Rio Frio Regional Archaeological Project (RiFRAP): Report on the Fourth (2023) Field Season

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Chapter 1: Introduction and Executive Summary of the Fourth Season of the Rio Frio Regional Archaeological Project

From 10 June to 15 July, 2023, the Rio Frio Regional Archaeological Project (RiFRAP) conducted its fourth season of investigations in the Mountain Pine Ride Forest Reserve (**Figure 1**). That work was conducted under the auspices of IA permit, IA/H/2/1/23(04). All the work described herein was conducted in the Mountain Pine Ridge Forest Reserve, managed by the Belize Forest Department under permit FD/WL/1/22(23). Funds for the project were provided by the author's university, as well as an Archaeological Institute of America-National Endowment for the Humanities Post-Fieldwork grant. The chapters in this report detail those investigations. Also included are the results of an additional radiocarbon dates for Rio Frio Cave A from charcoal that was exported for that purpose in 2022. Lastly, an interim report on a study RiFRAP PI, Spenard conducted on a collection of artifacts collected from the Rio Frio Caves in 1928 by Gregory Mason (Mason 1928) and now housed by the Museum of the American Indian-Smithsonian Museum is included here.

RiFRAP had six specific goals for the 2023 field season, several of which stem from the results of the results of an aerial LiDAR survey collected as part of the NCALM Belize 2022 LiDAR Campaign (Spenard 2023). The goals of the season were:

1. Complete survey of Nohoch Batsó's site core, with a focus on the newly identified monumental areas reveled by the LiDAR survey and begin ground truthing other cultural constructions (isolated mounds, plaza groups, agricultural terraces, etc.) in the site's periphery.

2. Continue excavations to establish site chronology and development of Nohoch Batsó. Activities include stratigraphic excavations and shovel testing regimens, and cleaning and refilling looter's trenches.

3. Continue mapping the Buffalo Hill Quarries site, including new areas identified in the LiDAR survey.

4. Initiate detailed investigations of work areas in Buffalo Hill Quarries site including GIS aided documentation, surface sampling, and shovel testing.

5. Ground-truth and shovel test potential settlement affiliated with Buffalo Hill Quarries identified in LiDAR survey.

6. Ground truth potential cave entrances identified in LiDAR survey near Buffalo Hill Quarries, and Nohoch Batsó to evaluate their cultural significace and potential relation to quarrying activities.

Goals 1, 3, 4, and 6 were fully or partially realized. As explained in detail below, time did not permit working toward goals 2 and 5. Simply put, meeting Goals 3 and 4 dominated the field season as the sites were more complex and contained many more artifacts that we had predicted.

Figure 1. Satellite image showing RiFRAP permit concession area in orange polygon, sites investigated by RiFRAP and others in the surrounding region.

While we were unable to investigate any settlements associated with the Buffalo Hill Quarries, we did confirm the presence of several rural house mounds, including one above Tunnel Cave, and evidence of several others just south of Dougalas D'Silva Forest Station on the valley floor that had unfortunately been leveled during the ongoing road work. On a hilltop adjacent to them was a single mound that we named the Satah Witz site. Adjacent to the structure was a small sinkhole that we named Actun Satah Witz.

During the field season, intensive excavations were undertaken at two loci, the Buffalo Hill Quarries south of Pinol Sands, and the Satah Witz site. Reconnaissance and ground truthing aerial LiDAR data was also conducted at the Buffalo Hill Quarries site, in the Douglas D'Silva Forest Station area, and Nohoch Batsó (Spenard 2023). The work at Satah Witz was a salvage operation, undertaken because the hill it sits on was scheduled to be quarried in full for the Caracol Road construction project. The site, consisting of a house mound and diminutive cave, were going to be destroyed in those activities. Time constraints and the unexpected complexity of the quarry pits investigated at Buffalo Hill Quarries allowed for only three field days for ground truthing LiDAR data around Douglas D'Silva; nevertheless, several new sites were recorded as discussed below.

Overview of the Buffalo Hill Quarries

The Buffalo Hill Quarries site was the primary focus of investigations for the 2023 season. Project activities undertaken there included ground truthing and documenting 28 suspected quarry-workshop loci revealed in the LiDAR data. Our field work confirmed all but two of the potential sites. The two that we rejected were a bush and a log sitting near the base of a sloped natural drainage. More surprising was the extant of extraction-workshop areas that are not immediately obvious in the aerial scan. Extraction features such as cut faces and strip mines are found throughout the site, yet they are indistinguishable from the surrounding ground topography in the scans. The conclusion is that future remote sensing operations related to the granite groundstone industry in the Mountain Pine Ridge must be accompanied by aerial photography and by traditional boots-on-the-ground survey to fully inventory the sites there.

By all accounts, the research at the Buffalo Hill Quarries site can be considered a great success. A primary research question we aimed to address was, "how was material extracted from quarry pits"? In short, our excavations revealed that material was extracted by excavating pits in the sandy surface matrix until fresh, "living" rock was uncovered. Expedient pry bars made from beveled granitic blocks were then wedged between natural joints and fractures in the bedrock resulting in sheets and blocks of raw material being extracted. Extracted material, especially sheets that were too thin or otherwise insufficient to transform into tools were simply tossed to the edges of the pits, creating berms of discarded material around them. Sheets or blocks that were of appropriate thickness were at least partially reduced along the edges of the pits. Yet, just how much reduction and finishing was happening at the extraction loci remains unknown, but is a goal for future investigations.

At least some reduction and finishing happened at the extraction sites as evidence by the range of quartzite hammerstones recorded. The largest recorded, likely wielded by multiple individuals, weighed an estimated 25-30 kg, but most were single-handed weighing on average 750 g. The likely source of those tools is a large quartzite vein that runs along Pinol Creek at the northern extent of the site. Within the vein, we recorded, a 1-m tall mound with a footprint of approximately 20 m x 10 m that appeared to be a quartzite hammerstone workshop.

At the start of the season, the RiFRAP had mapped an area of approximately 15 hectares of the site. At the conclusion of the current season, we have mapped close to 50 hectares. Within the Buffalo Hill Quarries site, we have also identified a quartzite quarry where the hammerstones used in the quarry-workshops originated. Across Pinol Creek, we recorded the largest-yet quarry and workshop area. The site, nicknamed, "Moshy's Hill," but given the official site designation of MPR-2023-006, meaning it was the 6th distinct site recorded in the Mountain Pine Ridge in 2023. It is on a ridge with steeply sloping sides, which are covered in multiple, deep terraces of granitic rock debitage. The site continues to the top of the ridge where debitage piles continue. We were unable to locate its full extent.

At the Buffalo Hill Quarries site, we conducted detailed mapping on a multi-component bedrock exposure (Feature 21) that included multiple cut face quarries and bedrock milling features. We also placed a single excavation unit on an extraction area that was adjacent to a milling feature and where we recorded ceramics. The unit helped inform about how raw material was being extracted.

Most of the season was spent in an area of the Buffalo Hill Quarries designated Feature 25. There, we fully cleaned the vegetation from the quarry area to gain a deeper understanding of the quarrying and mano and metate production that took place there. That particular work area was chosen because it was away from the main road, and it had a similar appearance in the LiDAR data as another suspected major quarry area north of the Moshy's Hill site north of Pinol Creek. Time did not permit a visit to ground truth that site, but approximately 10 suspected large quarry pits are visible in the LiDAR data. Feature 25 contains just two.

After Feature 25 was cleared of vegetation, we placed an excavation trench composed of three adjacent 3 m x 2 m units across the larger of the two quarry pits. Three other units were excavated. Unit 2 was placed on the north side of the second quarry pit. It was situated to learn more about an upright granitic block that had a dense ceramic concentration associated with it. Unit 3 was intentionally placed off and away from the quarry area. Its goal was to expose the natural stratigraphy against which we could compare the stratigraphy in the Trench 1 operation. Comparative mineralogical samples were also collected form each level. Unit 4 was dug in the south side of Quarry Pit 1. It too was placed because of the presence of a high density of ceramics with charcoal adhered to it.

Much was learned about the quarrying process in these excavations. All proceeded either to bedrock or the undisturbed native soil. In particular, the excavations revealed that the natural laminar bedding of the granitic rock was used to extract material. The Maya made expedient wedges of a variety of sizes and shapes that they would use to separate and remove the laminar sheets of bedrock. Material deemed too thin was simply disposed of and left otherwise unworked along the sides of the work area. Thicker blocks and bricks were turned into preforms and tools that we refer to as picks. Those latter tools were likely used to knap away unwanted rock during metate production. Like the wedges, they were expedient tools that may have been created from discarded mano preforms. It may also be that picks were transformed into mano preforms after being used. We are still working out the *chaine opertoire*.

In addition to excavation, we piece-plotted all surface and excavated non-debitage artifacts into the project GIS. Recorded artifacts include hammerstones, mano preforms (partial, half, and full loaf), metate preforms, ceramics, picks, and anvil stones. Hammerstones, picks, and mano preforms were the most common non-debitage artifacts recorded. In-field measurements (length, width, thickness) were collected for all the objects except hammerstones. GIS data collection also included photographing each object using the iPad. Multiple photographs were often made of each object to capture its multiple sides. At the start of work at Feature 25, we aimed to collect a random 10% sample of the surface artifacts; however, we collected a larger sample of artifacts from our excavation, precluding the need to collect them from the surface. Surface objects were collected when they were within the confines of the units or if they were in excavation rock toss areas. More than 300 surface artifacts were plotted and recorded. All excavation units at the Buffalo Hill Quarries were marked with flagging tape or pin flags and either a Belizean quarter or nickel and then backfilled.

Work at the Satah Witz site was salvage in nature due to the hill being scheduled for quarrying activity. The site name means Disappearing Hill in Yucatec Mayan. The site consists of

a single house mound built on top of an artificially leveled hilltop. Approximately 4 m southeast of the house mound is a small cave that was named Actun Satah Witz. Six excavation units were placed around the structure, although only five dug. The units were placed to locate any remaining architecture of the mound. Unfortunately, the architecture had been completely destroyed by tree roots and intact walls were not able to be located. Nevertheless, a likely cache (Satah Witz Cache 1) consisting of three vessels and three limestone bars was recovered from the north side of the unit. To the east of the structure, we recorded a discarded metate with deep basin. To the north of the structure, below the hilltop platform, a roughly hewn metate preform was also collected. The recovery of that object suggests that the past inhabitants may have been stoneworkers in the mano and metate industry. The structure had been built directly on bedrock, and with only one construction phase identified, it was likely a single-phase occupation. The ceramics from the site suggest it was inhabited in the Late Classis period.

Actun Satah Witz was excavated in its entirety. Beyond a modern debris cone covering the natural white powdery soil, strata were absent in the cave. Notable artifacts recovered include two spent obsidian prismatic blade blanks and a metate fragment, all of which were collected. The latter objects were recovered from a few cm below the natural white powdery soil and no other objects were associated with them. They have been given the tentative designation of Actun Satah Witz Cache 1. Their proximity to one another suggests they were deposited in the cave at the same time, although the lack of any other evidence of ritual associated with them suggests they may have just been discarded there. The metate fragment was recovered from the bedrock floor of the cave approximately 1 m from the modern surface. No other cultural materials were recovered at that depth, suggesting either it was intentionally buried, or it was deposited deep in the past. Ceramics recovered from the cavern also stylistically date to the Late Classic period.

Offering a short aside, ceramics were collected from well below Satah Witz half-way up the trail to the site suggesting another structure is present in that area. As well, a mound with large granite blocks was also noted by the parking area close to the valley floor. On the last day of work, we stayed to watch a portion of the hill be blasted. We waited on the Caracol Road and as we did, we conducted a non-systematic pedestrian survey of the area. Across the road to the new working entrance of the quarry we noted a dense collection of ceramics in the new road cut. A closer study of the LiDAR suggest two mounds may have been in that area. A surface collection of diagnostic ceramics was collected from the push piles made during the road construction. The LiDAR do reveal several other house mounds on the valley floor and surrounding hilltop. There is also a large ritual group on the west side of the road that was reported in last season's progress report.

Three field days were dedicated to ground truthing the LiDAR data. On the first day, we confirmed a range structure on a ridgetop near Tunnel Cave, although technical difficulties prevented its mapping into the project GIS. A small cave entrance was also recorded down slope from the structure, although it was too choked to enter and was unlikely to have been used by the Maya. The second day of ground truthing included verifying two previously unrecorded caverns in the east side of the hill as Rio Frio Cave A. They are behind the campground at Douglas D'Silva. Both are landscape drains but have choked entrances. We recorded the one to the north first and then the southern one second. Following local naming conventions, we've named them Rio Frio Caves F and G respectively. Time and lack of proper equipment prevent exploration beyond their immediate entrance areas, but ceramics were recovered from Cave F. A deep pool of standing

water prevented exploration of Cave G, although passages were seen beyond it that may have been used by the Maya. After recording the two new caverns, we proceeded to Nohoch Batsó where we mapped Plaza 5 which was confirmed during our January 2023 season. It was revealed after the delivery of preliminary LiDAR data. The plaza and structures were constructed with a mix of limestone and granitic blocks. Moreover, granitic artifacts abound on the surface, including hammerstones and a large grooved half-loaf resembling a net weight or very large hammer. The possibility exists that the plaza was a granitic marketplace. We will test that hypothesis in future field seasons.

To conclude, we had a very productive and exciting season where much was learned about the past inhabitants of the Mountain Pine Ridge Forest Reserve. We have come to learn how they were quarrying bedrock and the kinds of tools they were using to do so. We have also learned more about the kinds of implements they were making there. We have also learned that the broadleaf areas of the reserve were inhabited. Ground truthing has allowed us to more confidentially identify smaller structures such as house mounds. We have also confirmed and recorded three new caverns, but the LiDAR data suggests there may be over 100 more. In the end, this work has revealed that the Mountain Pine Ridge Forest Reserve was a vast cultural landscape that past Maya people interacted with in a variety of ways, many unique to it.

References Cited

Mason, Gregory
1928 *Pottery and Other Artifacts from Caves in British Honduras and Guatemala*. Indian Notes and Monographs, No. 47. Museum of the American Indian. Heye Foundation, New York.

Spenard, Jon
2023 Initial Observations of the NCALM Belize 2022 LiDAR Campaign Aerial Survey of the Mountain Pine Ridge. In *Report on the Third Field Season of the Rio Frio Regional Archaeological Project (RiFRAP) (June-July 2022, January 2023)*, edited by Jon Spenard, pp. 55-64. Occasional Paper No. 3. Department of Anthropology California State University San Marcos. Report Submitted to the Institute of Archaeology, National Institute of Culture and History, and Forest Department, Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development, and Immigration, Belmopan, Belize.

Chapter 2: Investigations of the Mountain Pine Ridge Granite Quarries and Workshops

A primary focus of RiFRAP's 2023 investigations was the systematic documentation of ancient Maya granite quarry-workshop sites in the Mountain Pine Ridge first documented in the 2022 field season (Spenard et al. 2023). The proposed work was informed by the results of a high-resolution aerial LiDAR scan of a portion of our permit area collected as part of the NCALM Belize 2022 Collaborative LiDAR Campaign (Spenard 2023). Though we had identified it prior to the arrival of the data, the scan revealed the Buffalo Hill Quarries site, the first granite quarry and ground stone tool workshop ever documented in the ancient Maya Lowlands, was significantly larger than we previously recognized (Mirro et al. 2023; Spenard et al. 2023) (**Figure 1**). At the end of the 2022 season, we had mapped approximately 15 ha of the site, which contained 15 granite rock extraction features that we divided into two classes, quarry pits and isolated cut faces. Ringing the extraction areas and strewn about the site were berms of reduction debitage intermixed with a range of reduction tools (hammerstones of varying sizes) and discarded products (discarded mano and metate preforms, and possibly granite picks). Unfortunately, most of the components of the site were covered in thick grass making it difficult to gain a comprehensive view of them and their components.

The LiDAR data revealed that we had mapped only about 1/3 of the site, but also that there was one other large quarry area on the north side of Pinol Creek (Spenard 2023) (**Figure 2**). Overall, our work during the 2022 season had securely identified the presence of an extensive a granite extraction and workshopping industry in the Mountain Pine Ridge, but questions remained about methods of raw material extraction, the chain of operations of ground stone tool reduction, and more. Securing funding from the Archaeological Institute of the Americas-National Endowment for the Humanities Post-Fieldwork Grant, we returned in 2023 with the following goals:

1) Continue mapping the quarries with a focus on completing the Buffalo Hill Quarries map and then starting the quarry area to the north. Mapping activities included ground truthing quarry features identified in the LiDAR data.

2) Clear one reduction area of vegetation and perform a total coverage survey plotting all features and non-debitage artifacts into the project GIS.

3) Conduct stratigraphic excavations to learn more about site development, chronology, and methods of extraction.

Quarry Mapping

Although a primary goal of the 2023 project was to begin surveying the unnamed northern quarry-workshop area identified in the LiDAR data, the vast majority of our time was spent at the Buffalo Hill Quarries site. The reason was two-fold. Preparing for the field season, we had identified twenty possible quarry pits that remained undocumented. Our plan was to ground truth and plot confirmed loci, to finish mapping the full extent of the site. Ground truthing would also

Figure 1. Hillshade map showing the extent of the Buffalo Hill Quarries site. The site boundaries are indicated by the large, yellow polygon. Quarry pits and surrounding debitage are the hollow black line pologyons. The grey polygon at the northwest corner of the site is the quartzite vein. The small polygon within is the hammerstone workshop mound.

Figure 2. Hillshade map showing the Buffalo Hill Quarries site (yellow polygon) and large unnamed quarry-workshop site to its north (black polygon).

allow us to better distinguish between natural and cultural features in our LiDAR data (Horn and Ford 2019; Reese- Taylor et al. 2016). As well, other studies have shown that some archaeological features visualize poorly in LiDAR making them difficult to identify (Ebert et al. 2016; Thompson 2020). Both of these observations were true of our data. We confirmed eighteen potential sites as quarry pits, but two were rejected. One turned out to be a bush and the other a short natural drainage channel on a hillside. We also recorded several others that were overlooked in the data, and we identified a previously unrecognized form of extraction feature, strip mining, that was prominent at the site, but largely unrecognizable in the remote sensed data.

We define strip mines as extraction features that occur on low-profile exposures of bedrock where natural fractures and bedding planes are common. They differ from quarry pits because they are not excavated below the surface, although given their many other similarities, the two types of extraction features may be ends of a continuum rather than formally distinct methods. Strip mines vary in size, with their extent being determined by the quantity of exposed rock and presence of natural fractures and bedding planes. They are identified by angular scars on low-profile exposures, the result of naturally bedded slabs of granite being pried from the ground.

We started our ground truthing efforts following protocols established during the 2022 season. As we have done for other mapping components of the project, we used an SXBlue Platinum GNSS device with Atlas 50 RTK correction capable of real-time sub-30 cm location solutions to complete the work. Geolocational data were collected on an iPad tablet running the Field Maps application. All of the GIS data discussed in this chapter has been provided to the Institute of Archaeology with the delivery of this report.

The entire Buffalo Hill Quarries site has been given the designation, MPR-2022-002 meaning it is the second site we recorded in the Mountain Pine Ridge in the year 2022. When we confirmed an extraction site, we assigned it a unique feature number added to the end of the site number designation (MPR-2022-002-FXX). The numbers used in the 2023 season continued from those assigned in 2022. Pedestrian survey was used to determine the extent of the debitage berm surrounding the extraction location, and to identify any non-debitage artifacts on the surface. All data were plotted into the project GIS. Perimeters of pit floors and cut faces were also recorded. We identified 27 extraction features; however, it became increasingly difficult to meaningfully distinguish them as we found that debitage and spoil piles frequently overlap, and multiple extraction events occurred in the same pit. As such, we discontinued tallying activity areas and instead simply recorded the boundaries of distinct debitage/spoil piles in the GIS. By the end of the season our work revealed that the site covers an area of approximately 48-hectares (~120 acres) and measures 1km east-west by 0.5 km north-south, although likely closer to 50-hectares, as some potential extraction areas were identified in the LiDAR data off the southeast corner of the site following the 2023 season.

