Development of sedentary communities in the Maya lowlands: Coexisting mobile groups and public ceremonies at Ceibal, Guatemala

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Our archaeological investigations at Ceibal, a lowland Maya site located in the Pasión region, documented that a formal ceremonial complex was built around 950 B.C. at the onset of the Middle Preclassic period, when ceramics began to be used in the Maya lowlands. Our refined chronology allowed us to trace the subsequent social changes in a resolution that had not been possible before. Many residents of Ceibal appear to have remained relatively mobile during the following centuries, living in ephemeral post-in-ground structures and frequently changing their residential localities. In other parts of the Pasión region, there may have existed more mobile populations who maintained the traditional lifestyle of the preceramic period. Although the emerging elite of Ceibal began to live in a substantial residential complex by 700 B.C., advanced sedentism with durable residences rebuilt in the same locations and burials placed under house floors was not adopted in most residential areas until 500 B.C., and did not become common until 300 B.C. or the Late Preclassic period. During the Middle Preclassic period, substantial formal ceremonial complexes appear to have been built only at a small number of important communities in the Maya lowlands, and groups with different levels of sedentism probably gathered for their constructions and for public rituals held in them. These collaborative activities likely played a central role in socially integrating diverse groups with different lifestyles and, eventually, in developing fully established sedentary communities.

Significance

The results of our research at the lowland Maya site of Ceibal add to the growing archaeological understanding that the transition to sedentism did not necessarily occur simultaneously across different social groups within a region and that monumental constructions did not always postdate fully established sedentism. Whereas sedentary and mobile populations are, in many cases, interpreted to have maintained separate communities, our study suggests that groups with different levels of mobility gathered and collaborated for constructions and public ceremonies. These data indicate that the development of sedentism was a complex process involving interactions among diverse groups, and that collaborative construction projects and communal gatherings played a critical role in this social transformation by facilitating social integration among different groups.

Recent archaeological investigations have shown that the development of agriculture and sedentism was more diverse than the simple model of agriculture leading to sedentism and then to social complexity. In Europe, for example, the farming lifestyle that originated in the Near East spread in complex ways, involving the coexistence of farmers and foragers in relatively small areas and differential adoptions of Neolithic cultural elements in different regions (1–5). Studies of early monuments, such as Göbekli Tepe in Turkey, Watson Brake in Louisiana, and Caral and earlier mound complexes in the Andes, show that large constructions involving significant collective labor could be built by preceramic peoples who were still foragers or were at the early stage of farming adaptation (4–7). These emerging understandings lead to important questions about how sedentary and mobile populations interacted and how their relations affected the process of social change. To address these questions, researchers need fine-grained chronological information and a broad spatial coverage, which are not easy to obtain in many cases. A uniquely rich dataset obtained from the Maya site of Ceibal (or Seibal) suggests the possibility that groups with different levels of mobility gathered and collaborated for constructions and public ceremonies, which contrasts with the common assumption that sedentary and mobile groups maintained separate communities.

In the areas surrounding the Maya lowlands, including the southern Gulf Coast, the southern Pacific Coast, and northern Honduras, settlements with ceramic use emerged between 1900 and 1400 B.C. (8, 9). Some inhabitants of the Maya lowlands adopted maize and other domesticates possibly as early as 3400 B.C., but did not accept sedentary lifeways and ceramic use for many centuries (10). Once they began to establish villages with ceramic use around 1000 B.C., the subsequent social change was rapid. Within 1,000 y the lowland Maya developed numerous large centers with pyramids and centralized political organizations. Although a few scholars have suggested the possibility that early sedentary villages in the Maya lowlands coexisted with mobile groups (11), the specific social configurations and the process of transition have not been well understood, partly because of the rapidity of social change and partly because of difficulty in investigating early deposits deeply buried under later constructions.

Since 2005 we have been conducting archaeological investigations at the site of Ceibal, Guatemala, located in the Pasión region of the southwestern Maya lowlands (Fig. 1). Previous explorations by Harvard University in the 1960s demonstrated that Ceibal was one of the earliest sedentary communities in the Maya lowlands and subsequently became a major center (12–14). Building on this pioneering work, our deep, intensive excavations targeted specific locations to reveal early constructions and deposits.


