GPR mapping to reconstruct a Late Classic Period Compound Wall, Chichen Itza, Mexico

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Abstract

Integrating a lidar relief map with GPR subsurface mapping, accompanied by locating known and inferred surface structures allowed for the reconstruction of a Late Classic Period walled compound. It was found that this enclosure is not perfectly rectangular, was partially dismanteled in the past, added on to in some places, and in some areas almost completely destroyed during the construction evolution of this city. The compound contained the Casa Colorada as its predominant temple within its walls, but also other structures of unknown function. In Post Classic time the compound walls were used as partial walls to new large buildings, while elsewhere the wall was almost completely removed to open up the area to a large plaza in front of the Observatory. The GPR analysis located the bases of some of the mostly-destroyed walls, and a spatial analysis of those defines the layout of one corner of the compound.

Introduction

The Chichen Itza site on the Yucatan Peninsula of Mexico is one of the country's most visited tourist locations, visited by thousands of people every day. It is billed as one of the ***7 Wonders of the New World*** by some, especially the Mexican tourist authorities. The city's dominant pyramid named the Castillo, which welcomes hoards of tourists, is the centerpiece of many posters and other advertising outreaches (Figure 1).

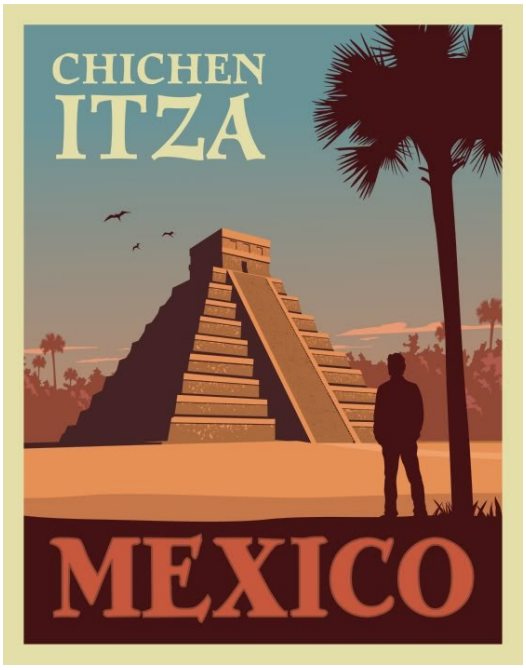


Figure 1: Mexican tourist poster featuring the dominant pyramid at the site (poorly named by 16th century Spanish as El Castillo "the castle").

South of much of the monumental architecture dominated by the El Castillo pyramid and surrounding it, are located a variety of interesting architectural features (Figure 2), some of which date to Late Classic time (generally from about AD 800-950). Some are visible on a lidar relief image of this area of the site, the most prominent being the temple named Casa Colorada (Figure 3) because of the red painting inside one of its rooms. This large structure was added on to in Post Classic time (after about AD 900) with a ball court abutting it to the east. Other Late Classic structures are the Deer House (Figure 4), Maudslay Temple (Figure 5) and the Observatory (Figure 6) (also named Caracol because of its dome on top that somewhat mimics the shape of a sea shell).

