THE SACBE AND AGRICULTURAL FIELDS AT JOYA DE CEREN, EL SALVADOR
REPORT OF THE 2013 RESEARCH

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Chapter 1 Introduction

Payson Sheets

Introduction

The recently-discovered sacbe and adjoining agricultural fields at the Cerén site allow for an exploration if the means of production, construction, and maintenance were controlled politically, and if so, to what degree and at what level. Strategic excavations of the 2013 field season have tested hypotheses that decisions on agriculture and sacbe maintenance were made by local farmers, village elders, or by higher authority outside the village. If construction and maintenance of different sacbe sections were the responsibility of those individual farmers with adjoining plots, then plot boundaries should correlate with maintenance boundaries. If work gangs from the village operated sacbe maintenance, those boundaries would not exist and the sacbe may formalize as it enters the village. Or, if a higher authority to the south controlled the sacbe, it should not show individual plot boundaries and it should become more formalized in that direction. These three hypothesized relationships regarding socio-political organization were tested with excavations of eight operations during the 2013 field season.

Sacbe function or functions were explored by following it into the village where it could end at the locus of political authority and social gatherings (plaza and Str. 3) or of religious power (Str. 10) where a ceremony was underway when Loma Caldera volcano erupted. Likely economic functions were explored by paleoethnobotanical identification of plant remains dropped along the sacbe. Ceren is unusual because it represents an expansive, uninterrupted activity surface that relates to a single time. On that surface are the remains of hundreds and thousands of tiny seeds that are reflective of agricultural practices, trade activities, ceremonial practices and other plant uses.

Decisions were explored within the agricultural fields. Farmers were rotating seed with root crops, changing microtopography, and occasionally fallowing in fields discovered in other seasons. The reasons for those decisions can be discovered in edaphic conditions of fertility, friability, and moisture/drainage.

Local decision-making among commoners is a challenging component in the effort to understand the internal organization of ancient Maya society. Who decides what was constructed, maintained or cultivated, where, and how? Why were those decisions made? Roadways and agricultural authority reside at what levels of society? The political economy of ancient commoner villages in many world culture areas has resisted detailed reconstruction, most often because of poor preservation of fragile agricultural features.

This project was designed to utilize the unusual preservation of the sacbe and adjoining agricultural features, including individual plants, microtopographic field features, and field boundaries. Three quite different agricultural zones in and south of the village present the opportunity to explore the full range of authority in the ancient political economy, from household to village and to weak-to-strong elite influence, even to possible elite control of the intensive manioc fields. Cerén must not be unique, and techniques to extrapolate from it to other sites with more common preservation conditions are being made.

Cerén is the only World Heritage site in El Salvador, and the research reported here should contribute new understanding of what many Salvadorans call their most important cultural feature. This research promoted education by training Salvadoran undergraduates and US graduate students in field and laboratory techniques, conservation practices, and how to possibly incorporate the northern portion of the sacbe into the public-visitation portion of the Cerén site. An average of 4000 people visit the site weekly.

Background Contextual Information

Payson Sheets and David Lentz (Co-PI) were awarded NSF grant titled "Root Crop Agriculture, Land Use, and Authority Outside of the Cerén Village, El Salvador" #BCS-1115775 for June-August 2011 fieldwork. During the 2011 field season a total of 14 test pits was excavated (Figure 1-1), most measuring 3x3m, to an average depth of 3.7 meters to reach the Classic period ground surface. Evenings and weekends were devoted to data entry, mapping, laboratory analyses of maize, manioc, and other plant casts. A standard procedure is to have each project member write a detailed chapter for the report on an aspect of the research results during the final two weeks of the field season, prior to their being allowed to leave El Salvador. Each chapter was critiqued by two others, and revised. The result was an eleven-chapter, 125 page monograph (Sheets and Dixon 2011) that was published electronically one month after excavations ceased.

A primary objective of the 2011 research was to explore agricultural patterning, variation, and decision-making in the zone between the village and the manioc fields discovered in 2009. As important as where agriculture was practiced, Halmbacher (2011) describes where decisions were made as to where it was **not** practiced, thus providing a perspective on space that is rare in the archaeological literature, and she explores the reasons why areas were left uncultivated. Lamb and Heindel (2011) discovered surprising variation in maize agriculture in this intermediate zone (Figure 1-1), and more areas in fallow than found in the other two zones. That is in striking contrast to the uniformity of maize ridges and planting densities in high-performance milpas (*sensu* Wilken 1971) within the village (Sheets 2002, 2006). A considerable amount of variation in manioc (*Manihot esculenta*) cultivation also characterized the intermediate zone (Dixon 2011a).

In the course of exploring for agricultural patterning and variation, a serendipitous discovery was made in Operation S (Figure 1-1). In the 3x3m excavation, a formal roadway (sacbe) 2.15m wide was encountered (Dixon 2011b). It was further documented in Operations U and W, for a distance of about 50 m. It has drainage canals on both sides, and maize milpas beyond the canals. It was constructed of hard-packed TBJ tephra from the Ilopango volcanic eruption, carefully maintaining the top with white ash, thus fitting the definition of sacbe as "white road" in Yucatec Maya (Shaw 2008:4). The sacbe is wider than necessary for purely economic uses, and it heads north into the village. Its southward terminus is unknown. It is headed toward San Andres, 5 km south of Cerén, but it could go to other loci. To the north, the sacbe continues towards the site center, but it was unclear towards which structures it was directed Without further study the ultimate destination of the sacbe remained unknown and the 2013 field season was initiated to investigate the extent, as well as the potential meaning or meanings of the sacbe.

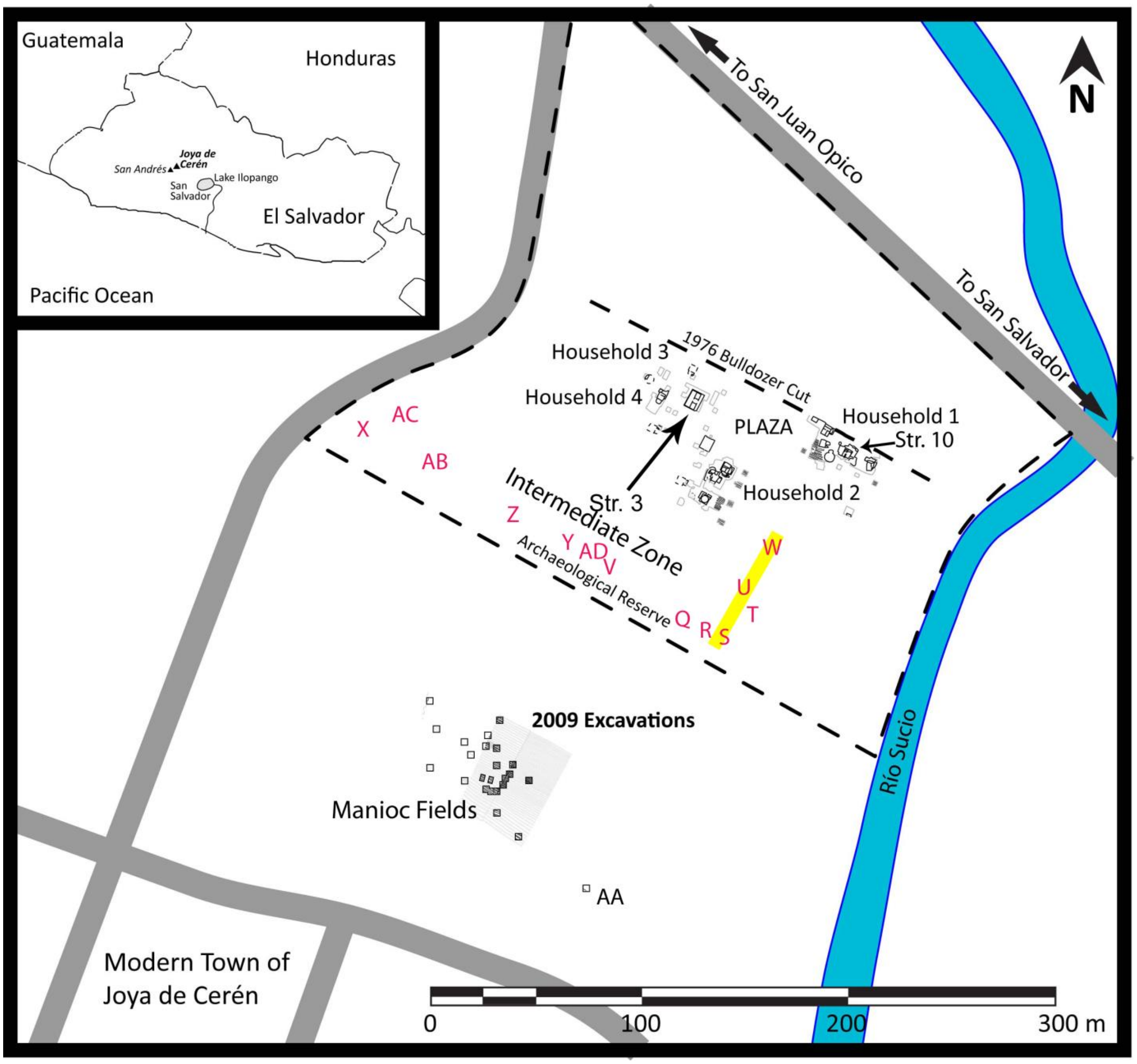

Figure 1-1. Map of the Cerén village.
Map indicates household agriculture, intermediate zone with red letters, and southern manioc fields excavated in 2009. Sacbe in yellow, Op. S to W.

Detailed analyses of paleoethnobotanical samples are continuing at the University of Cincinnati, largely of carbonized macroremains (Lentz and Hoffer 2011). The lithic and ceramic artifacts were analyzed (Sheets 2011 a & b), and durable indicators of root crop processing that could be preserved at other sites are being sought, with some success. The obsidian prismatic blade with abundant fine striations parallel to the edge, from Operation P adjacent to the manioc fields, likely was used to cut the cortex of the manioc tubers. That use wear has been replicated by experimentation (Sheets 2011c). The artifact from Op. P along with two flakes from Op. AA and two sediment samples from manioc tuber cavities were undergoing Crossover Immunoelectrophoresis (CIEP) analyses in an attempt to detect manioc organic residues. Unfortunately, that effort was unsuccessful, as manioc does not leave diagnostic organic residues that preserve in archaeological sites, even with the preservation that Cerén offers.

Two other chapters present other aspects of the research program. Lamb (2011) describes continuities and discontinuities in houselot gardens from the Classic period to the present. Heindel (2011) describes malanga (*Xanthosoma violaceum*), another root crop found growing at Cerén. Malanga is important because it was cultivated by households at Cerén, it favors very different edaphic conditions than manioc, and Cerén is the only archaeological site to date where it has been found growing. It likely was widely cultivated in Precolumbian times, but is exceedingly difficult to detect in the archaeological record. Malanga's importance was iconographically recorded in the headdress decorations of late Formative Maya elites (Pohl et al. 2000: Figure 1-1). Sheets has found other depictions of malanga in sculptures from other sites, such as Cerro de las Mesas.

Description of the 2013 Research Program: Political Economy Theory

The 2013 research focused on agricultural decisions, decisions on sacbe construction and maintenance, and the locus of authority for those decisions. What were the decisions, by whom, and why? Were some aspects influenced or controlled by outside higher authority?

In Mesoamerica, as in other world culture areas with complex societies, conceptualizations of political economies have become diverse, with top-down, bottom-up, marketplace, hierarchical, heterarchical, and agency approaches (e.g. Dahlin et al. 2010, Douglass 2002, Garraty and Stark 2010, A. Joyce et al. 2001, Masson and Freidel 2002, Potter and King 1995, Scarborough et al 2003, Schortman and Urban 2004, Sharer 2006, Smith 1991, Wells 2006). Most studies have focused on large sites, often including their peripheries, with some studies being regional in scope.

The degree of elite control or influence over agricultural production is a subject of considerable uncertainty and debate. For decades the lack of evidence for the control of food production inhibited understanding the complexities of ancient Maya economies (Potter and King 1995; Scarborough and Valdez 2009). Webster (2002: 175) argues the "greatest ignorance about Maya farmers concerns the ancient political economy," referring to the lack of knowledge about possible elite influence on agriculture, how decisions were made, how labor was organized and production distributed. The most controversial problem is the degree to which ancient Maya households grew their own food, with some scholars arguing that households must have diversified their economies and grown at least some food (Dunning et al. 2003). Fortunately preservation by the Loma Caldera eruption is proving sufficient to begin to shed some light on that question, at least for Cerén (Dixon 2013). Many scholars argue that food production was locally controlled (e.g. Foias 2002, Hageman and Lohse 2003, McAnany 1989, and Scarborough and Valdez 2003). Sanders and Webster (1988) viewed households at Copan as relatively independent. Others argue that intensive agricultural systems were under the purview of managerial elites who ensured that crops were impelled upward in the social hierarchy (Chase and Chase 1996, Ford 1996). Each may be true, in different areas or times. Houston and Inomata (2009: 240-249) wrestle with these issues of authority and ownership, and note that elite control over agriculture results in highly standardized and large scale features, while household-controlled fields vary considerably. Regarding land tenure, they state “land ownership does not leave any clearly recognizable archaeological signature” (ibid: 242), although Freidel and Sabloff (1984) found stone-partitioned fields on Cozumel. Preservation at Cerén may divulge ownership insights in an area where stones were not used. Applying Netting’s survey of land tenure variation (1993) to known land use at Cerén , the gardens and milpas adjacent to households probably were owned and descent-systematized. The intermediate zone was less individualized and possibly included usufruct. The manioc fields could well be owned.

Sub-Royal (non-elite) Political Economy

An alternative to top-down hierarchical views of economies utilizes social theory and focuses on agency, as people negotiate and contest aspects of ownership, production, circulation, and consumption processes (A. Joyce et al. 2001, Wells 2006). This approach is generally “ascending” (bottom-up), exploring the activities of subalterns, or exclusively of commoners. Studies focused on commoners have provided insights regarding their contributions to society, but often left them disembedded from the dynamics of the full economic system. Commoners are perceived as making their own decisions in certain domains. By managing local resources commoners can be economic and political agents (Robin 2003), for instance in deciding which market, in which elite center, to take their surplus crops, or craft products, along the lines of Carol Smith’s ambitiously proposed interlocking system (1976). Cerén commoners had some degree of choice in which market to participate (Sheets 2000), and thus could have had at least some effect on local elites.

A village economy, as a part of the greater domestic economy, is here defined as the production and distribution of goods such as manioc, and services, inside the village and its environs, beyond the control, but not necessarily beyond the influence, of elites. As surplus food, basic commodities, construction material, or labor was made available to elites, potentially via markets, commoners supported elites. Jade axes, polychrome ceramics, and obsidian implements were the items commoners took back to Cerén, in apparently symbiotic relationships (Sheets 2002). Internally, authority within the village economy can function at different levels, the highest being decisions made by village elders in allocating land for farming, or designating open space for processing the harvest, perhaps exemplified by the constructed platforms and the land use lines 2). Adjudicating disputes among residents is another high-level political economy function, likely done by village elders at Structure 3 (see below). This could be considered an intra-village political economy, an example of sub-elite governance. Or village elders may have been influenced to some degree by external hierarchies, as documented in northern Yucatan at contact (Roys 1957:6). The next level down within the village is the "horizontal economy" (Sheets 2000), in a heterarchical configuration, where each household produced specific commodities beyond what they needed for their own consumption, and exchanged them with other households in the village, or with other villages. The third level is the household economy, where people constructed and maintained their own buildings, produced items for their own consumption, kept a kitchen garden, and maintained infields and outfields that supplied the bulk of their food.

When Cerén was founded in the 6th century (Sheets 2002), evidently by Maya immigrants from the northwest (Sheets 2009a) the founding families and their lineages probably maintained significant local power. With village and regional population growth, competition and conflict must have increased, necessitating transfer of some authority within the village, probably to village elders. We interpret Structure 3 (Figure 1-1), the public building with two benches in the front room, as the locus of power and dispute resolution, i.e. the locus of non-royal governance. Each bench would seat cross-legged a maximum of three individuals. Six individuals of authority, likely elders of the more prominent households, would represent a small subset of the households in the village. Decisions made there might have affected construction and maintenance of the sacbe, and aspects of agriculture in the zones. This could represent non-royal governance, an under-researched and under-theorized topic with the ancient Maya.

In summary, the organization of the ancient Maya political economy has come under close attention in recent years, and a salutary result is a better understanding of the full range of economic behavior, with markets, hierarchy, heterarchy, and agency at all social levels including elites, secondary elites, commoners, rural households and villagers. Wells' broad formulation of ritual economy (2006) encapsulates this theoretical domain and includes the social dimensions of religion in addition to production, distribution, and consumption. At Cerén we intend to make progress answering Turner's (1983:120) challenging questions of "the degree of control the elite exerted on the farming units, how decisions were made, how labor was organized, how production was distributed…."And "were cropping decisions controlled by communities? What did the farmer gain by supporting the elite, or did they gain?"

Research Objective # 1: Agricultural Variation, Authority, and Political Economy

Boundaries are distinct in the southern agricultural zone (Figure 1-1) south of Cerén (Sheets 2009b). Crisp and straight boundaries separate individual manioc plots, and the manioc beds from the flat constructed platforms. The boundary between maize and manioc is equally distinct, and all boundaries are azimuth-aligned to about 30^{o} east of magnetic north. The large adobe block found in Operation P may mark an intersection where four fields meet. Earthen platforms were constructed on the western and eastern sides of the manioc fields (Maloof 2009), presumably for processing the harvested tubers.

Boundaries are equally distinct and aligned within the Cerén village (Sheets 2002, 2006), but the features that are separated are of course quite different from the southern agricultural zone. Within the village the demarcations are aligned and abrupt between high-performance milpa and garden, milpa and walkway, milpa and patio, and among buildings and a plaza.

The intermediate agricultural zone (Sheets and Dixon 2011) is quite different from the highly organized village zone and the southern zone. It is less formal, with a striking variability in cultivation strategies, somewhat irregular fallowed areas, and less distinct boundaries. The alignments of ridges and boundaries were less strict than in the village and in the manioc fields. The ridges and mounds inside fields were much more variable than in the two other zones (Lamb and Heindel 2011).

The pattern discovered so far is quite formalized kitchen gardens and milpas adjacent to the household buildings, perhaps as a visual expression of identity and success/pride as agriculturalists. Farther from the houselots, in the intermediate zone excavated in 2011, informality reigns and farmers apparently were more culturally free to fallow or use whatever milpa technique they wished. The significant increase in formality at greater distance, in the southern area, presents explanatory alternatives. The variation could result from varying edaphic conditions that favor different cultigens, or necessitate different microtopography such as ridging of different sizes or orientations (perpendicular or parallel to slope). Or the variation could result from political economy, as tenure changed from individual households owning their immediate plots and extending into the more informal intermediate zone. It is possible that the more formal southern zone was under a higher authority outside the village, a suggestion that we did not consider in the report (Sheets and Dixon 2011).

Hypothesis 1-A: Variations in edaphic conditions correlate with variations in cultigens and cultivation strategies, and thus contribute to decision-making.

Maize and manioc have distinctly different edaphic requirements (Cock 1982). Manioc is very drought-tolerant and grows well in less fertile and more acidic soils than does maize. Manioc growth is more suppressed by dense soils than is maize. Maize is highly nitrogen-demanding, and manioc is not. Manioc is mildly phosphorous and potassium-demanding (Rehm and Espig 1991). High soil moisture, approaching saturation, suppresses manioc growth more than maize. Agronomists in the soils laboratory at the Centro Nacional de Tecnologia Agropecuaria (CENTA) have examined and measured pH, texture, grain sizes, nitrogen, phosphorus, potassium, zinc, manganese, iron, copper, % organics, calcium, magnesium, potassium, sodium, interchangeable acids, base saturation, and chemical relationships (see chapter below). The chemical-physical-edaphic factors are compared to patterns and variations in surface microtopography (ridges perpendicular and parallel to slope, size of ridges, mounding, lack of ridges and mounds, soil density, and slope) to explore if they correlate and thus might be involved in agricultural decisions.

<u>Research Objective # 2: Who makes decisions on construction and maintenance of the sacbe?</u>

The sacbe averages 2m in width, and has formal drains on each side (Dixon 2011b). It was constructed of highly compacted white volcanic ash from the Ilopango eruption. It could have been constructed and maintained by communal work groups organized from the village, or by individual landowners with properties adjacent to it, or by a higher authority presumably to the south. Each alternative is testable. Investigating the political aspects of the scabe focuses on the locus of authority involved in its construction and maintenance. The economic aspects involve transporting food produced in the outlying agricultural zones into the village (see paleoethnobotanical section below), and transporting surplus production from the village to an elite center for exchange to obtain obsidian tools, jade axes, and polychrome ceramics (Sheets 2000). The sacbe likely had ritual functions as well (Shaw 2008).

Hypothesis 2-A: The sacbe was built and maintained communally by the Cerén village.

Support for this hypothesis would be consistency in construction from the beginning of the sacbe in the village, through the intermediate agricultural zone, and farther south. Construction data have been obtained from excavations exposing its surface, sides, and ditches, and trenches to expose internal construction and maintenance details. During the rainy season considerable maintenance efforts were necessary, especially along the sacbe’s edges and of the canals (Figure 1-2). Consistency in maintenance would support this hypothesis, as would be a broadening and increase in formality as it enters the village. Construction and maintenance variation would not correlate with agricultural property boundaries adjacent to the sacbe.

Figure 1-2. Sacbe in Op. W.
Featured in the picture is the sacbe with drainage ditches and maize fields on both sides. (C. Dixon)

Hypothesis 2-B: The sacbe was built and maintained in sections by adjoining farmers.

If individual landowners (or users) were responsible for construction and maintenance, significant variation along the sacbe would be expected. Preliminary indications that this hypothesis is not unreasonable were encountered in 2011 in Operations S, U, and W (Dixon 2011b), as the width varied from 140 to 214 cm, and maintenance varied somewhat. Data and interpretations on sacbe variation are presented below.