To understand the full artifact assemblage associated with a standard quarry pit, we conducted a 100-percent coverage survey of one quarry pit feature completely cleared of vegetation. Each non-debitage artifact encountered was piece plotted into the project GIS. That activity turned into an unexpectedly long, time-consuming task, and is largely responsible for the project not confirming the quarry site north of Pinol Creek. During the 2022 field season, we had recorded a few dozen non-debitage artifacts in the entire 15 hectares that we surveyed. A similarly

low density of artifacts was noted when comprehensively mapping a portion of the site called Feature 21, discussed below. We expected that we would observe a higher density of objects when a site was cleared of vegetation, perhaps a few dozen, but we were mistaken.

The pit we chose to for the full coverage survey was named. We chose that one because it appeared in the LiDAR data similar to the extraction sites in the quarry area north of Pinol Creek that we intended to investigate later in the season. It is a double pit measuring 40 m in diameter, and the two extraction pits are surrounded by a continual berm of debitage with another berm separating them (**Figure 3**). The larger pit to the northeast was dubbed Quarry Pit 1 and the smaller called Quarry Pit 2. To understand the chain of operations of reduction, we had planned to collect a 10% sample of non-debitage artifacts encountered; however, it soon became apparent that piece plotting was going to be time consuming, especially as one of the two iPad tablets we were using to map them was catastrophically mishandled rendering it inoperable. More to the point, once cleared of vegetation, a much higher concentration of non-debitage artifacts were present at the site than expected, and as our eyes became trained to distinguish them, more were noted every day. As a result, we decided to also commence with excavations to learn more about the extraction process during which we collected all non-debitage artifacts uncovered. The excavations are described in more detail below. By the end of the season, we had piece plotted over three hundred non-debitage surface artifacts (**Figure 4**) as well as multiple ceramic scatters around the rim of the berm, many of the sherds are thickly smudged and the concentrations hold large quantities of charcoal (**Figure 5**). Project foreman Javier Mai noted that the charcoal is from tree sap, and that it appears to be copal. Future studies should consider submitting the charcoal for radiocarbon dating and for elemental analysis to identify the sap.

For purposes of recording, we divided the artifacts into two general classes of data, hammerstones and granite objects, each of which was further subject to in-field analysis. Hammerstones were scrutinized for completeness, and evidence of wear, and at least one photograph was collected to record each object. Granite artifacts were similarly scrutinized for completeness and evidence of wear. Length, width, and thickness measurements were also captured, and object identifications were assigned. The object types include half-loaf "mano preforms," full-loaf mano preforms, metate blanks, metate discards, and other. The half-loaf items are discussed in more detail below. At least one photograph was captured for each granite object, but as we continued with the work, we recognized the need to capture the objects from multiple angles. At the end of the season, the workflow was updated to capture five images, especially for the half-loaves.

Regarding the half loaves, though the Buffalo Hill Quarries is the first ancient Maya granite extraction and ground stone tool workshop identified in the Maya region, a workshop site is known from Pacbitun (Ward 2013; Skaggs et al. 2020). There, archaeologists have also recovered a large number of granite half-loaves that they interpret as discarded mano preforms (see also Spenard 2014). Those objects constitute the largest number of non-debitage artifacts at the Buffalo Hill Quarries site as well; however, our data suggest they were relatively standardized in size suggesting they are intentionally made rather than discards. Moreover, many have intentionally created pointed ends that show signs of battering wear, further supporting our hypothesis that they may have been used as reduction tools similar to the pics used by contemporary stoneworkers in highland Guatemala (Mirro et al. 2023; Nelson 1987; Searcy 2011).

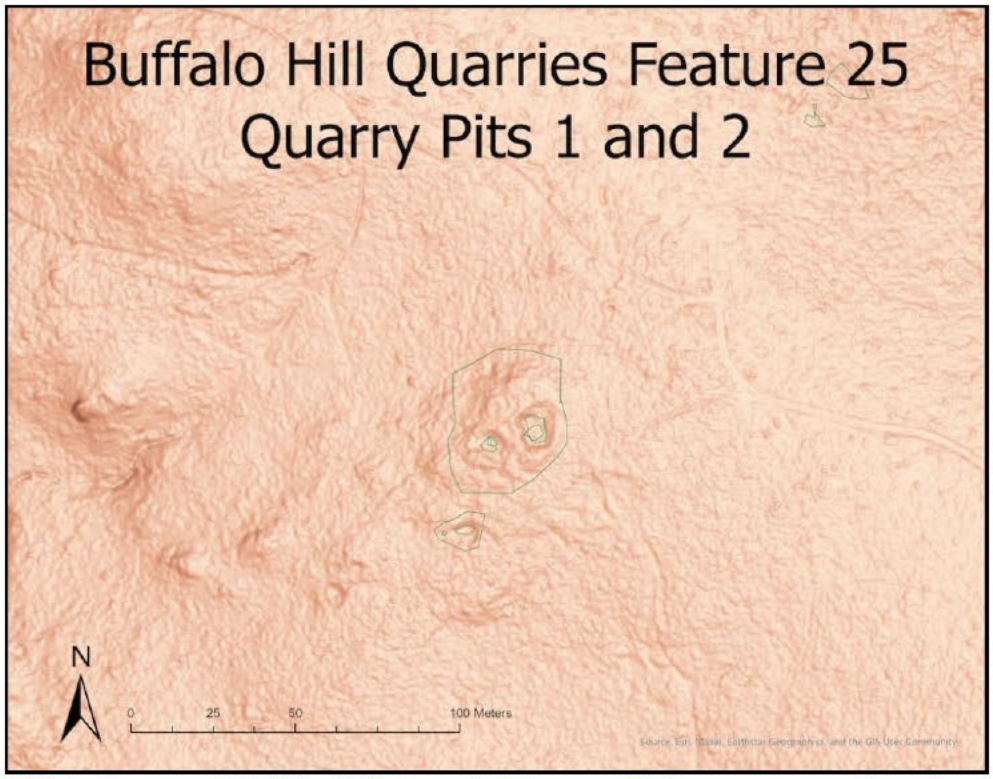

Figure 3. Hillshade map of Buffalo Hill Quarries Feature 25 (larger green polygon).

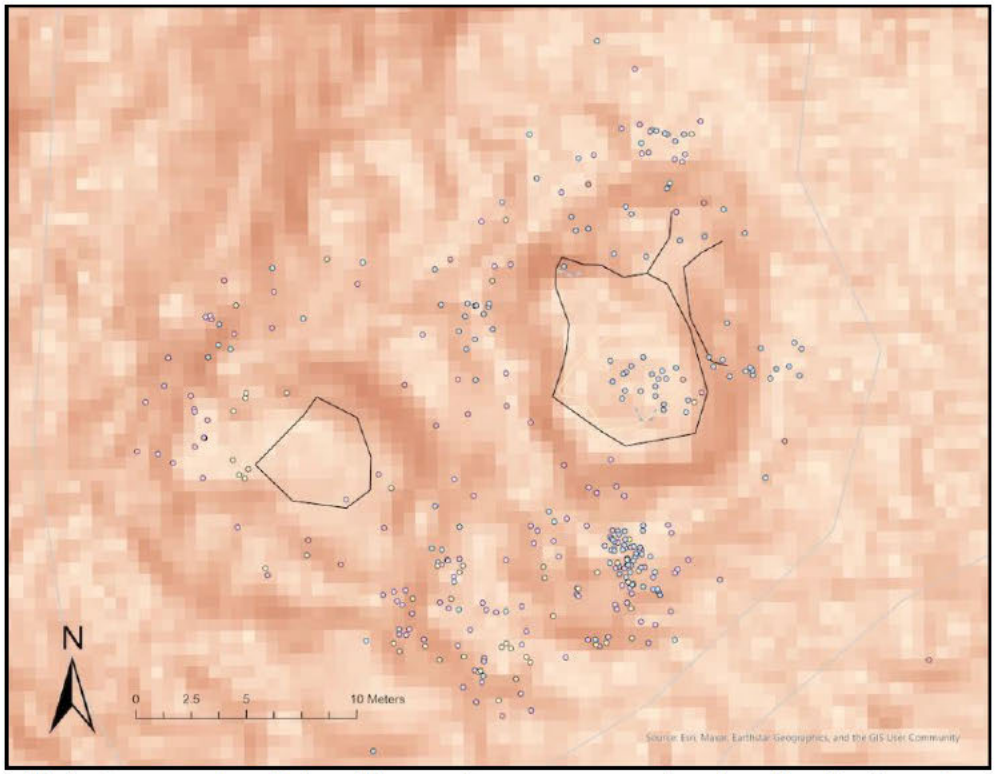

Figure 4. Hillshade map of Buffalo Hill Quarries Feature 25 showing distribution of non-debitage artifacts recorded. Quarry Pit 1 is to the right of the image, Quarry Pit 2 is to the left.

Figure 5. Charcoal concentration in Buffalo Hill Quarries Feature 25 (red circle).

We collected length, width, and thickness measurements for 102 half loaves, revealing they were semi-standardized. Length is the most variable measurement ranging from 10 cm to 30 cm with the average length being 18 cm. Sixty-four of the objects are between 16 cm and 23 cm in length. Evidence for standardization is more prevalent in the width and thickness measurements. Widths range between 9 cm and 15 cm with most (n=89) falling between 10 cm and 14 cm averaging slightly over 11.5 cm overall. Thicknesses range between 7.5 cm to 13.5 cm with most (n=86) falling between 7.5 cm x 11.5 cm. Average thickness of all recorded objects is just shy of 10 cm. These data suggest the objects are intentional creations rather than poorly executed items.

With just 14 recorded, full loaf mano preforms appear much less frequently than half-loaves, another indicator that the latter represent intentional creations. The two artifact types are differently shaped. Whereas half-loaves are generally bell-shaped, the full loaves all have two slightly tapered ends, with bodies that are uniformly thick. A single large flake scar at the mid-point on most of the full loaf preforms, reveal part of the reduction and shaping process (**Figure 6**). Measurements were collected at mid points revealing most full loaf preforms were between 7 cm to 12 cm thick with an average of 9.5 cm. Lengths also varied between 20-31 cm, although most (n=10) were between 23-25 cm long. Object widths varied between 8 cm to 12 cm, although most (n=9) were between 10 cm to 11 cm.

Hammerstones are ubiquitous in the quarry sites. They are most often made of quartzite, although some are made of chert and rarely granite. The objects are commonly spherical or disc shaped and range in size from 12 to 20 cm in diameter, although larger ones have been recorded. The largest, likely a two-handed or multi-person implement, was over 60 cm in diameter and estimated to be over 30 kg (**Figure 7**). Many were broken in flakes and possibly repurposed. In a few instances, hammerstones were found clustered together. Today, quarry workers cache their tools to keep them safe from one another and to avoid the extra weight of transporting them home, a likely explanation for their occurrence at the MPR quarries (Hayden 1987; Nelson 1987).

Figure 6. Photograph of Feature 25 Excavation unit 1C. The red arrow points to a mano preform, specifically a large flake scar commonly seen in such objects. A bedrock mortar at the left center of the image, and the object between the mortar and mano preform is an expedient wedge used to pry off slabs of granite, similar to those beneath the mano and hammerstone in the image.

Figure 7. The author holding a massive quartzite hammerstone. Photo by R. Horowitz.

Located at the northeast corner of the Buffalo Hill Quarries site, Feature 21 is the largest strip mine identified to date. It measures approximately 80 m-long and is defined by a series of adjacent extraction features (**Figure 8**). Like the others, debitage berms of variable size mixed with a suite of artifacts, particularly milling features, hammerstones, and metate preforms, are associated with them. Mano preforms and half- loaves were present but are less common than in other areas of the Buffalo Hill Quarries site. Whether the differences in artifact assemblages reflect different activities or is a product of survey bias remains unclear. We did not have permission from the Forest Department to clear vegetation from the site, which tended to grow densely in the debitage-covered areas. As a result, we were unable to thoroughly investigate the berms for artifacts, however, we did initiate excavations at the site to learn more about the methods of extraction used at the features. Excavations are discussed below. Due to their low profiles, strip mines do not always appear in the LiDAR data. Those that do are easily confused with other areas of exposed, but otherwise unworked bedrock. Future remote sensing work aimed at identifying other similar features should also include aerial photography to locate exposed bedrock.

Our ground truthing efforts also led to the identification of the probable source of quartzite used to make hammerstones. A vein of the material was located on a low ridge on the southern bank of Pinol Creek at the northwest of the Buffalo Hill Quarries site. The entire ridge is covered in quartzite boulders, tested cobbles, and flakes (**Figure 9**). Moreover, a mound of debitage approximately 10 m long x 1 m tall surrounds a large outcrop of the material (**Figure 10**). The complex appears to be a quartzite quarry and hammerstone workshop. Future investigations of the Buffalo Hill Quarries should consider this feature a top priority.

Figure 8. Buffalo Hill Quarries Feature 21, an ancient Maya strip mine with large bedrock mortar in foreground.

Figure 9. Photograph of tested outcrop and cobbles commonly to the quartzite vein on the northwest end of the Buffalo Hill Quarries site.

Figure 10. Quartzite mound, the remains of a possible hammerstone workshop on the quartzite vein on the northwest end of the Buffalo Hill Quarries site.

Though we were unable to confirm the large quarry site observed in the LiDAR data, our ground truthing efforts identified another sizeable site that was overlooked in it. The site, dubbed Moshy's Hill (MPR-2023-006), was identified by project member Moses "Moshy" Flores, and is substantially different than the Buffalo Hill Quarries site. Whereas the latter site is spread out over a large area, Moshy's Hill is much more compact; nevertheless, it appears to have been a major extraction-workshop loci. Unfortunately, time did not allow for a full exploration of it, but it is located on the side of and top of large hill rising up from the northern bank of Pinol Creek, about 0.5 km downstream from the Buffalo Hill Quarries site. The hillside, a slope over 30 m long, is covered by a series granite debitage terraces up to 2 m-tall (**Figure 11**). To see a navigable iPad LiDAR scan of the hillside visit the website, https://poly.cam/capture/2CBB0A27-80AD-41DB-9FA7-960EA8714 023, or click here if reading the digital version of this report. The lengths of the terraces were difficult to determine as they continued into heavy impenetrable vegetation. Similar debitage piles were noted on the hilltop as seen at the Buffalo Hill Quarries site, but no quarry pits were noted. Instead, cut faces and strip mines abound on the summit. Moreover, the explored top of the hill holds over a dozen bedrock milling features of varying size (**Figure 12**). Visit the website, https://poly.cam/capture/504D3BD0-CDDA-47A3-863E-3E30924C97C8 or click here to see a navigable iPad LiDAR scan of the hilltop. Many of the milling features are located at the bases of small slopes positioned in such a way so that an individual can sit on the elevated portion of the rock and work between their feet (**Figure 13**). This site should be a top research priority for future projects investigating the ancient Maya granite ground stone tool industry in the Mountain Pine Ridge as the quantity of discarded material indicates it was a prime locus in it.

Figure 11. Debitage terraces on hillside below the Moshy's hill site (Photo by Moses Flores).

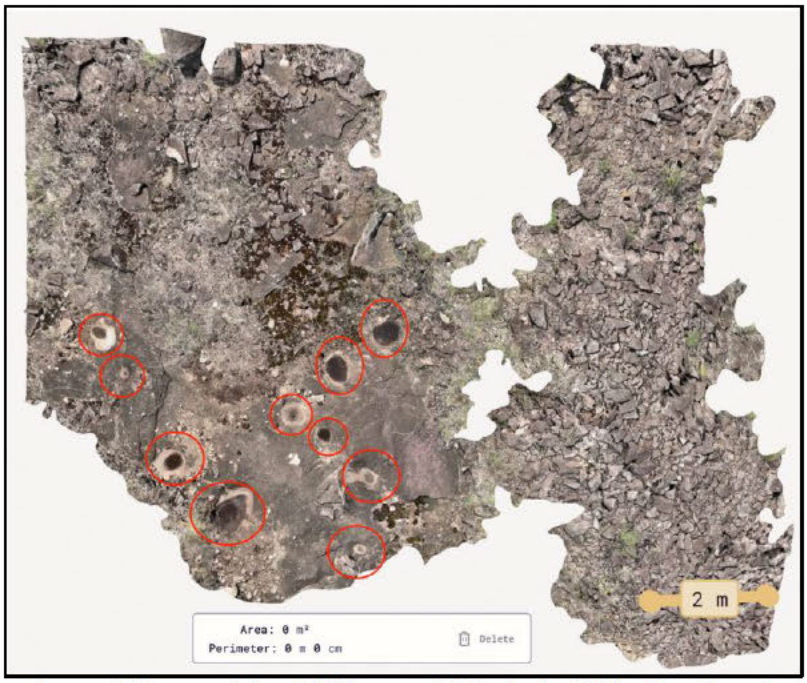

Figure 12. Screenshot of 3D model of hilltop of Moshy's Hill site showing multiple milling features (red circles). Note also the debitage berm on the right side of the image.

Figure 13. RiFRAP PI, Jon Spenard demonstrating how a bedrock milling feature may have been used. Photo by R. Horowitz.

Archaeological Excavations

We conducted stratigraphic excavations at two extraction features in the Buffalo Hill Quarries site, Feature 21 and 25. The excavation in Feature 21 (MPR-2022-002-F21-EU1) was placed over a partially buried milling feature (**Figure 14**). It was dug to test how grinding features were used and made. Our working hypothesis was that they were created as an unintended byproduct of mano reduction. We developed the proposition from a photograph Hayden (1987) and Nelson (1987) included in their ethnoarchaeological study of a contemporary stone worker from Guatemala. Specifically, the photograph shows the worker finishing a mano whose point rests in the ground by pecking and turning it. Though they do not discuss the specific component of the image, the result is that the process digs a small cupule into the sand holding the point of the worked mano. We proposed that the industrial scale mano production that was undertaken in the Mountain Pine Ridge granite quarry-workshops might result in similar cupules being carved into the bedrock as the tools were formed. Evidence of mano pecking in our excavations would be fine grained sand below the mortar similar to that found at the mano workshops at Pacbitun (Skaggs et al. 2020). The excavations in Feature 25 (MPR-2022-002-F24-EU 1, -EU 2, -EU3, -EU4) were undertaken to learn about the extraction process and site chronology. There, we dug four pits of varying size, three into the quarry pit itself, and the other off-site aimed at understanding the local natural stratigraphy. Though all of our quarry-workshop excavations were made in two different types of extraction features, they both revealed similar results, namely that natural fractures and bedding planes were exploited in the removal of raw material.

Figure 14. Photograph of the start of Feature 21 EU1 showing the partially exposed milling feature (red circle) that was the subject of the excavation.

MPR-2022-002-F21-EU1

The Feature 21 unit measured 1 m x 2 m and was aligned with the outcropping rock (65° east of north). Though close to a dozen mortars were identified in Feature 21, we chose to excavate the one we did because ceramics were recovered from the surface when we first exposed it. The unit was excavated in one level to bedrock, reached at a maximum depth of 30 cm below surface (**Figure 15**). For that reason, no plan or profile drawing was made of the unit. The matrix was sand as expected, but it was mixed in with large concentrations of granite debitage. Unfortunately, determining if the sand was natural or a product of pecking went unanswered, although the former is likely because the matrix throughout the Buffalo Hill Quarries site is granite-derived sand.

Although we were unable to confirm if the milling feature was the result of mano reduction, the unit did unexpectedly inform about extraction methods. The excavations revealed that the sand and debitage had infilled the edge of a strip mine. An unknown number of blocks had been removed with the aid of a series of natural joint fractures in the bedrock. Moreover, we also noted several large discarded slabs had refit into the western side of the unit revealing that they had been pried off by a method that became apparent during our excavations of Feature 25 discussed below (**Figure 16**).

