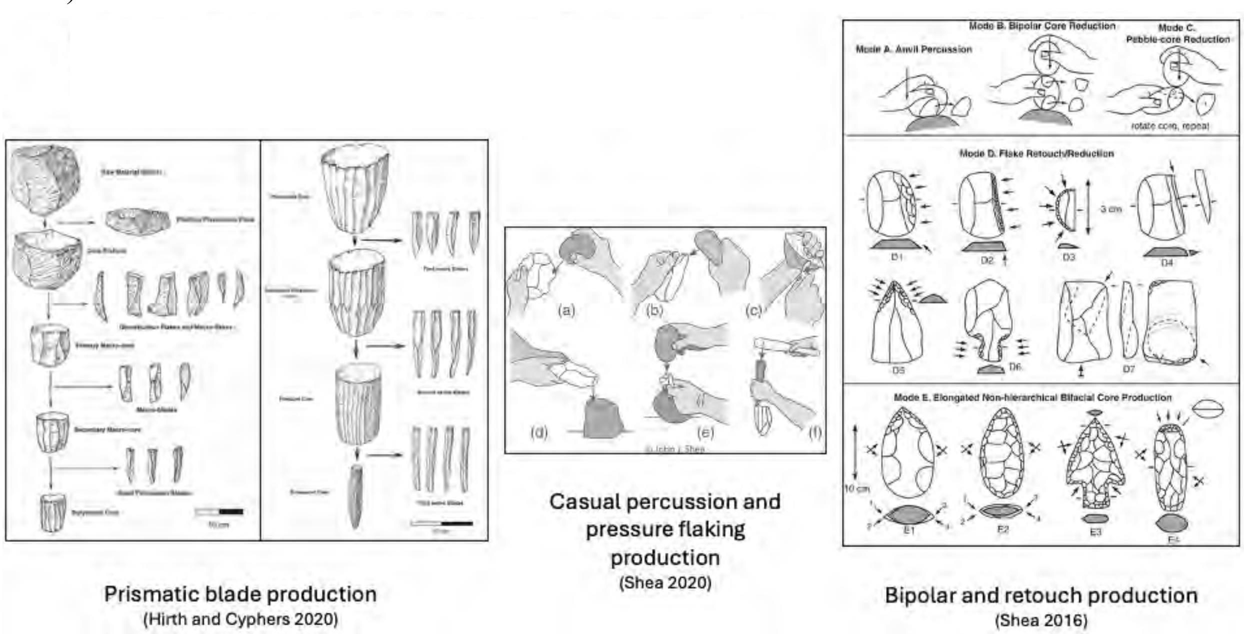

Figure 14.4 Different lithic industries employed to shape obsidian artifacts (from Hirth and Cyphers 2020; Shea 2016, 2020).

Metric attributes collected included length, width, and thickness, and were obtained with a Mitutoyo electronic caliber. The length of "cutting edge" was collected for blades and included the sum of cutting-edge length on both linear edges. Each piece was weighed using an Ohaus Scout Pro balance (0.1-2000 g).

When possible, a color description was recorded for specimens following Braswell et al. (2000:272). While it is difficult to source obsidian by visual analysis of coloration, we thought it would be insightful to compare the visual analyses with the XRF results in order to test this conjecture.

After basic data analysis was complete, a select number of obsidian specimens (n=15) were drawn and photographed for documentation purposes by Bazarsky. These specimens included two bifaces, 11 cores, and two core reversal flakes (see below), and were chosen to help illustrate flake marks, percussion scars, production techniques, and other miscellaneous wear.

pXRF Analysis

To geochemically analyze and source the obsidian specimens to specific volcanic outcrops, we used an Olympus Vanta C-Series with a rhodium filter. A sample of 810 pieces were shot in the BREA field laboratory using Geochem mode, 3 beam, for total of 45 seconds. One shot was collected per sample to average the results and avoid erroneous readings. Those not shot either did not have enough surface area to cover the full beam or were too thin to yield an accurate chemical signature.

Back in the Digital Anthropology Lab at the University of Vermont, we obtained a comparative set of source samples (n=18) and archaeological samples (n=17) from the Peabody-Yale Reference Obsidians (PYRO; Frahm 2019) calibration set and the University of Missouri Research Reactor (MURR) calibration set. We followed the same XRF shot methodology used on the archaeological samples from the BREA project to obtain these comparative geochemical ranges. Up to three points were collected when possible for experimentations' sake.

Results

The obsidian described below derives from a subset of the 35 sites from which the BREA team has collected obsidian. From the middle reaches, this included obsidian from nine ancient Maya sites: Chikin Chi'Ha, Hats Kaab, Hum Chaak, Ik' Nal, Kaax Tsaabil, Ma'xan, More Tomorrow, Otley's Flat, and Saturday Creek. From the lower reaches, the obsidian derived from five sites: Ek'tok, Chulub, Jabonche, Najil Iik, and Xtabentun (see **Figure 14.1**).

Typological Results

A subset of the full assemblage (n=761) is described here and includes primarily excavated obsidian. However, in two instances (at Hats Kaab and Ma'xan) we also included surface collected obsidian from the plow zone, as excavation at these sites revealed obsidian in all of the uppermost stratigraphic layers (**Figure 14.5**).

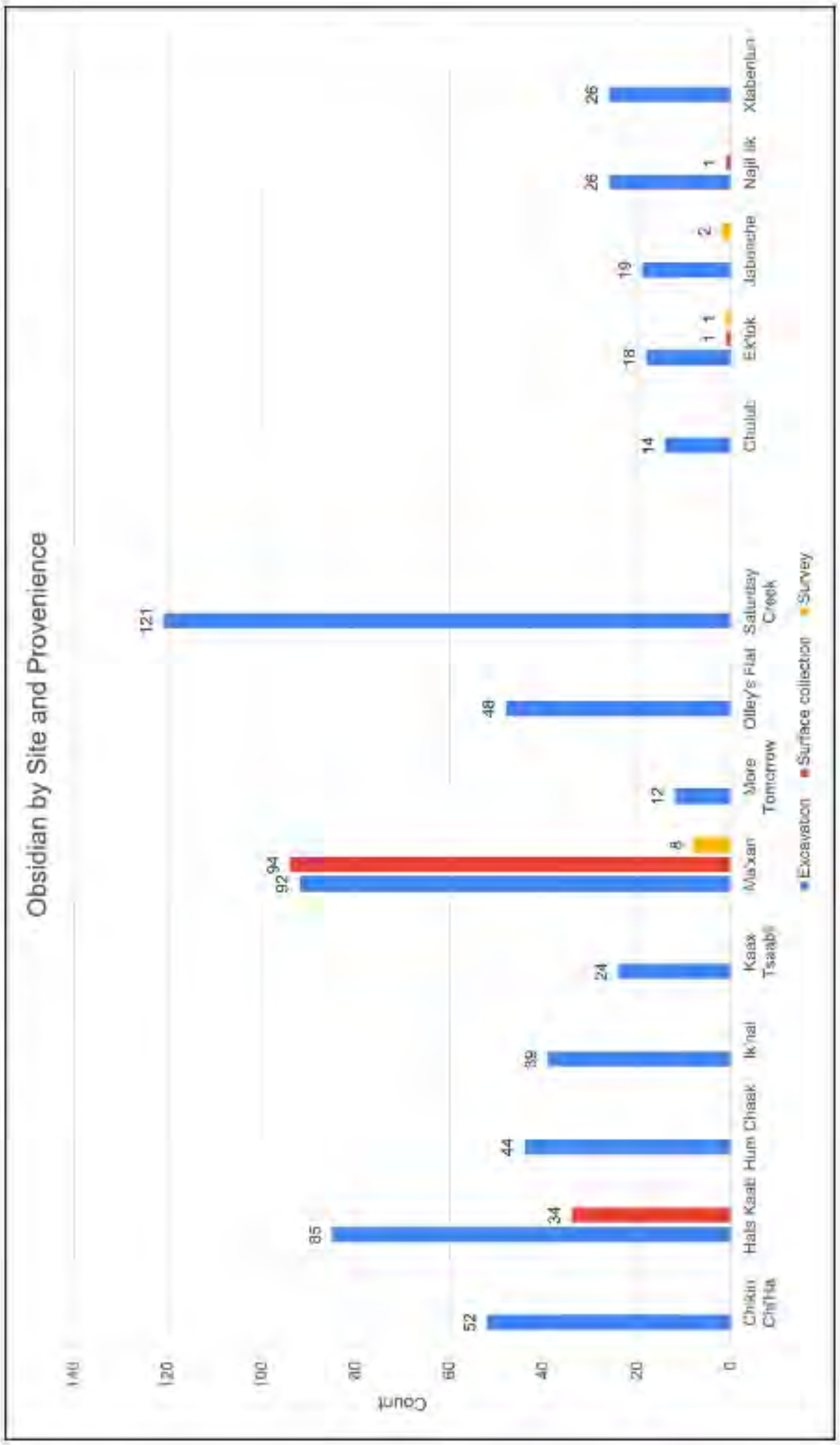

Figure 14.5 Count of obsidian specimens from the main sites excavated by the BREA project. Note: middle reaches sites on the left; lower reaches sites on the right (image by M. Brouwer Burg).

Of the total sample, the vast majority derives from the middle reaches (86%), while only 14% derives from the lower reaches (**Figure 14.6**). We note that equal amounts of research time and funding have been allocated to these two areas, so research bias is likely not skewing the results.

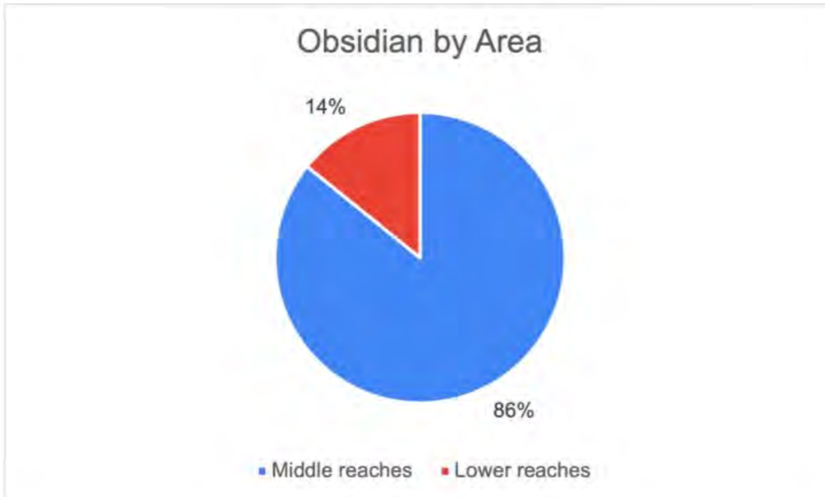

Figure 14.6 Obsidian by area of the Belize River Watershed (image by M. Brouwer Burg).

The majority (82%) of the middle reaches collection derives from the sites of Hats Kaab, Saturday Creek, Chikin Chi'Ha, Ma'xan and Otley's Flat (**Figure 14.7**). These sites are clustered together and likely represent a sprawling regional center occupied from the Late Preclassic through Terminal Classic periods. In the lower reaches, the sites of Najil Iik and Xtabentun yielded the most obsidian (49%). These sites also lie near each other (<1 km) are may once have represented a contiguous settlement.

As can be seen in **Figure 14.8**, blades comprise the overwhelming majority of the BREA obsidian assemblage (89%), followed by a meager 7% flakes, and 2% each cores and chunks, leaving 0.26% attributed to bifaces. The dominance of blades — in conjunction with the very low proportion of "production debris" (cores, chunks, and flakes) — in this assemblage suggests that obsidian tools were not widely produced in the mid-to-lower reaches of the Belize Valley and were most frequently exchanged in their finished form. The vast majority of blades are fragmentary and that medial and proximal fragments are prevalent in the sample.

In regard to the evidence of *in situ* obsidian production, cores were recovered at only six sites, four in the middle reaches and two in the lower reaches (**Figure 14.9**). The middle reaches cores constitute the bulk of the collection, with only 2 specimens coming from the lower reaches. Almost half of the cores (42%) from the middle reaches derive from the site of Hats Kaab. It is important to highlight that the four sites in the middle reaches with cores all lie within three km of one another. It is thus possible that this was a production locus in the middle reaches. **Figure 14.10** displays some of the size variation among the prismatic blade cores from the collection.

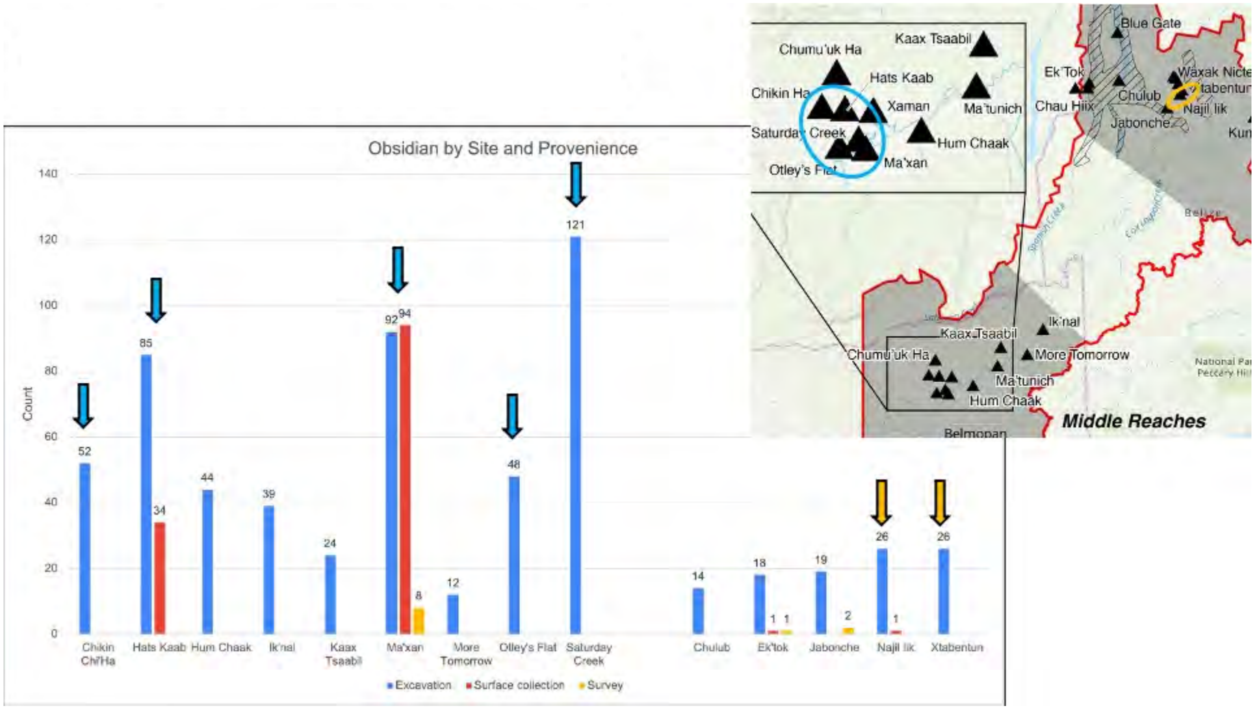

Figure 14.7 Sites with the highest percentage of obsidian specimens (Figure by M. Brouwer Burg).

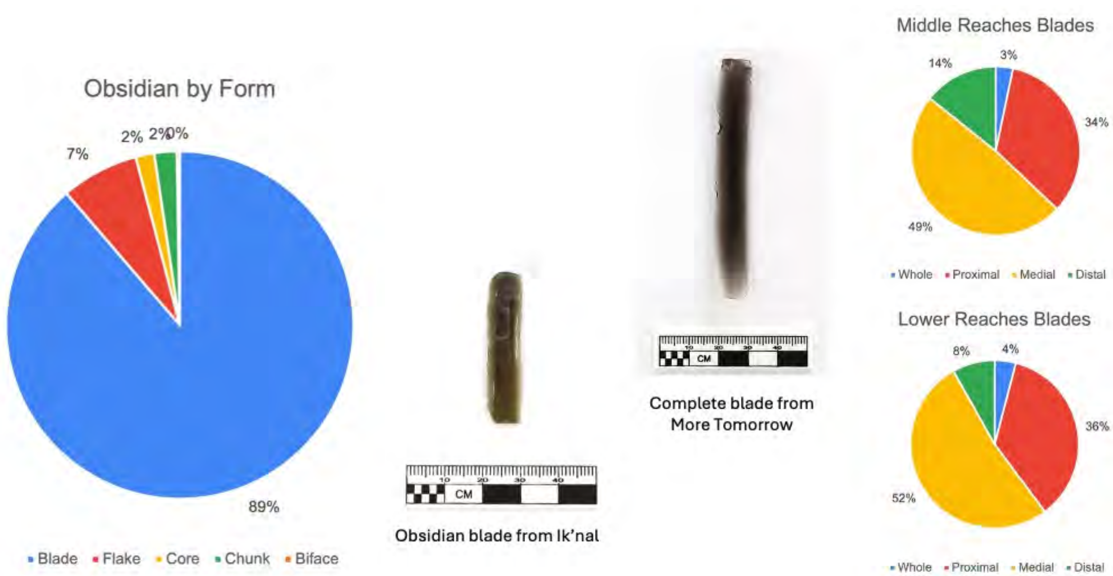

Figure 14.8 Left: Obsidian specimens and distribution by middle/lower reaches (images by M. Brouwer Burg).

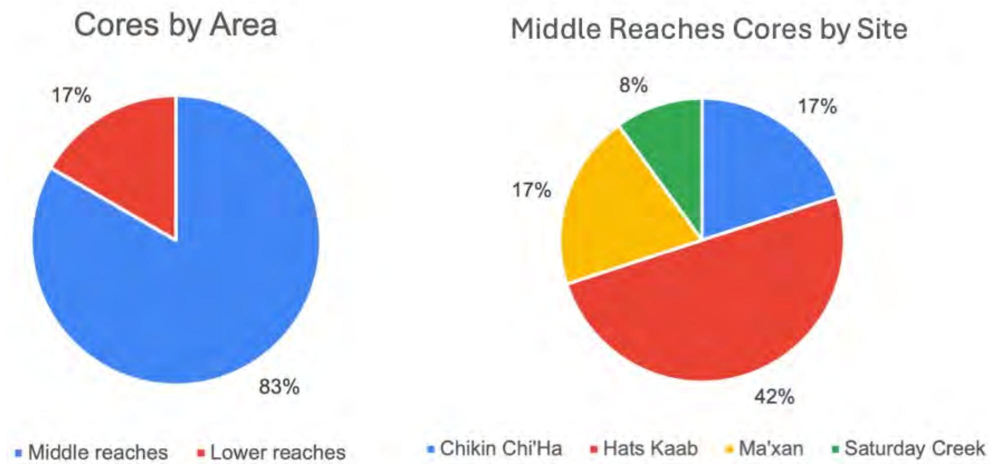

Figure 14.9 Left: cores by area; Right: middle reaches cores by site (images by M. Brouwer Burg).

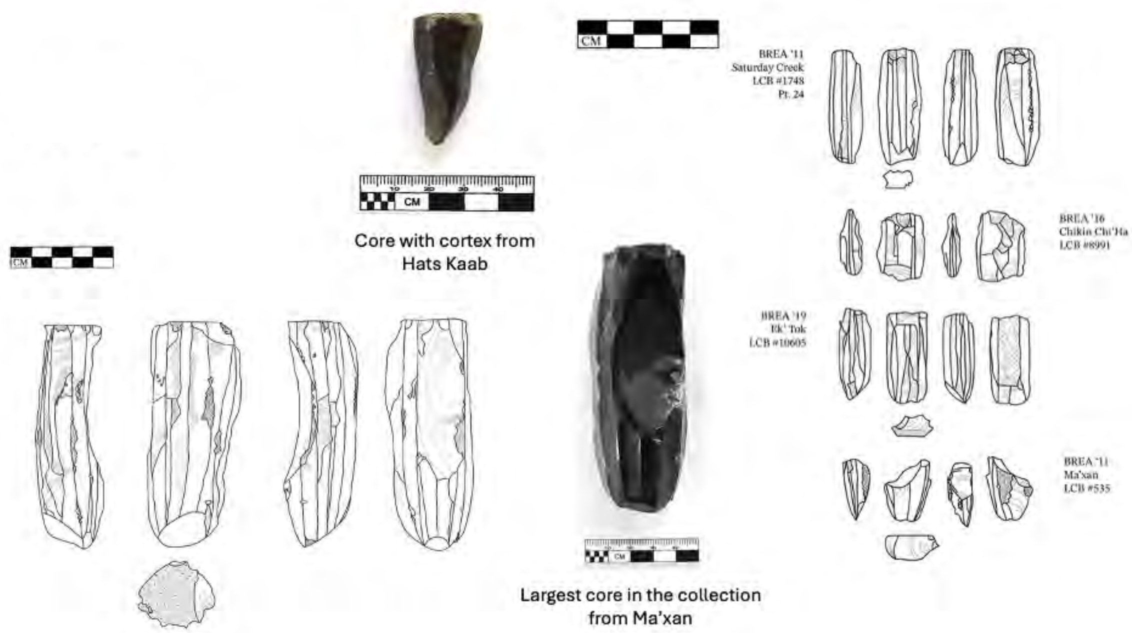

Figure 14.10 A selection of the prismatic blade cores from sites excavated by the BREA project (drawings and photos by A. Bazarsky).

Of the flakes analyzed, 93% derive from the middle reaches and 7% from the lower reaches (**Figure 14.11**). Again, the middle reaches assemblage is dominated by flakes from Hats Kaab, followed by Ma'xan and Saturday Creek. This data also appears to bolster the hypothesis that the area around Saturday Creek may have served as an obsidian production location at various times. Additionally, less than 1% of the assemblage has any traces of cortex present, further underscoring the lack of evidence for primary production in the region.

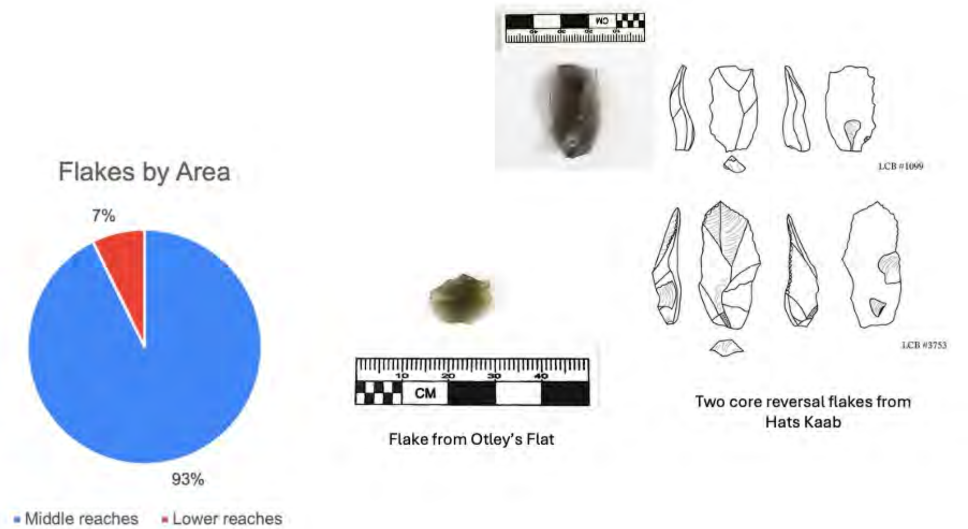

Figure 14.11 Flakes by area (drawings and photos by A. Bazarsky).

While we cannot yet make many definitive claims about temporal patterns in the obsidian assemblage—as ceramic analysis is ongoing for many of the sites—we can make a few observations based on the type of proximal blade platforms present in the assemblage (**Figure 14.12**). Other scholars have noted that plain or lightly striated platforms were gradually replaced with pecked-and-ground platforms in the Maya region during the Terminal Classic and Postclassic. Twelve sites have scratched platforms (seven in the middle reaches and five in the lower reaches), 11 sites have pecked-and-ground or lightly ground platforms (nine in the middle reaches and three in the lower reaches), and Najil Iik has some blades with unique "Mayapan style" crescent-shaped platforms which are also indicative of Late Classic and Postclassic manufacture (Rovner 1974).

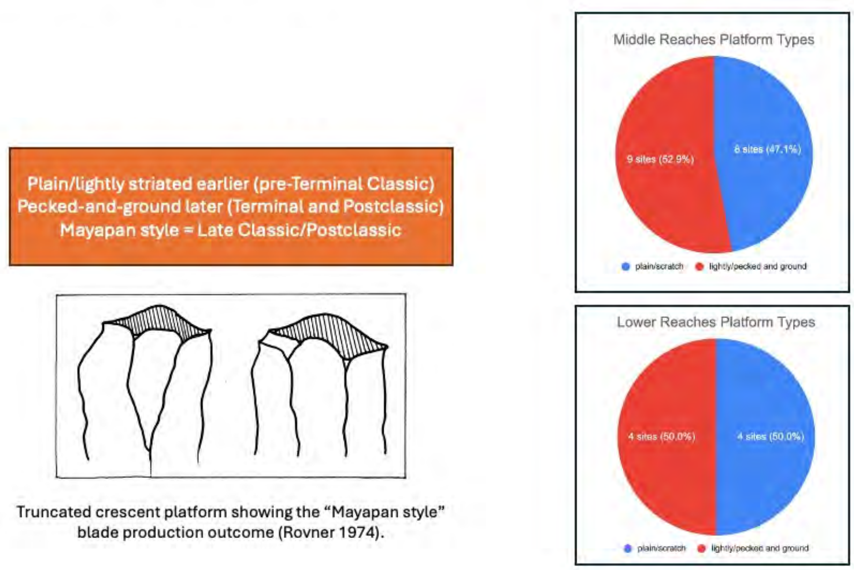

Figure 14.12 Types of blade platforms (image from Rovner 1974; charts by A. Bazarsky).

Individual Site Descriptions (by A. Bazarsky)

Before we discuss the results of XRF analysis, we provide a description of obsidian artifacts found at each site. We note below whether the site is located in the middle or lower reaches of the study area and readers are directed to **Figure 14.1** for specific locations.