Hypothesis 2-C: Sacbe construction and maintenance were by higher authority.

It is possible that the sacbe connected Cerén to an elite center to the south, perhaps San Andres (Dixon 2011b). That presents the possibility that construction and maintenance were organized at a hierarchical level above the village. Evidence to support the hypothesis would be finding no correlation between agricultural property boundaries and sacbe sections and sacbe consistency through the southern agricultural zone, and farther south. Additional evidence to support this hypothesis could be decreasing size and formality of the sacbe entering the village, and the opposite as it continues southward toward a more powerful settlement. This was not supported by evidence collected during 2013.

<u>Research Objective #3: Where does the Sacbe end in the Cerén Village?</u>

Shaw (2008: 106-124) documents multiple functions of sacbeob (the plural form of sacbe) on the Yucatan peninsula, including economic, religious, social, practical, hydraulic, military, symbolic, and astronomical. The assumption that **a** function of the Cerén sacbe was economic seems reasonable. The locus and nature of its termination within the village may shed light on another function. If it continues straight northward from Operation W, it could end at the town plaza, indicating more economic and social, or possibly political, functions (Figure 1-1). If its gentle curve continues, it could end up in the religious complex of Structures 10 and 12. Structure 10 was built for village ceremonies, and a ceremony celebrating the harvest was in progress when Loma Caldera volcanic vent blasted into eruption, 600 m north of the village. Thus it could have served as the emergency exit during the eruption.

<u>Research Objective #4: Economic Function of the Sacbe?</u>

Sacbeob were not only loci for ritual activities, but also served an economic function by facilitating transportation (Chase & Chase 2001: 277-279). As such, excavations along the Cerén sacbe can be viewed as a paleoethnbotanical transect through a Late Classic farming community as many of the crops and other plant products of the community at some point would have moved along this central artery (Folan 1991:224). Because of this commercial activity, it seems likely that the plant products being transported would be routinely, if inadvertently, deposited along the route. At a typical Late Classic Mesoamerican sacbe, these plant remains would be lost to the ravages of time, exposure and microbial activity. At Cerén, because of the rapidly-deposited ash cover rendered by the Loma Caldera eruption, these informative plant parts are recoverable from the surface and sides of the sacbe, and a systematic and intensive plant retrieval strategy was implemented (see chapter below).

Cerén has the deserved reputation as an ancient Maya site with unprecedented preservation, and large number of archaeological plants have been identified from the site. However, evidence of other plants that might be expected has not been recovered. Tobacco (*Nicotiana* spp.), goosefoot (*Chenopodium* spp.), amaranth (*Amaranthus* spp.) and chia (*Salvia hispanica* L.) are but a few examples of small-seeded New World crops that are known ethnographically from Mesoamerica (Lentz 2000), but are rare or absent at ancient Maya sites (Lentz 1999).

Methodology

To increase our ability to retrieve small seeds, we expanded our flotation sampling to intensify the plant retrieval process. We employed a modified Apple Creek water flotation system (Pearsall 2000:15) to process soil samples for paleoethnobotanical analysis. This technique has been used at Cerén in the past (Lentz et al. 1996a, 1996b; Lentz and Ramírez 2002) because it matched both the limited supply of clean water available and the desired retrieval efficacy for macroremains. Fortunately, the water system at Joya de Ceren has been greatly improved enabling us to develop a more effective flotation machine. In an effort to increase our retrieval capacity, a new device, a modified SYMAP flotation tank (Pearsall 2000) was constructed for our project that has the capability of processing more soil with greater efficiency. We have tested this device and have found that it is highly efficient at recovering tiny seeds. For this new phase of research, we expanded the sample size to about twenty liters of soil per archaeological unit.

To minimize the handling and maximize the retrieval of tiny seeds, we caught the light fraction from the flotation tank with fine mesh nylon fabric backed by a fine mesh geological screen (150 µm sieve opening) which captured even the smallest of seeds. The light fraction was collected in the nylon fabric then immediately hung up to dry in the shade. When dry, the plant remains in the nylon fabric, as well as any trapped in the metal geological sieve, were placed in paper bags, labeled and sealed for transport to the UC Paleoethnobotany Laboratory for further analysis with light microscopy and environmental scanning electron microscopy (ESEM).

The Sacbe Replica

Lacking stone linings, the sacbe would disappear soon after abandonment. To explore how long that would take, a replica was constructed July 2013 in a fenced area within the archaeological park, and photographed every week by guards for a year. The PI and a graduate student will return July 2014 to examine the photographic documentation and excavate the remains to understand the time needed for it to disappear. It is likely earthen sacbeob were common in the Maya highlands but have not been preserved.

Overview

The subsequent chapters in this report cover the key topics being researched, including patterns and variations in the sacbe during its entire length excavated, soils, paleoethnobotanical remains discovered, ceramics, and agricultural fields found on both sides of the sacbe. More specifically, Christine Dixon and Payson Sheets describe the sacbe and its drainage canals. It is a fascinating feature that runs south of the village, and it probably had multiple functions. At least the northern end, near the village center, had earlier phases of construction and use. Christine Dixon describes the agricultural fields found on both sides of the sacbe. Excavations encountered hundreds of maize plants as hollow cavities, which we filled with dental plaster to preserve them in perpetuity. Important new discoveries were made, including the fascinating small inter-ridges that often were built in between the maize ridges. In one place we found an ayote (squash) plant that was growing between two rows of maize plants.

Alexandria Halmbacher and Rachel Egan present abundant data on soils in their chapter. That is followed by a chapter by David Lentz and Venicia Slotten on their paleoethnobotanical research, most of which will be conducted at the University of Cincinnatti beginning in September of 2013. Rocio Herrera and MichelleToledo conducted a detailed analysis of the ceramics collected during the research, some from the agricultural fields and some from the sacbe. The ceramic chapter is followed by another artifact chapter: lithics, by Payson Sheets. Nancy Gonlin wrote a thoughtful chapter comparing Copan with Joya de Ceren. The final chapter is an overview of accomplishments of the project during the 2013 research season.

Conclusions

The report outlines the findings of our 2013 research. The report begins with a discussion of the main focus of the project, the sacbe and its associated canals and features. Agricultural production and cultivation at the site are then explored, followed by the contributions from analysis of soil chemistry, paleoethnobotanical remains, and the ceramic and lithic artifact recovered during this field seasons. Finally, these findings and the Cerén site are then contextualized in the broader context of Mesoamerican archaeology and a summary of our findings is provided.

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Chapter 2 Cerén Sacbe

Christine C. Dixon, Ph.D. and Payson Sheets, Ph.D.

Introduction

The burial of the Cerén site beneath multiple meters of Loma Caldera tephra (c. A.D. 630) resulted in the remarkable preservation of Cerén's structures, features, artifacts, and agricultural fields. Research at the site continues to afford a detailed view of one ancient Maya community (Sheets 2002). The 2013 Cerén field season focused on the exploration of the earthen *sacbe* (road; plural *sacbeob*) (Freidel et al. 1993: 77) and associated canals first identified at Cerén in 2011 (Figure2-1). This chapter begins by describing the context of the project and previous related findings at the site; it then offers a detailed account of each of the 2013 excavation that encountered the sacbe before turning to broader considerations of sacbe construction techniques, earlier sacbeob at the site, canal drainage and construction, associated agricultural fields, as well as the related features of a platform and footprints discovered this season. Finally, the chapter concludes with a discussion of the implications of these results and potential future research.

Sacbe Background

With the discovery of an earthen sacbe at Cerén, it is imperative to consider in the context of other Maya sacbeob. The term *sacbe,* while literally translated to "white way" in the Yucatec Mayan language, has been used to describe a diversity of roadways that have been documented throughout the Maya area, prominently in the Yucatan Peninsula (Freidel et al. 1993:77). The majority of sacbeob recorded were constructed with stone architecture and coated in limestone plaster, resulting in a white color, for which the name is likely derived (Folan 1991: 222). The central areas of the sacbeob were often raised which facilitated drainage to either or both sides (Schwake 1999). These roads varied greatly in size and typically ranged in length from multiple meters to many kilometers and from one to thirty meters in width (Folan 1991; Schwake 1999). There is also variation in the formality of drainage canals and ditches that are associated with sacbeob (Folan 1991; Schwake 1999). As with modern roads, the size of any given sacbe was likely to vary in width and height.

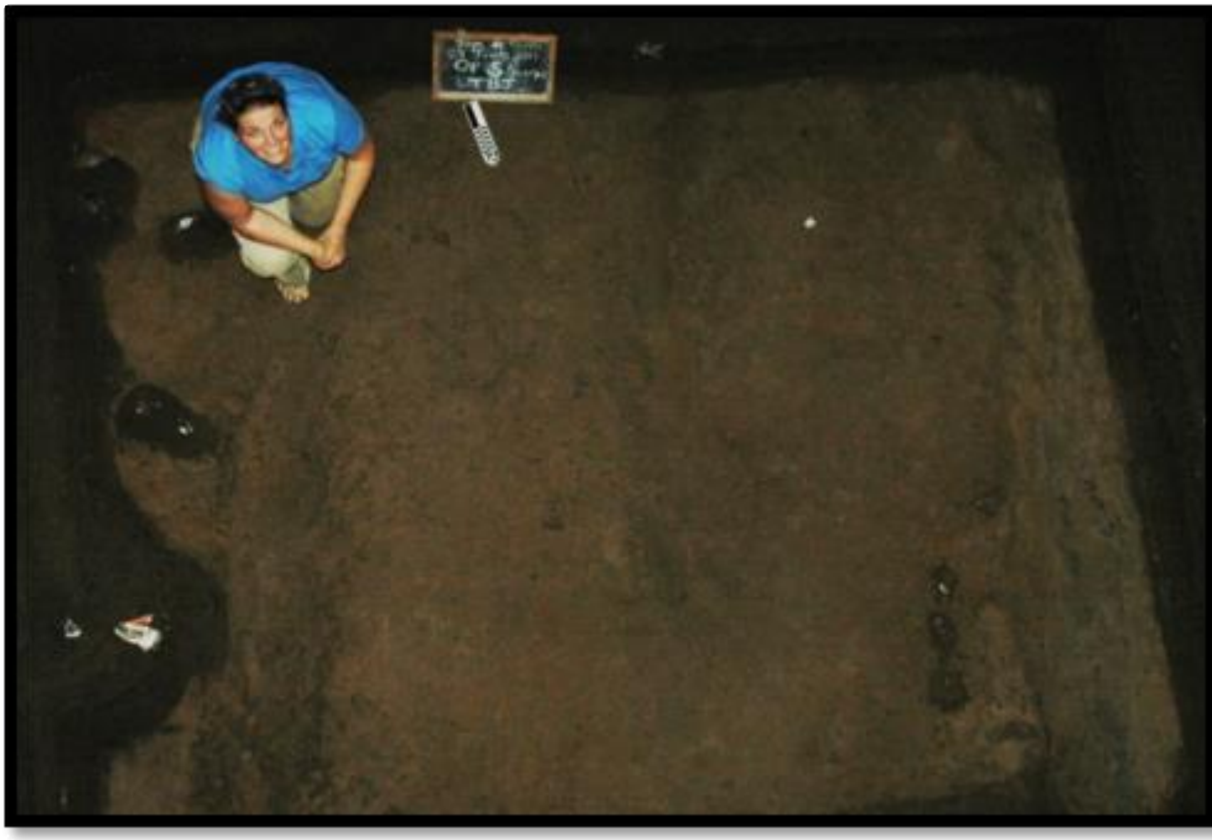

Figure 2-1. Cerén Sacbe (Op. S- 2011)

The functions and meanings of sacbeob were likely multiple (Sharer 2006; Schwake 1999). Intra- and inter-site transportation were obvious usages (Chase and Chase 1996; Cheetham 1994; Schwake 1999), but social, political, and religious meanings were also interwoven with basic functions of movement (Chase and Chase 1994; Folan 1991; Freidel et al. 1993; Tedlock 1985). Such significance includes the potential connection of sacbeob to the Milky Way (Freidel et al. 1993: 76-77), a role in the creation story of the Popol Vuh (MacLeod and Puleston 1978: 71), and the function of sacbeob to both physically and symbolically connect political centers (Ashmore 1992; Folan 1991).

Research Goals

The 2013 field season aimed to further document the extent, construction, and maintenance of the earthen sacbe discovered in 2011. The first key research objective for this project was to assess the degree of maintenance for sections of the sacbe and their potential correlation with adjacent agricultural fields to determine if maintenance of the sacbe was conducted by local farmers, work groups, or a higher political organizing force. Such correlations would have important implications for the understanding of the socio-political economy (Dixon 2013) of the community, including how governing decisions were potentially made and operationalized in everyday life. The regular and central practices of agricultural production, food processing, and maintenance of features such as the sacbe and structures, would have profoundly shaped, and have been shaped by, political, social, and ideological structures at the site.

The second central research objective was to locate the northern and southern extent of the Cerén sacbe and analyze the degree of construction formality of the sacbe and canal in each area. It was hoped that such findings might inform relationships of power between the Cerén center and settlements to the south, such as the major regional center of San Andrés, located 5 km to the south. The final research objective for the investigation of the sacbe was to explore its potential functions. By documenting the point of entry for the sacbe into the site center, it was expected we would gain insight into its significance. The connection of the sacbe to the locus of political authority (Structure 3) or religious power (Structure 10) or other locations might have different implications for its symbolic and physical purposes.

Summary of the 2011 Cerén Findings

The Cerén sacbe was initially discovered in the 2011 excavation of Op. S located just north of the southern boundary of the Cerén Archaeological Park. Operations S, U, and W revealed three sections documenting an estimated 42 meter extent of the earthen road, with an average width of two meters, an average height of 21 cm, and clearly defined drainage canals along the eastern and western edges of the sacbe (Table 2-1) (Dixon 2011).

2011 Op.	Average Sacbe Orientation (degrees E of True N)	Average Sacbe Width (cm)	Length Visible in excavation (cm)	Average Height from West Canal to top of Sacbe (cm)	Average Height from East Canal to top of Sacbe (cm)	Average Sacbe Slope	Average Canal Slope
S	24	214	321	12	14	3° towards western canal	2° towards North
U	26	193	322	34	19	1° towards northern end of the sacbe; 5° towards western side of the sacbe	4° towards North
W	33	151	352	22	28	3° towards the western side of the sacbe	1° towards South
Average	**28**	**186**	**Total: 995**	**23**	**20**	**4° to the west**	**3° towards north (Ops. S and U)** **1° towards south (Op. W)**

Table 2-1, Summary of Cerén Sacbe Data from 2011 Ops. S, U, and W[1]

In each of these three sacbe sections the center showed heavy compaction of the surface from significant foot traffic. This compaction resulted in a very hard central surface that showed concavity along the central axis of the sacbe. Furthermore, a trench into the north side of Op. S allowed us to document construction and showed that the sacbe in this area was a single building episode achieved by packing large amounts of the Cerén living surface (Figure 2-2). This Cerén living horizon is comprised of the Tierra Blanca Joven (TBJ) soil that was weathered from the Ilopango eruption and named for the whitish color of the tephra (Sheets 2002). The TBJ soil used to construct the sacbe in Op. S was a light whitish-brown color and a thin layer of white TBJ had been selected for the uppermost layer of the road (Dixon 2011). The careful selection of the whiter tephra is significant given that white plaster is used on other sacbeob throughout the Maya area.

[1] Tables constructed by Alexandria Halmbacher and Christine Dixon

Figure 2-2. Cross-section of the 2011 Op. S Cerén Sacbe
The western (left) and eastern (right) canals shown- This image is the profile of a trench excavated into the sacbe to determine construction techniques. The resulting profile shows the careful selection of white TBJ tephra for the uppermost layer of the sacbe.

Another noteworthy preliminary finding of the 2011 field season was that the formality of sacbe edges and canals possibly correlated with the degree of formality of agricultural fields adjacent to those edges. From these observations we developed a hypothesis that individual land cultivators might have had a caretaking relationship for sacbe maintenance in their zone (Dixon 2011). If present, this type of labor organization would fit well with the service-relationships hypothesized for households and public structures within the Cerén site center whereby particular households appeared to have had a special relationship with certain public structures (e.g., Household 2 and Structure 9) (Sheets 2002). Research this summer was aimed at further examining the relationship between agricultural fields and the sacbe to ascertain if such a relationship was present. This association will be discussed in more detail below.

Methodology

In the pursuit of our research objectives we established ten operations (Ops. AE-AN), eight of which (Ops. AE-AK, AN) were excavated to the TBJ soil, the Cerén living surface. Each operation was assigned a letter designation, in alphabetical order, following the naming sequence from the 2009 and 2011 field seasons. These excavations ranged in size from three meters by three meters to four meters by seven meters, and each will be described in detail below.

A general protocol of excavation has been established for Cerén, which is briefly outlined first, followed by an additional description of specific measurements used to document the sacbe and associated canals. Excavations were undertaken with standard methods where Post Classic remains were carefully documented and excavated when present above the Loma Caldera tephra sequence. The Loma Caldera eruption (c. AD 630) deposited multiple meters of tephra on the site, beginning with Unit 1 and ending with Unit 14 (Sheets 2002). The upper section of the Loma Caldera tephra sequence from Units 14 through 4 was removed from each operation with shovels and picks. At the top of Unit 3 excavations slowed due to the presence of hollow cavities typically beginning at this horizon. From Unit 3 to Unit 1 *azedone*s (hoes) and trowels were used to slowly excavate down to the Cerén TBJ Classic Period living surface. The hollow cavities are the voids left from plants that were present at the time of the eruption. When hollow cavities were encountered, dental plaster was poured into these spaces, allowed to set, and then excavated to reveal a plaster cast of each plant. While, some of the dental plaster casts did not set as well as in the dry season given the wet nature of the matrix, hundreds of plant casts were successfully recovered and allow us to investigate the agriculture surrounding the sacbe (see Dixon this report Ch. 3).

Sacbe and canal measurements were developed and standardized during the 2011 field season upon first documentation of the feature (Dixon 2011). For each exposed portion of the sacbe we took the measurement of width from the west canal to the east canal, taken perpendicular to the sacbe. When possible, this measure was recorded for the sacbe in the north, middle, and southern portions of the sacbe and then an overall average was calculated. This provided documentation of the variation in width often seen in the sacbe from one portion of an operation to the other. The total visible length of the sacbe was recorded in each excavation and was taken in the center of the sacbe from parallel to the edges, along an approximate north-south axis. The height of the sacbe was recorded by measuring from the top of the sacbe to the base of each canal. Again these measurements were taken on each side of the sacbe and for each canal, where possible, measures were taken in the northern, middle, and southern portions and then were averaged.

A Brunton compass was used to measure the directionality of each sacbe edge to true north. The Brunton compass was also used to identify the slope of the sacbe and the slope of each canal. Canals were each measured for width in the north, middle, and southern parts of the feature and the depth to the base of each canal was taken from the sacbe and the other canal edge, typically an associated agricultural field, again in the north, middle, and southern portions of the canal and then averaged. Soil samples were collected from the sacbe, canals, and associated agricultural fields and are being analyzed by our paleobotanical team (see Lentz and Slotten this report Ch. 5). Finally, the relative hardness of each edge of the sacbe, each canal, and agricultural fields was taken using a penetrometer that measured the relative degree of resistance each area had to applied force, in kilos per square centimeter. The same individual took these measurements throughout the field season to assure consistency of force for each reading. The hardness data are useful in providing an assessment for the variation in compaction and hardness seen throughout our excavations, particular in the difference between the sacbe centers and edges. These measures provide us with a detailed assessment of the sacbe, canals, and associated features found at Cerén. The results of these data afford an opportunity to examine the integration of different sacbe sections from each operation to afford a view of the larger whole feature and understand the construction, use, and social, political, and ideological significance of the sacbe to the Cerén community.

Results of 2013 Excavations Documenting the Cerén Sacbe

The findings of the 2013 excavations of the Cerén sacbe are presented here based on their location in relation to one another and the site center (Figure 2-3). Data from 2011 excavations of Ops. S, U, and W are included in the analysis when pertinent to the discussion. To aid the reader findings from each 2013 excavation will be discussed from the sacbe excavation furthest to the south, Op. AJ, in sequential order towards the north, with a description of the final operation being that closest to the site center, Op. AK. Following this detailed presentation of each excavation, we will turn to discussion of the entire sacbe, canals, associated features, fields, and artifacts, and the broader implications of these findings.