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With detailed stratigraphic information and ceramic data, as well as through the Bayesian analysis of radiocarbon dates, we developed a high-resolution chronology of Ceibal, which we correlated with the archaeological sequences in other parts of the Maya lowlands (SI Text, Figs. S1–S3, and Table S1). This refined chronology allowed us to reconstruct social processes on a fine temporal scale that was not possible before.

In addressing the development of sedentism, we need to examine its multiple dimensions as continuums rather than categorical divisions (15). In this regard, the lowland Maya of the Classic period (A.D. 250–950) possessed a particularly strong sense of attachment to fixed localities. Houses were repeatedly rebuilt over older ones in the same locations, and some of the dead were buried under house floors. In other words, kin-based groups, or at least their central members, were tied to fixed locations physically and symbolically through generations, although this practice did not preclude certain members from moving out to establish new residences. Temples and public plazas were also periodically rebuilt over previous ones, tethering entire communities to fixed locations. In examining the trajectory leading to this system, we need to analyze diverse levels of residential mobility and the possible coexistence of different modes, potentially including seasonal mobility without ceramic use, residential relocations every few years with ceramic use, and the use of durable houses without transgenerational continuity. These levels of mobility were most likely associated with different subsistence strategies and different notions of property and land ownership (16).

**Ceibal and the Pasión Region**

The primary focus of our excavations at Ceibal has been the ceremonial core called Group A (Fig. 2). T.I. noted the resemblance of Group A’s layout to a configuration called the Middle Formative Chiapas pattern, which is found at Middle Preclassic (1000–350 B.C.) centers located mainly in Chiapas. The center of this configuration is a so-called E-Group assemblage, made up of a square or conical mound on the western side and an elongated platform on the east. Multiple large platforms are placed along the north–south axis of the E-Group assemblage (17). Our focused excavations examined whether an E-Group assemblage and other elements of the Middle Formative Chiapas pattern were indeed present and, if so, when they were built.

In addition, we have been investigating residential areas of Ceibal. Rich data from the settlement survey and excavations by Tourtellot during the Harvard project allowed us to design deep or extensive excavations in six residential groups at Ceibal and at the satellite site of Cacbal (13) (Fig. S4). The combination of the broad sampling by the Harvard project and our more focused excavations provided one of the best datasets in the Maya lowlands with which to examine the development of sedentism.

A high-resolution chronology is the key to understanding the rapid change that took place in the Maya lowlands. We found the previous chronology developed by Sabloff to be sound and reliable (18), and our further study refined this sequence. We subdivided the early Middle Preclassic period into the Real 1 (1000–850 B.C.), Real 2 (850–800 B.C.), and Real 3 (800–700 B.C.) phases. The late Middle Preclassic period was subdivided into the Escoba 1 (700–600 B.C.), Escoba 2 (600–450 B.C.), and Escoba 3 (450–350 B.C.) phases. For the Late Preclassic period, we assigned the separate phase name of Xate to Sabloff’s Late Cantutse phase and defined the Cantutse 1 (350–300 B.C.), Cantutse 2 (300–250 B.C.), Cantutse 3 (250–1 B.C.), Xate 1 (A.D. 1–75), and Xate 2 (A.D. 75–225) phases.