Beaver Dam/Ma'kaax

Located in the middle reaches, near the site of More Tomorrow, this site had one medial blade fragment, found during surface collection (see Harrison-Buck ed. 2011). It could not by visually identified.

Chan Colha

Located 2 km west of Altun Ha in the lower reaches, this site yielded two medial blades fragments (see **Brouwer Burg et al., Chapter 6**). Neither could be visually sourced.

Chik'in

Located in the middle reaches, just west of Saturday Creek, this site yielded six specimens (five cores and one blade), all from surface collection (see Harrison-Buck ed. 2011). The blade is whole and one of the cores is a proximal piece that broke during a failed core rejuvenation strike. Visual sourcing suggests that four pieces are Ixtepeque and the other two are El Chayal. Five of the six pieces have plain platforms. Three cores are exhausted, one was flipped/reversed, and one has scars indicating that an attempt was made to repurpose the specimen into a tool.

Chikin Chi'Ha

Located in the middle reaches about a 1 km northwest of Hats Kaab, this site yielded 46 blades, three chunks, two cores, and one flake (n=52; **Figure 14.13**). Out of the blades, two are whole, eight are distal, 16 are proximal, and 22 are medial fragments. One of the blades is of particular interest because it has evidence of unifacial retouch, and the side is notched below the bulb of percussion for hafting. It is possible this tool was intended for bloodletting. In terms of visual sourcing, 12 pieces are of Ixtepeque origin, 20 are El Chayal, four are Ucareo, four are generally Mexican, four are probably Guatemalan, and eight are indeterminate. Seven pieces had a scratch platform, two had lightly ground platforms, and six had plain platforms.

Figure 14.13 Exhausted core from Chikin Chi'Ha (photo by A. Bazarsky).

Chulub

Located in the lower reaches on the southern tip of Crooked Tree Island, this site yielded 13 blades and one chunk (n=14). Of the blades, one is whole, one is a distal fragment, four are proximal fragments, and seven are medial fragments. Only two pieces are Ixtepeque while 12 are El Chayal. The chunk was originally part of a blade core but was later struck using casual percussion, causing it to become shatter. Three of the blades have scratch platforms and one has signs of rejuvenation.

Chumu'uk Ha

Located in the middle reaches north of Hats Kaab, this site yielded five blades, all from surface collection. There are two proximal, two medial, and one distal fragments. Only one piece was visually sourced to Ixtepeque. One blade had a pecked and ground platform, one had a plain platform, and one blade seemed to be a manufacturing error.

Crawford Bank

Located in the lower reaches on the eastern shoreline of Crooked Tree Island, this site yielded only one piece, a medial blade fragment.

Crooked Tree

Located in the lower reaches on the eastern shoreline of Crooked Tree Island, this site yielded 13 blades, all recovered via shovel test pit. Specifically, there is one whole blade and one proximal, five distal, and six medial fragments. Nine pieces were visually sourced to Ixtepeque, three to El Chayal, and one was indeterminate. Two blades had lightly ground platforms, one of which was also stunted.

Ek'tok

Located in the lower reaches, on the western bank of Western Lagoon, this site yielded 16 blades, one flake, one chunk, one core, and one biface (n=20). These pieces came mostly from excavation, but one piece was from surface collection and another was from a shovel test pit. The blades are split 50/50 proximal and medial fragments. One piece was sourced to El Chayal, nine to Ixtepeque, and 10 were unidentified. Two pieces have pecked and ground platforms, two have lightly ground platforms, and one had a scratch platform. The chunk seems to be from an exhausted core. The biface is in the shape of an arrowhead or spearpoint with notching (**Figure 14.14**). The bulk of the obsidian from this site represents reused tools and cores.

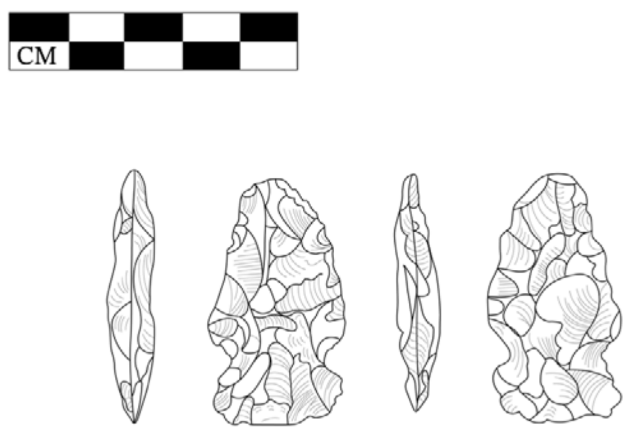

Figure 14.14 Bifacial tool from Ek'tok (image by A. Bazarsky).

Hats Kaab

Located in the middle reaches about 1.5 km north of Saturday Creek, this site has the third highest obsidian count at 119 pieces (see **Figure 14.2**). There are 80 blades, 28 flakes, six chunks, and five cores. Four pieces have cortex, four pieces have evidence of retouch, and one blade is first series (the only non-final blade in the entire BREA collection). Within the blade category, 4.4% are whole, 14.3% are distal, 39.6% are proximal, and 41.8% are medial fragments. All but two pieces were visually sourced: 93.1% (n=109) are El Chayal and 6.9% (n=8) are Ixtepeque. Some other notable features of the obsidian sample from this site are failed and stunted blades, very thin and light pieces, evidence of core recycling and bipolar reduction, step and hinge fractures, core rejuvenation marks, core reversal flakes (**Figure 14.15**), exhausted cores, three scratch platforms, and one pecked and ground platform. Taken together, the obsidian from Hats Kaab indicates that some production took place here, but the lack of finished products suggests that the tools were being used elsewhere.

Figure 14.15 Core reversal flake from Hats Kaab (photo by A. Bazarsky).

Homer's Head/Unnamed Site #4

Located in the middle reaches along Labouring Creek, this site yielded three blades and six cores (n=9), all from surface collection (**Figure 14.16**). Two blades are distal fragments while one is proximal. Four pieces were visually sourced to Ixtepeque, two are El Chayal, and 3 are indeterminate. There are three scratch platforms and one plain platform. All six cores are exhausted, and one core and one blade show evidence of the core reversal technique. Also, one core in particular on its ventral side had deep and rough flake/blade marks possibly indicating the core was reshaped into a tool.

Figure 14.16 Three cores from Homer's Head/Unnamed Site #4 (photo by A. Bazarsky).

Huum Chaak

Located in the middle reaches on the southern side of the Belize River, this site yielded 43 blades and one flake (n=44). 62.8% of those blades are medial fragments, 20.9% are proximal, and 16.3% are distal. Only 16 pieces were visually sourced and out of those 12 are Ixtepeque, three are El Chayal, and one was generally Guatemalan. Two blades have plain platforms, one has a scratch platform, and two have a pecked and ground platform. The single flake is the product of core rejuvenation.

Ik'nal

Located in the middle reaches, this site yielded 38 blades and one flake (n=39). There is one whole blade, three distal, 10 proximal, and 23 medial fragments. One of the blades is a corrective series blade. Nine pieces are Ixtepeque, one is El Chayal, and one is Pachuca; the rest could not be visually sourced. Three blades have a plain platform, two have lightly ground platforms, and one has a scratch platform. Other notable features of specimens from this site are thinning flakes, stunted and error blades, and one scrapper tool with visible use.

Jabonche

Located in the lower reaches along Black Creek, this site yielded 18 blades, two flakes, and one core (n=21). The specimens were from excavation and shovel test pits. Of the blades, there is one whole, three distal, seven proximal, and eight medial fragments. Nine specimen are Ixtepeque, one is El Chayal, and eight are indeterminate. At this site there are two bipolar worked pieces, one blade with a plain platform, four blades that have lightly ground platforms, and one error blade.

Kaacha'al Baat

Located in the middle reaches along Labouring Creek and west of Home's Head/Unnamed Site #4, this site yielded one obsidian specimen from surface collection. It is a medial fragment of a blade that appears to derive from the Ixtepeque source.

Kaax Tsaabil

Located in the middle reaches, this site yielded 24 blades. Three pieces are distal fragments, 10 are proximal, and 11 are medial. Four pieces appear to source to El Chayal while one comes from Ixtepeque. Six blades have a plain platform and three have lightly ground platforms.

Ma'xan

Located in the middle reaches, south of Saturday Creek, this site has the highest total obsidian count at 194 pieces. The pieces were collected from multiple contexts such as surface collection, shovel test pits, and traditional excavations. 91.8% of the pieces are categorized as blades, 5.2% are flakes, 1.5% are chunks, 1% are cores, and 0.5% are bifaces. There is one piece with cortex and one piece with visible retouch. Of the blades, five pieces are whole, 37 are distal, 55 are proximal, and 84 are medial fragments. Of the pieces that could be visually sourced, 70 are Ixtepeque, 22 are El Chayal, two are generally Guatemalan, five are possibly Central Mexican, and one is possibly Ucareo. There are 18 specimens with pecked and ground platforms, 17 with lightly ground platforms, and 2 with plain platforms. Other notable features of specimens in this assemblage are shatter, step and hinge fractures, stunted blades, and scrapper tools. There are many indications of recycling and reuse with physical signatures of exhausted core use, core reversal, other chunks and flakes used as cores, and platform rejuvenation. Ma'xan also has two particularly interesting pieces: the largest prismatic blade core in the entire BREA collection, and one of the two bifaces in the collection. The core is 108.03 mm long, 43.78 mm wide, 34.16 mm thick, and weighs 222.7 g. The core was found on the surface and has a chunk taken out of the side most likely from agricultural equipment (**Figure 14.17**). The biface was made from a macroblade and probably used as a handheld knife (**Figure 14.18**). It is 58.86 mm long, 31.88 mm wide, 15.84 mm thick, weighs 26 g, and has a cutting-edge length of 110.5 mm.

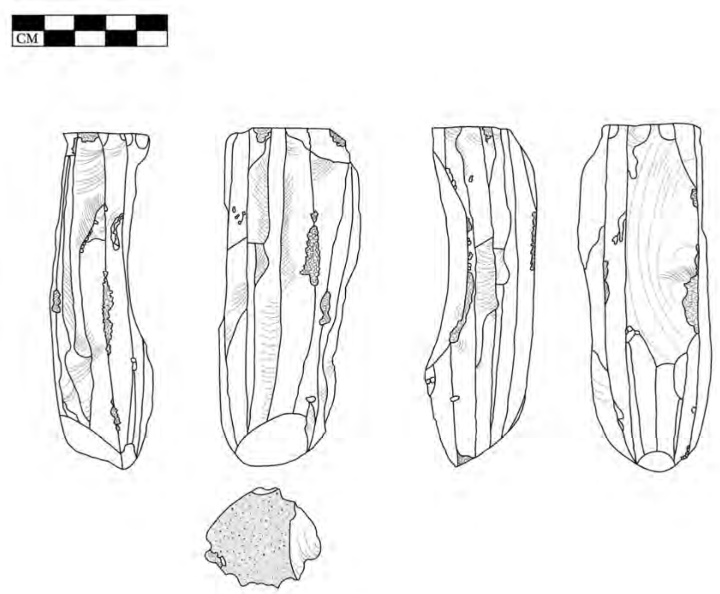

Figure 14.17 The large prismatic blade core from Ma'xan (drawing by A. Bazarsky).

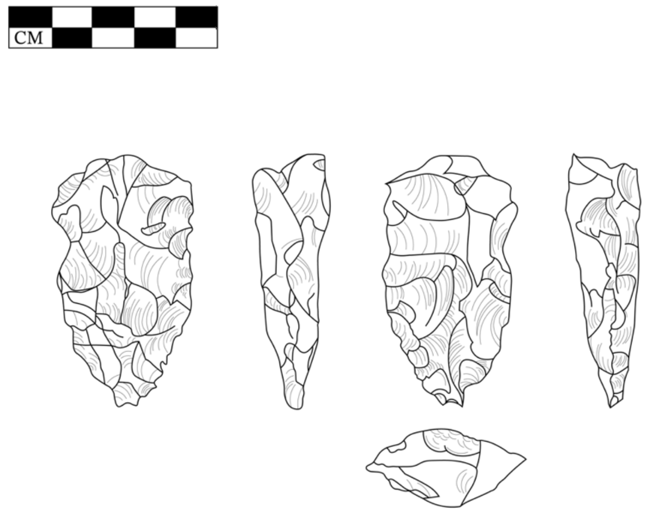

Figure 14.18 Bifacial tool from Ma'xan (drawing by A. Bazarsky).

McRae Stallworth

Located in the middle reaches near Saturday Creek, this site yielded two medial blade fragments, neither of which could be sourced.

More Tomorrow

Located in the middle reaches, this site yielded 12 blades, one of which is whole, and three of which are proximal, three medial, and 5 distal fragments. Of the specimens that could be visually sourced, five are Ixtepeque and one is El Chayal. Two of the blades have pecked and ground platforms.

Najil Iik

Located in the lower reaches, this site yielded 27 blades. Two are whole, two are distal, eight are proximal, and 15 are medial fragments. Visual sourcing suggests 22 are El Chayal, four are Ixtepeque, and one is indeterminate. Five specimens have lightly ground platforms, one has a scratch platform, one is a stunted blade, one blade is from a small, exhausted core, one has abrading or overhang, one is a scrapper tool, and one is a medial blade that was recycled as a bipolar core and then crunched at both ends leaving telltale flake scars. Interestingly, a distinctive platform preparation technique was used by obsidian workers at this site, known as "Mayapan style" platforms (see left side image in **Figure 14.12**).

Otley's Flat

Located in the middle reaches near Saturday Creek, this site yielded 48 obsidian specimens, 46 of which are blades and two of which are flakes (**Figure 14.19**). One blade has cortex and one flake has evidence of retouch. Four blades are distal fragments, 18 are proximal, and 24 are medial. Six specimens have scratch platforms, five have plain platforms, three have pecked and ground, and one is lightly ground. Other notable features of the specimens from this site are hinge and step fractures, stunted blades, very thin and light fragments, and evidence of flake bifacial retouching and resharpening. Visually, there is one piece of Pachuca, one piece generally Mexican, 24 are El Chayal, 16 are Ixtepeque, two are either El Chayal or San Martin Jiltopeque, and one is either Mexican or El Chayal.

Figure 14.19 One flake from Otley's Flat that appears to be of Pachuca origin (green in hue; photo by A. Bazarsky).

Penner/Ma'kaax

Located in the middle reaches, this site yielded one specimen of obsidian from surface collection. It is a proximal blade with a plain platform. It may be of Mexican origin.

Saturday Creek

Located in the middle reaches, this site yielded the second highest obsidian count at 121 specimens. There are 110 blades, eight flakes, two chunks, and one core. Within the blades there are six whole, 12 distal, 44 proximal, and 50 medial fragments. One flake has visible retouch. Only 52% (n=63) of the sample could be visibly sourced, of which 49.2% (n=31) is from Ixtepeque, 36.5% (n=23) from El Chayal, 6.3% (n=4) from Guatemala generally, 1.6% (n=1) from Ucareo, and 6.4% (n=4) indeterminate. Fifteen pieces have pecked and ground platforms, five have plain platforms, three have lightly ground platforms, two have scratch platforms, and three have noticeably small platforms. Some notable features from this site are multiple instances of core reversal, stunted blades, evident hinge and step fractures, shatter, a thinning flake, and a scrapper.

Site 47

Located in the middle reaches close to More Tomorrow, this site yielded four pieces, all blades, half of which are distal fragments and the other half are medial. All pieces were visually sourced to Ixtepeque, and one piece had interesting and evident sediment inclusions.

Site 49/Ch'uul'ook

Located in the middle reaches southwest of Ik'nal, this site yielded 11 blades. Three of these are proximal fragments, seven medial, and one distal. Four pieces could not be visually sourced, although three seem to be from El Chayal, three are Ixtepeque, and one was indeterminate. One blade had a lightly ground platform and two had noticeably small platforms.

Spanish Creek/North Xaman

Located in the middle reaches, this site contained two blades found via surface collection–one proximal and one distal fragment. The proximal piece is possibly from a Mexican source and has a plain platform. The distal piece is El Chayal.

Spanish Creek/Kahal Tuucha'

Located in the middle reaches, this site yielded one proximal blade from surface collection. It is probably Ixtepeque and has a pecked and ground platform.

Unspecified

These are obsidian specimens recovered from various surface collection locations. Just under half of the pieces have a GPS point anchoring their provenience. The other pieces have unfortunately lost their provenience. There are 20 blades, one core, and one flake (n=22). Of these, 14.3% are distal fragments while medial and proximal fragments each make up 42.9%. Three blades have scratch platforms, one has a plain platform, two have pecked and ground platforms, two have lightly ground platforms, and one had a noticeably small platform. Additionally, one blade suggests core reversal. The flake is whole. The pieces that could be visually sourced are all Guatemalan with over 70% being Ixtepeque and the rest belonging to El Chayal.

Unnamed Site #1

Located in the middle reaches, this site yielded two specimens from surface collection. Both are medial blades. One piece is possibly of Mexican origin while the other is probably Guatemalan.

Unnamed Site #5

Located in the middle reaches, this site yielded one piece from surface collection. It is a medial fragment of a blade. Visually, it appears to be from the Ucareo or other Central Mexican source.

Wade Bank

Located in the lower reaches, this site yielded four distal end blades and one chunk (n=5). Three pieces are Ixtepeque, one is El Chayal, and one piece could not be identified. The chunk seems to have been used as a bipolar core before being worked with bipolar techniques.

Waxak Nicte

Located in the lower reaches, this site yielded seven blades—five medial fragments, one proximal fragment, and one whole blade. Visual sourcing indicated that five are El Chayal, and two are Ixtepeque. The complete blade is small, stunted, and has a scratch platform.

Xtabentun

Located in the lower reaches, this site yielded 24 blades, one flake, and one chunk (n=26). Out of the blades, 56% were medial fragments, 32% proximal, and 12% distal. Based upon visual sourcing, most pieces seem to be from Ixtepeque (n=11) and El Chayal (n=11). There are two pieces which could be from the San Martin Jiltopeque source. There are five blades with a pecked and ground platform, and one blade with a scratch platform.

Yaxche Nal

Located in the middle reaches, this site yielded two pieces from surface collection. They are both final series prismatic blades. One is a medial fragment while the other is a distal end. Visual sourcing suggests both are Ixtepeque. One blade also has signs of visible use with flake scars on the side indicating it might have been used as a scrapper tool.

XRF Results (by T. Tibbits)

A subsample of 751 obsidian specimens were shot in the field with an Olympus Vanta-C handheld XRF instrument, and compared to the PYRO and MURR source and archaeological collections to determine provenance. Overall, 113 specimens were too small or thin to be shot and were thus excluded.

A few clear trends emerge: El Chayal dominates the assemblage at 65% of the total obsidian recovered thus far by the BREA Project (**Figure 14.20**). Ixtepeque is the second most common source, comprising 34% of the obsidian in this sample. San Martin Jilotepeque makes up a scant 1%, followed by just a few pieces of Otumba (n=1), Zaragoza (n=1), and Zacualtipan (n=2). Notably, none of the obsidian analyzed with the XRF sourced to the Ucareo or Pachuca deposits.

Another trend is that the middle reaches obsidian exhibits greater source location variation than lower reaches obsidian. **Table 14.1** displays some of this variety. Six sites have obsidian from three sources: Chikin Chi'Ha, Chumu'uk Ha, Hats Kaab, Ik'nal, and Otley's Flat. Ma'xan is the only site with more than three obsidian sources present, including Ixtepeque, El Chayal, San Martin Jilotepeque, and Zacualtipan. By contrast, the lower reaches assemblages are more uniform. Apart from Jabonche, the lower reaches assemblage displays a very similar proportion of sources.

The unknown readings on specimen from Otley's Flat and Crooked Tree may be the product of XRF shot errors; further shots are needed to explore this possibility.

Blades—by far the most common tool type present in this dataset—display the most variety in identified sources (**Figure 14.21**). The middle reaches have blades from San Martin Jilotepeque (n=8) and Ucareo (n=1), as well as six artifacts that could not be attributed to a source location with reasonable certainty. The remainder come from Ixtepeque, with n=223 from the middle reaches and n=35 from the lower reaches, and El Chayal, with n=353 in the middle reaches and n=60 in the lower reaches.

As mentioned above, two pieces from this assemblage were identified as bifaces. They are both made of Ixtepeque obsidian; one was recovered from Ma'xan in the middle reaches and the other was from Ek'tok from the lower reaches. Regarding cores, the majority (88%) source to El Chayal (n=15); only 11.8% (n=2) source to Ixtepeque. Of those 17 cores, 15 (88%) were recovered from sites in the middle reaches. Flakes source to El Chayal or Ixtepeque, and again, the majority derive from the middle reaches (n=39, lower reaches n=4).

When we compare results of the visual sourcing to the XRF sourcing, we can see that the visual sourcing is indeed not very accurate (**Figure 14.22**). Visual sourcing only correctly identifies El Chayal about half of the time—XRF indicates that 65% of the assemblage is El Chayal but visual sourcing indicates only 32%. Visual sourcing was slightly more accurate with the Ixtepeque specimens (32% according to XRF vs. 28% according to visual). Only one specimen (0.1%) appears to have a Zacualtipan signature according to the XRF analysis although visual sourcing suggested eight specimen were Ucareo or Pachuca. Visual sourcing did not identify any Otumba or San Martin Jilotepeque.

Figure 14.20 Top: XRF signatures of archaeological obsidian collected by the BREA project; Bottom: XRF signatures of source and archaeological specimens from PYRO and MURR reference sets (image by T. Tibbits and M. Brouwer Burg).

Table 14.1 Count and percentages of obsidian source derivation from BREA sites.

Site	El Chayal	Ixtepeque	San Martin Jilotepeque	Other	Unknown	Total count
Middle Reaches						
Chikin Chi'Ha	N=46, 90%	N=4, 8%	-	N=1, 2% (Otumba)	-	51
Chumu'uk Ha	N=1, 60%	N=3, 60%	-	N=1, 20% (Zaragoza)	-	5
Hats Kaab	N=89, 79%	N=19, 17%	N=4, 3.5%	-	-	112
Unnamed site #4	N=1, 17%	N=5, 83%	-	-	-	6
Huum Chaak	N=19, 45%	N=23, 55%	-	-	-	42
Ik'nal	N=17, 45%	N=20, 53%	N=1, 3%	-	-	38
Kaax Tsaabil	N=22, 92%	N=2, 8%	-	-	-	24
Ma'xan	N=103, 54%	N=82, 43%	N=3, 1.5%	N=2, 1% (Zacualtipan)	-	190
More Tomorrow	N=3, 27%	N=8, 72%	-	-	-	11
Otley's Flat	N=40, 83%	N=7, 15%	-	-	N=1, 2%	48
Saturday Creek	N=70, 69%	N=31, 31%	-	-	-	101
Total count	**411**	**204**	**8**	**4**	**1**	**628**
Lower Reaches						
Chulub	N=11, 79%	N=3, 21%	-	-	-	14
Crooked Tree	N=5, 38%	N=7, 54%	-	-	N=1, 8%	13
Ek'tok	N=15, 75%	N=5, 25%	-	-	-	20
Jabonche	N=5, 24%	N=16, 76%	-	-	-	21
Najil Iik	N=14, 58%	N=10, 42%	-	-	-	24
Waxak Nicte'	N=3, 60%	N=2, 40%	-	-	-	5
Xtabentun	N=21, 81%	N=5, 19%	-	-	-	26
Total count	**74**	**48**			**1**	**123**
Grand Total	**485, 65%**	**252, 34%**	**8, 1%**	**4, 0.5%**	**2, 0.2%**	**751**

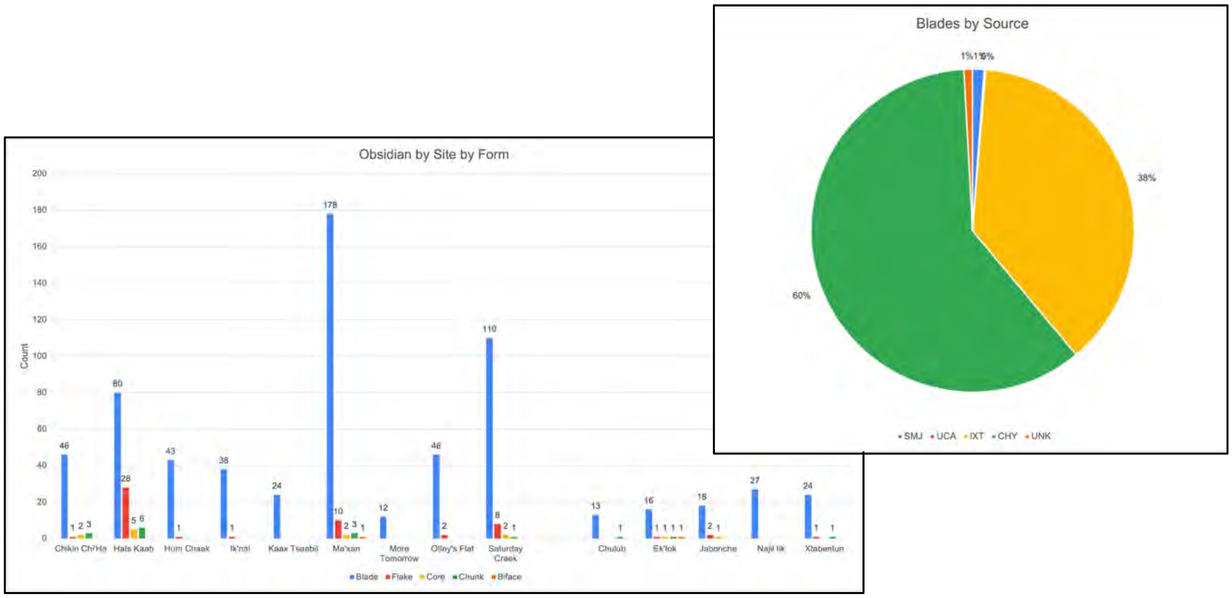

Figure 14.21 Source derivation of blades found in the assemblage. Note: SMJ = San Martin Jilotepeque, UCA = Ucareo; IXT = Ixtepeque; CHY = El Chayal; UNK = Unknown (images by M. Brouwer Burg).

