In Search of the Preceramic: 2006 Season Investigations at Actun Halal, Belize

by Jon C. Lohse

with contributions by Lisa LeCount, John G. Jones, Tim Beach, and Ashley Hallock

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Abstract

Excavations in the shallow cave site of Actun Halal in western Belize recovered evidence for a well defined Late Archaic stratum dating from ca. 2400-1200 B.C.E. Within this stratum, two distinct components are indicated. Pollen data provide evidence for Late Archaic maize and cotton horticulture and also for possible ritual use of the cave by pre-Maya peoples. Ceramic recoveries reveal extended Maya use from the Middle Preclassic through Late Classic and into the Terminal Classic. Though earlier excavations had reported late Pleistocene fauna and associated artifacts, this question remains unresolved at present.

Resumen

En las excavaciones realizadas en Actun Halal, un sitio arqueológico localizado en una cueva de profundidad baja en el occidente de Belice, se descubrió evidencia para un estrato bien definido con la fecha temprana de 2400-1200 A.E.C. Adentro de este estrato, se indican dos componentes distintos. Los datos del polen provee evidencia para la horticultura de maíz y algodón en el Arcaico Tardío, y además para el uso posible de ritual por gente más antiguo de los mayas. La cerámica recuperada indica el uso de la cueva desde el Preclásico Medio temprano hasta el Clásico Tardío, y posiblemente hasta el Clásico Terminal. Anteriormente han reportaron índices de fauna con artefactos asociados del Pleistoceno tardío, pero esta cuestión se queda sin evidencia directa para ahora.

Introduction

With the support of the Foundation for the Advancement of Mesoamerican Studies, Inc., (FAMSI), the New World Archaeological Foundation, and the National Speleological Society, investigations were carried out in 2006 in the shallow cave site of Actun Halal, located in the Macal River Valley of Western Belize (Figure 1). Prior research at the site from 1999 to 2001 by the Western Belize Regional Cave Project had recovered Pleistocene fauna including spectacled bear (Ursidae), peccary (Tayassuidae), and horse (Equidae, possibly *Equus*) (Egeland 2003, 2004; Hecker 2000) reportedly in association with artifacts, indicating the possibility of intact cultural deposits of early Paleoindian age. Additional evidence was also recovered indicating use of the cave by the Maya for primarily ritual purposes (Griffith and Helmke 2000; Griffith et al. 2002; Griffith and Morehart 2001). Because sites containing extinct fauna and associated artifacts are exceedingly rare in Mesoamerica, these initial reports warranted additional excavations. Our excavations were therefore focused on confirming this early artifact-fauna association while also seeking additional evidence for pre-Maya use of the site. Geomorphological analyses of the site's depositional history and integrity were undertaken, and samples were collected for microbotanical studies to help provide information on past environmental conditions in the general vicinity as well as possible activities carried out within the cave.

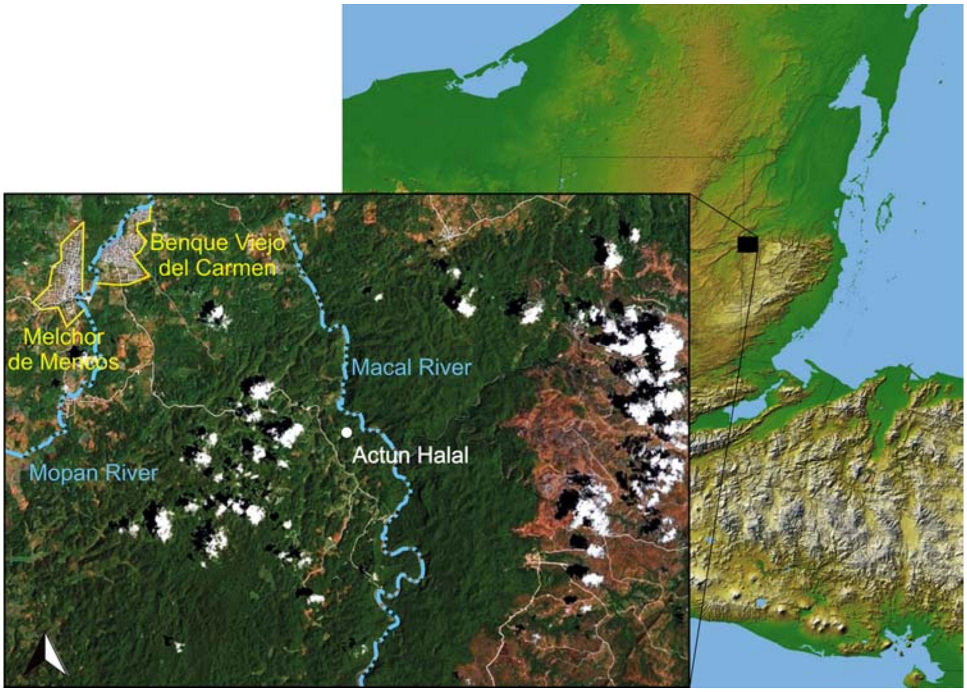


Figure 1. Location of Actun Halal in upper Belize River watershed.

The earliest confirmed evidence for human presence in the cave comes from the Late Archaic, around 2200 B.C.E., based on radiocarbon, artifact, and pollen evidence. It is possible that two Late Archaic components, one dating from ca. 2400-1800 B.C.E. and a second dating to between 1440-1210 B.C.E. (two sigma ranges), are present. An earlier radiocarbon assay of ca. 4240 B.C.E. lacks corroborating artifact association and should be viewed as merely suggestive, rather than a confirmation, of human presence. Maya period visitations or occupations are documented by ceramic and radiocarbon evidence as early as the Middle Preclassic and are strongest in the Terminal Preclassic through Late Classic. Earlier, Paleoindian visitations remain an unresolved question. The Late Archaic materials are significant as they provide information for horticulture and land use practices just prior to sedentism in the upper Belize River Valley and adjacent eastern Petén, Guatemala, an area from which no other excavated and dated pre-Maya information is yet available.

Pre-Maya Chronology

The earliest firm evidence of human presence in Belize or elsewhere in Central America comes primarily from fluted projectile points that compare with early Paleoindian lanceolate and fishtail types described from North and South America, respectively. Unlike a number of early Paleoindian (e.g., Clovis and Folsom) sites in North America, associations between cultural remains and extinct Pleistocene fauna are exceedingly rare anywhere in Central America. Such associations have been confidently documented in Central Mexico (Aveleyra and Maldonado-Koerdell 1952; Pichado 2000) and reported at a small handful of other sites including Loltun Cave in the northern

Yucatán (see Zeitlin and Zeitlin 2000) and Chivacabe in Guatemala's Western Highlands (Godoy 1992), though these claims are not without controversy and await confirmation. To date, the only reported association of artifacts with Pleistocene fauna in Belize is that from Actun Halal; all other evidence of Paleoindian occupation comes from fluted points, most of which have been collected from surface contexts (see Lohse et al. 2006). Based on technological similarities with well dated point styles in North and South America, estimated ages for the earliest human presence in Belize could range from ca. 11,500 to 10,000 radiocarbon years before present (ca. 9500-8000 B.C.E.). Considering the absence of any dates for such finds, however, this range must presently be viewed as conjectural. Clearly, considerably more work needs to be done before archaeologists can better understand Belize's Paleoindian record.

Fortunately, a good deal more information is available for what can be considered Late Archaic developments in Belize. Unfortunately, most of these data come from the northern part of the country, leaving the Archaic record of the rest of the country either completely unknown, such as Southern Belize, or understood only through comparison with better documented sequences to the north. Nevertheless, the understood sequence begins around 3400 B.C.E., with pollen evidence indicating sporadic forest clearing and the initial appearance of cultigens that include maize and manioc (Jones 1994; Pohl et al. 1996). Maize pollen has been reported in at least trace amounts by approximately 2500 B.C.E. in virtually every part of the country where paleoenvironmental research has sampled mid-to-late Holocene deposits, indicating that pre-Maya occupations were wide-spread, if sparse, and had begun to increasingly rely on maize agriculture. Both forest clearing and maize cultivation intensified through the end of the Archaic and into the Preclassic, so that when the earliest settled villages appeared by ca. 1000 B.C.E. they occupied a landscape that had already undergone modification and disturbance for as much as 2500 years.

Archaic period stone tool traditions have been defined by work at Colha and nearby areas (Iceland 1997; Kelly 1993), and these pose a general sequence against which finds from elsewhere in Belize can be compared. Macroblade technology appears with the earliest microbotanical evidence for horticulture; these large blades were themselves used, or provided blanks for fashioning other tools such as pointed unifaces. The only bifacial artifacts commonly recovered in this earlier portion of the Late Archaic include projectile points (or perhaps hafted knives) such as Lowe points, tentatively dated to 2500-1900 B.C.E., and the undated Sawmill points; nearly all other stone tools were unifacially flaked. Perhaps the most diagnostic tool form of the Late Archaic is the constricted adze, which has been dated in northern Belize to 1500-900 B.C.E. At Colha and adjacent areas where raw material is abundant, these tools are almost always unifacially flaked, though occasional bifacial specimens are found where stone materials are not as plentiful (Lohse 2003). Use wear studies have shown these artifacts to have been come into contact with both hard and soft wood as well as soil, suggesting that they served as general purpose tools for land clearing activities (Gibson 1991; Hudler and Lohse 1994; see below).

Previous work, again conducted in northern Belize, has suggested that a slight hiatus is present in the artifact record between around 1900-1500 B.C.E. (Iceland 1997). Pohl et al. (1996) have identified changes in local inland water tables during this interval, perhaps responding to changes in sea levels. A lowering of water tables from ca. 1700-

1300 B.C.E. is likely to have had negative effects on local sedimentation, meaning that rather than being abandoned, the northern Belize region may simply lack sediment packages containing radiocarbon dates and cultural deposits from this period. By 1300 B.C.E., water levels began to rise once again, and microbotanical evidence for preceramic occupations is more widespread than ever. The fact that this environmental sequence corresponds roughly to the stone tool sequence suggests that Late Archaic adaptations can be divided into an early (3400-1900 B.C.E.) and late (1500-900 B.C.E.) facets (Lohse et al. 2006) (Figure 2). As noted, virtually all of this evidence has been derived from the northern part of the country, leaving to future research to demonstrate whether pre-Maya populations in other geographic settings undertook the same adaptations. To this end, the work reported here is significant in that it represents the first excavated Late Archaic data from the western part of the country.

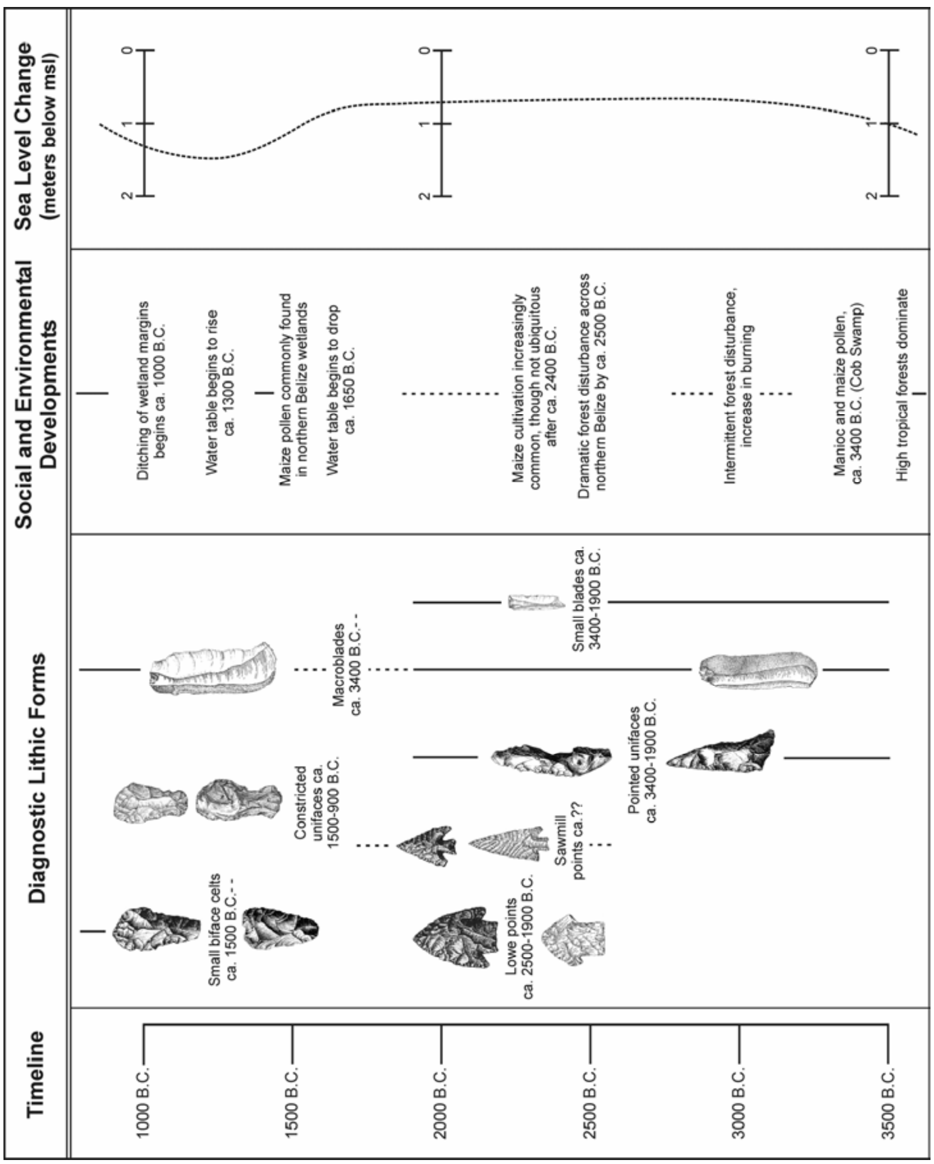


Figure 2. General sequence of Late Archaic developments as documented in northern Belize (Lohse et al. 2006: Figure 8).

The Actun Halal Site and Prior Research

Actun Halal was reported by the Western Belize Regional Cave Project, under the direction of Jaime J. Awe, in 1999 in the Macal River Valley in western Belize (Griffith and Helmke 2000). This small cave is more accurately considered a shallow rockshelter; two entrances at either end of an east-west running cavern approximately 26 to 33 m long and 11 m high create a light zone that dominates the chamber with a recessed twilight zone in the middle (Figure 3). Actun Halal lies in the Vaca Plateau, a rugged karst region of approximately 450 m of local relief drained by a number of fluviokarst streams. One such arroyo lies immediately below Actun Halal, and contains a number of rounded and stream rolled cobbles and boulders indicating that periodic flows course through the channel. The shelter itself is largely limestone and lies below sandstone and shale that crop out upstream in the watershed. These strata prevent ground water from percolating deep into the limestone bedrock, and provide a number of shallow, near surface aquifers that are still accessible today through shallow wells dating to the period of Maya occupation. Indeed, an extraordinary number of very large terraces, channels, and other agrarian features cover this landscape, attesting to the potential productive capacity of the region's combined geologic and hydrologic regimens.

Figure 3. Views into Actun Halal from Entrance 1 (left) and Entrance 2 (right).

A number of other caves are found both in the immediate vicinity of Actun Halal as well as in the general region. Like these, Actun Halal has formed by dissolution of limestone preferentially along fault lines, joints, fractures, bedding planes, and in bat bells. It has both dissolution in the cave itself and calcite precipitation in flowstone, dripstone, and dripstone layered into over 1.5 m of sediments. Entrance 2, to the west, is somewhat smaller than Entrance 1, and formed when dissolutioning at the back portion of the chamber breached the fault block that forms the vertical face into which the cave is formed. The subsequent collapse produced a significant talus slope that runs south back into the cavern, including a number of very large limestone boulders and colluvium (see Figure 3B). This "back" (west) part of the cave is considerably more active than the main part of the chamber in terms of both spalled limestone and drip lines and resulting flowstone formations. For the purposes of our research, we designated the west near Entrance 2 as Area A, and the east end as Area B.

Earlier research reported at least five “petroglyphs” or carved faces in the soft flowstone formations on some of the chamber’s walls, and a large slab that might be a stela (Griffith and Morehart 2001). Our research confirmed only one or perhaps two of these petroglyphs, and the purported stela is thought instead to be a large boulder representing a portion of a collapsed wall of the cavern. The cave shows evidence of modern use, with ash pits and debris littering the ground surface.

Initial excavations in the 1999 season at Actun Halal consisted of six 1x1 m test pits spaced about the chamber to search for Maya mortuary deposits. All units were excavated according to natural sediment layers, and some revealed deposits of up to a meter deep containing a lower stratum described as “orange, damp dirt” (Griffith and Morehart 2001:202). In the first season of testing, Unit 4 (located in our Area A) yielded stone tools and the right upper cheek tooth from a horse (Equidae, possible *Equus*) from the lowest level, approximately 60-80 cm beneath the surface. The following season, Unit 4 was expanded into a 2x2 m unit. Additional extinct fauna were recovered including the right maxillary fragment of a spectacled bear (Ursidae) and a right maxillary fragment of a peccary (Tayassuidae) (Figure 4). Though the fossils have not been dated directly, horses became extinct in North America between 10,000 and 11,000 radiocarbon years ago; this figure provides an estimated minimum age for Actun Halal’s lower deposits. The lithic assemblage consists mostly of small flakes with definite striking platforms. Tools include one bifacially chipped river cobble and a discoidal flake core (Lohse and Collins 2004). Pottery sherds are present across the surface, and were also recovered from all excavations.