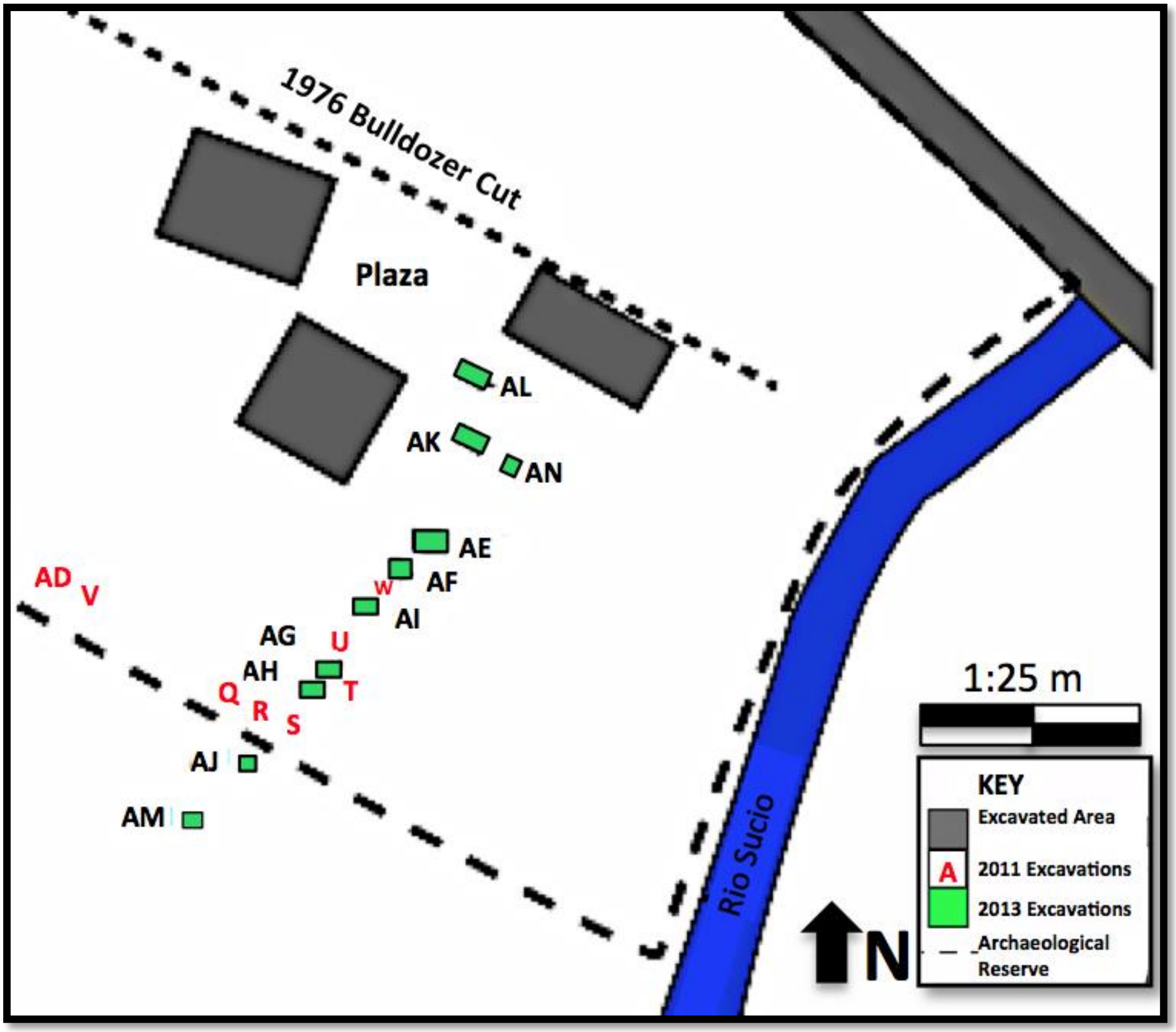

Figure 2-3, Map Showing the Location of the 2013 Excavations in Relation to the Site Center and Pertinent 2011 Excavations.

<u>Operation AJ</u>

Operation AJ was the southern-most excavation in which we have identified the Cerén sacbe (see Figure 2-3). Located approximately twenty meters south of 2011 Op. S and south of the Cerén Archaeological Park's southern border, this was a 3 x 3 meter excavation, oriented to true north and the Cerén living surface was encountered 312 cm below the modern ground surface. Since the operation was located in a modern agricultural field of a local farmer, the farmer was compensated for crop damages and the topsoil was kept separate from the other tephra removed, so as to maintain the integrity of the soil upon backfilling. The TBJ living surface revealed the sacbe, an east and west canal, and a very small section of an eastern agricultural field.

The sacbe section recorded in Op. AJ was an average of 183 cm in width, 23 cm in height, and extended across a length of 390 cm. There was an average slope along the surface of the sacbe running 2 degrees towards the west and 4 degrees towards the south. The average directionality of the sacbe was 28 degrees east of true North and along the eastern edge of the sacbe showed a noticeable turn in the center and southern portion of the operation towards the east (Table 2-2). Along the southern portion of the sacbe a large lava bomb directly hit the center of the sacbe and left a bomb sag, approximately 50 cm in diameter; thus, the measures of slope and hardness were taken in the middle and northern portions of the operation. The center of this section of sacbe was compacted and hard-packed but each side of the sacbe was somewhat eroded and very soft, especially along the eastern edge. This erosion was clearly visible in the divergent hardness measures along each edge of the sacbe in comparison with the center. An approximate 50 cm trench was dug into the northern-most section of the sacbe in this Op. to examine construction methods, which will be discussed below.

Both a western and eastern canal were visible on each side of the sacbe. The western canal was approximately 20 cm in depth, 59 cm in width, and had a slope of 2 degrees towards the north (Table 2-3). This canal was very sandy with non-compacted, loose sediment present that was deposited by the water running through the canal.

OP	Avg. Sacbe Width (cm)	Length of Sacbe (cm)	Average Sacbe Slope	Orientation of Sacbe (degrees E of true N)	Average Sacbe Height (cm)	Average Hardness (West Side of Sacbe)	Average Hardness (Center of Sacbe)	Average Hardness (East Side of Sacbe)
AJ	183	390	2° towards west; 3.5° towards south	28	20	0.2	4.6	1.6

Table 2-2. Op AJ Sacbe data

West Canal Average Depth from the Sacbe (cm)	West Canal Average Depth from West Agricultural Field (cm)	West Canal Width (cm)	West Canal Slope	West Canal Average Hardness
23	18	59	2 degrees towards north	0.07

Table 2-3. Op. AJ west canal data

The eastern canal of Op. AJ had an average depth of 12 cm, average width of 7 cm, and sloped 12 degrees towards the north (Table 2-4). This canal was very soft and delicate particularly along the eastern edge of the canal bordering a maize field. The ground surface of TBJ in this excavation was more fragile than those of other areas and both canals were not compacted. One explanation for the softness of TBJ in this location is the smaller amount of Loma Caldera tephra deposited to the south of the site, potentially resulting in more ground-water infiltration and a moister TBJ horizon.

East Canal Average Depth from the Sacbe (cm)	East Canal Average Depth from East Agricultural Field (cm)	East Canal Width (cm)	East Canal Slope	East Canal Average Hardness
17	7	7	12 degrees towards North	1.6

Table 2-4. Op. AJ east canal data.

Also found in Op. AJ was a maize field on the eastern side of the sacbe. While only a small section of this maize field was visible, it appeared to be a very productive field with eight stalks bent over in harvest and two ears of corn (*mazorcas*) present. Additionally, three ceramic sherds were found compacted into the top of the sacbe and no artifacts were found in either canal or the eastern maize field.

Op. AJ documented the furthest southern extent of the Cerén sacbe to date. An additional excavation, Op. AM was placed south of Op. AJ to intersect the sacbe further to the south; however, the sacbe appears to have turned slightly more towards to east in this region and is likely located just beyond the eastern wall of Op. AM. Op AM was dug to the Unit 3 horizon, but upon realization that there was an agricultural field in this location based on the presence and distribution of hollow cavities, it was decided that due to time constraints it was best to prioritize our excavations in other regions that were yielding greater documentation of the sacbe. Op. AM was carefully backfilled with tinfoil used to protect the hollow cavities at the top of Unit 3 for future excavations. Op. AJ clearly indicates that the sacbe continues to the south an unknown distance and the findings in Op. AM show that the most likely location of the sacbe continuation in the south is just east of Op. AM.

<u>Operation AH</u>

Op. AH was positioned north of Op. AJ and of 2011 Op. S on the inside the Cerén archaeological park (See Figure 2-3). This excavation was 3 meters by 5 meters in size and the TBJ horizon was approximately 430 cm below the modern ground surface. Op. AH documented the sacbe in the central part of the excavation with both western and eastern canals present, as well as maize fields to the east and west.

The section of the sacbe present in Op. AH was an average of 232 cm in width, 16 cm in height, and had a slope of 4 degrees to the northwest. The average directionality of this section was 29 degrees east of True North (Table 2-5). Along this portion of the sacbe, the central area was heavily compacted and slightly concave, presumably from deliberated packing and maintained by heavy foot traffic. The eastern edge of the sacbe was sloped into the canal and had some erosion and destruction to the edges where individuals had probably stepped on the edge of the sacbe and cause slumpage into the eastern canal. Two possible footprints were identified along this eastern edge with accumulation of tephra below them in the eastern canal where a footstep would have dislodged a small portion of the sacbe edge. The western edge of the sacbe was very uneven and sandy with a gradual slope down into the western canal. A total of five possible footprints were identified along this edge and there were many areas where the edge of the sacbe had been dislodged into the canal from foot traffic.

OP	Avg. Sacbe Width (cm)	Length of Sacbe (cm)	Average Sacbe Slope	Orientation of Sacbe (degrees E of true N)	Average Sacbe Height (cm)	Average Hardness (West side of Sacbe)	Average Hardness (Center of Sacbe)	Average Hardness (East Side of Sacbe)
AH	232	365	4° toward NW	29	16	1.9	Greater than 5	2.2

Table 2-5. Op. AH sacbe data

Both eastern and western canals bordered the sacbe in this region. The base of the western canal in Op. AH was very sandy and the eastern edge of the canal, along the sacbe's western edge was very sloped and eroded. The average depth of the west canal was 16 cm, the average width was 30 cm, and there was approximately 1 degree of slope towards the north (Table 2-6).

West Canal Average Depth from Sacbe (cm)	West Canal Average Depth below West Maize Field (cm)	West Canal Width (cm)	West Canal Slope	West Canal Average Hardness
19	12	30	1° towards North	1.2

Table 2-6. Op. AH West Canal Data

The eastern canal was a shallow canal with sloped edges on each side. This canal was better maintained than its counterpart in the western canal and had a harder surface, as visible in the comparative hardness measures. There were two possible areas where footprints had created lumped areas of sacbe-fall within the canal. The eastern canal was approximately 9 cm in depth, 27 cm in width, and sloped 2 degrees towards the north (Table 2-7).

East Canal Average Depth from Sacbe (cm)	East Canal Average Depth below East Maize Field (cm)	East Canal Width (cm)	East Canal Slope	East Canal Average Hardness
12	6	27.3	2 ° towards North	2.1

Table 2-7. Op. AH East Canal Data

Maize fields bordered each side of the sacbe and canals, although only a very small fraction of the western field was visible with one plant locus and three very small sections of ridges. The eastern field was more visible in the excavation and had both ridges and small interridges and one bent over stalk and two mazorcas. There were 20 ceramic sherds found in the eastern field, 2 sherds in the west field, 13 sherds found along the top of the sacbe, many of which were compacted into the surface, and no sherds in either canal. Findings from Op. AH were very similar to that of Op. S from 2009, just south of Op. AH, as well as Op. AG, located to the north.

Operation AG

Op. AG was located approximately 5 meters north of Op. AH and was a 3 by 5 meter excavation oriented to true North. Op. AG was also positioned west of Op. T and south of Op. U from the 2011 excavations (See Figure 2-3). The Cerén horizon was encountered approximately 475 cm below the modern ground-surface and revealed a section of the sacbe with east and west canals and maize fields on each side.

The average width of the sacbe was 176 cm, the length recorded was 340 cm, and the average slope was 2 degrees towards the south. The sacbe was orientated to an average of 29 degrees east of true North and had an average height of 22 cm (Table 2-8). Similar to Ops. AJ and AH, the sacbe was very hard, compacted, and slightly concave along the central region, again showing probable evidence for heavy use in the center of the feature. The western edge of the sacbe was very irregular with a significant amount of damage to the edge and a gentle, sloped edge that was eroded and showed many areas of damage from foot traffic, where portion of the sacbe were pushed into the western canal. The eastern sacbe edge was more linear with some areas of damage but more regularity and a more linear termination. The variation in hardness measures when comparing each side to the center, also confirms this observation. An approximately 50 cm wide trench was dug across the northern-most portion of the sacbe visible in this operation to examine sacbe construction techniques. This trench showed a clear selection for whiter TBJ along the upper-most portion of the sacbe. This trench will be further discussed below in regard to sacbe construction

OP	Avg. Sacbe Width (cm)	Length of Sacbe (cm)	Average Sacbe Slope	Orientation of Sacbe (degrees E of true N)	Average Sacbe Height (cm)	Average Hardness (West Side of Sacbe)	Average Hardness (Center of Sacbe)	Average Hardness (East Side of Sacbe)
AG	176	340	2° towards South	29	22	1.8	4.3	2

techniques.

Table 2-8. Op. AG sacbe data

Following the same pattern seen in the Op. AH western canal, the southern section of the Op. AG western canal was very eroded with multiple footprints and areas where the sacbe edge had been pushed down into the canal. The western edge that bordered the west maize field was more uniform and smoother, likely due to less foot traffic and water flow from the fields into the canal. The western canal had an average depth of 26 cm, an average width of 52 cm, and sloped approximately 2 degrees towards the north (Table 2-9).

West Canal Average Depth from Sacbe (cm)	West Canal Average Depth below West Maize Field (cm)	West Canal Width (cm)	West Canal Slope	West Canal Average Hardness
30	21	52	2° towards North	2.5

Table 2-9. Op. AG west canal data

The eastern canal of Op. AG showed some similar damage where small portion of the sacbe edge had been compressed into the canal, but was much more uniform and less eroded than the western canal along this section of the sacbe. This canal was on average 9 cm in depth, 27 cm in width, and slope approximately 2 degrees towards the north (Table 2-10). This canal was shallow, particular along the edge bordering the eastern maize field.

East Canal Average Depth from Sacbe (cm)	East Canal Average Depth below East Maize Field (cm)	East Canal Width (cm)	East Canal Slope	East Canal Average Hardness
14	4	27	2° degrees towards North	1.8

Table 2-10. Op. AG East Canal Data

Of the two maize fields associated with the sacbe in this region, a smaller portion of the eastern field was visible in our excavations. The eastern field had the beginning portion of four ridges visible and with four stalks bent in harvest and no mazorcas present. A slightly large section of the western field was document including three ridges that had three maize stalks bent for harvest and four mazorcas. There were 39 ceramic sherds identified along the top of the sacbe, many of which had been compressed into the surface, 8 sherds in the eastern canal, 2 sherds in the western canal, 1 sherd in the eastern agricultural field, and 5 sherds in the western field. The variation in ceramic sherds present in each canal might suggest one had a heavier water volume more recently than the other, or might be an arbitrary finding.

<u>Operation AI</u>

Op. AI was positioned north of Op. AG and between two excavations from 2011, south of Op. W and north of Op. U (See Figure 2-3). Approximately 479 cm below the current ground-surface this excavation documented the sacbe, east and west canals, and eastern and western maize fields.

The portion of the sacbe visible in Op. AI had an average width of 147 cm, an average height of 21 cm, and an average orientation of 34 degrees east of true North. Along the 370 cm long portion of the sacbe in this operation, it had a significant slope of 12 degrees towards the west and a more subtle slope of 4 degrees to the south (Table 2-11). As with the sacbe sections to the south, this portion showed significant compaction and hardness along the central region and was slightly concave along the central corridor of the sacbe where the majority of traffic would have occurred. The western edge of the sacbe was irregular, very wide from erosion, and sloped gradually into the western canal. There appeared to be much evidence for erosion along this side of the sacbe where people had dislodged portions of the sacbe into the canal and little recent maintenance had occurred. The side was also very sandy and much softer than the central region of the sacbe. The eastern side of the sacbe was also soft but showed less damage and more uniform termination along the edge of the eastern canal than that of the west. An approximately 50 cm wide trench was dug along the northern-most section of the sacbe in this Operation to better understand sacbe construction.

OP	Avg. Sacbe Width (cm)	Length of Sacbe (cm)	Average Sacbe Slope	Orientation of Sacbe (degrees E of true N)	Average Sacbe Height (cm)	Average Hardness (West Side of Sacbe)	Average Hardness (Center of Sacbe)	Average Hardness (East Side of Sacbe)
AI	147	370	12° towards west, 4° towards south	34	21	1.7	3.3	1.5

Table 2-11. Op. AI Sacbe Data

The western canal of Op. AI was heavily eroded and very irregular. It had an average depth of 21 cm and an average slope of 4 degrees towards the south (Table 2-12). The average width of this canal was 75 cm and this size is likely due to the destruction of the western edge of the sacbe and the heavy impact from trampling of the sacbe edge into the canal. Additionally, the western canal was very sandy and delicate.

West Canal Average Depth from Sacbe (cm)	West Canal Average Depth below West Maize Field (cm)	West Canal Width (cm)	West Canal Slope	West Canal Average Hardness
25	16	75	4° towards South	1.2

Table 2-12. Op. AI West Canal Data

The Op. AI eastern canal was shallow and narrow. This canal was much more regular and uniform than its western counterpart, despite some small areas of erosion. The canal had an average depth of 13 cm, an average width of 29 cm, and an average slope of 4 degrees to the south (Figure 2-13).

East Canal Average Depth from Sacbe (cm)	East Canal Average Depth below West Maize Field (cm)	East Canal Width (cm)	East Canal Slope	East Canal Average Hardness
17	9	29	4° towards South	1.7

Table 2-13. Op. AI east canal data

Portions of agricultural fields to the east and west were also associated with the sacbe in this operation. A larger portion of the eastern canal was visible in the excavation and included four ridges and three interspersed interridges. The ridges of this field were spaced further apart than is typical for maize at the site, an average of 108 cm in spacing, and were somewhat wider than typical maize ridges, an average of 42 cm in width (See Dixon this report Ch. 3). This east maize field had no maize stalks bent over in harvest and no mazorcas. The western maize field revealed three small portions of ridges with two maize stalks bent over in preparation for harvest and two mazorcas. Two partial vessels were present in the eastern field and 9 ceramic sherds: 3 ceramic sherds on the top of the sacbe, 2 sherds in the west field, 3 sherds in the west canal, and 3 sherds in the east canal. Op. AI facilitated another window of the sacbe, canals, and maize fields in this region of the site.

<u>Operation AF</u>

Operation AF was located immediately north of Op. W from 2011 (see Figure 2-3). Until this season, remains in Op. W had documented the furthest northern extent of the sacbe previously recorded at the site. Op. AF was positioned to follow the sacbe north of this region and assess where in the site center this road might connect. The primary goal of Op. AF was to determine the continuation and directionality of the sacbe to the north, so it was established as a 3 meter by 3 meter excavation aligned with the projected course of the sacbe from Op. AG and Op. W. Approximately 482 cm below the current ground-surface, we documented the continuation of the sacbe, associated east and west canals, and two very small portions of agricultural fields.

In Op. AF, a 382 cm long section of the sacbe was recorded that had an average width of 2 meters, an average height of 23 cm, and a significant slope of approximately 10 degrees towards the west and 5 degrees towards the south. The sacbe was orientated approximately 39 degrees east of true North (Figure 2-14). The sacbe showed similar trends in this region as those to the south in terms of the compaction and hardness of the central corridor of the road. The western edge of the sacbe was a very gradual slope down into the western canal and it appeared there had been significant water run-off on this portion of the sacbe as a result of the large slope towards the west. A lava bomb impacted the northern end of the sacbe edge and left a bomb sag. Furthermore, possible footprints and areas of tephra from the sacbe present in the canal indicate that this edge had not been recently maintained. The eastern sacbe edge was much more formal in construction with a clear termination of the sacbe at the canal's edge. This eastern edge had some slight damage in the north where evidence of possible footprints showed areas where it appeared that people had possibly stepped on the edges and caused tephra from the sacbe to slump and fall into the canal.

OP	Avg. Sacbe Width (cm)	Length of Sacbe (cm)	Average Sacbe Slope	Orientation of Sacbe (degrees E of true N)	Average Sacbe Height (cm)	Average Hardness (West Side of Sacbe)	Average Hardness (Center of Sacbe)	Average Hardness (East Side of Sacbe)
AF	200	382	5^{o} towards South; 10^{o} towards West	39	23	0.7	4.5	1.5

Table 2-14. Op. Ag Sacbe data

The western canal of Op. AF was extremely sloped and had irregular and damaged edges. A lava bomb in the northern section of the canal significantly damaged that end but in general the canal was informal and did not appear to have been recently maintained. The canal had an average depth of 17 cm, an average width of 30 cm, and sloped 4 degrees towards the south (Table 2-15). In general, the canal was informal and did not appear to have been recently maintained with substantial damage to the edges.

West Canal Average Depth from Sacbe (cm)	West Canal Average Depth below West Maize Field (cm)	West Canal Width (cm)	West Canal Slope	West Canal Average Hardness
17	N/A	30	4° towards South	2.7

Table 2-15. Op. AF West Canal Data

The Op. AF eastern canal was a formal, regular canal in the southern end of the excavation and appeared to have been well-maintained. The northern portion of the canal was less uniform with some areas where small amounts of tephra had been pushed into the canal from the eastern edge of the sacbe. This eastern canal had an average depth of 29 cm and an average width of 30 cm. There was an approximately 3 degree slope of the canal towards the south (Table 2-16).

East Canal Average Depth from Sacbe (cm)	East Canal Average Depth below West Maize Field (cm)	East Canal Width (cm)	East Canal Slope	East Canal Average Hardness
29	22	30	3° towards South	3.75

Table 2-16. Op. AF East Canal Data

Portions of two maize fields were also identified in Op AF. Only a very small portion of the western field was visible with one plant locus that appeared to be present on a small planting mound or the very edge of a small ridge approximately 4 cm in height. There were no bent over stalks in this plant from the western field, but there was a mazorca. A larger portion of the western maize field was present in the excavation with two agricultural beds. Maize was planted in these beds, but the size and spacing suggest that these beds might have been previously used for manioc cultivation (Dixon this report Ch. 3). There were not bent over maize stalks, but two mazorcas were found in this field. There were four ceramic sherds in the western maize field and 6 sherds in the east field. Along the top of the sacbe 22 ceramic sherds were recovered, many of which had been pressed into the top of the road. No ceramic remains were found in the west canal, but 15 sherds and an almost complete vessel were present in the eastern canal. Op. AF allowed for documentation of the sacbe closer to the site center and to project the continued orientation of this feature and the canals and agricultural fields in which it was situated.

Operation AE

Op. AE was positioned approximately 5 meters north of Op. AF and an estimated 10 meters east of the Cerén Household 2 complex (see Figure 2-3). The major objective of this operation was to determine whether the sacbe turned to the east toward Household 1 and the religious complex, continued straight towards the likely eastern extent of the Cerén plaza, or turned to the west and headed toward another area of the site, such as the political center, Structure 3 (Sheets 2002). Op. AE was 4 meters by 7 meters in size to facilitate a greater chance of locating the sacbe in this area. At approximately 443 cm below the current ground-surface we uncovered a section of the sacbe in the far western side of the excavation, the eastern canal, and a large section of a maize field to the east.