Our excavations during the 2005–2012 seasons revealed the earliest version of a probable E-Group assemblage that was constructed at the beginning of the Real 1 phase, around 950 B.C. (19). The western building [Structure (Str.) Ajaw] was a low platform measuring 2.0 m in height. Its lower part was carved out of a high point of natural marl, and the upper part was made of a fill of dark soil. The eastern long platform (Str. Xa’an) was also carved out of natural marl, and probably measured 42–55 m in length. Its back wall, reinforced with limestone blocks, had a height of 1.0 m, and its front part, exposed during the 2013 and 2014 seasons, was defined by two steps. This eastern building may have originally been conceived as a raised part of the plaza rather than a well-defined platform. The open plaza flanked by Strs. Ajaw and Xa’an consisted of a scraped, leveled surface of natural marl. Throughout the history of Ceibal, community members repeatedly made substantial labor investments to renovate this ceremonial complex. The western building grew into a pyramidal temple with a height of 3–5 m during the Real 2 phase, and the eastern building was moved twice to the east to provide wider plaza spaces during the Real and Escoba phases. New plaza floors were also frequently built up over the existing ones. From its inception, the complex most likely served as a stage for communal rituals. Along the east-west axis of the complex, we uncovered 20 caches containing greenstone axes and other objects dating to the Middle Preclassic period.

The first version of the A-24 platform (Platform Sulul), located to the southwest of the E-Group assemblage, measured 1.3 m in height and may have been built at the beginning of the Real phase. Within the excavated area, we did not find any traces of roofed structures supported by this platform other than a dense concentration of carbon, and it is not clear whether the platform served as a residential complex. During the Escoba phase, a renovated version of the platform (Platform Ch’och’) supported multiple buildings associated with middens. Their arrangements, however, are different from those of residential patio groups prevalent in later periods, and we do not have sufficient evidence to judge whether these buildings were used as residences or communal buildings for feastings and other collective events. A single burial (CB110) found in this platform was placed during...
either the Real 2 or Escoba 1 phase, and it is not clear whether it represents a subfloor burial of a household member or not.

Under the East Court located to the northeast of the E-Group assemblage, our excavation uncovered a small platform (Str. Fernando) carved out of natural marl, which may have been a dwelling (Fig. 3A). Newly obtained radiocarbon dates place this building in the Real 3 phase. Str. Fernando was covered by a large platform (Platform K’at), which was built during the Real 3 phase and measured 1.6–1.9 m in height. During the Escoba phase, Platform K’at supported multiple buildings surrounding a patio and a midden was deposited to its north. This configuration probably began during the Real 3 phase, and the platform appears to have served as a residential complex of the emergent elite. Two burials (CB116 and 117) placed in the patio during the Escoba 3 phase probably represent sacrificial victims (20), but another Escoba interment (Burial 11) found by the Harvard project may have contained a resident of this complex.

The Harvard research made clear that Real occupation was limited to the immediate vicinity of Group A and a nearby area called Group C (13). In our excavation in the northern part of Group A (Op. 202A), the earliest four floors dated to the Real-Escoba transition, and in the western part of Group A (Op. 204A) the earliest three floors were built during the Real 3 phase. We suspect that a significant part of the Real deposits found by the Harvard project in Group A, with the exception of the E-Group assemblage and the A-24 Platform, dates to the Real 3 phase. Our extensive excavations in the Kariel group (Unit 47), located near Group A, uncovered Real 2 ceramics deposited in small concentrations directly on bedrock. The inhabitants of the group apparently removed humus and used the exposed rough bedrock as occupation surfaces from the Real 2 through Escoba 1 phases (Fig. 3A). A burial (CB132) placed in a cavity dug into bedrock contained three individuals and seven Real-3 ceramic vessels (Fig. 3C), but the recognizable artificial fills of structures, platforms, or floors found in our excavations all dated to the Escoba 2 phase or later. Although there may still be architectural remains of earlier periods in unexcavated areas, it is highly unlikely that any substantial structures were built in this group before the Escoba 2 phase. We uncovered four burials (CB128, 149, 157, and 160) deposited during the Escoba 2 or 3 phase, and two of them were placed under a probable residence.

Our excavations in the peripheral parts of Ceibal did not find any recognizable evidence of Real settlements. In Unit 54 the earliest evidence of occupation was a large pit that contained a burial (CB126) and dense refuse, including Escoba 2 ceramics. The earliest occupation documented so far in the Amoch group (Unit 4E-14) dates to the Escoba phase. In the Muknal group (Units 4E-10/4F-15) and the Pek group (Units 4G-5/4G-12), construction fills of the Cantutse phase were placed directly on bedrock. Extensive excavations in Group D by Damien Bazy confirmed Harvard archaeologists’ interpretation that recognizable constructions in this area began during the Xate phase. The Harvard excavations uncovered no burial that is clearly datable to the Real or Escoba phase, besides the aforementioned Burial 11.