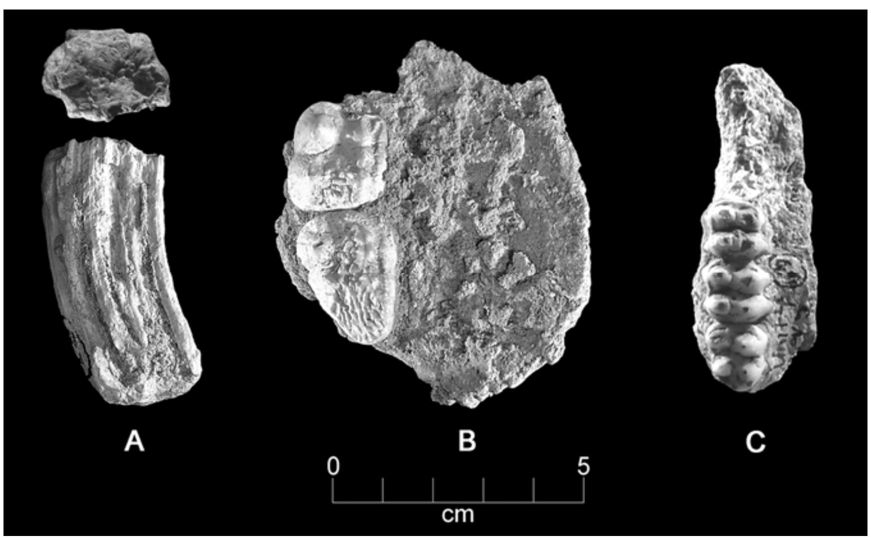


Figure 4. Pleistocene fauna recovered during previous excavations at Actun Halal. Photographs by Sam Gardner (Lohse et al. 2006: Figure 5).

2006 Season Excavations

Earlier testing conducted by the WBRCP was designed to recover Maya burials and other evidence of ritual activities that might be present. All units were placed along the walls of the cavern either below possible petroglyphs or at the base of the putative stela. Additionally, excavations were conducted according to perceived natural stratigraphy, such as changes in sediment color or texture. This methodology has the potential for best accommodating the depositional history of cave sediments. However, it also at times results in defined contexts that correspond with neither natural nor cultural events or processes, but rather highly randomized processes such as the localized concentration of calcium carbonate resulting from spray zones associated with drips. In the case of Actun Halal this is particularly problematic as various parts of the cavern are quite active in terms of ground water; many drips or even flows, and their associated spray zones with higher calcium loads, are located around the edges and to the west end of the chamber. Moreover, when following using natural stratigraphy it becomes difficult if not impossible to maintain excavation control in cases where the sediments are highly mixed, are poorly differentiated, or are difficult to discern. Finally, the uneven closing elevations of natural excavation levels makes it possible for artifacts collected in Level 5, as an example, to be from the same or even lower elevation than artifacts from Level 6 or 7. Under this system, unless careful geologic analyses and technical sediment descriptions are conducted alongside excavations, it can be impossible to reconstruct depositional contexts or associated assemblages in any meaningful way.

With these points in mind, the 2006 excavations sought potentially undisturbed deposits that would offer the best possibility for extended, stratified sediments. Our efforts were concentrated in two units, a 2x3 m unit in Area A where the previous project had reported Pleistocene faunal recoveries, and a 1x2 m unit in Area B. Excavations in these two areas were conducted in individual one meter squares. To the degree possible, these units were placed away from cave walls or obvious flowstone formations. In addition, a 1x1 m test unit (N101E127) was excavated outside Entrance 1 (Figure 5). Units were located within a horizontal grid that was extended across the entire site. An elevation datum, arbitrarily assigned a value of 100.00 m, was also established and to which each unit was linked in order to provide vertical control. Excavations in Areas A and B were conducted in 10 cm arbitrary levels until sediments felt to be of preceramic age were reached, at which point levels were changed to 5 cm thickness. Uniform closing elevations were defined for all adjoining units in these areas, creating either a 1x2 or a 2x3 m collection unit of uniform thickness subdivided into individual 1x1 m units. Using arbitrary elevations rather than following natural stratigraphy runs the risk of mixing some cultural contexts, though overall was felt to provide a better opportunity to recover associated assemblages in ways that could be reconstructed in the lab. Moreover, even with the possible mixing involved, ceramic recovery should indicate whether deposits are vertically ordered and intact by showing a general progression through time periods from the top to bottom of any particular unit. The test unit outside the cave was excavated in 20 cm levels all the way to bedrock, and all sediments from all units were passed through ¼" screen. Beginning with the test unit, each of these excavations is presented below, including discussions of stratigraphy, artifact recovery, and general interpretations of what they represent in terms of cultural occupation and depositional integrity.

N101E127

This test unit was placed immediately outside the cave's primary entrance in order to help provide contextual information on the cave's sedimentation history. Additionally, through analyses of recovered artifacts it allows us to evaluate and compare periods of the site's occupation history. The unit extended a little over a meter in depth before reaching eroded and exfoliating bedrock. Stratigraphy here showed a combination of colluvial slope wash, some gravel and boulder content from spalling limestone, bird and bat guano, and anthropogenic activity such as burning (visible in charcoal and burned rocks) and ceramic artifact refuse (see Appendix A for soil discussions) (Figure 6). A faint zone of concentrated charcoal, along with a small cluster of sherds, was present at approximately 60 cm below the surface that corresponds with some cultural event or process. It is not known if this activity occurred outside the cave's opening, or took place inside and the debris was simply tossed out.

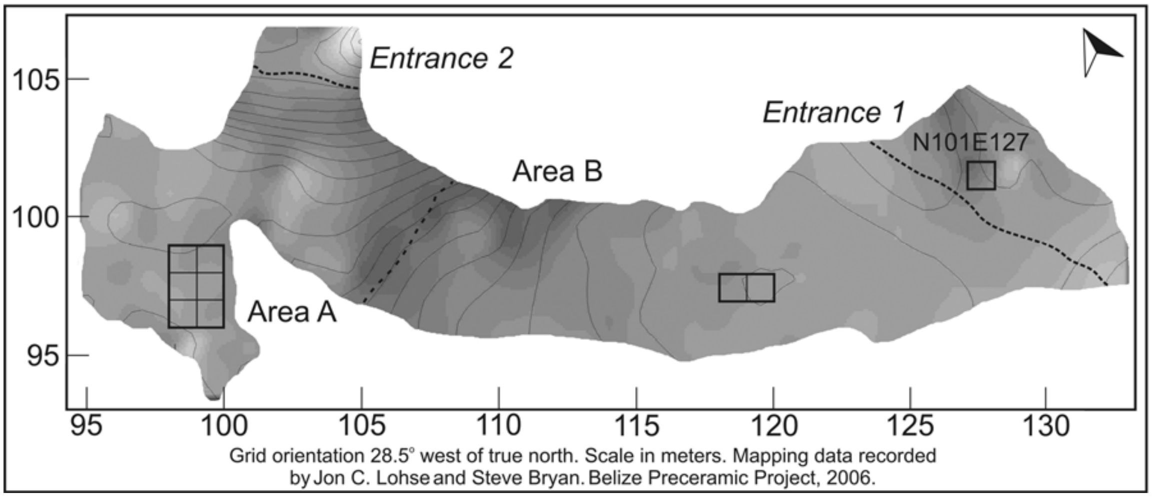
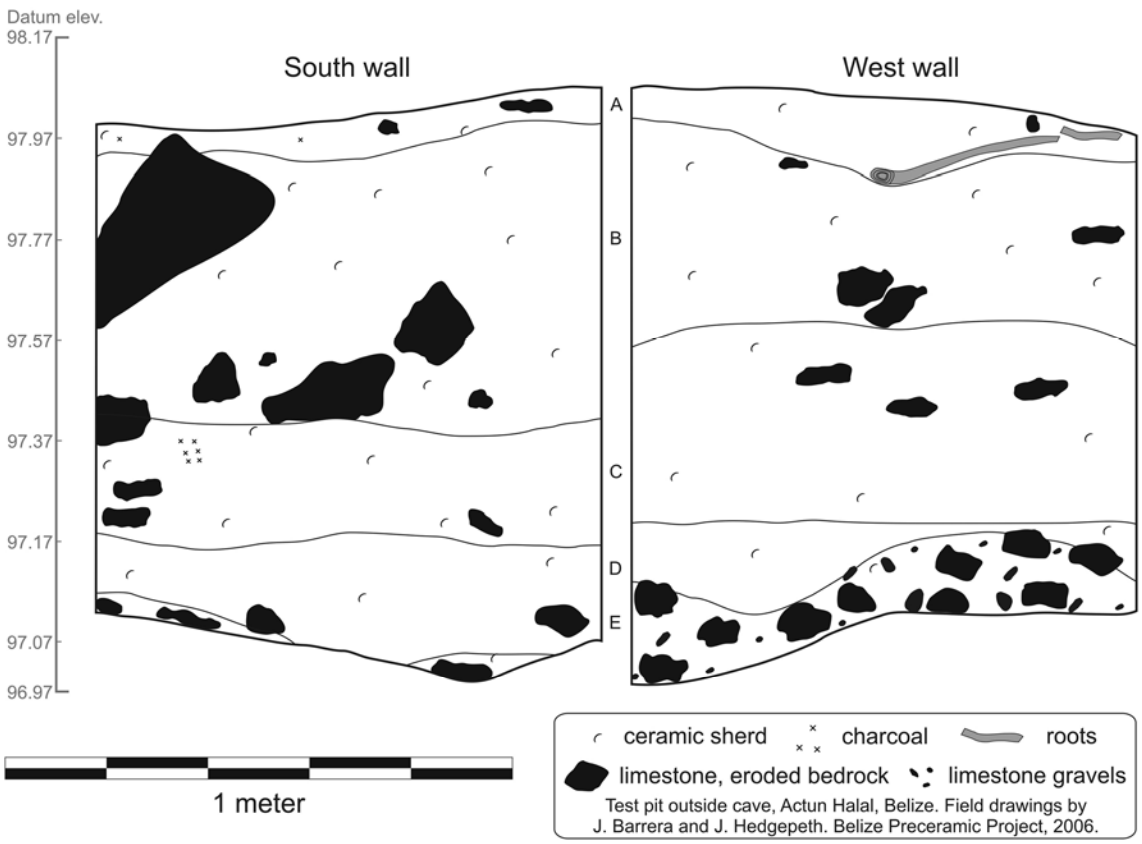


Figure 5. Map of Actun Halal interior, showing designated Areas A and B, Entrances 1 and 2, and location of excavation units.

Ceramics were recovered all the way to the bottom of the unit, with highest frequencies toward the middle of the profile (Figure 7). Surface preservation on all the ceramics was very poor, and analysis was possible only to the group or ware, rather than type, level (see Appendix B for full discussion of Actun Halal ceramics). Within this coarse level of temporal resolution, wares belonging to time periods ranging from Terminal Preclassic to Terminal Classic were present from Levels 1 through 4. Sherds from the lowest elevations were indiscernible, but Middle Preclassic wares were identified only in Level 4 (Figure 8), suggesting that this unit potentially represents somewhat ordered deposits.

Area A

Based on the earlier reports of late Pleistocene faunal recoveries in the west end of the cave, we dedicated most of our excavation efforts in Area A. As it turned out however, this part of the site is characterized by highly complex and poorly resolved stratigraphy resulting from prolonged and ongoing geologic and hydrologic activity, a moderate to high amount of mixing and disturbance from both humans and animals, and less than clear cultural components. Excavations in this area reached only about a meter below the surface by the time the season ended (Figure 9), and it remains a possibility that future excavations in this area might encounter cultural materials of early age.



Strata descriptions

A: dark brown clay-loam, dense roots and rootlets, limestone gravels, and land snails; ceramics and charcoal throughout
B: reddish brown clay-loam, very large limestone cobbles/spall, few gravels
C: reddish brown clay-loam, flecks of $CaC0^3$; charcoal and possibly burned rocks, moderate ceramics throughout
D: light reddish brown clay-loam, 10% $CaC0^3$, some limestone bedrock spalls
E: large limestone spalls with gravel matrix, eroded bedrock

Figure 6. Excavation profiles from N101E127.

Cave deposits here appear to have derived primarily from bird and bat guano, anthropogenic sources, colluvial downslope wash from the nearby Entrance 2, precipitated calcium carbonate from both direct drips and splash or spray zones, and a large quantity of medium to large sized boulders and cave spalls from wall and roof collapse. These depositional sources and processes have combined into a well developed though highly generalized two-component stratigraphy in this part of the cave (Figure 10). The lower component (Stratum II in Figure 9) is of much greater antiquity than the upper stratum and almost certainly corresponds with what Griffith and Morehart (2001:202) describe as "orange, damp dirt," though the contact between the two is irregular and often indistinct. Even within this two-meter-wide (E-W) excavation unit there proved to be a considerable amount of sediment variability. A large flowstone formation is located immediately west of the unit (Figure 11) that extends far below the modern cave floor and has created an extended spray zone as calcium carbonate-rich water drips onto it from the ceiling. This spray zone extends mostly across the eastern part of the unit, where the calcium carbonate has mineralized, compacting and cementing sediments in place. However, deposits directly adjacent to the flowstone, though moist,

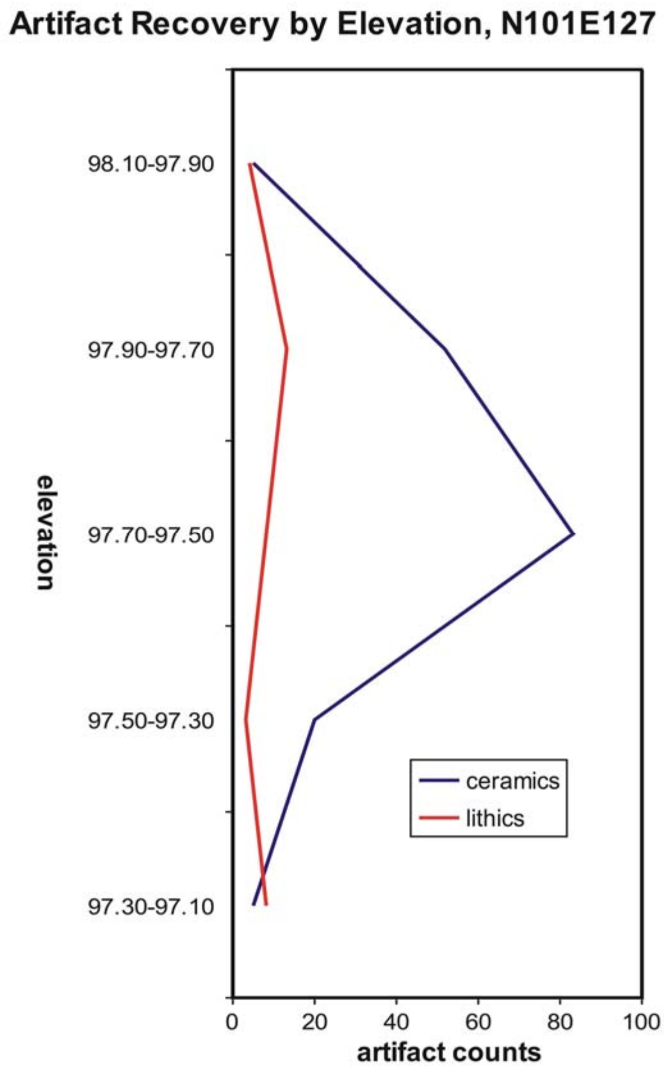


Figure 7. Artifact recoveries by elevation from N101E127.

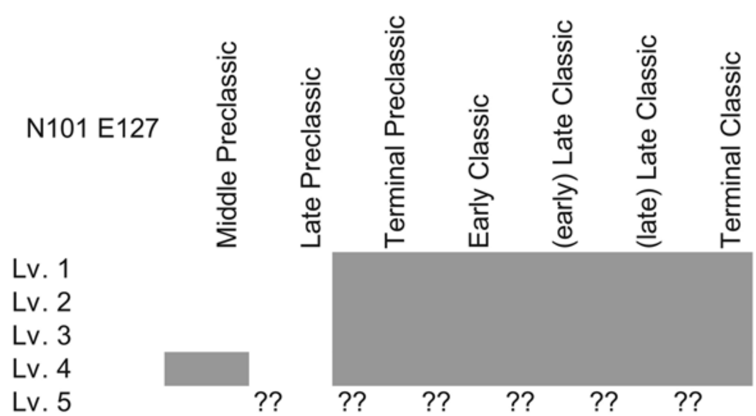


Figure 8. Temporal range indicated by ceramics from N101E127. Because ceramic groups or wares span multiple time periods, light gray shading indicates maximum possible temporal span.

were relatively uncompacted and were apparently the preferred habitat of burrowing rodents. Faunal recoveries, consisting primarily of mandibular fragments, were consistently higher to the west of Area A than to the east.