Figure 15. Plan view photograph of the bottom of Feature 21 EU1. Note the angular edge below the north arrow that aligns (north-south) with a natural fracture joint in the bedrock, and the parallel fractures running east-west.

Figure 16. Refit granite slabs from Feature 21 EU1 that were removed from the parent rock by past quarrying activity.

After excavations were completed, the unit was backfilled with the debitage and matrix that had been removed. Flagging tape, pin flags, and corner stakes were placed at the bottom of the pit to mark it before it was refilled. Unfortunately, no photographs of the activity or completely backfilled unit were collected.

MPR-2022-002-F25-EU1

The first excavation unit excavated into Feature 25 was placed in Quarry Pit 1. In total, it was a 9 m-long x 2 m-wide trench **(Figure 17**). It was positioned to stretch from the center of the pit to past the outer berm of debitage. Its orientation was determined by the presence of a pile of granite debitage and artifacts near the center of the hole. Moreover, the northern and western portions of the pit floor were largely exposed bedrock that had been quarried in the past. Thus, to understand site development and chronology, we chose a location where matrix remained. Once established, the trench was excavated into three equal sub-units roughly corresponding to different components of the quarry pit. Unit 1A encompassed the outer berm of debitage to the forest floor outside it. Unit 1B captured the outer berm and slope to the start of the pit floor. Unit 1C revealed the pit floor including the concentration of objects at the center of it. Another goal of the latter unit was determining how work was organized and to locate any activity areas.

Our discussion starts with Unit 1C as it is the least complex component of the unit. In short, the stratigraphy consists of a single level of post abandonment sandy loam (10YR 2/1) between 15-30 cm below surface intermixed with debitage and artifacts from the concentration. The only distinct activity area noted was a single, shallow bedrock mortar uncovered beneath the artifact concentration in the western wall of the unit (**see Figure 6**). Its purpose remains unknown. Among the artifacts recovered was an expedient beveled tool, a pry bar that would have been hammered between the natural bedding planes and fractures to extract blocks of granite that were reduced into tools. The pry bar was made from a block extracted from bedrock that had parallel fracture joints similar to those we noted in Feature 21 (**see Figure 15**).

Sub-units 1A and 1B are discussed together because they contain data on raw material extraction and site development. The depths of the units varied from between 60 and 90 cm, yet only the latter pit was excavated to bedrock. The matrix of the surface and first level of Sub-unit 1A was a dark gray followed by yellowish brown (10YR 5/6) dry sandy loam that contained charcoal, and high concentrations of granite debitage. Little of the debitage was the result of percussion flaking though, instead, much of it was large slabs too thin to be reduced into tools (**Figure 18**). Although charcoal continued, no debitage was encountered below 30 cm, a depth at which the matrix became a damp olive yellow (2.5Y 6/6) sandy clay. The lack of artifacts suggests that level was the original ground surface of the forest prior to the quarrying activities. At approximately 50 cm below the surface, another matrix change was encountered. The moisture content remains high, but the color changes to a brownish yellow (10YR 6/8) sandy clay with extensive red and white mottling (**Figure 19**).

Sub-unit 1A's stratigraphy is replicated in Sub-unit 1B, however, there is a noticeable disruption to the mottled sandy clay. In the eastern part of the middle sub-unit, it is observed to be in direct contact with heavily weathered granite, but it abruptly ends at a series of stepped breaks in the bedrock. In its place is a thicker layer of the yellowish brown dry sandy loam found at the surface and first layer in Sub-unit 1A. That layer continues across the unit until it reaches the edge of the artifact concentration in Sub-unit 1C. A very thin layer (approximately 2 cm thick) of dark gray sandy loam, similar to that found on the current surface of the quarry pit was uncovered sitting beneath the yellowish brown dry sandy loam and the underlying bedrock the ancient quarry workers uncovered. I interpret that thin dark layer as the working floor of the pit, deposited near the end of its use life. The yellowish brown dry sandy loam is matrix that accumulated after the pit fell into disuse.

The reason the mottled layer ends abruptly is directly related to extraction. In short, the mottled soil is only found above the weathered granite. It represents the original, undisturbed soil, and its abrupt termination marks the wall of the original pit the quarry workers dug to expose the underlying granite. Our excavations revealed that beneath the weathered layer was a series of natural bedding planes that the quarry workers pried out, likely using expedient pry bars similar to the one recovered in Sub-unit 1C to extract raw material (**Figure 20**). The material that was too thin to be reduced into tools was simply tossed to the side of the pit, becoming the slabs uncovered in Sub-unit 1A. Artifacts recovered during excavations of the three sub-units include full loaf mano preforms, half-loaf tools, pics, and metate preforms all of granite. Some ceramics and quartzite hammerstones were also recovered. Analysis of those materials is ongoing and will be reported after it is complete.

Figure 17. Photograph of start of Feature 25 Excavation Trench 1, facing east. Note the concentration of debitage and artifacts at foreground of photograph.

Figure 18. Debitage slabs recovered from Feature 25 Excavation Trench 1.

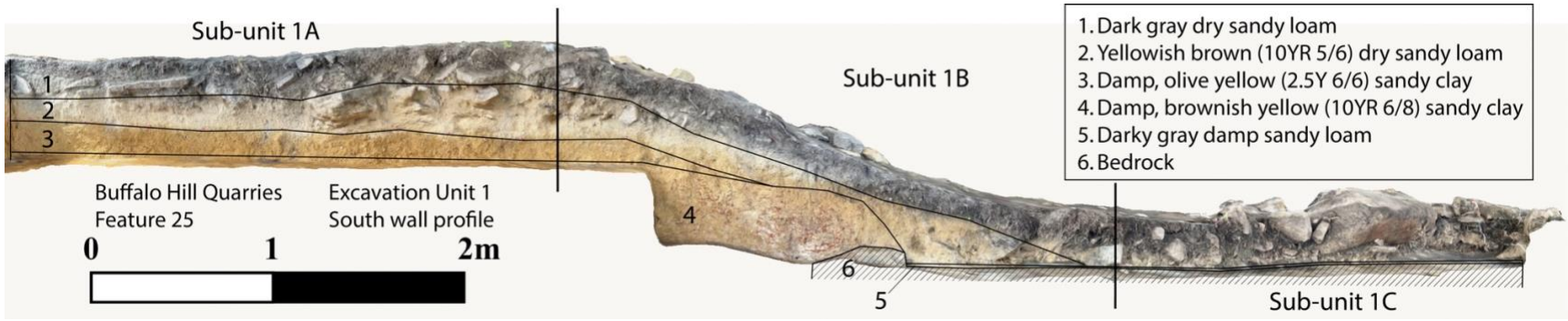

Figure 19. Digital model and profile drawing of Feature 25 Excavation Trench 1 south wall profile. East is toward the bottom of the page, west is toward the top.

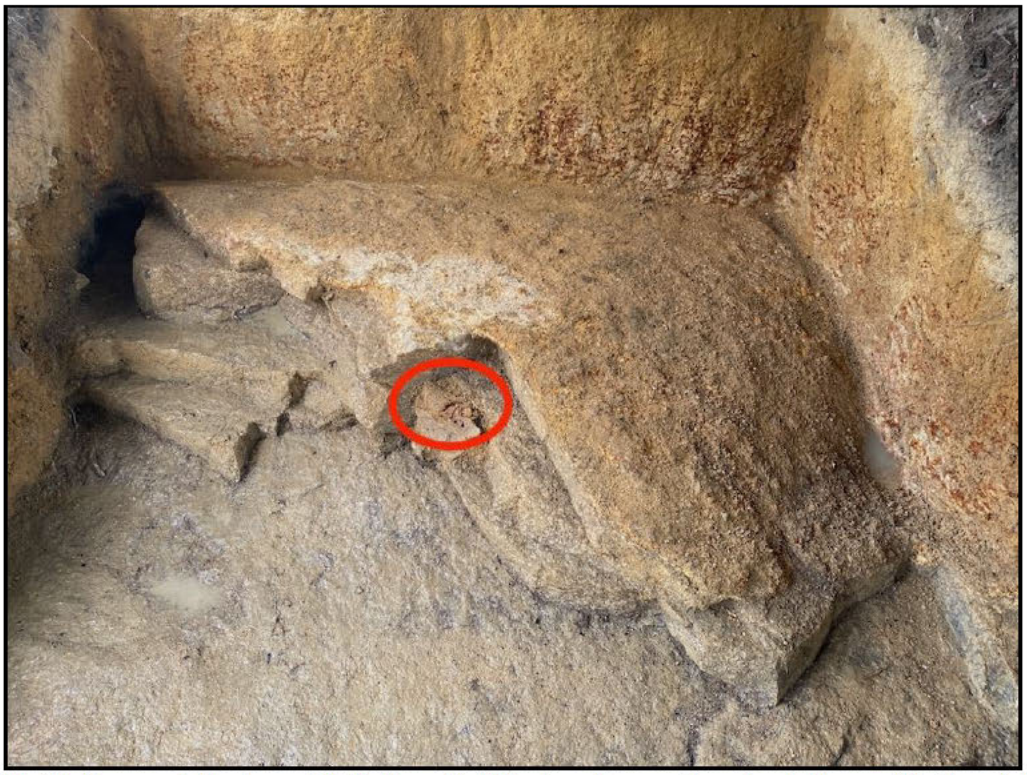

Figure 20. Bottom of Feature 25 Sub-unit 1B showing red and white mottled matrix above weathered outer surface of underlying granite, beneath which is a series of bedded granitic layers that were pried from the quarry pit. A concentration of ceramics, fragments of an unslipped jar sit on one of the bedding planes in the center of the image, indicated by the red circle.

MPR-2022-002-F25-EU2

Feature 25 Unit 2 was established on the outer downslope of the debitage pile associated with Quarry Pit 2 (**Figure 21**). The location was chosen because a granite shaft approximately 30 cm tall measured from the surface was noted. Directly in front of it was a heavy concentration of ceramics covered in thick residue intermixed with a large quantity of charcoal, and another charcoal concentration nearby. The surface assemblage suggested the location may have served a ritual function.

The unit measures 2 m x 1 m and is aligned 290^{o} along the long axis. It was excavated to bedrock in two levels, the final depth of which varied. The matrix of the first level is a yellowish brown (10YR 5/6) loamy sand intermixed with granite debitage, non-debitage artifacts, charcoal, and ceramics. The second level began at a variable depth following a strong brown (7.5 YR 5/8) loamy sand. Our excavations confirmed that the granite shaft that prompted the unit excavation was purposefully erected. Interestingly, a quartzite hammerstone was placed at its base (**Figure 22**). Unfortunately, no other deposits were encountered to determine how the shaft was used. Besides the matrix color change, the artifact density dropped to nearly zero in the second level suggesting it was the original ground surface that predated quarrying activities. Though few artifacts were recovered in Level 2, excavations proceeded until bedrock was fully exposed throughout the floor of the unit (**Figure 23**). Once excavations concluded, pink pin flags were

placed along the base of the walls of the unit, and a Belizean coin placed on bedrock in the center of it.

MPR-2022-002-F25-EU3

Feature 25 Excavation Unit 3 is a 1 m x 1 m excavation unit aligned to the cardinal directions (**Figure 24**). It was purposefully placed approximately 4 m east of the debitage berm of Feature 25 Quarry Pit 1. The goal of the unit was to understand the native soil in the area to interpret the stratigraphy encountered in Unit 1. No artifacts were encountered, although several liters of matrix were collected per level for paleoenvironmental reconstruction. Additionally, some charcoal was noted while excavating. It is not considered cultural but dating it can help understand the geological setting of the site. Because this unit was probing soil geology, no unit forms were collected for it. Nevertheless, the stratigraphy encountered resembles that uncovered in Feature 25 Unit 1. The surface layer measures approximately 18 cm thick is a dark gray loamy sand with charcoal intermixed. The color of the layer is a likely effect of wildfires introducing charcoal and ash to the environment. Level 2 is an olive yellow (2.5Y 6/6) sandy clay that averages 45 cm in thickness. Level 3 was the last soil level uncovered. We continued into it for approximately 30 cm. It is the same red and white mottled brownish yellow (10YR 6/8) sandy clay that marked the undisturbed edge of the quarry pit in Unit 1.

Figure 21. Image of top of Feature 25 EU2. The erected granite shaft, indicated by the red arrow, is in the southeast (top left) corner of the unit. In front of it is a ceramic/charcoal residue scatter, indicated by the oval shape. At the bottom of the photo, center north of the unit is another charcoal scatter, indicated by the red circle.

Figure 22. Photograph displaying granite shaft base supported with cobbles on top of which was placed a quartzite hammerstone, indicated by the arrow.

Figure 23. Photogrammetric model of Feature 25 Unit 2 east wall profile at the completion of excavation activity. Note the drop in debitage density at the matrix color change. The granite shaft was erected near the area of the scale bar.

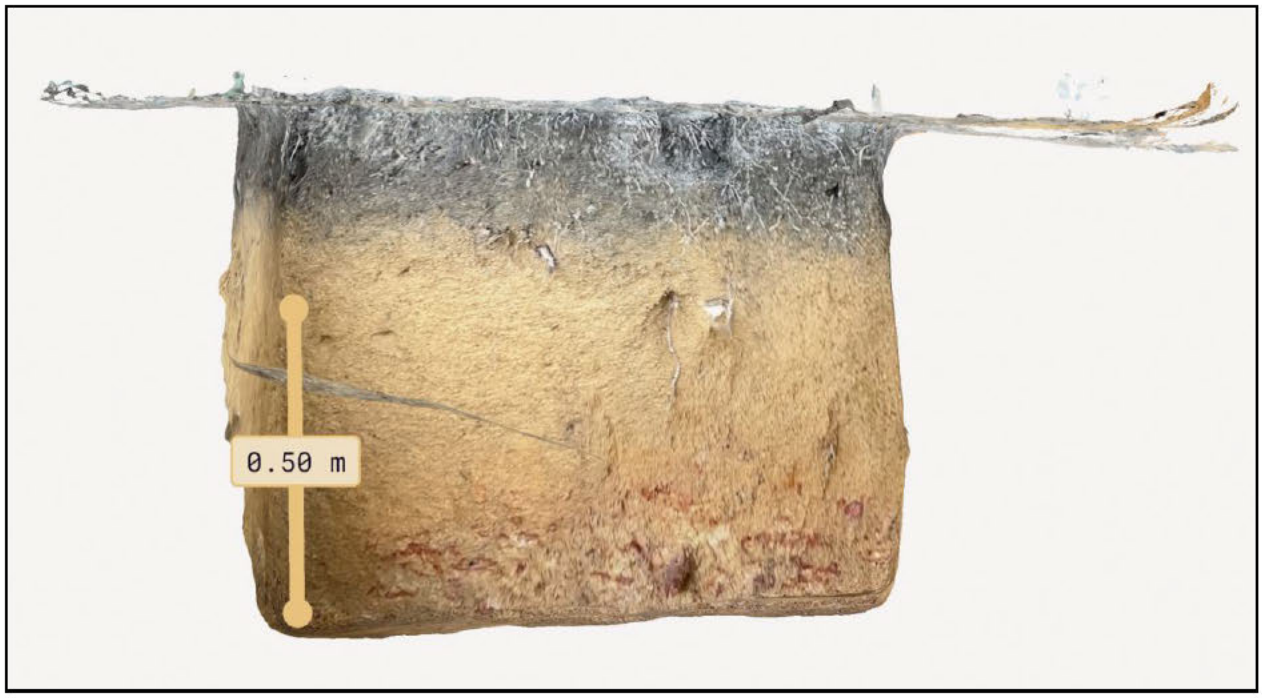

Figure 24. Photogrammetric model of Feature 25 Unit 3 excavation unit. The pit was dug to reveal the natural soil stratigraphy and to collect data for paleoenvironmental reconstruction.

MPR-2022-002-F25-EU4

Feature 25 Unit 4 was placed on the south side of Quarry Pit 1. There, a heavier concentration of debitage and non-debitage artifacts was noted compared to other portions of the site. In fact, no matrix was present on the surface and excavating there would allow us to gain an understanding of how deep the berms are. The particular spot chosen for excavation contained a heavy concentration of ceramics, making it an area potentially comparable to Unit 2. The pit measures 2 m x 2 m and is aligned with the cardinal directions. For reasons discussed below, it is uncertain that this unit was excavated to bedrock (**Figure 25**). The matrix of Level 1 is granite debitage. No soil was encountered. On the surface and intermixed with the debitage were half-loaves, half-loaf pics, full loaf mano preforms, ceramics, charcoal, and quartzite hammerstones and hammerstone fragments. As with the surface assemblage mapped, the unit contained a higher concentration of artifacts than the other pits did, suggesting the south side of Feature 25 is a workshop area.

Level 2 began after the quarrying debitage was removed from the surface and smaller finishing debitage was encountered. The change in artifacts was accompanied by a change in the matrix. Specifically, it changes to a very dark brown (10YR 2/2) sandy loam. Ceramics were absent from the unit starting with this level, although there was a noticeable increase in reduction tools and discarded products than the level above. As is the case for all quarry excavation units, the locations of each non-debitage artifact encountered was piece plotted in the project GIS and then collected for later lab analysis. Four bags of debitage samples were collected for chain of operation analysis and geochemical sourcing.

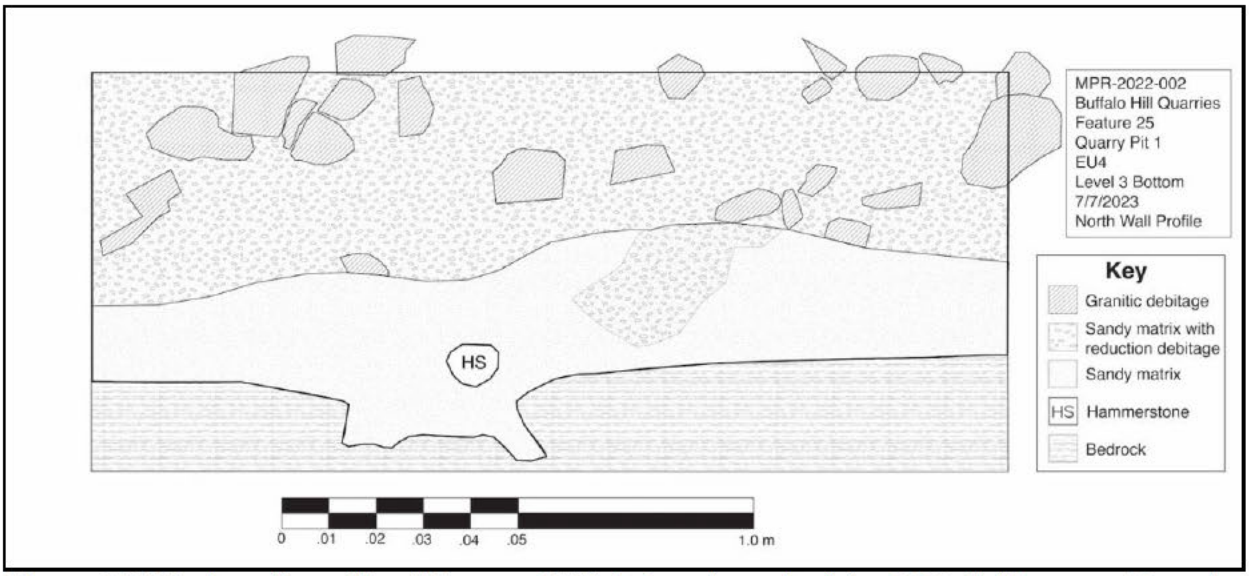

Figure 25. North wall profile of Feature 25 Unit 3 at the end of the 2023 field season. Note that the debitage at the top of the unit was not included in the profile.