The sacbe was present in the western edge of the operation and a 40 cm by 40 cm extension was dug into the north and west excavation walls to locate the western edge of the sacbe. The center of the sacbe did not feel as compacted as areas to the south and appeared to be very slightly raised in the center, where other portions of the sacbe to the south showed slight concavities along the central corridor. The western edge of the sacbe was not visible until the extension was completed. It revealed a very small section that showed this edge to be shallow and eroded that sloped into a shallow western canal. The eastern edge of the sacbe came to a distinct and formal edge that had a steep, vertical drop into the eastern canal. The sacbe was approximately 182 cm in width, which was measured from the west edge identified in the extension to the eastern edge, parallel to the sacbe. The sacbe had an average height of 29 cm, sloped 3 degrees towards the south, and was oriented approximately 40 degrees east of true North (Table 2-17).

OP	Sacbe Width (cm)	Length of Sacbe (cm)	Average Sacbe Slope	Orientation of Sacbe (degrees E of true N)	Average Sacbe Height (cm)	Average Hardness (West Side of Sacbe)	Average Hardness (Center of Sacbe)	Average Hardness (East Side of Sacbe)
AE	182	200	3^{o} towards the South	40	29	1.1	4.8	2

Table 2-17. Op. AE sacbe data

An approximately 40 cm wide trench was excavated along the northern end of the sacbe. In the course of this excavation two earlier sacbeob were identified beneath the previously recorded sacbe. We named these sacbeob Sacbe 1 for the earliest interior sacbe, Sacbe 2 for the sacbe found in the center (Table 2-18), and Sacbe 3 for the ultimate sacbe that has been the focus of our investigation. Sacbe 2 was approximated 14 cm below the upper sacbe, Sacbe 3 and approximately 9cm above the earlier sacbe below, Sacbe 1. Sacbe 2 was visible as a very compact, cement-like white surface that was approximately 80 cm wide and extended in the western side of Sacbe 3. It is possible that Sacbe 2 extended 125 cm in width, but it was more difficult to discern the edges of the less-compacted and non-white areas. This sacbe was oriented approximately 25 degrees east of true North and a very hard red portion of oxidized TBJ along the surface indicates the sacbe might have been in use for a significant period of time, since TBJ is sometimes oxidized by sunlight into a red color. There was a burned area of charcoal along this horizon and samples were collected for paleobotanical investigation. Sacbe 1, the original sacbe surface had a very white and compacted surface that was approximately 81 cm in width and had both an east and west canal visible. The eastern canal of Sacbe 1 was approximately 28 cm in depth and was approximately 40 cm wide with a lot of sandy sediment present in its canal. The western canal of Sacbe 1 was approximately 40 cm in depth and 18 cm in width. It appeared to be more uniform and defined than that of the eastern canal. It is very significant that we are finding earlier phases of construction closer to the site center but not in the southern excavations. This layering likely indicates that the sacbe we have been recording (Sacbe 3) is a more extensive than the earlier phases closer to the site center.

OP	Sacbe #	Average Sacbe Width (cm)	Length of Sacbe N-S (cm)	Avg. Slope of Sacbe	Orientation of Sacbe (degrees E of true N)	Average Sacbe Hardness Measure
AE	3 (Ultimate)	182	200	3° towards the South	40	4.8
AE	2 (Penultimate)	80	237	N/A	25	2.4
AE	1 (Earliest)	81	79	2° slope to the north	32	5+

Table 2-18. Op. AE Sacbeob Data

The small section of the western canal that was visible in the northwest extension was a shallow, eroded canal that appeared to have had a significant amount of water run-off that had drained west off the sacbe. The western canal was approximately 25 cm deep, 40 cm wide, and had a 2 degrees slope towards the south (Figure 2-19).

West Canal Average Depth from Sacbe (cm)	West Canal Average Depth below West Maize Field (cm)	West Canal Width (cm)	West Canal Slope	West Canal Average Hardness
25	N/A	40	2° towards South	1.9

Table 2-19. Op. AE West Canal Data

The eastern canal of Op. AE was very well defined and uniform. The steep sides and depth of the canal, as well as the lack of damage to the edges indicated that the sacbe edge might have been maintained and less water run-off flowed over the eastern edge. The canal maintained a uniform depth and width throughout with only one area that appeared impacted by someone stepping on the side of the sacbe and pushing a small amount of tephra into the canal. Linear color striation along the base of the canal, running parallel to the canal might have been formed from the movement of water across this area. The eastern canal had an average depth of 30 cm, an average width of 34 cm, and sloped 3 degrees towards the south (Figure 2-20).

East Canal Average Depth from Sacbe (cm)	East Canal Average Depth below West Maize Field (cm)	East Canal Width (cm)	East Canal Slope	East Canal Average Hardness
33	26	34	3° towards South	2.5

Table 2-20. Op. AE East Canal Data

A large portion of a maize field was found east of the sacbe in Op. AE. This field had only four maize stalks bent over in preparation for harvest and had 19 mazorcas. There were well-formed ridges and interridges present and it appeared to be a well-maintained field. In addition to maize, this field yielded an *ayote* (squash) plant cast growing nearby to one of the maize ridges that had a portion of the stem preserved and facing toward the interridge. This is a significant contribution to our understanding of Cerén agriculture because it facilitates direct date of how and where this crop was grown at the site (Dixon this report Ch 3.). There were 5 ceramic sherds recovered on top of the sacbe and 22 sherds found in the eastern agricultural field. Op. AE indicated that the sacbe continued to head straight and did not turn significantly to one side or the other as it approached the site center and documented two earlier phases of sacbeob construction present in the central area of the site but not to the south.

<u>Operation AK</u>

Op. AK was located north of Op. AE and aimed to intersect the sacbe as it continued into the central area of the Cerén site. Op. AE was positioned northeast of Household 2 and southwest of Household 1 (see Figure 2-3). This operation was 3 meters by 6 meters and positioned approximately perpendicular to the sacbe, based on the projected continuation of the sacbe. The ground-surface was a culturally made hill where in part of the excavation area the upper Loma Caldera strata had been removed. Thus, the depth below the modern day ground-surface varied greatly from the west side of the Op. where it was approximately 550 cm and the depth of TBJ below the ground surface on the east side, which was approximately 370cm. The excavation of the Cerén living surface in this area documented the continuation of the sacbe into the middle of this operation, with a maize field to the east and a maize field to the west of the sacbe. The canals of this operation were different than those of previous excavations. The western canal extended through from the northern to southern wall of the pit, but was intersected by a perpendicular canal, termed the drainage canal. This drainage canal would have drained the water from the northern portion of the west canal towards the west. The drainage canal was bordered by the western maize field to the north and by a constructed platform to the south. To better assess the platform, we excavated an approximately 50 cm extension into the southern wall. An eastern canal was present in the operation but only along the southern portion of the sacbe in this area. One possibility is that this is the beginning of the eastern canal, potentially marking a change in the sacbe or a nearing of the sacbe terminus. Alternatively, there is an area between the eastern maize field and the known sacbe that appears concave. It is possible there was once a canal extending across this region but it had since been filled in.

The sacbe in Op. AK was impacted during the Loma Caldera eruption by two large lava bombs along the northern section and the southern section. Each of these large lava bombs left bomb sags approximately 60 to 90 cm in diameter. Additionally, a massive square portion of country rock (soil and sediment pushed into the air during the eruption) created another large bomb sag. The country rock was deposited during the Loma Caldera eruption immediately west of the sacbe, notably damaging the eastern agricultural field and possibly a drainage depression or slight eastern canal in the northern portion of the excavation. The central area of the sacbe not impacted by the bomb sags was very compacted with numerous ceramic sherds that had been compressed into the sacbe surface. There was a slight concavity along this central corridor with a slight raise in elevation to the east of the depression that might mark the edge of this sacbe, or at least the heavier traffic areas of the sacbe. The eastern edge of the sacbe is not visible in the north and central part of the excavation except for a slight sloping of the ground surface between the known sacbe and the eastern agricultural field (Figure 2-4). A clear eastern sacbe edge was visible in the southern part of the excavation with the shallow beginning of the eastern canal. Along the western edge of the sacbe there was a smoothed, sloped edge that appeared to have had significant water run-off impact it. The western sacbe edge clearly curved towards the east at the intersection with the drainage canal in the southern section portion of the operation.

Figure 2-4. Op. AK Sacbe.
The Western Canal is visible (left side) and the Eastern Canal (right - bottom) with slight depression visible north of that canal

The section of sacbe present in Op. AK was 326 cm in length, had an average width of 187 cm, an average height of 16 cm, and an average slope of 2 degree towards the west and 6 degrees towards the south (Table 2-21). The overall orientation of the sacbe was 25 degrees east of true North, though this is an approximation given that only one side of the sacbe was clearly evident throughout the excavation.

OP	Avg. Sacbe Width (cm)	Length of Sacbe (cm)	Average Sacbe Slope	Orientation of Sacbe (degrees E of true N)	Average Sacbe Height (cm)	Average Hardness (West Side of Sacbe)	Average Hardness (Center of Sacbe)	Average Hardness (East Side of Sacbe)
AK	187	326	2° towards west; 6° towards south	25	16	1.1	3.7	3.1

Table 2-21. Op. AK Sacbe Data

The western canal in this area was shallow and broad with sandy areas, particularly in the northern section of the canal. The sacbe sloped down into the canal in the north, where it appeared more eroded, but became more uniform towards the middle and southern areas. The average depth of the western canal was 19 cm, the average width 40 cm, and it had an average slope of 4 degrees towards the south (Table 2-22). The slope of the western canal changed slightly south of the drainage canal, where the western canal immediately had a slope of approximately 8 degrees towards the north for 20 cm. Still further south, the slope of the western canal returned to a southern direction, thus it appears water further north of the drainage intersection was purposefully being diverted to exit along the drainage canal to the west.

West Canal Average Depth from Sacbe (cm)	West Canal Average Depth below West Maize Field (cm)	West Canal Width (cm)	West Canal Slope	West Canal Average Hardness
25	12	40	4° towards South	2.9

Table 2-22. Op. AK West Canal Data

The drainage canal that intersected the west canal appeared very uniform and well maintained. Clear vertical boundaries were formed between the platform to the south and also the agricultural field to the north. The drainage canal headed approximately 121 degrees east of true North. It had an average depth of 21 cm, an average width of 24 cm, and sloped approximately 3 degrees towards the west.

Drainage Canal Average Depth below West Agricultural field (cm)	Drainage Canal Average Depth below Platform (cm)	Average Drainage Canal Width (cm)	Average Drainage Canal Slope
17	25	24	3 degrees towards the west

Table 2-23. Op. AK Drainage Canal Data

The eastern canal of Op. AK was visible only in the southern section of the excavation, terminating approximately 70 cm to the north of the south wall. A 50 cm extension into the southern wall of this area allowed for further documentation of the canal, as well as the eastern agricultural ridges. The canal began very shallow, only a few centimeters in depth and then quickly sloped down to form an overall average depth of 8 cm. This shallow canal was uniform in shape and maintained a consistent width of approximately 25 cm and a slope towards the south of 3 degrees (Table 2-24).

East Canal Average Depth from Sacbe (cm)	East Canal Average Depth below West Maize Field (cm)	East Canal Width (cm)	East Canal Slope	East Canal Average Hardness
7	8	25	3° towards South	2.8

Table 2-24. Op. AK East Canal Data

The rich array of data on the sacbe and canals provided during the 2013 field season yield key insights into its construction, maintenance, and meaning. Such findings greatly advance our understanding of sacbeob in the Maya area and notably inform archaeological research of a type of sacbeob previously unknown in the archaeological record. Construction, maintenance, canal drainage and water control, and the features associated with the sacbe in these excavations are explored.

Sacbe Construction and Maintenance

<u>Overall construction methods</u>

The predominant material used for construction of the sacbe in all excavations where it was encountered during 2011 and 2013 was the volcanic ash (“tephra”) from the TBJ eruption of Ilopango volcano. The very white TBJ tephra was generally found to have been packed on top of the sacbe, sometimes in repeated remodeling, very probably to maintain it as a “white way,” a true sacbe. In most trenches it was clear that the TBJ along the sides, where the sacbe dipped down into the canals, had to be replaced often after erosional events during heavy rainstorms. The sacbe edges usually were packed to increase durability, but not in all cases. In some construction phases a tephra from another eruption was used either as a discrete horizon or mixed with the TBJ tephra. The source of that other tephra is unknown, and here is referred to as “tephra X” to distinguish it from the TBJ tephra. It presumably is an eruption that is older than the TBJ eruption. Its larger grains are coarser than the TBJ and it is a gray color, in contrast to the white TBJ. A suggestion is made here that an aspect of construction with volcanic ash may have been reverential, making reference to the power of explosive eruptions and their effects on people and their environments.

Civil engineers in El Salvador have long known about the utility of the TBJ tephra as a foundation layer for construction. They use heavy equipment such as steamrollers and percussion packing devices to compact the TBJ into an almost cement-like hard layer. The reason it packs so well is in the grain morphology. The individual tephra grains are remarkably small compared to most other tephras, and the grain shapes are highly angular. Thus when packed hard together they make a very durable horizon. We suggest here that the ancient Maya during the Classic period also discovered the hard packing characteristics of this material. The evidence is the very hard surface of the central zone of the sacbe, averaging 4.2 kilos per square centimeter by a penetrometer.

An experiment was begun in July 2013 to investigate the packing characteristics of the TBJ tephra, and to study how a TBJ-based sacbe would deteriorate without maintenance and without a sudden burial by another volcanic eruption.

Figure 2-5. The experimental sacbe.
Salvador Quintanilla demonstrating the percussion packing device on top of the 2 x 2 meter sacbe replica.

The experiment began by collecting one cubic meter of TBJ tephra and packing it by two workers walking on it, and stomping their feet. Even when adding some moisture, they were able to get only to a hardness of almost 1 kilo per square centimeter, and further walking and stomping did not increase the hardness. That plateau was exceeded by shifting to packing by pounding with the backs of shovels and especially with azedones, the heavy metal hoes used in agriculture. The hardness increased to between 1.5 and 1.8 kilos per square centimeter, and it also hit a plateau and did not increase with further pounding. Therefore a heavier compaction device was used (see Figure 2-5) consisting of a large metal can filled with cement with an iron pole for a handle, and weighing about 10 kilos. Two days of pounding with this device finally achieved the hardness readings of the ancient sacbe, ranging from 4 to over 5 kilos per square centimeter. Moisture affects the compaction in two different ways. If the tephra is dry it will not compact well. Adding water to moisten it is essential. But when water is added to an already packed surface it softens it somewhat. Repeated pounding then eventually results in a surface harder than it was before moistening. This result brings up the question of what kind of percussion pounding device could have been used by the Maya. It could have been a wooden pounder such as a specially shaped heavy tree branch, or a branch as a handle and a portion of trunk as the pounding portion. The hardness of the central zone of the sacbe had to be achieved by heavy pounding during construction, and that hardness could have been maintained by use, by people walking on it.

As discovered in doing hardness testing of the sacbe itself, the central portion was consistently very hard, averaging 4.2 kilos per square centimeter (Table 2-25). The sides of the sacbe were less than half as hard as the center. They had been compacted, to reach hardness measures averaging 1.2 (west side) and 1.9 (east side), but the wetting from rain runoff would weaken that, and the running water would erode the edges. The profiles are consistent with repeated replacement of sacbe sides with new loads of TBJ tephra, followed by compaction.

The sacbe replica experiment will continue for a year, from July 2013 until July of 2014. It is fenced to keep animals away from it. It will be photographed every Monday for the full year, from the west and from the east, to document natural processes. The objective is to study the durability/disintegration of an earthen sacbe of TBJ with no maintenance. Such would be the fate of all abandoned sacbeob without stone linings in the volcanically active Maya highlands.

Cerén 2013	SACBE							
OP	**Average Sacbe Width**	**Length of Sacbe N-S (measured in middle)**	**Avg. Slope of Sacbe**	**Orientation of Sacbe (degrees E of true N)**	**Sacbe Height**	**Hardness Measure (West Side of Sacbe)**	**Hardness Measure (Center of Sacbe)**	**Hardness Measure (East Side of Sacbe)**
AJ	183	390	2 degrees east towards west; 3.5 degrees slope towards the south	28	20	0.2	4.6	1.6
AH	232	365	4 degrees toward NW	29	15.65	1.9	5+	2.2
AG	176	340	2 degrees towards South	28.5	22	1.8	4.3	2
AI	147	370	12 degrees east towards west, 4 degrees north towards south	34	21	1.7	3.3	1.5
AF	200	382	5 degrees towards South; 10 degress towards West	39	23	0.7	4.5	1.5
AE	182	200	3 degrees towards the South	40	29	1.1	4.8	2
AK	187	326	2 degrees from east towards west; 6 degrees from north towards south	25	16	1.1	3.7	3.1
Averages	**186.7143**			**31.92857143**	**20.95**	**1.214285714**	**4.2**	**1.985714286**

Table 2-25. Summary of Sacbe Data.
Data includes hardness measures in kilos per square centimeter. (Halmbacher)

Sacbe construction in Operation AJ

At this location, the farthest from the Joya de Ceren site center, sacbe construction began by laying down a substantial deposit composed of a mixture of TBJ tephra with a gray tephra from an unknown source, the “tephra X” mentioned above.

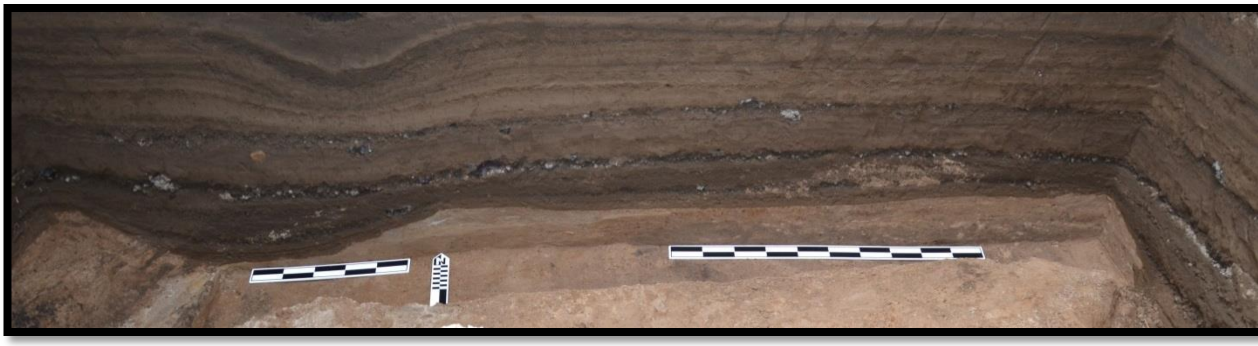

Figure 2-6. Trench showing cross-section of sacbe in Operation AJ.
Note the mix of TBJ and gray "tephra X" in lower portion, and white TBJ above.

After laying down the core of mixed tephras, substantial amounts of pure TBJ were added to the sides all the way to the canals, and on top. It is apparent that the builders wished to have the sacbe top and sides as white as possible. They may have been well aware of the meaning of “sacbe” and their use of the TBJ was effective in meeting that objective. The sacbe received hard packing in the center, resulting in a hardness of 4.6 kilos per square centimeter. Presumably foot traffic maintained that hardness. The eastern side of the sacbe, where it dips down toward the eastern canal, measured 1.6 in hardness, and had received some packing. It probably had been replaced or repaired after heavy rains, and the packing would increase its durability for the next rainfall. An overhang of TBJ tephra was observed along the eastern edge, visible in the photograph. It presumably was caused by the earthquake at the beginning of the eruption, and is clear evidence that very little time passed between the earthquake and the emplacement of Unit 1. They must have been almost simultaneous, as the overhang would not maintain itself for more than a very short time.

The western sacbe edge down into the western canal was quite eroded away, presumably by a heavy rain and the runoff carrying away the tephra. It left a very soft TBJ tephra, measuring a very soft 0.2 kilos per square centimeter. Based on observations of sacbe edge maintenance in other operations, this situation is a case of maintenance deferred, with TBJ tephra replacement interrupted by the Loma Caldera eruption. Unpacked TBJ tephra measured about the same during construction of the replica.

Sacbe construction in Operation S

Figure 2.2 (early in this chapter) is a photograph of the trench sectioning the sacbe in Operation S, excavated in 2011 (Dixon 2011). The previous publication of the description of the sacbe means a detailed repetition is not needed here. Rather, a brief description and interpretation are appropriate, as this is the second southernmost excavation exposing the sacbe. The section revealed that the sacbe at this location received more small additions of slightly differing construction materials than at any other location. There are lenses of pure TBJ along with lenses of TBJ mixed with a little clay, and lenses of TBJ mixed with “tephra X”, and even a large lens of “tephra X” mixed with some TBJ that averages five cm thick and is 33 cm long. Two to four cm below the finished final top of the sacbe is a boundary that probably represents a penultimate form. It probably served as the sacbe surface for quite some time. However, it became darkened by use, and was capped by a new fresh layer of pure TBJ that ranges from two to five cm in thickness. Dixon (2011) noted it must have been placed there to maintain the whiteness needed to qualify in the Maya mind as a sacbe, as a "white way."

Sacbe construction in Operation AG

The sacbe construction encountered in Operation AG was the simplest of all locations trenched in 2011 and 2013 (Figures 2-7 and 2-8). The trench bottom was the well-developed paleosol that existed prior to the Ilopango TBJ eruption. Atop that was intermittent patches of in-situ TBJ. The first construction was to lay down a deposit of mixed TBJ and the gray "tephra X". That layer was followed by abundant amounts of TBJ ranging from relatively pure to somewhat mixed with the pre-eruption clay-rich soil. That was added to both the top and large amounts to the sides, especially to the west side. Finally the sacbe was finished with a thin layer of very pure white TBJ on top.