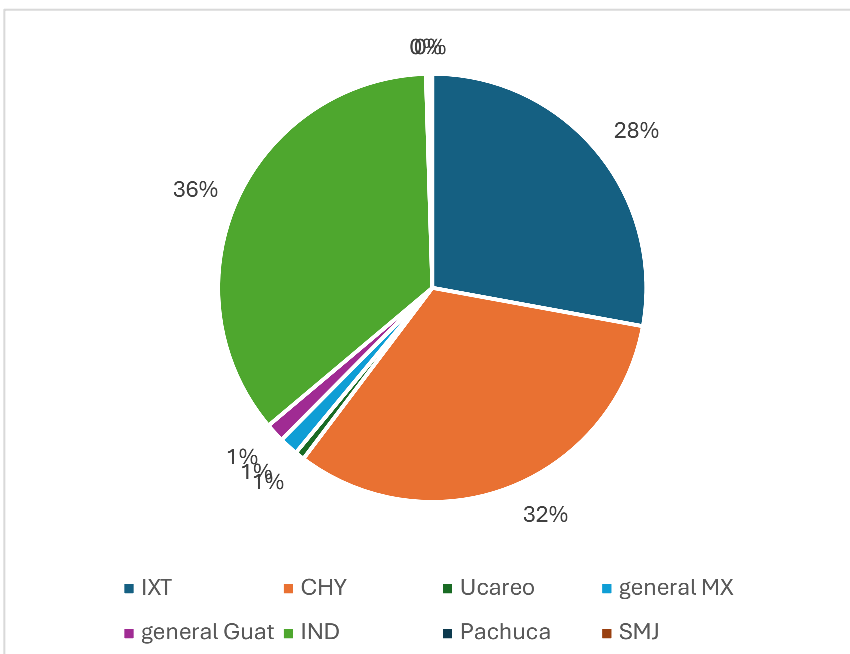

Figure 14.22 Results of visual sourcing. Note: SMJ = San Martin Jilotepeque, UCA = Ucareo; IXT = Ixtepeque; CHY = El Chayal; UNK = Unknown (analysis by A. Bazarsky; image by M. Brouwer Burg).

Discussion and Conclusions

There are a few key themes that emerge from our consideration of the attribute and typological descriptions of obsidian specimens from each site, along with the XRF data. First, there is very little evidence to suggest that much primary or secondary production was occurring in the middle or lower reaches of the Belize River Valley. Only a handful of sites yielded cores and flakes (see **Figure 14.8**); overall, blades are the most prevalent artifact type and suggest that these tool forms were transported in their finished or near-complete form. Production debris (including cores, flakes, and chunks) is scarce overall, found primarily from sites lying within a 5 km radius of one another in the middle reaches (e.g., at Chikin Chi'Ha, Hats Kaab, Ma'xan, and Saturday Creek) and at Ek'tok and Jabonche in the lower reaches. We suggest that the area around Saturday Creek may have been a locus of production-related activities and perhaps served as a regional obsidian distribution center, made possible by proximity to the Belize River. Ek'tok lies near the large Maya center of Chau Hiix, where undoubtedly some obsidian was worked. Jabonche, along Black Creek, may have been a distribution center for the easternmost section of the lower reaches. The site of Ma'xan, in particular, contained the highest concentration of obsidian and source variability, suggesting integration into a large obsidian exchange network.

The second key finding is that the majority of obsidian derives from the El Chayal and Ixtepeque sources. Only 3% of the sample derives from central Mexican sources, suggesting that the greater distance to these sources prevented large flows of obsidian into the middle and lower reaches of the Belize River Valley. Yet, some pieces did make their way into this area, a distance of over 1000 km. How this transportation occurred is not fully known, although it has been suggested that trade took place along the coastline via canoe (Stemp et al. 2011). The only sites with San Martin Jilotepeque obsidian (considered by McKillop [2004] to date to the middle Preclassic) are Hats Kaab, Ik'nal, and Ma'xan (**Tables 14.1** and **14.2**). This accords with the architecture of Hats Kaab, which contains an E-Group architectural arrangement indicative of Preclassic building preferences. Ma'xan, too, contained some ceramics that appeared to date to Preclassic times. We assume that, were we to conduct deeper excavations at Saturday Creek, Late Preclassic signatures would be found. Lucero (pers. comm.) indicated that some Late Preclassic ceramic types were found at that site. By contrast, a Preclassic obsidian source signature at Ik'nal contradicts the architecture of the site; the circular structure here is typically associated with the Terminal Classic period.

What is clear is that sites throughout the middle and lower reaches of the Belize River Valley maintained a strong connection to the El Chayal source for many centuries—likely from Late Preclassic through Late Classic times—with an Ixtepeque presence emerging during the Late Classic to Terminal Classic. Additionally, we see a similar trend in increased obsidian source diversity by the Terminal Classic and Postclassic, as suggested by McKillop (2004), especially at the sites of Chumu'uk Ha (Terminal Classic-Postclassic), Huum Chaak (Late Classic/Terminal Classic), Ik'nal (Late Classic/Terminal Classic), Jabonche (Terminal Classic/Postclassic), and More Tomorrow (Terminal Classic/Postclassic). At Huum Chaak and Ik'nal, circular structures have been identified and investigated. This architectural arrangement is typically associated with Terminal Classic occupation. At Jabonche and More Tomorrow, traces of possible columnar architecture have been identified, suggesting a stylistic connection with the architectural trends of the Yucatan. These findings also bolster McKillop's (2004) suggestion that during the Terminal Classic and Postclassic periods, there were more open avenues for trade that allowed for greater variability in raw material and finished products.

Third, this work has revealed that sites in the lower reaches of the Belize River Valley had comparatively fewer obsidian specimens than sites in the middle reaches. We do not yet have a clear understanding of why this is—could it be related to the greater distance of these sites from the production nexus around Saturday Creek? If obsidian from the Guatemalan highlands was being transported overland and down the Belize River, this paucity could be the result of a simple distance-decay trend. However, sites in the lower reaches are closer to the coast and thus we might expect to find greater numbers and varieties of central Mexican obsidian here, at least in Terminal Classic and Postclassic contexts. Additionally, we must consider that the lower reaches are situated near or within the Norther Belize Chert Bearing Zone (NBCZ; Shafer and Hester 1991; Brouwer Burg and Harrison-Buck 2024) and that the local abundance of chert—which can also be fashioned into very sharp and durable cutting tools—may have obviated the need to import large amounts of obsidian. In the lower reaches, it is possible that obsidian was valued differently than in the middle reaches, where high quality local tool stone is not readily available.

Overall, the obsidian collection from the BREA study area reveal some preliminary insights about obsidian exchange in the middle and lower reaches of the Belize River watershed, but also pose many new questions. The obsidian pieces are overwhelmingly comprised of Guatemalan sources, which is not divergent from most other ancient Maya sites in Belize. Notably, the two 'formal' bifacial tools are Ixtepeque in origin. Additionally, sites in the middle reaches, around Saturday Creek, display the most convincing evidence of production. Taken together, it appears that the mid-to-lower reaches of the Belize River Valley were involved in the Guatemalan obsidian trade economy from the Late Preclassic through Terminal Classic periods, and that exchange likely followed a west to east conduit, perhaps making use of the Belize River for transportation. Later, from the Terminal Classic through Postclassic, there is a slight increase in source variety, including some pieces from central Mexican sources which likely arrived via a coastal route. This suggests that trade networks became more open and expansive during this time.

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Chapter 15

Analysis of Chipped Stone Artifacts from Ops. 51, 57, 58, 59, 61, and 62, STP Series 035, and Surface Collection at Crawford Bank

W. James Stemp

Introduction

This report summarizes the results of the analysis of the chipped stone tools excavated from operations (Ops.) 51, 57, 58, 59, 61, and 62 at Crawford Bank, Crooked Tree, Belize, by the Belize River East Archaeology (BREA) project between January 2020 and Summer 2022 (see Brouwer Burg 2022:49-73; Brouwer Burg 2023:114-147). Overview results from STP Series 035 and surface collection are provided at the end of this report. A total of 1,615 stone artifacts were analyzed in terms of raw material, metrics, and technology. Additionally, use-wear analysis was conducted on a portion of the 1,083 chipped stone artifacts from Op. 51. The lithic artifacts were recovered from aceramic contexts. Three radiocarbon dates from strata located 62-65 cmbd in Op. 57 yielded historic to modern dates (200 +/- 30 BP or 1720-1780 cal CE; see Brouwer Burg 2023:128), underscoring the extreme amount of sediment mixing that has occurred along the Crooked Tree lagoon shoreline. However, the artifacts described below are considered to be preceramic based on the absence of pottery in the units from which they were recovered and the presence of some tool types similar to those recovered from other preceramic contexts in Belize (see below).

Raw Materials

The lithic assemblage from the six operations at Crawford Bank consists of 1,603 (99.3%) cryptocrystalline silicates (chert or chalcedony) and 12 (0.7%) limestone artifacts (**Figure 15.1**). Of the cryptocrystalline silicate chipped stone artifacts, 561(35.0%) were identified as chert from the Northern Belize Chert-bearing Zone (NBCZ) based on their fine texture and characteristic banding and/or mottling and colors ranging from yellow/gold, honey brown, grayish brown, tan, to gray (Hester and Shafer 1984:164; Mitchum 1994:54; Shafer and Hester 1983:521; see McAnany 1989:334). This high-quality chert is distributed throughout Northern Belize in what were once called the ‘flint bearing soils’ (Wright et al. 1959) of central Northern Belize but is typically referred to now as the ‘chert-bearing zone’ (Shafer and Hester 1983; Hester and Shafer1984:158-159; also see Cornec 1985) that contains Colha and other lithic workshops nearby (e.g., Chicawate, Kunahmul, Maskall, and Sand Hill). In addition to Colha and neighboring workshops, NBCZ chert has been found at many Maya sites throughout mainland Northern Belize, as well as on Ambergris Caye, in the form of finished tools and debitage (e.g., Dockall and Shafer 1993; Hult and Hester 1995; Lewenstein 1987; McAnany 1989; McSwain 1991; Mitchum 1991; Mock 1997; Shafer 1983; Speal 2006, 2009; Stemp 2001, 2004; Stemp and Graham 2006). A number of preceramic bifaces and constricted unifaces have also been made from NBCZ chert, in addition to cores and flakes at preceramic sites (see Iceland 1997; Lohse 2010; Rosenswig et al. 2014; Stemp et al. 2016, 2018; Stemp and Harrison-Buck 2019; Stemp and Rosenswig 2022).

In addition to NBCZ chert, 80 (5.0%) chipped stone artifacts were made from medium-fine- to coarse-grained cherts that were primarily brown and gray in color, some of which were semi-translucent. A few have banding. They tended to have variable amounts of microvoids and small inclusions. It is not known where these cherts originate, but minimally they can be differentiated from the better quality NBCZ material. It is suspected that these are local cherts from the Crooked Tree area. It is possible that some may have come from further afield. Some of the coarser-grained cherts may be from around Northern River Lagoon (Mock 1997), Rocky Point (Kelly 1982), Midwinter Lagoon (Stemp 2001), Saktunha/Cabbage Ridge (Speal 2006, 2009), or near Laguna de On (Masson 1993, 1997; Oland 1999; see Paris 2012:114-115, Fig. 1 for the "Cryptocrystalline Pebble Zone")

There were 24 (1.5%) chalcedony artifacts recovered. The chalcedony artifacts possessed a whitish-gray, porous cortex and the stone itself had a fibrous texture and was variably translucent brown/honey and yellow in color. The chalcedony recovered from these sites may have come from the limestone facies north of the NBCZ, across the Freshwater Creek and New River faults (Hester and Shafer 1984:158), near Orange Walk Town (Hester and Shafer 1984:160), or around Laguna de On (Oland 1999:105, Table 1; see Paris 2012:114-115, Fig. 1 for the "Cryptocrystalline Pebble Zone")

Most of the chipped chert or chalcedony artifacts (938 or 58.5%) were classified as "indeterminate" in terms of chert type due to the significant burning and/or patination of the raw material. Burning changed both the internal and external structures and the colors of the stone with pink, gray, red, white, and black variously occurring (based on the intensity and/or degree of burning). Burnt chert was also recognized based on one or more structural changes of the raw material, including fracture into angular chunks, potlids, crazing, calcination, and a change in luster to a greasy/shiny 'gloss' (Luedtke 1992:97, 106; Mandeville 1973:183; see Clemente-Conte 1997; Purdy 1974). The patinas that developed on the tools included 'black' patination/oxidation, glossy patination, and white patination based on the specifics of the chemical interactions with the environments in which they were found (Cackler et al. 1999; Glauberman and Thorson 2012: Howard 2002; Hult and Hester 1995; Lévi-Sala 1986: 230, 240, 1993; Luedtke 1992:99-100; Plisson and Mauger 1988; Purdy and Clark 1987:232; Rottländer 1975; Stapert 1976:12; Stemp 2001:28-29; Thiry et al. 2014). Patinas altered the surface color and/or surface textures of the artifacts. Artifacts with white patinas possessed variably porous microsurfaces and yellowish-white to white coloration. Those with 'black' patinas tended to range from glossy to matte and smooth in surface textures. Glossy patinas created very smooth and lustrous surfaces, but did not, in and of themselves, alter the surface coloration of the cherts. Artifacts with glossy patinas do not seem to develop white or 'black' patinas.

The 12 limestone artifacts were dolomitic and likely came from areas in or around Crawford Bank. In some cases, the limestone was very similar to coarse-grained chert. Like the cherts, the limestone tended to be badly burnt.

Tool Types and Production Technology

Of the 1,615 chipped artifacts excavated from Ops. 51, 57, 58, 59, 61, and 62 at Crawford Bank, 22 (1.4%) were classified as 'formal' tools (**Table 15.1**). The 'formal' tools consist of 4 thin biface fragments (**Figure 15.2**), 2 thick biface fragments, either a poorly made thick biface or a biface preform (**Figure 15.3**), 7 edge fragments from small bifaces/celts (**Figure 15.4**), 1 macroblade fragment, 2 unifacially retouched macroblade fragments (**Figures 15.5 and 15.6**), 3 pointed unifaces (the distal ends of retouched macroblades) (**Figure 15.7**), 1 whole blade (**Figure 15.8**), and 1 blade fragment. Most of these tools (12 or 54.5%) were made from NBCZ chert, 2 (9.1%) were produced from other chert and the remining 8 (36.4%) were indeterminate chert (some of which are also likely NBCZ chert) or chalcedony that cannot be identified visually due to post-depositional alteration). Many of the tool types in this report are similar to those described for the Archaic period in Belize (Iceland 1997; Lohse et al. 2006: 222, Fig. 8; Stemp et al. 2021:418-420) and are similar to some of those recovered from excavations at Crawford Bank in 2017 (Stemp and Harrison-Buck 2019). Based on the debitage recovered, specifically the bifacial thinning flakes and the lack macroflake or macroblade cores, it seems unlikely that bifaces and microblade tools were produced at Crawford Bank (see below). At least some blades may have been locally produced given the recovery of a single NBCZ chert blade core with multiple unidirectional blade scars originating from the striking platform and perhaps some crude bifaces (see below).

Table 15.1 Formal tools by raw material types from Ops. 51, 57, 58, 59, 61, and 62.

Tool type	NBCZ chert	Other chert	Chalcedony	Indeterminate chert	Limestone
Thin bifaces	1	1[a]	-	2	-
Thick bifaces/celts	1	-	-	1	-
Thick biface/celt preforms	-	1	-	-	-
Biface edges	3	-	-	4	-
Macroblades	1	-	-	-	-
Retouched macroblades and pointed unifaces (unifacial)	4	-	-	1	-
Blades	2	-	-	-	-
Total	**12**	**2**	**0**	**8**	**0**

[a]Serrated thin biface; partial beveling from pressure flaking/retouch.

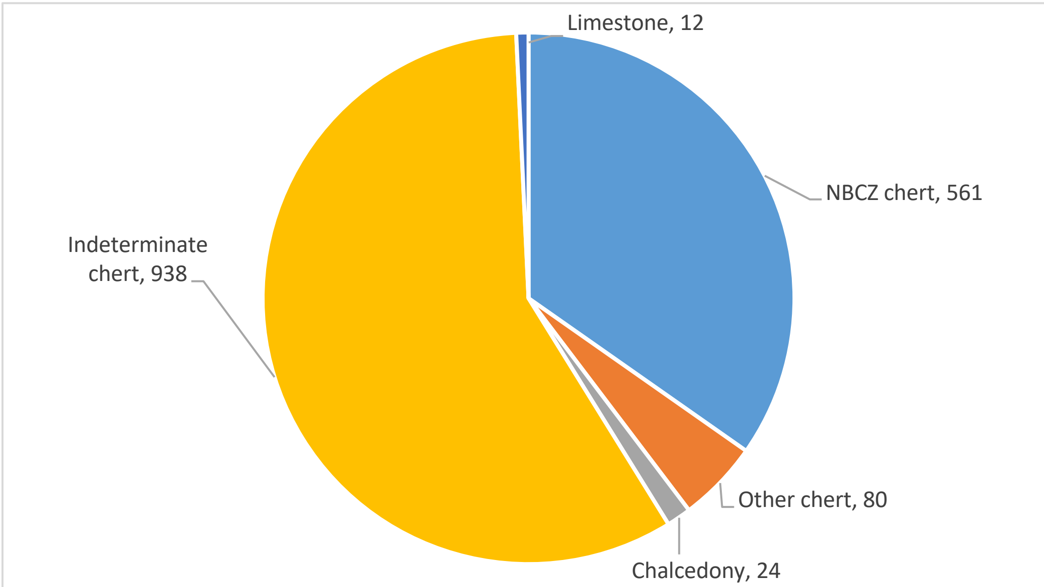

Figure 15.1 Number of lithic artifacts by raw material type from Ops. 51, 57, 58, 59, 61, and 62 (image by W. J. Stemp).

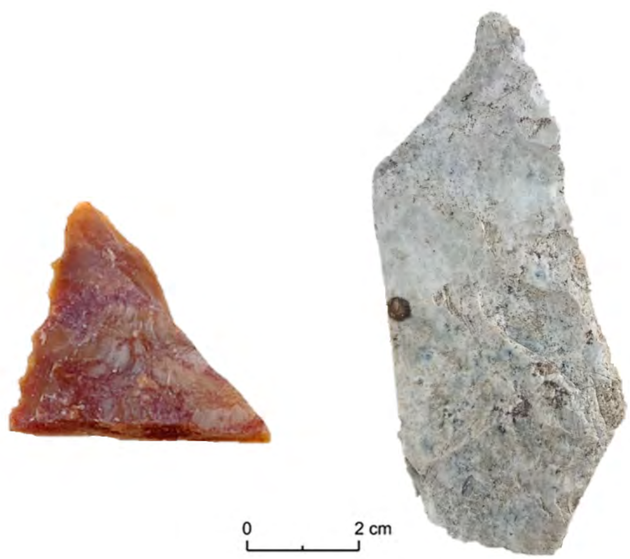

Figure 15.2 A serrated thin biface fragment from Op. 51 (left) and a thin biface fragment from Op. 57 (right; photos by W. J. Stemp).

Figure 15.3 A crude thick biface fragment from Op. 58 (photo by W. J. Stemp).

Figure 15.4 Two biface edge flakes from Op. 51. Note: The biface edge flake on the right is burnt (photos by W. J. Stemp).

Figure 15.5 A nearly complete retouched macroblade [four fragments] from Op. 61 (photo by W. J. Stemp).

Figure 15.6 A retouched proximal macroblade fragment STP 035-F4. Note: The white patina on the microblade fragment (photo by W. J. Stemp).

Figure 15.7 A distal retouched macroblade fragment [pointed uniface] from Op. 62 (left) and a refit medial retouched macroblade fragment [pointed uniface] from STP 035-D19 (right). Note: The fragments both have 'black' patination (photos by W. J. Stemp).

Figure 15.8 A whole blade with a hinge termination from Op. 51. Note: The blade has some 'black' patination from manganese oxidation (photo by W. J. Stemp).

Of particular note is the medial thin biface fragment recovered in Square M, Zone 20 of Op. 51 (LCB 11085-7; **Figure 15.2**, left). The biface fragment is made from medium/fine-grained brown, semi-translucent chert. The chert has a 'fibrous' texture reminiscent of chalcedony. Red portions of what appear to be slightly coarser material are the product of texture and color changes due to exposure to fire, although this is not thought to be deliberate heat-treatment of the raw material. The raw material most likely comes from Northern Belize; however, it is not the typical fine-grained variety from the NBCZ proper. Technologically, the biface demonstrates flake scarring consistent with bifacial flaking using a 'softer'-hammer and the edge is partially serrated using pressure-flaking. This edge retouch is unifacial on the dorsal surface of the tool and creates a bevel on a portion (about half) of the biface's edge. Given the general size and production technology of this medial fragment, it is possible that it was part of a preceramic stemmed biface, such as a Lowe point. However, without additional diagnostic features, such as the Lowe point's wide stem with basal thinning, corner-notching, or a large barb, it is difficult to say for certain (Kelly 1993; Lohse et al. 2006; Stemp and Awe 2013; Stemp et al. 2016).

The rest of the assemblage from excavations in Ops. 51, 57, 58, 59, 61, and 62 at Crawford Bank consists of different types of debitage (1593 or 98.6%; **Table 15.2**). The majority of the pieces have not been modified into specific types of tools (see Iceland 1997 for lack of retouched tools in the preceramic of Northern Belize); however, there were 4 unifacially retouched non-cortical flakes (**Figure 15.9**), 1 unifacially retouched cortical flake, 1 unifacially retouched flake-blade, and 4 unifacially retouched blocky fragments recovered. These artifacts were all retouched on the dorsal surface using hard-hammer percussion. The edge angles of all the retouched flakes and flake-blade are generally acute (<45^{o}); whereas 2 of the retouched blocky fragments' edges were acute (<45^{o}) and 2 were about 50-55^{o}. In addition to the retouched flakes, there were 910 (57.1% of all debitage) hard-hammer flakes, including flake-blades (**Figure 15.10**). Three macroflakes [2 cortical and 1 non-cortical] were also recovered (**Figure 15.11**).

Table 15.2 Informal tools/debitage by raw material from Ops. 51, 57, 58, 59, 61, and 62.

Tool type	NBCZ chert	Other chert	Chalcedony	Indeterminate chert	Limestone
Flakes – 100% cortex	4	3	0	22	-
Flakes – >50% cortex	15	3	3	22	-
Flakes – <50% cortex	70	9	2	74[b]	2
Flakes – 0% cortex	235[a]	34	6	383[c]	4
Flake-blades – >50% cortex	1	-	-	-	-
Flake-blades – <50% cortex	4	1	-	1	-
Flake-blades – 0% cortex	7	1	1	3	-
Retouched flake-blades - >50% cortex	-	-	-	1	-
Bifacial thinning flakes – >50% cortex	-	-	1	1	-
Bifacial thinning flakes – <50% cortex	2	-	-	2	-
Bifacial thinning flakes – 0% cortex	30	-	-	21	-
Bifacial thinning pressure flakes – 0% cortex	1	-	-	1	-
Biface edge retouch/repair flakes – 0% cortex	2	-	-	11	-
Uniface edge retouch/repair flakes – <50% cortex	1	-	-	1	-
Uniface edge retouch/repair flakes – 0% cortex	1	-	-	8	-
Retouched flakes (unifacial) – >50% cortex	1	-	-	-	-
Retouched flakes (unifacial) – 0% cortex	3	-	-	1	-
Macroflakes - <50% cortex	1	1	-	-	-
Macroflakes - <0% cortex	-	1	-	-	-
Microdebitage (<3.0 mm x 3.0 mm)	88	4	1	30	-
Simple flake cores	18	4	2	15	-
Bifacial/discoidal flake cores	1	1	-	-	-
Blade cores	1	-	-	-	-
Simple flake cores/hammerstones	-	1	-	-	-
Blocky fragments	59	12	8	256	6
Retouched blocky fragments (unifacial)	2	1	-	1	-
Potlids and burnt fragments	2	1	-	76	-
Cobble	-	1	-	-	-
Total	**549**	**90**	**24**	**930**	**12**

[a]Two flakes are from bifaces/celts, but they are not bifacial thinning flakes.
[b]Two flakes could be refit.
[c]Two flakes are from bifaces/celts, but they are not bifacial thinning flakes.

Figure 15.9 A distal retouched flake fragment from Op. 51. Note: The white patina on the flake fragment (photo by W. J. Stemp).

Figure 15.10 Debitage from Op. 51. Note: 'Black' patination, white patination, and burning on some artifacts (photos by W. J. Stemp).

Figure 15.11 A macroflake from Op. 62. Note: 'Black' patination and white patination (photo by W. J. Stemp).

In all, the hard-hammer retouched and non-retouched flakes and flake-blades were mostly made from 'indeterminate' chert (507 or 55.3%). The rest were produced from 340 (37.1%) NBCZ chert, 51 (5.6%) other chert, 12 (1.3%) chalcedony flakes, and 6 (0.7%) limestone flakes. The numbers of cortical and non-cortical flakes varied by raw material type, but there is a full range of reduction debitage for the cherts and chalcedonies (**Figure 15.12**). There are no statistically significant differences in the numbers of cortical versus non-cortical NBCZ and 'indeterminate' chert flakes (x^2 = 1.60552, p >0.05) suggesting that similar reduction processes are represented. The data tend to support the belief that a majority of the 'indeterminate' chert was, in fact, originally NBCZ material before patination and/or burning. The percentages of cortical-to-non-cortical flakes, as well as the presence of cores, core fragments, and blocky fragments (some cortical) indicate that *ad hoc*/expedient flake production occurred at Crawford Bank and is the main form of reduction there. The cores and/or cores fragments [including a bifacial core] of NBCZ chert, other chert, and chalcedony provide evidence for local reduction of these three types of raw material at the site (**Figure 15.13** and **15.14**). The sizes of the flakes indicate a fairly wide range, but at least some cores were quite large. Based on the flakes with cortex, specifically the primary (100% cortex) flakes, the NBCZ cores were likely brought to Crawford Bank at least partially decorticated. With the exception of some biface repair (see below), almost all of the reduction was the result of hard-hammer percussion. This is supported by the relatively few thinning flakes, the flat and cortical platforms observed on the whole flakes and proximal flake fragments (**Table 15.3**) and the high percentages of hinge terminations on the whole flakes and distal flake fragments (**Table 15.4**). Further evidence against local biface production is that there was a total of 974 flakes, including flake-blades and bifacial thinning flakes (see below), for all raw material types from Ops. 51, 57, 58, 59, 61, and 62 at Crawford

Bank. Based on experimental data for Classic Maya biface production, a single biface might produce somewhere between 748-884 flakes (Whittaker et al. 2009:147, Fig. 9).