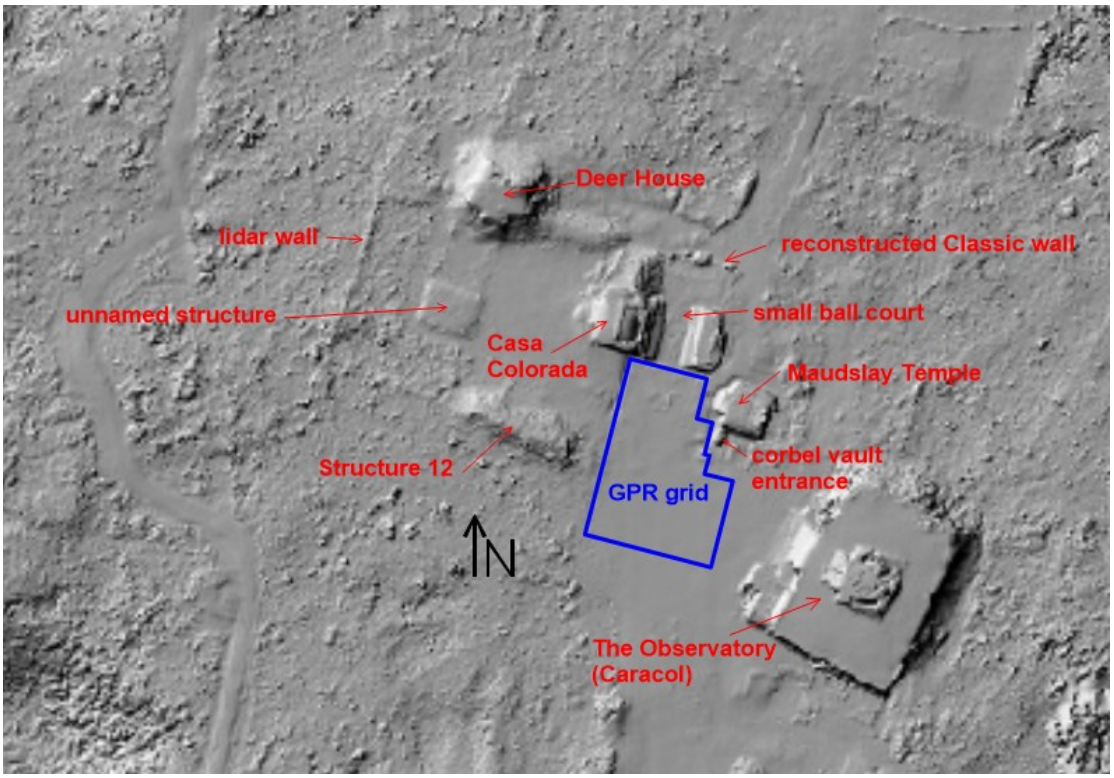


Figure 2: Base Map of the features of interest in this study placed on a lidar relief image with the location of the GPR grid.

Below I describe the important architectural features that play a role in this study. Most have been partially or totally reconstructed in the last 80 years by Mexican authorities. The focus in this study is on the compound, as these were features of Mayan cities that bounded important places, which were likely used or occcupied by prominent people. Their presence indicates they were features of exclusion to most of the Mayan population, and inclusion for those who were allowed inside. Within these precincts important rituals took place, which were the domain of the most elite of society (Marcus 2009).

Figure 3: The Casa Colorado is a large temple, which is Late Classic in age (left photo of the front pointing west). The sloping ball court (right photo) was added on to its eastern wall in Post Classic time.

Figure 4: The Deer House, which is mostly in ruins, contains a small temple on its summit, which at one time contained a deer sculpture, giving the structure its name.

Figure 5: The Maudslay Temple on the right with the eastern sloping platform of the ball court added to it.

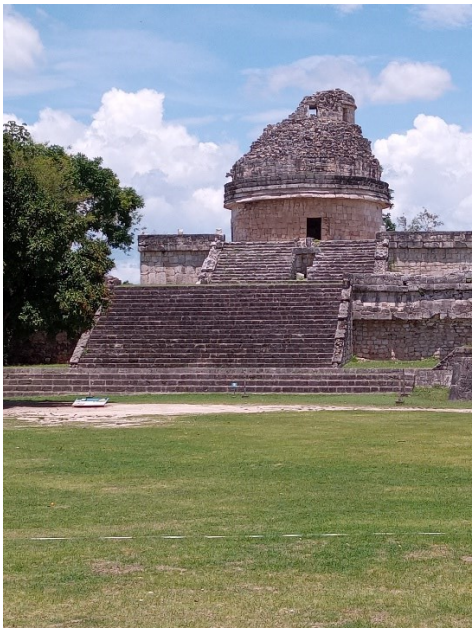


Figure 6: The Observatory (or Caracol), is a Post Classic structure with a large open plaza in front.