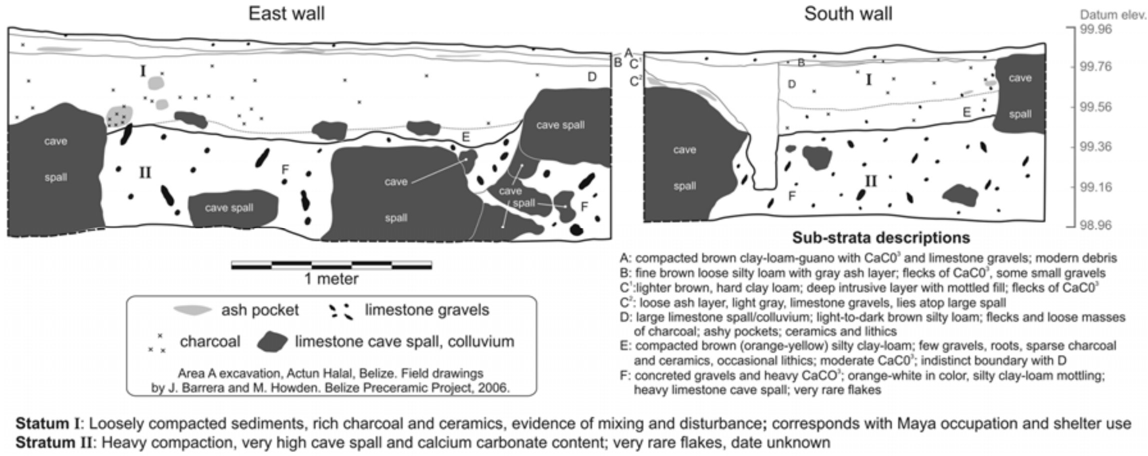


Figure 9. Excavation profiles from Area A.

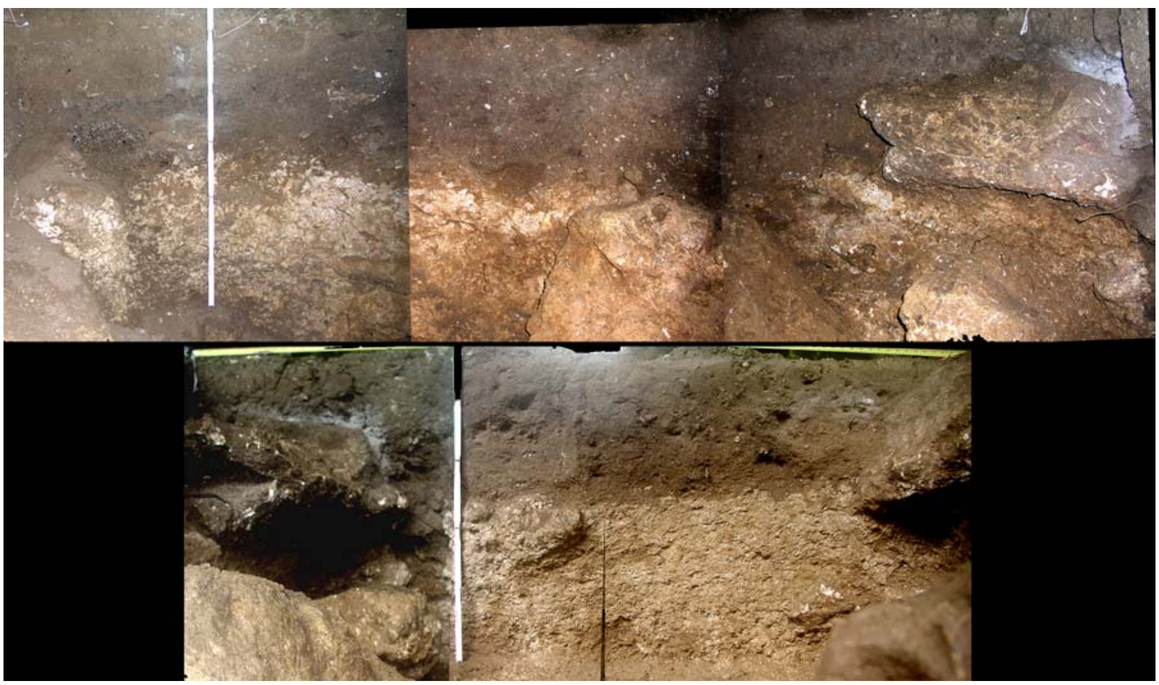


Figure 10. Compiled photos of east (top) and south (bottom) walls of Area A showing well developed two-component general stratigraphy.

Stratum I, in contrast, appears to date from early in the Maya period to modern times. Glass fragments, batteries, plastic bags, and pieces of metal were recovered as much as 15 cm below the surface, indicating that most of the artifacts from the upper elevations in this area can not be considered to be in good context. Profiles of Stratum I show relatively undifferentiated sediments with localized concentrations and lenses of carbon and ashy deposits. Some intrusions are present, such as the one visible in the south wall (Figures 9 and 10), that could represent either modern or Maya disturbances.

Ceramics recovered from Area A varied widely in terms of preservation; many were badly eroded and/or covered with calcium carbonate, leaving surfaces treatments unidentifiable. Others, however, were well enough preserved that specific types could be recognized, providing a clearer picture of occupation chronology than is available for N101E127 (see Appendix B). The earliest pottery from this part of the cave is from the Middle Preclassic, though by and large ceramic recovery indicates mixed sediments. Even considering our use of arbitrary excavation levels, temporal ranges of ceramic types should reflect a general trend from early-to-late periods from lower to upper levels. However, such is the case only in one or two 1x1 m squares; all others show time diagnostic sherds from early periods such as Middle Preclassic as high as Level 2, and Terminal Classic sherds as low as Level 5 (Figure 12). Units that reflect more or less ordered deposits include N96E98 and N96E99. At least one rim refit confirms the disturbed nature of upper sediments in this area. Three pieces of a Vaquero Creek Red jar rim were found in N97E99 Level 5, N96E98 Level 3, and N97E98 Level 3, proveniences which span at much as 3 m of horizontal and 20 cm of vertical space (Figure 13).

Figure 11. Area A, looking south, showing large flowstone to west of unit, directly behind excavator (at right).

Lithic artifact recoveries mirror to some degree the strong though largely undifferentiated Maya component. Plotting chipped stone artifacts from all units by elevation yields a roughly bimodal distribution, with the densest concentrations clustering around 99.70-99.60 and 99.20-99.10 m elevations (Figure 14). A third, fainter spike occurs at 99.35-99.30 though this elevation range falls at the transition between ceramic-bearing and apparently preceramic deposits. Not only do the sediments change from brown and dark brown to orange-brown in color at this depth, but ceramic frequencies diminish rapidly between 99.50 and 99.30 with the lowest sherds recovered between 99.30-99.25. A unifacial scraper that was recovered from 99.55 m helps to define the approximate bottom of the Maya zone. The artifact was found in mottled dark-to-orange brown sediments and within a couple of centimeters of a piece of carbon that yielded a two sigma calibrated date of 780-380 B.C.E. (Figure 15; radiocarbon data are presented in full detail in the Area B discussion, below). This association not only confirms the ceramic date for Middle Preclassic Maya occupation of the cave, but also helps define the transition from upper, Maya-age Stratum I to the less well defined and apparently preceramic Stratum II. Refitting lithics also support the ceramic evidence for mixing and disturbance in the upper elevations of Area A. Two mending obsidian blade segments were recovered from units N97E99, Level 5 (99.60-99.50) and N98E99, Level 3 (99.80-99.70) (Figure 16). Similar to the Vaquero Creek Red jar rim discussed above, these artifacts were collected as much as 2 m of horizontal and 20 cm of vertical distance apart.

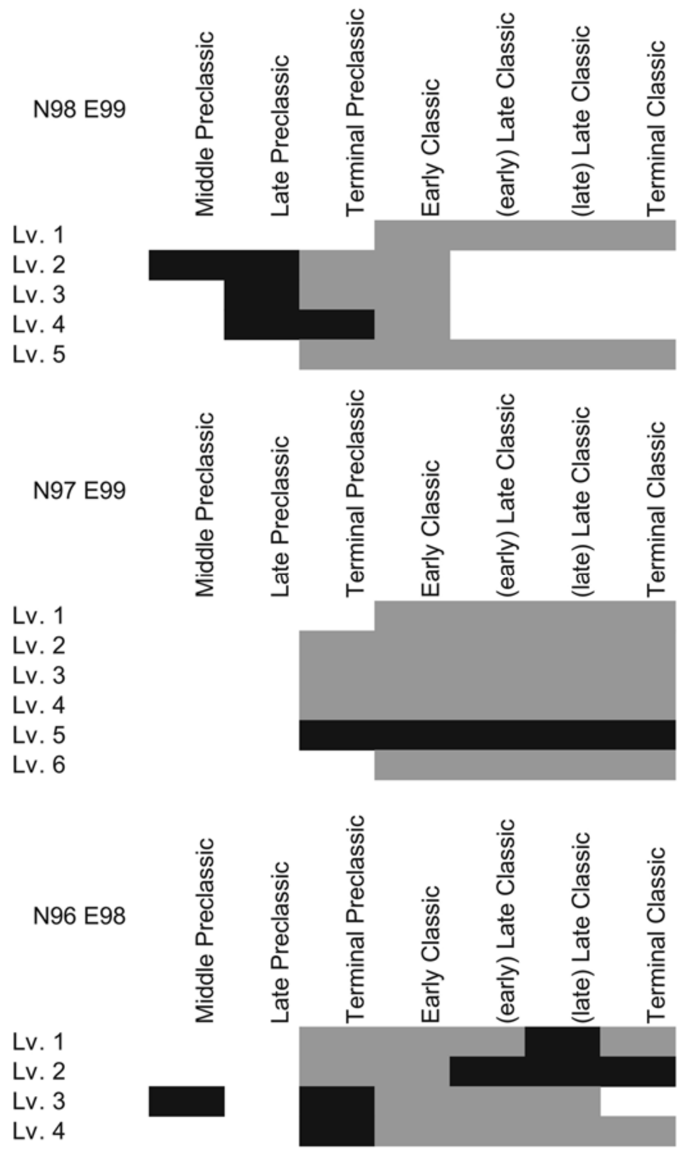


Figure 12. Area A temporal ranges as indicated by ceramics from three units selected to illustrate widely varying distributions of time diagnostic types. Because ceramic groups or wares span multiple time periods, light gray shading indicates maximum possible temporal span for each level. Dark shading limits the temporal range of the deposit based on co-occurrence of diagnostics and specific types.

Figure 13. Vaquero Creek Red jar rim refits from as far as 3 m of horizontal and 20 cm of vertical space in Area A.

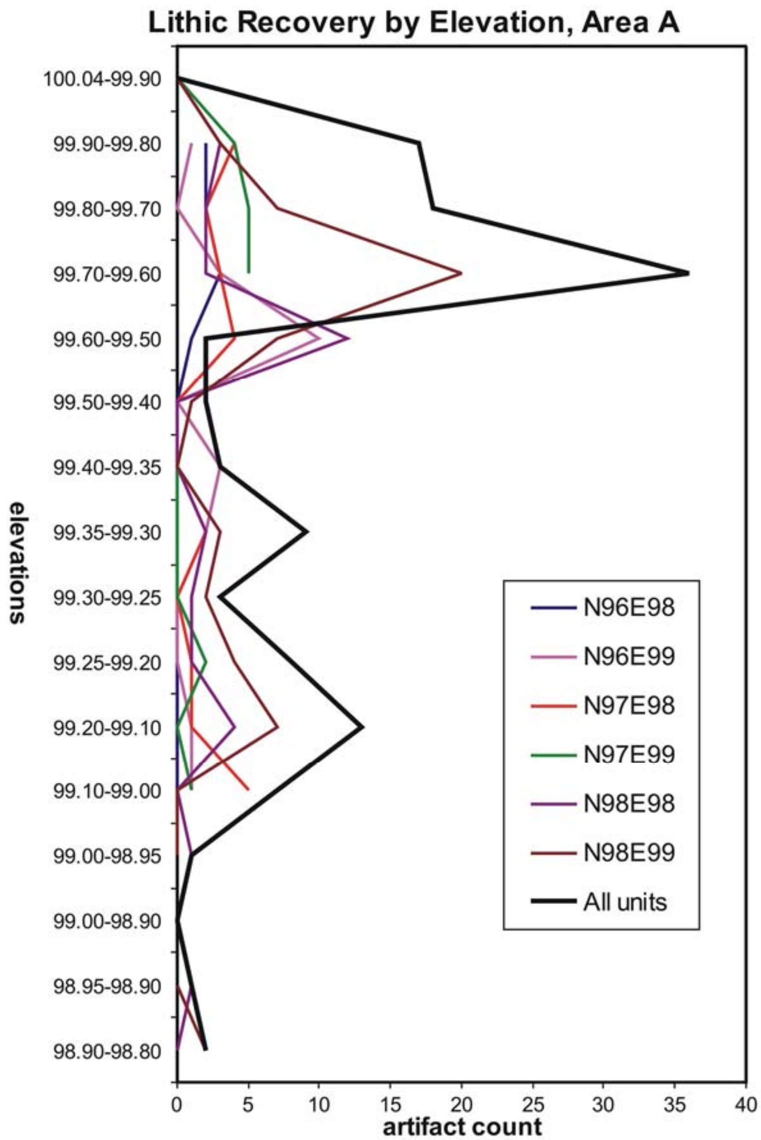


Figure 14. Lithic artifact recovery rates by elevation for Area A.

The possibility of an earlier Archaic or Paleoindian component in Area A must be left unresolved at this point. The recovery data shown in Figure 14 is slightly misleading in that, while total counts of flaked chert are presented, most of these items can not be identified as being of cultural origin with complete certainty. Rather, they include all small chips and fragments of silicious stone; most lack defining traits of true flakes and it is possible that these were created in the process of excavating compacted sediments or are small spalls that occurred when larger pieces of roof or wall collapse impacted one another. The lowest elevations from which true flakes were recovered are 99.40-99.35 in unit N96E99 (two flakes) and 99.25-99.20 in N98E99 (1 flake). These artifacts have well pronounced proximal bulbs, and complete simple or faceted striking platforms (Figure 17). Eraillure scars are even visible on the two artifacts from N96E99. Assuming that Area A ceramic recoveries are an accurate indication of the full extent of Maya occupation and that all cultural remains below the lowest sherd occurrence reflect actual human visitations, then only one flake, that from N98E99, can be confidently identified as an artifact of preceramic age in this part of the site. Thus, while Stratum II undoubtedly contains late Pleistocene and perhaps early-to-mid Holocene deposits that might contain Paleoindian and/or Archaic materials, no diagnostic or dateable artifacts were encountered and no evidence was recovered to indicate the presence of an earlier, pre-Maya component. At this point, the association between the late Pleistocene fauna and flaked stone tools reported by Griffith and Moorehart (2001) remains the only indication of early Paleoindian occupations at the site. Still, it is possible that future excavations in this vicinity might yet provide corroborating evidence.

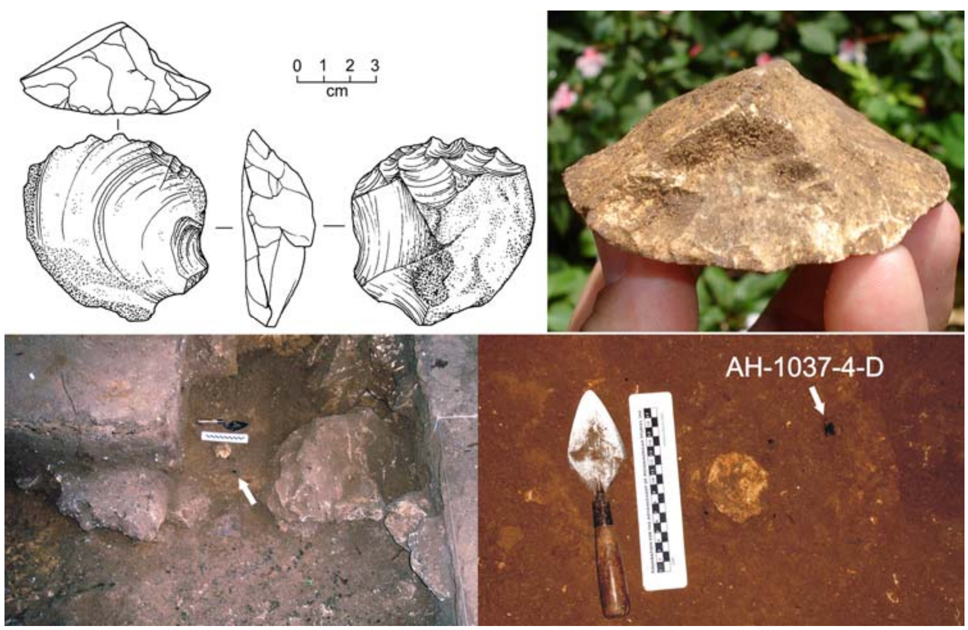


Figure 15. Unifacial scraper and carbon sample recovered from 99.55 m elevation. Illustration by David Kilby.

Figure 16. Refitting obsidian blade fragments recovered from as much as 2 m apart. Gridded paper shows mm and cm for scale.