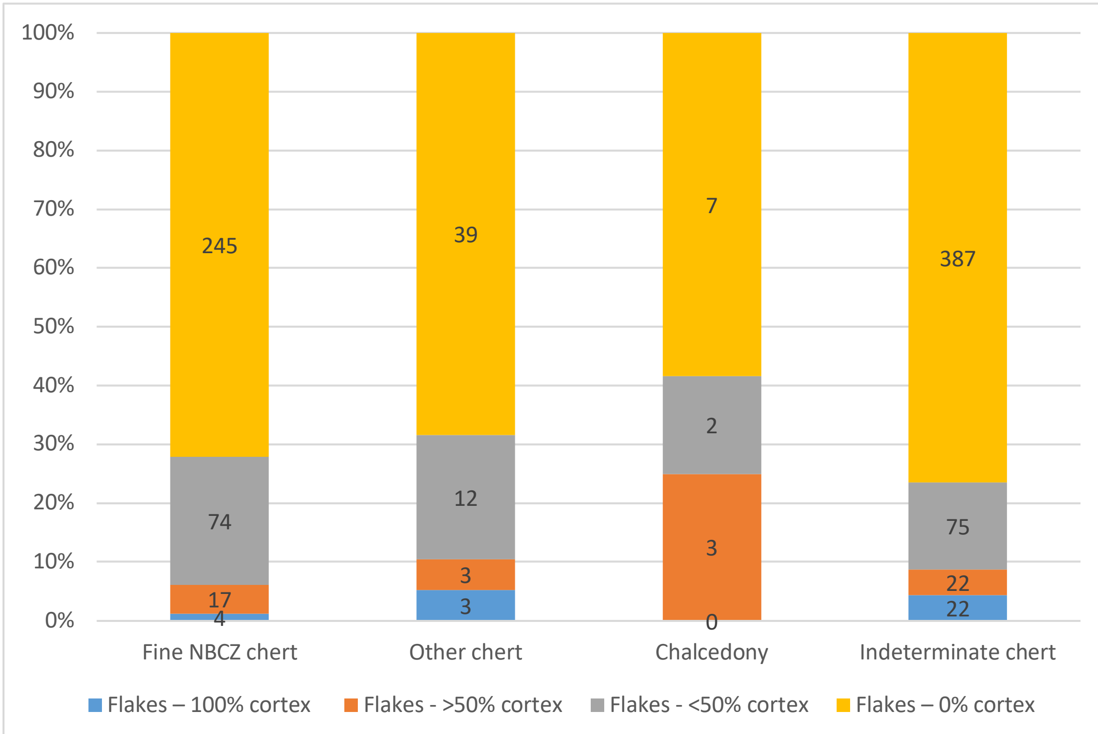

Figure 15.12 Percentages of cortical and non-cortical flakes by raw material type from Ops. 51, 57, 58, 59, 61, and 62 (image by W. J. Stemp).

Figure 15.13 Three chert flake cores from Op. 51. Note: One core (left) is burnt, and two cores (middle, right) have 'black' patination (photo by W. J. Stemp).

Figure 15.14 Large bifacial/discoidal chert flake core from Op. 51. Note: Slight burning on the core (photo by W. J. Stemp).

Table 15.3 Platforms for whole flakes and proximal flake fragments from Ops. 51, 57, 58, 59, 61, and 62.

	Cortical	Cortical /flat	Flat	Flat/ lipped	Di-hedral	Facetted	Facetted/ lipped	Linear	Puncti-form	Crushed
NBCZ chert	12 (5.0%)	17 (7.1%)	170 (70.5%)	10 (4.1%)	12 (5.0%)	1 (0.4%)	3 (1.2%)	7 (2.9%)	2 (0.8%)	7 (2.9%)
Other chert/ limestone	5 (13.9%)	4 (11.1%)	24 (66.7%)	1 (2.8%)	-	1 (2.8%)	-	-	-	1 (2.8%)
Chalcedony	-	1 (14.3%)	5 (71.4%)	-	-	-	-	-	-	1 (14.3%)
Indeter-minate chert	14 (5.6%)	11 (4.4%)	177 (70.2%)	13 (5.2%)	6 (2.4%)	3 (1.2%)	1 (0.4%)	11 (4.4%)	4 (1.6%)	12 (4.8%)

Table 15.4 Flake termination types on whole flakes and distal flake fragments from Ops. 51, 57, 58, 59, 61, and 62.

	Feather	Hinge	Step
NBCZ chert	119 (55.9%)	88 (41.3%)	6 (2.8%)
Other chert/limestone	13 (59.1%)	9 (40.9%)	-
Chalcedony	5 (83.3%)	1 (16.7%)	-
Indeterminate chert	171 (62.6%)	92 (33.7%)	10 (3.7%)

Notably, the microdebitage (123) from the excavations supports some local reduction at Crawford Bank. However, the locations of highest concentrations of microdebitage (i.e., Op. 57) cannot be reliably interpreted as the specific areas for primary reduction due to post-depositional factors along the shoreline of the lagoon. It seems most likely that the small microdebitage accumulated in specific areas due to natural transformation processes that moved the artifacts into secondary contexts like the other lithic artifacts (see Stemp and Harrison-Buck 2019). Most microdebitage is NBCZ chert (88 or 71.5%), while the rest consists of other chert (4 or 3.3%), chalcedony (1 or 0.8%), and 'indeterminate' chert or chalcedony (30 or 24.4%).

The 70 bifacial thinning flakes and biface edge repair flakes from Ops. 51, 57, 58, 59, 61, and 62 at Crawford Bank constitute 4.4% of the debitage and are mostly non-cortical (64 or 91.4%), representing end stage flaking and biface repair (**Figure 15.15**). The few bifacial thinning flakes suggest that biface production was not occurring on-site (**Figure 15.16**). The majority of these flakes (56 or 98.2%) are NBCZ chert and 'indeterminate' chert [of which most is suspected to be NBCZ chert]. This is consistent with the assumption that the biface technology at Crawford Bank was primarily associated with NBCZ chert. Some of the bifacial thinning flakes are quite large. Notably, two bifaces made from other chert were recovered at Crawford Bank, but no bifacial thinning flakes of other chert were. Two different types of bifacial thinning flakes were identified at Crawford Bank based on thickness, morphology, and platform type. The first type includes 'harder'-hammer percussion flakes (Callaghan 1979; Hayden and Hutchings 1989:249) that usually have: 1) beveled or 2) lipped and beveled striking platforms. These flakes tend to have cone-like initiations and more pronounced bulbs of percussion. (Shafer and Hester 1983:524, Fig.6a, c-e; Shafer 1991:40). The second type of bifacial thinning flake typically has a lipped striking platform, a flatter and more diffuse bulb of percussion, and often tends to widen near the distal end (Callaghan 1979; Hayden and Hutchings 1989:246, Fig. 6, 247; Shafer and Hester 1983:531, Fig.6b, f). For both types of bifacial thinning flakes and biface edge flakes, many of the striking platforms are faceted to variable degrees (47 or 74.6%), and most are lipped (55 or 87.3%; **Table 15.5**). In all, 37 (52.8%) of the flakes are consistent with 'harder'-hammer percussion, while 7 (10%) are consistent with 'soft'-hammer percussion. For the remaining bifacial thinning flake fragments (26 or 37.1%), there is not enough production evidence to distinguish hammer type or there are combinations of traits from both hammer reduction types. Most (46 or 97.9%) whole bifacial thinning flakes and distal bifacial thinning flake fragments end in feather terminations (**Table 15.6**).

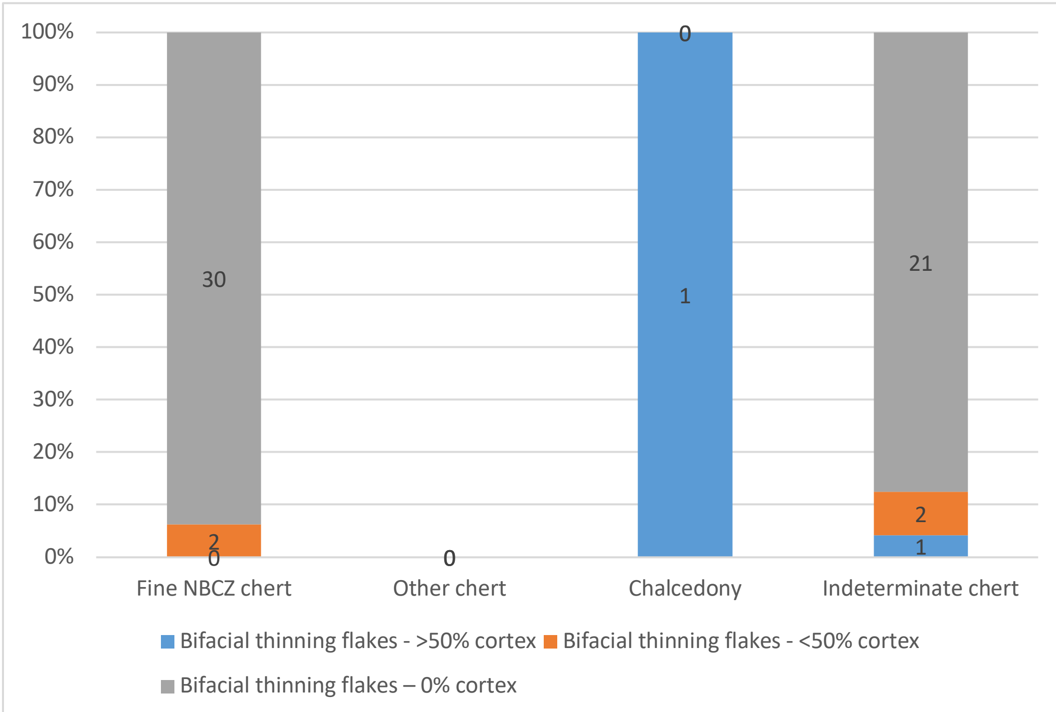

Figure 15.15 Percentages of cortical and non-cortical bifacial thinning flakes by raw material from Ops. 51, 57, 58, 59, 61, and 62. Note: There are no 'other' chert bifacial thinning flakes (image by W. J. Stemp).

Figure 15.16 Bifacial thinning flakes from Op. 51. Note: All the flakes are burnt (photos by W. J. Stemp).

Table 15.5 Platforms for whole bifacial thinning flakes and proximal bifacial thinning flake fragments from Ops. 51, 57, 58, 59, 61, and 62.[a]

	Cortical	Cortical/ flat	Flat	Flat/ lipped	Dihedral	Facetted	Facetted/ lipped	Linear/ lipped	Crushed
NBCZ chert	-	-	2 (6.3%)	4 (12.5%)	-	2 (6.3%)	22 (68.8%)	-	2 (6.3%)
Other chert/ limestone	-	-	-	-	-	-	-	-	-
Chalcedony	-	-	-	-	-	-	-	-	-
Indeterminate chert	-	-	-	5 (16.1%)	-	-	23 (74.2%)	1 (3.2%)	2 (6.5%)

[a]Includes biface edge retouch/repair flakes

Table 15.6 Flake termination types on whole bifacial thinning flakes and distal bifacial thinning flake fragments from Ops. 51, 57, 58, 59, 61, and 62.[a]

	Feather	Hinge	Step
NBCZ chert	20 (100%)	-	-
Other chert/limestone	-	-	-
Chalcedony	-	-	-
Indeterminate chert	26 (96.3%)	1 (3.7%)	-

[a]includes biface edge retouch/repair flakes

The simple flake cores and core fragments (40) are mostly NBCZ (18 or 45.0%) and 'indeterminate' cherts (15 or 37.5%) although there were 5 core fragments of other chert and two of chalcedony. All show multiple striking platforms and somewhat random flake scar patterns. The bifacial or discoidal flake core fragments are made from NBCZ and other chert. Of most interest, is the NBCZ chert blade core fragment. It appears to be somewhat *ad hoc* in that it lacks a prepared striking platform (the platform is partially cortical). There are four unidirectional blade removal scars that all originate from the proximal (platform) end. One blade scar demonstrates a deep hinge termination. It appears the core fragment itself was struck from a larger core based on the ventral surface of the fragment. All the flaking associated with the blade core is hard-hammer.

The lithic raw material and technology data demonstrate a heavy reliance on NBCZ chert debitage as tools. The debitage was used without further modification with a few exceptions. Although some biface fragments, biface flakes, and some macroblade fragments were recovered at the site, these tool types do not appear to have been made at Crawford Bank. More likely, they were acquired as finished tools. With the exception of the two biface fragments, and some bifacial thinning flakes, all of the reduction is hard-hammer. With the exception of the edge resharpening of two thin biface fragments, retouch on the rest of the artifacts was accomplished using hard-hammer percussion. Overall, the assemblage points to people who primarily relied on chert debitage, usually unretouched, for most of their stone tool needs. This appears to be typical of the preceramic period in northern Belize (Stemp and Harrison-Buck 2019; Stemp and Rosenswig 2022).

Use-wear Analysis

Method and Equipment

The protocol for observing and recording the use-wear on the lithic artifacts is essentially the same as that previously used by Stemp et al. (2010, 2013, 2015, 2018; also see Stemp 2001; Stemp and Harrison-Buck 2019; Stemp and Rosenswig 2022) for chipped chert and chalcedony tools. However, the cleaning procedure was changed. Rather than using solutions of 15% hydrochloric acid (HCl) and 20% sodium hydroxide (NaOH) as done previously, the artifacts were first rinsed in cold water and laid out to air dry. The main reason for this cleaning procedure was to potentially preserve some residues on the stone tool surfaces (see Stemp and Rosenswig 2022: Online Supplement 1). During the use-wear analysis, some unidentified residues were noted on the artifacts. Whether they are simply sand/soil still adhering to the surfaces or contain some plant or animal materials remains to be seen.

A metallurgical microscope [Unitron MS-2BD] was used to locate and identify use-wear features at both low- (40×) and high-power (100×, 200×, 400×) magnification under angled and incident light. Photomicrographs of the tools' worn surfaces were taken using a Moticam X3 (4.0 MPX) digital microscope camera. The identification and interpretation of the use-wear on the chert and chalcedony artifacts was based on the previous experimental use-wear analysis programs conducted by Stemp (see Stemp 2001, 2004, Stemp et al., 2010 for full descriptions of experimental use-wear feature categories and damage criteria). The use-wear characteristics were also considered in terms of the experimental and archaeological work of other use-wear analysts, specifically Aoyama (1995, 1999, 2007, 2009), Aldenderfer et al. (1989), Keeley (1980), Lewenstein (1987), Odell (1977), Rots (2010); Sievert (1992), Tringham et al. (1974), van Gijn (1989), and Vaughan (1985). The analysis included observation and documentation of edge-damage (microflaking), striations, and surface polish on the artifacts. As in previous use-wear analyses, used areas on the stone tools were recorded using an independent use-zone (IUZ) method (Stemp et al. 2010, 2013, 2015, 2018; see Aoyama 2009; Vaughan 1985).

Problems due to post-deposition

The use-wear analysis of the chipped stone tools from the 2020 BREA excavations at Crawford Bank was only possible for a proportion of the entire assemblage because the damage to the tools due to post-depositional forces was quite severe. A total of 299 (27.6%) of the 1083 chipped chert, chalcedony, and limestone artifacts were in good enough condition for use-related wear analysis.

There are many problems associated with post-depositional alteration of stone tool surfaces at Op. 51 at Crawford Bank. The most significant post-depositional changes to the lithic artifacts from the site was burning. Burnt cryptocrystalline silicates demonstrate changes, sometimes extreme, that include the following: color changes (from pinks, to reds, grays, blacks, and whites), potlid fractures and heat crazing, increased susceptibility to edge microflaking, increased surface smoothing or 'gloss', some edge rounding, and the possible addition of non-use-related residues. The alterations usually damaged tool surfaces to variable degrees and frequently made observation of use-wear on stone tools very difficult, if not impossible (see Luedtke 1992; Olausson 1983; Sievert 1992). In general, mildly to severely burnt artifacts were evenly distributed throughout the sub-assemblages in the excavation units of Op. 51 (**Table 15.7**).

Table 15.7 Number of burnt lithic artifacts by Square from Op. 51.

	Op. 51	Op. 57	Op. 58	Op. 59	Op. 61	Op. 62
Burnt	779/1082 (72.0%)	201/267 (75.3%)	68/117 (58.1%)	28/45 (62.2%)	35/67 (52.2%)	24/37 (64.9%)

Patination of different types also affected the conditions of the lithic artifacts. Although there were not many artifacts that developed a heavy white or yellowish-white patina, some did. Well-developed white patination creates a porous microsurface that destroys surface polishes and striations, which greatly hinders microscopic use-wear analysis (see Anderson-Gerfaud 1981; Glauberman and Thorson 2012; Keeley 1980; Luedtke 1992; Rottländer 1975). 'Black' patination/manganese oxidation not only changes the color of the stone tool surface but seems to reduce the brightness of polishes. Use-wear polishes and striations are still observable, for the most part, but more developed 'black' patinas make it more difficult to observe polishes microscopically under high magnification (>100×). Overall, the percentage of tools with significantly developed black patinas was low in Op. 51; however, it was proportionately higher in Squares L, M, and O (see Stemp 2022: Table 10). The percentages of tools with 'black' patination are generally higher the closer the operations are to the lagoon shoreline (Ops. 35, 59, 61, and 62; **Table 15.8**) (see Stemp and Harrison-Buck 2019: Online Supplement 1). It has been argued that the pattern of repeated exposure to air and salty/brackish water results in the development of a 'black' patina. Glossy patinas produce shiny or lustrous surfaces due to the dissolution and then re-precipitation of the silica on the artifacts' surfaces (Glauberman and Thorson 2012; Howard 2002; see Lévi-Sala 1986; Luedtke 1992; Stapert 1976); however, 'glossy' stone tools surfaces (not associated with burning) were rare in the lithic assemblages from Crawford Bank.

Table 15.8 Number of 'black' patinated lithic artifacts by Square from Op. 51.

	Op. 51	Op. 57	Op. 58	Op. 59	Op. 61	Op. 62
'Black' patination	0/129 (0%)	0/108 (0%)	7/298 (2.3%)	7/167 (4.2%)	12/242 (5%)	11/139 (7.9%)

There were series of physical/mechanical forces that also altered the edges and surfaces of the chert and chalcedony artifacts from the operations at Crawford Bank. Mechanical damage can either obliterate existing use-wear on stone tools or introduce non-use-related wear (see Lévi-Sala 1996; Pevny 2012). Some of the artifacts were water-rolled, which caused the blunting of tool edges, the smoothing of flake scar arises, and the addition of non-use-related (typically multi-directional) striations (Burroni et al. 2002; Donahue and Burroni 2004; Lévi-Sala 1986; Shackley 1974). In many cases, distinguishing use-related edge chipping from post-depositional edge chipping was difficult because fracture scars along edges could mimic use-related edge flaking. Many artifacts from Crawford Bank have these microscars that indicate movement in the soil, trampling, or some other force application that was "perpendicular to the ventral surface plane" (Donahue and Burroni 2004: 145; see Tringham et al. 1974) of the flakes. This flaking occurs on either the ventral or dorsal surface of flakes and is typically unifacially, rather than bifacially, distributed, suggesting force application from one direction.

Microchipping along a tool edge could also be identified as the result of post-deposition because it had sharp margins and either intersected the surfaces with white or 'black' patinas or cut through polished regions of stone tool surfaces (see Donahue and Burroni 2004: 143, Fig. 15.2B). Edge damage, surface abrasion/mild particulate polishing, and striations may have also been caused by tool movement in the soil due to other actions, such as trampling (Asryan et al. 2014; Chu et al. 2015; Donahue and Burroni 2004; Driscoll et al. 2015; Eren et al. 2010; Keeley 1974, 1980; McBrearty et al. 1998; McPherron et al. 2014; Pargeter and Bradfield 2012; Pevny 2012; Pryor 1988; Schoville 2010, 2014; Shea and Klenck 1993; Tringham et al. 1974). The movement of lithic artifacts in the ground could also cause contact friction with stones or other chert artifacts creating 'bright spots' on some of the chipped stone tools from the Crawford Bank excavations. The bright spots are usually localized or spatially clustered and consist of a very reflective flat polish (see Lévi-Sala 1986: 231).

It should also be noted that many lithic artifacts were scratched by the aluminum 'context' tags that were included in the bags containing the stone tools. The metal tags left very bright silver-colored linear traces on the stone tools' surfaces. The metal residue is the product of adhesive wear (Donahue and Burroni 2004: 144). These linear traces are quite bright and distinctive; however, they can cover or alter possible use-related wear. Aluminum tags should be inserted into their own plastic bags before being placed in the bags with the lithic artifacts.

Use-wear Analysis Results

In the preceramic period of Belize, there are very few use-wear studies of chipped stone artifacts. Most have focused on two types of formal tools – constricted unifaces/adzes (Gibson 1991; Hudler and Lohse 1994; Iceland 1997: 227-228; Lohse 2007) or stemmed bifaces (Stemp et al. 2016). Two other studies have primarily focused on debitage (Stemp and Harrison-Buck 2019; Stemp and Rosenswig 2022). The main reason why there are so few use-wear analyses of chipped stone tools from the preceramic is likely due to the conditions of the artifacts; many of which are heavily damaged due to post-deposition (see above). In this analysis, 9 'formal' tools, and 290 pieces of debitage from Op. 51 were examined for microscopic traces of use.

In total, 95 of the 299 (31.8%) chipped chert and chalcedony artifacts possessed some use-related wear. The use-wear analysis was not performed on a true random sample. As such, it is possible that the percentage of used artifacts in the total assemblage excavated from Crawford Bank could be higher or lower. The artifacts with use-related wear were identified as NCBZ (41 or 43.2%) chert, other chert (8 or 8.4%), chalcedony (3 or 3.2%), and 'indeterminate' chert/chalcedony (43 or 45.3%) based on raw material type. None of the limestone artifacts had evidence of use. However, if the numbers of artifacts with use-wear are considered in terms of all of the chipped stone tools excavated in 2020, then the total percentage of used tools would only be 8.8%. By raw material type, 41 of the 285 (14.4%) NBCZ chert artifacts, 8 of the 64 (12.5%) other chert artifacts, 3 of the 18 (16.7%) chalcedony, and 43 of the 704 (6.1%) 'indeterminate' chert artifacts were used. Most of the used 'indeterminate' chert artifacts had some mild white patination and were either not burnt or minimally heat-modified. It is also possible that a fairly elevated amount of very small 'indeterminate' debitage is contributing to its lower percentage of used tools.

There was a total of 105 IUZs on the 95 stone tools with use-wear traces (**Table 15.9**). Most of the used stone tools only possessed one IUZ (89 or 93.7%); however, there were three (3.2%) that had two IUZs, and two (2.1%) that had three IUZs, and one (1.1%) that had possibly four IUZs. Only one of the tools with two IUZs was a bifacial thinning flake that had use-wear on its dorsal surface and/or near its proximal end/striking platform that was the product of use while it was still attached to a biface and use-wear that was associated with its use as an *ad hoc*/expedient tool after having been detached from the biface (see below). The other two tools with two IUZS were flakes. One of the tools with three IUZs was a flake and the other was a blocky fragment. The single tool with possibly four IUZs was a large flake.

Table 15.9 Number of IUZs on chipped stone tools from Op. 51.

IUZs	Thin bifaces	Retouched macro-blades	Pointed unifaces (macro-blades)	Blades	Flakes[c]	Bifacial thinning flakes[e]	Blocky fragments
Bone/antler							
cut/slice	-	-	-	-	1 (1.0%)	-	-
saw	-	-	-	-	4 (3.8%)	-	-
Meat/skin/fresh hide							
cut/slice	-	-	-	-	5 (4.8%%)	-	-
Meat/skin/fresh hide and bone							
cut/slice	1[a] (1.0%)	-	-	-	2[d] (1.9%)	-	-
Plant							
cut/slice	-	-	-	1 (1.0%)	6 (5.7%)	-	-
Soil							
dig/hoe	-	-	-	-	1 (1.0%)	1 (1.0%)	-
Wood							
adze/chop	-	-	-	-	-	5[f] (4.8%)	-
cut/slice	-	-	-	1 (1.0%)	9 (8.6%)	-	-
saw	-	-		-	14 (13.3%)	-	1 (1.0%)
scrape/plane	-	-	-	-	5 (4.8%)	-	-
whittle	-	-	-	-	10 (9.5%)	-	-
Soft							
cut/slice	-	-	-	-	4 (3.8%)	-	-
Hard							
adze/chop	-	-	-	-	-	1 (1.0%)	-
cut/slice	-	-	-	-	3 (2.9%)	-	-
saw	-	-	-	-	11 (10.5%)	-	2 (1.9%)
scrape/plane	-	-	-	-	2 (1.9%)	-	-
whittle	-	-	-	-	3 (2.9%)	-	-
Indeterminate							
saw	-	-	-	-	3 (2.9%)	1 (1.0%)	1 (1.0%)
indeterminate	-	-	1[b] (1.0%)	-	3 (2.9%)		3 (2.9%)
Total	**1**	**0**	**1**	**2**	**86**	**8**	**7**

[a]May include other contact materials as well; burning of the tool renders identifying other contact materials difficult.
[b]Complex polish mostly restricted to the tool's edges; sometimes it looks like bone or wood, but it seems like there is a soft contact material involved as well.
[c]Includes retouched flakes.
[d]Traces of wood polish noted (bright, domed polish).
[e]Also includes biface edges.
[f]Two bifacial thinning flakes also have wear consistent with soil.