Other interesting features, which do not warrant much attention by tourists or the park authorities are important to this study. A wall (reconstructed recently by the park authorities) is north of the small ball court and inferred to be Late Classic in age (Figure 7). Another reconstructed wall, with a corbel vault (an arch constructed by layering stones so that each layer slightly extends inward, creating a supported opening without the need for a keystone), is just south of the Maudslay Temple (Figure 8). This interesting gate does not appear to connect to anything and is rarely commented on, but it was likely the entrance in the past to the walled compound, which is the focus of this work.

Figure 7: A reconstructed wall, which is about 2.5-3 meters in width, has a well defined corner. It is inferred to be Late Classic in age. It was constructed in Mayan times by creating outer walls of well-cut stones, placed in courses, filled by loose rubble and capped by other well-formed stones.

Figure 8: A corbel vaulted "gateway" reconstructed south of the Maudslay Temple, hopefully in the location where one existed in the past.

In this study I attempt to place these features into a chronology that starts in Late Classic time, extending through the transition into the dramatic building events that occurred at Chichen Itza in the Post Classic. While some of the features and buildings from Late Classic are still visible today, others remain in ruins, and a variety of others have been reconstructed. To study one area of the proposed Late Classic compound, a GPR grid was collected west of the Observatory and southeast of the Casa Colorada (Figure 2). This area today is a flat well-maintained grassy area, with a few trees along its permimiter (Figure 6).

Lidar mapping displayed in a gray-scale relief image shows all the features discussed above (Figure 2), but most interestingly a subtle wall on the west of the study area, with two well-formed corners. This area is largely inaccessible today, being overgrown with very dense vegetation. Within the possible enclosed area that is defined by lidar is Structure 12, which is un-excavated and of unknown age. Another square platform exists nearby, which is less than a meter high and was probably a structure or platform of some sort. It also remains unexcvated.

This lidar-defined wall to the west and the reconstructed wall (Figure 7) to the northeast appear to delineate three corners of a large rectalinear wall that enclosed the Casa Colorada (and likely other buildings), in Late Classic time. The way these structures and features annotated in Figure 2 may fit within or as part of this proposed walled compound is the focus of this research. In addition, placing known architecture, and other associated features withthose defined with GPR, can provide an evolution of the construction of important features at this part of the site, over about a 200-250 year period of time.

GPR data collection and analysis

Both 400 and 900 MHz reflection data were acquired using a GSSI SIR-3000 system at the site in June, 2025. Reflection profiles display well-defined reflections within a 50 ns time window for the 400 MHz data and 30 ns window with the 900 MHz. There is very little interference in the recorded data, and no post-collection processing was performed other than basic background-removal filters. An identical grid was used for both the 400 and 900 MHz reflection data, which was 40x56 meters in maximum dimension. Profiles were collected in both x and y, with the 400 MHz data collected in x and the 900 MHz in y. All profiles with both antennas were separated 50 cm.

Two-dimensional reflection profiles display a wide variety of very jumbled and random high amplitude reflections, which were likely generated by reflections from small stones and general rubble. There are concentrations of these stones in some areas, and in other locations only very fine-grained sediments exist, which generated few reflections of any amplitude. It is generally known from other areas of the site by excavation analysis (Brasswell and May 2014) that there was a re-organization of the city in early Post Classic time, where many Late Classic age buildings and other structures were torn down. Well formed stones were recycled in these events and used in Post Classic building projects, while the others were used as fill to level some areas and build platforms upon which the dominant structures are visible today.