Figure 2-7. Western portion of section in sacbe Operation AG.
Note the mix of TBJ and "tephra X" in lower portion, and TBJ only on top and on left, by canal. The small overhang on the left was probably caused by an earthquake and encased in Unit 1 tephra almost immediately with Loma Caldera tephra. There is a thin very white layer of TBJ on top.

Figure 2-8. East side of sacbe trench in Operation AG.
Note the zone of gray admixture of TBJ tephra and "tephra X" on the lower right.

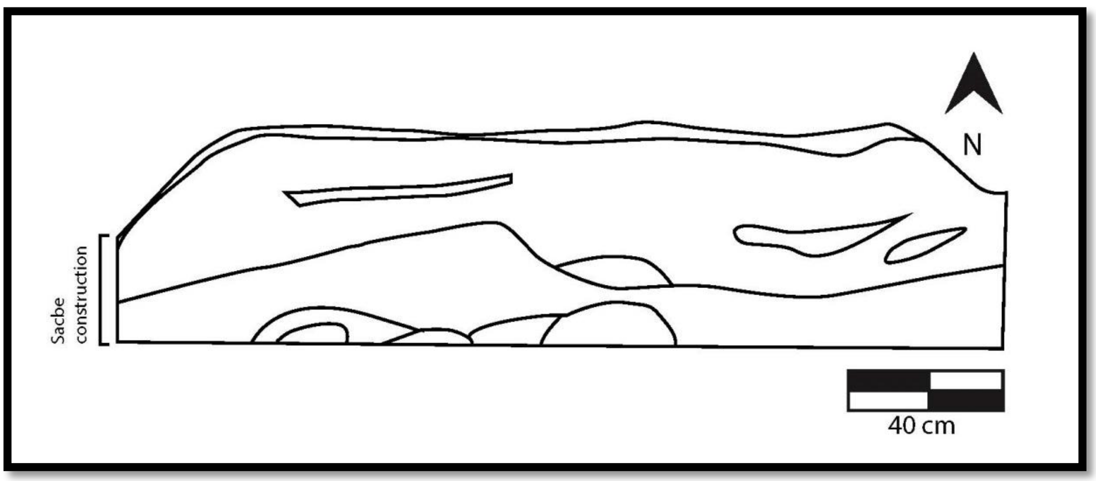

Figure 2-9. Profile of section through sacbe in Operation AG
(Drawn by Rachel Egan)

Sacbe Construction in Operation AI

At the bottom of the trench is the pre-Ilopango clay-laden paleosol, overlain by very small amounts of intact TBJ (Figure 2-10). Construction began very close to that paleosol, by laying out many horizontal beds of almost pure TBJ. The penultimate sacbe surface was the top of those TBJ beds, and they were exposed to solar radiation enough to experience some oxidation. Surprisingly, the final renovation was with a mixture of enough “tephra X” with TBJ to give a grayish tone to the finished sacbe surface. This trench is the only one that does not have very white TBJ as the topmost surface.

Figure 2-10. Section of canals and sacbe in Operation AI.
Most construction was with quite pure white TBJ, including the penultimate version. The final renovation was with TBJ mixed with enough of the "tephra X" to give a grayish tone to the top of the sacbe.

Sacbe construction in Operation AF

At the bottom of the trench is intact lowermost TBJ as a thin in-situ deposit (Figure 2-11). The majority of construction was by laying down beds of TBJ mixed with small amounts of the “tephra X” with only occasional admixture of some clay. The mixing of the three was more thoroughly done than in the other locations excavated. The final sacbe was created by laying down a bed of quite pure white TBJ, three to six centimeters thick.

Figure 2-11. Sacbe trench section in Operation AF.
Most of construction done with TBJ, a little "tephra X", and some clay, very well mixed. The final version has a white stratum of TBJ.

Sacbe construction in Operation AE

This is the deepest trench excavated into the sacbe, and the thickest and most complex stratigraphy created by natural deposits at the bottom and considerable cultural activity throughout the rest (Figure 2-12). At the base of the trench is the pre-Ilopango clay-laden paleosol. The base of the Ilopango tephra is the characteristic thin pumice zone, which is overlain by the very white in-situ fine-grained tephra. The top of that layer is irregular and had been eroded, but exposed not long enough to form a paleosol.

The first cultural layer is a grainy gray tephra that is very pure, with virtually no admixture of other materials. At first glance it looks like an intact airfall tephra, but if it were, it would show sorting, with the larger and heavier particles falling faster, and thus grade upward into finer particles. Great care must be exhibited to lay down a deposit of tephra with no admixture.

The next cultural unit is composed of a broad and thin bed of TBJ with enough pre-TBJ clay to give it a slightly orange hue. It was not a finished surface that functioned as a sacbe. Above that unit is a predominantly white TBJ deposit that thickens greatly in the center, making up the bulk of the construction there. It thins to almost nothing nearing the eastern canal, and looks like it was dug into and removed before the subsequent unit was emplaced. It was a finished surface, functioning as a sacbe. Why it was partially removed is unclear.

Following that unit is a very thick deposit of largely TBJ with enough clay to give it a more orange hue, with its top the finished sacbe. The final stage of renovation was made by emplacing three to five cm of white TBJ on top. The overall impression of the complexity of the sacbe in this location is one of modification and renovation much more often than in other localities.

Figure 2-12. Great cultural/ constructional complexity of the sacbe discovered in Operation AE.
One canal is visible on the right, filled with Loma Caldera tephra. Another canal is visible on the left, below the photo board, filled with TBJ tephra. The final canal is at the far left.

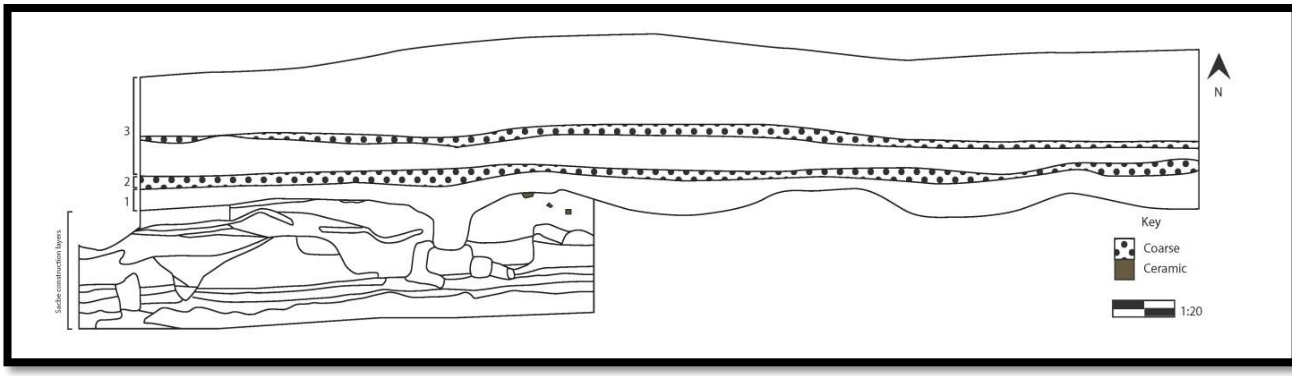

Figure 2-13. Stratigraphy in the lower portion of Operation AE.
Volcanic ash units 1, 2, and 3 from the Loma Caldera eruption are shown across the north wall of the excavations. Unit 1 covers maize ridges on the right, and the sacbe on the left, with canals on both sides. The sacbe constructional complexity visible in the photograph above is abundantly clear in this section (Drawn by Rachel Egan). Scale is 40 cm long.

Sacbe construction in Operation AK

Operation AK is the northernmost excavation of the 2013 season (Figure 2-14). It is closest to excavated structures in Household 1, and to the civic plaza to the northwest. Its trench was excavated down only 18-20 cm. It divulged the TBJ-“tephra X” mix in the center, flanked by two zones of quite pure TBJ on both sides, highly reminiscent of the sacbe construction in Operation AE. Above that was a mottled layer of lumps of TBJ with some clay and other materials, but largely TBJ. The final finishing layer was a more pure TBJ surface. The sacbe in AK may well have been as complex as that in AE. A most important feature was discovered to the west of it, a formal constructed hard-surfaced platform, separated from the sacbe by a canal. It has the strong appearance of a “step-over” offering an exit from the sacbe to the village center to the west and perhaps northwest. A partial canal was discovered on its east side, but of insufficient length to understand its function.

Figure 2-14. Top stage of renovation of sacbe in Operation AK.
TBJ and "tephra X" mixture in the middle, with more pure TBJ on either side. The dip in the middle of the sacbe was caused by a large lava bomb. The bomb sad continued deeper into the sacbe, as visible under the 25 cm long north arrow. A large "country rock" that was pulled up by the magma blasting forth landed at the far left, and also did damage to the Classic Period land surface, in this case the edge of a maize field.

Overview of Sacbe Construction

Patterning and variation in sacbe construction were discovered by sectioning the feature in seven operations. The patterning is seen in the overall standards of construction and maintenance. The standards for the patterning reside in the culture, as people are acculturated into the expected ideal forms of a valued feature, and they can be enforced by a higher authority than the individual or the household. For a small village like Joya de Ceren the most likely locus for that authority would have been the village elders, perhaps meeting in the inner room of Structure 3, and resolving disputes by sitting on the front-room benches. A shared value of high priority is the use of the Ilopango Tierra Blanca Joven as the dominant construction material to make the sacbe about two meters wide, flanked by a canal on each side. Only one exception to the rule of using pure white TBJ as the finishing layer was only a partial exception, as in one case a slight admixture with "tephra X" resulted in a slightly grayish tone. And all constructors used some "tephra X" at some point in their excavations, usually mixed with a greater amount of the TBJ, but in one case an essentially pure deposit of this unknown tephra was emplaced. All constructors did impressive compacting of the top sacbe surface, and we learned from building our replica that many days of hard pounding with a heavy implement are necessary to arrive at hardness measures over 3.5 or 4 kilos per square cm. Another shared procedure was to replace the eroded edges of the sacbe with quite pure TBJ and to pack it at least to a moderate hardness.

In the sacbe sections we discovered a striking amount of variation in how the above standards were achieved. Individuals had much greater latitude to achieve the overall goals than we had expected. People constructing the sacbe could include the "tephra X" in a wide range of ways. Some built up their section in small loads, probably basket loads, spread them out, and often compacted them, resulting in lenses of construction. Others preferred laying down a thin and widespread deposit, resulting in a thin zone in profile. Others preferred to add elements, especially TBJ, in large thick amounts. Constructors had agency in that they had the power to decide how they would achieve the ultimate result. Variations in maintenance were also discovered, as many areas showed completed repairs to sections eroded by water moving in the canals, while other areas had yet to be attended to. One sacbe section had yet to be finished, as the eruption interrupted the process of refurbishing.

<u>Features Associated with the Sacbe</u>

There were three types of features found in association with the sacbe in 2013: footprints along the edges of the sacbe, a constructed platform, and eastern and western agricultural fields. These features provide contextual information that aid in our interpretations of the sacbe.

Footprints

In various areas of the 2013 excavation we were able to see locations where individuals had stepped along the side of the sacbe and pushed small sections of the sacbe tephra into the adjacent canal. The western edge of the sacbe in AJ possibly displays evidence for this type of damage, while the damage across the western edge of the sacbe in Op. AI is more readily identifiable with one possible print in the southern portion that is 22 cm in length, 16 cm in width at the ball of the foot, and 6 cm in width at the possible heel. Additionally there is continued evidence for this type of sacbe edge damage in one area along the eastern edge of the sacbe in Op. AE and possible evidence for some destruction of the northern-most portion of the western canal in Op. AK. In some cases, these features were distinct enough to see individual footprints.

Following the organization of this chapter, I will discuss the areas where specific footprints are visible along the sacbe from the operations excavated furthest south in sequential order towards the site center in the north (Tables 2-26 And 2-27).

OP	Sacbe Edge	Footprint	Length	Width at the Ball of the foot	Width at the Heel of the foot	Side of Foot and Direction Facing
AH	East	1	16	7	6	Right foot facing South
AH	East	2	17	8	6	Left foot facing South
AG	East	1	23	8	6	Left foot facing North
AG	East	2	19	7	4	Right foot facing North
AF	East	1	22	12	8	Right foot facing South

Table 2-26. East Sacbe Edge Footprint Data

OP	Sacbe Edge	Footprint	Length	Width at the Ball of the foot	Width at the Heel of the foot	Side of Foot and Direction Facing
AH	West	1	17	7	5	Left foot facing south
AH	West	2	18	9	7	Right foot facing South
AH	West	3	22	8	6	Left foot facing West
AH	West	4	21	10	6	Right foot facing North
AH	West	5	19	9	6	Left foot facing North and slightly west
AH	West	6	22	9	7	Left foot facing South
AG	West	1	18	/	9	Left foot facing South
AG	West	2	24	9	4	Right foot facing South
AG	West	3	31	10	8	Left foot facing South
AG	West	4	21	/	8	Left foot facing North

Table 2-27. West Sacbe Edge Footprint Data

In Op. AF a footprint along the eastern edge of the excavation was possibly made by a person's right foot as they moved in a southernly direction. This print was approximately 22 cm in length, 12 cm in width in possibly ball of the foot, and 8 cm in width along the possibly heel area. This footprint was distinct enough to allow us to pour dental plaster into the depression and create a cast with the impression of the print (Figure 2-15). This footprint cast well and it is possible to see a small portion of the second or third toe.

Figure 2-15. Excavation of the Op. AF Footprint Cast

In Op. AH there were footprints found on both the east and west side of the sacbe, though considerably more along the western edge. The eastern edge only had two possible footprints, one of which was located in the southern part of the operation and was 16 cm in length, 7 cm in width at the ball of the foot, and 6 cm in width at the heel of the print. This impression was possibly created by a person's right foot as they moved towards the south but was more difficult to identify than other prints documented at the at site. In the northern portion of the excavation, there was a second footprint present along the eastern edge that was 17 cm in length, 8 cm in width at the ball of the foot, and 6 cm in width at the heel area. This footprint appears to have possibly been made by a person's left foot when they were headed to the south and one possibility is that this was the same individual as the one who made the right footprint to the south, given the very close size of these two features.

Along the western edge of the Op. AH section of the sacbe, we documented the largest numbers of identifiable footprints yet discovered along the sacbe, six clear prints in total. The footprint furthest to the south was possibly made by a person's left foot as they headed to the south and was 17 cm in length, 7 cm in width at the ball of the foot, and 5 cm in width at the heel. There was a clear portion of the sacbe edge pushed down into the canal by this step. Approximately 10 cm to the north was another print of a possible person's right foot as they moved north. This print was approximately 18 cm in length, 9 cm in width at the ball of the foot, and 7 cm in width at the heel of the foot.

There was again a portion of the sacbe edge that had been pushed into the canal. Excavations also encountered another clear footprint 25 cm towards the north that was possibly made by a person's left foot as they were facing west was encountered. This print was 22 cm in length, 8 cm in width at the ball of the foot, and 6 cm in width at the heel. There were portions of the sacbe edge pushed down into the canal to the south and to the west of the print. An estimated 120 cm to the north a fourth western edge footprint was identified. This print was 21 cm in length, 10cm in width along the ball of the foot, and 6 cm in length along the heel. It appears the print was made by a person's right foot as they were moving towards the north and the sacbe edge was pushed in to the north and to the west. The fifth footprint of this side was found approximately 10 cm to the north and was possibly made by a person's left foot as they moved toward the north and slightly west. This print was 19 cm in length, 9 cm in width along the ball of the foot, and 6 cm in width along the heel. There was some sacbe tephra pushed into the west and slightly north of the print. The sixth footprint along the western edge of the sacbe in Op. AH was approximately 20 cm further north, but unlike the other prints along this side, it was found an estimated 10 cm in from the western edge. This print was likely made by a person's left foot as they moved south and was 22 cm in length, 9cm in width at the ball of the foot, and 7cm in width at the heel. Sacbe tephra was indented to the west and slightly north of the print but the sacbe maintained a clear edge between this print and the beginning of the western canal. There was a seemingly high flow of traffic in this region and the edge had not been maintained recently due to both the high number of footprints visible and the significant erosion and damage to the western edge of this section of the sacbe.

Op. AG had a similar density of footprints to those found along the western edge of Op. AH to the south. Along the eastern side of the sacbe in this area there was one likely footprint in the northern end extending down into the eastern canal. This footprint was likely from a person's left foot as they moved to the north. The print was 23 cm in length, 8 cm in width at the possible ball of the foot, and 6 cm in width at the possible heel. Approximately 250 cm south of this footprint is another potential footprint that was possibly made by a person's right foot as they headed to the north. It was 19 cm in length, 7 cm in width at the ball of the foot, and 4 cm in width at the heel of the foot. It is possible this was the footprint of a smaller individual or possibly an adolescent. In both cases the potential footprints along the eastern edge of the sacbe showed a depression of tephra from the sacbe edge into the eastern canal.

Along the western side of the sacbe in Op. AG there were many areas that appeared to be destroyed from traffic along the edge, with five possible footprints visible, one of which we were able to be cast with dental plaster (Figure 2-16). In the south end of the excavation the first possible partial footprint was identified measuring 18 cm in length and 9 cm wide in the possible heel area. The second identifiable print was found approximately 8 cm further to the north of this possible print was a more distinguishable footprint. The print was 24 cm in length, 9 cm in width in the ball of the foot, and 4 cm in width in the heel portion of the foot. The third footprint was found along this western edge 22 cm further to the north. This print was more distinct with portion of the sacbe pushed into the canal below and it was 31 cm in length, 10 cm in width at the possible ball of the foot, and 8 cm in width at the possible heel. This footprint was possibly made by a person's left foot as they headed to the south. A slight amount of the sacbe edge appeared pushed into the canal surrounding this print. A fourth possible footprint was present along this edge approximately 50 cm further north and was possibly made by a person's left foot as they headed towards the north. It was approximately 21 cm in length, though the northern portion of the feature was not visible. It appeared to be 8 cm in width at the possible heel. The fifth and northern-most identifiable print was located another 21 cm to the north and was possibly made by a person's left foot as they moved in a north direction. The footprint was 23 cm in length, 9 cm in width at the possible ball of the foot, and 6 cm in width at the heel. This footprint had a significant amount of sacbe tephra that was pushed down into the western canal. The large number of footprints along this western edge and the significant erosion into the western canal strongly indicate that there was a heavy traffic flow in this area and the sacbe had not been recently maintained.

Figure 2-16. Op. AG Western Side of the Sacbe showing significant damage and multiple footprints

The documentation of damaged areas of the sacbe edge damage and the direct association of footprints with these edges supplies vital information about the regular processes that would have continuously impacted the sacbe surface, in particular foot traffic along the edges. The ability to examine individual footprints is helpful in determining the degree and scheduling of maintenance for the sacbe. The majority of footprints were found along the southern portion of the western edges of the sacbe. While footprints were found on the eastern side as well, these data suggest that the eastern side had been more recently maintained, as the soft nature of the sacbe sides shows that foot-traffic along these regions would have likely easily and quickly resulted in damage to the edges.

Platform of AK

Associated with the furthest northernmost excavation of the sacbe to date, in Op. AK, we found a very small corner of a platform. The platform was located in the southwest corner of the excavation, just south of the drainage canal. Only 10 cm of the western edge was visible in the original excavation. The unusual find of a third canal, the drainage canal, combined with the leveled and raised edges of this feature along the drainage canal and partially along the furthest south portion of the western canal warranted an extension of approximately 60 cm by 120 cm into the southern wall. This extension confirmed the presence of a constructed feature that was raised, leveled, and had a distinct corner at the intersection of the exit drainage canal and the western canal of this operation (Figure 2-17).

Figure 2-17. Op AK Platform
The platform (left) has a distinct corner formed by the west canal (bottom) and drainage canal (middle)

The section of this feature visible for documentation measured approximately 70 cm by 100 cm and it clearly continued farther to the south and west an unknown distance. The average height of the feature as measured from the drainage canal wall, was25 cm and the average height, as measured from the southern portion of the western canal, was 19 cm. Thus, we documented the northeast corner of an unknown platform that appeared to be constructed with built-up TBJ. This feature could be the northwest corner of the plaza that was previously documented near Structure 3 (Sheets 2002). It is also possible that the platform construction is another small portion of a sacbe that intersects the main sacbe we have been studying and runs along an east-west axis and the continuation of the western canal that separated the main sacbe from this feature would have easily been stepped over by individuals using the roads. A third possibility is that this platform is part of other nearby construction, such as a built and well-maintained activity surface associated with a nearby household or public structure. Since we were unable to follow this feature any further to the south or west, and due to the time constraints of this current project, future research is needed. Continued exploration of this region would significantly aid in our understanding of the sacbe and its integration into the site center.

Relation of Agricultural Fields to the Sacbe

Agricultural fields were another key type of feature found associated with the sacbe and canals. Based on data from the 2011 field season, it was hypothesized that the cultivators on either side of the sacbe might have had a caretaking responsibility for maintenance of particular sacbe edges, similar to the service relationship documented between households and public buildings in the site center. We expected that if this type of relationship was present, the degree of maintenance of the sacbe edge and the adjacent agricultural ridges would be comparable. In this model a very uniform canal with very clear vertical walls and little erosion, would be bordered by an agricultural field with distinct and uniform maize ridges that showed a similar lack of erosion and for the edges of the sacbe that were eroded, damaged, and irregular, we would see a similar array of disrepair in the adjacent agricultural field. This hypothesis was developed out of the observation of Op. W from 2011, which unlike the other excavation of that season was a larger size excavation of 3 x 4.5 meters (Dixon 2011). The width of the excavation allows us to observe the maize fields on both sides of the sacbe (Figure 2-19).