Level 2 continued for 25 cm after which another change in matrix color was encountered, changing to the similar mottled yellowish brown (10RYR 5/6) sandy loam found throughout the site. The artifact assemblage also changed in this level. Fewer non-debitage artifacts were uncovered than above, but small finishing debitage continued to be present. Also noted were high concentrations of chert and quartzite flakes. What we initially suspected was bedrock was reached after about 7 cm from the start of the level, approximately 50 cm from the surface; however, as the unit was being prepped for final photographs, a series of deep cracks began to appear in the bottom of the pit. We proceeded to clean them out, and the matrix held chert and quartzite flakes. After all of the matrix was removed, a series of blocks resulting from unknown processes remained on the floor of the unit (**Figure 26**). They are removeable, suggesting they are the product of natural weathering, although multiple geologists and geoarchaeologists who have seen the image provided in **Figure 26** have all returned different interpretations of what they might be. Unfortunately, time did not permit further excavations of the pit. Pin flags, flagging tape, and a Belizean coin were used to mark the bottom of the excavation unit. The removed matrix and debitage were returned to the pit at the end of the season.

Conclusions

We had high expectations for gaining a deeper understanding the ancient Maya granite ground stone tool industry in the Mountain Pine Ridge during the 2023 field season. Those expectations largely revolved around mapping and documenting multiple large quarry-workshop sites. For myriad reasons, we were unable to accomplish many of the regional goals we had set for ourselves; however, through other means, we met them. Though we never had the time to visit the large quarry site to the north, we located the Moshy's Hill site, a significant granite ground stone tool manufacturing site. Moreover, we also learned much about how raw material was extracted, both through our identifying a previously unrecorded type of extraction feature to the common use

Figure 26. Granite blocks uncovered at the bottom of Feature 25 Unit 4.

of expedient pry bars used to extract material from them and quarry pits. Yet, many questions remain about the sites we have investigated, and the ancient industry they represent. When do the sites date to? Of the few diagnostic sherds recovered, the ceramics stylistically date to the Late Classic period, a date that finds broad support in Belize (Skaggs et al. 2020) and into Guatemala (Halperin et al. 2020). While we learned much about extraction, our knowledge of the chain of operations remains limited. That will be a primary goal for our next field season.

Looking beyond the immediate area, we still do not have a good idea of who the quarry workers were. Are they a local population, behold, perhaps to local centers, particularly Nohoch Batsó? Household excavations at the Satah Witz site, discussed in Chapter 4 of this report suggests regional households were involved. Were other local households participating in the industry, if so, which ones? Were the quarries supporting the industry at Pacbitun, or were those stone workers acquiring their material by other means? We only have LiDAR data for about 1/5 of our permit concession area. Other quarry sites, much further from any known center in the Mountain Pine Ridge are likely to be identified as our regional reconnaissance efforts expand. If we do, who was using and controlling them? Lastly, scholars working in early Middle Preclassic sites in Guatemala (Hansen et al. 2020) and as far away as Late Classic period Calakmul (Gunn et al. 2020) report granite ground stone tools that likely originated in the Mountain Pine Ridge. How were those objects traded out after being finished? Might the differently aligned Plaza 5 at Nohoch Batsó,

reported in Chapter 4 of this report, been a ground stone implement marketplace? Were there multiple distribution networks that served different client networks? More refined sourcing studies that can distinguish between the granite from different quarries could help answer that question if possible. Overall, now that we have identified and begun investigating the literal source of the ancient Maya granite ground stone tool industry, we can begin to ask more substantive questions about it than has been possible in the past.

References Cited

Ebert, Claire E., Julie A. Hoggarth, and Jaime J. Awe
2016 Integrating Quantitative Lidar Analysis and Settlement Survey in the Belize River Valley. *Advances in Archaeological Practice* 4:284-300.

Hayden, Brian
1987 Traditional Metate Manufacturing in Guatemala Using Chipped Stone Tools. In *Lithic Studies among the Contemporary Highland Maya*, edited by Brian Hayden, pp. 8-119. University of Arizona Press, Tucson.

Horn III, Sherman W., and Anabel Ford
2019 Beyond the Magic Wand: Methodological Developments and Results From Integrated Lidar Survey at the Ancient Maya Center El Pilar. *STAR: Science & Technology of Archaeological Research* 5(2):164-178.

Mirro, Michael, Javier Mai, Jon Spenard, and Konane Martinez
2023 The Buffalo Hill Quarries Site. In *Report on the Third Field Season of the Rio Frio Regional Archaeological Project (RiFRAP) (June-July 2022, January 2023)*, edited by Jon Spenard, pp. 39-54. Occasional Paper No. 3. Department of Anthropology California State University San Marcos. Report Submitted to the Institute of Archaeology, National Institute of Culture and History, and Forest Department, Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development, and Immigration, Belmopan, Belize.

Nelson, Margaret C.
1987 Site Content and Structure: Metate Quarries and Workshops in the Maya Highlands. In *Lithic Studies among the Contemporary Highland Maya*, edited by Brian Hayden, pp. 120-147. University of Arizona Press, Tucson.

Reese-Taylor, K., A.A. Hernández, F.A.F. Esquivel, K. Monteleone, A. Uriarte, C. carr, H.G. Acuña, J.C. Fernandez Diaz, M Perumäki-Brown, and N. Dunning
2016 Boots on the Ground at Yaxnohcah: Ground-truthing LiDAR in a Complex Tropical Landscape. *Advances in Archaeological Practice* 4:314-338.

Searcy, Michael T.
2011 *The Life-Giving Stone: Ethnoarchaeology of Maya Metates*. The University of Arizona Press, Tucson.

Skaggs, Sheldon, George Micheletti, Michael Lawrence, Nicaela Cartagena, and Terry G. Powis
2020 Identification of an Ancient Groundstone Production Site in the Periphery of Pacbitun, Belize. In *An Archaeological Reconstruction of Ancient Maya Life at Pacbitun, Belize*, edited by Terry G. Powis, Sheldon Skaggs, and George J. Micheletti, pp. 159-174. Archaeology of the Maya, Elizabeth A. Graham, David M. Pendergast, and Genner

Llanes Ortiz, general editor. BAR International Series 2970, BAR Publishing Series, Oxford.

Spenard, Jon
2014 Underground Identity, Memory, and Political Spaces: A Study of the Classic Period Maya Ceremonial Karstscape in the Pacbitun Region, Cayo District, Belize, Unpublished Ph.D. dissertation. Department of Anthropology, University of California, Riverside.

Thompson, Amy E.
2020 Detecting Classic Maya Settlements with Lidar-Derived Relief Visualizations. *Remote Sensing* 12(2838):1-29.

Ward, Drew
2013 Investigations of a Ground Stone Tool Workshop at Pacbitun, Belize, Unpublished Master's Thesis, Department of Anthropology, Georgia State University, Atlanta.

Chapter 3: Geochemical Analysis of Buffalo Hill Quarries Granite

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Introduction

Granite is a well-established material used in ground stone tool production in Belize. The recent discoveries by Spenard and the Rio Frio Regional Archaeology Project within Mountain Pine Ridge have solidified its role as a primary zone of granite ground stone production. This is the first-identified granite quarry in the Maya sphere. Previous work at Pacbitun has identified a mano workshop within the Tzib Group and highlighted the manufacturing process that was being conducted at the site (Skaggs et al. 2020, Ward 2013). However, the production locus for metates as well as the initial zone of raw material acquisition remained unknown until the quarryscapes were mapped by Spenard.

Analysis of the Buffalo Hill Quarries granite will facilitate a larger discussion on ground stone tool exchange and use throughout Belize, and hopefully the Eastern Maya Lowlands as a larger region. By establishing the geochemistry of known quarry locations, it may be possible to trace back artifacts from other ancient Maya communities to these sources. This would allow for archaeologists to parse out the social, economic, and political factors that may have led to the movement of granite across vast portions of the Eastern Maya landscape.

Methods

During the 2023 field season, granite samples were collected by the Rio Frio Archaeological Project and exported for analysis at the University of Iowa. Eleven samples were analyzed visually and via x-ray fluorescence (XRF). Of these, ten samples were analyzed by both a Delta Olympus and Vanta Olympus XRF using the methodology outlined in Tibbits (2016). Five randomly selected data points were taken per sample, then averaged, and compared to the outcrop dataset that has been established in previous field seasons. The single piece that was not analyzed with both units was slightly burned and therefore, only the ten unburned samples were analyzed twice.

The collected samples represent debitage from the ground stone tool production site of Buffalo Hill Quarries, located on the western sector of Mountain Pine Ridge within the greater geological feature of the Maya Mountains. Mountain Pine Ridge is known to have been used extensively by the Maya as a resource for raw materials to produce manos and metates (Powis et al. 2020, Ward 2013,). The recent work by the Rio Frio team has identified several potential quarryscapes by aerial data, some of which were ground truthed during the 2023 season.

Results and Conclusions

Of the eleven samples, one (16 Puma) was fairly badly burned and therefore only analyzed using the Vanta XRF. Of the eleven samples, all have geochemical signatures that indicate they originated in the Mountain Pine Ridge pluton. This is to be expected, as they were collected from within the pluton. However, it is a nice test of the methodology for determining source pluton. All are clustered fairly tightly within the Mountain Pine Ridge pluton (**Figure 1**).

In addition to simply determining source location, I took this opportunity to compare the results obtained on an older model, Delta, XRF to those obtained on a newer model, the Vanta. Both units have been purchased by and are housed at the University of Iowa. As can be seen in the table below, the Vanta has slightly higher counts of Rb and Sr, however, it does not seem to be a large enough increase to negatively impact the comparison of this data to the original outcrop dataset which was analyzed using the Delta unit (**Table 1**). Further work is needed to assess if any additional calibrations are needed in order to back compare now that a newer unit is being used in this work. When the Delta and Vanta results are directly compared within the outcrop database, there is very little shift in placement (**Figure 2**). There is the potential for some slight variation due to the heterogeneous nature of granite and the role of random sampling. Further work is needed to determine if there is a difference in detection between the Delta and the Vanta units.

Overall, this initial exploration into the geochemistry of Buffalo Hill Quarries has given a deeper insight into the variation within Mountain Pine Ridge. Future work to continue sampling the pluton, as well as the quarry sites, will be needed to paint a complete picture of the granite. Additional avenues for future investigation will include determining a method for intra-pluton sourcing that could be used to tie artifacts from sites throughout the region directly to the Buffalo Hill Quarries production zone. It is very likely that XRF will not be suitable for such investigations, leading to the need to explore different methodologies such as single-mineral analysis via electron microprobe.

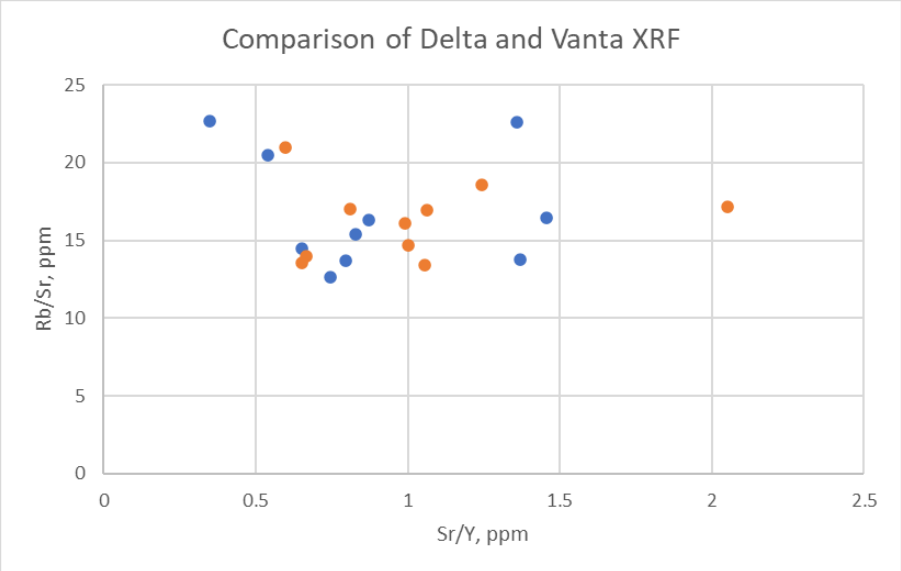

Figure 1. Comparison of Delta and Vanta XRF results.

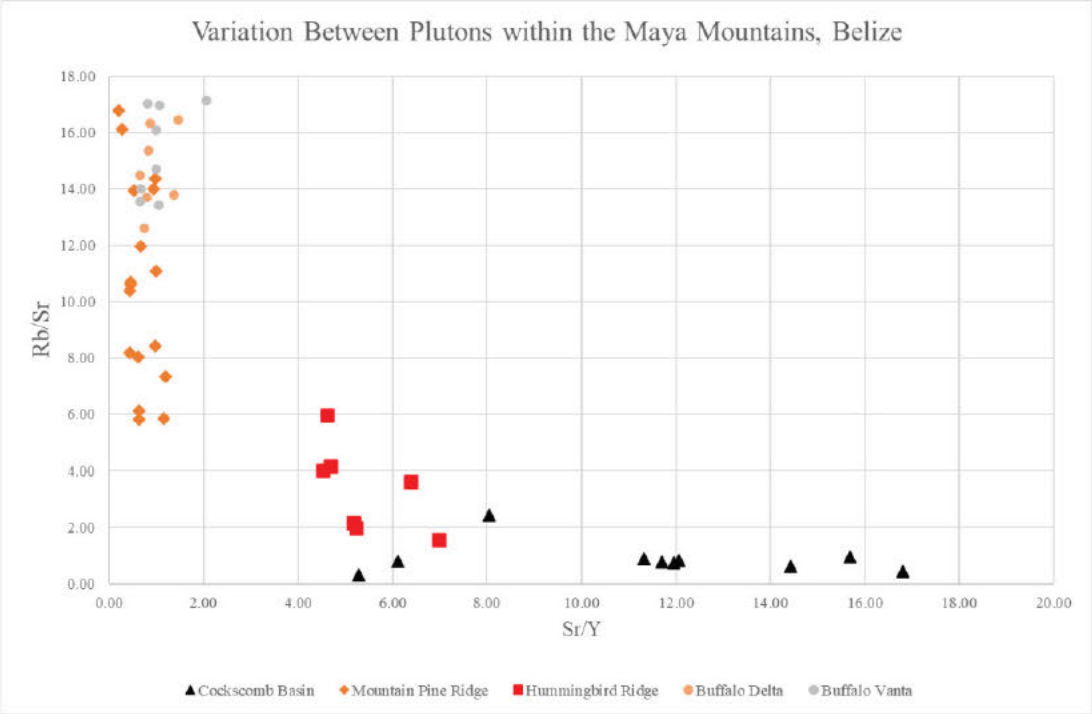

Figure 2. Variation between Plutons within the Maya Mountains, Belize.

Table 1. Comparison of the Sr/Y and Rb/Sr ratios (in ppm) for the Buffalo Hill Quarries sample set

Delta XRF	Sr/Y	Rb/Sr
BHQD1	0.650246	14.48889
BHQD2	0.797386	13.69388
BHQD3	0.826816	15.37079
BHQD4	0.87037	16.33673
BHQD5	0.746988	12.60606
BHQD6	1.456522	16.45977
BHQD7	1.37037	13.79
BHQD8	0.348525	22.69014
BHQD9	1.358025	22.6125
BHQD10	0.538462	20.46753

Vanta XRF	Sr/Y	Rb/Sr
BHQV1	0.989011	16.1
BHQV2	0.809917	17.03061
BHQV3	0.664179	13.98876
BHQV4	1.053763	13.41837
BHQV5	0.651316	13.55556
BHQV6	1.060976	16.95402
BHQV7	1	14.7
BHQV8	0.596639	21.01408
BHQV9	2.051282	17.1625
BHQV10	1.241935	18.61039

Works Cited

Powis, T. G., Skaggs, S. & Micheletti, G. J. (Eds.). (2020). An archaeological reconstruction of ancient Maya life at Pacbitun, Belize. BAR International Series 2970. British Archaeological Reports.

Skaggs, S., Micheletti, G. J., Lawrence, M., Cartagena, N., & Powis, T. G. (2020). Identification of an ancient Maya groundstone production site in the periphery of Pacbitun, Belize. In T. G. Powis, S. Skaggs, & G. J. Micheletti (Eds.), An archaeological reconstruction of ancient Maya life at Pacbitun, Belize. BAR International Series 2970 (pp. 159–173). British Archaeological Reports.

Tibbits, T. L. B. (2016). Geochemical sourcing of granite ground stone tools from Belize [Unpublished doctoral dissertation]. University of Iowa.

Ward, Drew T. (2013) Investigations of a Ground Stone Tool Workshop at Pacbitun, Belize. Unpublished M.A. thesis, Georgia State University, Atlanta.

Chapter 4: Ground Truthing LiDAR Data in Broad-Leaf Forested Areas

As Horn and Ford (2019) note, "[e]very researcher employing Lidar in the Maya Lowlands understands the need to ground-truth features identified in remotely sensed images, and a variety of methods have been used to assess the accuracy of Lidar imagery." The reason is that current LiDAR technology is unable to differentiate between cultural features and natural ones that resemble them (Horn and Ford 2019), and it misses some (Thompson 2020). In regions that have been surveyed previously, LiDAR data are ground-truthed or verified by comparing the results with existing maps and noting agreement or not between features (Chase et al. 2011; Chase et al. 2014; Horn and Ford 2019; Cap et al. 2018). In lightly or unsurveyed regions, such as the RiFRAP research area, the data can be used to target areas with cultural remains while avoiding those that lack them (Fisher et al. 2017).

During the 2023 field season, we dedicated three days to ground-truthing LiDAR data of the broad-leaf forested areas of the Mountain Pine Ridge Forest Reserve collected as part of the NCALM Belize 2022 Collaborative LiDAR Campaign (Spenard 2023). Our primary focus was confirming and mapping Nohoch Batsó Plaza 5, but we also visited suspected caves and isolated mound sites near Rio Frio Caves A and B and the Buffalo Hill Quarries site. Mapping efforts at the plaza were successful, and we confirmed two previously unreported cave entrances as well as a large mound near Tunnel Cave. We were unable to confirm suspected settlements near the quarry site, although local conditions made it difficult to conduct a thorough survey. More focused work in the area is recommended.

Mapping efforts at Nohoch Batsó Plaza 5 were undertaken by the PI, local project workers, and volunteer, Mr. Jorge de Leon. We used a SXBlue Platinum GNSS device with Atlas 50 RTK correction capable of real-time sub-30 cm location solutions to complete the work. Geolocational data were collected on an iPad tablet running the Field Maps application. Given time restraints, little vegetation was cleared from the plaza, making it difficult to fully assess, and it will need to be better cleared in the future to produce a more accurate map. Nevertheless, points were taken at the ground corners of the plaza and base corners of all structures on it. The plaza is approximately "Z" shaped and was built on a the side of a small slope of a hillside. As a result, its height varies, but at its tallest, it rises approximately 1.5 m above the ground surface. Six structures are located on top of it, one of which is pyramidal in shape (**Figure 1**). The remaining constructions are range structures and low mounds. Interestingly, the northwest corner of the plaza seemingly lacks a construction and may be the formal entrance to the space, perhaps a ramp. Another possible mound is visible in the LiDAR data immediately west, and off of that corner of the plaza, but it remains unconfirmed. Materials used to make construction blocks used to for Plaza 5 were carved from limestone and granitic rock blocks (**Figure 2**). Moreover, granitic reduction debitage and tools (**Figure 3**) were noted on the surface of the plaza suggesting it may have been a marketplace for ground stone implements.

When reviewing our results from the NCALM Campaign (Spenard 2023), we noticed two arroyos that originate in the forest near the campground in the Douglas D'Silva Forest Station (**Figure 4**). They continued into the base of the hill that Rio Frio Cave A and Closing Jaw penetrate, but on the east side of it, their position suggesting that they lead to caverns. Visiting both, we

Figure 1. Map of Nohoch Batsó Plaza 5. Contour interval is 0.5 m.

Figure 2. Granitic architectural block from Nohoch Batsó Plaza 5.

Figure 3. Grooved granitic rock ground stone tool noted on the surface of Nohoch Batsó Plaza 5.