When profiles of both frequencies are displayed, there are some very prominent non-random reflection features of interest (Figure 9). These are “stacked” planar reflections likely produced from layered flat stones used in retaining walls (as in Figure 7). Each course of stones generated a distinct planar reflection, and the reflections are stacked, over a vertical distance of a meter or less. These are likely

the retaining stones of the wall. Once identified in reflection profiles, they can be readily discovered in many of the two-dimensional reflection profiles in the GPR grid. They are not visible in standard amplitude maps, as the discreet walls produce reflections that appear much like those of the much more numerous random stones of the wall fill or the remains of the wall when it was partially dismanteled (Figure 10).

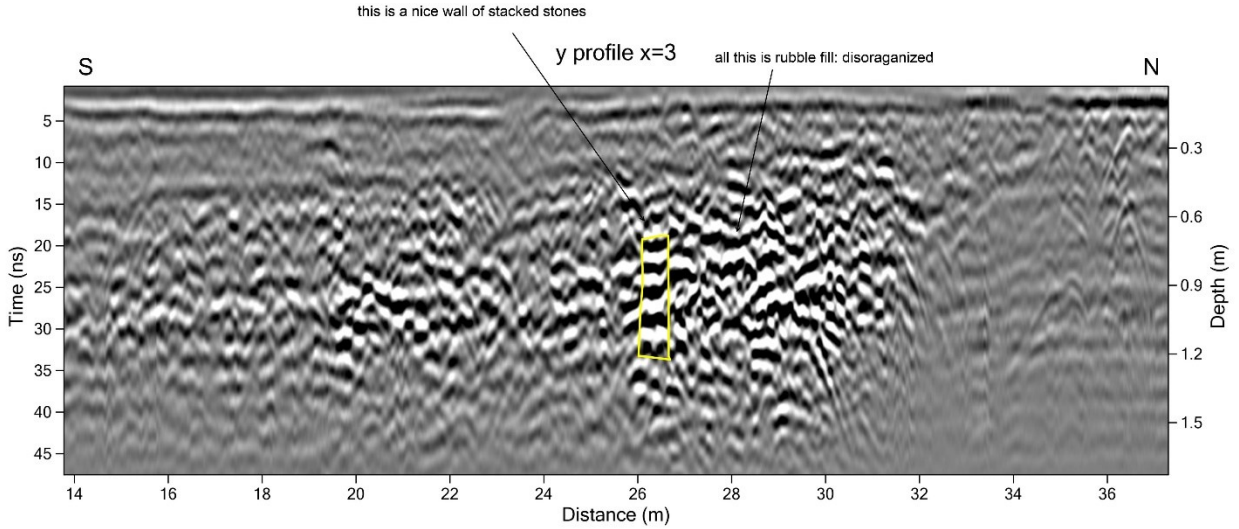
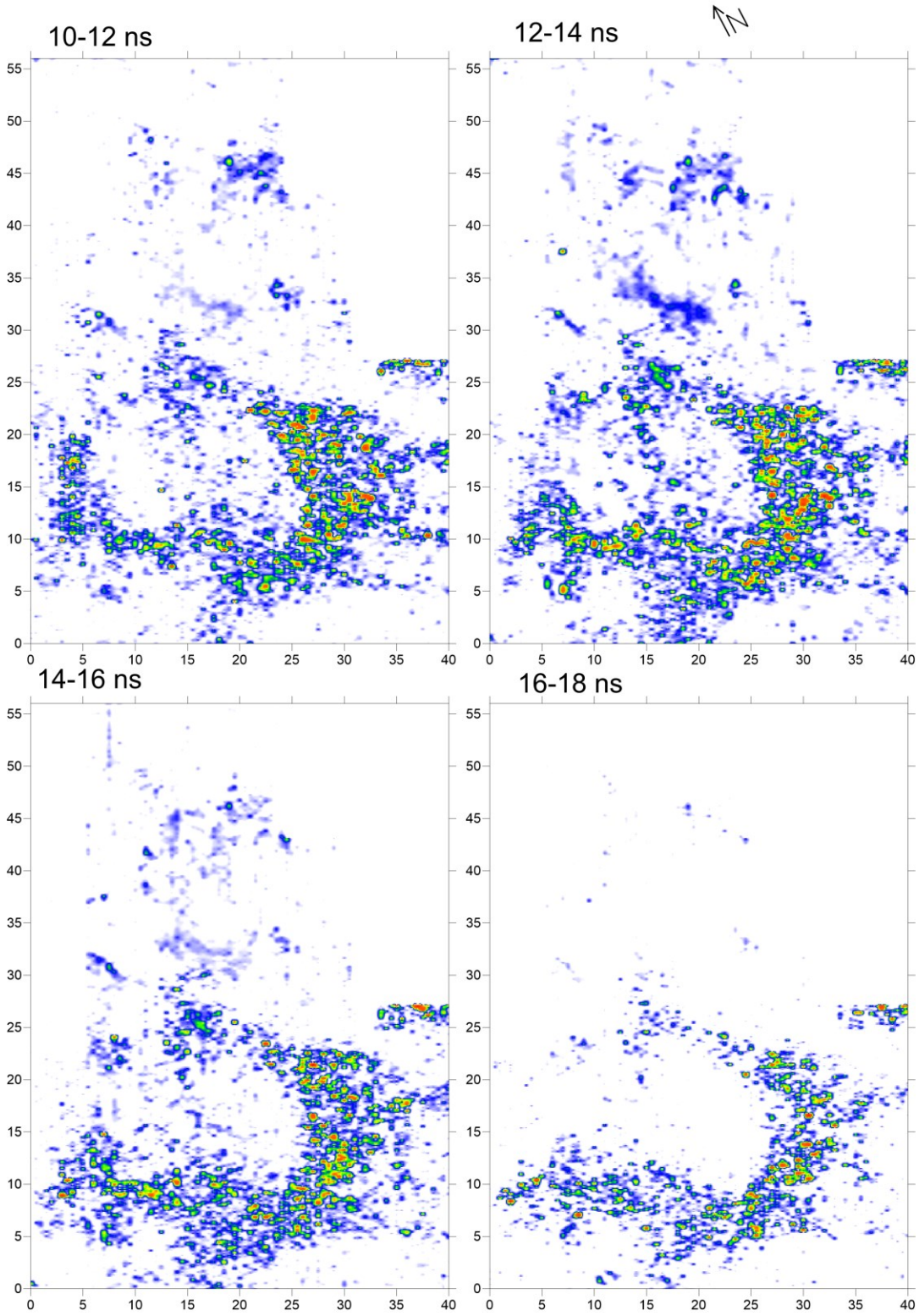