At the minor site of Caobal, located 3.2 km to the west of Ceibal’s Group A, our excavation uncovered Real 2 or 3 ceramics mixed in construction fills. The deep excavation into Str. 1 exposed...
postholes dug into the scraped surface of natural marl, with one reaching a depth of 0.4 m (Fig. S4). An ephemeral dwelling was built, probably during the Real 2 or 3 phase (Fig. 3D). A low platform (Str. 1 Sub-8) that covered this part during the Escoba 1 phase may have served as a dwelling. The probable first version of the pyramidal building (Str. 1 Sub-7), constructed during the Escoba 2 phase, had an orientation slightly different from Str. 1 Sub-8. In the area of Str. 2, a low earthen platform (Str. 2 Sub-6) was built directly on scraped natural marl, most likely during the Escoba 2 phase. A fire pit dug in front of this building contained a large quantity of ceramics, lithics, and food refuse. The subsequent house platform (Str. 2 Sub-5), measuring 0.7 m in height, was probably constructed during the Escoba 3 phase, and a burial (AN4) was placed under its floor.

In other parts of the Pasión region, evidence of occupation with ceramic use during the Real-corresponding period has been reported from Altar de Sacrificios, Itzan, and Punta de Chimino (21–23). The majority of the ceramics from those sites corresponds to the Real 3 phase in our refined chronology. For the Real 3-corresponding Xe phase at Altar de Sacrificios, archaeologists found postholes and pits dug into sterile soils or thin deposits placed directly on the natural ground level (Ops. 62 and 99). Xe fills measuring 0.6–1.0 m in thickness were found in a few locations (Ops. 62, 85, and 90) and may represent platforms or other constructions. One probable Xe burial is reported (24), but the ceremonial core of Altar de Sacrificios was not built until the Escoba-corresponding San Felix phase.

**Interpretations**

It appears that during the Early Preclassic period (before 1000 B.C.) the Maya lowlands were sparsely occupied by mobile populations without the use of ceramics or substantial architecture. These populations cultivated some domesticates but relied heavily on hunting, gathering, and fishing. Such foragers were certainly present in Belize and possibly in northern Peten, but evidence is still ambiguous in most other parts of the Maya lowlands (10, 25, 26). In the Pasión region and the central lowlands, lake core data indicate a decline in rainforest taxa and an increase in soil erosion starting between 2500 and 1500 B.C., but it is not clear whether these changes were a result of anthropogenic effects or climate drying (27, 28). We need to consider the possibility that, before maize became productive enough, the karstic lowlands were not an environment desirable for foraging populations, whereas rivers and lakes in Belize provided enough resources. Although some archaeologists have argued that the use of ceramics began in the Maya lowlands around 1200 B.C., we agree with Lohse that there is no unequivocal evidence of ceramics in this area before 1000 B.C. (11). The nearly simultaneous adoption of ceramics marked a major step in the transition toward sedentism in the Maya lowlands. This social change may have been triggered by a heavier reliance on more productive maize, which appears to have occurred around this time across Mesoamerica (29–31).

The construction of a formal ceremonial complex at Ceibal around 950 B.C. represented a substantial change in this region. Similarities in the construction method and the spatial configuration indicate that the Ceibal residents had close contacts with
the inhabitants of Chiapas and other areas to the west and that there may have been some migrants from those regions to Ceibal. The Real pottery of Ceibal, however, exhibited somewhat stronger affinities with ceramics from other parts of the Maya lowlands than with Chiapan materials. This observation leads us to think that a significant part of the Ceibal community was made up of the original inhabitants of the Maya lowlands. Despite the extensive excavations conducted by Harvard University and by ourselves, we have not found any unequivocal residential structures of the Real 1 and 2 phases at Ceibal. The only potential exception is Platform Sulul, but it may have been used for communal activities. The presence of Real 1 sherds in the initial fill of St. Ajaw indicates that the use of ceramics began before the construction of the ceremonial complex, but outside of the E-Group assemblage and the A-24 Platform the earliest deposits containing ceramics appear to date to the Real 2 phase or later. It is probable that during the Real 1 phase a substantial part of the Ceibal residents did not use ceramics regularly.