Figure 2-18. Op. W from 2011 showing a portion of the sacbe with maize fields on each side

The Op. W eastern canal was very uniform and had vertical walls and the associated maize field had well-formed ridges that were evenly spaced and appeared to be well maintained. Alternatively, the western canal was much more shallow, particularly along the edge bordering the west maize field. This canal appeared to have more damage to the western side of the sacbe and the western wall of the western canal. The sacbe was sloped slightly towards to the west, which likely resulted in greater run-off into this canal (Dixon 2011). The ridges of the western maize field were small and more irregular than those to the east, therefore inspiring the hypothesis of service relationships between cultivators and adjacent sacbe sections.

To assess the relationship between the agricultural fields and the sacbe, many of the excavations this season were larger than the standard 3 m by 3 m size typically used in our research. Three 3 m by 5 m pits (Ops. AH, AG, and AI) were established, as well as two larger operations, AE which was 4 m by 7 m and AK which was 3 m by 6 m. While the larger size of these excavations resulted in fewer overall pits this season, the wider viewpoint better enabled us to examine the relationship between the sacbe and agricultural fields on both sides of the sacbe. I will briefly describe these findings in general and then provide a specific assessment of the agricultural fields in Op. AK where we were best able to view both the sacbe and agricultural fields.

Originally, we had expected to see variation along the edges of the sacbe that could be compared with the nearby agricultural fields, yet the more we excavated, the clearer it became that the variation of the sacbe edges was most significant from one side of the sacbe to the other.

Significantly, in every operation where the sacbe was documented (Op. AJ through Op AK, including Ops. S, U, and W from 2011) there was a western, sometimes southern, slope to the sacbe that would have resulted in greater water run-off towards the western canal. The western edge of the sacbe and canal showed significantly more damage and footprints, while the eastern edge and canal revealed more uniform and well-defined canals.

In Op. AK it was possible to best assess the relationship of maize fields and the sacbe due to the position of the sacbe in the center of the excavation with a maize field to the east and west of the sacbe (Figure 2-20). The Eastern field was heavily impacted by a large portion of country rock that profoundly damaged a few of the ridges of this field. A total of 5 ridges were distinguished in the eastern maize field with two small intterridges present between ridges in the southern portion of the excavation that was less damaged by the bomb sag. The ridges of this field were an average of 12 cm in height, 30 cm in width, and orientated approximately 115 degrees east of true North. The ridges had a regular spacing of approximately 82 cm and there were two bent over stalks with one mazorca. This field appeared relatively well-maintained where visible around the bomb sag, yet the eastern canal of the sacbe was only clearly distinguishable in the southern part of the operation with only a faint depression towards the north end of the excavation. The western agricultural field of Op. AK was less maintained than the east and had three small ridges and three very eroded interridges. The ridges in this field had an average height of 5 cm, an average width of 21 cm, and were spaced approximately 75 cm apart. This field showed a high degree of erosion, particularly of the interridges. The bordering western canal had evidence for erosion along the northern portion but much more uniformity along the southern section. The drainage canal also bordered the western agricultural field and this canal was very well-maintained with uniform shape and little to no erosion visible along the canal edges.

Figure 2-19 Op. AK.
The photo shoes the Eastern Agricultural Field and Eastern Canal (bottom), Sacbe (center) with Lava Bomb craters (north and south end of the sacbe), Western Cana and Western Agricultural Field (top), and the Drainage Canal and Platform (top left)

The comparison of evidence for maintenance of the sacbe edges and canals with that of the adjacent agricultural fields strongly indicates that while cultivators might have been responsible for sacbe maintenance, there is no correlation between the state of their agricultural field and the edges of the sacbe and canals. A more organized and coordinated effort of maintenance is suggested by this evidence, whereby a communal form of governance organized the continuous maintenance of this feature.

Conclusions

The 2013 Cerén field season documented important research regarding the location, construction, and maintenance of the earthen sacbe and associated canals. These findings reveal key insights into the socio-political organization of labor (Dixon 2013), the use of canals for water management, and the movement patterns of people throughout the site and the meaning of this feature.

<u>Sacbe Maintenance, Power, and Community Organization</u>

The detailed investigation of multiple sections of the Cerén sacbe has yielded essential information about how the sacbe was constructed and maintained, which in turn has important implications for understanding the socio-political organization of the site. The excavation of six trenches into different sections of the sacbe during this field season, in addition to the sacbe trench excavated in the 2011 Op. S, demonstrate significant variation in micro-construction techniques over a relatively small distance. Decisions in sacbe construction are visible in the types of tephra used in various layers of construction and demonstrate that there was not one uniform manner in which to construct the sacbe, but there were rather multiple different styles of sacbe construction. The large quantity of construction variation over this short distance did not appear to have functional purposes, but appear to mark a different construction style of likely different builders. The lack of standardization in the careful construction of the sacbe strongly indicates that different sections were possibly likely built by different individuals, possibly the family, household, or lineage groups.

Of great note in that this field season disproved our original hypothesis that individual cultivators might have been responsible for sacbe construction and maintenance and that a correlation between agricultural fields and the sacbe edges would show such a relationship. While cultivators might have been responsible for sections of sacbe maintenance, the agricultural fields show no correlations with the state of the sacbe maintenance. Instead, the entire sacbe excavated to date appears to have been coordinated by a larger communal governing body.

The sacbe has been documented over 90 m length, had an average width of 187 cm, an average height of 21 cm, and an average slope of 6 degrees to the west and 3 degrees to the south. While there was slight variation from one section to another in orientation, height, and width, there were very strong consistencies in slope and the eastern and western canal forms. Consistently the sacbe was sloped to the west, where significant water run-off in a rainstorm would have been channeled into the western canal. The western edge of the sacbe and the western canal showed considerable erosion, lack of recent maintenance, and had multiple regions where individuals had pushed the sacbe into the western canal, destroying the sacbe edge, often leaving footprints, and creating a shallower western canal. The western edge was significantly different from the more uniform, well-formed eastern canal. The eastern canal had only a few footprints where people had stepped on the side of the sacbe and cause it to fall into the canal and the overall canal maintained a structured and clear shape with vertical walls.

One explanation for the relationship between these two canals is that water was being heavily directed towards the western canal to facilitate maintenance of the eastern canal (Janice Skadsen personal communication 2013). Furthermore, the purposeful funneling of water to the west and the shallow height of the eastern edge of the western canal would have facilitated greater run-off into the nearby western agricultural fields in a heavy rainstorm. It is likely that the sacbe would have required constant maintenance given the softening of TBJ when it is contacted with water, the heavy rains characteristic of the rainy season, the sediment load that would be deposited in the canals, and the ease with which the edges of the sacbe would have been damaged by traffic. The few areas of erosion or footprints on the eastern side of the sacbe suggest that this side might have been very recently maintained, while the western side was the current side used for major water run-off during the time just before the eruption. It is possible that had the eruption not occurred, the Cerén inhabitants would have switched the slope of the sacbe to drain to the east, allowing them to then maintain the western edge. Further supporting evidence for this practice is found in the earliest sacbe, Sacbe 1, documenting in Op. AE. This sacbe had a uniform, well-defined canal along its western canal and a shallow, eroded eastern canal, a clear switch from the penultimate sacbe (Sacbe 2), and the ultimate sacbe (Sacbe 3) (Figure 2.20). Notably the presence of Sacbe 1 beneath Sacbeob 2 and 3 demonstrates that the canal shape is likely not a result of micro-topographical features in the region, but rather decisions for water flow made by Cerén inhabitants, possibly connected with scheduling of sacbe and canal maintenance.

The coordination of sacbe slope and edge maintenance provides strong evidence for a form of community organization, possibly through non-royal governance (Dixon 2013; Sheets 2009). Importantly, the combination of variation in construction techniques with the larger organization of the drainage of the sacbe suggests that while community governance was responsible for organization, individual groups, possibly lineages groups or households, had the power to operationalize that organization in their own manner. This pattern of communal organization with individual autonomy matches what Dixon (2013) documented in the agricultural fields south of the Cerén site, where farmers made decisions about their own planting techniques and practices, yet were organized into a broader community through field boundaries and harvest scheduling.

Studies of Water Management and Control at Sites

The documentation of a coordination of sacbe slope also demonstrates sophistication in water control and management at Cerén. Such research helps to inform how water control and flow might have been maintained and operationalized on a daily basis. The significant effort, labor, and coordination required for such water management would have served as one locus of community interaction on a regular basis, likely a combination of compliance, resistance, unity, conflict, contention, and agreement (A.

Joyce 2004). Such daily practices of maintenance of canals and features such as the earthen sacbe were tangible and lived experiences of community organization but the variation in sacbe construction styles show individuals likely maintained power operationalizing community decisions.

Sacbe Movement and Meaning

Documentation of the sacbe continues to inform our understanding of movement within the Cerén settlement. The sacbe facilitated easier movement between the southern fields and the site center, but clearly was more formalized and larger than what would be required for basic movement. Furthermore, the continued documentation of whiter TBJ tephra used along the sacbe surface indicates meaning of the sacbe beyond simply facilitating travel from one place to another. While we did not find the termination of the sacbe in either the north or the south, Op. AE and Op. AK documented that earlier sacbeob existed within the site center before the ultimate sacbe was constructed and stretched a significant distance beyond the site center. These phases of sacbeob might speak to the changing movement of people to the southern region of the site as the community become more established but it also speaks to the likely origin of the sacbe construction originating in the Cerén center, in contrast with manufacturing of it being imposed upon Cerén by another nearby center. Further exploration of the earlier Cerén sacbeob will clarify the potential genesis of these features in the site.

Future Studies:

Continued investigation of the sacbe would yield valuable understanding regarding the meaning and use of the feature at Cerén, as well as the dynamic development of formal sacbeob at the site possibly related to community growth and expansion. There are three main areas in which the 2013 research should be expanded upon.

First, to better understand the meanings and functions of the sacbe at Cerén, it is necessary to document its extent, both the locus of origination in the site center, as well as the area to which the sacbe continues to the south. This study would be greatly aided by an initial phase of in-depth ground-penetrating radar (GPR) research to facilitate efficient placement of excavations, as well as potentially informing us of the context in which the sacbe was situated. Advances in GPR technology and processing software have resulted in higher accuracy and greater resolution images of the sub-surface (Conyers 2004). The Cerén living surface provides a clear horizon to explore and the sacbe would likely be readily visible in GPR reflections. A second phase of research could therefore aim to document the extent of the sacbe using targeted excavation loci informed by GPR to the south of the site and within the site center.

Through documenting the southern location and extent of the sacbe, we could better assess the potential reasons for the extension of this phase of sacbe so much farther to the south than the two previous Cerén sacbeob. It is possible that as the Cerén community grew, their connection with the nearby regional center of San Andrés became more formal and the sacbe was a physical manifestation of this connection. Or the sacbe could have formed a way of contesting interference from San Andres elite, by physically marking Cerén's own political autonomy as the village grew (Nancy Gonlin personal communication 2013). Additionally, south of the southern-most recognized section of the sacbe (Op. AJ), we have excavated manioc fields along a western-hill that were planted parallel to ground slope in order to facilitate the drainage needed for manioc growth (Dixon 2007, 2009, 2011). The drainage of these fields towards the east would result in very significant water run-off in a heavy rainstorm directed towards the western edge of the sacbe. Excavation of the sacbe in this region would contribute to documentation of water management at the site.

The second key investigation that should be developed from the 2013 research is the continued exploration within the site center of the platform identified in Op. AK. Given the location of this platform immediately west of the sacbe and the western canal, additional excavation of this feature will inform the connection of the sacbe to the site center. The platform might be a second sacbe further connecting the buildings of the site center. Alternatively, this platform might be the northeast corner of the main plaza or a feature associated with nearby buildings. The function of the feature is currently unknown, given the very small section of it that we were able to explore. Additionally, the associated drainage canal to the north of the platform intersected the western canal and would have drained water to the west of this area, towards the central area of the site. Following this drainage canal might greatly inform our knowledge of the use of drainage and water management at the site. Cerén engineers were clearly and purposefully directing the flow of water and how this feat was achieved and organized is another important component of site organization and function.

The third area for future research is an investigation of the two earlier sacbeob at the site. The documentation of these earlier phases in Op. AE are a central contribution to our understanding of the site's development and might allow us to assess the earliest regions of settlement at Cerén and possibly identify founding families of the site (McAnany 1995). Furthermore, the comparison of earlier sacbeob at the site would document the growth of roads, walkways, and directed movement at the site. Socio-political. Such investigation would also facilitate an assessment of the dynamics, which might have caused Cerén occupants to expand and extend the latest phase of sacbe construction so much further to the south.

The 2013 field season afforded key insights into sacbe construction, maintenance, and development. The unexpected finding of sacbe construction variance over a short distance suggests that individual families, households, or lineage groups might have been responsible for different sections of the sacbe's construction and maintenance. While there was no correlation found between adjacent agricultural fields and the sacbe maintenance, cultivation plots might have proved boundary markers of different sacbe sections. The additional documentation of western and eastern canal differences and sacbe slope towards the western canal provides evidence of a centralized organization at the community level, likely through non-royal governance (Dixon 2013; Sheets 2000). Furthermore, the complex control of water run-off shown through the coordinated slope of the sacbe and the use of canals indicates that water management at Cerén was more sophisticated and engineered than previously known. Finally, the discovery of two earlier sacbeob closer to the site center that are not present in the southern region also speak to the dynamic development of the community through time and might inform our understanding of the growth of Cerén. Continued investigation of the sacbe will facilitate a more dynamic and complex understanding of Cerén’s socio-political economy, development, organization, and underlying ideology.

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Chapter 3 Cerén Agriculture

Christine C. Dixon, Ph.D.

Introduction

The extraordinary preservation of Cerén agricultural fields has greatly contributed to our understanding of ancient Maya farming. Rarely in the archaeological record is it possible to examine molds of ancient plants directly and the construction and organization of the fields in which such crops once grew. More often archaeologists are limited to the examination of microbotanical remains, soil composition, and large constructed agricultural features such as terraces (Fedick 1996). The detailed documentation of Cerén agricultural fields affords data from which to examine cultivation decisions, farmer autonomy, field organization, and community governance (Dixon 2013). Such data provide access to local knowledge involved in agricultural production and its organization. The 2013 field season further documented agricultural production at the site and examined the relationship between the earthen sacbe and adjacent maize field construction. This chapter provides a brief description of previous agricultural research at the site and the specialized methodology used to document Cerén agriculture. The chapter then presents the agricultural data collected during the 2013 field season and discusses the implication of these findings, as well as avenues of continued research.

Background

The Loma Caldera (c. AD 630) eruption produced fine-grained ash that encased the Cerén plants and preserved their molds in the surrounding tephra (Miller 2002). From such molds, and the agricultural ridges and beds in which the plants were found, Cerén excavations have revealed a variety of agricultural techniques, crop types, and agricultural organization in both the site center (Sheets 2002) and the southern fields (Dixon 2013). Such data have and continue to significantly contribute to our understanding of Classic Period Maya agriculture.

A variety of floral species were grown at Cerén including, but not limited to, malanga (*Xanthosoma sp.*), maize (*Zea mays*), manioc (*Manihot esculenta* Crantz), squash (*Cucurbita sp.*), cotton (*Gossypium hirsutum*), and cacao (*Theobroma cacao*) (Lentz et al. 1996; Lentz and Ramírez-Sosa 2002: 36-37; Sheets and Woodward 2002: 184).

Initial excavations in the site center revealed eight maize fields immediately adjacent to structures, only one of which was fallow, thus indicating continuous, permanent infield agriculture within the village (McKee 1990; Sheets and Woodward 2002: 184-186; Woodward 2003). Substantial dietary contribution, both in calories and variety was supplied by gardens (Lamb 2011; Lentz et al. 1996). Maize was initially hypothesized to be the only principal staple crop of Cerén until the 2007 discovery of intensively cultivated manioc fields south of the site center (Dixon 2007, 2009, 2011, 2013; Sheets 2007, 2009; Sheets and Dixon 2011; Sheets et al. 2011; Sheets et al. 2012).

Field projects at Cerén in 2007, 2009, and 2011 were aimed at documenting the diversity, organization, and nature of agricultural production. A combined total of thirty-eight excavations were opened during those field seasons, with six operations conducted in 2007 (Test Pits 1-6), 18 operations in 2009 (Ops. North, South, East, West, and A-P, excluding Op E and N to prevent confusion), and 14 operations in 2011 (Ops. Q-AD) (Sheets 2007, 2009; Sheets and Dixon 2011). In the course of these excavations we have documented intensive manioc production, maize fields, diversity in the styles of maize and manioc cultivation, as well as cleared areas, a small corner of a structure, and an earthen sacbe. The 2011 excavations of Ops. Q, R, S, T, U, and W are pertinent to this discussion given their proximity to the 2013 excavations and their likely inclusion in many of the field portions documented this season (Table 3-1).

2011 Op.	Surco Height (cm)	Ridgetop to Ridgetop Spacing (cm)	Directionality (° east of true N)	Total # of Plant Clusters	Total # of Plants	Total # of Mazorcas
Q	8.8	88.5	122	18	48	13
R	11.75	85	122	16	37	2
S	7	71.5	110	3	10	1
T	6.5	80	115	15	21	1

Table 3-1. Summary of Maize Field Data from 2011 Ops. Q, R, S, and T[2]

Methods

Archaeological research has been conducted at Cerén from 1978 to the present (Sheets 2000, 2002, 2007, 2009; Sheets and Dixon 2011) and specialized methods have been employed in the excavation of site given its unique preservation. These general methods are briefly reviewed, as well as those used for the excavation and documentation of the Cerén plant casts and agricultural fields.

After an excavation pit was established, surface artifacts and, if present, Postclassic deposits were collected and documented. Picks and shovels were used to rapidly remove the upper sequence of the Loma Caldera eruption, given there are not culturally significant data in the uppermost Loma Caldera tephra strata (Miller 2002). Excavations slowed as we proceeded to the more culturally sensitive layers of Unit 3 and below. At this stage hoes and trowels were then used to the clear the remaining tephra slowly and researchers were vigilant for hollow cavities preserved in the tephra.

Since the plant forms (molds) were preserved by the moist, fine-grained tephra of Units 1 and 3, while most of the plant remains have decomposed, the hollow cavities

[2] Tables by Alexandria Halmbacher and Christine Dixon

with the mold of the plant have been left in the surrounding tephra. Upon encountering a hollow cavity in Cerén excavations the hole was first investigated and then plugged with newspaper. The area was pedestaled as excavations proceeded and once closer to the Cerén living surface dental plaster was poured carefully into the hole, allowed to set, and then excavated (Sheets 2002, 2006). The result was a plaster cast of the plant growing on the Cerén horizon when the volcanic erupted.

Special documentation methods have been developed to record the agricultural fields at Cerén. Standardized measurements were taken for the agricultural beds, ridges, and interridges that included height of the bed, ridge, or interridge as measured from the base of the walkway to the north, unless otherwise specified, to the top of the bed. Width was measured perpendicular to the directionality of the bed, ridge, or interridge and the ridge-top to ridge-top spacing was taken from the center of one ridge to the center of the next. Where interridges were present, the ridge-top to ridge-top spacing was taken both between the ridges and between the ridges and interridges. A Brunton compass was used to measure the slope of the ground between ridges or beds and the orientation of those ridges to true North. The width of walkways between ridges was also measured to provide an idea of the size of these inter-ridge spaces.

Standardized methods were also used to describe the agricultural plants present in each operation. Each plant loci was given a cluster number for provenience and within each plant cluster, individual plants were given separate letters. For maize stalks, the overall cluster height above TBJ was measured from the base where the plant cluster contacted TBJ, usually on the ridge, to the top of the tallest plaster pour hole. In most cases the lengths of these plant stalks were arbitrary measurements since the maize plants did not typically survive above the Loma Caldera Unit 3. Thus, we did not measure individual plant length, except in the case when an entire maize stalk was present and bent over to dry in the field for harvest. When such plants were present we measured the distance from TBJ to the plaster pour hole at the top, then the distance from the plaster pour hole to the edge of the bent over stalk, and then added these together to get a more accurate measure of the actual plant height. The cluster height provides us with a comparative framework for the height at which plants were present and preserved in each portion of maize field, while the plant casts heights of bent over maize stalks provide a more real measurement of the actual plant heights.

The plants were each cleaned and then photographed *in situ* to provide detailed documentation of each plant cast. These photographs afford an important record since many of the casts did not survive excavation or become fragmented in the process due to wet mixtures of the plaster, coarse tephra, or damp tephra conditions. Once photographed and mapped, the plant were removed and labeled with provenience. Upon their removal we described each plant and measure the stalk diameter for each maize stalk present in a cluster, as well as the length, width, and thickness of ears of corn (*mazorcas*), branches, roots, or any unidentified plant casts. The measuring of the plants in the field before these are transported to the lab ensured more accurate and representative measures of the plant casts.

Once brought to the lab, plant casts were allowed to further dry and then were brushed gently with toothbrushes for cleaning. Each plant cluster was then photographed again and wrapped and labeled for submission to the David J. Guzmon Museum in San Salvador. Similar methods have been utilized in 2007, 2009, and 2011 for the excavation of agricultural plants at Cerén, however this is the first year we have consistently measured plants while still in the field and are confident this provides more reliable results.

Summary of the 2013 Cerén Findings

During the 2013 field season, a total of nine excavations documented agricultural production at Cerén (Ops. AM, AJ, AH, AG, AI, AF, AE, AK, and AN). Following the organization of the previous chapter on the sacbe, I will discuss the Cerén excavations in sequential order from south towards the site center in the north (Figure 3-1).