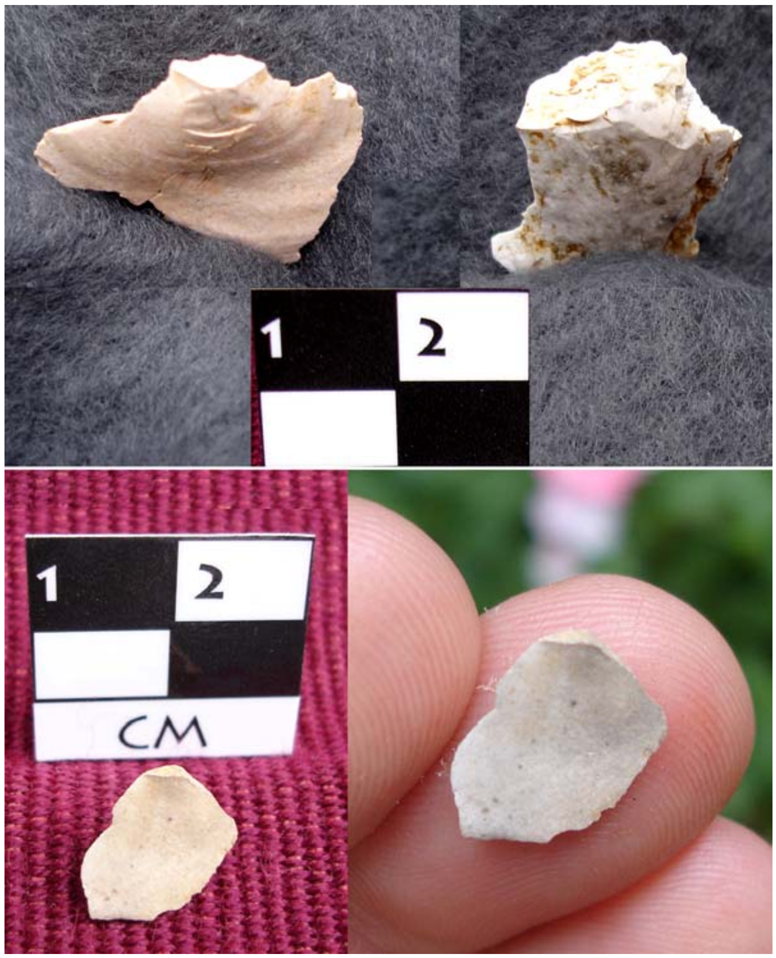


Figure 17. Two flakes recovered from 99.40-99.35 elevation in N96E99 (top) and one from 99.25-99.20 elevation in N98E99 (bottom), Area A. These are the deepest positively identified artifacts from Area A.

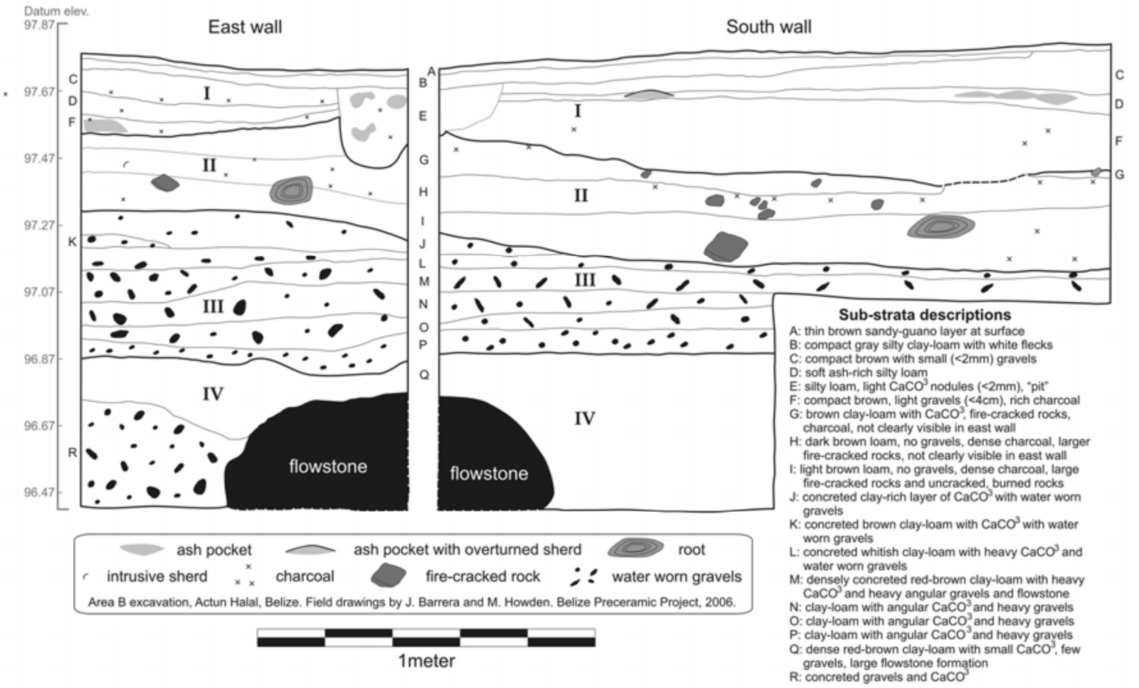
Area B

Excavations in the larger, more open part of the site consisted of a 1x2 m unit that was excavated as two adjoining m squares, N97E118 and N97E119. The unit was laid out near the center of the large end of the chamber close to Entrance 1 and away from cave walls and flowstone formations (Figure 18). In the interests of time, N97E118 was terminated at approximately 80 cm, while N97E119 was closed at about 1.5 m below the surface. As in Area A, bedrock was not reached. Sediments in this part of the cave are derived from bat and bird guano, human activities including burning and refuse disposal,

Figure 18. Area B excavation overview, looking west into the cave. Entrance 2 and Area A in background.

calcium carbonate precipitation from dripping cave water, sandy loam from slope erosion both through and into the cave, and some worn limestone gravels from episodic water coursing through the cavern. These flood deposits occur rather low in the profile, approximately 65 to 90 cm below the surface, corresponding with sub-strata J-P and Stratum III (Figure 19). The water worn gravels are interbedded with thin lenses of sandy loam and are concreted to varying degrees, indicating that different surfaces were exposed for some time before being over-deposited by a subsequent event (Figure 20). A faint burned lens, discussed below, is visible in this stratum. Upper elevations of Area B are characterized by high charcoal content and pockets and lenses of ash and ashy soil, including one area covered by an overturned sherd (visible to left near top in Figure 20). What appears to be an intrusive pit is also present in the southeast corner of the unit.

Ceramic recoveries are used both to assess the relative intactness of upper levels and also to provide a general estimate for the history of Maya occupation and cave use. Unlike Area A, no Middle or Late Preclassic pottery was recovered from these units. Instead, the earliest diagnostic pottery here dates to the Terminal Preclassic and continues through to the Late Classic. A Terminal Classic presence here is possible, though not confirmed at present. As with Area A, however, the distribution of diagnostic types reveals that cave sediments are turbated to some degree, though not as badly as in the west end of the cave. Unit N97E118 actually reveals a near-perfect progression of time periods from lower to upper levels. It is noteworthy here that the apparent mixing in N97E119 also corresponds with the intrusions visible in profile, and it is possible that what appears as disturbance is actually a product of the excavation strategy. The sherd recovered from level 14 in N97E119 is believed to have fallen into the unit from higher in the profile during excavations.



Statum I: Loosely compacted sediments, rich charcoal and ceramics, evidence of mixing and disturbance, corresponds with Maya occupation and shelter use
Stratum II: Greater compaction, rich charcoal, very few intrusive ceramics, burned and fire-cracked rocks, intact deposits, corresponds with Archaic occupation(s)
Stratum III: Concreted gravels and clay-loam, "bedded" deposits, period of apparent water activity in shelter, faint burned residues, possible Archaic component
Stratum IV: Densely compacted clay-rich sediments, variable calcium carbonate content, large flowstone, no demonstrated cultural component, date unknown

Figure 19. Excavation profiles from Area B.

Figure 20. South (top) and east (bottom) walls of Area B.

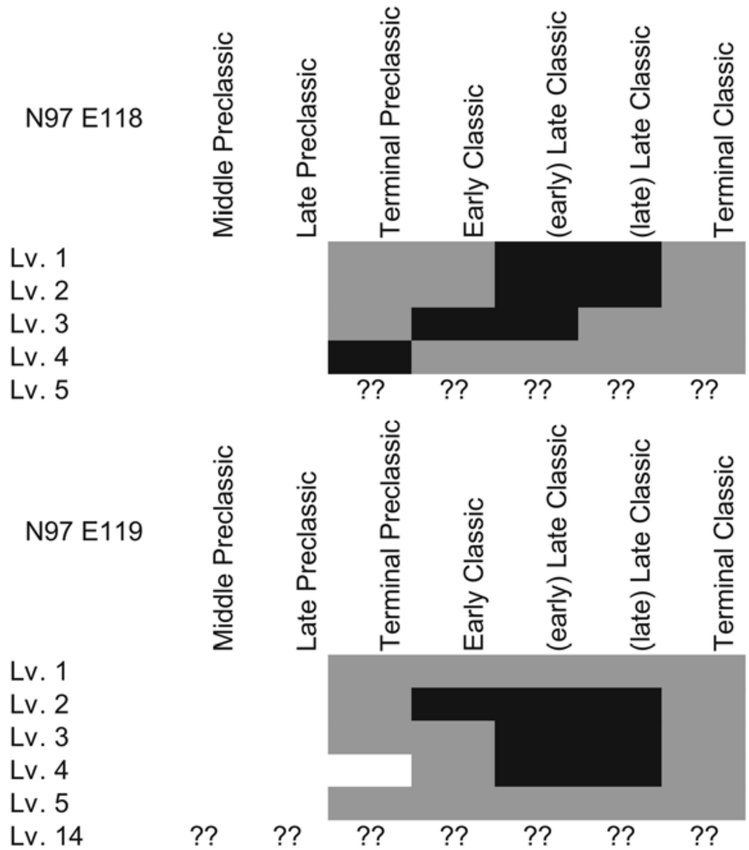


Figure 21. Area B temporal ranges as indicated by ceramics. Because ceramic groups or wares span multiple time periods, light gray shading indicates maximum possible temporal span for each level. Dark shading limits the temporal range of the deposit based on co-occurrence of diagnostics and specific types.

By and large, ceramic recoveries diminished significantly by 97.30 m elevation in both units. Quite soon after, lithic counts also diminish, though for whatever reason this seems to happen earlier in time (i.e., lower in the profile) than for ceramics (Figure 22). Lithic counts, however, spike faintly again between 97.20 and 97.05. Analysis showed many of the items included in this count to be of definite human production. Of the 17 pieces recovered from level 9 (97.15-97.10) in N97E119, for example, six are definite flakes (four of the same milky white material type), eight are flake fragments (six of milky white chert), and one is a biface fragment. While admittedly a small sample size, these assessments are important in understanding the cultural sequence in this area. This transition, the near total disappearance of ceramics with a slight increase in lithic counts, corresponds with important stratigraphic changes and indicates the presence of a lower cultural component. It is important to note that, as shown in Figure 19, the contact between this component, designated Stratum II, and the overlying ceramic-bearing zone is wavy and uneven, and dips slightly in elevation to the west. Nevertheless, the break is clear enough that the lower component was easily recognized during excavation.

In addition to near-zero ceramic recovery, the ashy content also diminished to virtually nothing and sediments become lighter in color and moister in texture. Also, excavators soon encountered a loose concentration of burned and fire cracked rocks

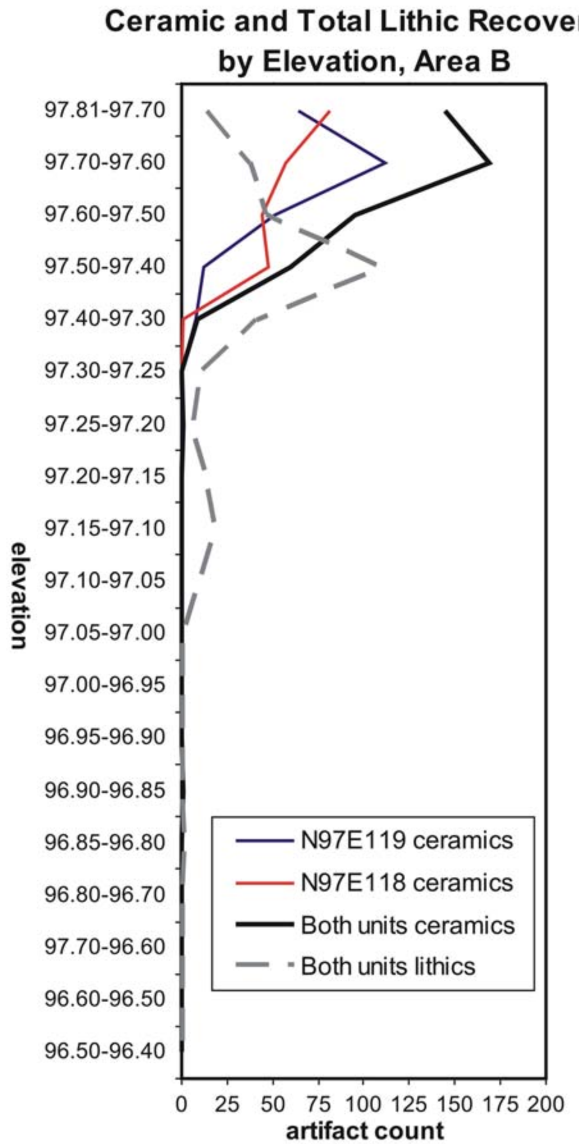


Figure 22. Ceramic and total lithic recoveries by elevation, Area B.

unlike any deposit noted to that point in ceramic-bearing levels (Figures 23, 24). These rocks continued for approximately 20 cm, becoming larger, less frequently broken, and more concentrated at lower depths. At an elevation of approximately 99.20 in N97E119, a chipped stone tool was recovered in situ among the burned and fire cracked rocks (Figure 25). The tool had been dislodged slightly by a large tree root running through the unit, but was recorded in place before being removed. Once lifted from its context, it was identified as a bifacially flaked cobble of the same milky white chert identified in the debitage analysis, above, with a convex adze-like distal bit and a constriction at the proximal end (Figures 26, 27). Similar tool forms have been documented in well dated Late Archaic contexts in northern Belize, and have also been reported from Western Belize though never recovered through excavation.

Figure 23. Burned and fire cracked rocks documented at 97.30 m elevation, Area B.

Use wear studies conducted in conjunction with experimental tool use programs (Hudler and Lohse 1994) have recorded wear patterns on replica constricted adze specimens that were used for cutting and chopping wood on some archaeological specimens. Other specimens have shown evidence of contact with sediments, suggesting that these tools were perhaps used for clearing patches of forest for early agriculture, where they came into contact not only with wood but also sediments. Preliminary use wear studies were conducted on the Actun Halal specimen, and evidence of both kinds of usages are documented. Faint striations are visible at high (200x) magnification along parts of the distal edge while polish is observed elsewhere at higher points along the tool's dorsal face. Parts of the distal end also show heavy crushing from contact with hard materials (Figure 28).

While artifact evidence for a preceramic component in Stratum II is compelling, a yet-lower faint burn lens was also noted within Stratum III. This lens was actually not observed until flash photography was employed at the season's end to record stratigraphy and unit profiles (Figure 29). No artifacts correspond with this lens and it is possible that the carbon content here is a result of natural events that took place during the period when water coursed periodically into the cave. While in the field, magnetic susceptibility (MS) readings were taken along the east wall of N97E119 to record yet another line of information for characterizing these sediments. Averaged values by elevation show three distinct points along the profile of notably high MS values; in Stratum I corresponding with Maya occupation, in Stratum II with the burned rock stratum described above, and one from the burn lens identified within the water born gravels of Stratum III (Figure 30). While MS readings themselves can not identify a cultural origin for this sub-stratum, they do further indicate the unusual nature of this particular lens. Future research can determine whether this faint lens represents a brief occupation of the cavern.

Figure 24. Burned and uncracked rocks documented at 97.15 m elevation, Area B.

Figure 25. Chipped stone tool in situ at 97.20 elevation in N97E119.

Figure 26. Photos of constricted adze associated with burned rock cluster in Area B.

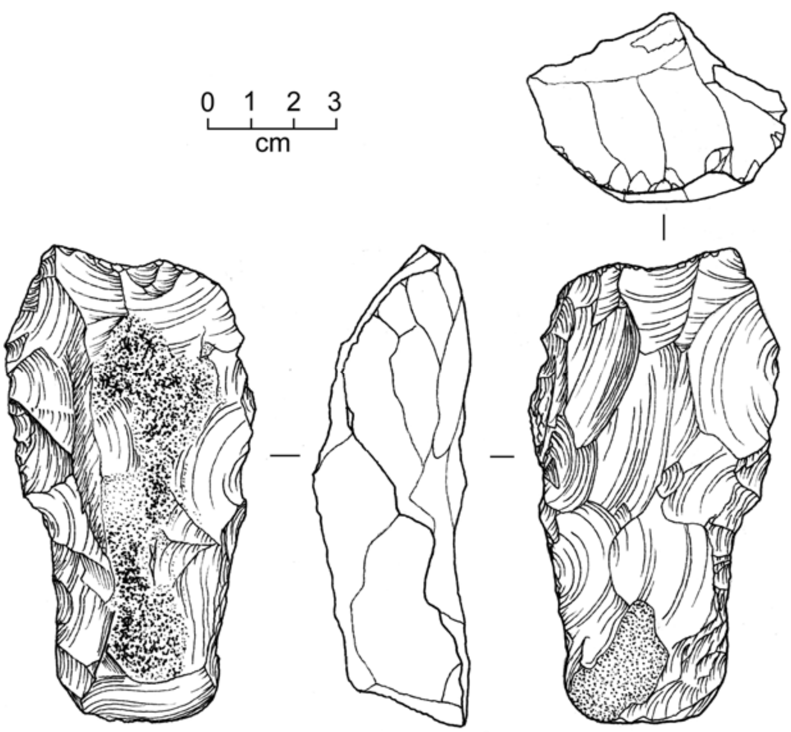


Figure 27. Technical illustration of constricted adze associated with burned rock cluster in Area B. Illustration by David Kilby.