Figure 9: A two-dimensional 400 MHz reflection profile displaying the stacked reflections generated by courses of flat stones, surrounded by random reflections. The random reflections were generated by stones used as fill.

Using standard amplitude slicing methods, the 900 MHz reflections are displayed in the upper meter or so (Figure 10). While the patterns in these maps are moderately interesting, they did not display the intact walls visible in profiles, and no distinct linear trends were apparent in these maps without using a good deal of imagination. There appears to be a curve or perhaps a right angle of the higher amplitudes, which were initially interpreted as being the remains of what were linear walls or perhaps the corner of walls.



To produce a more accurate display of the small “wall segments” visible in profiles, within a very large volume of rubble fill, each profile was interpreted and the locations of stacked courses of stones were digitized. Any profile that displayed three or more courses of stone, no matter at what depth in the

rubble pile was assumed to be a wall and its location noted. The idea was that as the Late Classic walls and other structures were dismantled and then covered with fill during the Post Classic building phase, with a few wall segments remaining intact. These were then covered over with fill rubble. The ground was leveled on top of both the remains of the walls and the surrounding fill to produce a large plaza surface, similar to what exists today (Figure 6).

When the locations of all reflections that were interpreted as wall segments were placed on one of the amplitude maps, very distinct linear trends are apparent (Figure 11). Not all wall segments line up perfectly, as the wall was likely 2.5-3 meters in width (much like the reconstructed wall in Figure 7 just to the north). Sometimes one bounding wall was preserved in the reconstruction process, and sometimes a different one, producing a complex pattern. Wall segments were plotted using those identified in both the 400 and the 900 MHz profiles (Figure 11). The general line segments are interpreted as a dotted red line, with the individual walls discovered in profiles as black dots in Figure 11.

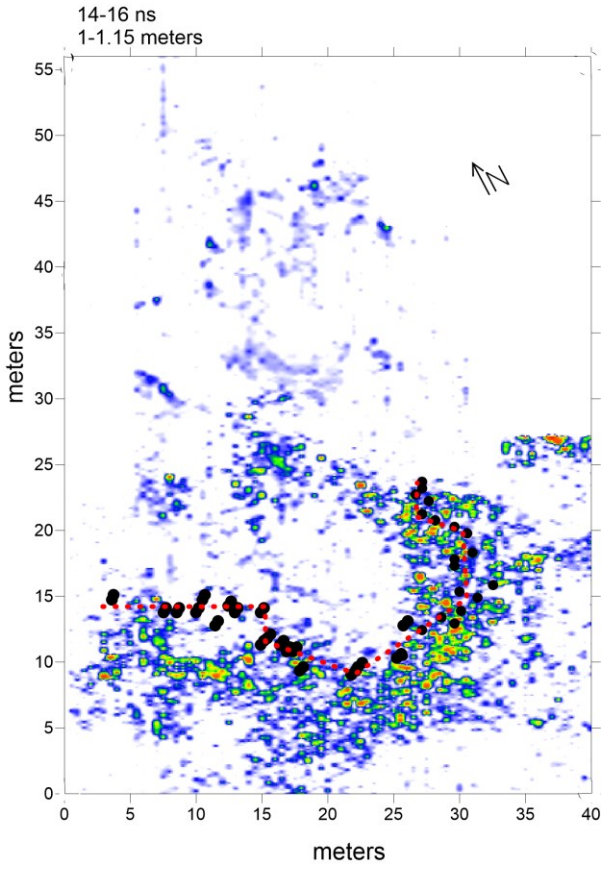


Figure 11: Black dots interpreted as wall segments are plotted on a 900 MHz amplitude map. The general linear trends are in red.

I had hoped that these walls would form a well-defined southeast corner of the compound wall with a right-angle like was visible in the lidar-defined wall to the west. They did not. The walls are still distinct, but the pattern of these intact walls is much more complicated. This will be discussed in greater detail below.

Once the compound walls had been partially delineated, other segments not immediately visible on the ground surface were hunted for. A portion of the wall connecting the reconstructed wall and the Deer House, is visible today as a wide elongated pile of stones (Figure 12). It can also be discerned as a raised area on the lidar relief image (Figure 2). This wall trends toward the Deer House but disappears in front of it under the stairs. That stairway leading to the top of the Deer House temple sits is directly on where the Late Classic wall would have been. It was likely dismantled here, and the stones used elsewhere.

Figure 12: Collapsed portion of the compound wall just east of the Deer House.

Moving around the compound wall to the west of Deer House, a similar collapsed wall is visible today, but its extent is soon lost in the vegetation growth to the west. It can be picked up in the lidar image there, and its corner is visible as the wall then trends to the south (Figure 2). Another corner is just barely visible in lidar (Figure 2) as the wall then projected back to the east toward the Observatory. Some of this wall is either hidden by or was incorporated within Structure 12 along its trajectory to the east. Structure 12 remains un-excavated and consists of mostly a pile of stone rubble. It is not known if Structure 12 existed in Late Classic, and would therefore have been within the compound, or was built in Post Classic and constructed up against the existing compound wall. Moving to the east from Structure 12 there is no indication on the ground surface or with any other data set of the wall until it is picked up by the GPR (Figure 11), perfectly aligned with the west edge of Structure 12.