The use-wear on the chipped chert and chalcedony artifacts from the 2020 BREA excavations at Crawford Bank is mostly consistent with working wood (45 IUZs or 42.9%; **Figure 15.17a**). Other tools were used on bone or antler (5 IUZs or 4.8%; **Figure 15.17b**), meat/skin/fresh hide and bone (3 IUZ or 2.9%; **Figure 15.17c**); plants (7 IUZ or 6.7%; **Figure 15.17d**), unidentified soft materials (4 IUZs or 3.8%), unidentified hard materials (22 IUZs or 21.0%), meat/skin/fresh hide (5 IUZs or 4.8%; **Figure 15.17e**), and indeterminate materials (12 IUZs or 11.4%). Some artifacts were used to dig in soil (2 IUZ or 1.9%; plus use-wear traces on one bifacial thinning flake used to adze/chop wood; **Figure 15.17f**).

Based on the results of the use-wear analysis, the people at Crawford Bank clearly relied on wood as an important resource and worked it in a number of different ways. Cutting and sawing were the main motions associated with woodworking (21.9%), but scraping, planing, and whittling of wood was also quite common (14.3%). These motions likely represent tasks such as making handles for hafted tools and weapons, supports for perishable structures, making containers, forest clearance, or firewood. Because wooden artifacts were not found at Crawford Bank, the use-wear on the stone tools serves as important secondary evidence for a reliance on wood. There is good use-wear evidence for subsistence activities in terms animal hunting and butchery (12.4%) and plant cutting/slicing (6.7%). Other items used for non-dietary purposes may have been produced using animal or plant parts as well. Some of the unidentified soft and hard materials used by the Crawford Bank inhabitants were likely animal or plant parts of some kind.

Most of the motions on the tools recovered from the 2020 excavations at Crawford Bank were cutting, slicing, or sawing (71 IUZs or 67.6%). Far fewer tools were used with a scraping, planing, or whittling motion (20 IUZs or 19.0%), for adzing or chopping (6 IUZs or 5.7%) or digging in soil (2 IUZs or 1.9%). The fact that most of the flakes had fairly acute edge angles assists in understanding why evidence indicating longitudinal motions was most commonly found of the tools' surfaces. Few flakes had edge angles that exceeded ~ 45-50^o, which are typically associated with scraping, planning, or whittling activities.

The use-wear data also demonstrate that *ad hoc*/expedient flake technology was an important source of tools for the people of Crawford Bank, as noted in other debitage studies from preceramic sites in Belize (Stemp and Harrison-Buck 2019; Stemp and Rosenswig 2022). Although lithic debitage has been recovered at other preceramic sites in Belize, it has not undergone a detailed use-wear analysis (e.g., Brown et al. 2011; Griffith and Morehart 2001; Griffith et al. 2002; Hester et al. 1980, 1996; Lohse 2006; Lohse and Collins 2004; Pohl et al. 1996; Iceland 1997; Shafer et al. 1980).

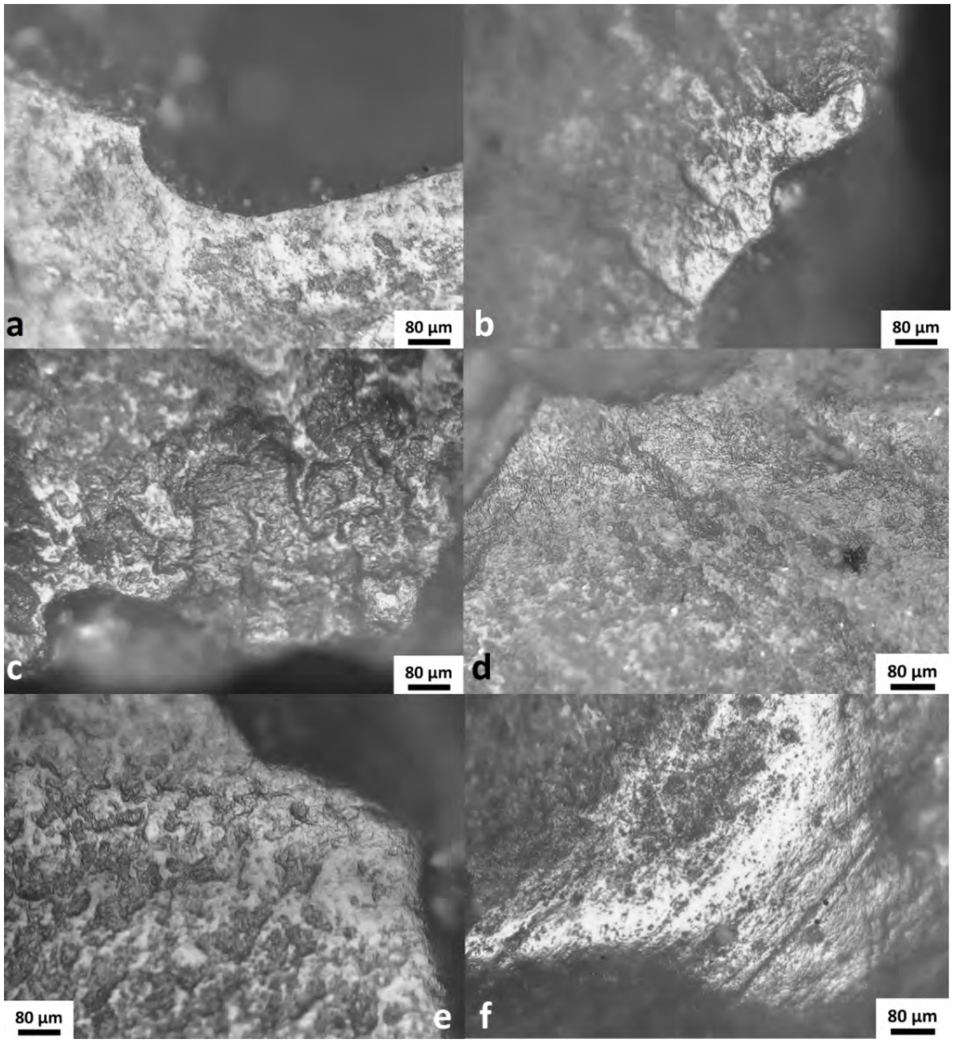

Figure 15.17 Photomicrographs of usewear (200x) – a) unretouched chert flake used to saw wood The polish is well-developed and is beginning to link up beyond the reticular stage of development. The flake is partially patinated; b) unretouched chert flake used to saw antler/bone. The polish is limited in distribution to the very edge of the flake]; c) thin chert biface used to cut/slice meat/skin/fresh hide and bone. The thin biface is burnt]; d) unretouched chert flake used to cut/slice non-woody plant; e) unifacially retouched chert flake used to scrape hide; f) unretouched chert bifacial thinning flake [dorsal surface] used to dig/hoe in soil and adze/chop wood (photos by W. J. Stemp).

STP Series 035 and Surface Collection

The raw materials from the STP series 035 test pits and the surface of Crawford Bank are similar to those reported for the operations above. However, there were no limestone artifacts documented and the percentage of stone tools and debitage that could be identified as NBCZ chert was higher than that for the operations (**Figure 15.18**). Specifically, 151 (59.4%) chipped stone artifacts were made from NBCZ chert, 9 (3.5%) were made from other chert, 7 (2.8%) were produced from chalcedony, and the rest 87 (34.3%) of the chert or chalcedony artifacts were considered ‘indeterminate’ in terms of raw material type.

More or less, the tool type and reduction data from the test pits and surface collection mirror those from the excavated operations. Formal tools constituted 11 of the 254 (4.3%) chipped stone artifacts recovered through test pitting and surface collection with the rest (243 or 95.7%) being debitage of various types (**Tables 15.10** and **15.11**). The formal tool types include fragments of thick bifaces/celts, some biface edges, and unifacially retouched macroblades, in particular two refit pointed uniface fragments. One new tool type – the tranchet-bit biface was recovered from the surface of Crawford Bank (**Figure 15.21**).

Most reduction products in the test pits were the result of hard-hammer percussion and the general distribution of cortical and non-cortical flakes is similar to that from the operations. The cortical and non-cortical flakes similarly suggest NBCZ chert cores were arriving at Crawford Bank (**Figure 15.19**). The expedient reduction of NBCZ chert, other, and chalcedony to produce usable flakes is further supported by the simple flake cores and core fragments from the test pits.

Limited evidence for biface reduction/repair is provided by the 7 NBCZ chert and 1 indeterminate chert bifacial thinning flakes, all of which were non-cortical, from the test pits (2.9% of all debitage). There were no bifacial thinning flakes of other chert or chalcedony found in the test pits (**Figure 15.20**).

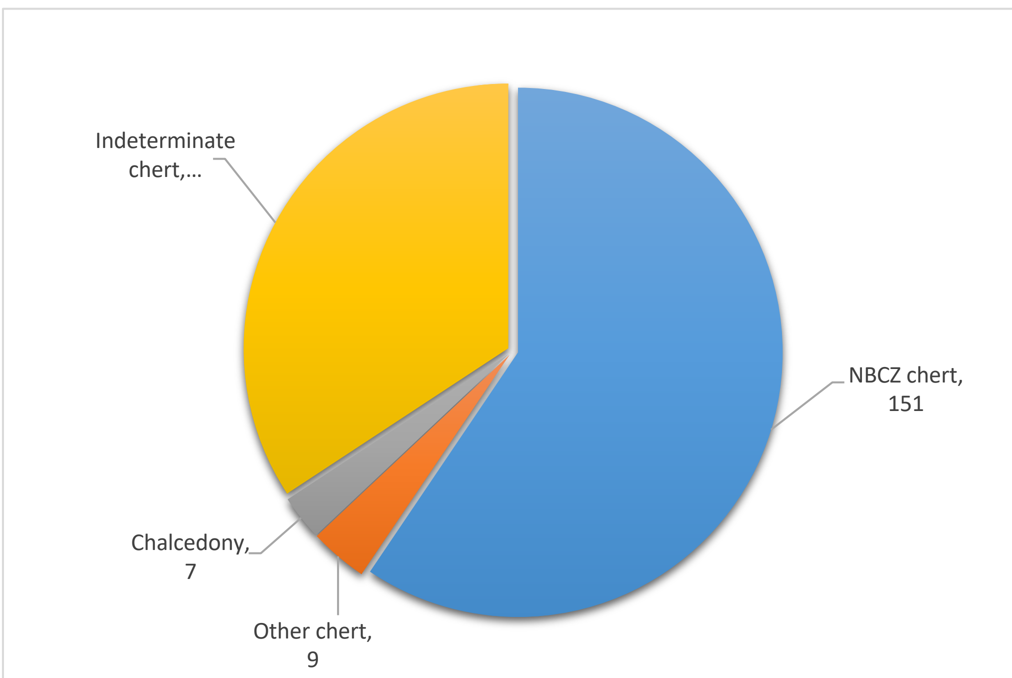

Figure 15.18 Number of lithic artifacts by raw material type from STP Series 035 and surface collection.

Table 15.10 Formal tools by raw material types from STP Series 035 and surface collection.

Tool type	NBCZ chert	Other chert	Chalcedony	Indeterminate chert	Limestone
Thin bifaces	-	-	-	-	-
Thick bifaces/celts	3	-	-	-	-
Thick biface/celt preforms	-	1	-	-	-
Tranchet bit adze	1	-	-	-	-
Biface edges	1	-	-	1	-
Macroblades	-	-	-	-	-
Retouched macroblades and pointed unifaces (unifacial)	3	-	-	1[a]	-
Blades	-	-	-	-	-
Total	**8**	**1**	**0**	**2**	**0**

[a]Two refit medial fragments.

Table 15.11 Informal tools/debitage by raw material types from STP Series 035 and surface collection.

Tool type	NBCZ chert	Other chert	Chalcedony	Indeterminate chert	Limestone
Flakes – 100% cortex	-	2	-	1	-
Flakes – >50% cortex	4	-	-	3	-
Flakes – <50% cortex	25	1	1	11	-
Flakes – 0% cortex	70	2	5	43	-
Flake-blades – >50% cortex	-	-	-	-	-
Flake-blades – <50% cortex	1	-	-	-	-
Flake-blades – 0% cortex	2	-	-	-	-
Retouched flake-blades - >50% cortex	-	-	-	-	-
Bifacial thinning flakes – >50% cortex	-	-	-	-	-
Bifacial thinning flakes – <50% cortex	-	-	-	-	-
Bifacial thinning flakes – 0% cortex	7	-	-	1	-
Bifacial thinning pressure flakes – 0% cortex	-	-	-	-	-
Biface edge retouch/repair flakes – 0% cortex	-	-	-	-	-
Uniface edge retouch/repair flakes – <50% cortex	-	-	-	-	-
Uniface edge retouch/repair flakes – 0% cortex	-	-	-	-	-
Retouched flakes (unifacial) – >50% cortex	-	-	-	-	-
Retouched flakes (unifacial) – 0% cortex	1	-	-	1	-
Macroflakes - <50% cortex	-	-	-	-	-
Macroflakes - <0% cortex	1	-	-	-	-
Microdebitage (<3.0 mm x 3.0 mm)	4	-	-	5	-
Simple flake cores	5	2	1	-	-
Bifacial/discoidal flake cores	1	-	-	-	-
Blade cores	-	-	-	-	-
Simple flake cores/hammerstones	-	-	-	-	-
Blocky fragments	22	1	-	19	-
Retouched blocky fragments (unifacial)	-	-	-	-	-
Potlids and burnt fragments	-	-	-	2	-
Cobble	-	-	-	-	-
Total	**143**	**8**	**7**	**85**	**0**

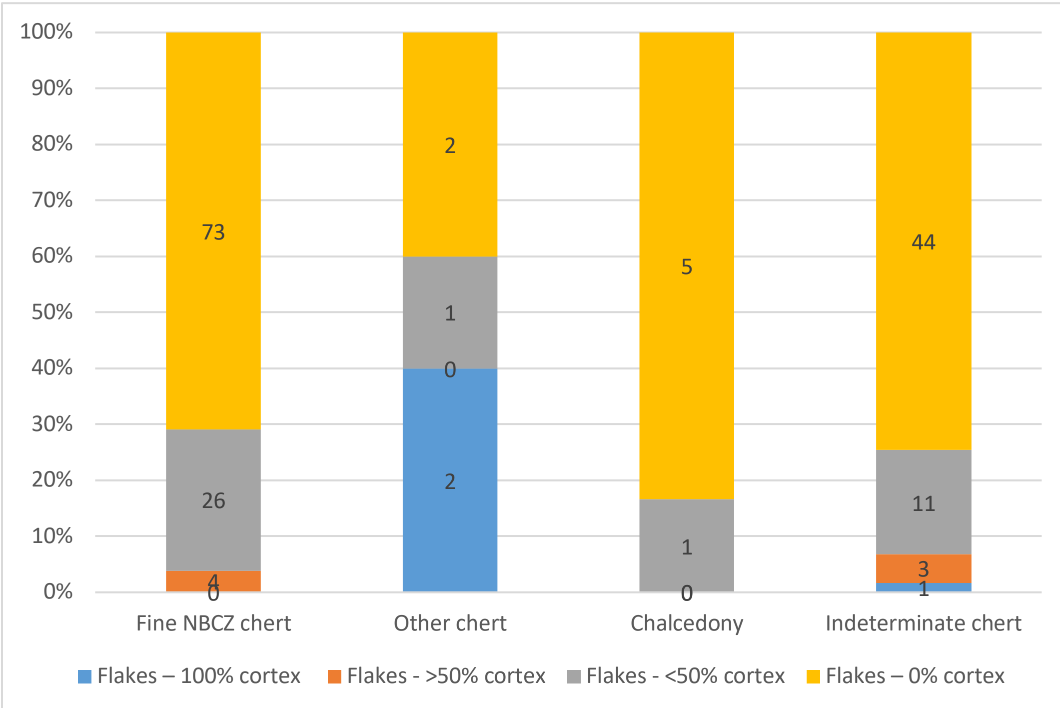

Figure 15.19 Percentages of cortical and non-cortical flakes by raw material type from STP Series 035 and surface collection.

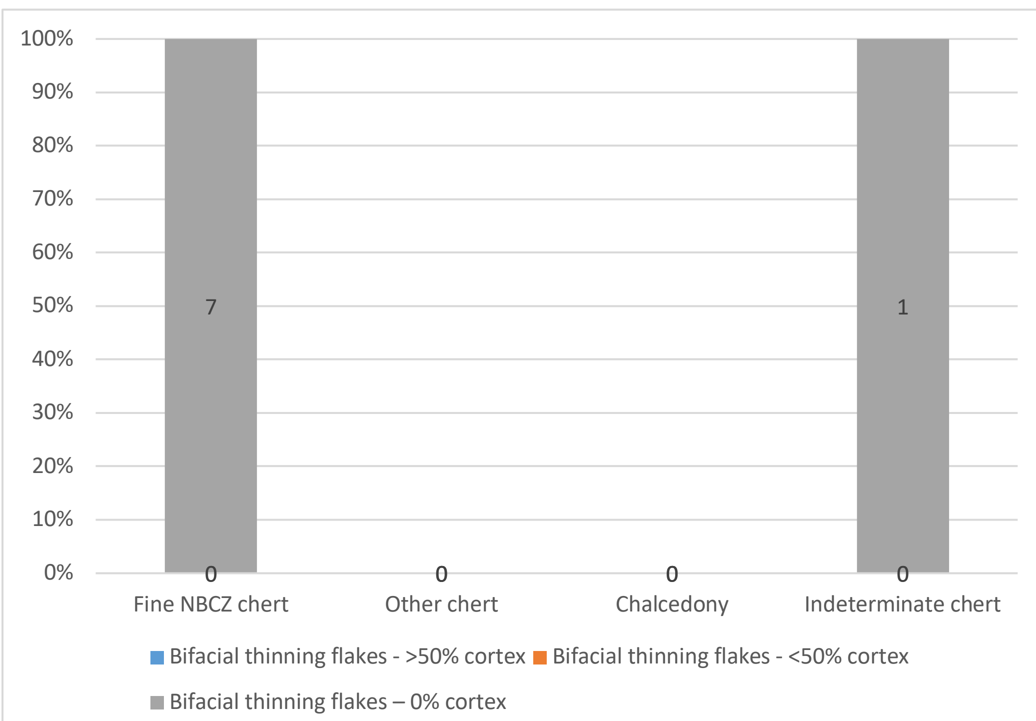

Figure 15.20 Percentages of cortical and non-cortical bifacial thinning flakes by raw material from STP Series 035 and surface collection. Note: There are no 'other' chert or chalcedony bifacial thinning flakes.

Discussion and Conclusions

Based on the analysis of lithic raw material types for the artifacts recovered at Crawford Bank by BREA, the inhabitants relied on sources of chert and chalcedony from Northern Belize with most identifiable stone coming from the NBCZ and smaller amounts originating from locations in the 'Pebble Zone', within which Crawford Bank is located. The results of the lithic analysis from the excavations undertaken in 2017 at Crawford Bank (Op. 35) by BREA can be compared to those from Ops. 51, 57, 58, 59, 61, and 62). Although significant proportions of the chert artifacts were classified as 'indeterminate' in terms of raw material type in all operations and there are generally similar high percentages of burnt chert and chalcedony at all locations, far fewer lithic artifacts a 'black' patina overall. Based on the locations of the excavation units for all operations, it generally appears that proximity to the lagoon shoreline and related fluctuations in the water levels over time are responsible for this difference.

The 22 'formal' stone tools from the excavations in Ops. 51, 57, 58, 59, 61, and 62 at Crawford Bank are similar to those reported from Op. 35 at this site, specifically the macroblades, blades, and thick bifaces/celts (Stemp and Harrison-Buck 2019:189, Table 1). It is also worth noting that some tools are missing from all operations at Crawford Bank, specifically, there are no obvious constricted unifaces [although one trimmed microblade fragment was recovered from Op. 35], no Sawmill points, and no scraper forms. It is possible that the medial thin biface fragment with a serrated edge and partial beveling from Op. 51 was originally part of a preceramic stemmed biface (e.g., Lowe point), but this is difficult to know for certain. Most of the 'formal' tools with a recognizable raw material were made from NBCZ chert. In general, the raw materials from which the tools were made and the tool types (e.g., bifaces,/celts, macroblades, and blades) are similar to those recovered at various other preceramic sites in Northern Belize (see Hester et al. 1996; Iceland 1997; Kelly 1993; Lohse et al. 2006; Pohl et al. 1996; Rosenswig et al. 2014; Rosenswig 2015; Stemp et al. 2016).

Based on the types and quantities of debitage at all operations, in the STP 035 series, and on the surface at Crawford Bank, the absence of macroflake and macroblade cores, the few cortical bifacial thinning flakes, and the few biface preforms, most of the 'formal' tools were most likely not made at Crawford Bank (see Stemp and Harrison-Buck 2019). Specifically, macroblades are represented by interior versions and there are no examples of external or cortical [>50% or 100 dorsal cortex] 'first' or 'second' series macroblades (see Iceland 1997: 134 for Zone D, Op. 4046 [South] at Colha). Some of the bifacial thinning flakes have use-wear on their dorsal surfaces, which suggests biface repair/refurbishing rather than biface production. Aside from a few unifacially retouched flakes and blocky fragments, there were no other 'intentional' flake tools (e.g., burins, denticulates, scrapers, etc.) in the overall Crawford Bank assemblage. The inhabitants may have been making some bifaces based on the recovered preforms, as well as some blades locally based on the recovery of the blade core fragment at Op. 51. The people who made and used the preceramic Crawford Bank chipped stone artifacts had access to nodules of NBCZ chert, chalcedony, and other chert based on the cores, and core fragments, cortical flakes [specifically the flakes with 100% cortex and >50% cortex], and the striking platforms that are cortical or partially cortical. At least some cores appear to have been partially decorticated and reduced before arriving at the site based on the ratios of flakes to cores and core fragments and the high percentages of non-cortical flakes (see Tomka 1989: 138, Table 1). Based on flake types, platform types, and termination types, the NBCZ chert and other chert were similarly reduced using hard-hammer percussion. Chalcedony was also used to produce simple hard-hammer flakes, but with fewer non-cortical versus cortical flakes.

The use-wear on the lithics from Op. 51 at Crawford Bank indicates a reliance on expedient technology to complete tasks (also see Stemp and Harrison-Buck 2019; Stemp and Rosenswig 2022). Many tasks involve wood (see Acosta Ochoa 2010:2; Pérez 2009; Stemp and Harrison-Buck 2019; Stemp and Rosenswig 2022), but tools were also used to a fairly high degree on animals (bone, meat/skin/fresh hide), and plants as well. There is little evidence for contact with soil, which seems to argue for minimal horticultural activity that may have involved stone tools at Op. 51. For the most part, the use-wear seems consistent with activities undertaken by hunter-gatherers. The residues on some tools, such as the serrated thin biface fragment, could be analyzed to get a better understanding of particular plants or animals exploited by the inhabitants of Crawford Bank.

Overall, the results of the analysis of stone tools from Ops. 51, 57, 58, 59, 61 and 62 are very similar to those from Op. 35 (Stemp and Harrison-Buck 2019). The lithic artifacts from these areas were mostly made using hard-hammer percussion of chert from Northern Belize, specifically the NBCZ. There were few formal tools recovered in any operation. Cores and core fragments of NBCZ chert, other chert, and chalcedony and flake ratios in all operations demonstrate a pattern of acquiring nodules that were partially decorticated and reduced before reaching Crawford Bank. Macroblade and macroflake cores are absent in the assemblages in all operations. Tool use-wear patterns are similar, with wood being the most common contact material and most tools being used for longitudinal motions. Proportionately, more tools were used on bone or antler, meat/skin/fresh hide, and plants at Op. 51; however, there is no evidence for contact with dry hide and fewer stone tools contacted soil than at Op. 35.

As at Op. 35 (Stemp and Harrison-Buck 2019), it is believed that some activities performed using stone tools are underrepresented by the use-wear evidence. At Op. 51, the use-wear overwhelmingly consists of contact with hard materials (wood, bone/antler, unidentified hard). Use-wear consistent with meat/skin/fresh hide, non-woody plants, and other 'soft' materials is much less frequent. As with Op. 35, there are two hypotheses for the use-wear pattern distribution observed at Op. 51. Either the activities involving animals (meat/skin/fresh hide) or plants (other than wood) were only being minimally performed with the stone tools recovered from Crawford Bank or the use-wear traces associated with contact with these materials were disproportionately altered or eliminated by post-deposition. Because much of the assemblage was burnt, it is noteworthy that some researchers (Clemente-Conte 1997: 533; Rutkoski et al. 2020) observed that burning affects use-wear polishes differently. For example, bone and wood polishes seem to survive exposure to burning better than polishes associated with soft contact materials, such as meat, fat, and sinew. As well, Plisson and Mauger (1988) noted that use-related polishes resulting from contact with animal tissues (i.e., meat, hide) are less resistant to chemical alteration associated with white patination than polish produced by contact with harder materials, specifically wood. Given full consideration of the use-wear patterns and the significant post-depositional damage to the artifacts, the second hypothesis is believed to be more likely correct.

Post-depositional damage, specifically edge microchipping, surface abrasion, flake scar ridge rounding, and burning on the Op. 51, 57, 58, 59, 61, and 62 lithics, suggests that these tools accumulated in various locations along the shore as a result of secondary deposition of some kind. There was movement of these artifacts at some point in the past, possibly due to water action, along the shoreline. This has also been suggested for the stone tools from Op. 35 (Stemp and Harrison-Buck 2019).

In the entire area where excavations and test-pitting occurred around Crooked Tree Lodge in Crawford Bank, the only example of a tool that is clearly Maya based on the technology of production and cross-dating with Late Preclassic Colha workshop production is a tranchet bit biface made from NBCZ chert that was collected from the surface (LCB 16617) (**Figure 15.21**; see Shafer 1991:33).