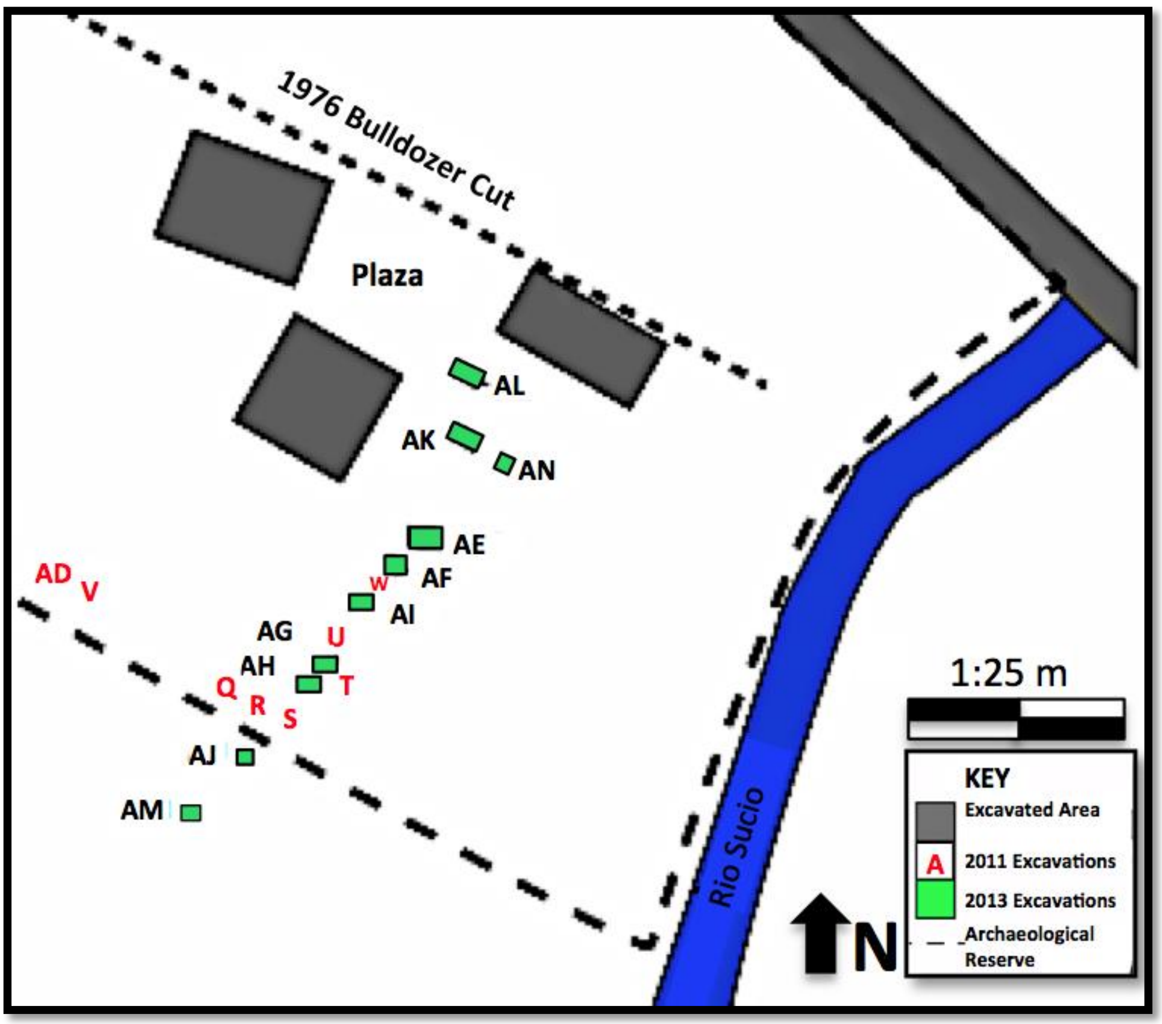

Figure 3-1. Map Showing the Location of 2013 Excavations, Excavated Areas of the Site Center, and Pertinent 2011 Excavations.

Operation AM

Op. AM was located furthest south of the 2013 excavations and was a 3 x 3 meter pit oriented to true North. This operation was established in an attempt to document the sacbe farther to the south; however, when excavations reached the top of Unit 3, the numerous hollow cavities throughout the operation indicated that we had encountered an agricultural field, likely of maize, rather than the earthen sacbe. Due to significant time restrictions, we halted excavations in this region, used aluminum foil to protect the hollow cavities of the plants, and backfilled the operation. While, Op. AM did not provide the detailed agricultural data found elsewhere at Cerén, it did documented the presence of a continued maize cultivation zone in this region.

Operation AJ

Op. AJ was located approximately 13 meters north and 1.5 m east of Op. AM and approximately 20 m south of 2011 Op. S. This excavation was just south of the Cerén Archaeological Park boundary and was 3 x 3 meters in size and oriented to true North. This excavation was located in a modern sugarcane field of a local farmer, thus the farmer was compensated for crop damages and the topsoil was kept separate so as to maintain the integrity of the soil upon backfilling. Approximately 312 cm below the modern ground-surface, the Cerén TBJ (Tierra Blanca Joven) living surface was located and revealed a portion of the sacbe, an east and west canal, and a very small section of eastern agricultural field (Figure 3-2).

Figure 3-2. Op. AJ Eastern Agricultural Field with Sacbe in the Foreground

The eastern maize field of Op. AJ had ridges and interridges present. The maize ridges had an average height of 7.3 cm, average width of 36 cm, and an average ridge-top to ridge-top spacing of 79 cm. The orientation of the field was approximately 56^{o} E of true N and the walkways between the ridges were approximately 50 cm in width

(Table 3-2). The interridges were very eroded and had an average height of 4 cm, an average width of 13 cm, and an average spacing between the ridges of 44 cm. This small section of the maize field bordered the eastern canal and the TBJ of the field was somewhat eroded and very soft and fragile.

OP. AJ	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	7.3	36	56° E of true N	79	50	3° towards East
INTERRIDGE	3.5	12.5		44		

Table 3-2. Op. AJ Maize Field Data

Given the small size of the maize field identified in Op. AJ, there was only three plant clusters, or plant loci, present in the excavation but surprisingly 8 maize stalks were found bent over in harvest and two mazorcas (Figure 3-3). The plant clusters had an average height of 69 cm above TBJ and the average plant height for the maize stalks bent over in preparation for harvest was 102 cm (Table 3-3). The average maize stalk diameter was 1.68 cm and the two mazorcas had an average length of 17 cm, an average width of 5.4 cm, and an average thickness of 3.5 cm (Table 3-4). It appears that this was a mature and productive field that was drying for harvest at the time of the Loma Caldera eruption.

Figure 3-3. Op. AJ Maize Stalk Bent in Preparation for Harvest with attached Mazorca

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AJ	East	3	11	68.67	102	1.68	8	2

Table 3-3. Op. AJ East Maize Field Plant Cast Data

Op.	Field	# of Mazorcas	Avg. Mazorca Length (cm)	Avg. Mazorca Width (cm)	Avg. Mazorca Thickness (cm)
AJ	East	2	16.66	5.36	3.49

Table 3-4. Op. AJ East Maize Field Mazorca Data

<u>Operation AH</u>

Op. AH was located north of Op. AJ and 2011 Op. S and was inside the southern portion of the Cerén Archaeological Park (See Figure 3-1). The operation was 3 x 5 meters in size, oriented to true North, and TBJ was encountered 430 cm below the modern ground-surface. The Cerén sacbe and associated east and west canals were identified in the center of this operation with portions of eastern and western maize fields present on either side (Figure 3-4).

Figure 3-4. Op. AH Sacbe.
East Maize Field (left) and West Maize Field (right)

Op. AH Eastern Maize Field

The eastern maize field of Op. AH consisted of clear ridges, interspersed with smaller interridges. Portions of four maize ridges were present with an average height of 6 cm, an average width of 40 cm, and an average ridge-top to ridge-top spacing of 94 cm (Table 3-5). The ridge-top to ridge-top spacing was unusually large, as maize ridge-top spacing is more commonly 80 cm, while manioc bed spacing is more often 90-100 cm. The large width of these maize ridges was also slightly unusual and might mark an area that had previously been used for manioc cultivation. The ridges were oriented 119 degrees east of true North and the walkways were approximately 50 cm wide and sloped 3 degrees towards the east, away from the sacbe. The interridges had an average height of 3 cm, an average width of 13 cm, and were spaced an average of 19 cm between the ridges.

OP. AH EAST FIELD	Average Height (cm)	Average Width (cm)	Directionality (E of true N)	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	6	40	119° E of true N	94	50	3° towards East
INTERRIDGE	3	13		19		

Table 3-5. Op. AH East Maize Field Ridge Data

A total of ten plant cluster and 19 individual plants were identified in the eastern maize field. These included one maize stalk bent in preparation for harvest and two mazorcas. These plants had an average cluster height of 37 cm and average maize stalk diameter of 1.84 cm (Table 3-6). The two mazorcas had an average length of 9.8 cm, average width of 3.5, and an average thickness of 2.9 cm (Table 3-7).

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam.	# of Bent over stocks	# of Mazorcas
AH	East	10	19	37	-	1.84	1	2

Table 3-6. Op. AH East Field Maize Plant Data

Op.	Field	# of Mazorcas	Avg. Mazorca Length (cm)	Avg. Mazorca Width (cm)	Avg. Mazorca Thickness (cm)
AH	East	2	9.84	3.52	2.86

Table 3-7. Op. AH East Field Mazorca Data

Op. AH West Maize Field

Only a very small portion of the Op. AH maize field was visible in this excavation and the ridges were difficult to identify due to the small segment of the field the was visible. Three partial ridges were visible; although, the measurements for this field should be considered preliminary given there was such a small sample from which to draw. The average height of the ridges was 9 cm, average width 43 cm, and average ridge-top to ridge-top spacing was 88 cm (Table 3-8). The walkways were difficult to clearly measure but had an overall slope of 4 degrees towards the east. The field was oriented approximately 120 degrees east of true North.

OP. AH WEST FIELD	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	**8.5**	**43**	**120° E of true N**	**88**	**-**	**4° towards East**

Table 3-8. Op. AH West Maize Field Data

There was only one plant cluster found in the Op. AH maize field, which is unsurprising given the small portion of the field present. This cluster height was 57 cm above TBJ with a stalk diameter of 1 cm, and no bent-over stalks or mazorcas found (Table 3-9).

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AH	West	1	1	57	-	1	0	0

Table 3-9. Op. AH West Field Maize Plant Data

There were two other plant casts found in Op. AH (Clusters 2 and 3). Both plants were branches found on top of the sacbe and in the case of Cluster 3 the branch was under TBJ of the sacbe in one area. It appears this branch might have fallen onto TBJ before the eruption and possibly have been compacted into the sacbe by foot traffic or that the turbulence of the Loma Caldera eruption blast and decompression waves might have caused the branch to be compressed into the TBJ surface. The Cluster 2 branch was 60 cm in length and 4 cm in width and the Cluster 3 branch was 260 cm in length and 5 cm in width.

<u>Operation AG</u>

Approximately 5 meters north from Op. AH was Op. AG, another 3 x 5 meter sized exaction oriented to true North. Op. AG was also situated near two excavations from 2011; it was south of Op. U and east of Op. T (See Figure 3-1). Approximately 475 cm below the modern ground surface we recorded the continuation of the sacbe and canals with maize fields to the east and west (Figure 3-5).

Figure 3-5. Op. AG showing the West Maize Field (upper right), Sacbe (center, and East Maize Field (lower left)

Op. AG Eastern Maize Field

The eastern maize field of Op. AG had small portions of five ridges visible that had an average height of 5.8 cm, average width of 30 cm, an average ridge-top to ridge-top spacing of 63 cm, and were oriented 123 degrees east of true North (Table 3-10). The walkways between ridges were approximately 31 cm wide and had an overall slope of 2 degrees towards the northwest. The small height and close spacing of the ridges was very different from the ridges of Op. AH and will be addressed in the discussion section of this chapter.

OP. AG EAST FIELD	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	5.8	30	123° E of true N	63	31	2° towards Northwest

Table 3-10. Op. AG East Maize Field Ridge Data

There were only two plant clusters (Clusters 8 and 9) present in the far eastern end of the visible portion of the east maize field but Cluster 8 had 5 plants, 3 of which were bent for harvest, and Cluster 9 have 2 plants, one of which was bent. These plants had an average cluster height of 69 cm, an average maize stalk diameter of 1.4 cm, and no mazorcas were present (Table 3-11).

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AG	EAST	2	7	69	-	1.4	4	0

Table 3-11. Op. AG East Maize Field Plant Data

Op. AG West Maize Field

Small portions of three ridges were visible in the western maize field of Op. AG. These ridges had an average height of 9 cm, an average width of 40 cm, an average ridge-top to ridge-top spacing of 87 cm, and were oriented 118 degrees east of true North (Table 3-12). The walkways between ridges were space 42 cm and had an overall slope of 3 degrees east towards the sacbe.

OP.	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	9	40	118° E of true N	87	42	3° towards East

Table 3-12. Op. AG West Maize Field Ridge Data

There were a total of 7 clusters in the west maize field of Op. AG, with 24 plants total. There was an average cluster height of 51 cm and the three maize stalks bent over in harvest provided an average plant height of 92 cm. The maize stalks had an average diameter of 1.5 cm (Table 3.13). There were also 4 mazorcas present with an average length of 11 cm, an average width of 4 cm and thickness of 3.6 cm (Table 3.14).

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AG	West	7	24	51	92	1.5	3	4

Table 3-13. Op. AG West Maize Field Plant Data

Op.	Field	# of Mazorcas	Avg. Mazorca Length (cm)	Avg. Mazorca Width (cm)	Avg. Mazorca Thickness (cm)
AG	West	4	11.2	3.95	3.62

Table 3-14. Op. AG West Maize Field Mazorca Data

<u>Operation AI</u>

Op. AI was located north of Op. AG and positioned north of 2011 Op. U and south of 2011 Op. W (See Figure 3-1). The Cerén living surface was encountered 479 cm below the modern ground-surface and the sacbe was found in the center of the excavation with small portions of an eastern and a western maize field present (Figure 3-6).

Figure 3-6. AI showing the Sacbe (center), East Maize Field (left), and West Maize Field (right)

Op. AI Eastern Maize Field

The eastern maize field of Op. AI had four ridge and three interridges present. The ridges had an average height of 10 cm, average width of 41 cm, average ridge-top to ridge-top spacing of 108 cm, and an orientation of 119 degrees east of true North (Table 3.15). The interridges were very short with an average height of 1 cm, an average width of 19 cm, and an average spacing between the ridges of 56 cm. The short height and wider width of the interridges might suggest these had been stepped on and eroded, since interridges found this season had an average height of 3 cm and an average width of 14 cm.

OP. AI EAST FIELD	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	10	41	119° E of true N	108	66	6° towards East
INTERRIDGE	1	19		56		

Table 3-15. Op. AI Eastern Maize Field Ridge Data

There were 6 plant clusters identified in the eastern maize field and a total of 24 plants. These clusters had an average height of 72 cm and the maize stalks had an average diameter of 2.3 cm (Table 3-16). There were no maize stalks found bent-over to dry for harvest and no mazorcas present in this field.

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AI	East	6	24	71.6	N/A	2.26	0	0

Table 3-16. Op. AI Eastern Maize Field Plant Data

OP. AI WEST FIELD	Average Height	Average Width	Directionality	Ridge-top to Ridge-top spacing	Spacing of Walkways	Average Slope of Walkways
RIDGE	11	47	114° E of true N	83	38	5° towards East

Table 3-17. Op. AI West Maize Field Ridge Data

Op. AI West Maize Field

Only a very small portion of the Op. AI western maize field was visible in this excavation (Figure 3.7). The portion of the field visible had only three ridges that had an average height of 11 cm, an average width of 47 cm, an average ridge-top to ridge-top spacing of 83 cm, and were oriented approximately 114 degrees east of true North (Table 3-17). The walkways between ridges had an average spacing of 38 cm and an overall slope of 5 degrees towards the sacbe in the east.

There were a total of four plant clusters in the western maize field of Op. AI, with 12 plants total. The average height of the clusters was 46 cm and the average maize stalk diameter of these plants was 2.1 cm (Table 3-18). There were two maize stalks bent and two mazorcas recovered from this field. The mazorcas had an average length of 18 cm, an average width of 5.3 cm, and an average thickness of 4.4 cm (Table 3-19). One other plant cast was recovered from Op. AI, Cluster 1, that was a branch above found approximately 82 cm above TBJ that was 31 cm in length and 5 cm in average diameter.

Figure 3-7. Op. AI Western Maize Field (top) bordering the Sacbe (center)

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm(	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AI	WEST	4	12	46	N/A	2.06	2	2

Table 3-18. Op. AI West Maize Field Plant Cast Data

Op.	Field	# of Mazorcas	Avg. Mazorca Length (cm)	Avg. Mazorca Width (cm)	Avg. Mazorca Thickness (cm)
AI	West	2	18.25	5.25	4.35

Table 3-19. Op. AI West Maize Field Mazorca Data

<u>Operation AF</u>

Op. AF was a 3 x 3 meter excavation located north of 2011 Op. W. This excavation was intended to follow the sacbe to the north, a purpose for which it was successful. Due to the small size of the excavation, the agricultural remains from this operation are more limited than those of larger size. Two very small portions of the east and west maize fields were found on each side of the sacbe in this operation (Figure 3-8).

Figure 3-8. Op. AF Showing the West Maize Field (top left), Sacbe (center), and East Maize Field (bottom right)

Op. AF Eastern Maize Field

The small portion of the Op. AF Maize field visible in the excavation had three partial ridges visible, though the shape and size of these features appeared to be more similar to manioc beds than to maize ridges. It is likely these ridges, like others we have documented at the site (Dixon 2013) had been previous employed as manioc beds and were repurposed for maize cultivation. The ridges had an average height of 10 cm, average width of 40 cm, average ridge-top to ridge-top spacing of 103 cm, and an orientation of 143 degrees east of true North (Table 3-20). The walkways were only 35 cm in width and had an overall slope of 3 degrees towards the eastern canal of the sacbe in the northwest.

OP. AF EAST FIELD	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	10	40	143° E of true N	103	35	3° towards Northwest

Table 3-20. Op. AF Eastern Maize Field Ridge Data

There were seven plant clusters with a total of 22 plants recovered from the eastern field of Op. AF. The clusters had an average height of 35 cm and the maize stalks had an average diameter of 1.8 cm, with no stalks bent-over and two mazorcas present in this field (Table 3-21). The mazorcas had an average height of 16 cm and an average width of 5 cm (Table 3-22).

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AF	East	7	22	34.97	N/A	1.76	0	0

Table 3-21. Op. AF Eastern Maize Field Plant Cast Data

Op.	Field	# of Mazorcas	Avg. Mazorca Length (cm)	Avg. Mazorca Width (cm)	Avg. Mazorca Thickness (cm)
AF	East	2	16.33	5.3	N/A

Table 3-22. Op. AF Eastern Maize Field Mazorca Data

Op. AF West Maize Field

An even smaller section of the western Op. AF maize field was visible in this excavation. Here only one small ridge or planting mound was present. The limited view of the field allowed us to only record that this feature had a height of 4 cm and we were unable to ascertain the width, directionality, spacing, or even nature of the planting ridge or mound. There was one plant cluster visible on this ridge with a total of four plants. The cluster was 4 cm in height from the top of TBJ and the maize stalks had an average diameter of 1.55 cm (Table 3-23). None of the stalks were bent and there was only one mazorca recovered. The small area of the documented field significantly limits these data. The mazorca had a length of 18 cm and average width of 3.7 cm (Table 3-24).

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AF	West	1	4	4	N/A	1.55	0	1

Table 3-23. Op. AF West Maize Field Plant Cast Data

Op.	Field	# of Mazorcas	Avg. Mazorca Length (cm)	Avg. Mazorca Width (cm)	Avg. Mazorca Thickness (cm)
AF	West	2	18.4	3.69	N/A

Table 3-24. Op. AF West Maize Field Mazorca Data

<u>Operation AE</u>

Operation AE was located north of Op. AF and to the east of Household 2. This excavation was 4 x 7 meters in size and intended to locate the sacbe to the north and its surrounding context. The excavation of Op. AE revealed the continuation of the sacbe in the far western side of the operation, with the western side of the sacbe continuing into the western wall. The majority of this operation revealed the maize field immediately east of the sacbe (Figure 3-9).

Figure 3-9. Op. AE East Maize Field with Sacbe in the western side of the excavation

Op. AE Eastern Maize Field

The large area of the Op. AE Eastern Maize Field allowed for a clearer picture of the construction of this field and the examination of numerous maize casts. The ridges were well-maintained and interridges were visible throughout most of the operation. The ridges had an average height of 6 cm, an average width of 39 cm, an average ridge-top to ridge-top spacing of 82 cm, and were oriented 125 degrees east of true North (Table 3-25). The walkways between the main ridges were spaced 34 cm and had an overall gentle slope of 1 degree towards the sacbe to the southwest.

OP. AE EAST FIELD	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	6	39	125° E of true N	82	34	1° towards Southwest
INTERRIDGE	2	13		42		

Table 3-25. Op. AE East Maize Field Ridge Data

There were 57 plant clusters in Op. AE and 135 separate plants. Most of these were maize, however eight of the plant clusters were not maize. The maize plants found in the eastern field had an average cluster height of 57 cm. There were 4 maize stalks found bent over and from these we calculated an average plant height of 60 cm (Figure 3-10). The maize stalks had an average diameter of 2.1 cm and 19 mazorcas were identified in the field (Table 3.26). The mazorcas had an average length of 15 cm and an average width and thickness of 3.6 cm (Table 3-27).

Figure 3-10

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AE	East	57	135	38.03	59.67	2.08	4	19

Table 3-26. Op. AE East Maize Field Plant Cast Data

Op.	Field	# of Mazorcas	Avg. Mazorca Length (cm)	Avg. Mazorca Width (cm)	Avg. Mazorca Thickness (cm)
AE	East	19	15	3.63	3.6

Table 3-27. Op. AE East Maize Field Mazorca Data (

Op. AE also yielded non-maize plants. Importantly, excavations in this operation revealed an *ayote* (squash) plant cast growing on top of the edge of a maize ridge (Figure 3.11). The ayote cast was 23 cm in length and 5.9 cm in width with a small stalk present. This is the first ayote cast recovered at the site and provides important insight into the use of this crop at Cerén. No other ayote casts were recovered in this field or any of the excavations at Cerén. Thus, it is probable that this plant was a volunteer, perhaps allowed to grow despite the lack of other squash plants present. It is possible squash was being grown along the maize ridges or interridges of this field but that it had been harvested before the volcano erupted.