The proposed compound wall corner in the northeast was that which was reconstructed recently (Figure 12) and its continuation south from that corner is not defined. The trend of the wall is to the west of Maudslay Temple, which aligns perfectly with the reconstructed wall that contains the corbel arch (Figure 8). If that wall, which adjoins the Maudslay Temple, was placed in the correct spot when it was re-built in the late 20th century, then it forms the east wall of the Late Classic compound. As the Maudslay Temple is Post Classic in age, it was likely built using a portion of the existing compound wall, incorporating it into its foundation structure.

This proposed wall projection orientation along the edge of Maudslay Temple means that the “stand alone” corbel vault (Figure 8), if accurately reconstructed, was probably the entrance or “gate” within the wall of the Late Classic compound.

To accurately depict what this Late Classic compound looked like about the year AD 900 or so, we must remove Maudslay Temple, Structure 12, Deer House and the ball court attached to Casa Colorada. The un-interpreted, and largely unknown square structure within the compound to the west, may or may have not been extant at that time. This leaves only the Casa Colorado within the defined compound walls, and it is known to date to the Late Classic. Perhaps it is best if we start discussing this compound as the Casa Colorada Compound, as that large temple structure was completely enclosed by the compound walls.

This leaves the unusual corner of the walls, as denoted with GPR on the southeast corner of the compound. A perusal of walls surrounding compounds, which have been mapped in other Mayan sites shows that they rarely have perfectly square corners and are often connected to buildings within them. This observation suggests that Structure 12, which adjoins the projected wall on the west may be this type of connected building.

This brings us back to the unusual wall orientation denoted by GPR on the southeast corner of the compound (Figure 13). If the entrance to the compound was through the corbel vault gateway, it would likely have been the only accessible entry point to this enclosure. The unusual configuration of the southeast corner, as defined with GPR can then be hypothesized as the foundations of a building that occupied that corner and was part of the Casa Colorada compound complex. Or it could have been a building that once stood in that location during Post Classic and was built adjoining the compound wall much like at Maudslay Temple and Deer House.