Figure 4. LiDAR derived hillshade showing location of Rio Frio Caves F and G to other known cave sites in the area.

confirmed that the arroyos both continue under the hill as cave passages. Unfortunately, our headlamps were inadvertently left at the lab, and we were thus unable to explore them except a small way by cell phone flashlight. We visited the northern arroyo first, followed by the southern one. Following Mason's and Anderson's naming conventions for caverns in area, we dub them Rio Frio Cave F and Rio Cave G respectively.

The entrance of Rio Frio Cave F is a small sinkhole that drops about 0.5 m and then opens up into a low crawl horizontal tunnel (**Figure 5**). In the entrance area, a granitic rock sphere was recorded, but left uncollected (**Figure 6**). Inside the cave, team members recovered unslipped ceramic sherds that were collected as proof of ancient Maya use of the cavern. Though our investigations of it were minimal, we did note that water flows inside, likely originating from the arroyo. The northern position of the cavern on the hill suggests the stream may be the same that flows at the back of Rio Frio Cave A.

The entrance to Rio Frio Cave G is much smaller than Cave F, though it is also a sinkhole. The restricted nature of the opening is reminiscent of Tzul's Cave at Pacbitun, a small cavern that is entered via a crack in the hillside that opens in the ceiling of a chamber below (Powis 2010; Spenard et al. 2020). The passage in Rio Frio Cave G drops approximately 1.5 m before leveling out, but the passage trends downward. No artifacts were noted, but a deep pool of water is present near the entrance area. RiFRAP member Pacho Mai probed for the bottom of the pool with his machete until his arm was completely submerged up to his shoulder, but he never reached the bottom. The cave does continue beyond that point, but proper equipment was necessary to safely explore it. The southern position of the cave on the hill suggests the water inside it likely connects with the water at the back of Closing Jaw Cave. Both of the caverns reported here should be more thoroughly investigated during future seasons with proper equipment.

Figure 5. Photograph of RiFRAP crew standing in front of entrance to Rio Frio Cave F. Starting at the bottom left and proceeding clockwise are Javier Mai Sr., Moses Flores, Javier Mai Jr., Rony Mai, Pacho Mai, Boh Mai, and Jorge de Leon.

Figure 6. Granitic rock sphere noted at Rio Frio Cave F entrance.

While potential caverns, such as Rio Frio Caves F and G, quarries, and plazas are obvious in the LiDAR data, isolated mounds in heavily forested area have been more difficult to identify from the remote sensed data alone. We have identified potential mounds largely based on hilltops that appear to have been flattened, and they are especially common around Nohoch Batsó. We hypothesize that configuration, termed here rural plaza groups, are domestic, and likely the homes of farmers. To test our hypothesis, we selected one on a hilltop near Tunnel Cave on the Rio Frio Cave Road (**Figure 7**). Although less obvious than other rural plaza groups in the data, we chose to visit that site because it is accessible by following the pre-established trail leading to Tunnel Cave. Working at that mound allowed us to respect the wilderness protection requirements the Forest Department places on researchers working in reserves. We confirmed the mound site during our time there, but our GNSS antenna had malfunctioned. We attempted to map the structure using the GPS in my cellphone, but it was inadequate for the task. Nonetheless we determined that the mound is aligned roughly northeast-southwest and measures approximately 14m long x 6m wide x 1.5 m high (**Figure 8**).

To conclude, though we only dedicated a short time to ground truthing our LiDAR data outside the quarry areas during the 2023 field season, we learned a great deal. Confirming and mapping Nohoch Batsó Plaza 5 has suggested the presence of a granitic groundstone tool marketplace centered there. Investigations of that plaza during future field seasons should be a project priority as confirming it will allow us to begin to address larger-scale questions about the ancient Maya trade and the domestic economy. Confirming that arroyos heading into hills likely indicates caverns has implications for understanding the northern region of our permit area near the known granite quarry-workshops. There several hills have arroyos leading to them, suggesting yet unrecorded cave systems will be located there. During his dissertation research with the

Pacbitun Regional Archaeological Project, Spenard (2014) documented a small two-plaza settlement and cavern on the north side of Privasion Creek now known to be in the vicinity of the quarry-workshop sites we document in this report. Both the plazas and the cavern had an unusually large number of granite ground stone implements, particularly half-loaf objects the Pacbitun project calls discarded mano preforms. Their presence in the cavern suggested to Spenard (2014) that perhaps the ancient Maya used caves in the vicinity to perform rituals to an Earth Lord-like being as part of the granite quarrying process. The arroyos mentioned above lead into hills that surround the known quarry-workshop sites. Locating them will allow us to test Spenard's (2014) hypothesis that cave ritual was a component of granite extraction. Lastly, confirming the mound and plaza near Tunnel Cave as noted already, suggests a wide-spread rural ancient population was present in the Mountain Pine Ridge Forest Reserve.

Figure 7. LiDAR derived hillshade image of showing suspected mound on artificially leveled hilltop nearTunnel Cave.

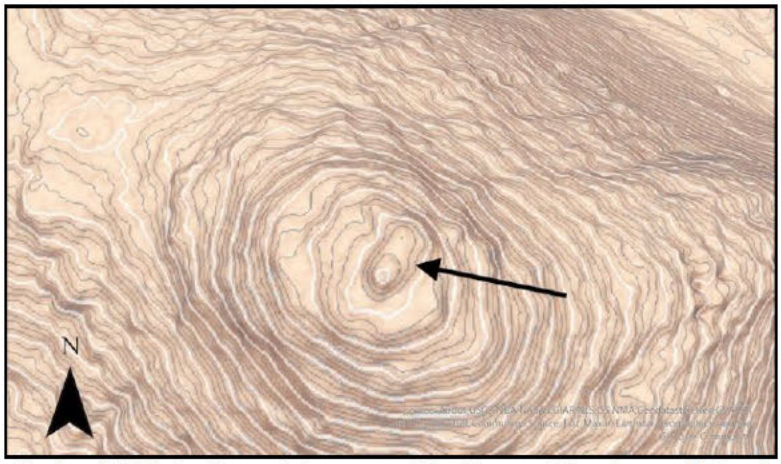

Figure 8. LiDAR derived hillshade and topographic isometric view of the isolated mound and plaza near Tunnel Cave. The arrow indicates the mound.

References Cited

Cap, Bernadette, Jason Yaeger, and M. Kathryn Brown
2018 Fidelity Tests of Lidar Data for the Detection of Ancient Maya Settlement in the Upper Belize River Valley. *Research Reports in Belizean Archaeology* 15:39-51.

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

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

Fisher, Christopher T., Anna S. Cohen, Juan Carlos Fernández Diaz, and Stephen J. Leisz
2017 The Application of Airborne Maping Lidar for the Documentation of Ancient Cities and Regions in Tropical Regions. *Quaternary International* 448:129-138.

Horn III, Sherman W., and Anabel Ford
2019 Beyond the Magic Wand: Methodological Developments and Results From Integrated Lidar Survey at the Ancient Maya Center El Pilar. *STAR: Science & Technology of Archaeological Research* 5(2):164-178.

Spenard, Jon
2014 Underground Identity, Memory, and Political Spaces: A Study of the Classic Period Maya Ceremonial Karstscape in the Pacbitun Region, Cayo District, Belize, Unpublished Ph.D. dissertation. Department of Anthropology, University of California, Riverside.

2023 Initial Observations of the NCALM Belize 2022 LiDAR Campaign Aerial Survey of the Mountain Pine Ridge. In *Report on the Third Field Season of the Rio Frio Regional Archaeological Project (RiFRAP) (June-July 2022, January 2023)*, edited by Jon Spenard, pp. 55-64. Occasional Paper No. 3. Department of Anthropology California State University San Marcos. Report Submitted to the Institute of Archaeology, National Institute of Culture and History, and Forest Department, Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development, and Immigration, Belmopan, Belize.

Thompson, Amy E.
2020 Detecting Classic Maya Settlements with Lidar-Derived Relief Visualizations. *Remote Sensing* 12(2838):1-29.

Chapter 5. Archaeological Salvage Operations of the Satah Witz Site and Actun Satah Witz in the Mountain Pine Ridge Forest Reserve

Introduction

From 26 June through 30 June, an archaeological salvage operation was undertaken on a small hilltop site in the Mountain Pine Ridge Forest Reserve immediately south of Douglas D'Silva Forest Station and military checkpoint. The site consists of a single house mound (Structure 1) built on an artificially leveled hilltop, and a small sink hole cave adjacent to it (**Figure 1**). The hill side is very steep and one of the tallest in the region. The excavations at the site represent the first household archeological work undertaken in the Mountain Pine Ridge Forest Reserve. The site was named *Satah Witz* meaning "Disappearing Hill," and the cave named, *Actun Satah Witz*, meaning "Disappearing Hill Cave" both in Yucatec Mayan (**Figure 2**). The operation was undertaken because the hill was scheduled to be quarried for fill for the Caracol Road paving project. That quarrying activity was set to result in the complete removal of the hill and, as a result, the total loss of the site. In sum, Structure 1, and off mound areas adjacent to it were excavated completely to bedrock revealing a single construction phase dating to the Late Classic period (c.a. 600-900 A.D.). One possible cache (Cache 1) was encountered during the mound operation, and another in the cave. The presence of granite blocks and a roughly hewn metate preform suggests the inhabitants may have been part-time stone workers. In Actun Satah Witz, excavations also proceeded to bedrock. Few artifacts were recovered from it, and, with the exception of a possible cache, described below, it was unlikely to have been used for ritual purposes. All photographs in the chapter are by the author unless specified.

Excavation overview

Two crisscrossing trenches aligned to the cardinal directions were placed over the mound and adjacent areas to locate intact architecture. They were further divided into five units to maintain spatial control over the excavated material. The unit sizes were determined by the working conditions, particularly to avoid trees and boulders while testing as much as the structure as possible and to capture any possible patio spaces and middens associated with it. Unit sizes and orientations along the longest axis are given in **Table 1**. A sixth trench, Unit 6, was placed between Units 1 and 4 to fully reveal the mound. Unfortunately, tree roots had severely disrupted the entire structure making its footprint and orientation difficult to discern (**Figure 3**). Moreover, the leveled area was unplastered and is presumed to have been made of tamped earth. All units were excavated by hand using trowels and picks, and all matrix was passed through 1/4" wire mesh to recover any artifacts overlooked in the pit. Three-dimensional scans of the structure and cave at the start, and during, and end of excavations were made using the PolyCam app and the LiDAR scanner on an iPad pro tablet. Having the ability to scan the architecture from the ground and process the model in the field allowed us to gain a birds-eye view of the mound in real time and adapt our excavation

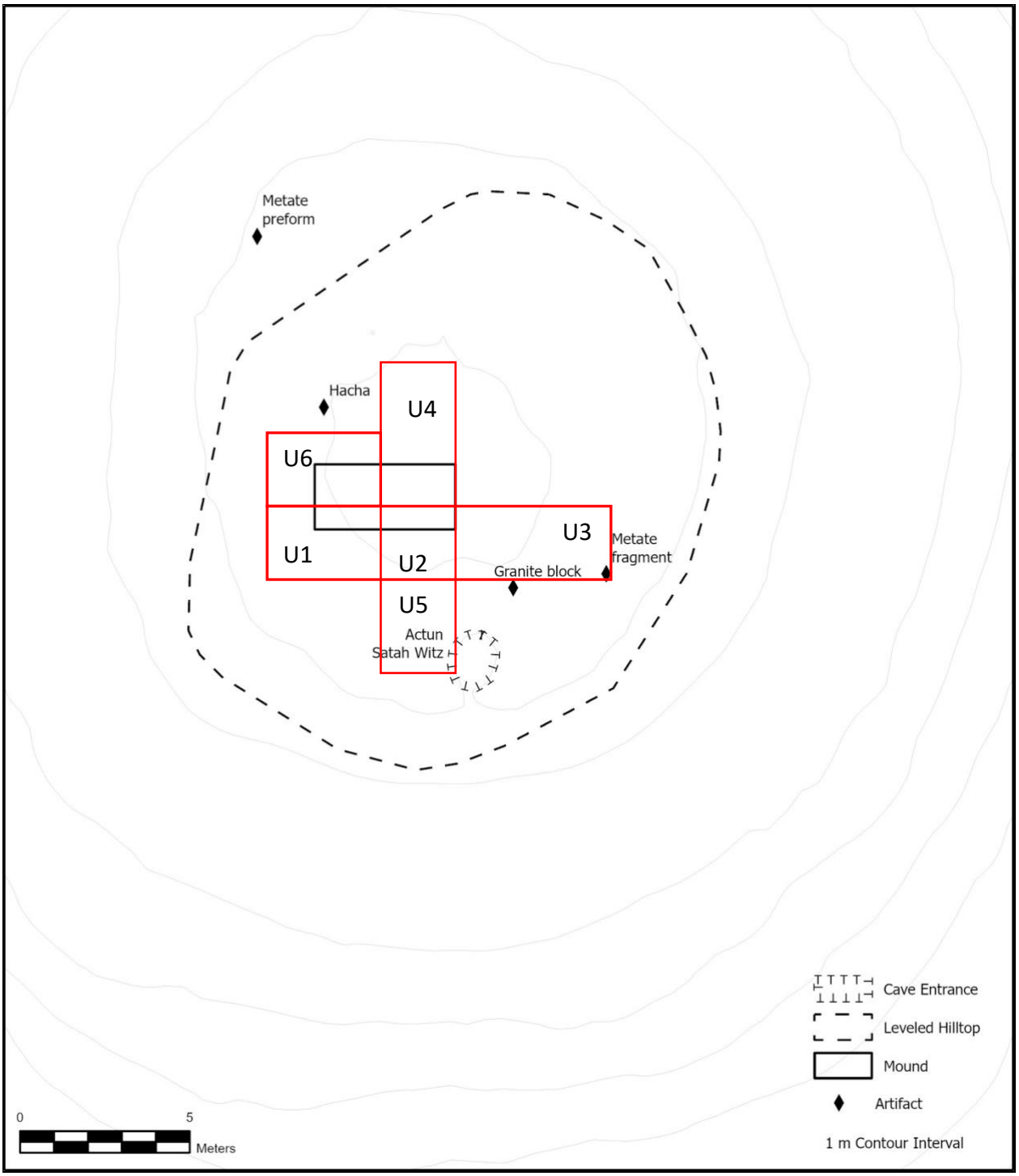

Figure 1. Plan view map of Satah Witz site (map drafted by M. Mirro).

Figure 2. Photograph showing Actun Satah Witz entrance (foreground) in relation to the Satah Witz Structure 1 (center top).

Table 1. Excavation unit information, size, and orientation.

Unit Number	Unit Measurements	Unit Orientation
U1	4.5m x 2m	E-W
U2	2m x 2m	Cardinal directions
U3	3.5m x 2m	E-W
U4	5m x 2m	N-S
U5	4.5 x 2m	N-S
U6	4.5m x 2m	E-W

Figure 3. Satah Witz Structure 1 being cleared of underbrush. Note the two large black Chechem trees marked in orange colored flagging tape are growing in the center of the structure.

strategy accordingly. In particular, from the scan, we were able to study the remnants of the walls as they were exposed, determining which remained intact, and those that were disturbed by tree growth. Specifically used it to determine where to place Unit 6.

Each unit on and around the mound was excavated in either one or two levels, each labeled "Surface," and "Level 1." The Surface level consists of a thick root mat and humus which rarely

contained artifacts. Within the structure, dislodged rubble was also considered part of the surface level. In all areas excavated, the root mat was thick, exceeding 20 cm in many places (**Figure 4**).

On Structure 1, we identified Level 1 by the appearance of limestone gravel fill beneath larger cobbles of the same material that had presumably made up the sub-floor. Off the structure, Level 1 was identified by the same gravely fill found below the cobbles on the mound, although Unit 4 was dug in only one level. Excavations in each unit proceeded to bedrock, the depth of which varied greatly throughout the site and within the individual excavation pits. In some spots, excavations encountered it approximately 20 cm below the top of the humus. In other areas, such as the west side of U3 and the north side of U4, it was encountered over 50 cm below the surface. Neither of those final depth measurements account for the thick root mat that covered the site when work begun there.

By far, the most productive units in terms of quantity of artifacts recovered were Units 4 and 6, both positioned at the north side of Structure 1. That side of the structure faced the leveled hilltop, while the south side overlooked the cave and impressive and unobstructed view of the

Figure 4. Javier Mai Jr. clearing the root mat from the structure and surrounding area.

Maya Mountains (**Figure 5**). The distribution of artifacts provides a hint about the original orientation of the structure. Maya trash middens are commonly located behind houses and are identified archaeologically by the high density of artifacts compared to the other areas of a site (Halperin and Foias 2016). Assuming that pattern holds for Satah Witz then the front of the structure likely faced the vista of the Maya Mountains to the south.

Excavations in the cave also proceeded in two levels. The first level was the modern talus cone directly below the entrance. It was excavated until a white powdery matrix was fully revealed. Due to its conical nature, starting and ending depths could not be meaningfully taken. Level 2 consisted of the matrix in the remainder of the cavern below the debris cone. It was primarily white powdery soil mixed with limestone pebbles. On average, the entire matrix of Levels 1 and 2 measured 1 m thick throughout the cavern.

Artifacts

Most of the artifacts recovered during excavation consist of eroded ceramic sherds. A rough count of 1,321 sherds weighing a total of 12,805.5 g were collected from the structure units.

Figure 5. View of Maya Mountains from Satah Witz, facing south.

Analysis of the material is still ongoing; however, a few patterns can be noted at present. The most common identifiable form is a large basin, inward curving bowl (**Figure 6**). Pendergast (1970:42) notes that such vessels are common to the Late Classic period (Tepu 2) and were found in the nearby Rio Frio Caves (Mason 1928). I have reported elsewhere that sherds of similar vessels have been found at Nohoch Batsó (Spenard 2023:16). Although no slip was immediately obvious on any of the pieces from Satah Witz, the form is similar to specimens in the Tinanja Group at Tikal (Culbert and Kosakowski 2019: Figures 50 and 51) and Uaxactun (Smith and Gifford 1966:163). At Caracol, the form is also found in the Tinaja Group, but it is also similar to Valentin Unslipped (Chase 1994). At Satah Witz, most appeared unslipped and undecorated although a few pieces had a single row of punctations similar to those from Nohoch Batsó. Three sherds that mend had a single meandering S-shaped incision around the neck of the vessel. Interestingly, the pattern appears only on part of the vessels. Elsewhere, it was made over the entire vessel.

Red-slipped volcanic ash ware sherds are present, but they make up a very small portion of the assemblage. We assigned them to the Belize group of ceramics. Though a minor component of the assemblage, they are strong temporal diagnostic marker of the Spanish Lookout phase in the Belize Valley (Gifford 1976) and elsewhere (Chase and Chase 2012) further reinforcing the proposed Late Classic period date for Satah Witz.

One other regularly recurring type of vessel found in both Structure 1 and the cave are very crudely made and very coarse paste bowls, some resembling pinch pots. Similar vessels have been recovered from the nearby Rio Frio caves (Mason 1928), Nohoch Batsó (Spenard 2023), and further away at Caracol where they are classified as Ceiba Unslipped (Chase and Chase 2004). Awe and colleagues (2005:21) show similarly crude vessels recovered from a cache from the site of Garapata in the Upper Macal River region.

Figure 6. Example of inward curving bowls sherds common to Satah Witz.

In the cave, jar rims were more common than any other form (**Figure 7**). They vary from having outflaring to direct, upright rims. Assigning those forms to a particular time period is difficult for the region, but similar forms are found in the Rio Frio Caves (Mason 1928; Spenard 2018), suggesting they too date the Late Classic period.

Another artifact of note, a teardrop-shaped shell pendant, was recovered from Unit 4 on the leveled hilltop away from the structure. The object was drilled (not biconically) and likely strung as a necklace (**Figure 8**). It was not in obvious association with any other objects suggesting it was lost or discarded rather than intentionally placed in its recovery location. National Park Service zooarchaeologist Brian Worthington identified the piece with photographs and a video as the worked columella of either a queen conch (*Strombus gigas)* or milk conch (*Strombus costatus*), both originating in the Caribbean Sea.