Figure 15.21 A NBCZ chert tranchet-bit biface surface collected from Crawford Bank (photo by W. J. Stemp).

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Chapter 16

A Follow-Up Analysis of Ground Stone Tools from the BREA Study Area

Marieka Brouwer Burg and Tawny L. B. Tibbits

Ground stone tools are ubiquitous in the archaeological record of the ancient Maya, and are still often used by living Maya groups today. However, as we have noted elsewhere, this artifact category often receives less research attention than categories like ceramics and lithics, on account of the perceived lack of interpretive data that can be extracted from ground stone (Brouwer Burg et al. 2021; Tibbits 2016; Tibbits et al. 2022). We believe that ground stone tools can yield a greater variety of analytical data if we simply ask new questions of them, using technological applications such as x-ray fluorescence (XRF). This a relatively new and fruitful method is helping us to determine the geochemical signature of the tools and match them to their sources. Such analyses are supporting richer interpretations of ground stone resource management, political economies, and material culture studies.

In Belize, ground stone tools were made of a variety of materials. The geology of Belize is varied, with a large segment that is dominated by sedimentary bedrock, the central Maya Mountains which are comprised of three petrographically distinct granites: the Cockscomb Basin, Hummingbird Ridge, and Mountain Pine Ridge (see Figure 13.1 in **Tibbits and Brouwer Burg, Chapter 13**). Just to the south is the sole volcanic deposit, the Bladen. And surrounding these igneous deposits is a metamorphic aureole that is largely composed of schist, slate, and quartzite. The ancient Maya of Belize constructed their manos and metates from nearly every rock type that has been identified within the country, and some from beyond its current political borders, including granite and rhyolite, to limestone, sandstone, dacite, and basalt, whose nearest deposits are in Guatemala. It appears that granite was one of the preferred resources for use in the production of ground stone tools in the region. This is likely because it is hard, durable, and yields less grit than other tool stones (Adams 2014). Granite is also an excellent candidate for geochemical sourcing because of its geographically restricted distribution within the Maya Mountains. Here, we focus on the distribution of granite in the modern-day country of Belize, where granite outcrops in three distinctive plutons in the Maya Mountains: the Cockscomb Basin (CCB), the Hummingbird Ridge (HBR), and Mountain Pine Ridge (MPR).

In previous work, we collected a representative sample of geological outcrop specimens from the three granite sources and characterized their elemental concentrations using lab-based XRF in conjunction with a handheld XRF and thin section petrography (see Tibbits 2016). It was determined that by looking at Rb/Sr and Sr/Y ratios, it was possible to differentiate between plutons. In fact, when granite cobbles from river drainages are removed and only primary outcrop samples are used, the three plutons are distinct and there is no overlap. This is likely reflective of the magmatic evolution over time, as Cockscomb Basin is the oldest pluton and Mountain Pine Ridge the youngest. We are likely viewing the cooling sequence in these different signature ranges.

Because granite is coarse-grained, a technique needed to be developed in order to generate an average geochemical signature that was accurate. Using a Monte Carlo simulation, Tibbits (2016) determined that the handheld XRF could detect the same elemental concentrations as lab-based XRF when using five random analysis points on each sample and averaging them together to generate a composite geochemical signature. These findings also mirror petrographic results which show there are slight differences in the mineralogy of each pluton. We have reported on the validity and utility of using a handheld XRF for such purposes in a handful of publications (Brouwer Burg et al. 2021; Tibbits et al. 2022). In Tibbits and Brouwer Burg, Chapter 13, we report on the newly collected database of source granites, against which our archaeological specimens will be cast. Below, we will discuss the results of recent ground stone analysis and how the new data obtained adds to the ongoing story of granite ground stone provisioning in the Belize River East Archaeology (BREA) study area.

Previous Work

In 2014, Tibbits visited the BREA field lab to sample the 67 granite specimens collected thus far by the project. The majority (84%) of the granite tools derived from the MPR, with 4% from the HBR, 3% from the CCB, and 9% indeterminate (**Figure 16.1**).

That the majority of granite from the middle reaches of the Belize River Valley came from the Mountain Pine Ridge was intriguing to us because we assumed that the closest source in geographic distance would likely be the source supplying these granites. And HBR, not MPR, was the closest source in linear distance (**Figure 16.2**). Clearly, there was something important about the MPR granite that made it either more desirable, accessible, or attainable than ground stone tools made of either HBR or CCB granite.

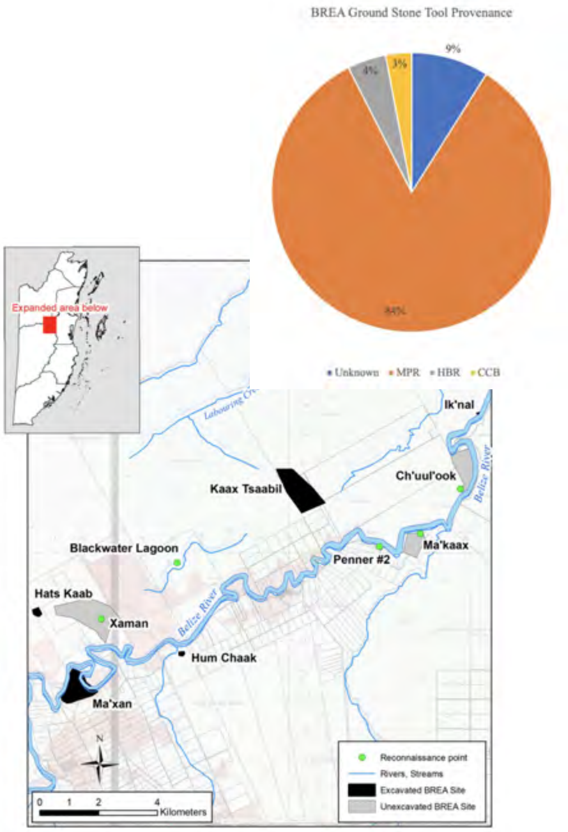
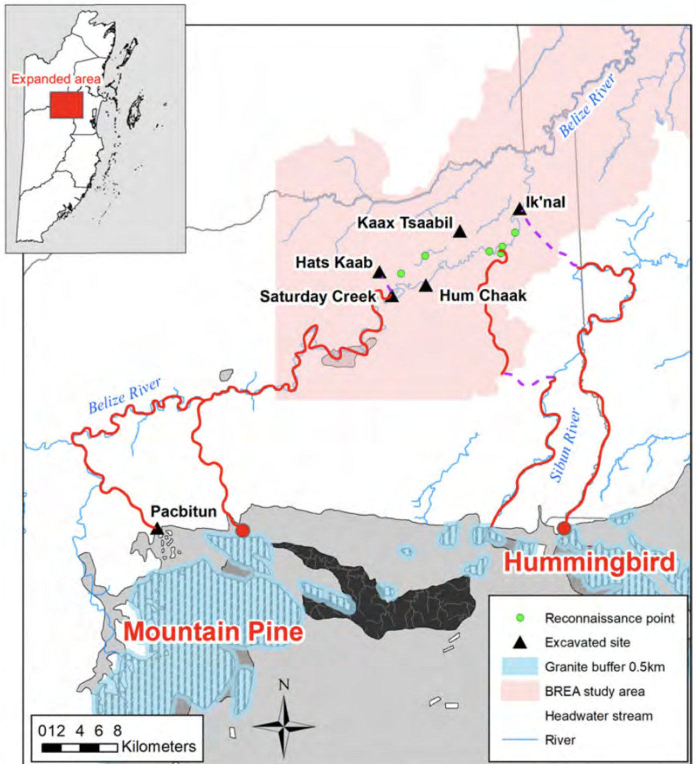


Table 2. BREA Granite Ground Stone Tool (GST) Forms.

Site	Recovery Context	Form	Count (*n*)
Hats Kaab	Excavation (*n* = 6)	Mano	2
		Metate	3
		Unidentifiable	1
Hats Kaab	Surface collection (*n* = 23)	Mano	9
		Metate	11
		Unidentifiable	2
		Other (axe)	1
Hum Chaak	Excavation (*n* = 4)	Mano	2
		Metate	1
		Unidentifiable	1
Ik'nal	Excavation (*n* = 19)	Mano	11
		Metate	6
		Unidentifiable	2
Kaax Tsaabil	Excavation (*n* = 3)	Mano	1
		Metate	2
Ma'xan	Excavation (*n* = 7)	Mano	1
		Metate	6
Blackwater Lagoon	Reconnaissance (*n* = 1)	Mano	1
Ma'kaax	Reconnaissance (*n* = 1)	Mano	1
Penner #2	Reconnaissance (*n* = 1)	Mano	1
Ch'uul'ook	Reconnaissance (*n* = 1)	Metate	1
Xaman	Reconnaissance (*n* = 1)	Mano	1
	GST by form, *n* (%)		
Manos			30 (44.8)
Metates			30 (44.8)
Other			1 (1.5)
Unidentifiable			6 (9.0)
	GST by recovery context, *n* (%)		
Excavation			39 (58.2)
Surface Collection			23 (34.4)
Reconnaissance			5 (7.5)
N			67

Figure 16.1 Left: map showing find locations of BREA ground stone tools; Center: granite provenance; Right: recovery context, form, and count of BREA ground stone tools, as of 2014 (map by M. Brouwer Burg; table and chart from Brouwer Burg et al. 2021).



	Distance from approximate sources via waterways		
Excavated sites	Mountain Pine (km)	Hummingbird (km)	Cockscomb (km)
Hats Kaab	31.0	33.7	59.3
Hum Chaak	32.6	29.8	57.3
Ik'nal	45.1	34.3	65.1
Kaax Tsaabil	39.1	33.7	62.7
Ma'xan	29.5	30.9	56.6
Average distance	35.5	32.5	60.2

Figure 16.2 Distance from granite sources to sites in the BREA study area via waterways (map by M. Brouwer Burg).

We have since posited (see Brouwer Burg et al. 2021) that MPR might have been the primary supplier of granite ground stone tools for a couple of reasons. First, the best evidence of mano production we have in the region has been documented at the Tzib Group, adjacent to the ancient Maya site of Pacbitun (Ward 2013). Spenard and colleagues have also reported on mano quarrying in the Buffalo Hills Quarry in the Mountain Pine Ridge (Spenard et al. 2025). We are hopeful that continued work in the Mountain Pine Ridge region will yield new insights into mano quarrying and production. This would bolster the idea that at least mano preforms were being produced in the area before being transported elsewhere for either further manufacturing or for consumption. We know of no evidence of ancient granite quarrying from the Hummingbird Ridge or Cockscomb Basin, nor do we have evidence or granite production anywhere else in Belize other than indirectly, at the site of Alabama (see Tibbits et al. 2021). Furthermore, we are still, conspicuously, missing any recorded data for a metate workshop.

Second, we argue that the MPR source may dominate simply as a result of its location upstream from the middle reaches of the Belize River. Hummingbird Ridge has accessible granite, however it is far from the Sibun and not near any other major waterways. A dense, heavy material like granite cannot have been an easy load for human porters to carry over many miles. Instead, rafting these wares down the Belize River would have been more energy efficient and could account for the widespread distribution of MPR granite artifacts in the downstream reaches of the Belize River.

To test this hypothesis, we wanted to source granite artifacts from further east along the river, as it heads towards its mouth in Belize City. Fortuitously, since 2015 the BREA project has also shifted investigations further northeast along the Belize River, into the lower reaches of the river. **Figure 16.3** depicts the geographic extent of sites in the BREA project area excavated in the middle reaches of the river, running from Cocos Bank up through Ik'nal and in the lower reaches, defined as the region surrounding the Crooked Tree Wildlife Sanctuary. Our focus in this paper is to provide a follow-up study of granite ground stone tools recovered by the BREA team. Below, we identify and characterize all remaining granite artifacts from the middle reaches that had been collected during or after Tibbits' initial analysis undertaken in 2014. Then, we provide an overview analysis of the ground stone tools from the lower reaches of the Belize River Watershed.

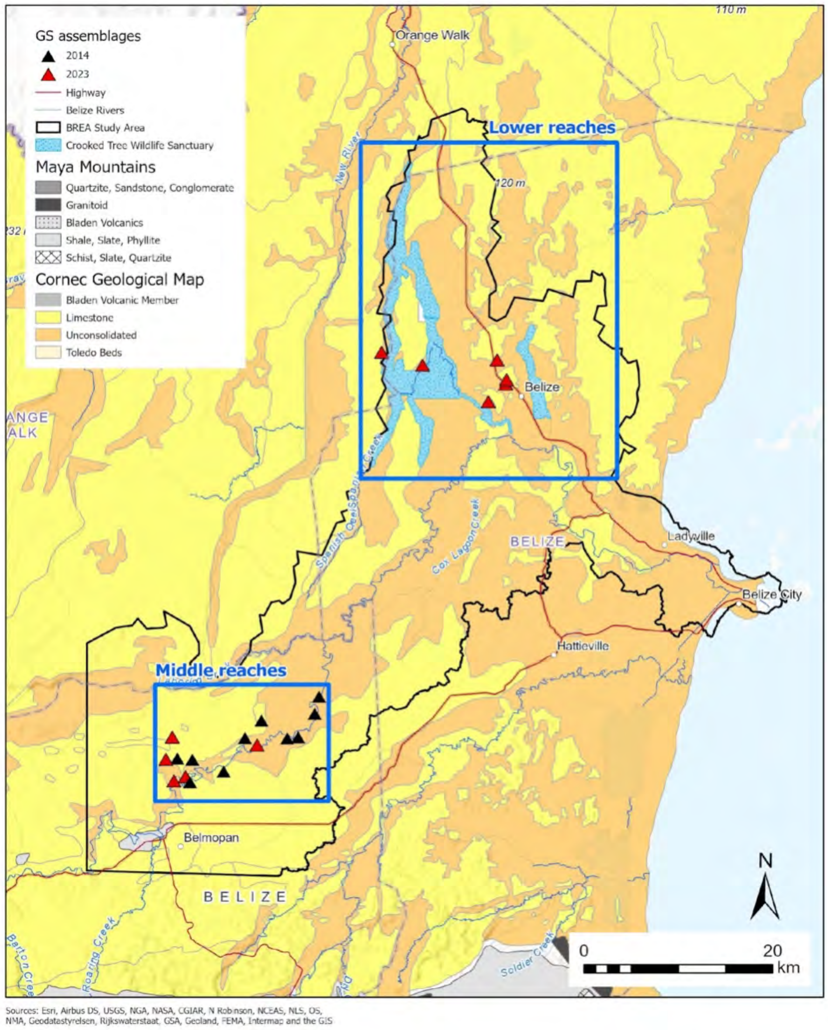


Figure 16.3 Location of sites investigated by the BREA project with ground stone tools (map by M. Brouwer Burg).

Background on the Present Study

The context, both temporal and physical, for this project varies through space; in general, the sites from which the granite artifacts for this study were recovered are largely Terminal Classic in age. There is more variation in physicality: the middle reaches are nestled on a region of predominantly limestone bedrock with some restricted sandstone zones. The lower reaches are also predominantly on limestone bedrock, but there are also extensive chert-bearing zones. Both areas are connected by the Belize River. Within the broader context of Belize and the eastern Lowlands of the Maya, the BREA project area is located approximately 25 km from the nearest granite source in the Maya Mountains. Without consideration of topography, it is clear from this map that the nearest source to BREA is Hummingbird Ridge.

During a week-long laboratory session in the BREA field lab in March 2023, we observed, analyzed, and took XRF readings on 207 ground stone specimens from the middle and lower reaches collected since 2014 (**Figure 16.4**). From these samples, only 36 were chosen for final analysis, based on the fact that their parent material was granite and they did not exhibit concerning amounts of weathering. We used the five-shot methodology for handheld XRF discussed above (see Tibbits 2016). Every ground stone specimen was thus subjected to no fewer than five randomly selected data points, taken via an Olympus Vanta handheld XRF analyzer. This method produced results that were statistically indistinguishable from those generated on powdered samples. The Olympus Vanta used in the present study was an upgraded version of the Olympus Delta used in Tibbit's (2016) doctoral research. A correction matrix for the Olympus Vanta was developed to ensure readings between the two units were compatible.

Figure 16.4 Top: Tibbits analyzing geochemical signatures of granite with the Olympus Vanta; Bottom: all samples laid out in BREA field lab (photos by M. Brouwer Burg).

Results

There were 152 pieces of ground stone from the middle reaches and of these, 26 were classified as granite tools. From this, 22 were plotted using Rb/Sr and Sr/Y concentrations in ppm (**Figure 16.5**). Four samples were removed because they were very weathered or not able to be identified as granite to the level of certainty we would like to have. As shown in **Figure 16.5**, the dominant source location is Mountain Pine Ridge. Four pieces were removed from analysis because of concerns with weathering or identification.

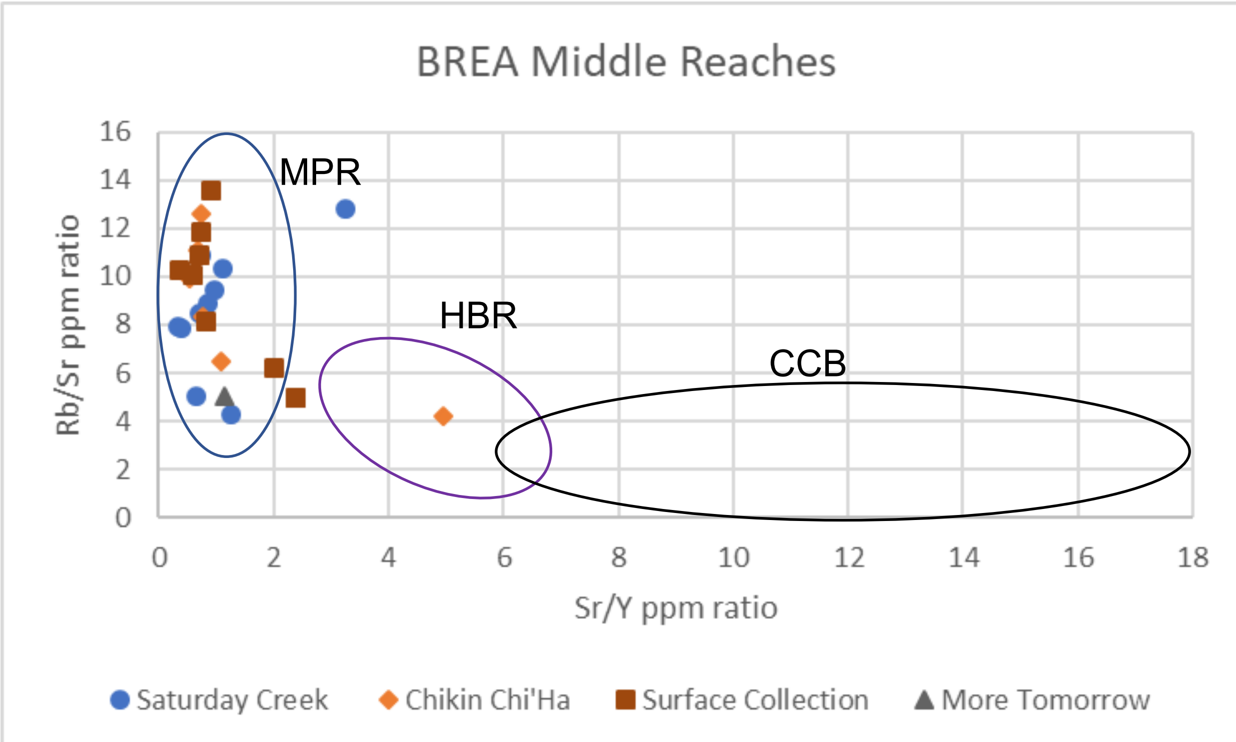


Figure 16.5 Results of XRF on granite specimens from the BREA middle reaches sample (image by T. Tibbits).

There were 55 pieces of ground stone from the lower reaches of the Belize River, of which 10 were granite. All 10 granite specimens were plotted using Rb/Sr and Sr/Y concentrations in ppm (**Figure 16.6**). The dominant source location was also Mountain Pine Ridge ,with eight out of the 10 specimens falling into the MPR range. However, two of the specimens seem to match the HBR source. With this small sample size, that 20% could be meaningful.

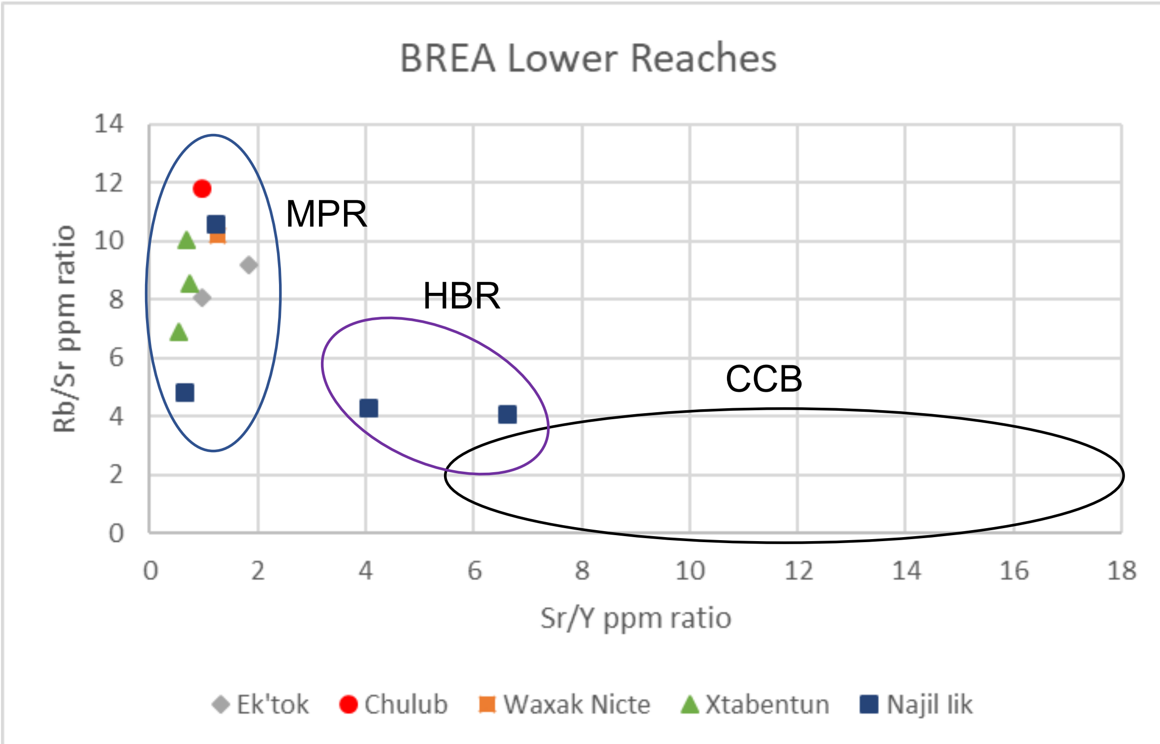


Figure 16.6 Results of XRF on granite specimens from the BREA lower reaches sample (image by T. Tibbits).

Generally speaking, ground stone tool raw material varied more in the lower reaches than in the middle reaches. The previously analyzed assemblage from the middle reaches was predominantly granite; the few exceptions were typically still igneous in nature but likely from the Bladen Volcanic complex in the southern portion of Belize. The lower reaches, however, presented a different story for geological resource management. We see more variety in raw material type and more procurement of locally available resources in addition to non-local materials. The materials from the lower reaches included locally available chert and limestone ground stone tools in addition to non-local materials such as basalt, dacite, chlorite, jade, and pumice. There were also some samples where conclusive identification was difficult due to weathering, alteration, and oxidation from post depositional processes.

In terms of the granite, visual differentiation between the plutons was not a viable indicator. While grain size and crystalline nature in many samples matched MPR, color was not always as pink as we have come to expect from the region. The pink hue is due to the presence of potassium feldspar, a mineral that can exhibit a salmon-pink color but can also be pale cream to white (**Figure 16.7**). Due to this variation in this mineral's characteristics, visual identification of granites is dubious at best. Geochemical or petrographic analysis should always be the standard procedure for accurate granite identification.

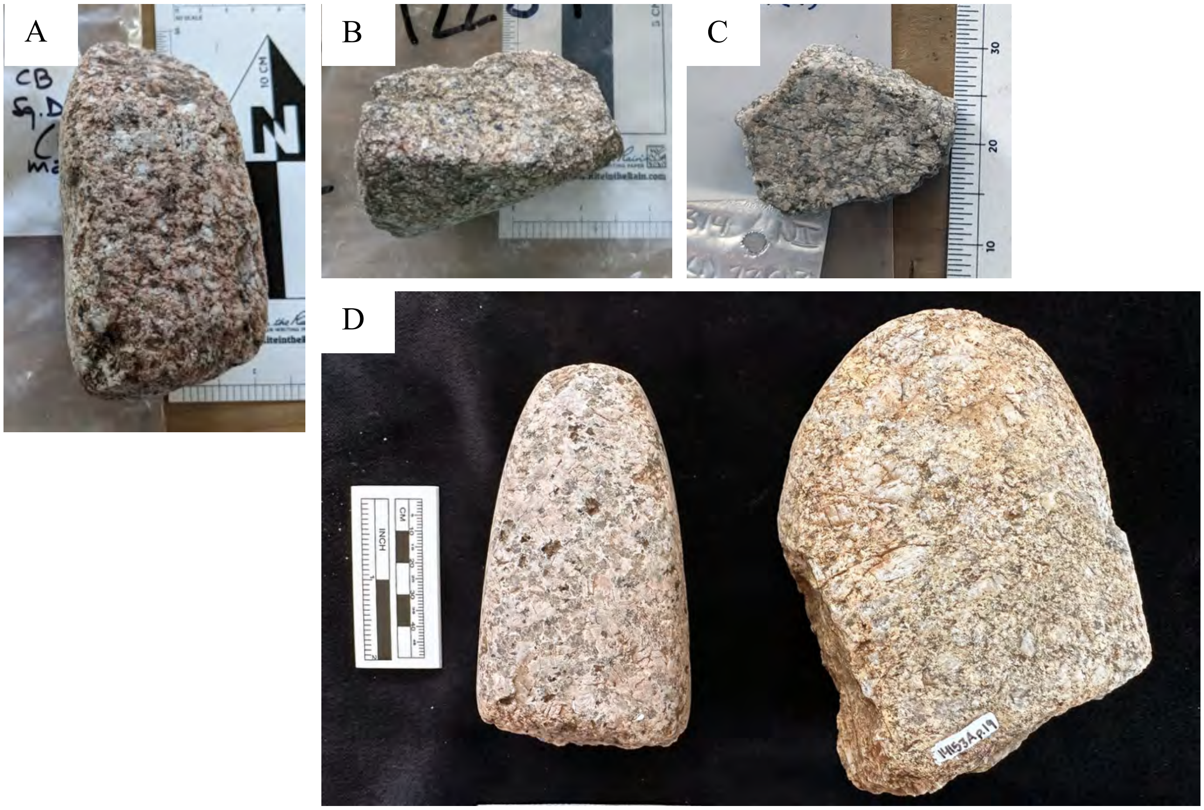


Figure 16.7 Granite specimens displaying different hues and grain size. A and D: MPR granite; B and C: HBR/CCB overlap zone (photos by T. Tibbits).