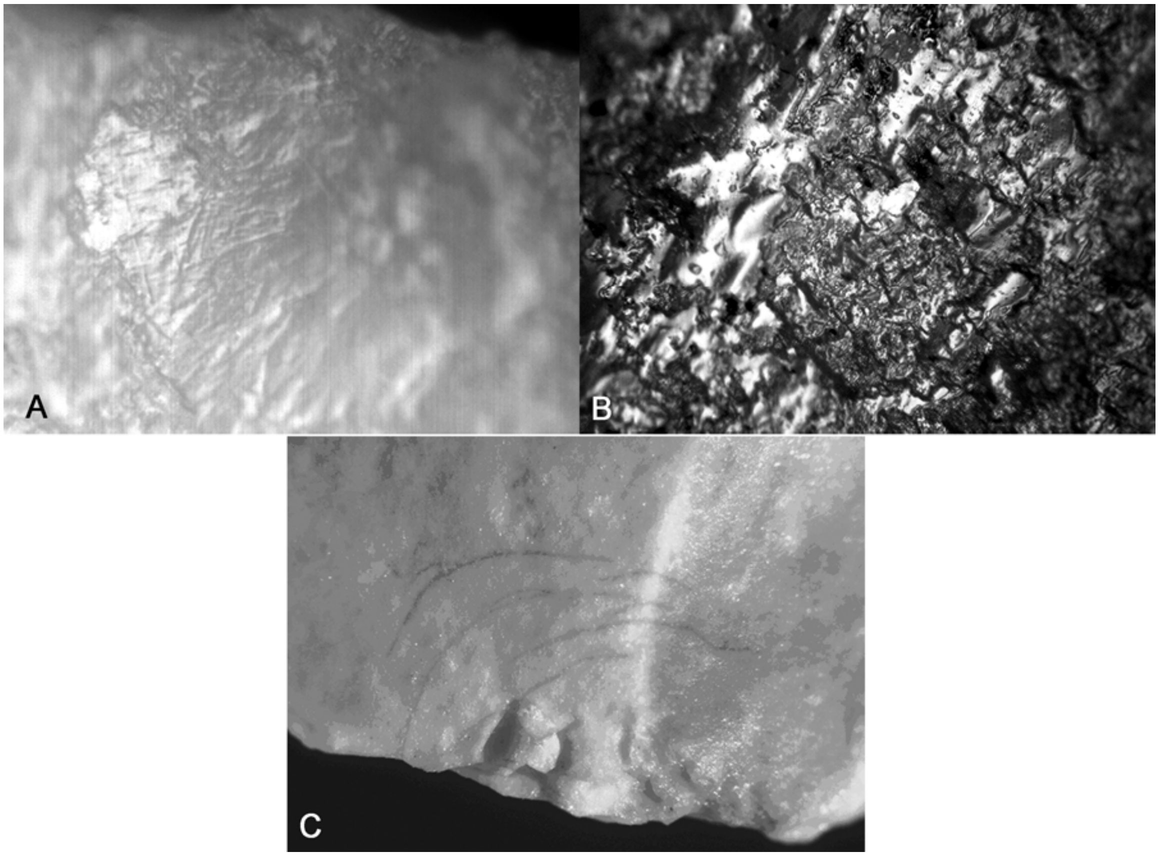


Figure 28. Photomicrographs of use wear on constricted adze from Actun Halal. Striations (A) and polish (B) visible at 200x while edge crushing (C) appears at lower magnification, 12.8x. Courtesy of Marylin B. Shoberg.

Figure 29. Lower portion of Area B profile, showing Strata III and IV. Black flecks visible in the profile are carbon and burned organics.

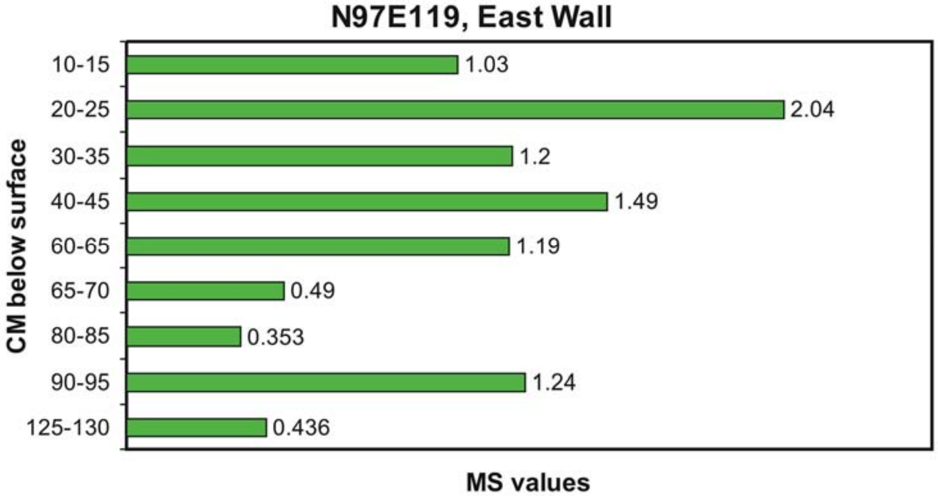


Figure 30. Magnetic susceptibility readings, taken by Tim Beach, by depth below surface for the east wall of N97E119. Three distinct spikes are visible: at 20-25 cm, 40-45 cm, and 90-95 cm below the surface. These correspond with Stratum I, Stratum II, and the burn lens in Stratum III.

Dating Actun Halal

Assessing the record of cultural occupation at Actun Halal requires employing different lines of evidence for different time periods. The ceramic record clearly indicates that Maya were entering the cave and leaving pottery behind between the Middle Preclassic, perhaps as early as 700-800 B.C.E. and the Late Classic. Some Terminal Classic visitations are also indicated, though these appear to have been much less intense or frequent based on ceramic counts. Earlier research has reported artifacts associated with late Pleistocene fauna which, while imprecise, provides a potential date (to be confirmed) of no less than 10,000 years ago for some of the earliest occupations. A suite of five radiocarbon assays from samples collected during the 2006 season is useful for bridging these time periods and providing greater resolution for what appears according to other evidence to be an Archaic component (Table 1). While each sample was chosen to provide chronological resolution to what appeared to be pre-Maya components, future radiocarbon dating could no doubt help resolve the history of Maya cave use as well.

The youngest date in the series, AH-1037-4-D, was briefly mentioned in the Area A discussion, above. This sample was collected from within a few centimeters of a unifacial stone tool that was initially thought to be potentially Archaic in age (see Figure 15). Though merely Middle Preclassic, the fact that carbon was present in abundance below the depth of this sample depth suggests that Archaic dates may yet derive from Area A. Whether these would be associated with discernable cultural components that can be distinguished from other time periods is yet to be demonstrated. The other four dates came from a series of samples from N97E119. The lowest of these was taken out of the profile from the burn lens in Stratum III, yielding a two-sigma date of 4340-4050 B.C.E. (calibrated intercept 4240 B.C.E.) that falls within the long, undated Archaic period. Though no artifacts were associated with this lens, it is possible that this date represents a brief human visitation to the cave. The remaining three dates nicely bracket the Late Archaic component identified in Stratum II. Each of the samples was point provenienced in the field; carbon was also collected below the earliest of these (AH-

1046-2-B), though only from general bulk samples taken from the screen. Based on the closeness of AH-1046-2-B (2210 B.C.E. intercept) and AH-1038-2-B (1920 B.C.E. intercept), these two dates are interpreted as defining a lower zone within the larger Late Archaic component. The intact portion of the burned rock feature seems to belong with this component, and it is clear that Late Archaic occupants of the region were using the cave by this time. The remaining intercept date of 1380 B.C.E. (1440-1210 B.C.E., 2 sigma,) comes from carbon collected from within centimeters of and at precisely the same elevation as the constricted adze. This date matches perfectly the chronological sequence developed for northern Belize, and is considered a reliable indication of the general time span during which such artifacts were in use in western Belize and perhaps adjoining eastern Petén, Guatemala. Moreover, it raises the possibility that two Late Archaic components are actually present in this locale, one dating somewhere between ca. 2400-1800 B.C.E. and a second that dates from ca. 1400-1210 B.C.E.

Paleoenvironmental Evidence

A series of bulk sediment samples for microbotanical analyses was taken in 10 cm intervals from a column from the east profile of N97E119. In addition, bulk samples were collected from each of the 5 cm levels excavated within the burned and fire cracked rock layer. Many of these samples (Table 2) were processed according to standard procedures for pollen analyses (see Appendix C), and the analysis of six of these provides excellent information on not only the paleoenvironment of the cave's vicinity, but also about the use of early cultigens and other economically useful plants by the region's preceramic inhabitants.

Two distinct zones are indicated by this preliminary analysis; based on the radiocarbon data presented above, these zones correspond primarily to Archaic to Maya deposits, and to historic-to-modern periods. The lowermost zone, occurring from 97.16 to 97.56m in elevation, shows an assemblage dominated by Asteraceae, Convolvulaceae and Poaceae types. These taxa indicate that the area around the cave was likely to have been heavily disturbed, probably for agricultural purposes. In fact, samples from 97.16, 97.46 and 97.56m all contained small percentages of maize pollen indicating that this crop was likely being cultivated near the cave. A single cotton pollen grain was identified in the sample from 97.36m. A ritual use for this plant may be indicated as cotton pollen rarely leaves the fields in which it was grown as it is heavy and tends to stay in the flower unless removed by a pollinator.

The presence of large quantities of Convolvulaceae (which includes morning glory) pollen is somewhat problematic, as these grains are also rarely found far from their flower. These grains are large, heavy, and poorly dispersed. Thus their presence in the Actun Halal samples may be significant. Some species of morning glory are hallucinogenic (Krochmal and Krochmal 1973), although it is not known if the flowers themselves have any economic value. As these flowers are large and showy, they could well represent items that were deliberately collected and introduced into the cave for some ritual purpose. Members of the Convolvulaceae family are insect pollinated and an alternative explanation is that insects that were pollinating these plants were eaten by bats. Pollen on these insects would have passed through the digestive tract of the bats, and could have been introduced in to the cave sediments when the bats defecated. The lack of appreciable quantities of other insect pollinated types, however, argues against this mode of deposition, and it seems likely that morning glory flowers or pollen were deliberately brought into the cave area by humans for some unknown reason.

The presence of notable quantities of *Coccoloba* pollen may also represent past human activity in the cave. *Coccoloba* fruit are edible, and may have served as a food source. Other potential foods represented in the pollen record from this zone include Sapotaceae, *Spondias*, and at the top of the zone, *Chrysophyllum*. All of these taxa would likely be found in the local flora of the region, and could also be parts of the natural pollen rain for the area. But as they are rarely encountered in the natural pollen rain in the region, their presence argues for a cultural use.

At 97.56m, there is a significant change in pollen types present in the profile. Here, there is a dramatic decrease in Asteraceae and Poaceae pollen, along with a corresponding increase in Arecaceae, *Coccoloba*, *Salix*, *Zanthoxylum*, *Metopium*, *Sebastiana* and *Cecropia*. Most of these taxa are non-economic parts of the local forest, and the pattern represented in the pollen record is one of reforestation of the region. It is clear from reconnaissance outside the cave that the Maya farmed in this area well into the Classic, so it seems likely either that this sample represents post-Maya abandonment of the region or that people no longer brought economic plants into the cave area. Cultigens are wholly lacking in this uppermost sample.

Based on these initial results, it is clear is that the uppermost sample in the Actun Halal pollen sequence is notably different than the earlier Archaic age samples. This indicates that the cave was being utilized in a different fashion at this point. The Archaic age pollen samples suggest people living in, or at least utilizing the cave for everyday (and possibly also ritual) purposes. There is no good evidence from the single uppermost sample, however, that people utilized this cave. Whether this suggests that the earlier occupants were related to the Maya remains to be demonstrated.

Conclusions

Multiple lines of evidence are available from Actun Halal that inform on both Maya and pre-Maya use of the site. The presence of Archaic components is indicated by artifact recovery patterns, and confirmed by a suite of four perfectly ordered radiocarbon dates. The earliest of these dates suggests the possibility for a brief visitation sometime around 4200 B.C.E., though supporting artifact data are lacking. A better case can be made for two sequential Late Archaic components, the first conservatively dated from 2400-1800 B.C.E. and the second from about 1400-1210 B.C.E. The later aspect of this component compares well with contemporary developments elsewhere in the country in terms of stone tool technologies, and the constricted adze from Actun Halal adds important information to the potential diversity that is to be expected of this tool type. Though our efforts were focused on investigating Archaic and possible Paleoindian deposits, it is clear that the site was also important to people in the vicinity from the Middle Preclassic through the Late Classic and possibly into the Terminal Classic.

Paleoenvironmental data from pollen analysis provide important evidence for the early appearance of cultigens and other useful plants in the region long before settled villages and the appearance of ceramic technologies. These sequences also compare well with those documented elsewhere, and are significant in that they begin to fill in the enormous blank spot on map of Late Archaic developments in the Upper Belize Valley and adjoining eastern Petén, Guatemala. Important among the palynological findings is the probability that preceramic peoples were consuming hallucinogenic plants in cave settings long before the Maya recognized these locales as ritually significant. Hopefully more cave researchers will examine the question of the longevity of cave associated ritual in their research designs.

The research reported here points to the potentially long temporal span that is contained in many of the cave sites in the Maya area. Actun Halal has proven to contain a record of, at a minimum, 3200 years of near-continuous use and visitation that begins at least in the Late Archaic and continues through the Late and perhaps Terminal Classic. Earlier cultural deposits have been reported that can not be verified by our research, though at the same time we can not rule out their presence. As such, the site begins to provide important information concerning regional developments in the eastern part of the central Maya lowlands, while also raising a number of questions that future research might address.

Acknowledgements

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Table 1. Radiocarbon results from 2006 season excavations at Actun Halal, Belize.

Field Sample No.	Beta Lab No.	Material	Unit, Area	Elevation (cm b.s.)	Conventional Radiocarbon Age BP	13C/12C Ratio	Calibrated Years BP	Calibrated Intercept	Calibrated 2-Sigma Dates
AH-1023-2-A	Beta-221895	Charred material	N97E119, B	97.43 m (37 cm)	3080 +/- 50	-25.8 o/oo	3390-3160	1380 BC	1440-1210 BC
AH-1038-2-B	Beta-221898	Charred material	N97E119, B	97.20 m (60 cm)	3580 +/- 50	-26.1 o/oo	3990-3720	1920 BC	2040-1760 BC
AH-1046-2-B	Beta-221896	Charred material	N97E119, B	97.16 m (64 cm)	3800 +/- 50	-27.7 o/oo	4380-4070, and 4040-4000	2210 BC	2430-2120 BC, and 2090-2050 BC
AH-1110-1-A	Beta-221897	Organic sediment	N97E119, B	96.99 m (81 cm)	5380 +/- 50	-28.4 o/oo	6290-6000	4240 BC	4340-4050 BC
AH-1037-4-D	Beta-221899	Charred material	N98E98, A	99.55 m (49 cm)	2410 +/- 60	-11.4 o/oo	2730-2330	420 BC	780-380 BC

Table 2. Pollen samples from Actun Halal that were processed. Those that were counted are indicated. Additional samples were collected that await processing.

Lab No.	Sample No.	Elevation	Preservation	Counted?
1	1117-14	97.66-97.76	Good	Yes
2	1117-13	97.56-97.66	Good	Yes
3	1117-12	97.46-97.56	Good	Yes
4	1117-11	97. 36-97.46	Good	Yes
5	1117-10	97.26-97.36	Good	Yes
6	1117-9	97.16-97.26	Good	Yes
1A	1117-4	96.66-96.76	Poor	No
2A	1117-2	96.46-96.56	Poor	No
9	1023-3-B	97.40-97.30	Unanalyzed	No
10	1041-B	97.20-97.18	Unanalyzed	No
11	1053-3-B	97.15-97.10	Unanalyzed	No

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Appendix A

Geoarchaeology of Actun Halal Cave in Western Belize

Tim Beach, Georgetown University

Background

Accompanied by my field assistant Sandra Kirtland, 2006 SFS-STIA graduate and current doctoral student in Oceanography at Scripps Institute, I studied the geomorphology and sedimentology of the caves around Actun Halal. Ms. Kirtland was funded for travel by the SFS Deans Office of Georgetown University and I was funded by a GU International Collaboration Grant.

We first surveyed the hydrology and geomorphology of the cave system within this broader karst landscape. This entailed some basic topographic surveying, water chemistry testing, and field geological and geomorphic mapping. In the process, we found that the watershed above Actun Halal was an intensively managed ancient Maya landscape with many, very large, well crafted agricultural terraces, some mounds, and water features like canals and wells. To understand solute flows in regional groundwater, I measured electrical conductivity of the water in three wells that lie about 310 m in elevation, and these ranged from 239 to 247 mg/l at 26 degrees C. This was similar to the EC at stream through Chechem Ha Camp (196 mg/l at 26.1 degrees C).