We by no means preclude the possibility that future investigations will reveal early residential remains. Our argument is not that sedentary occupation was absent, but rather that mobile populations persisted, potentially coexisting with more sedentary groups, after the construction of the ceremonial group. In this regard, we find it significant that in the excavated areas outside Group A, the earliest deposits dating to the Real 2 phase or later were placed directly on bedrock without any recognizable traces of contemporaneous house platforms. The early occupants of these areas most likely lived in post-in-ground structures like the one found at Caibal or other ephemeral dwellings built on the natural ground level. Although we do not know the specific patterns and cycles of the occupants’ residential mobility, the low labor investment in these buildings implies that the inhabitants moved their residences frequently. In addition, the use life of such constructions in the tropical lowlands is limited because of decays from high humidity and termite damage. Possible patterns may include seasonal mobility between different farming plots or according to the farming and foraging seasons (32), and residential relocation every few years according to fallow cycles (33). Some groups may also have compensated reduced residential mobility with increased logistical mobility, that is, the frequency and length of foraging treks from the home bases (34).

At the very least we can be sure that most residents of Ceibal had not started the practice of rebuilding their residences over the existing ones. Thus, it is likely that a substantial portion of the Ceibal community maintained considerable residential mobility even during the Real 2 phase, when the ceremonial complex reached a monumental scale. Moreover, given the apparent absence of settlements with ceramic use at Altar de Sacrificios, Itzan, and Punta de Chimino during the Real 2 phase, we need to consider the possibility that many inhabitants of areas outside Ceibal maintained the traditional foraging lifestyle without the use of ceramics, as many Ceibal residents possibly did during the Real 1 phase.

During the Real 3 phase, some households began to live in somewhat more substantial residences built on low platforms, such as Str. Fernando. Platform K’at, a probable elite residential complex built later during the same phase, reflected more advanced sedentism with the format of a patio group and the practice of repeated renovations in the same locations. Its residents, however, may have not yet begun to place the dead under house floors. The lifestyle of other Ceibal inhabitants changed slowly. Some started to place the dead near their residences as indicated by the find in the Karinel group, but most residents continued to live in ephemeral structures. Settlements with ceramic use began at Altar de Sacrificios, Itzan, and Punta de Chimino. Thus, the Real 3 phase is characterized by the gradual spread of more sedentary ways of life and by more pronounced differences in the level of mobility, particularly between the elites and other groups.

During the following Escoba phase, the number of settlements with ceramic use increased substantially both in the peripheral areas of Ceibal and in the Pasión region (13). The examples from the Kariel group and Caobal show that some residents began to rebuild new structures over older ones and to place some burials under house floors, although the practice of placing the dead in preexisting underground cavities continued, as in the case of Unit 54. In other words, the residential pattern that characterized lowland Maya society of later periods was adopted by a broader range of the population during the Escoba phase. The construction of monumental ceremonial buildings started at Caobal, at Altar de Sacrificios, and possibly in the Amoch group, indicating the spread of such constructions. During the subsequent Cantutse phase, this residential pattern and the broader distribution of ceremonial structures were firmly established.

Based on these settlement data, Tourtellot estimates that the Escoba-phase and Cantutse-phase populations of Ceibal grew 7-times and 40-times, respectively, larger than the Real-phase population (13). We, however, suggest that the adoption of more sedentary lifeways by previously mobile groups also contributed to this increase in archaeologically documented settlements. If most residents lived in ephemeral structures built on exposed bedrock or marl during the Real phase, many of them probably remain undetected archaeologically. Their traces would be quickly obliterated by tropical rains unless they were buried by later constructions. Once these inhabitants began to construct more substantial residences during the Escoba and Cantutse phase, they became more easily recognizable by archaeologists. Moreover, the annual construction volume of public constructions in Group A during the Real phase is estimated to be as large as those of the Escoba and Cantutse phases (Table S2). Although such estimates may have considerable errors, the magnitude of construction is significant enough to indicate that a population substantially larger than the one currently documented in the archaeological data contributed to public construction projects during the Real phase. If such an undetected population existed, a substantial part of it was most likely made up of highly mobile groups.