Interpretations and Conclusion

While our sample sizes were small, the results of our study indicate that the dominance of Mountain Pine Ridge granite continues from the middle reaches into the lower reaches of the Belize River Valley. Of the ten characterized granite ground stone tools from the lower reaches, two (or 20%) displayed some variation, coming from either Hummingbird Ridge or Cockscomb Basin. Clearly, obtaining a larger assemblage of ground stone tools from the lower reaches will be important to clarify these results. Further work is also necessary to develop the correction matrix for the Vanta analyzer, which will hopefully help to distinguish between plutons. As we report in **Tibbits and Brouwer Burg, Chapter 13**, we have revised the geochemical signatures such that the overlap between the Hummingbird and Cockscomb geologic samples has been eliminated.

In addition to the patterns in granite usage, we also highlight the expanded range of materials used for ground stone tool production in the lower reaches. We find it very interesting that the ancient Maya of the lower reaches appear more likely to utilize local materials (e.g., chert, limestone, and sandstone) as well as a wider variety of non-local materials (e.g., basalt, pumice) for their ground stone tools compared to the Maya of the middle reaches.

Figure 16.8 Non-granitic ground stone tools from the lower reaches. Left: chert mano fragment; Right: Basalt mano fragment (photos by M. Brouwer Burg).

As we continue to explore granite use and movement throughout Belize, some avenues we wish to investigate include:

- How were ground stone tools being moved physically throughout the region? Were the Maya utilizing the waterways which would seem to be the most energetically efficient mode of transport for these burdensome loads? How would we determine if this was the case?
- While our work focuses on the Belize River, the transport from Mountain Pine Ridge would likely have started on the Macal River, so what role do the other major rivers play? Are granites being moved on the New or Sibun Rivers?
- Why is Hummingbird Ridge granite not as extensively utilized? It appears today to be easy to obtain, there are readily accessible boulders at the surface, and the vegetative cover is not as intense as Cockscomb Basin, but yet very little ground stone material appears to have derived from there.

We will continue to address these questions in future research and note that we have a manuscript accepted for publication in the journal *Ancient Mesoamerica* that attempts to hypothesize some of the different mechanisms for granite ground stone movement (see Brouwer Burg et al. in press).

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Chapter 17

Bioarchaeological Analysis of an Altun Ha Burial from the January 2024 Field Season

Jack A. Biggs

Introduction

Excavations conducted by the BREA team during the January 2024 field season took place, in part, just outside the boundaries of the Altun Ha Archaeological Reserve in an area designated by David Pendergast as 'Zone E' (Pendergast 1990). The 2024 archaeological investigations of Zone E targeted marine shell processing and bead production with Operations 72 and 74 (see **Kaeding et al., Chapter 5** and **Harrison-Buck et al., Chapter 7**). The massive amount of small marine shells found during the excavation of Op.72 led the BREA team to investigate a nearby structure that had not been noted on earlier maps of Altun Ha. This structure was designated as Str. E-66, following the naming scheme originally devised by Pendergast during his excavations in the 1960s. The discovery of a poorly preserved burial within Str. E-66 was then given the designation of Bu.E-66/1, again following the naming schema used by Pendergast for the many other burials discovered at Altun Ha. Given that the BREA excavations were conducted on the land surrounding the Altun Ha Archaeological Reserve, the site annotation of these investigations is AH-BL (Altun Ha-Brenda Lopez, named after the landowner). This chapter will detail the archaeological context and lab analyses for the Bu.E-66/1 individual from AH-BL.

Description of Research and Methods Used

Both *in situ* and field lab analyses were conducted on the remains so that as much information as possible could be gathered. Excavation of the remains was done slowly and carefully using wooden clay modeling tools, bamboo skewers, and fine-haired brushes. Once removed, the remains were taken back to the BREA field lab and washed with water and fine-bristled toothbrushes then placed on ¼-in screen and/or fine window screen to dry before any analyses were conducted.

All data collected during analyses were done in accordance with the *Standards for Collection of Data from Human Skeletal Remains* (Buikstra and Ubelaker 1994) combined with the opensource Transition Analysis 3 (TA3) software when possible. Human bone identification was done using multiple reference books present at the BREA field lab (White et al. 2011) and in the field (White and Folkens 2005). Dental development was scored using the London Atlas of Human Tooth Development and Eruption (AlQahtani et al. 2010). As much data per individual was collected using these sources including a full osteological inventory, estimations of age at death and biological sex, and the presence and interpretations of pathological conditions, cultural modifications, and taphonomy. Skeletal inventory and analysis sheets were created for the BREA Project to accommodate the cultural- and region-specific circumstances in which human remains have been found. These forms are a combination of skeletal forms from other institutions and projects (such as Arizona State Museum Osteology Recording Packet from the University of Arizona and the Anthropology Recording Form for Individual Adult Skeletons from the International Forensic Centre of Excellence and the California State University, Chico).

Archaeological Context

Burial E-66/1 (henceforth Bu.E-66/1) was found while excavating Str. E-66 (**Figure 17.1**). This structure was chosen for investigation due to its proximity to a large open area/platform where shovel test survey and targeted excavations (Op.72) revealed vast amounts of marine shells (see **Kaeding et al., Chapter 5**). Str. E-66 is a small, square structure, measuring roughly 4-x-4 m and oriented cardinally. At least three construction phases have been identified. While the BREA team originally interpreted Str. E-66 as a thick-walled, free-standing building during its final construction phase, excavations indicated the structure was actually a square platform topped by a perishable superstructure. A construction pen was erected and then filled in to create this platform, as seen in **Figure 17.1.**

Some of the uppermost platform stones were visible on the ground surface. While excavating Zone 1 (topzone) fragments of human bone were found in Square C near the northwest corner of the structure. More human bone fragments were found in Zone 2 (collapse) just under Zone 1 in the same area. When a cluster of arm bone fragments were found wedged in between in situ architectural stones, it was determined that these were not isolated, randomly dispersed human remains within the construction fill, but rather a discrete event representing either a burial or bone cache/deposit (**Figure 17.2**). This feature was given its own zone (Zn.6) and a burial designation: Bu.E-66/1.

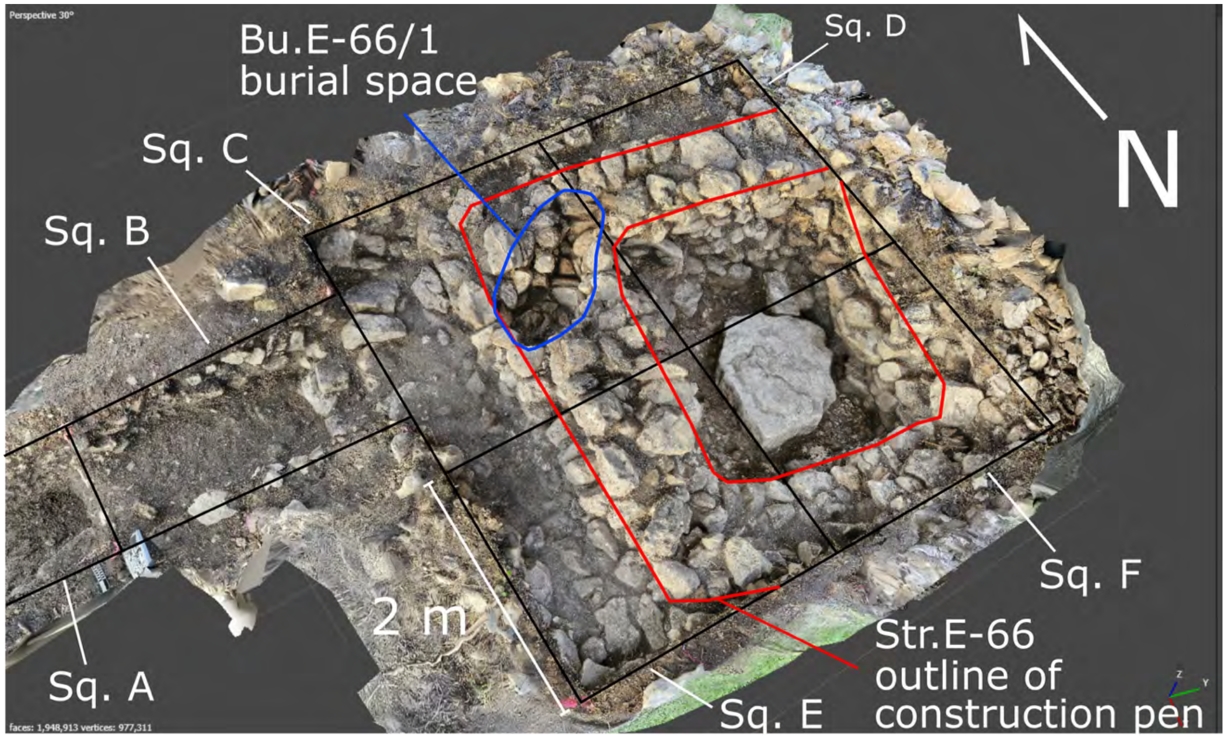

Figure 17.1 Str.E-66 with burial area indicated (photo by J. A. Biggs).


Figure 17.2 *In situ* arm bones of Bu.E-66/1 poking out of the western edge of Str. E-66 (photo by J. A. Biggs).

There were no capping stones or rocks demarcating the boundaries of an interment pit. This suggests that Bu.E-66/1 was interred within and as part of the construction fill as the final phase of the structure was being built. Additionally, the matrix in which the remains were found did not differ in terms of texture, consistency, or the number and type of inclusions compared to the surrounding matrices associated with the final phase construction. While some of the remains were still somewhat *in situ*, namely the long bones of the arms and legs, many of the smaller bones and fragments were “spilling” out of the structure’s west side or had fallen into voids between rocks associated with the platform construction.

As a result, the original orientation and burial position was disturbed. However, the presence of cranial bones, teeth, a vertebral fragment, and the proximal humerus coming out of the structure on the west side; metatarsals and foot elements located to the northeast; and the likely *in situ* leg bones suggest that the Bu.E-66/1 individual was interred flexed on their right side with their head to the west or maybe southwest (**Figure 17.3**). Preliminary ceramic analyses suggest the structure’s final phase, and therefore the interment of Bu.E-66/1, dates to the Terminal Classic Period (Harrison-Buck, personal communication 2024).

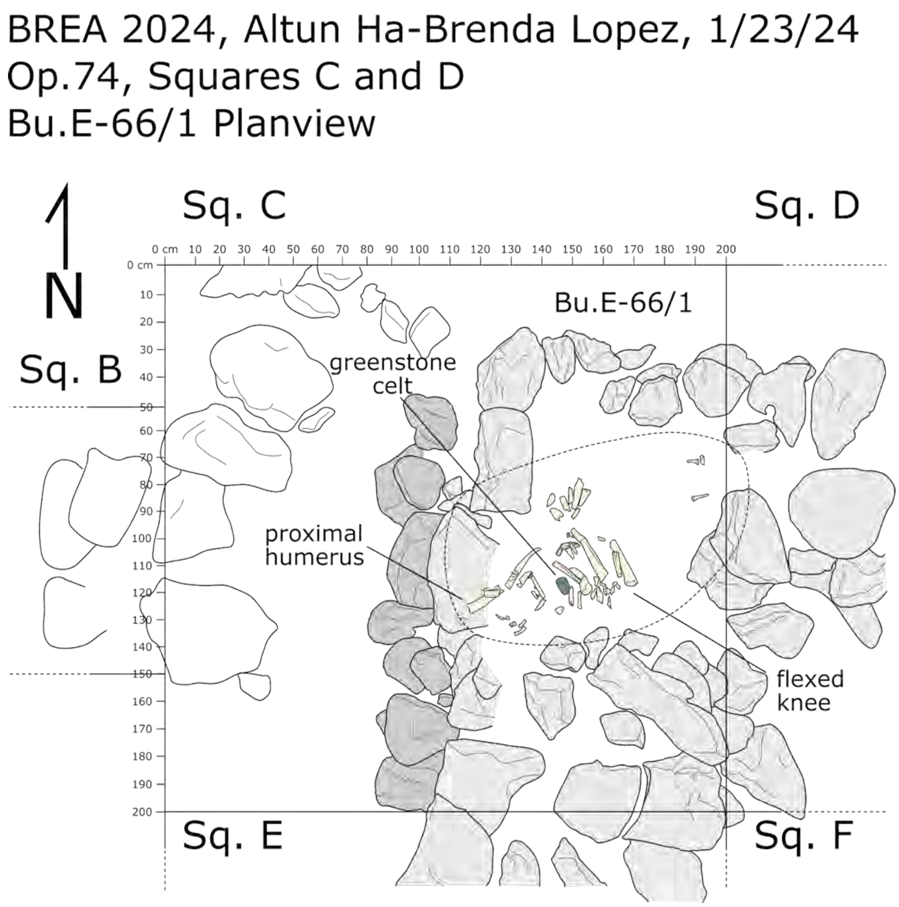

Figure 17.3 Planview map of Bu.E-66/1 within Str. E-66 (map by J. A. Biggs).

The only non-perishable good associated with this individual was a greenstone celt measuring about 6-x-4 cm (**Figure 17.4**). It was located just west of the main leg bone clusters and near/within the arm bone clusters (**Figures 17.5**). As this individual was likely interred in a flexed position on their right side, the placement of the celt would have been near their arms and/or lower torso during burial. Use wear analysis has not been conducted on the celt, so it is unknown whether it was functional or ritual in nature.

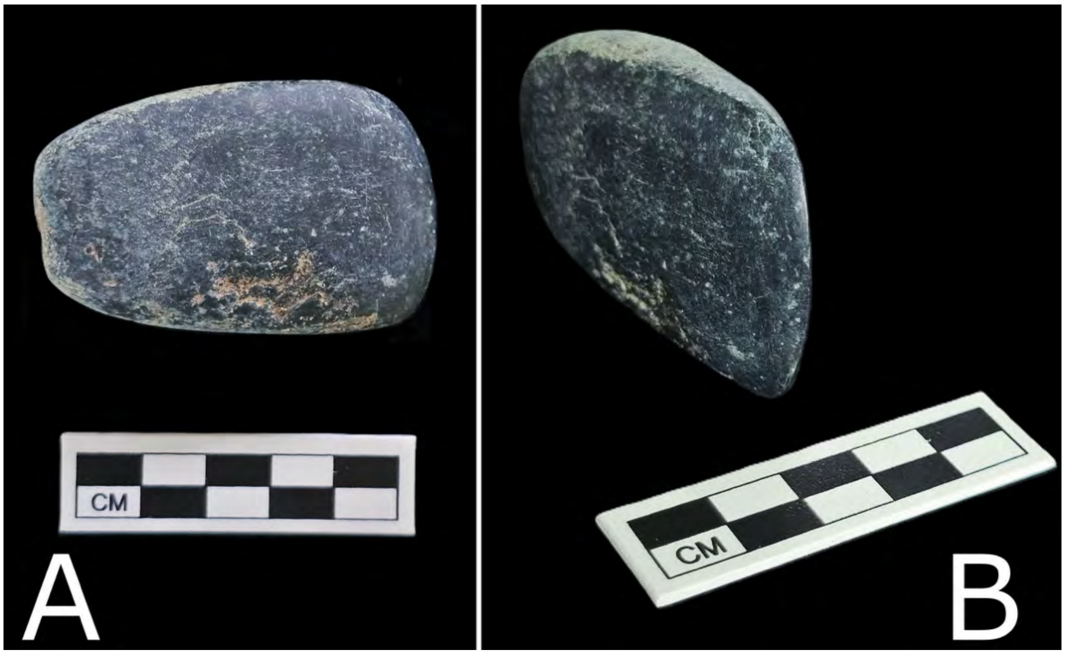

Figure 17.4 The greenstone celt associated with Bu.E-66/1 (photos by J. A. Biggs).

Greenstone celts are mostly thought of as prestige items and are commonly found in Preclassic ritual contexts such as celt caches and less often included in burials (Apyama et al. 2017). The greenish hue of these celts appears to have been of great importance as it has been argued that the color green is associated with the center of the world in Yucatec Maya codices (Miller and Taube 1993). The shape of a celt has also been interpreted as representative of an ear of maize or an individual maize kernel, symbolizing seeds and a connection to agriculture and abundant harvests (Freidel and Reilly 2009; Taube 2000).

Taube (2004) also argued that in Olmec art, celtiform depictions are sometimes intended to represent a loincloth or a phallus. He suggested that that celts are reflective of the heavy labor carried out by men when clearing forests and fields. While it is inadvisable to base a sex estimation or gender identity of a burial individual on the items they were interred with, gendered items, such as celts, can help bolster interpretations and add context and meaning. Thus, the presence of the greenstone celt with the Bu.E-66/1 individual, whose few skeletal remains suggest a sex estimation of possibly male (discussed in greater detail below), indicate that this individual is *more likely* to be male.

Figure 17.5 The greenstone celt *in situ* with Bu.E-66/1 (photo by J. A. Biggs).

Another burial from Altun Ha (Bu.TB-4/1) excavated by Pendergast contained a serpentine celt. Located near the stair block of Temple B-4 in a stone-lined tomb of an adult of unknown sex, this celt was part of a large set of prestige goods including 432 shell fragments, 285 jade pieces, 132 crystal hematite pieces, 24 obsidian blades, eight shells, seven pearls, four ceramic jars, four chert eccentrics, three jade pendants, three chert blades, two ceramic *incensarios* filled with ash, two shell bivalves, two shell beads, two stingray spines, and a coral fragment. This interment was dated to the early Muan ceramic phase at Altun Ha (AD 750-800).

An early burial at Ceibal (burial 153, c. 600-450 BCE), contained five sacrificed individuals and contained a proximal fragment of a greenstone celt, the only instance of a celt included in a burial at the site (Aoyama et al. 2017). Four of the five individuals in the burial were infants and placed with their heads facing each of the cardinal directions, while a 3–4-year-old was placed between the west and south individuals. This was clearly a significant and spiritually charged interment; the inclusion of a greenstone celt fragment is not accidental nor incidental, but incredibly meaningful given the context. It may have functioned as a representation of life or a seed, as Taube has posited (2000).

Lastly, burial A64 from Uaxactun (AD 800-900)—a crypt burial located within a bench in Room 28 of Str. A-V, part of the palace complex at the site—contained the skeletal remains of an adult female lying supine and interred with 3 ceramic vessels, 1 jade bead, 1 obsidian flake, a bone tool, crystal hematite, and a celt. While the number of burials containing celts is undoubtedly greater than these three examples and the individual reported in this chapter, these cases highlight the variability of the burial contexts in which greenstone celts have been found. While celt caches seem to have been more common during the Preclassic, the presence of celts in burials dating to the Late and Terminal Classic suggests their significance did not wane but possibly accrued new or different meanings. Moreover, these other burial examples were of elite individuals or those used in ritually significant deposits. This makes the inclusion of the greenstone celt with no other goods in the burial of an isolated individual within the construction fill of a small Terminal Classic platform at Altun Ha all the more intriguing.

Whether or not this celt was created specifically for this individual's burial or if it was used as a woodworking tool is not known at this time. However, its inclusion is nonetheless interesting and somewhat enigmatic as all other evidence of this structure's purpose suggests it may have been involved in shell bead production/distribution (see **Kaeding et al., Chapter 5**). This celt may have been placed in this burial as a prestige item for an important, possibly male individual within the community.

Osteological Assessment of the Bu.E-66/1 Individual

Assessment of the remains belonging to Bu.E-66/1 were analyzed both in the field while *in situ*, as well as in the field lab. As previously mentioned, only some of the long bones were still in their original location within the burial space, while others fell into voids between rocks and were also "spilling" out of the structure's walls. Additionally, many of the *in situ* remains were highly fragmented.

Skeletal Preservation and Completeness

Overall, the remains of the Bu.E-66/1 individual were in fair to poor condition with a high degree of fragmentation, despite good bone quality. Less than 50% of the skeleton was recovered and able to be analyzed. **Table 17.1** shows the skeletal inventory for Bu.E-66/1.

Age and Sex Estimation

Estimation of the age of the Bu.E-66/1 individual at the time of their death was hampered by the numerous missing skeletal elements used in such estimations, as well as the poor preservation of indicators on remains that were recovered. The bone classes found during excavation are almost all represented by diaphyseal fragments with few articular surfaces. Thus, the age estimation for Bu.E-66/1 was based almost entirely on the dentition.

All teeth found during excavation had fully formed and closed off root tips, except for all four of the third molars (wisdom teeth). The root tips for the third molars were almost closed, but slightly open. This indicates that the teeth were almost developed, but not fully (AlQahtani et al. 2010; Moorrees et al. 1963). While the developmental completion times of the third molars are the most variable of all teeth, this nearly completed development of the third molar root tips suggest that the Bu.E-66/1 individual was a young adult, falling into the earlier end of that age classification. This could place them within an age range from about 18-22.5 years old at the time of their death.

Table 17.1 Skeletal inventory for Bu.E-66.1. Presence reported as percent complete; blank = absent/not observed.

Element	Left	M/?	Right
Frontal			<25%
Parietal			50%
Occipital		<25%	
Temporal			<25%
Maxilla	<25%	50%	
Zygomatic			
Sphenoid			
Nasal			
Ossicles (#)			
Mandible			50%
Hyoid			
C1/Atlas			
C2/Axis		50%	
C3-C6			
C7			
T1-T9			
T10			
T11			
T12			
L1-L4			
L5			
Sacrum			
Coccyx			
Manubrium			
Sternal body			
Xyphoid			

Element	Left	?	Right
Rib 1			
Rib 2			
Rib 3-10			
Rib 11			
Rib 12			
Clavicle			25%
Scapula		<25%	
Humerus	50%		90%
Radius	90%		
Ulna	90%		25%
Ilium			
Ischium			
Pubis			
Acetabulum			
Auricular			
Femur	50%		90%
Tibia	25%		50%
Fibula	50%		90%
Patella			25%
HANDS			
Carpals			
Metacarpals		75%	
Manual Phalanges		50%	
FEET			
Tarsals			
Talus			
Calcaneus			
Metatarsals	<25%		50%
Pedal Phalanges		<25%	

Corroborating this young adult age estimation based on the third molars are the attrition scores for all recovered dentition. Overall, the scores were very low based on the lack of wear patches/facets and the very small amount of exposed dentine.

Sex estimation for this individual suffered the same constraints as did the age estimation. Very few elements were preserved well enough to be utilized. Moreover, those that were available are more effective when used to bolster, rather than be used as the primary basis of an age estimation. With these considerations in mind, only a fragment of the mandible and the general robusticity of the long bones were used.

A portion of the right half of the mandible had a wide mandibular ramus. Unfortunately, neither the gonial angle nor any portion of the mental eminence was recovered. This suggests that the mandible belonged to a possible male individual, as the mandible is typically a sexually dimorphic bone in its overall morphology. Moreover, the general size and robusticity of the long bones, namely the femora, tibiae, and humeri, are ambiguous to possibly male. Thus, a tentative sex estimation for the Bu.E-66/1 individual is possibly male. However, it should be reiterated that this sex estimation was conducted using only two qualitative indicators, neither of which exhibit features that strongly point to one sex over the other.

Dentition

Dental preservation for Bu.E-66/1 was good with almost all recovered teeth exhibiting complete crowns and roots. A total of 28 teeth were found. Due to poor preservation of the maxillae and mandible, it is unknown if any of the teeth not recovered were lost antemortem. **Table 17.2** shows the dental inventory for Bu.E-66/1.

Table 17.2 Dental inventory for Bu.E-66/1 'X' = tooth present/recovered.

RM^3	RM^2	RM^1	RP^2	RP^1	RC^1	RI^2	RI^1	LI^1	LI^2	C^1	LP^1	LP^2	LM^1	LM^2	LM^3
X	X	X		X	X	X	X	X		X		X	X	X	X
X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
RM_3	RM_2	RM_1	RP_2	RP_1	RC_1	RI_2	RI_1	LI_1	LI_2	C_1	LP_1	LP_2	LM_1	LM_2	LM_3

Caries were observed primarily on the posterior teeth. The only anterior tooth with caries was the right maxillary canine. **Table 17.3** breaks down the number and type of caries per tooth.

Table 17.3 Dental caries by tooth and type for Bu.E-66/1.

Tooth	Occlusal	Interproximal	Cervical	Smooth Surfaces
RC^1				3
RP^1			1	
RM^3	6			
LM^1		1		1
LM^3	2			
RM_2	4			1
RM_3	2			
LM_1	2			1
LM_2	2			1
LM_3	1			1

Calculus was observed on all but three teeth (RM^3, LM^3, and RM_3). Calculus was scored on a scale of having a small, moderate, or severe amount present on each tooth. Ten teeth had a small amount, 14 had a moderate amount, and one tooth had a severe amount. The number of caries present and the moderate amount of calculus is surprising given the likely age of the individual, a young adult in their late teens to early 20s (discussed above). Taken together, it is possible that this individual consumed a diet high in sticky carbohydrates, such as maize or amaranth.