Figure 7. Unslipped jar rim recovered from Actun Satah Witz. Photo by J. Wojack.

Figure 8. Conch (*Strombus spp.*) shell columella pendant recovered from Satah Witz Unit 4.

Five granitic rock objects were recorded during our investigations of both sites, but we collected only three (see Figure 1 for locations). Two of the objects were in the plaza area of the site, only one of which was collected for future comparative studies. Two of the other objects are discarded metates. One, comprising approximately ¼ of the original tool, was collected from just above bedrock in the cave (**Figure 9**). The other is nearly complete, measuring 37 cm L x 21 cm W x 9 cm tall from bottom to rim of working area. It has a very deep basin, measuring 3 cm in depth, and it is heavily polished suggesting it had a very long use life (**Figure 10**). It was recovered from the eastern wall of Unit 3. The fifth granitic rock object recorded at the site is a metate preform collected on the north side of the site on the hillside below the artificial leveled area (**Figure 11**). It measures 59 cm L x 34 cm W x 15 cm thick. Its roughly worked condition suggests that the past people living at the site were at least part time *metateros*-mano and metate makers.

Caches

We uncovered two potential caches during our investigations. One was near Structure 1, and the other in the cave. The cache found on the surface was uncoverd at the approximate midpoint of the south side of the mound beyond the limits of the structure. It consists of two crudely made bowls like those described above (**Figure 12**). Both have out-flaring rims and made from very coarse calcite paste. The third cache vessel is a heavily eroded, orange-slipped, and incised cylindrical tripod with solid rectangular nubbin feet (**Figure 13**). The vessel has a pair of linear incisions running along its rim and base, and diagonal band of circular medallions, possibly a hieroglyphic text, also framed by incisions. It is similar in form to a Pala Incised vessel found at Caracol, although that other vessel has a red slip (Chase and Chase 2014:Figure 135f). Three

Figure 9. Metate fragment recovered from Actun Satah Witz.

Figure 10. Partial metate recovered from Satah Witz Unit 3.

Figure 11. Metate preform recovered off mound at Satah Witz.

Figure 12. Satah Witz Cache 1 bowls.

Figure 13. Satah Witz Cache 1 cylindrial tripod vessel.

limestone bars were associated with the pots, but only one is complete (**Figure 14**). Measurements and weights for the objects are given in **Table 2** below.

After excavation, it remains difficult to say with absolute certainty that the six objects constituted a cache. They had been tangled in the primary roots of the trees growing directly on top of the Structure 1, and the ceramics were crushed up against the roots (**Figure 15**). Several were completely encased in the roots. Yet, the completeness of the two bowls, the uniqueness of the Pital Incised-like tripod, which was likely a highly prized object for the past residents, and the proximity of those vessels with the limestone bars suggest they were intentionally placed together. Limestone bars are known from Caracol where they have been found in ritual caches and burials and with other implements used for cloth and net production (Chase et al. 2008).

The potential cache recovered in the Actun Satah Witz consists of two spent prismatic obsidian blade cores (**Figure 16**). They were recovered from the unstratified white powdery matrix below the recent talus cone in a small alcove in the north side of the cave, below the sinkhole entrance. Measurements are given for the two objects in **Table 3** below. Blade Core #1 no longer had a striking platform on either edge, instead both ends had been reduced to chisel-like edges. Blade Core #2 has step fractures on multiple faces and along the striking platform that would have prevented any other blades being produced from it. That no other objects were associated with the blade cores nor other signs of ritual, such as charcoal, combined with observation that they were both spent suggests they may have simply been discarded into the cave as a pair.

Figure 14. Satah Witz Cache 1 limestone bars.

Figure 15. Project member Eddie Tzib excavating Satah Witz Cache 1. Note the rim of the vessel abuts the tree root.

Figure 16. Actun Satah Witz Cache 1 spent obsidian blade cores.

Table 2. Measurements of Satah Witz Cache 1 hachas.

Object number	Provenance	Dimensions (LxWxT)	Weight
Hacha #1	U6-Surf	14.48 cm x 5.58 cm x 3.51 cm	305.3 g
Hacha #2	U6-Surf	12.49 cm x 4.54 cm x 2.35 cm	130.9 g
Hacha #3	U4L1	7.98 cm x 3.67 cm. 2.48 cm	75.7 g

Table 3. Measurements of Actun Satah Witz Cache 1 obsidian blade cores.

Object number	Provenance	Dimensions (LxW)	Weight
Blade Core #1	North Alcove	7.15 cm x 1.62 cm	24.0 g
Blade Core #2	North Alcove	6.83 cm x 1.83 cm	25.7 g

Conclusion

This report detailed the results of RiFRAP's investigations of the Satah Witz site, the first household archaeological investigations undertaken in the Mountain Pine Ridge Forest Reserve. Satah Witz is a small, rural, hilltop site located just south of Dogulass D'Silva Forest Station and the military checkpoint. Six units of varying size were excavated to bedrock, revealing a single phase of occupation during the Late Classic period (ca 700-900 AD). The artifacts recovered indicate the inhabitants were of low economic status who may have been part-time crafters of granite ground stone tools and possibly textiles or cordage.

Works Cited

Awe, Jaime J., Douglas M. Weinberg, Rafael A. Guerra, and Myka Schwanke
2005 Archaeological Mitigation in the Upper Macal River Valley: Final Report of Investigations Conducted Between June–December 2003, January–March 2004, October–December 2004. *Report Submitted to the Belize Institute of Archaeology and Belize Electric Company Limited: By Belize Valley Archaeological Reconnaissance Macal River Project*.

Chase, Arlen F.
1994 A Contextual Approach to the Ceramics of Caracol, Belize. In *Studies in the Archaeology in Caracol, Belize*, edited by Diane Z. Chase, and Arlen F. Chase, pp. 157-182. Monograph 7, Pre-Colombian Art Research Institute, San Francisco.

Chase, Arlen F., and Diane Z. Chase
2004 Terminal Classic Status-Linked Ceramics and the Maya "Collapse": De Facto Refuse at Caracol, Belize. In *The Terminal Classic in the Maya Lowlands*, edited by Arthur A. Demarest, Prudence M. Rice, and Don S. Rice, pp. 342-366. The University Press of Colorado, Boulder, CO.

2012 Belize Red Ceramics and Their Implications for Trade and Exchanged in the Eastern Maya Lowlands. *Research Reports in Belizean Archaeology* 9:3-14.

2014 *Ancient Social Integration in a Maya Neighborhood: Investigation of Adjacent Residential Complexes near Caracol's Epicenter: Caracol Archaeological Project Investigations for 2014: A Continuation of the 2012 and 2013 Research Focus*. Report Prepared for the Belize Institute of Archaeology.

Chase, Arlen F., Diane Z. Chase, Elayne Zorn, and Wendy Teeter
2008 Textiles and the Maya Archaeological Record: Gender, Power, and Status in Classic Period Caracol, Belize. *Ancient Mesoamerica* 19:127-142.

Culbert, T. Patrick, and Laura J. Kosakowsky
2019 *The Ceramic Sequence of Tikal*. Tikal Report 25B. University Monograph 152. University of Pennsylvania Musuem of Archaeology and Anthropology, Philadelphia.

Gifford, James C.
1976 *Prehistoric Pottery Analysis and the Ceramics of Barton Ramie in the Belize Valley*. Memoirs of the Peabody Museum of Archaeology and Ethnology. Harvard University Press, Cambridge.

Halperin, Christina T., and Antonia A. Foias
2016 Household Garbage: Classic Period (ca. 300-900 CE) Maya Practices of Discard. In *Household Archaeology–A Transatlantic Comparative Approach: Proceedings of the Internaional Symposium, October 24-25 2014*, edited by Claude Chapdelaine, Adrian L. Burke, and Karim Gernigon, pp. 126-145. P@lethnology, 8, Université de Montréal, Montreal.

Mason, Gregory
1928 *Pottery and Other Artifacts from Caves in British Honduras and Guatemala*. Indian Notes and Monographs, No. 47. Museum of the American Indian. Heye Foundation, New York.

Pendergast, David M.
1970 *A.H. Anderson's Excavations at Rio Frio Cave E, British Honduras (Belize)*. Occasional Paper, 20. Royal Ontario Museum, Division of Art and Archaeology, Toronto.

Smith, Robert E., and James C. Gifford
1966 *Maya Ceramic Varieties, Types, and Wares at Uaxactun: Supplement to "Ceramic Sequence at Uaxactun, Guatemala"*. Middle American Research Institute Publication 28 Tulane University, New Orleans.

Spenard, Jon
2018 Rio Frio Cave A Artifacts. In *Rio Frio Regional Archaeological Project (RiFRAP) Report on the Inaugural (2018) Field Season*, edited by Jon Spenard, pp. 39-57. Occasional Paper No. 1 Department of Anthropology, California State University San Marcos, Report submitted to the Institute of Archaeology, National Institute of Culture and History, Belmopan, Belize.

2023 Nohoch Batsó Plaza 1 Investigations. In *Report on the Third Field Season of the Rio Frio Regional Archaeological Project (RiFRAP) (June-July 2022, January 2023)*, edited by Jon Spenard, pp. 11-28. Occasional Paper No. 3. Department of Anthropology California State University San Marcos. Report Submitted to the Institute of Archaeology, National Institute of Culture and History, and Forest Department, Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development, and Immigration, Belmopan, Belize.

Chapter 6: Report on a Fourth Radiocarbon Date from Rio Frio Cave A

In last season's progress report, I presented three radiocarbon dates from Rio Frio Cave A, including two from successive, well defined stratigraphic layers in Unit 2 that were surprisingly early (Spenard 2023b). Both layers date to the Late Preclassic period between 178 cal BC – 26 cal AD (**Table 1**). The early dates were surprising because all of the identified ceramics recovered from the cavern from our investigations (Spenard et al. 2020) and Mason's (1928) stylistically date to the Classic period with the Late to Terminal Classic most represented. Other evidence for earlier use of the cavern was unknow. Hoping to confirm the early dates, I submitted another single piece of wood charcoal from Unit 2 Level 3 to Beta Analytic laboratories in Miami, Florida for analysis. The new result (Beta 692746) is presented below in **Table 1** along with the other results from the cavern reported last year (Spenard 2023b). In short, the new date confirms the Late Preclassic period date for the level and potentially pushes its earliest use back two decades. Considering the integrity of the stratified deposits we recovered the piece from and that it aligns with the previously acquired dates, the results are accepted.

Table 1. Radiocarbon Determinations from Rio Frio Cave A. The * indicates the newly determined date.

Site	Provenience	Lab #	Conventional C-14 Age	Calibration Results (2σ)
Rio Frio Cave A	U2 L2	Beta - 656175	2050 +/- 30 BP	158 cal BC - 26 cal AD (94.8%) 50 - 55 cal AD (0.6%)
Rio Frio Cave A	U2 L3	Beta - 656176	2090 +/- 30 BP	178 - 38 cal BC (91.2%) 13 cal BC - 4 cal AD (2.8%) 196 - 185 cal BC (1.3%)
*Rio Frio Cave A	U2 L3	Beta - 692746	2100 +/- 30 BP	198 – 42 cal BC (94.2%) 336-330 cal BC (0.8%) 7-5 cal BC (0.3%)
Rio Frio Cave A	U1 L5	Beta - 656174	1490 +/- 30 BP	545 - 642 cal AD (95.4%)

Collectively, the early dates from Rio Frio Cave A are significant for our understating of the archaeology of the region, particularly at Nohoch Batsó. Our excavations at that site have been limited to date but reveal that Plaza 1 was constructed in the Late Classic period. Dates for other parts of the site are currently unknown, but the architecture in the core area is aligned suggesting it is contemporaneous. Yet, the cave data indicate the presence of a population in the area that predates the site. An aerial LiDAR survey of the region in 2022 revealed another large plaza in the north end of the valley (Spenard 2023a). The complex stands out because its alignment is significantly different than the rest of the site, suggesting it may date to another time period, perhaps a Preclassic period component. Upcoming work at Nohoch Batsó will focus on the plaza to determine its date, function, and relation to other parts of the site.

Works Cited

Mason, Gregory
1928 *Pottery and Other Artifacts from Caves in British Honduras and Guatemala*. Indian Notes and Monographs, No. 47. Museum of the American Indian. Heye Foundation, New York.

Spenard, Jon
2023 Initial Observations of the NCALM Belize 2022 LiDAR Campaign Aerial Survey of the Mountain Pine Ridge. In *Report on the Third Field Season of the Rio Frio Regional Archaeological Project (RiFRAP) (June-July 2022, January 2023)*, edited by Jon Spenard, pp. 55-64. Occasional Paper No. 3. Department of Anthropology California State University San Marcos. Report Submitted to the Institute of Archaeology, National Institute of Culture and History, and Forest Department, Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development, and Immigration, Belmopan, Belize.

2023 Report on a Suite of Radiocarbon Dates from Rio Frio Cave A and Domingo Ruiz Cave. In *Report on the Third Field Season of the Rio Frio Regional Archaeological Project (RiFRAP) (June-July 2022, January 2023)*, edited by Jon Spenard, pp. 69-82. Occasional Paper No. 3. Department of Anthropology California State University San Marcos. Report Submitted to the Institute of Archaeology, National Institute of Culture and History, and Forest Department, Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development, and Immigration, Belmopan, Belize.

Spenard, Jon, Andres Berdeja, Jessica Garcia, Ariana Yanez, Javier Mai, and Michael Mirro
2020 Excavations and Interpretation in Rio Frio Cave A, Chamber 1. In *Rio Frio Regional Archaeological Project (RiFRAP) Report on the Second (2019) Field Season*, edited by Jon Spenard, pp. 8-36. Occasional Paper No. 2 Department of Anthropology, California State University San Marcos, Report submitted to the Institute of Archaeology, National Institute of Culture and History, Belmopan, Belize.

Appendix A: Reports of Radiocarbon Dating Analysis

Beta Analytic, Inc.
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Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

REPORT OF RADIOCARBON DATING ANALYSES

Jon Spenard — Report Date: March 28, 2024

California State University San Marcos — Material Received: March 21, 2024

Laboratory Number	Sample Code Number	Conventional Radiocarbon Age (BP) or Percent Modern Carbon (pMC) & Stable Isotopes	
Beta - 692746	**1-007.2**	**2100 +/- 30 BP**	IRMS δ13C: -26.1 o/oo

(94.2%)	**198 - 42 cal BC**	**(2147 - 1991 cal BP)**
(0.8%)	**336 - 330 cal BC**	**(2285 - 2279 cal BP)**
(0.3%)	**7 - 5 cal BC**	**(1956 - 1954 cal BP)**

Submitter Material:	Charcoal
Pretreatment:	(charred material) acid/alkali/acid
Analyzed Material:	Charred material
Analysis Service:	AMS-Standard delivery
Percent Modern Carbon:	77.00 +/- 0.29 pMC
Fraction Modern Carbon:	0.7700 +/- 0.0029
D14C:	-230.05 +/- 2.88 o/oo
Δ14C:	-236.91 +/- 2.88 o/oo (1950:2024)
Measured Radiocarbon Age:	(without d13C correction): 2120 +/- 30 BP
Calibration:	BetaCal5.0: HPD method: INTCAL20

Results are ISO/IEC-17025:2017 accredited. No sub-contracting or student labor was used in the analyses. All work was done at Beta in 4 in-house NEC accelerator mass spectrometers and 4 Thermo IRMSs. The "Conventional Radiocarbon Age" was calculated using the Libby half-life (5568 years), is corrected for total isotopic fraction and was used for calendar calibration where applicable. The Age is rounded to the nearest 10 years and is reported as radiocarbon years before present (BP), "present" = AD 1950. Results greater than the modern reference are reported as percent modern carbon (pMC). The modern reference standard was 95% the 14C signature of NIST SRM-4990C (oxalic acid). Quoted errors are 1 sigma counting statistics. Calculated sigmas less than 30 BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d13C values are on the material itself (not the AMS d13C). d13C and d15N values are relative to VPDB. References for calendar calibrations are cited at the bottom of calibration graph pages.

BetaCal 5.0

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL20)

(Variables: d13C = -26.1 o/oo)

Laboratory number **Beta-692746**

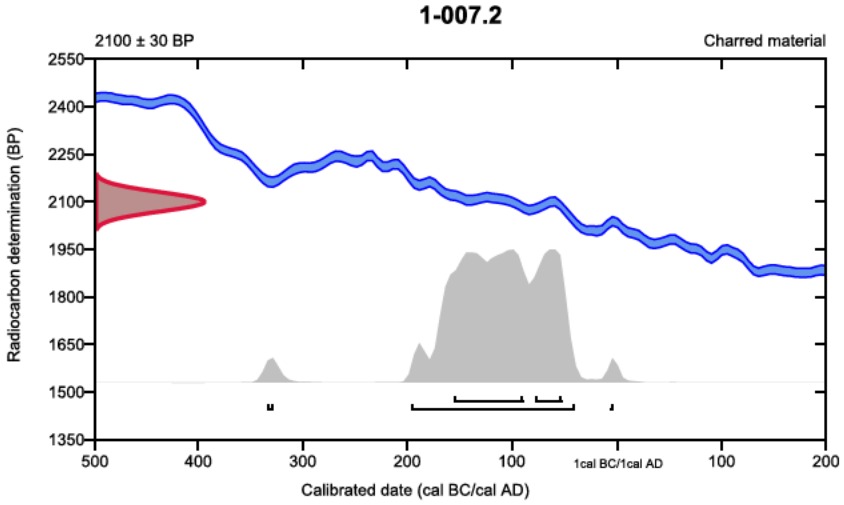
Conventional radiocarbon age **2100 ± 30 BP**

95.4% probability

(94.2%)	198 - 42 cal BC	(2147 - 1991 cal BP)
(0.8%)	336 - 330 cal BC	(2285 - 2279 cal BP)
(0.3%)	7 - 5 cal BC	(1956 - 1954 cal BP)

68.2% probability

(49.7%)	157 - 91 cal BC	(2106 - 2040 cal BP)
(18.5%)	79 - 54 cal BC	(2028 - 2003 cal BP)



Database used

INTCAL20

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

References to Database INTCAL20

Reimer, et al., 2020, Radiocarbon 62(4):725-757.

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Chapter 7. Interim Report on a Study of Gregory Mason's Rio Frio Caves Artifacts Housed at the National Museum of the American Indian, Smithsonian Institution, Washington, D.C.

Introduction

In 1928, the Museum of the American Indian (MAI) in New York contracted Gregory Mason to lead an expedition to Belize, Guatemala, and Mexico to collect ethnographic objects to add to the institution's collections. Accompanying Mason on the expedition was Harvard zoologist, Oliver L. Austin Jr. who collected birds and bats, and mammal skins (Mason 1929), and identified two species of birds then unknown to science on the trip (Austin 1929). For our purposes, the most notable component of the expedition was unexpected archaeological work that Mason conducted in three caves he called Rio Frio Cave A, B, and C (Mason 1928, 1929, 1940). The work was unexpected because he had come to learn about just one of the caverns after he arrived in Cayo, being described to him by Mr. Alfred August as "filled with marvelous pottery" (Mason 1940:105). Though not part of his contractual duties with the MAI, he took the opportunity to visit the cave to collect materials for the museum, and during that trip, he and his team located the other two caverns. Ultimately, he conducted excavations and made collections in all three (Mason 1928). Today Caves A and B are known locally as Twin Cave, and Cave C is the Rio Frio Cave. When attempting to export the assemblage, authorities at the dock informed Mason that his archaeological work was illegal law because he did the work without getting the status of concessionaire (Mason 1940:119). He was able to negotiate for the status after the fact, and as was standard practice at the time the MAI was allowed to keep roughly half of the collection while the other half remained the property of the colony. The material was divided piece by piece, with a coin flip deciding who got to choose first. Though the assemblage was officially split between the MAI and colonial authorities, the half belonging to the latter was loaned to the foundation for a short period of time (Mason 1940:120).