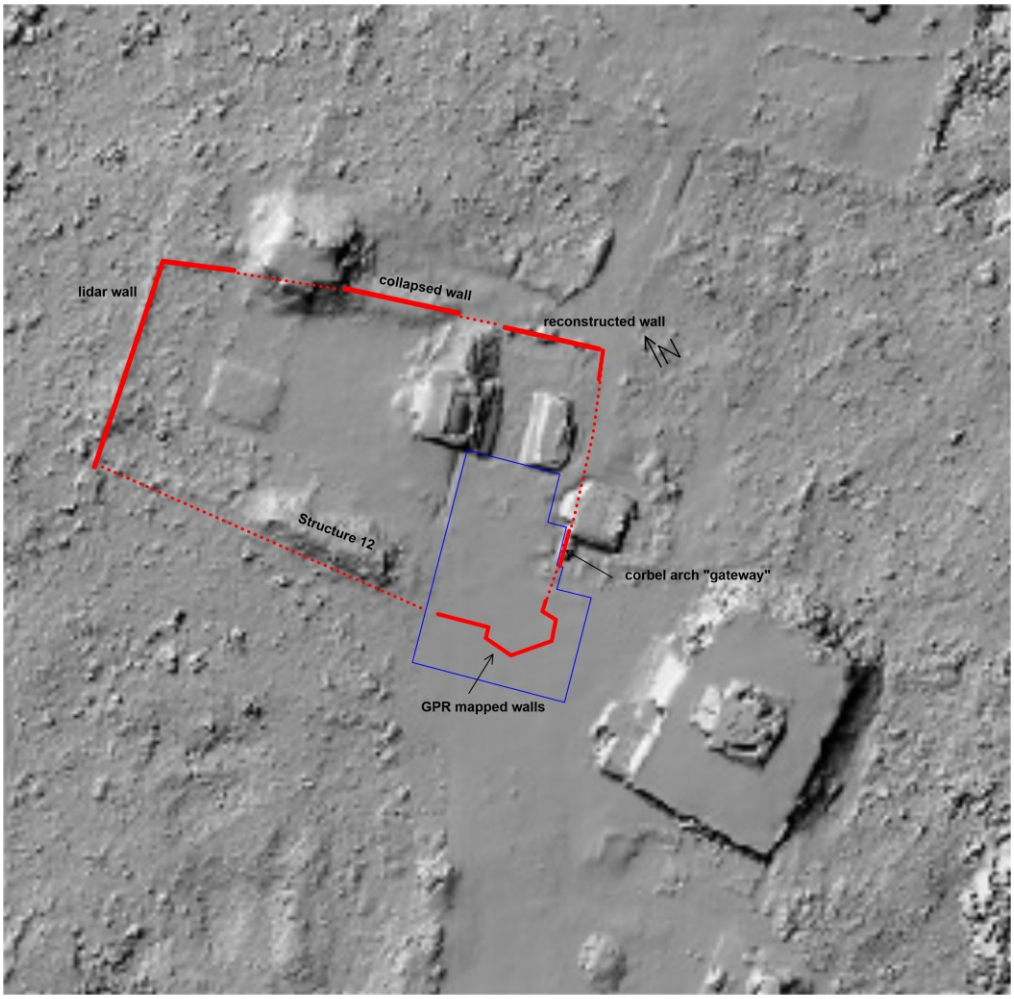


Figure 13: Interpretation of the location of the Late Classic compound walls from both surface mapping, lidar images and GPR analysis.

I prefer the first hypothesis, as it appears that Mayan people left much of the Late Classic compound wall intact, building on to it, and incorporating it into new buildings. Only the southeast corner of the compound was totally dismantled, to open this area to "the more general public" when the large open plaza area in front of the Observatory was in use. This fits a pattern common in Post Classic, when elite members of society still existed, but the other classes of Mayan people became more integrated into ceremonies and other rituals. Removing just that corner of the compound wall to make it less "exclusive" for only the elite Mayan people would have been consistent with what was happening in their society in general.

Elsewhere in the Yucatan Peninsula researchers have been analyzing architecture during the Late Classic-Post Classic transition and have noted there were significant modifications to the built environments, which varied between Mayan cities (Kratimenos 2025). At some ancient cities existing architecture was venerated, elsewhere it was destroyed or re-contextualized and, in some cases, it was ignored (Kurnick 2019). At the Casa Colorada compound all appear to have taken place. The main temple Casa Colorada remained in place over the transition, while being added on to on its east edge with a ball court. The compound wall itself remained intact in some places (along the west and north,

except for Deer House, where it was re-contextualized and incorporated into that structure. The entrance at the corbel vault gateway was apparently just ignored and left in place, even after the whole southeast corner of the compound wall was totally destroyed to produce a new open plaza in front of the Observatory. This study has taken the first step in identifying architecture that played a role in this transformation, which can be built on to further define the social factors at work during this important social transition in the ancient Mayan world.

Conclusions

A Late Classic portion of the Mayan city of Chichen Itza contained a compound wall that surrounded the Casa Colorada and other buildings. It had one entrance on the southeast, which was a corbel arch gateway that those entering and leaving the compound transited. In the Post Classic some of this compound wall was incorporated into monumental buildings such as the Maudslay Temple and the Deer House. The southeast corner of the compound wall was dismantled and buried under stone rubble and other fill to level an open area east of the Observatory. This opening of what was previously an exclusive area reserved for the elite indicates a transformation of Mayan culture away from a focus on just a few select members of society to one what was more inclusive of many different people. Some parts of this compound were left intact, others destroyed, and some modified and added onto. What the motives of the people who initiated these events were remains obscure but could be better defined with excavation information. Whatever those motives were, the architecture can tell us much about this important period in Mayan history.

Acknowledgements

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