Lastly, linear enamel hypoplasias (LEHs) were observed on only two teeth. Horizontal grooves occurred on the left maxillary second premolar and the left mandibular canine. This suggests that the Bu.E-66/1 individual survived at least one stress event during their childhood.

Pathology and Trauma

Only two small examples of pathologies were observed on Bu.E-66/1 (excluding the dental pathologies discussed above). The first were small patches of woven bone seen on mandibular fragments. These periosteal reactions could be attributed to numerous maladies, thus making it impossible to ascertain a specific cause. However, the woven bone patches are not located near alveolar bone and do not exhibit any drainage channels, suggesting that they are not the result of dental abscesses.

The second set of pathologies are likely examples of porotic hyperostosis seen on cranial fragments. An occipital fragment located near the lambdoidal suture exhibited the porotic appearance indicative of porotic hyperostosis with some healing, indicating that it was no longer active at the time of death. A fragment of frontal bone located near the supraorbital foramen also showed some signs of possible porotic hyperostosis, however this is less clear than that seen on the occipital fragment. Porotic hyperostosis only occurs during childhood and is considered a general indicator of childhood disease or stress (Ortner 2003; Waldron 2009). Thus, the inactive nature of these porotic hyperostosis examples is not surprising given the individual's estimated age as a young adult at time of death.

No signs of trauma were presented on these bones.

Taphonomy

While excavating the final phase of Str. E-66, large chunks of plaster were discovered that were likely the result of termite activity (breaking down the plaster and reconsolidating it in their tunnels). These large chunks of plaster (up to 20+ cm thick) were also located near the western "wall" of the structure, near Bu.E-66/1. In some instances, "plaster melt" had adhered to bone fragments found during excavation (**Figure 17.6**). This prevented some analyses as certain bone surfaces were covered by up to 0.5 cm of "plaster melt".

Figure 17.6 Bu.E-66/1 bone fragments with adhered plaster "melt" (photo by J. A. Biggs).

Further evidence of termite activity was seen in the presence of stellate scarring on some of the cortical surfaces of long bones (**Figure 17.7**). Stellate scarring is the result of termites gnawing on the bone surface from multiple directions, creating a small star-like pattern (Parkinson et al. 2010). Taphonomic damage due to termites has been observed at other ancient Maya sites in Belize, though mostly within caves and rockshelters (Wrobel and Biggs 2018).

Figure 17.7 Termite damage in the form of gnawing and stellate scarring on the right tibia diaphysis of Bu.E-66/1 (photo by J. A. Biggs).

Interpretations and Conclusions of Bu.E-66/1

Burial E-66/1 was the first burial excavated at the site of Altun Ha since the original excavations were completed by Pendergast and his team in the 1960s and 70s. Osteological analyses from this poorly preserved burial revealed that the interred individual was possibly male individual and died as a young adult in their late teens or early 20s. Few pathologies were visible apart from nonspecific periosteal reactions on their mandible and evidence of childhood illness in the form of porotic hyperostosis and linear enamel hypoplasias. No other major health events can be interpreted from the remains at this time given the overall paucity of skeletal elements that were preserved and recovered.

Given the young age of this individual, the amount of calculus and number of caries present is somewhat surprising. As discussed previously, a diet high in foods such as maize and/or amaranth could account for this. Future research could include the use of dietary stable isotopes from the dentition to test whether this individual consumed a diet high in C4 plants such maize and amaranth. White et al. (2001) conducted a dietary reconstruction of residents from Altun Ha using the dentition of 72 individuals. These authors found that the individuals from Altun Ha had elevated $\delta^{15}N_{col}$ values, suggesting the individuals consumed a diet high in reef and marine resources. Moreover, the average $\delta^{15}N_{col}$ values seen in the Altun Ha individuals were higher than those of burial populations from Copan, the Upper Belize Valley, and the Petén region (White et al. 2001). While a diet high in marine resources could account for the amount of caries and calculus seen on Bu.E-66/1's dentition, C4 plants and foods are the more likely culprit. Thus, further research is needed to determine if the Bu.E-66/1 individual had a diet that diverged from other Altun Ha burials and other burials in the Maya world.

The inclusion of the greenstone celt in the burial is another interesting facet. As discussed in greater detail above, celts are usually included in caches or as part of elite, high status burials and generally thought of as more ritual than practical. Moreover, the interpretations of greenstone celts (ears of maize, maize kernels, land-clearing, woodworking, etc.) do not conform to the archaeological evidence seen in the excavations of Str. E-66 which is possibly associated with shell bead production or distribution.

Lastly, the actual burial position of Bu.E-66/1 is somewhat aberrant. This individual was buried in a flexed position, likely on their right side with their head to the west. Over 300 of the individuals found during the original excavations at Altun Ha were published in Welsh's dissertation (1988), as he attempted to standardize burial data for the Maya region. These data show that of the 325 individuals reported by Welsh, only 16 (4.9%) were buried in a flexed position like Bu.E-66/1, making this an uncommon burial style at the site. Moreover, only one individual dating to the Terminal Classic was buried in a flexed position (1.4%). If Bu.E-66/1 dates to the Terminal Classic, it would only be the second example of this burial style from this time period at the site.

While relatively few skeletal remains of Bu.E-66/1 were recovered and preserved, a surprising amount of information can still be interpreted, especially when we look at the archaeological contexts in which the remains were found. Despite the short life of this individual, they may have played an important role or had a unique position within the community, based on the aberrance of their interment. It is possible that there are more interments within the construction fill of Str. E-66 that might further elucidate the structure's function or clarify the life of the Bu.E-66/1 individual. However, no further excavations of Str. E-66 are planned at this time. Nonetheless, this burial adds to the complex history of the site and sheds insight into the structure itself and the surrounding area, which had previously received only minimal archaeological attention.

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Chapter 18

Future Directions for BREA

Eleanor Harrison-Buck and Marieka Brouwer Burg

In the last 14 years, the Belize River East Archaeology (BREA) team has probed the deep history of human-environment interactions in the middle and lower reaches of the Belize River Valley, casting our sights back over the last ~8,000 (Brouwer Burg and Harrison-Buck 2024; Brouwer Burg, Harrison-Buck, and Krause 2023; Harrison-Buck et al. 2017, 2018, 2020). In the lower reaches, particularly, we have benefited from working in an area of high ecosystem diversity (there are no less than eight types of ecosystems present in this portion of the study area) and high connectivity (via the river, coastline, and overland routes, and today, via roads). We have been able to investigate many different questions about the ways people moved through, made a living, and imbued these landscapes with meaning. While the area was once considered to be devoid of much Prehispanic settlement (see Chase and Garber 2004), we now know that this section of the watershed has been inhabited for many generations, extending from the present to the preceramic past.

The results of our 2024 research campaigns contribute important information to our understandings of these past human-landscape interactions, specifically within the coastal plain of north-central Belize in the lower Belize River watershed. Here, ground and aerial survey and reconnaissance have indicated that a number of Archaic, ancient Maya, and historic sites existed between Chau Hiix and Altun Ha (see **Figure 1.1** in **Brouwer Burg and Harrison-Buck, Chapter 1**). Within this part of the watershed lie six sizeable inland lagoons (Revenge, Crooked Tree/Northern, Western, Southern, Mexico, and Jones); archaeological sites representing a variety of activities have been found in proximity to these lagoons and associated drainage features (e.g., Chulub, Ek'Tok, K'ak Mutnal, Jabonche, Morales, Chukte'ob, and Xtabentun). Unraveling how people used these "hydroscapes" and the higher and dryer ecosystems in between is critical to our investigations, which ask concomitant questions about how past groups organized themselves on the landscape, made use of local resources, imported goods like granite and obsidian, and interacted with other regions within the Maya Lowlands.

We have brought together an interdisciplinary team of archaeologists, geomorphologists, geologists, ecologists, and remote sensing and geospatial analysts to address a number of these questions through field and laboratory research. In this manner, moving forward we will continue working to reconstruct an increasingly detailed narrative about past human behavior in this low-lying area of Belize with our future research, described below.

Future Research Objectives

We will continue to investigate human-landscape interactions over time and space as a central component of future BREA research, focusing our efforts on the ancient Maya period as well as the preceding Archaic period. These complementary research efforts are designed to provide us with a fuller understanding of environmental, climatic, and behavioral changes over time. Below, we outline the future goals of these two main research initiatives.

Archaic Occupation

In the upcoming year of field research, we will investigate questions about preceramic Archaic groups who lived on the landscape prior to the advent of sedentary society and widespread reliance on maize domestication. Since 2020, the Northern Belize Archaic Adaptive Strategies (NBAAS)—a subproject of the BREA project—has documented a handful of new Archaic occupations in and around the CTWS, including New River Pine Savanna, Joe Goff, and Gloria Camp (Brouwer Burg et al. 2023; Brouwer Burg, Krause, and Haverland 2023; Brouwer Burg, Harrison-Buck, and Krause 2023). Predictive models generated by the NBAAS project identified additional areas of high Archaic settlement suitability (see **Brouwer Burg and Harrison-Buck, Chapter 2, Figure 2.3**; Brouwer Burg and Harrison-Buck 2024), mostly within ecotonal, transitional zones. In one such high suitability location, we identified the Morales site. In our initial visit to the site, we spoke with workers who reported regularly recovering ground stone and chipped stone tools diagnostic to the Archaic. Given the results of our surface survey and shovel test-pitting (STP) campaigns, in the coming year we plan to open excavation units in the northwest section of the Morales site where we identified clusters of chipped stone artifacts along the edges of a forest island. Our STP survey also indicated that the subsurface is at least partially intact and can therefore potentially reveal horizontal relationships and vertical stratigraphy. We will continue to survey the site on foot to identify areas of dense lithic scatters. Concentrations will be transected using STP survey with the goal of locating Archaic habitation sites. As noted in **Brouwer Burg and Harrison-Buck, Chapter 2,** fragments of spherical ground stone bowls have been found in the vicinity, along with pestles and other grinding implements, suggesting that plant food processing transpired at some time in the past here, perhaps of heat tolerant, sand-loving plant like amaranth or manioc.

Additionally, given the results of our field work and detailed radiocarbon and lab-based analyses of the linear fish trapping facilities in the Western Lagoon—which date the onset of construction of these features to the Late Archaic period (c. 3400–1800 BCE; see Harrison-Buck et al. 2024)—we propose to continue the search for occupations or activity areas associated with these features. We will focus these efforts on the western shoreline of Western Lagoon (**Figure 18.1**), as it has a higher terrace that was later occupied by the Maya and may have been a favorable place for staging activities in the Archaic. We have demonstrated that the eastern shoreline, on the other hand, rises so gradually that it appears to be less ideal and lacks any archaeological visibility (see **Krause, et al., Chapter 9**). Our future research along the western shoreline is intended to provide insight into the types of lithic and non-lithic technologies utilized by these groups to prepare and maintain the linear fish trapping features, as well as to explore what kinds of settlement patterning and human labor and staging was required. We have attempted in previous years to identify Archaic settlement along this shoreline with little success on account of the thick Maya overburden, related to the rich arable soils that exist here (Brouwer Burg et al. 2023, 2024, 2025). However, we plan to focus upcoming efforts near the approximate locations where the linear channels intersected the shoreline and where, perhaps, greater deposition has preserved traces of human activity from before the Classic Maya occupation in this area (**Figure 18.1**).

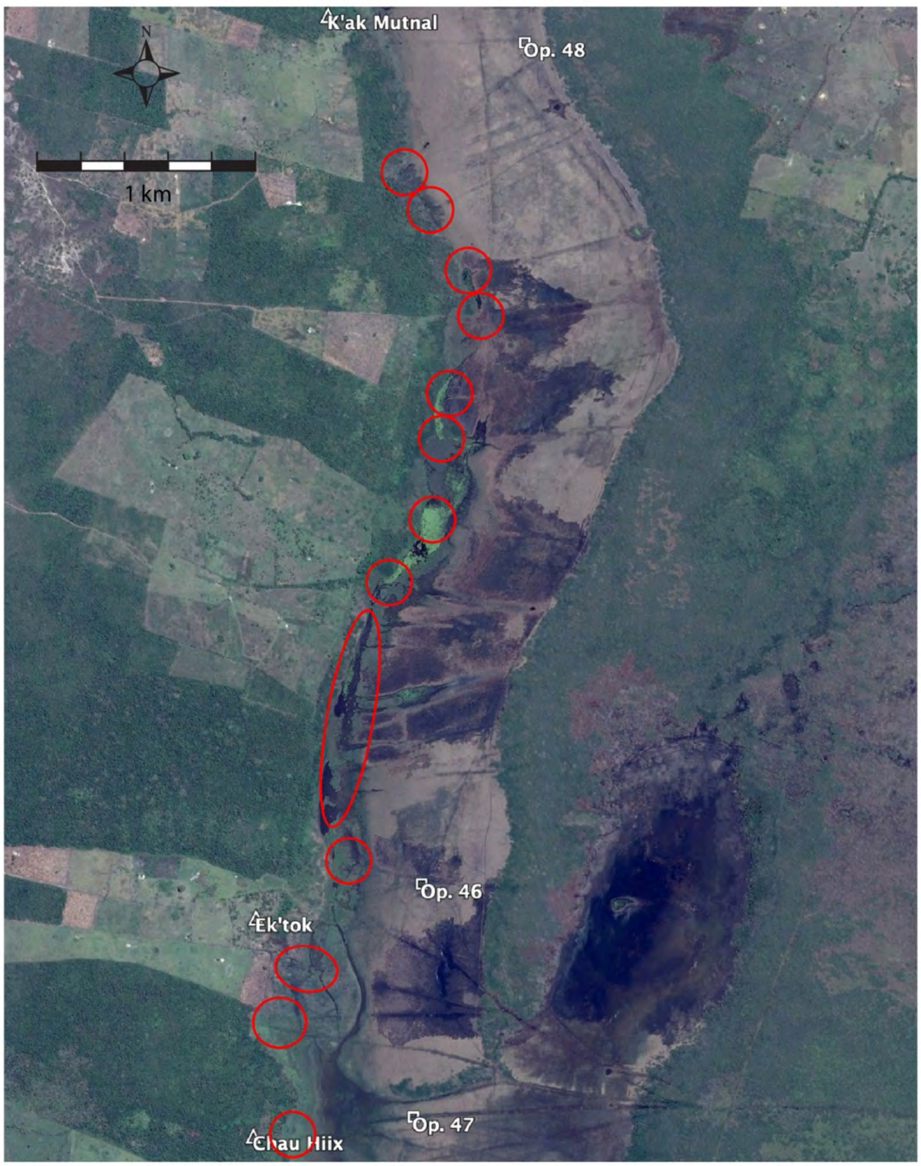

Figure 18.1 Areas along the western shoreline of Western Lagoon for future field testing (map by M. Brouwer Burg).

Maya Occupation

We plan to continue our investigations of Altun Ha in Plaza C, a possible marketing space just south of the ballcourt in the southwest quadrant of the site, just outside of the area developed for tourism (see **Brouwer Burg and Harrison-Buck, Chapter 1, Figure 1.3**). We also plan to conduct some of the first household level archaeology in the hinterlands of Altun Ha, with the goal of mapping the distribution of artifact categories like obsidian and shell to explore production and exchange within the site and beyond (**Figure 18.2**). As described in this report, during our January and Summer 2024 field seasons, we were granted permission by the landowner to access this area of Altun Ha, which contains the site's only ballcourt, several sizeable range structures, and multiple elite plaza groups (Zones C and E of Pendergast's original site map [see Pendergast 1979, 1982, 1990]). Despite being part of the site core, this western half of the site remains privately owned and is not included in the boundaries of the Altun Ha site core that has been developed for tourism. Using a LiDAR-equipped drone, BREA was permitted to fly over the site and produced a much more detailed topographic map of the entire Altun Ha site center and its surrounding peripheral settlement (see **Willis and Murata, Chapter 4**; **Figure 18.2**). We will continue to build on this site map in future seasons, flying more of the hinterlands and mapping with LiDAR the dense settlement surrounding the main site center. As there is a degree of misalignment between the LiDAR of Altun Ha and Pendergast's original site map, we also aim to ground truth each of his settlement zones in an effort to connect Pendergast's structure numbers to those in the revised topographic map.

As described in **Kaeding et al., Chapter 5**, the shovel test survey of Lopez Plaza in Zone E revealed thousands of whole and partial marine shell (*Melongena melongena*). Further excavations revealed that many of the marine shells were cut, perhaps for both meat extraction and also for shell bead processing. Excavations at Op. 74 on Structure E-66 yielded a high density of shell beads, a polisher, and a large number of chipped stone tools suggestive of shell bead craft production (see **Harrison-Buck et al., Chapter 7**). Other objects found in this same excavation include a small, polished greenstone celt, a copper bell, and several semi-precious stone beads made of hematite. In addition to shell beads, these particular types of exotic trade goods are described elsewhere as "currencies" used in marketplace exchanges (Masson and Freidel 2012).

Our excavations (Operations 80 and 81) in Plaza C were intended to further test whether the area was once used as a marketplace (see **Harrison-Buck et al., Chapter 10** and **Degnan et al., Chapter 11**). Studies have shown that long colonnade-like range structures and select ceremonial architecture, including ballcourts, often are found associated with marketplaces, but that these spaces generally lack domestic residential architecture (Dahlin et al. 2010; Jones 2015). In many cases, there are multiple entry points into the marketplace with paved roads (*sacbeob*) and numerous other smaller pathways (*callejuelas*) leading to these central plaza spaces from different directions, facilitating public access and the movement of people and goods (Cap 2015; Coronel et al. 2015; Hutson et al. 2017: 256; King 2015). Another characteristic associated with marketplaces is the presence of nearby water wells or *aguadas* (Dahlin et al. 2007). All of these features—long range structures, a ballcourt, multiple roads, and an aguada are associated with Plaza C at Altun Ha. From a configurational standpoint, the area strongly suggests a marketplace, but further excavation is needed to test this hypothesis.

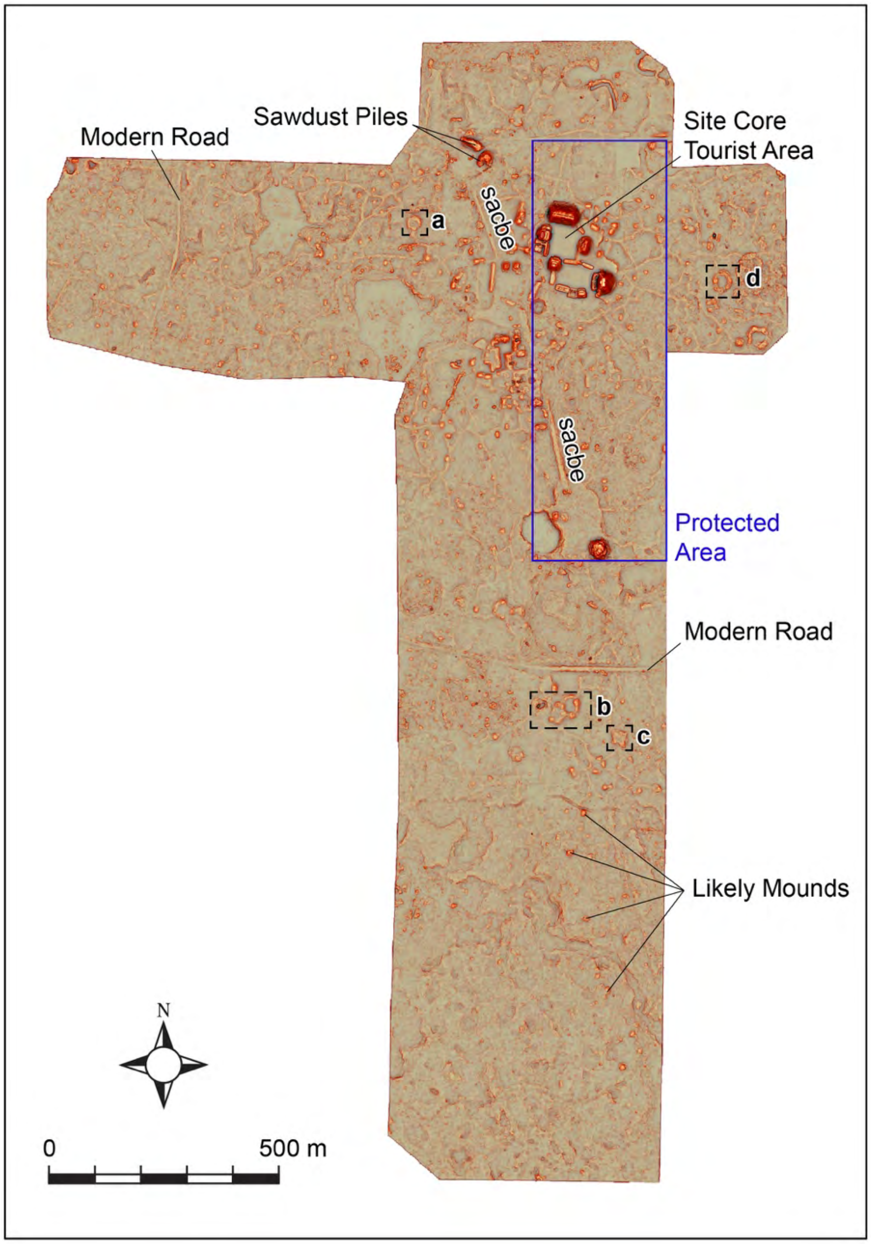

Figure 18.2 Areas of proposed research for upcoming research (LiDAR by M. Willis; image modified by M. Brouwer Burg).

In future research, we plan to reopen Operation 81 on Structure C3 and conduct a broad but shallow excavation across the summit of the platform to confirm the layout of the building. Preliminary analysis of the Operation 81 materials associated with the interior floor of Structure

C3 revealed a high density of stone tools suggestive of economic activities, including cores and stemmed blades likely dating to the Terminal Classic, which are indicative of cutting and perhaps butchering (see **Degnan et al., Chapter 11**; see also Masson 2001). These and other tool implements may point to specialized production, which is known to occur in the marketplace where participants were both vendors and producers of specific goods. Further horizontal exposure in Operation 81 will help us to evaluate the layout of the building, the range of activities taking place there, and the presence of spatially discrete artifact distributions that may be indicative of separate vending stalls and marketplace activities.

Elsewhere, vending stalls have also been detected as informal lines of stone constructed directly on the floors of open plaza areas at sites like Buenavista del Cayo in the upper Belize Valley and Chunchucmil in northwest Yucatan, Mexico (Cap 2022; Hutson 2017, ed.). Therefore, we also plan to carry out a series of shovel test pits across Plaza C in an effort to test for similar configurations in the plaza itself. Where concentrations of artifacts are found, we propose to conduct a series of test excavations in Plaza C. If time permits, we also plan to place an additional unit in the plaza area on and around Structure C-69 that lies on the southern edge of Plaza C. Like the neighboring Structure E-66 in the Lopez Plaza, this area may yield additional evidence of production associated with the marketplace, linking crafting and marketing between these two adjacent plazas.

A final goal for next year's field work is to conduct a pilot study of non-elite households at Altun Ha to supplement the existing record of palatial residences and tombs (Pendergast 1979, 1982, 1990). The aim of this subproject—the Altun Ha Household Archaeology (AHHA) project—will be to recover artifacts associated with craft specialization, such as obsidian and worked shell and to assess the distribution of household consumption and production patterns through time. Obsidian, shell, and other select trade items found in elite and non-elite households have been used to evaluate the presence of market economies at Maya centers, such as Tikal, Mayapán, and Chunchucmil (Hutson 2017, ed.; Masson and Freidel 2012). This study will assess whether a similar distributional approach (Hirth 1998) is applicable at Altun Ha and will complement the ongoing configurational and contextual studies in the proposed marketplace in Plaza C. If a central marketplace existed here at Altun Ha, we should expect to see an even distribution of such market-sourced trade goods represented in both elite and non-elite household contexts.

The AHHA pilot study will target areas visible in our recent LiDAR surveys that document numerous grouped and isolated mounds radiating from all sides of the Altun Ha site center and that are connected to Plaza C and the rest of the site core by a network of informal raised pathways or *callejuelas* (see **Willis and Murata Chapter 4, Figure 4.13**). Using these survey data, we have already identified four target areas for future work based on the following criteria: mound groups consisting of three or more mounds arranged around a small plaza ("residential groups"), located between 60.25–1 km from the site core, and connected directly to Plaza C by small, raised pathways (see **Figure 18.2**). To obtain a sample of domestic assemblages, we will target domestic refuse in midden deposits, which are likely to occur in the corners of residential plazas, against ancillary structures like kitchens, and along the outer base of residential mounds (Hutson and Stanton 2007; LeCount 2010). Middens will be identified through a series of systematic shovel test surveys. This will be the first study of non-elite residential contexts at Altun Ha and will assess the feasibility of a larger distributional study of non-elite households in future seasons.

Concluding Thoughts

The future research initiatives outlined above will guide our Archaic and Maya research goals for next year. Through the course of our research, we will be able to continue to monitor these sensitive archaeological areas in the BREA study area. Both the Morales site and Altun Ha have seen significant damage over the years due modern development and looting. The landowners at both sites have welcomed our requests to conduct survey, mapping, and test excavations. The sand mining at Morales has significantly impacted an important Archaic site that we believe was a residential occupation based on the presence of stone bowls and the large quantity of stone tools unearthed mostly by the excavator machinery. At Altun Ha, west of the site center (Zones C and E) there is a sawmill and cattle farm, which have contributed to some site destruction of the mounds in and around Zone C. However, the most devastating destruction at Altun Ha in recent years has occurred to the south in Zone E where, unbeknown to the landowners, looters have come on to the property and dug into several of the rooms in the main elite residence in the last several years. We have alerted the IA to this ongoing looting who have come out to inspect the damage. We have introduced them to the owners, who are open to a "land swap" for other government lands. We hope this might be possible so that the western part of the Altun Ha site center can be better protected and perhaps developed as an expansion of the site tour in the near future.

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