Unfortunately, it appears that Mason's last regular involvement with the entire collection was seeing it off from the docks as it left Belize. As a result, his publications about the cave work are substandard even for his time. He produced a report on the expedition as part of the MAI-Heye Foundation's Indian Noes and Monographs series (Mason 1928), and he dedicated a chapter to it in his autobiography (Mason 1940). Another account of the trip appears as a series of stories in Motoboating magazine (Mason 1929), as unlikely a destination for an archaeological publication if there was one. All of the "reports" read less as archaeological summaries than they adventure diaries. Site, excavation, and artifact descriptions are haphazardly presented and lack attention to detail, unit illustrations and site maps are completely absent, and unfortunately, the archeology is overshadowed by his detailing the trials and tribulations of the trip. When he does discuss the archaeology, he provides general descriptions of chambers intermixed with accounts of who and how the team explored the cave. Descriptions of archaeological findings are woven throughout the narrative, but objects and areas are often compared to others in the report with little provenience information given to just a few, but not every object. Object photographs illustrate the report, but the images were taken at the MAI, after they had been processed, and many partially or fully reconstructed. Unfortunately, the images are poorly reproduced in the publication making details of the decorations difficult to discern. Moreover, information is unsystematically reported in the

figure captions. Artifacts are sometimes listed as being from a specific cave, while other times being from a general geographic description such as "Rio Frio Caves 12 miles southeast by east of Benque Viejo." That latter locational description has several variations throughout the report. Captions often, but not always, include a single measurement, especially for whole vessels, but only ever one, and the measured part varies caption-by-caption. It may report a vessel height, or rim or base diameter. Those serious issues aside, to date, those reports (Mason 1928, 1940) have been the only publications on the collection and no formal study of the assemblage has ever been made.

In 1989, the MAI was transferred to the Smithsonian Institution, becoming the core of the National Museum of the American Indian (NMAI) in Washington D.C., though it retained the New York campus. Most of the MAI's collection is hosed at the Cultural Resource Center (CRC), an off-site curation, conservation facility and archive in Suitland, MD, a town on the outskirts of Washington, D.C. During the fieldwork pause caused by the COVID-19 pandemic, I set out to relocate Mason's Rio Frio collection in hopes of making the first formal study of it. My interest in tracking it down was sparked by a tip from former RiFRAP member, Joel Aspytia, who had visited the New York NMAI campus and reported to me seeing a whole ceramic vessel from the Rio Frio caves on display there. I contacted the NMAI who confirmed the collection was being curated at the CRC. I applied to the museum and was approved to conduct the study reported here, timing it to a research sabbatical leave from my university in Spring 2023. With grant support from the American Philosophical Foundation, I made two trips to the CRC (April and July-August 2023) and spent a total of 8 days with the collection and associated photo archives. The accession record and correspondence between Mason and the Foundation were provided electronically to me before the trip.

One of the initial goals of the project was determining if the entire assemblage remained with the NMAI or if the British portion had been returned as required. My uncertainty stemmed from reading through Mason's correspondence with the MAI and published accounts of the expedition. In his published works, he openly discusses the colonial authorities retaining ownership over half of the collection, but that the museum was permitted to borrow it on a short-term loan (Mason 1928). Yet, in his correspondence with the MAI, he seemed to be dismissive of the requirement to return the objects. None of the accession records provided to me originally indicated the MAI had returned the objects, and the overall lack of reporting Mason made of the collection made it difficult to know how much should be there. The only indication that it may have been is a shipping ledger from 1929 that records a shipment of two cases to the British Museum on January 4 of that year (NMAI Archive Center [B184.11] 1929 Jan MAI Shipping Log), within the period of time granted for the loan. Mason included a letter to the MAI with the shipment of artifact in which he noted the British portion was contained in two cases that he labeled as "B.M." in pencil. That description matches the number of containers recorded in the 1929 shipping log. NMAI staff informed me that the MAI would not have had any other business with the British Museum at that time. Overall, the data suggests that the MAI did return the British half of the assemblage as required by way of the British Museum.

I have reached out to that institution to confirm if the shipment had been received, but they have been unable to confirm receipt. Moreover, none of the objects are listed on their online collections indicating they have not been properly received. Unfortunately, a bill of lading nor

other paperwork associated with the shipment from the MAI to the British Museum has turned up to be able to provide more context for a storage search. I speculate that perhaps lacking a detailed record of what the crates contained, the fact that they were shipped from New York may mean they are in storage with material from the Eastern. United States rather than Central America. I remain hopeful that they will be relocated in the future.

Methods

The remaining portion of the original assemblage I studied, hereafter referred to as the "Mason Rio Frio Collection" includes NMAI catalog numbers 161823.000 through 161885.000 (**Table 1**). It is largely composed of ceramic items (n=451) including whole and partial vessels, sherds, and ceramic objects. It also includes 37 *jute* (*Pachychilus spp.*) shells (**Figure 1**), two partial bifaces (**Figure 2**), and two ground stone spheres (**Figure 3**). The museum assigned unique catalog numbers to whole and partial vessels and rims. *Jute* and the two classes of stone tools were also given their own catalog numbers. The process the MAI used for sherds was to sort them first by decoration (slipped, applique, punctated, incised, incised and punctated and undecorated) and then body part (rim, body, base, handle), although those sorts were not always accurate. For example, a sherd with a heavily eroded slip may have been sorted into an unslipped group. Each decoration-part class was assigned a unique MAI catalog number. For example, catalog number 161823 are slipped rims while 161824 are slipped body sherds, and so on. Lot numbers, starting with .000 were also assigned, seemingly in reference to storage containers. For example, 161823.000 refers to the first lot of artifacts housed together, and 161823.001 identifies the contents as the second box. In all cases, even for whole and partial vessels, lot numbers had also been assigned. Individual sherds were not assigned more specific numbers, but I found doing so necessary for this study. Following the museum's conventions, I assigned unique artifact numbers to each sherd within a lot, starting with .001. For example, I assigned the number, 001 to the first object I cataloged in lot 161823.000. The full catalog record assigned to that item is 161823.000.001. The second sherd I cataloged in that lot was assigned number 161823.000.002, and so on.

Once confirming that only half of Mason's original collection remained housed at the NMAI, my remaining goals for the visits were to perform type-variety classifications on the ceramics, collect standard measurements, photograph, and produce technical drawings of all of the non-shell the objects. The shell objects were just photographed. Unfortunately, time did not permit every object in the collection to be fully recorded. I had also hoped to make 3D digital models of the ceramic objects to establish a digital 3D type collection to host on my project website, among other goals, but that portion of the project was ultimately rejected by the NMAI board for lack of broad support from Maya communities throughout Belize even though my application materials included a letter of support from the San Antonio Village Council.

I made technical drawings and photographs of the lithic materials, whole and partial vessels, decorated rim sherds, and ceramic objects, (see **Table 1**). For technical drawings, I gave highest priority to slipped rims, especially polychromes specimens and lowest priority to undecorated jar forms. On the first trip, drawings were made with the assistance of a device called

Table 1. Summary of NMAI accession records for the Mason Collection and information recorded during study. Note that "P" in profile column means profiles were made for a part of the lot.

NMAI Cat#	NMAI Lot Number	# of Specimens	Material Class	Decoration Type	Part class (for sherds)	Individual Object Photos?	Profile Drawn?
161823	0	43	ceramic	sherds-slipped-polychrome	Rim	Y	Y
161823	1	41	ceramic	sherds-slipped-polychrome	Rim	Y	Y
161824	0	38	ceramic	sherds-slipped	Body	Y	P
161825	0	12	ceramic	sherds-slipped-polychrome	Base	Y	N
161826	0	4	ceramic	whole vessel-partial vessel-sherd	Partial & object	Y	Y
161827	0	55	ceramic	sherds-undecorated	Rim	Y	N
161827	1	25	ceramic	sherds-undecorated	Rim	Y	N
161828	0	1	ceramic	sherds-undecorated-handle	Rim	Y	Y
161829	0	2	ceramic	Sherds-drilled	Rim	Y	Y
161830	0	10	ceramic	Sherds	Variety	Y	N
161831	0	84	ceramic	sherds-undecorated	Body	N	N
161832	0	21	ceramic	sherds-unslipped-decorated	Rim	Y	N
161832	1	1	ceramic	sherds-punctate	Rim	Y	N
161832	2	9	ceramic	sherds-incised	Rim	Y	N
161833	0	26	ceramic	sherds-incised	Body	Y	N
161833	1	25	ceramic	sherds-punctate	Body	Y	N
161834	0	7	ceramic	Sherds-calcite coated	Variety	Y	N
161835	0	1	ceramic	Object	Object	Y	Y
161836	0	1	ceramic	Rim-incised-punctate	Partial	Y	N
161837	0	1	ceramic	Rim-punctated	Partial	Y	N
161838	0	1	ceramic	Rim- punctated	Partial	Y	N
161839	0	1	ceramic	Vessel-punctated	Partial	Y	Y
161840	0	1	ceramic	Rim-punctated	Whole	Y	N
161841	0	1	ceramic	Rim- punctated	Whole	Y	N
161842	0	1	ceramic	Rim-punctated	Whole	Y	N
161843	0	1	ceramic	Rim- punctated	Whole	Y	N
161844	0	1	ceramic	Rim-punctated	Whole	Y	N
161845	0	1	ceramic	Rim-punctated	Whole	Y	N
161846	0	1	ceramic	Rim-punctated	Whole	Y	N
161847	0	1	ceramic	Rim-punctated	Whole	Y	N
161848	0	1	ceramic	Rim-undecorated	Whole	Y	N
161849	0	1	ceramic	Vessel-undecorated	Partial	Y	N
161850	0	1	ceramic	Vessel-undecorated	Partial.	Y	N
161851	0	1	ceramic	Vessel-undecorated	Partial	Y	N
161852	0	1	ceramic	Vessel-undecorated	Partial	Y	N
161853	0	1	ceramic	Vessel-node handle	Partial	Y	N
161854	0	1	ceramic	Rim-node handle	Whole	Y	N
161855	0	1	ceramic	Vessel-applique-unslipped	Partial	Y	Y
161856	0	1	ceramic	Vessel-indeterminate	Partial	Y	Y
161857	0	1	ceramic	Vessel-indeterminate	Partial	Y	N

NMAI Cat#	NMAI Lot Number	# of Specimens	Material Class	Decoration Type	Part class (for sherds)	Individual Object Photos?	Profile Drawn?
161858	0	1	ceramic	Vessel-indeterminate	Partial	Y	Y
161859	0	1	ceramic	Vessel-undecorated	Partial	Y	N
161860	0	1	ceramic	Vessel-bichrome	Partial	Y	Y
161861	0	1	ceramic	Rim-slipped	Partial	Y	Y
161862	0	1	ceramic	Rim-polychrome	Partial	Y	Y
161863	No info provided	No info provided	N/A	N/A		Y	N
161864	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161865	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161866	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161867	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161868	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161869	0	2	rock	ground stone	N/A	Y	Y
161870	0	2	rock	chipped stone	N/A	Y	Y
161871	0	37	shell	jute	N/A	Y	N
161872	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161873	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161874	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161875	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161876	0	1	ceramic	Vessel-Undecorated	Whole	Y	Y
161877	0	1	ceramic	Vessel- undecorated-reconstructed	Partial	Y	Y
161878	0	1	ceramic	Vessel-undecorated	Whole	Y	Y
161879	0	1	ceramic	Vessel-polychrome	Whole	Y	Y
161880	0	1	ceramic	Vessel-polychrome	Whole	Y	Y
161881	0	1	ceramic	Vessel-polychrome	Whole	Y	Y
161882	0	1	ceramic	Vessel-polychrome	Whole	Y	Y
161883	0	1	ceramic	Vessel-unslipped	Whole	Y	N
161884	0	1	ceramic	Vessel-unslipped	Whole	Y	N
161885	0	1	ceramic	Vessel-unslipped	Whole	Y	N

a Laser Aided Profiler that uses lasers and infrared cameras to produce immediately publication-ready images (Demján et al. 2022). A catastrophic fall of the device en route during the second trip incapacitated the machine, requiring profiles to be drawn by hand. Priority was given to the slipped rims and smaller whole and partial vessels over very large and unslipped and undecorated specimens many of which remain undrawn. Completing those will be a priority for a future trip.

Photographs were made using a Canon EOS 80D DSLR camera with as a primary device and an iPhone 11 Pro as a backup. I recorded all whole and partial vessels, except for 161841.000, a partial punctated jar, according to the accession record, which was not pulled from storage during either trip due to an oversight. Interior and exterior sides of each individual sherd in the assemblage was photographed except for those in catalog number 161831.000 (84 pieces), although I photographed them in a series of group photos as I packed up all the objects at the end of the last day of my second trip. As I was doing so, I recognized an undecorated rectangular ceramic plate, but time did not permit further recordation of it (**Figure 4**).

Figure 1. NMAI 161871.000. *Jute* (*Pachychilus spp.*) snail shells recovered from terrace between altar and steep drop to river near southeast entrance of Cave C. See **Figure 32** for discussion.

Figure 2. NMAI 161870.000. Chert bifaces in Mason's Rio Frio Cave's collection. The larger object (M-F29) was collected from terrace between altar and steep drop to river near southeast entrance of Cave C. See **Figure 32** for discussion.

Figure 3. NMAI 161869.000. Ground stone objects (M-F29) Mason (1928) identifies as a hammerstone (above) and slingstone (below). Recovered from terrace near southeast entrance of Cave C. See **Figure 32** for discussion.

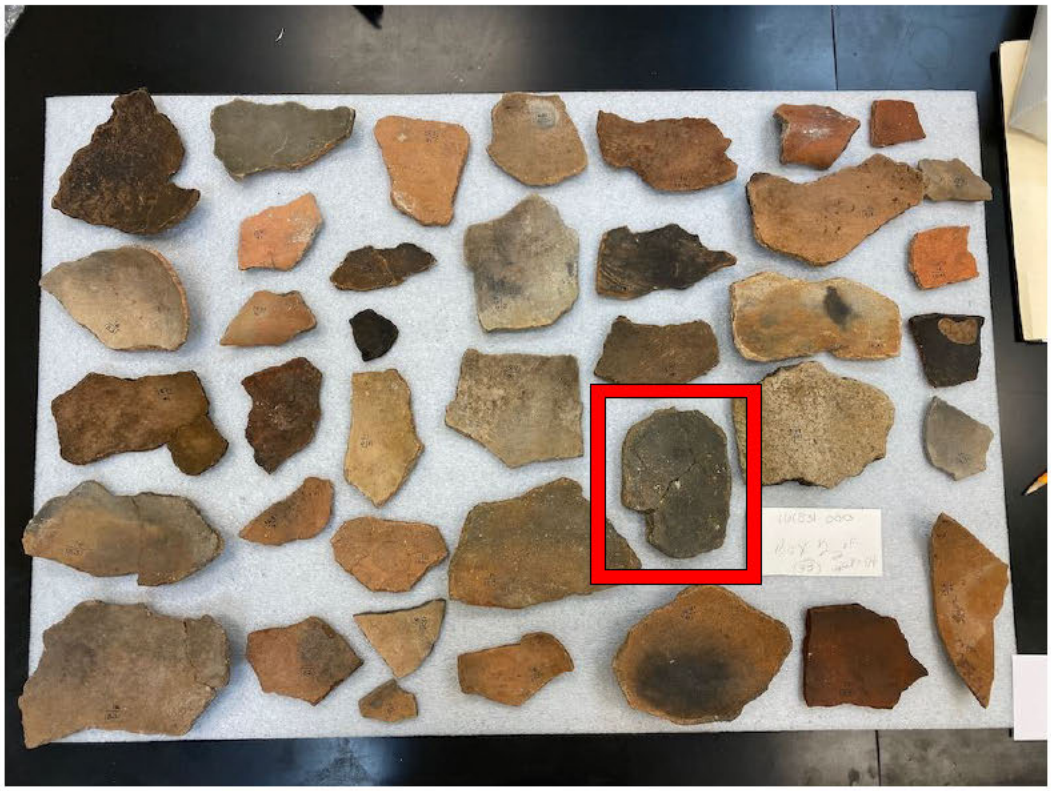


Figure 4. NMAI 161831.000. Interior view of one lot of undecorated body sherds from NMAI catalog number. The rectangular plate is highlighted by the red square.

Results

I collected over 1,300 photographs of the objects in the collection, although not all turned out and many were duplicates. They have been included with the digital data submitted to the Institute of Archaeology accompanying this report. Inking the hand-drawn profiles is still underway. I will submit all technical drawings made during the study in a future progress report. NMAI policies prohibit sharing photos of curated objects online. If that prohibition is waived, I will use the photos to create a digital type collection that will be hosted on the RiFRAP's website.

Below, I present photographs of the whole vessels, some partial vessels, and ceramic the objects I recorded. I present the whole polychrome vessels first, followed by slipped and unslipped bowls, and then slipped and unslipped jars. Last presented are the ceramic objects, which include a spiked censer, a mirror back, a brasier prong, and an awl-like a worked piece. Figure captions include the NMAI catalog, lot, and study number of the object, followed by the type-variety classification, if designated and justification. I also make note when the object appears in Mason's 1928 publication using the designation "M-FX." "M" refers to (Mason 1928). "F" is short for "Figure", and "X" is a variable element that indicates the figure number in the publication. For example, the captions for both **Figures 2 and 3** of this report include the note, (M-F29) indicating those objects appear in figure 29 of Mason's 1928 publication. Mason does include a few photographs of the objects in his 1940 autobiographical account of the expedition but they are on unnumbered plates between pages 114 and 115. I use the code M40 to refer to the artifacts

published there. Lastly, any published provenience information Mason provides about the objects are included.

Types that were confidentially identified in the collection include Aguila Orange, Cabrito Cream Polychrome, Dos Arroyos Orange-Polychrome, Garbutt Creek Red, Lucha Incised, Mt. Maloney Black, Palmar Orange-Polychrome, and Saxche Orange-Polychrome. Types from the Belize, Chunhuitz, Dolphin Head, and Tinaja Ceramic Groups are frequently encountered.

A comparative analysis of the ceramic material from published assemblages in the Peten, Guatemala (Culbert 1993; Culbert and Kosakowski 2019; Smith 1955; Smith and Gifford 1966), and Belize (Chase 1994; Gifford 1976; Pendergast 1969, 1970, 1971), indicate the ceramics in the Mason Collection stylistically date from the Early Classic through Terminal Classic period with the Late to Terminal Classic represented most strongly, yet radiocarbon dates reported in this volume and last year's progress report reveal use began at least as far back as the Late Preclassic period (Spenard 2023a). Interestingly, in Pendergast's analysis of the ceramic assemblage from Rio Frio Cave E, he notes a very strong connection with the Belize Valley and particularly Xunantunich and little connection with the Chiquibul. While the ceramics in the Mason Collection at the NMAI do share some affinities with the Belize Valley, they show a very strong connection with the ceramics from Caracol. There also appear to be many yet undefined types unique to the Rio Frio region. Confident identifications of those specimens will need to wait until more research has been undertaken at Nohoch Batsó and other sites nearby (caves, quarries, and others) for the regional ceramic sequence to be fully defined. The study of the NMAI collection reported here is a significant first step in that activity.

Polychrome Vessels

Figure 5. NMAI 161881.000 (M-F8b; M40). Saxche Orange Polychrome Vase with pseudoglph primary standard sequence. Recovered from Cave A. This vessel had been on display in the NY campus as part of the "Revealing Ancestral Central America" Exhibit (Joyce 2013). An image of the object, and another of Mason's contact, Alfred August holding the pot, while standing in a pine savannah also appears in the exhibits' catalog (see **Figure 7**; McMullen 2013). Form is common to Caracol (Chase 1994).

Figure 6. Rollout photo of NMAI 161881.000 (**Figure 5**) showing the pseudoglyph Primary Standard Sequence. The vessel is more symmetrical than appears in the image.