Actun Halal is a rock shelter that lies in the Vaca Plateau, a rugged karst region of approximately 450 m of local relief. Around Actun Halal are many other caves, which lie near the same elevation on the canyon wall of a fluviokarst stream. The cave zone is largely limestone and lies below sandstone and shale that crop out upstream in the watershed. During our research in the early wet season this stream never had flowing water, though the water table in wells in the channel was .6 to 1.3 m deep (depending on rainfall) at an elevation of about 195 m. The electrical conductivity of one channel well was consistently low, 65 to 82 mg/l, thus reflecting large rainfall dilution. Actun Halal and the surrounding caves lie about 30 m away and 8 m above this stream channel along 17 degree slopes. The stream channel must occasionally produce highly competent flows since it has rounded cobbles to boulders in its channel of up 1.5 cubic m and greater than 3 tonnes. Clearly, large flows are infrequent because most channel stones were covered by mosses, which would be scoured off with flows of high competence.

Actun Halal has formed by dissolution of limestone preferentially along joints, fractures, bedding planes, and in bat bells. Like most caves, it has both dissolution in the cave itself and calcite precipitation in flowstone, dripstone, and dripstone layered into the 1-1.5 m of sediments. Actun Halal is about 11 m high and 33 m long with both east and northeast entrances. It is formed along several joints and bedding planes and has many large bat bells that are up to 1.7 m wide and 11 m high.

I also measured water quality in the cave drip of Actun Halal, in drips which are eroding speleothems and drips building them. For example, the water in the cave at eroding sites had 160-168 mg/l and the water from a site that was actively producing speleothems was 1450 to 1530 mg/l.

Area B

Area B included one large excavation in the lower, center area of sediment accumulation near the east entrance to the cave. Descriptions of the depositional sequence is as follows.

Unit 1a: 0-20-25 cm, small granular, organic-rich loam, dark grayish brown (10YR4/2) with high amounts of charcoal and ash lenses. HCL reaction: strong; pH: 5.3

Magnetic susceptibility (MS): 0.929-1.11

Unit 1b: 20-25 to 38-40 cm, fine and platy, sandy loam (dark brown 7.5YR 3/4) with thin gray ash (10YR6/1) and charcoal layers, coated by $CaCO_3$ spray on peds but loose and not cemented. Most ceramic material from here upward. HCL reaction: strong; pH: 4.6

MS: 2.03-2.14 on sediments (1.44-1.57 on ash lenses)

Unit 1 corresponds to the present through late facet Late Archaic periods, with one AMS calibrated, 2-sigma radiocarbon date of 1440-1210 BC at 37 cm

Unit 2a: 38/40 to 52 cm, granular, organic-rich, clay loam, very dark grayish brown (10YR3/2), copious charcoal, fire cracked rock, few intrusive sherds; HCL reaction: strong; pH: 4.9

MS: 1.48-1.5 (1.16-1.24 in unburned areas)

Unit 2b: 38/40 to 60/65 cm, layered and massive sandy loam, brown (10YR 4/3). Very abrupt lower boundary to Unit 3 from brown to red and yellow; HCL reaction: strong; pH: 5.0

AMS samples from charred material at 60 and 64 cm from lower boundary of Unit 2 date to 2040-1760 BC and 2430-2120 BC, and 2090-2050 BC. The sediments between 40-64 cm are consistent with Archaic, fire-rich deposits and contain maize and cotton pollen and several other known food producing taxa.

Unit 3: 65-90 cm, clayey gravel (limestone and slate), cobble, dark yellowish brown (10YR 4/6) partially cemented by splatter associated with the formation of a stalagmite that forms from the bottom of the unit through this zone (possible flood deposit: flat, rounded gravels 2-3 cm pH 5.6); sloping downhill from W to E, laminated with $CaCO_3$; HCL reaction: violent; pH: 5.2-5.6

MS: .338 to .363

One zone, 65-70 cm from surface on E side of exposure, is red (2.5YR 4/6): MS: .483 to .493. Low MS, and red color, possibly as a result of cinnabar but awaiting further chemistry. From layer that dates to 2430-2120 BC, and 2090-2050 BC. This layer also has pollen from food taxa such as maize and Sapote.

One zone tapers out to the north but reach from 80-90 cm from the surface, across much of the East face is a charcoal rich layer that must be a burn layer, and one AMS assay from the layer yielded a calibrated 2-sigma date of 4340-4050 BC.

Unit 4: 90 -105 cm, massive brown clay (7.5YR 4/4 and 4/6), no charcoal, darkens with depth and increases in rounded gravel; HCL reaction: strong; pH: 4.9

MS: 1.23-1.26

Unit 5a: 105-155 cm, massive gravelly clay, strong brown 7.5YR 5/6, no charcoal, gravel 2 mm, blocky and angular; mottled with some redder clays in pores between rocks in the deepest zone in the pit. HCL reaction: strong, though initially delayed on red clays; ph: 4.9

MS: 115-120: .813 to .861
MS: 125-130: 1.03 to 1.13
MS: 135-140: 1.05

These sediments show the obvious signs of cave deposition from splatter from dripping, nearly saturated water, bird and bat guano and urine, some human made fires, and some input from slope erosion and even rare stream deposition. The cave's sediments have both high acidity (low pH) and strong reaction to Hcl, thus indicating that within this acidic soil matrix was the presence of carbonates (mostly Calcium carbonate from the surrounding limestone rocks). Bat guano often has a pH of 4.3 and thus the 4.6 to 5.6 pH of cave sediments reflects this variable input of guano. The least acidic sediments also coincided with those most likely derived from flood deposition. Magnetic susceptibility of the soils measures amount of magnetization in the presence of magnetic field. MS ranged from .338 to 2.14, and was highest in the upper layers that coincided with the Classic to current Maya times and presumably burning induced magnetization. Unit 2 from the Archaic also had relatively higher MS and significant evidence for burning.

Unit N101E127

Soils here are colluvial with some cave splatter and drip, near mouth of cave.

O: 0-2 cm, O horizon, black (7.5YR 2/0),humus, cohune nuts, and copious snail shells

A: 2-14 cm, medium granular, organic-rich, dark brown (7.5YR 3/2) clay with many fine roots, mollusk shells, and charcoal, few ceramics, 20-30% cobble and boulder, wavy lower boundary. HCL reaction: strong; pH: 4.9

MS: 5-10 cm: 1.98, 1.91, 1.99
MS: 10-15 cm: 1.39, 1.34, 1.36

B: 14-34 cm, medium sub-angular blocky, dark yellowish brown (10YR 3/3) clay with few roots, mollusk shells, and charcoal, few ceramics, 25-35% gravel to boulder, wavy lower boundary. HCL reaction: strong; pH: 4.8

MS: 20-25 cm: 1.71, 1.70, 1.68
MS: 30-35 cm: 1.67, 1.76, 1.73

Ab: 34-62 cm, fine granular, dark brown (7.5YR 3/2) clay with few roots, mollusk shells, and copious charcoal and burned rock, more ceramic, 50% boulder, wavy lower boundary. HCL reaction: strong; pH: 5.4

MS: 50-55 cm: 1.96, 1.91, 1.99
MS: 60-65 cm: 1.89, 1.83, 1.9

2Bk: 62-98 cm, small sub-angular blocky, dark reddish brown (5YR 3/4) clay with many mollusk shells and $CaCO^3$ coatings, few ceramics, 25-35% gravel to boulder, wavy lower boundary. HCL reaction: strong; pH: 5.6

MS: 75-80 cm: 1.61, 1.79, 1.73
MS: 85-90 cm: 1.27, 1.29, 1.24

2Bk2: 98-107 in pockets deeper, small angular blocky, mottled yellowish red (5YR 4/6) and strong brown (7.5YR4/6) clay with many mollusk shells and $CaCO^3$ coatings; 80% cobble to boulder. HCL reaction: strong; pH: 5.6

MS: 1.24, 1.32, 1.28

Ck and Cr: Upper Cr horizon has accumulated, indurated $CaCO^3$.

This soil profile shows signs of cave dripping and $CaCO^3$ illuviation, bird and bat guano and urine, some human made fires, and some input from slope erosion. The soil, like the cave, has both high acidity (low pH) and strong reaction to Hcl, thus indicating that within this acidic soil matrix was the presence of carbonates (mostly Calcium carbonate from the surrounding limestone rocks). Bat guano often has a pH of 4.3 and thus the 4.6 to 5.6 pH of soils reflects this variable input of guano and the higher acidity of organic matter. The soil's acidity and coatings in $CaCO^3$in crease with depth and indurate the lower levels, which indicated the downward elevation and illuviation of $CaCO^3$, though we found small evidence of illuvial clay. Magnetic susceptibility of the soils measures the amount of magnetization in the presence of magnetic field. MS ranged from 1.24 to 1.99, and was highest in the topsoil and in a buried soil that coincided with most ceramic, charcoal, burned stone, and thus burning induced magnetization.

APPENDIX B

THE CERAMICS OF ACTUN HALAL

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Analysis of subsurface ceramic materials from Actun Halal was undertaken from June 28 to July 3, 2006 at Chechem Ha Guest House using standard procedures I developed while working at Xunantunich and Actuncan (LeCount 1996). All sherds (n=1545) recovered from excavation units were analyzed by provenience to facilitate comparison of pottery attributes and types across contexts within the rockshelter and other local sites. Every sherd is characterized by composition (paste and temper), surface treatment, form, and decorative technique. In addition, the Barton Ramie classification scheme (ware, group, type and variety) was also utilized (Gifford 1976). Analyses are presented by excavation unit (Table B-1) and concentrate on understanding the relative date of materials by unit and level. Activity sets that took place in the rockshelter are also explored using vessel form portions.

Preservation

The condition of sherds within subsurface deposits was quite variable depending on depth and location. Overall, 52.2 percent of sherds were eroded or encrusted with dripstone formations. In some instances, sherds were totally covered with dripstone formations and many others required extensive cleaning and scrapping to expose ceramic surface treatments. In addition, as Christophe Helmke (Griffith and Helmke 1999:101) states in his analysis of the surface ceramics, many sherds show signs of exposure to water. This results in the leaching way of the soluble elements of the paste and surface. Further, five sherds from N97/E98 Level 1 appear to be water worn (i.e. exhibit rounded edges and smooth facets) as if they were subject to long periods of flowing water.

This said, some units contained better preserved sherds than others. In Area A, the eastern units of the 2x3 m excavation block all contained above average frequencies of sherds with preserved surface treatment. Good preservation is also true for material from the two side-by-side units located just inside the mouth of Entrance 1 (N97E118 and N97E119). This is not the case for material from the unit outside the rockshelter (N101E127), which exhibited the highest frequency (76 percent) of eroded or encrusted sherds. However, materials from the western units of Area A were nearly as eroded as those found outside the cave. These data suggest that parts of the cave experienced periods of flooding while others did not.

Deposits appear to be generally stratified, although many levels contain highly mixed ceramic complexes. By far the most well stratified and least mixed deposits come from N97E118, which displays an orderly sequence from the Late Classic to the Terminal Preclassic period (see Figure 21). Other units that show (more or less) orderly sequences are N96E98 and N96E99. Viewed in broad strokes, the Area A units indicate a shift from Late Classic to Early Classic deposits between levels two to three around 99.70 cm below datum and the transition to Terminal Preclassic deposits between levels 3 and 4 around 99.60 cm below datum. Transitional diagnostics associated with the Early Classic (Tzakol 3) are clearly situated between these levels. Unfortunately, some units appear to have instances of reverse stratigraphy, for example N98E99 (see Figure 12). I also encountered refit rims across multiple units and levels. Three pieces of a Vaquero Creek Red jar rim were found in N97E99 level 5, N96E98 level 3, and N97E98 level 3, proveniences which span at much as 3 meters in horizontal space and 20 cm in vertical space. Undoubtedly some of this mixing is likely due to bioturbation or past human activity within the rock shelter. Yet, poorly ordered temporal sequences evident in some units are likely a function of the coarse nature of dating deposits based on minimal ceramic data and not real patterning in the archaeological record.

Temporal Range

Assignment of ceramic phases is based on a number of attributes, not just type-varieties. Certain paste-wares, surface treatments and ceramic groups span several ceramic complexes, and therefore are indicative of broad archaeological time periods. For instance, Mars Orange is a bright orange, finely-tempered paste-ware associated with the Middle Preclassic period (Gifford 1976:73-74) and Holmul, a light pink to orange calcite ware, is indicative of some Terminal Classic complexes (Gifford 1976129). Ash wares are generally associated with the Late and Terminal Classic ceramic complexes, although they can appear in very limited frequencies throughout the sequence. Nonetheless, most calcite paste-wares, such as Uaxactun, are found throughout the sequence and are not temporally diagnostic. Broad temporal periods can also be understood using surface treatment. Waxy surfaces are prominent in the Late Preclassic and continue into the Terminal Preclassic period, but smaller frequencies of waxy types are associated with Early Classic forms such as basal flange bowls. The first glossy surfaces might appear as early as the Terminal Preclassic period (Brady et al. 1998), but are more indicative of the Classic period. Finally, some ceramic groups also are long-lived, such as Sierra, Belize, and Mount Maloney, and can be used to set temporal parameters if no more temporally definitive diagnostics are present. Type-varieties are the most sensitive temporal markers, yet they exist in the smallest frequencies within proveniences, even in large, open-air sites like Xunantunich (Table B- 2).

This said, most sherds are not diagnostic of any temporal phase. More than 54 percent of Actun Halal sherds are classified solely as calcite ware body sherds or unspecified rims. Uaxactun ware makes up another 26 percent of sherds, most of which are again undiagnostic unless it is a temporally sensitive rim style. Because of the eroded and encrusted nature of the deposits, assemblages from some proveniences are assigned relative dates based solely on broad temporal markers. The following discussion is based on the frequency of temporal diagnostics within the total assemblage.

The Actun Halal ceramic bearing deposits date from the Middle Preclassic (Jenny Creek) to the Late Classic periods (late facet of the Spanish Lookout). No subsurface Terminal Classic or Postclassic sherds were encountered. Nor is there any clear evidence of Cunil (early Middle Preclassic) styles. Although most diagnostics are associated with the Classic period, a few Mars Orange sherds (n=9; 0.6 percent of total assemblage) were found in four lots within four of the nine excavation units (N101E127, N98E98, N98E99, N96E98) and in two or the three areas sampled within the cave. Some coarsely-tempered brown body sherds might be in fact Jocote Orange-brown, but no rims were found to confirm the presence of this typical Middle Preclassic type. This pattern suggests an ephemeral use of the rockshelter during the Jenny Creek phase sometime between 800 and 300 BC. Late to Terminal Preclassic (300 BC to AD 250) diagnostics are slightly more frequent (n=18; 1.1 percent of total assemblage). Three Sierra Red type rims were found in N96E99 Levels 4 and 5, and two Terminal Preclassic types -- a Vaquero Creek Red jar rim and a Guacamallo Red-on-orange body sherd -- come from similar deposits.

Early Classic diagnostic types or attributes (n=6; 0.4 percent of total assemblage) associated with well-known Hermitage complex types were found in three units in both Area A (N97E99 and N96E99) and Area B (N97E118). Three body sherds are Dos Arroyos Orange-polychrome (two with basal flanges) and one is possibly Fowler Orange-red. A few glossy black body sherds, possibly Balanza Black, are not uncommon in levels associated with Early Classic types, but these glossy black sherds cannot be definitively assigned to the Hermitage complex. Gloss wares (n=7; 0.5 percent of total assemblage), regardless of slipped color, are indicative of the Classic period and cannot be reliably assigned to more specific complexes.

Most types are associated with Late Classic complexes, either Tiger Run or the early facet of the Spanish Lookout (n=20; 1.5 percent of total assemblage). Eroded ash ware (n=10; 0.6 percent of total assemblage) and Pine Ridge Carbonate (n=87; 5.6 percent of total assemblage) sherds or rims also lend evidence for Late Classic occupation of the rockshelter. In fact, all units contain some evidence of Late Classic occupation. Although no buried Terminal Classic diagnostic were encountered, this pattern alone does not rule out post AD 800 use or occupation. Many Late Classic types continued into the Terminal Classic, leaving open the possibility of occupation of the rockshelter during this critical time period.

Ceramic Spheres

Not surprisingly, all sherds from Actun Halal represent types that commonly occur in the Belize valley or the near-by uplands. More surprising is the low frequency of Mount Maloney Black bowls and jars, which are very common at Xunantunich and Chechem Ha. These domestic wares might have been emblematic of Upper Belize Valley populations around Xunantunich (Connell 2000; LeCount n.d.; Preziosi 2003). Mount Maloney group dominates Xunantunich assemblages and comprises between 37 and 47 percent of the Late and Terminal Classic complexes (LeCount et al. 2002). Holley Moyes (2006:Appendix 3, table 2) reports that roughly 31 percent of Late Classic vessels from surface survey within Chechem Ha cave are Mount Maloney bowls and jars. This frequency closely matches portions documented for Xunantunich, and suggests the cave was utilized during the Late and Terminal Classic periods by people associated with the regional center. At Actun Halal, only 22 percent of subsurface Late Classic types are Mount Maloney Black. The low frequency of Mount Maloney Black is also evident in surface collections. Helmke (Griffith and Helmke 1999:104) reports only four Mount Maloney rim sherds (17 percent) out of a total of 24 Late Classic diagnostic rims.