Discussion

Although the adoption of ceramics and the initial transition to sedentism occurred nearly simultaneously around 1000 B.C. in other parts of the Maya lowlands, the relative pace of change was diverse. Belize, in particular, witnessed the development of sedentism earlier than other regions. There, post-in-ground structures were built at the beginning of the Real 1-corresponding period and were soon followed by house platforms. Clear evidence of burials under house floors is also present at least as early as the Real 2- or 3-corresponding period (35, 36). Nonetheless, no formal ceremonial complexes earlier than 800 B.C. have been confirmed in the Maya lowlands outside of Ceibal. A similar pattern of early ceremonial constructions may have occurred at Komchen in northern Yucatan, but Komchen’s chronology remains imprecise (37). Whereas the early adoption of substantial residential structures in Belize probably derived from the region’s well-established populations dating back to the preclassic period, the early construction of the ceremonial complex at Ceibal was likely stimulated by close interactions with, or migrations from, Chiapas and the southern Gulf Coast. Despite these differences, the coexistence of different levels of sedentism seen in the Pasión region appears to have occurred in other parts of the Maya lowlands as well (SI Text).

The earliest known formal ceremonial complex with an E-Group assemblage in the Maya lowlands, after that of Ceibal, was built at Cival, in the central lowlands, during the Real 3-corresponding period (38). Slightly later, around the Real–Escoba transition, an E-Group assemblage was also built at Tikal (39). Nevertheless, it was not until the Late Preclassic period that E-Group assemblages spread more widely to numerous
settlements. During the early Middle Preclassic period, formal ceremonial complexes of substantial sizes appear to have existed only in a small number of important communities. These ceremonial centers may have attracted participants in construction activities and public ceremonies not only from coexisting sedentary and mobile groups within their core communities, but also from other sedentary villages and more mobile groups of their regions.

The coexistence of different levels of mobility has also been proposed for the Early Preclassic period in regions outside of the Maya lowlands, but with an important difference in interpretations (40, 41). Rosenswig suggests that, during the Early Preclassic period on the Pacific Coast, sedentary and mobile populations formed separate groups with limited social integration between them (41). Our data, however, strongly indicate that diverse groups with different levels of sedentism frequently gathered and collaborated, possibly forming communities. Although diverse processes of the transition to sedentism certainly occurred in different contexts, we suspect that intracommunity variation in residential mobility, which became recognizable at Ceibal through a fine-resolution chronology, may have existed in some other regions of Mesoamerica and of the world as well. In most cases, the transition to sedentism did not represent a wholesale subsistence change with the abrupt replacement of foraging with previously unknown gathering practices, but typically involved shifts in scheduling and combination among preexisting subsistence options, including hunting, gathering, fishing, and cultivation. If decisions regarding such subsistence practices were made primarily by individual households or other small groups rather than by entire communities, different levels of mobility may have resulted within individual communities, at least in a short term. In the case of the Pasión region, different political and subsistence strategies chosen by certain groups, including the elites as opposed to non-elites and migrants from other regions as opposed to local inhabitants, may have contributed to the difference in mobility. Despite such intracommunity variation in mobility, all community members of Ceibal were tethered to the ceremonial complex once it was built. Different degrees of sedentism were probably related to different notions of property rights and land ownership. Then, the coexistence of different levels of mobility may have caused tensions and conflicts among community members. It is probable that public ceremonies, as well the construction of ceremonial complexes, provided opportunities for groups with different lifestyles to gather and collaborate (7). Such collective activities possibly played a central role in facilitating social integration among diverse participants and eventually, in spreading more sedentary ways of life.

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