Figure 7. Alfred August holding NMAI 161881.000 in pine savannah, presumably, the "abandoned" Augustine cattle ranch Mason (1928) reports near the Rio Frio caves. Photo after McMullen 2013:Figure 104).

Figure 8. NMAI 161882.000 (M-F8a). Undesignated type. Possibly related to Juleki Cream-polychrome type based on distinctive red bands on basal portion of the vessel (Reents-Budet 1994:326; Object 24). Similar form as other Tepeu 2 vessels from Uaxactun (e.g. Smith 1955:Figure 62). Recovered from main passage in Cave C, between the excavated altar, and small chamber near southeast entrance of cavern identified as a tomb. The form is common to Caracol (Chase 1994).

Figure 9. NMAI 161862.000 (M-F1a). Probably Palmar Orange-polychrome with band of repeating pseudoglyphs. Vessel has been partially reconstructed, part of tall cylinder vase of unknown height. Sherds recovered toward the back of Cave A before slope to stream at rear of cavern.

Figure 10. Rollout of NMAI 161862.000. The tan areas are the MAI reconstruction. The arrow points to the sprouting head of a humanoid individual. Visible is the figure's eye, forehead, and earspool. Swirling vegetation sprouting from the top of the head suggests the depicted may be the Maize god.

Figure 11. NMAI 161879.000 (M-F9; M40). Probably Saturday Creek Polychrome. Poorly executed medial flang plate with ring base and unslipped exterior. Recovered from Rio Frio Cave A in area designated as the Breakdown Tunnels by RiFRAP (Mirro 2020). NMAI 161878.000 (**Figure 26**) was found nearby.

Figure 12. Oblique view of NMAI 161879.000 (**Figure 11**) showing unslipped exterior, medial flange, and poor vessel construction.

Figure 13. NMAI 161880.000. Undesignated type, partially reconstructed. Similar in form to NMAI 161879.000 (**Figure 11**). Likely recovered from Rio Frio Cave A in area designated as the Breakdown Tunnels by RiFRAP (Mirro 2020). Mason (1928:21) notes recovering nearly all fragments of three wide, shallow dishes form the area, but only two (NMAI 161870 and 161880) are in the NMAI collection.

Monochrome and Unslipped Bowls

Figure 14. NMAI 161857.000. Undesignated type. Round side bowl with slightly inward curving lip. Form similar to Tepeu 3 Tinaja Red style vessels from Uaxactun (Smith 1955:Figure 50, 23a). No recovery information. Accession record reads, "Cave, twelve miles south of Benque Viejo."

Figure 15. NMAI 161864.000. Probably Ceiba Unslipped, a type commonly encountered in Late Classic period deposits at Caracol (e.g. Chase and Chase 2017:Figure 10). Partially reconstructed. Likely recovered from Cave C. See **Figure 19** for discussion.

Figure 16. NMAI 161865.000. Probably Ceiba Unslipped. Probably recovered from Cave C. See **Figure 15** for discussion of form and **Figure 19** regarding recovery location.

Figure 17. NMAI 161866.000. Probably Ceiba Unslipped, partially reconstructed. Probably recovered from Cave C. See **Figure 15** for discussion of form and **Figure 19** regarding recovery location.

Figure 18. NMAI 161867.000 (M-F5a). Probably Ceiba Unslipped, partially reconstructed. See **Figure 15** for discussion of form Recovered from bank of creek at rear of Cave A.

Figure 19. NMAI 161868.000 (M-F5b). Probably Ceiba Unslipped, partially reconstructed. Recovered from Cave C. See **Figure 15** for discussion of type. Mason (1928:45) notes, "half a dozen complete saucers of a rough undecorated sandy ware (like the one shown [here] were found in a small chamber thirty feet above the main floor and forty feet toward the center of the cave from the altar."

Figure 20. NMAI 161872.000. Probably Valentin Unslipped, partially reconstructed. Probably recovered from Cave C. See **Figure 21** for discussion of recovery location. Similar flaring rim bowls are commonly reported at Caracol (Chase 1994) and have been reported at Caledonia (Awe 1985).

Figure 21. NMAI 161873.000(M-F23a). Valentin Unslipped. See **Figure 21** for discussion of the type at other sites nearby. Recovered from small passage near southeast entrance of the cave that Mason interpreted was used, in part, as a tomb. The objects associated with the remains, and the remains themselves were part of the collection returned to the British Museum. The are not part of the NMAI collection. Mason describes the vessels in a separate section of his report, indicating they were unaffiliated with the remains. Of this piece, Mason (1928:32) notes that one of his workers, "Chinda," "discovered in the rather loose dirt of the floor, at depth from two to six inches, six dishes of thick unpainted ware and of considerable similarity to one another in shape." He illustrates the vessel in this figure as exemplifying the broader type. Four of those bowls may be represented in the NMAI's collection (161872, 161873, 161875, and 161876), while the other two were presumably returned to the British Museum in 1929.

Figure 22. NMAI 161874.000 (M-F24b). Probably Valentin Unslipped. Recovered from Cave C. See **Figures 21 and 22** for discussion.

Figure 23. NMAI 161875.000 (M-F21a). Undesignated type, possibly related to Valentin Unslipped. Originally a tripod vessel, possibly a three-pronged brasier (see **Figures 34** and **35** for comparison). Recovered from small passage near southeast entrance of the Cave C. See **Figure 21** for discussion.

Figure 24. NMAI 161876.000 M-F21b. Ceiba Unslipped. Recovered from small passage near southeast entrance of the Cave C. See **Figure 21** for discussion. Similarly shaped vessels have been recovered in caches at Nohoch Batsó (Spenard 2023b), Caledonia (Awe 1985), and Caracol (Chase and Chase 2017:Figure 10). At the latter site, archaeologists refer to them as finger bowls because they often contain severed human phalanges, often the tips of little fingers (Chase and Chase 1998:319).

Figure 25. NMAI 161877.000. Possibly Valentin Unslipped, partially reconstructed. No provenience given.

Figure 26. NMAI 161878.000 (M-F10). Possibly Valentin Unslipped. Recovered from Rio Frio Cave A in area designated as the Breakdown Tunnels by RiFRAP (Mirro 2020). NMAI 161879.000 (**Figure 11**) found nearby.

Jars

Figure 27. NMAI 161839.000**.** Probably Hoya Punctated. Small jar, partial. No provenience information given by Mason. Accession record notes "Cave, twelve miles south of Benque Viejo" as its source. Many of the unslipped, punctated sherds and partial jars in the NMAI collection share the decoration pattern. Hoya Punctated jars with similar meandering bands of punctations, sometimes pared with dashed incisions, on jar vessel shoulders have been recorded at Caracol (Chase and Chase 2018: Figure 85a-b). RiFRAP's research in the Rio Frio Caves and Nohoch Batsó have also regularly encountered similarly decorated sherds (Spenard 2018; 2023b).

Figure 28. NMAI 161853.000. Probably Botifela Orange, partial vessel. Poorly smoothed, but heavily burnished. Fire clouding prevalent on side not depicted. The object is included in this report because of its unique rim and handles, but other jars and bowls with similar surface treatment were noted in the collection (e.g. **Figure 30**).

Figure 29. NMAI 161883.000 (M-F13). Probably Valentin Unslipped. Recovered from Cave A.

Figure 30. NMAI 161884.000 (M-F12). Probably Botifela Orange. Recovered from Cave A. Surface treatment and handles similar to NMAI 161853 (**Figure 28**).

Figure 31. NMAI 161885.000. Probably Hoya Punctated. Partially reconstructed. Shares similar meandering pattern of punctations between should and neck as vessel in **Figure 27**.

Ceramic Objects

Figure 32. NMAI 161855.000 (M-F30; M40). Miseria Appliqued, partially reconstructed. Recovered from a terrace between the altar and the steep slope down to the river near the southeast entrance of Cave C. Mason (1928:40-41) notes that the on the terrace also were quantities of freshwater snails (161871.000; **Figure 1**), a polychrome sherd (Palmar Orange 161824.000.032), three censer fragments (Pedregal Modeled 161830.000.001-003), a brasier prong (161835.000; **Figure 34**), two stone spheres (161869.000.001-002; **Figure 3**), the larger of the two chert bifaces (161870.000; **Figure 2**).

Figure 33. NMAI 161826.000.002. Undesignated. Modified mirror back (unslipped) with applique globules. No provenience given.

Figure 34. NMAI 161835.000 (M-F22b). Brasier prong. Recovered from Rio Frio Cave C between altar and steep slope near eastern entrance. See **Figure 32** for discussion.

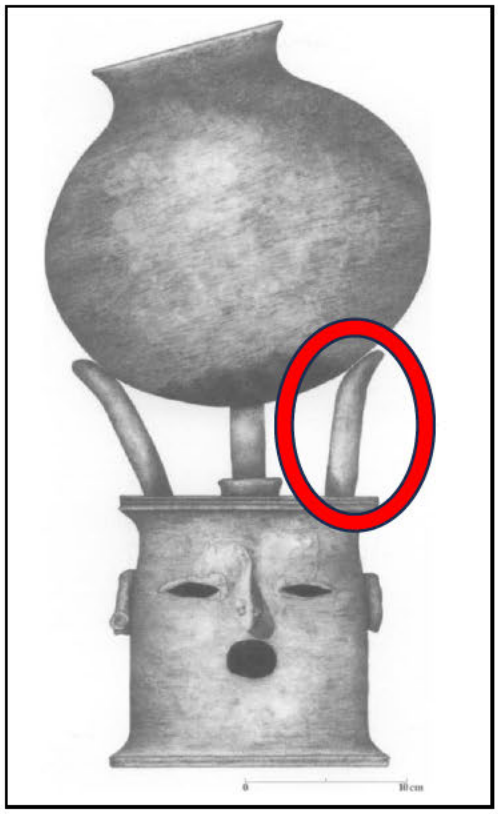


Figure 35. Illustration of three-pronged censer from Buena Vista del Cayo, Belize (after Ball and Taschek 2007:Figure 4).

Figure 36. NMAI 161824.000.034. Awl-like object knapped from Dos Arroyos orange polychrome basal flange fragment. No provenience information given.

Figure 37. NMAI 161834.000.007 (M-F22a). Hollow mammiform vessel support, vented. All objects from this lot are covered in calcite. Object is mistakenly identified as a jar by Mason (1928:Figure 22) who notes it was found in Cave A (Mason 1928:34).

References Cited

Austin Jr., Oliver L.
1929 No. 11- Birds of the Cayo District, British Honduras. *Bulletin: Museum of Comparative Zoology*:363-394.

Awe, Jaime J.
1985 Archaeological Investigations at Caledonia, Cayo District, Belize, Master's thesis, Department of Anthropology, Trent University, Peterborough, Ontario.

Ball, Joseph W., and Jennifer T. Taschek
2007 Sometimes a "Stove" is "Just a Stove": A Context-Based Reconsideration of Three-Prong "Incense Burners" from the Western Belize Valley. *Latin American Antiquity* 18(4):451-470.

Chase, Arlen F.
1994 A Contextual Approach to the Ceramics of Caracol, Belize. In *Studies in the Archaeology in Caracol, Belize*, edited by Diane Z. Chase, and Arlen F. Chase, pp. 157-182. Monograph 7, Pre-Colombian Art Research Institute, San Francisco.

Chase, Arlen F., and Diane Z. Chase
2017 *Interpreting Ancient Maya Society Through Residental Groups: Investigating Early Long-Distance Interaction in Caracol's Epicenter: Caracol Archaeological Project Investigations for 2017*. Report submitted to the Belize Institute of Archaeology and Alphawood Foundation.

2018 *Markets and Socio-Economic Integration of Caracol, Belize: Investigating Residential Groups and Public Architecture in the Vicinities of the Monterey Residential Group and the Puchituk Terminus: Caracol Archaeological Project Investigations for 2018*. Report submitted to the Belize Institute of Archaeology and Alphawood Foundation.

Chase, Diane Z., and Arlen F. Chase
1998 The Architectural Context of Caches, Burials, and Other Ritual Activities for the Classic Period Maya (as Reflected at Caracol, Belize). In *Function and Meaning in Classic Maya Architecture: A Symposium at Dumbarton Oak, 7th and 8th October 1994*, edited by Stephen D. Houston, pp. 299-332. Dumbarton Oaks Research Library and Collection, Washington, D.C.

Culbert, T. Patrick
1993 *The Ceramics of Tikal: Vessels from the Burials, Caches, and Problematical Deposits*. Tikal Report no 25A, University Museum Monograph 81. University of Pennsylvania, Philadelphia.

Culbert, T. Patrick, and Laura J. Kosakowsky
2019 *The Ceramic Sequence of Tikal*. Tikal Report 25B. University Monograph 152. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Demján, Peter, Peter Pavúk, and Christopher H. Roosevelt
2023 Laser-Aided Profiler Measurement and Cluster Analysis of Ceramic Shapes. *Journal of Field Archaeology* 48(1):1-18.

Gifford, James C.
1976 *Prehistoric Pottery Analysis and the Ceramics of Barton Ramie in the Belize Valley*. Memoirs of the Peabody Museum of Archaeology and Ethnology. Harvard University Press, Cambridge.

Joyce, Rosemary A. (editor)
2013 *Revealing Ancestral Central America*. The Smithsonian Latino Center and the National Museum of the American Indian, Smithsonian Institution, Washington, D.C.

Mason, Gregory
1928 *Pottery and Other Artifacts from Caves in British Honduras and Guatemala*. Indian Notes and Monographs, No. 47. Museum of the American Indian. Heye Foundation, New York.

1929 Caribbean Blue: Part II. *Motorboating: The Yachtsmen's Magazine* November, XLIV(5):34-37, 80, 86, 90, 94, 96.

1940 *South of Yesterday*. Henry Holt & Co., New York.

McMullen, Ann
2013 A New Dream Museum. In *Revealing Ancestral Central America*, edited by Rosemary A. Joyce, pp. 70-71. The Smithsonian Latino Center and the National Museum of the American Indian, Smithsonian Institution, Washington, D.C.

Mirro, Michael
2020 Rio Frio Cave A Mapping and Inventorying Operations during the 2019 Field Season. In *Rio Frio Regional Archaeological Project (RiFRAP) Report on the Second (2019) Field Season*, edited by Jon Spenard, pp. 37-62. Report Submitted to the Institute of Archaeology National Institute of Culture and History, and Forest Department, Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development, and Immibration. Occasional Paper No. 2. Department of Anthropology, California State University San Marcos.

Pendergast, David M.
1969 *The Prehistory of Actun Balam, British Honduras*. Occasional Papers, 16. Royal Ontario Museum, Division of Art and Archaeology, Toronto.

1970 *A.H. Anderson's Excavations at Rio Frio Cave E, British Honduras (Belize)*. Occasional Paper, 20. Royal Ontario Museum, Division of Art and Archaeology, Toronto.

1971 *Excavations at Eduardo Quiroz Cave, British Honduras (Belize)*. Submitted to Occasional Papers, 21. Royal Ontario Museum, Division of Art and Archaeology, Toronto.

Reents-Budet, Dorie J.
1994 *Painting the Maya Universe: Royal Ceramics of the Classic Period*. Duke University Press, Durham.

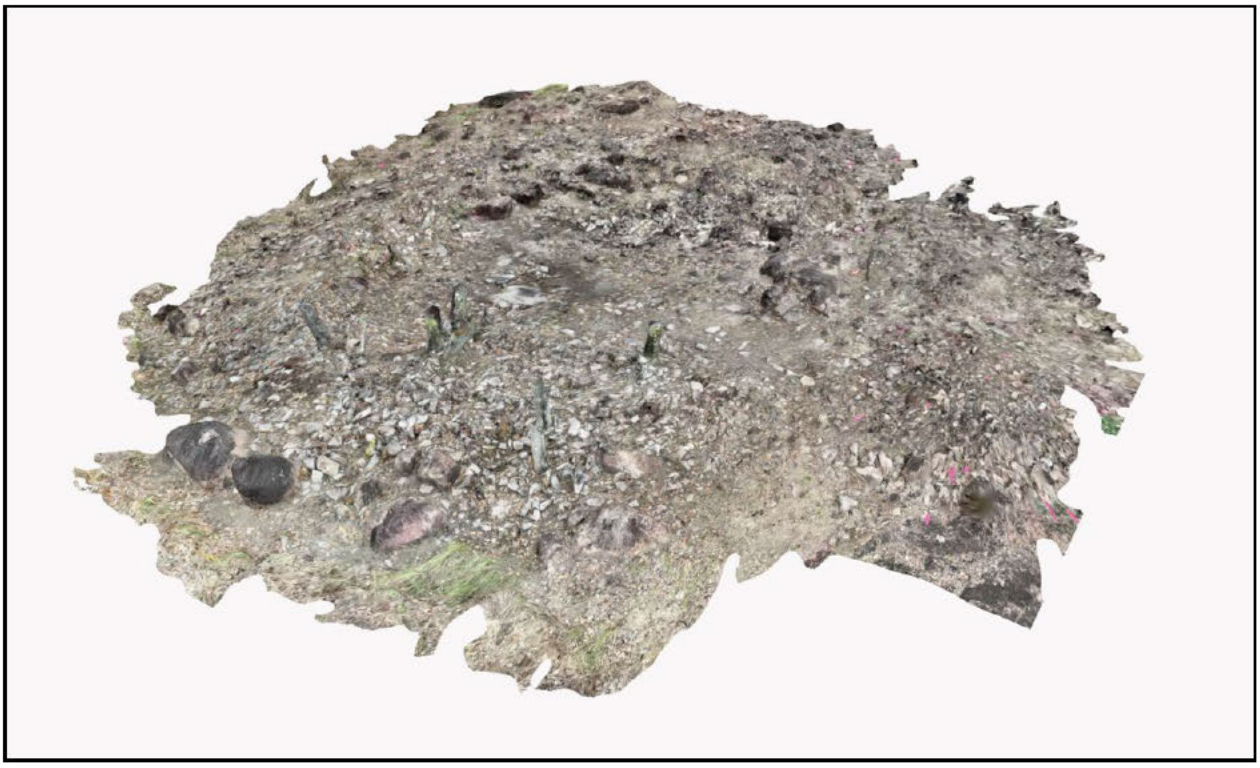
Smith, Robert E.
1955 *Ceramic Sequence at Uaxactun, Guatemala*, Vol. 20. 2 vols. Middle American Research Institute Publication No. 20. Tulane University, New Orleans, LA.

Smith, Robert E., and James C. Gifford
1966 *Maya Ceramic Varieties, Types, and Wares at Uaxactun: Supplement to "Ceramic Sequence at Uaxactun, Guatemala"*. Middle American Research Institute Publication 28 Tulane University, New Orleans.

Spenard, Jon
2018 Rio Frio Cave A Artifacts. In *Rio Frio Regional Archaeological Project (RiFRAP) Report on the Inaugural (2018) Field Season*, edited by Jon Spenard, pp. 39-57. Occasional Paper No. 1 Department of Anthropology, California State University San Marcos, Report submitted to the Institute of Archaeology, National Institute of Culture and History, Belmopan, Belize.

2023a Report on a Suite of Radiocarbon Dates from Rio Frio Cave A and Domingo Ruiz Cave. In *Report on the Third Field Season of the Rio Frio Regional Archaeological Project (RiFRAP) (June-July 2022, January 2023)*, edited by Jon Spenard, pp. 69-82. Occasional Paper No. 3. Department of Anthropology California State University San Marcos. Report Submitted to the Institute of Archaeology, National Institute of Culture and History, and Forest Department, Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development, and Immigration, Belmopan, Belize.

2023b Nohoch Batsó Plaza 1 Investigations. In *Report on the Third Field Season of the Rio Frio Regional Archaeological Project (RiFRAP) (June-July 2022, January 2023)*, edited by Jon Spenard, pp. 11-28. Occasional Paper No. 3. Department of Anthropology California State University San Marcos. Report Submitted to the Institute of Archaeology, National Institute of Culture and History, and Forest Department, Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development, and Immigration, Belmopan, Belize.



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