There could be two explanations for this pattern. First, it could be argued that Actun Halal sits near a boundary on the landscape between valley and upland populations. Actun Halal might have seen shifting usage by competing groups as populations and power shifted during the Late Classic period, thus giving the Late Classic assemblage a mixed appearance. Gyles Iannone (personal communication, 2006) suggests that ceramic assemblages from the nearby Vaca Plateau site of Minanha contain more brown-slipped Pine Ridge Carbonate wares than black, and in general, are more similar to Late Classic Caracol complexes than those from Xunantunich (Iannone 2005). It is also possible that the kinds of activities that occurred in the cave were not analogous to those occurring at Chechem Ha or Xunantunich during the Late Classic, thereby skewing the types that make up of the rockshelter assemblage. Chechem Ha is a dark cave, most likely associated with ritual activities (Moyes 2006) and/or long-term storage, whereas Actun Halal is an open rockshelter more appropriate for short-term use. Xunantunich was the largest regional center in the area, where the full range of political, social and economic activities occurred. A brief analysis of forms might lend evidence to address this question.

Ceramic Forms and Activity Sets

A total of 65 specific vessel forms are identified from rim sherds derived from all excavated proveniences within Actun Halal (Table B-3). Jars are the most dominant form (n=35; 54 percent). Bowls are next most common vessels (n=18; 28 percent) followed by ritual forms (n=4; 6 percent), vases (n=5 percent), and serving vessels (n=2; 3 percent).

Because jars are more common than expected, I will discuss them at more length than the other forms. Most jars are Uaxactun or Tumbac wares, but there are a few finer slipped types such as Gales Creek Red. Uaxactun ware jars, such as Cayo Unslipped Type, are generally associated with large open-mouthed storage vessels and Tumbac ware jars, such as Chan Pond, Negroman, or Macaw Bank are smaller vessels with short and wide-necks. Tumbac is a coarse brown ware that contains substantial amounts of sand, in addition to igneous inclusion and micaceous flecks (see Gifford 149-152; LeCount 1996:381-383). Given the composition of the paste and the presence of sooting, I have suggested that Late Classic Tumbac ware jars at Xunantunich might have been cooking vessels. Therefore, it is quite interesting that Tumbac ware sherds make up more than 10 percent of the Actun Halal assemblage (n=162). Moyes also reports substantial amounts of Tumbac ware at Chechem Ha Cave, where it represents 22 percent of all vessels.

At this point, is it difficult to determine why there are so many Tumbac jars in these two caves. Maybe cooking and storage was a common activity in the cave. But the high frequency of Tumbac ware in the cave also might be a function of the production location of these jars. Certainly the clays in the Vaca Plateau contain higher frequencies of igneous rock, mica and sandy. And it is entirely possible that Tumbac ware was produced somewhere close by. A third possibility that might explain the high frequency of coarse brown ware has more to do with temporal patterns than function or production. James Gifford places Tumbac ware within the Floral Park complex of the Terminal Preclassic period. Therefore, these jars might represent a substantial Terminal Preclassic period use of the cave. However, I have consistently found Late Classic examples of similar sandy ware at Xunantunich, and therefore, some of the Actun Halal sandy jars might date to the Classic period.

The Actun Halal formal assemblage can be compared to those from domestic contexts at Xunantunich. Jars are more common at Actun Halal than recorded for domestic contexts at Xunantunich. The emphasis on storage, and possibility cooking, at Actun Halal is also seen at Chechem Ha cave where Moyes reports that nearly 69 percent of all vessels are jars (2006:Appendix 3, table 1). On the other hand, bowls represent a smaller portion of the cave assemblage than found at Xunantunich. At Actun Halal, only

27.7 percent of vessels are bowls, whereas 38.6 percent of vessels at Xunantunich are bowls. Likewise, vessel forms associated with feasting, such as plates, dishes, and vases make up a smaller percentage of forms at Actun Halal (n=5; 8 percent) than domestic contexts at Xunantunich (n=261; 12 percent). Ritual vessels encountered at Actun Halal consist of two miniature pots and two effigy vessel fragments. No censers were found.

Although it is difficult to generalize about the activities performed at Actun Halal based on such a small sample size, it does appear that something very different might have been taking place in the rockshelter than in households at Xunantunich. It could be hypothesized that activities performed in Actun Halal revolved more around storage than "typical" food preparation and feasting. This set of activities might explain why Mount Maloney Black types, which are most often bowls and water-carrying jars, are lower in frequency than expected, and Tumbac ware jars, which might be cooking or storage containers, are more common. These ideas are tentative and require further testing.

Conclusions

In sum, the subsurface ceramics of Actun Halal represent occupation of the cave from the Middle Preclassic through Late Classic periods, although ephemeral Terminal Classic period use cannot be ruled out. Ceramic wares, groups, and types are typical of the Belize valley. Nevertheless, some differences are noted, such as the higher than expected frequency of Tumbac ware and lower than expected frequency of Mount Maloney group sherds. Jars are over-represented, whereas bowls are under-represented when Actun Halal forms are compared to those from Xunantunich. Most likely this difference is due to a different set of activities performed in the cave as compared to domestic contexts.

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Table B-1. Ceramic recoveries from all unit-levels at Actun Halal, 2006 season.

	Eroded/ encrusted		Surface present		Ash (unspecified)		Peten Gloss		Pine Ridge Carbonate		Tumbac [a]		Holmul [b]		Waxy [c]		Mars Orange		Gale Creek		Uaxactun		Calcite (unspecified)		Totals	Ceramic Groups
Unit	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
N101 E127																										
Lv. 1	2	.40	3	.60	-	-	-	-	2	.40	1	.20	-	-	-	-	-	-	-	-	-	-	2	.40	5	None identified
Lv. 2	94	.82	20	.18	-	-	-	-	2	.02	10	.09	-	-	-	-	-	-	-	-	9	.08	93	.82	114	None identified
Lv. 3	7	.33	14	.67	-	-	-	-	4	.19	10	.48	-	-	-	-	-	-	-	-	-	-	7	.33	21	None identified
Lv. 4	18	.90	2	.10	-	-	-	-	1	.05	1	.05	-	-	-	-	5	.25	-	-	-	-	13	.65	20	None identified
Lv. 5	4	.80	1	.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	.20	4	.80	5	None identified
totals	129	.76	40	.24					9	.05	22	.13					5	.03			10	.06	123 [d]	.73	169	
N97 E118																										
Lv. 1	57	.49	60	.51	-	-	-	-	13	.11	12	.10	-	-	-	-	-	-	-	-	35	.30	57	.49	117	Dolphin Head (1)
Lv. 2	25	.44	32	.56	-	-	1	.02	9	.16	9	.16	-	-	-	-	-	-	-	-	13	.23	25	.44	57	Mount Maloney (1), Teakettle (1)
Lv. 3	20	.46	24	.54	2	.05	-	-	5	.11	11	.25	-	-	-	-	-	-	-	-	3	.07	23	.52	36	Belize (1), Mt. Pine (1), Fowler (1)
Lv. 4	15	.31	33	.69	-	-	-	-	2	.04	-	-	-	-	-	-	-	-	-	-	31	.65	15	.32	50	Stumped Creek (1)
Lv. 5	1	1.00	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1.00	1	None identified
totals	118	.44	149	.56	2	.01	1	<.01	29	.11	32	.12	-	-	-	-	-	-			82	.31	121	.45	267	
N97 E119																										
Lv. 1	55	.86	9	.14	-	-	1	.02	1	.02	2	.03	-	-	-	-	-	-	-	-	5	.08	55	.86	65	None identified
Lv. 2	26	.23	86	.77	-	-	-	-	6	.05	17	.15	-	-	-	-	-	-	-	-	60	.54	29	.26	112	Mount Maloney (1)
Lv. 3	16	.32	34	.68	-	-	-	-	3	.06	7	.14	-	-	-	-	-	-	-	-	20	.40	20	.40	50	Dolphin Head (1), Zibal (1)
Lv. 4	6	.50	6	.50	1	.08	-	-	1	.08	-	-	-	-	-	-	-	-	-	-	5	.42	5	.42	12	Belize (1)
Lv. 5	4	.50	4	.50	-	-	-	-	-	-	1	.13	-	-	-	-	-	-	-	-	3	.38	4	.50	8	
Lv. 14	2	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.00	2	
totals	109	.44	140	.56	1	<.01	1	<.01	11	.04	27	.11									94 [c]	.38 [c]	75		249	
N96 E98																										
Lv. 1	16	.62	10	.38	-	-	-	-	2	.08	3	.12	-	-	-	-	-	-	-	-	5	.19	16	.62	26	Mount Maloney (1)
Lv. 2	48	.87	7	.13	1	.02	1	.02	2	.04	2	.04	-	-	-	-	-	-	-	-	3	.06	46	.84	55	Chunhuitz (1)
Lv. 3	12	.43	16	.57	-	-	-	-	-	-	5	.18	-	-	-	-	1	.04	1	.04	4	.14	16	.62	27	Vaquero Creek (1)
Lv. 4	5	.56	4	.44	-	-	-	-	1	.11	-	-	-	-	-	-	-	-	1	.11	-	-	7	.78	10	Vaquero Creek (1)
totals	81	.69	37	.31	1	.01	1	.01	5	.04	10	.09					1	.01	2	.02	12	.11	85	.72	118	
N96 E99																										
Lv. 1	34	.71	14	.29	1	.02	-	-	2	.04	-	-	-	-	-	-	-	-	-	-	12	.25	33	.69	48	None identified
Lv. 2	47	.54	40	.46	-	-	-	-	5	.06	8	.09	-	-	-	-	-	-	-	-	26	.30	48	.55	87	Mount Maloney (1)
Lv. 3	23	.45	28	.55	1	.02	1	.02	1	.02	3	.06	-	-	-	-	-	-	-	-	18	.36	27	.53	51	Dos Arroyos (1), Stumped Creek (1)
Lv. 4	15	.25	45	.75	1	.02	1	.02	8	.13	14	.23	-	-	7	.12		-	-	-	13	.22	16	.27	60	Dos Arroyos (1), Sierra (6), Sotero (1)
Lv. 5	1	.33	2	.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	.33	2	.67	3	None identified
Lv. 8	0		2	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.00	-	-	2	None identified
totals	120	.48	131	.52	3	.01	2	.01	16	.06	25	.10			7	.03					72	.29	126	.50	251	
N97 E98																										
Lv. 1	23	.72	9	.28	-	-	-	-	-	-	6	.19	-	-	-	-	-	-	-	-	2	.06	24	.75	32	Zibal (1)

Lv. 2	15	.75	5	.25	-	-	-	-	-	-	4	.20	-	-	-	-	-	-	-	-	1	.05	15	.75	20	None identified
Lv. 3	11	.79	3	.21	-	-	-	-	1	.07	2	.14	-	-	-	-	-	-	-	-	-	-	11	.79	14	Garbutt (1)
Lv. 4	14	.74	5	.26	-	-	-	-	1	.05			-	-	-	-	-	-	-	-	3	.16	15	.79	19	Sotero (1)
totals	63	.74	22	.26					2	.02	12	.14									6	.07	65	.77	85	
N97 E99																										
Lv. 1	2	.40	3	.60	-	-	-	-	1	.20	-	-	-	-	-	-	-	-	-	-	2	.40	2	.40	5	None identified
Lv. 2	16	.59	11	.41	1	.04	-	-	-	-	2	.07	-	-	-	-	-	-	-	-	8	.30	16	.59	27	None identified
Lv. 3	18	.30	42	.70	-	-	-	-	7	.12	9	.15	-	-	-	-	-	-	-	-	27	.45	17	.28	60	None identified
Lv. 4	31	.42	43	.58	-	-	-	-	4	.05	8	.11	-	-	-	-	-	-	-	-	25	.34	37	.50	74	None identified
Lv. 5	14	.22	51	.78	1	.02	2	.03	-	-	11	.17	1	.02	1	.02			1	.02	16	.25	32	.49	65	Belize (1), Dos Arroyos (2), Vaquero Creek (1), Guacamallo (1), Sierra (1)
Lv. 6	0		3	1.00	-	-	-	-	1	.33	-	-	-	-	-	-	-	-	-	-	2	.67	-	-	3	None identified
totals	81	.35	153	.65	2	.01	2	.01	13	.06	30	.13	1	<.01	1	<.01			1	<.01	80	.34	104	.44	234	
N98 E98																										
Lv. 1	8	.80	2	.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	.20	8	.80	10	None identified
Lv. 2	45	.73	17	.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	.24	47	.76	62	Cayo (4)
Lv. 3	31	.72	12	.28	1	.02	-	-	1	.02	1	.02	-	-	-	-	2	.05	-	-	10	.23	28	.65	43	None identified
totals	84	.73	31	.27	1	.01			1	.01	1	.01					2	.02			27	.23	83	.72	115	
N98 E99																										
Lv. 1	2	.67	1	.33	-	-	-	-	1	.33	-	-	-	-	-	-	-	-	-	-	1	.33	1	.33	3	None identified
Lv. 2	5	.36	9	.64	-	-	-	-	-	-	-	-	-	-	2	.14	1	.07	-	-	6	.43	5	.36	14	Savana (1)
Lv. 3	10	.36	18	.64	-	-	-	-	-	-	2	.07	-	-	1	.04	-	-	-	-	15	.54	10	.36	28	Sierra (1)
Lv. 4	4	.50	4	.50	-	-	-	-	-	-	-	-	1	.13	2	.25	-	-	-	-	1	.13	4	.50	8	None identified
Lv. 5	1	.25	3	.75	-	-	-	-	-	-	1	.25	-	-	-	-	-	-	-	-	2	.50	1	.25	4	None identified
totals	22	.39	35	.61					1	.02	3	.05	1	.02	5	.09	1	.02			25	.44	21	.37	57	

[a] Tumbac: characterized by brown vessels with hard grainy surfaces. Not restricted to those types designated by Gifford (1976:149) and includes Late Classic Macaw Bank Group (LeCount 1996:381-383) and possibly some body sherds associated with more sandy versions of Jocote Orange-brown.

[b] Holmul ware is poorly defined, but here is used to refer to sherds that display diagnostic modes reflective of Gifford's Floral Park Complex.

[c] Waxy: includes both Paso Caballo and Flores wares.

[d] Number: includes sherds from the profile

Table B-2. Ceramic Type-varieties by provenience.

Provenience	Ceramic Type	Variety	Form	Decoration	number
N97E119L4	Belize Red	Unknown	body	slipped	1
N97E99L5	Belize Red	Unknown	vase base	slipped and post-fire incised	1
N97E118L3	Belize Red	Platon punctuated-incised	dish rim	slipped and punctated	1
N98E98L2	Cayo Unslipped	Unspecified	jar rim	none	4
N96E98L2	Chunhuitz Orange	Benque Viejo Polychrome	body	slipped and painted	1
N97E119L3	Dolphin Head Red	Dolphin Head	bowl rim	slipped	1
N97E118L1	Dolphin Head Red	Dolphin Head	plate rim	slipped	1
N96E99L3	Dos Arroyos Orange-polychrome	Unknown	body	slipped and painted	1
N96E99L4	Dos Arroyos Orange-polychrome	Unknown	body	slipped and painted	1
N97E99L5	Dos Arroyos Orange-polychrome	Unknown	body with basal flange	slipped and painted	2
N97E118L3	Fowler Orange-red	Unknown	bowl rim	slipped	1
N97E99L5	Vaquero Creek Red	Unspecified	jar rim	slipped	1
N96E98L3	Vaquero Creek Red	Unspecified	jar rim	slipped	1
N96E98L4	Vaquero Creek Red	Unspecified	jar rim	slipped	1
N97E98L3	Garbutt Creek Red	Unknown	body	slipped	1
N97E99L5	Guacamallo Red-on-orange	Unknown	body	slipped and painted	1
N96E98L1	Mount Maloney Black	LCII	bowl rim	slipped	1
N96E99L2	Mount Maloney Black	LCII	bowl rim	slipped	1
N97E118L2	Mount Maloney Black	LCII	bowl rim	slipped	1
N97E119L2	Mount Maloney Black	Unspecified	bowl rim	slipped	1
N97E118L3	Mountain Pine Red	Unknown	bowl rim	slipped	1
N98E99L3	Quacco Creek Red	Quacco Creek Red	bowl rim	slipped	1
N98E99L2	Savana	Reforma Incised	rim	slipped and incised	1
N96E99L4	Sierra Red	Unspecified	rim	slipped and incised	2
N97E99L5	Sierra Red	Unspecified	rim	slipped	1
N96E99L4	Sotero Red-brown	Sotero	rim	slipped	1
N97E98L4	Orange-walk Incised	Orange-walk	vase rim	slipped and incised	1
N96E99L3	Stumped Creek Striated	Stumped Creek	body	notched fillet	1
N97E118L4	Stumped Creek Striated	Stumped Creek	body	notched fillet	1
N97E118L2	Teakettle Bank Black	Teakettle Bank	bowl rim	slipped	1
N97E119L3	Zibal Unslipped	Unspecified	jar rim	none	1
N97E98L1	Zibal Unslipped	Unspecified	jar rim	none	1

Table B-3. Comparison of primary forms from all lots at Actun Halal and Xunantunich domestic contexts.

Site	Plates & Dishes		Bowls		Vase		Jar		Ritual forms		Other		total
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Actun Halal	2	3.1	18	27.7	3	4.6	35	53.8	4	6.2	1	1.5	65
Chechem Ha	62	11.0	107	19.0	2	0.3	387	68.7	4	0.7	1	0.2	563
Xunantunich	227	6.0	1459	38.6	234	6.1	1612	42.6	118	3.1	136	3.6	3786

Ritual forms include censers, drums, lip to lip vessels, miniature vessels, and candelarios.
Other: Closed ollas, lids, tecomates, and other odd forms.

APPENDIX C

ANALYSIS OF FOSSIL POLLEN FROM ACTUN HALAL, BELIZE

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A total of 11 sediment samples from Actun Halal, a cave site in western Belize, were processed and examined for fossil pollen content. This site, located south of San Ignacio in the Cayo District, has significant time depth and the deposits are thought to span Paleoindian, Archaic, and Maya times, making this site one of the few locations in Belize featuring stratified deposits spanning these poorly understood time periods. The Paleoindian and Archaic periods in Belize are particularly poorly studied, and it was recognized that any paleobotanical information that could be gained from this study could be of major significance.

Samples were selected for analysis based on provenience and the likelihood of producing usable pollen counts. It was anticipated that a detailed study of any recovered fossil pollen grains would shed light on past environmental conditions in the region and prehistoric subsistence patterns and may offer additional insights into past agricultural activities. Further, as caves figure prominently in Maya mythology, changes in economic activities between Archaic and Maya times might reflect patterns of cultural continuity or discontinuity. Pollen samples selected for this study are presented in Table C-1.

Table C-1. Pollen Provenineces from Actun Halal, Belize

Lab #	Sample #	Depth	Provenience		Preservation
1	1117-14	97.66-97.76	N97 E119,	Sample 12, Bag 6	good
2	1117-13	97.56-97.66	N97 E119,	Sample 13, Bag 3	good
3	1117-12	97.46-97.56	N97 E119,	Sample 12, Bag 7	good
4	1117-11	97.36-97.46	N97 E119,	Sample 11, Bag 4	good
5	1117-10	97.26-97.36	N97 E119,	Sample 10, Bag 8	good
6	1117-9	97.16-97.26	N97 E119,	Sample 9, Bag 5	good
1A	1117-4	96.66-96.76	N97 E119,	Sample 4	poor
2A	1117-2	96.46-96.56	N97 E119,	Sample 2	poor
9	1023-3-B	97.40-97.30	N97 E119,	Sp. 3, L-5	unanalyzed
10	1046-B	97.20-97.15	N97 E119,	Sp. 4, L-8	unanalyzed
11	1053-3-B	97.15-97.10	N97 E119,	Sp. 3, L-9	unanalyzed

Methodology

The Actun Halal pollen samples were first quantified (5mls), placed in sterile beakers, and a known quantity of exotic tracer spores was added to each sample. Here, European *Lycopodium* spp. spores were chosen as an exotic, because these spores are unlikely to be found in the actual fossil pollen assemblages from this region. Tracer spores are added to samples for two reasons. First, by adding a known quantity of exotic spores to a known quantity of sediment, fossil pollen concentration values can be calculated. Second, in the event that no fossil pollen is observed in the sediment sample, the presence of *Lycopodium* tracer spores verifies that processor error was not a factor in the pollen loss.

Following the addition of the tracer spores, the samples were washed with concentrated hydrochloric acid. This step removed carbonates and dissolved the bonding agent in the tracer spore tablets. The samples were then rinsed in distilled water, sieved through 150 micron mesh screens, and swirled to remove the heavier inorganic particles. Next the samples were consolidated, and 50% hydrofluoric acid was added to the residues to remove unwanted silicates. Following this step, the samples were carefully rinsed until all acid had been removed.

Next, the samples were dehydrated in glacial acetic acid, and were subjected to an acetolysis treatment (Erdtman 1960) consisting of 9 parts acetic anhydride to 1 part concentrated sulfuric acid. During this process, the samples were placed in a heating block for a period not exceeding 8 minutes. This step removed most unwanted organic materials, including cellulose, hemi-cellulose, lipids and proteins, and converted these materials to water-soluble humates. The samples were then rinsed in distilled water until a neutral pH was achieved.

Following this treatment, the samples were next subjected to a heavy density separation using zinc chloride (Sp.G. 2.00). Here, the lighter organic fraction was isolated from the heavier minerals. After this treatment, the lighter pollen and organic remains were collected and washed in 1% KOH to remove any remaining humates. The residues were then dehydrated in absolute alcohol, and transferred to a glycerine medium for curation in glass vials.

Permanent slides were prepared using glycerine as a mounting medium, and identifications were made on a Nikon compound stereomicroscope at 400-1000x magnification. Identifications were confirmed by using the Palynology Laboratory's extensive pollen reference collection. Minimum 200-grain counts, standard among most palynologists (Barkeley 1934), were made for each sample when pollen was preserved in the sediments. 200-grain counts are thought to be fairly reflective of past vegetation and paleoenvironmental conditions.

Concentration values were calculated for all samples. Hall (1981) and Bryant and Hall (1993) note that concentration values below 2,500 grains/ml of sediment may not be well reflective of past conditions, and usually record a differentially preserved assemblage. As a result, counts with low concentration values should be viewed with caution.

Results

Well-preserved fossil pollen was identified in six samples (Samples 1-6) dating to the Archaic and Early to Middle Preclassic periods. Two deeper samples thought to date to either earliest Archaic or Paleoindian Periods (Samples 1A and 2A) were largely barren of fossil pollen, although a few poorly preserved grains and fragments were noted. These grains were heavily oxidized and were unidentifiable, indicating that further pollen analysis from these deposits is not possible. Three samples have been processed but remain unanalyzed.

Generally, pollen was in fairly good shape although preservation seemed to improve as the samples moved up the profile. Concentration values ranged from 3031 to 119448 fossil grains/ml of sediment, values considered to be acceptable for counting although it should be noted that values around 3000 are fairly low and probably signal that some form of differential preservation has occurred. A total of 49 different taxa were identified in the Actun Halal sediment samples, and included arboreal or forest elements, disturbance and weedy types, and cultigens and potential economics. Pollen counts and percentages are presented in Table C-2.

Table C-2. Pollen Counts and Percentages from the Actun Halal Sediment Samples

Taxon		**Sample**	
	1117-9	**1117-10**	**1117-11**
Acalypha	1 (0.5)		
Asteraceae	49 (24.5)	63 (31.5)	55 (27.5)
Borreria	1 (0.5)		
Cheno-Am	1 (0.5)	6 (3.0)	1 (0.5)
Convolvulaceae	21 (10.5)	8 (4.0)	36 (18.0)
Croton	3 (1.5)	1 (0.5)	1 (0.5)
Cyperaceae	2 (1.0)	3 (1.5)	3 (1.5)
Fabaceae	2 (1.0)	4 (2.0)	3 (1.5)
Gossypium			1 (0.5)
Lamiaceae			1 (0.5)
Malvaceae		1 (0.5)	
Poaceae	24 (12.0)	12 (6.0)	12 (6.0)
Polygonaceae	2 (1.0)	2 (1.0)	1 (0.5)
Solanaceae	1 (0.5)	2 (1.0)	1 (0.5)
Zea mays	1 (0.5)		
Anacardiaceae	1 (0.5)	5 (2.5)	1 (0.5)
Arecaceae	5 (2.5)	1 (0.5)	2 (1.0)
Bursera	1 (0.5)		1 (0.5)
Cassia	2 (1.0)		2 (1.0)
Cecropia		1 (0.5)	
Coccoloba	27 (13.5)	24 (12.0)	9 (4.5)
Combretaceae	9 (4.5)	13 (6.5)	11 (5.5)
Dorstenia		2 (1.0)	
Hirea	1 (0.5)	1 (0.5)	2 (1.0)
Ilex		1 (0.5)	
Machaerium	1 (0.5)	2 (1.0)	2 (1.0)
Maytenus			1 (0.5)
Metopium	1 (0.5)	1 (0.5)	2 (1.0)
Mimosa		1 (0.5)	
Moraceae	5 (2.5)	9 (4.5)	5 (2.5)
Myrtaceae	2 (1.0)		1 (0.5)
Pinus	3 (1.5)	3 (1.5)	6 (3.0)
Podocarpus	1 (0.5)	1 (0.5)	
Quercus	1 (0.5)	3 (1.5)	3 (1.5)
Rhizophoraceae			1 (0.5)
Salix			1 (0.5)
Sapotaceae	3 (1.5)	2 (1.0)	
Sebastiana			1 (0.5)
Spondias	4 (2.0)		2 (1.0)
Zanthoxylum			2 (1.0)

Unknown A			1 (0.5)
Unknown P	4 (2.0)	7 (3.5)	9 (4.5)
Indeterminate	21 (10.5)	21 (10.5)	20 (10.0)
Total	**200 (100)**	**200 (100)**	**200 (100)**
Concentration Value	**3583**	**3031**	**4688**

Table C-2, Continued

Taxon		**Sample**	
	1117-12	**1117-13**	**1117-14**
Acalypha		1 (0.5)	1 (0.5)
Alismataceae	1 (0.5)		
Asteraceae	97 (47.8)	86 (43.0)	1 (0.5)
Cheno-Am	1 (0.5)		1 (0.5)
Convolvulaceae	12 (5.9)	11 (5.5)	9 (4.5)
Croton		2 (1.0)	
Cyperaceae	3 (1.5)	3 (1.5)	2 (1.0)
Euphorbiaceae			1 (0.5)
Fabaceae	4 (2.0)	2 (1.0)	2 (1.0)
Malvaceae	1 (1.0)		
Poaceae	8 (3.9)	3 (1.5)	5 (2.5)
Polygonaceae	3 (1.5)	2 (1.0)	
Solanaceae	3 (1.5)		2 (1.0)
Zea mays	4 (2.0)	1 (0.5)	
Alchornea			1 (0.5)
Anacardiaceae	3 (1.5)	1 (0.5)	
Arecaceae	2 (1.0)	3 (1.5)	12 (6.0)
Bursera		1 (1.0)	2 (1.0)
Cecropia	1 (0.5)		4 (2.0)
Chrysophyllum	1 (0.5)	4 (2.0)	
Coccoloba	14 (6.9)	15 (7.5)	46 (23.0)
Combretaceae	6 (3.0)	22 (11.0)	26 (13.0)
Cupressaceae	1 (0.5)		
Gymnopodium			1 (0.5)
Hirea	1 (0.5)	4 (2.0)	1 (0.5)
Machaerium	1 (0.5)	2 (1.0)	2 (1.0)
Maytenus			1 (0.5)
Metopium	1 (0.5)	3 (1.5)	2 (1.0)
Moraceae	7 (3.4)	4 (2.0)	19 (9.5)
Myrica	1 (0.5)		
Myrtaceae	1 (0.5)		
Pinus	6 (3.0)	11 (5.5)	11 (5.5)
Podocarpus			2 (1.0)

Quercus	3 (1.5)	2 (1.0)	3 (1.5)
Rhizophoraceae			2 (1.0)
Salix		2 (1.0)	3 (1.5)
Sapindaceae			2 (1.0)
Sapotaceae	3 (1.5)		2 (1.0)
Sebastiana			3 (1.5)
Spondias		1 (0.5)	
Zanthoxylum			8 (4.0)
Unknown A		1 (0.5)	1 (0.5)
Unknown P	4 (2.0)	4 (2.0)	4 (2.0)
Unknown Z			2 (1.0)
Indeterminate	10 (4.9)	9 (4.5)	16 (8.0)
Total	**203 (100)**	**200 (100)**	**200 (100)**
Concentration Value	**5118**	**11,533**	**119,448**

Discussion

Surprisingly, the two dominant taxa in the Actun Halal pollen samples represent disturbance or open-area taxa. Asteraceae (Compositae or Aster Family) and Poaceae (Grass Family) were the dominant pollen types identified in most samples. While these plant families are widespread in terms of their preferred habitats, they are most commonly encountered in disturbed areas. In Belize particularly, large quantities of these types signals a disturbed environment (Jones 1994). Additional taxa found in reduced numbers in the Actun Halal samples that are normally associated with disturbance include *Borreria* and Cheno-Ams (goosefoot, pigweed).

Arboreal or forest taxa were also fairly common in the Actun Halal sequence. Important taxa include *Coccoloba* (bob), Combretaceae (probably mostly pucte, bullet tree), Moraceae (breadnut type) and *Pinus* (pine). Twenty one other arboreal pollen taxa were also noted in the Actun Halal samples.

Economic types were represented by pollen from *Zea mays* (maize) and *Gossypium* (cotton), found in four samples dating to the late Archaic period. Several pollen types, however, represent potential economic taxa and include Convolvulaceae (Morning Glory Family), *Coccoloba*, Sapotaceae (Sapote Family) and *Chrysophyllum* (star apple), *Spondias* (hog plum) and Arecaceae (Palm Family).

Pollen Sequence

Two distinct zones are represented, corresponding to Archaic and Early to Middle Preclassic and probable Late Preclassic deposits. The lowermost zone, occurring from 97.16 to 97.56m in elevation, shows an assemblage dominated by Asteraceae, Convolvulaceae and Poaceae types. These taxa indicate that the area around the cave was likely to have been heavily disturbed, probably for agricultural purposes. In fact, samples from 97.16, 97.46 and 97.56m all contained small percentages of maize pollen indicating that this crop was likely being cultivated near the cave. Alternatively, maize anthers could have been introduced into the cave for some form of activity. A single cotton pollen grain was identified in the sample from 97.36m. A ritual use for this plant may also be indicated as cotton pollen rarely leaves the fields in which it was grown as it is heavy and tends to stay in the flower unless removed by a pollinator.

The presence of large quantities of Convolvulaceae pollen is somewhat problematic, as these grains are also rarely found far from their flower. These grains are large, heavy and poorly dispersed, thus their presence in the Actun Halal samples may be significant. Some species of morning glory are hallucinogenic (Krochmal and Krochmal 1973), although it is not known if the flowers themselves have any economic value. As these flowers are large and showy, they could well represent items that were deliberately collected and introduced into the cave for some ritual purpose. Members of the Convolvulaceae family are insect pollinated and an alternative explanation is that insects that were pollinating these plants were eaten by bats. Pollen on these insects would have passed through the digestive tract of the bats, and could have been introduced in to the cave sediments when the bats defecated. The lack of appreciable quantities of other insect pollinated types, however, argues against this mode of deposition, and it seems likely that morning glory flowers or pollen were deliberately brought into the cave area by humans for some unknown reason.

The presence of notable quantities of *Coccoloba* pollen may also represent past human activity in the cave. *Coccoloba* fruit are edible, and may have served as a food source. Other potential foods represented in the pollen record from this zone include Sapotaceae, *Spondias*, and at the top of the zone, *Chrysophyllum*. All of these taxa would likely be found in the local flora of the region, and could also be parts of the natural pollen rain for the area, but as they are rarely encountered in the natural pollen rain in the region, their presence argues for a cultural use.

At 97.56m, there is a significant change in pollen types present in the profile. Here, there is a dramatic decrease in Asteraceae and Poaceae pollen, along with a corresponding increase in Arecaceae, *Coccoloba*, *Salix*, *Zanthoxylum*, *Metopium*, *Sebastiana* and *Cecropia*. Most of these taxa are non-economic parts of the local forest, and the pattern represented in the pollen record is one of reforestation of the region. While it is clear from archaeological excavations outside the cave that the Maya continued to farm in this area, it seems that they no longer brought economic plants into the cave area. Cultigens are wholly lacking in this uppermost sample.

Archaic Agriculture

It is clear from pollen studies throughout Belize, that agriculture was well-established in pre-Maya times. Pre-Maya maize pollen has been at the Cob Site dating to around 3000 BC (Pohl et al 1996), at Cobweb Swamp by around 2400 BC (Jones 1991, 1994), at Pulltrouser Swamp also around 2400 BC (Pohl et al 1996), and at an early but undated time near Santa Rosa in extreme northern Belize. At all of these locations, the type of maize pollen identified has been distinct from later maize types grown by the Maya. Maize occurring in pre-Maya context is generally smaller and thicker (45 to 90 microns) suggesting that a separate pattern of domestication or a separate source may be in play. Maize at Actun Halal, although dated at 2210BC and later, appears to represent the Maya-type, or morphologically modern maize, as these grains are large (85-120 microns) and fairly thin. What this means is not certain, but could suggest that different populations were farming different races of maize at an early date. Future research will shed more light on this fascinating but problematic area of study.

What is clear is that the uppermost sample in the Actun Halal pollen sequence is notably different than the earlier Archaic age samples. This indicates that the cave was being utilized in a different fashion at this point. The Archaic age pollen samples suggest people living in, or at least utilizing the cave for everyday (and possibly also ritual) purposes. There is no good evidence from the single uppermost sample, however, that people utilized this cave. Whether this suggests that the earlier occupants were related to the Maya remains to be demonstrated.

Summary

Eleven sediment samples from Actun Halal were examined for fossil pollen content. Fairly well preserved pollen was encountered in six samples, spanning Archaic to Preclassic times. Archaic deposits contain maize and cotton pollen and signal overall records an environment of disturbance near the cave area, probably for agriculture. Large quantities of normally rare Convolvulaceae pollen suggests that morning glory flowers or pollen was being introduced into the cave, possibly for ritual use. Other potential economic types are also present in the cave deposits, but are scarce.

A single Maya-age sample was also examined and paints a different picture. Here, cultigens are lacking and the pollen seems to suggest that the cave was not being utilized in the same fashion as in Archaic times.

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