Figure 3-11. Op. AE Ayote (Squash)-

The Op. AE eastern field also had an unidentified plant cast growing in a planting mount between the two maize ridges in the southwestern extent of the excavated field (Figure 3-12 and 3-13). The planted mound was constructed in the same manner as the maize ridges, with built-up TBJ tephra. The planting mound was approximately 14 x 16 cm in width and 11 cm in height above the walkway in which it is situated. The plant cast could not be identified but it appears to be possibly a different type of plant than previously documented at Cerén.

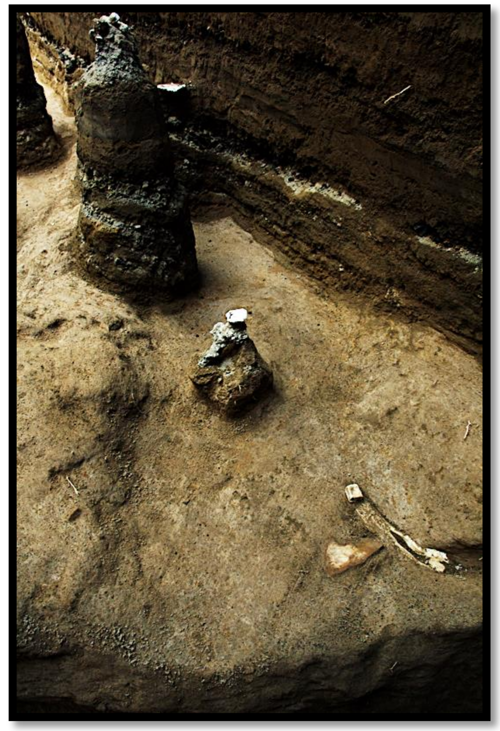

Figure 3-12 Op. AE Unidentified Plant Cast on a small Planting Mound (Left). Op. AE Small Planting Mound Located in the Walkway between two Maize Ridges (Right)

Operation AK

Op. AK was located north of Op. AE, northeast of Household 2, and southwest of Household 1. This was a 3 x 6 meter excavation that was aimed at continued documentation of the sacbe as it entered the site center. Op. AK successfully located the sacbe in the center of the excavation with maize fields on the east and west. Additionally, a drainage canal intersecting the west canal and a constructed platform were encountered south of the west maize field (Figure 3-14). The sacbe and the eastern maize field were impacted significantly by the Loma Caldera eruption. Two large lava bombs hit the sacbe directly and a large portion of country rock directly hit the east maize field. The resulting large bomb sags destroyed a section of the east maize field and the northern and southern portions of the sacbe. The size of the excavated area and the positioning of the sacbe between two fields, made this the single best area from which to view the relationship between the sacbe and the adjacent agricultural fields. The state of both the eastern and western fields of Op. AK showed no correlation with the degree of maintenance along either sacbe edge or canal.

Figure 3-13. Op. AK
showing the West Maize Field (top), Drainage Canal and Platform (top left), Sacbe (center), and East Maize Field (bottom)

Op. AK Eastern Maize Fields had five ridges and two interridges visible in this excavation. The northern ridges had been significantly impacted by the country rock and its resultant bomb sag and were less clear than the southern ridges. The east maize field ridges had an average height of 12 cm, an average width of 30 cm, an average ridge-top to ridge-top spacing of 82 cm, and were oriented 115 degrees east of true North (Table 3-28). The walkways between the ridges were approximately 34 cm in width and had an overall slope of 3 degrees towards the sacbe in the west. There was a clear eastern canal between the sacbe and the southern portion of the eastern maize field, but it was not clear where the water run-off from the northern section of the field would have been channeled.

OP. AK EAST FIELD	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	12	30	115° E of true N	82	34	3° towards West
INTERRIDGE	1	10		37		

Table 3-28. Op. AK East Maize Field Ridge Data

There were six plant clusters identified in this field with a total of 15 separate plants, two of which were bent and one of which was a mazorca. The average cluster height in this field was 53 cm, the average maize stalk diameter for these plants was 1.8 cm, and it is likely there would have been two or more additional plant clusters if the country rock had not impacted the field directly (Table 3-29). The mazorca was 11 cm in length and 3.6 cm in width and thickness (Table 3-30).

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AK	East	6	15	53.29	N/A	1.77	2	1

Table 3-29. Op. AK East Maize Field Plant Cast Data

Op.	Field	# of Mazorcas	Avg. Mazorca Length (cm)	Avg. Mazorca Width (cm)	Avg. Mazorca Thickness (cm)
AK	East	1	11	3.6	3.62

Table 3-30. Op. AK East Maize Field Mazorca Data

Op. AK West Maize Field

The western maize field of Op. AK was bordered by the western canal to the east and the drainage canal to the south. Thus we have identified the southeast corner of this agricultural field. The ridges were small and very eroded and did not appear to have maintained recently. The ground-surface in this field was very wet, soft, and eroded. These ridges had an average height of 4.8 cm, an average width of 21 cm, an average ridge-top to ridge-top spacing of 75 cm, and an overall orientation of 114 degrees east of true North (Table 3-31). The walkways between ridges were spaced approximately 62 cm apart and had an overall slope of 3 degrees away from the sacbe, towards the west. The interridges were also eroded and had an average height of 3.2 cm, an average width of 17 cm, and an average spacing between ridges of 41 cm.

OP. AK WEST FIELD	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	**4.8**	**21**	**114° E of true N**	**75**	**62**	**3° towards West**
INTERRIDGE	**3.2**	**16.7**		**41**		

Table 3-31. Op. AK West Maize Field Ridge Data

There were eight plant clusters in the western maize field of Op. AK and within these clusters there were 25 plants. The average cluster height was 44 cm and there were five bent maize stalks and no mazorcas in this field. The average maize stalk diameter was 1.7 cm (Table 2-32).

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AK	West	8	25	44.43	N/A	1.67	5	0

Table 3-32. Op. AK West Maize Field Plant Cast Data

<u>Operation AN</u>

Op. AN was located approximately five meters east and slightly south of Op. AK and was oriented approximately perpendicular to the sacbe (see Figure 3-1). This excavation was positioned south of the southwestern corner of the Household 1 excavation and was aimed at assessing if the sacbe turned towards the religious structures (Structures 10 and 12). While the sacbe was not found in this excavation, there was a maize field with an open, leveled area to the south (Figure 3.15).

Figure 3-14. Op. AN Maize Field and Southern Field Boundary with Flattened, Leveled Surface

The Op. AN Maize Field consisted of ridges and interridges that were well-formed and mostly uniform. The ridges had an average height of 11 cm, an average width of 36 cm, and average ridge-top to ridge-top spacing of 74 cm, and were oriented approximately 108 degrees east of true N (Table 3-33). The walkways between ridges were spaced 34 cm and had an overall slope of approximately 3 degrees towards the east. Thus, the water run-off in this field would have flowed away from the sacbe and towards the river. It is very important to note that the ridges of this field were oriented perpendicular to those identified in the southwest corner of Household 2 (Sheets 2002). The knowledge of a maize field with different ridge direction in the north and the boundary with the cleared area documented in the south of this operation suggested that this maize field was only approximately 10 meter in a north- south direction and extended an unknown distance to the east and the west.

OP. AN	Average Height (cm)	Average Width (cm)	Directionality	Ridge-top to Ridge-top spacing (cm)	Spacing of Walkways (cm)	Average Slope of Walkways
RIDGE	11.3	35.5	108° E of true N	74	34	3° towards East
INTERRIDGE	3	12.5		43		

Table 3-33. Op. AN Maize Field Ridge Data

The Op. AN Maize Field had 17 plant clusters with 34 plants cast during our excavations. The plant clusters had an average height of 51 cm. The maize stalks had an average diameter of 1.6 cm and there were three bent maize stalks (Table 3-34). There were two mazorcas found in this field and these had an average length of 15 cm, an average width of 4.6 cm, and an average thickness of 3.4 cm (Table 3-35).

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AN	North	17	34	51.44	N/A	1.57	3	2

Table 3-34. . Op. AN Maize Field Ridge Data

Op.	Field	# of Mazorcas	Avg. Mazorca Length	Avg. Mazorca Width	Avg. Mazorca Thickness
AN	North	2	15.35	4.58	3.43

Table 3-35. Op. AN Maize Field Mazorca Data

In addition to the maize, there was also a plant cast that appears to have been a stump of a small tree that had been growing adjacent to the maize ridge in this area (Figure 3-16). The cast extended an unknown distance below TBJ and had a diameter of 6.24 cm.

Discussion

The 2013 field season focused primarily upon the investigation of the earthen sacbe and the adjacent agricultural fields. Nine of the excavations of this season showed evidence for agricultural production, though in many instances the portion of the field visible in the excavation was not sufficient to draw definitive conclusions about the agricultural field. Despite the small areas of fields visible in most excavation, there were three major areas to which this research has contributed: 1) locating of agricultural fields and field boundaries at the site, 2) documenting variation in farming techniques and plants, and 3) assessing the hypothesized relationship between field and sacbe maintenance.

Figure 3-15. Op. AN Possible Small Tree Stump located adjacent to the Maize Ridges

Locating Fields and Field Boundaries

Previous excavations of the Cerén agricultural fields have documented numerous field boundaries between two fields of the same crop, two fields of different crops, fields and cleared areas, fields and platforms, and fields and the sacbe (Dixon 2013). In addition to documenting the field boundaries adjacent to the sacbe in each excavation, the 2013 field season directly identified two additional field boundaries and the approximate location of two more field boundaries.

Figure 3-16. Op. AK the Southwestern corner of the West Maize Field (top right) formed by the Intersection of the West Canal (bottom) and the Drainage Canal (left)

First, in Op. AK the western maize field was bordered by the west canal along its eastern edge and the drainage canal along its southern edge. Thus, we were able to document the southeast corner of this agricultural field (Figure 3-17). Second, in Op. AN a linear and distinct boundary was formed between the southern-most maize ridge and the cleared and leveled open space to the south (Figure 3-18). Third, given the position of Op. AN and Op. AE, the cleared and leveled space of Op. AN implies an additional boundary, the northern boundary of the Op. AE east maize field. Finally, the directionality of the AN maize ridges perpendicular to the maize ridges documented in the southwest corner of Household 1 (Sheets 2002) demonstrate that there is field boundary in the short distance between these two fields. Smaller maize fields planted perpendicular to each other in this way would have maximized water infiltration of the maize ridges, though it appears this was only done in certain locations at Cerén and the majority of maize ridges were generally planted perpendicular to ground-slope.

Following the previous findings for the Cerén agricultural fields (Dixon 2013), it is possible to compare the style, size, directionality, and state of each portion of agricultural field identified to assess possible additional boundaries between maize fields. When examining the ridge data for maize fields along the east side of the sacbe (Table 3-36) and the plant cast data for these eastern maize fields (Table 3-37), it is possible to see examples of field sections that are likely of the same field and others that are likely of different fields.

Figure 3-17. Op. AN Maize Field Southern Boundary formed with Cleared, Leveled space (right) to the south

Comparison of the maize fields located east of the sacbe show possible connections between some of these field sections. The close distance between Ops. AI and AF and the large ridge spacing of their eastern fields of 108 cm and 103 cm respectively suggests that at one time these areas might have been a unified field, likely used previously for manioc cultivation, however the directionality of these ridges and the presence of interridges in Op. AI but not in Op. AF, might suggest these were utilized as separate fields at the time of the eruption. Similarly, there was an apparent relationship between the eastern field of Op. AI and the eastern field of Op. AH where they shared the same directionality of ridges and both showed very larger ridge-top to ridge-top spacing and comparable ridge sizes; however, Op. AG was located between Ops. AH and AI and this field had a very small ridge-top to ridge-top spacing and overall size. Thus, it is possible that Ops. AF, AH, and AI were once part of an initial larger field, possibly cultivating manioc, but have since been divided into smaller fields. The sizes and maturity of plant casts can be used as additional evidence to assess the likely connection or separation of various maize fields. Further excavation is needed to confirm this relationship but these preliminary results allow for basic comparisons between potentially different maize fields.

Op	Field	Direction -ality	Avg. Ridge Height (cm)	Avg. Ridge Width (cm)	Ridge-top to Ridge-top spacing (cm)	Average Inerridge Height (cm)	Avg Interridge Width (cm)	Spacing between Interridges and Ridges (cm)	Spacing of Walkway (cm)	Average Slope of Walkway
AJ	East	56° E of true N	7.3	36	79	3.5	12.5	44	50	3° towards East
AH	East	119° E of true N	6	40	94	3	13	19	50	3° towards East
AG	East	123° E of true N	5.8	30	63	-	-	-	31	2° towards Northwest
AI	East	119° E of true N	10	41	108	1	19	56	66	6° towards East
AF	East	143° E of true N	10	40	103	-	-	-	35	3° towards Northwest
AE	East	125° E of true N	6	39	82	2	13	42	34	1° towards Southwest
AK	East	115° E of true N	12	30	82	1	10	37	34	3° towards West

Table 3-36. Summary of 2013 Agricultural Ridge Data for Fields East of the Sacbe

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AJ	East	3	11	68.67	102	1.68	8	2
AH	East	10	19	37	-	1.84	1	2
AG	East	2	7	69	-	1.4	4	0
AI	East	6	24	72	N/A	2.26	0	0
AF	East	7	22	35	N/A	1.76	0	2
AE	East	57	135	38.03	59.67	2.08	4	19
AK	East	6	15	53.29	N/A	1.77	2	1

Table 3-37. Summary of 2013 Plant Cast Data from Agricultural Fields East of the Sacbe

A similar assessment is possible for the 2013 data from the agricultural fields documented west of the sacbe. The excavations of the agricultural fields west of the sacbe showed much more uniformity and consistency. The western maize fields in Ops. AH, AG, and AI showed very uniform height, width, and ridge-top to ridge-top spacing. Furthermore, all of these field portions lacked interridges and had a similar degree of slope towards the west (Table 3.38). Thus, it appears that the western maize ridges documented in Ops. AH, AG, and AI were likely of one maize field. Alternatively, we know that the western field of Op. AK was separate from the other western fields due to the location of its southern field boundary and these field data presented here further support that separation.

Op.	Field	Direction -ality	Average Ridge Height (cm)	Average Ridge Width (cm)	Ridge-top to Ridge-top spacing (cm)	Average Inerridge Height (cm)	Average Interridge Width (cm)	Spacing between Interridge and Ridges (cm)	Spacing of Walkway (cm)	Average Slope of Walkway
AH	West	**120° E of true N**	**8.5**	**43**	**88**	-	-	-	-	**4° towards East**
AG	West	**118° E of true N**	**9**	**40**	**87**	-	-	-	**42**	**3° towards East**
AI	West	**114° E of true N**	**11**	**47**	**83**	-	-	-	**38**	**5° towards East**
AF	West	-	**4**	-	-	-		-	-	-
AK	West	**114° E of true N**	**4.8**	**21**	**75**	**3.2**	**16.7**	**41**	**62**	**3° towards West**

Table 3-38. Summary of Field Data for Maize Fields found West of the Sacbe

Op.	Field	Total # of Plant Clusters	Total # of Plants	Avg. Cluster Height (cm)	Avg. Plant Height (cm)	Avg. Diam. (cm)	# of Bent over stocks	# of Mazorcas
AH	West	1	1	57	-	1	0	4
AG	West	7	24	51	92	1.5	3	4
AI	West	4	12	46	N/A	2.06	2	2
AF	West	1	4	4	N/A	1.55	0	1
AK	West	8	25	44.43	N/A	1.67	5	0

Table 3-39. Summary of Plant Cast Data from Maize Fields Located West of the Sacbe

These field boundaries continue to add in our analysis of the organization, maintenance, and diversity of agriculture at Cerén; furthermore, the identification of fields with different styles of cultivation potentially inform our documentation of different cultivators in the past.

Farming Techniques

The agricultural fields documented this field season also showed evidence for variation in cultigens and cultivation techniques. The ayote (squash) plant growing in the maize field of Op. AE, is the first direct documentation of a squash plant growing at Cerén, or anywhere else in the ancient world. While squash seeds and microbotanical evidence have been found previously at the site, such as a pot found in Structure 10 that was filled with hundreds of squash seeds (Lentz et al. 1996), the contribution of the crop directly growing in a maize field aids in our knowledge of how the agricultural system functioned. The location of this squash plant cast within the maize fields confirms that Cerén farmers were likely interplanting maize and squash, or more likely phased interplanted in the same field where they were planted together at different stages of growth. The common planting season for the region today is for maize to be planted in May and doubled-over to dry for harvest in August. When the maize is doubled over for harvest, vine beans and squash are then planted so the beans can grow up the stalk and the squash (ayote) grows below the stalks (Payson Sheets personal communication 2013).

Also, in the course of the 2013 excavations we documented numerous fields with interridges. When interridges were first discovered in 2011 Op. T, we were unsure as to their potential genesis or function. The documentation of interridges throughout multiple operations, indicates that these were another farming technique utilized by some Cerén farmers. The excellent paleobotanic research by Dr. David Lentz and Venicia Slotten (see this report Ch 5) have documented numerous seeds (*Spilanthes*) from the soil samples of the interridges. Perhaps the interridges were used to grow these and other plants, near but not directly with the maize plants. although the plant can function medicinally, it appears it was more likely grown as a weed due to the large number of Spilanthes seeds present (David Lentz personal communication 2013).

Excavations of the portions of maize fields east of the sacbe in Op. AF, AI, and AH revealed ridges that had the spacing and were shaped more similar to manioc beds than to maize ridges. It is possible that this marks another location where a field had been rotate or converted from manioc cultivation to maize cultivation (Dixon 2013) and then was subdivided into separate maize fields.

Sacbe Relationship

One other major contribution of the 2013 excavations was the investigation of the relationship between the sacbe and the agricultural fields. In 2011 excavations of Op. W the maize field to the east of the sacbe had more formal, well-maintained ridges in and was bordered by a uniform, well-maintained eastern canal. Alternatively the maize field to the west of the sacbe had less clearly defined and maintained ridges and was bordered by a very eroded, less-uniform western canal. This finding inspired a hypothesis that different cultivators were responsible for different sections of sacbe maintenance. By examining the agricultural fields adjacent to the sacbe and canals, we were able to test this hypothesis.

The 2013 research indicates that there is not a readily identifying correspondence between the degree of maintenance of the sacbe edges or canals and the associated agricultural fields. Instead, the variation in sacbe edges and canal maintenance is from one side to the other, with the eastern canal very uniform and recently maintained before the eruption, and the western canal much more eroded and irregular, seemingly not maintained recently before the Loma Caldera eruption. Construction of different sacbe sections does appear to have been achieved by different individuals or groups, likely family lineages or households. So while groups appear to have worked independently on sections of the sacbe construction, there is a clear overall organization of such construction, given it was maintained with a consistent western slope and the eastern side of the sacbe was likely maintained recently before the volcano eruption, whereas the western side of the sacbe was not (See Dixon and Sheets this report Ch. 2). The implications of these findings are that individual groups maintained the power to build the sacbe in their own style, while a form of community integration, likely through non-royal governance (Dixon 2013; Sheets 2009), was responsible for organizing and planning. This pattern matches that of the agricultural evidence from Cerén. Namely, individual farmers had the power to select which crops to grow, in what manner to grow these crops, and when to rotate crops or leave fields fallow. At the same time these farmers were connected into an overall community through the orientation of field boundaries and the coordination of the manioc and maize harvest at the site (Dixon 2013). The 2013 research directly contributes to an understanding of the socio-political organization of Cerén, namely the role of non-royal governance in organizing the landscape and labor of the community, while individuals and households held authority over the ways in which they operationalized such organization.

Conclusions

The agricultural data of Cerén continues to inform our understanding of quotidian practices of Cerén farmers and extend our knowledge of Classic Period Maya farming. The variation of field boundaries and cultivation techniques, when contextualized in the agricultural data previously documented at the site (Dixon 2013), demonstrates that Cerén farmers likely maintained autonomy over their cultivation decisions, while still being integrated into a larger communal organization. Such communal governance is evidenced by the coordination of field boundaries, the synchronization of the harvest, likely timed with the site center ritual, and the organization of water management documented this field season in the form of sacbe slope and canal use. Continued research into the pattern of agricultural field layout and into the diversity of crops and cultivation techniques employed at Cerén will powerfully aid to understanding of the site and of ancient Maya agriculture.

Acknowledgments

I wish to express deep gratitude for the continued support I have received from Dr. Payson Sheets. I am truly fortunate to have Dr. Sheets as my mentor, research colleague, and friend. His overwhelming enthusiasm for Cerén and his commitment to the preservation of the site are inspiring. I also wish to extend my thanks to the National Science Foundation for their generous support of our continued work at Cerén. Gratitude is owed to the country of El Salvador, particularly the Patrimonio Cultural and director Dr. Gustavo Milan, the department of Archaeology and director Dr. Shione Shibata, and the Museo Nacional David J. Guzman and Roberto Gallardo. It is an honor to work in a country that is dedicated to the preservation of their vibrant cultural patrimony. Thank you to the Cerén Archaeological council for their support of our research and their stewardship of the site. Significant personal gratitude is extended to the 2012 fields season participants. Dr. David Lentz continues to provide valuable insight into the paleobotanical record of the site and I am grateful to be able to work with such an accomplished scholar. Dr. Nancy Gonlin also contributed very insightful perspectives on our research this field season and remains an important mentor and friend in my life. University of Colorado PhD student Rachel Egan was a great addition to our research team and cheerfully supplied her mapping expertise to our project, as well as provided a great sounding board of archaeological knowledge throughout the field season. University of Colorado MA student Alexandria “Zan” Halmbacher was a returning member of our project this year without whom we could not have been this successful. Zan provided great ideas for the operation and running of the project and worked tirelessly to make sure this project was a success. I am deeply grateful to her for both her continued work at Cerén and friendship. University of Cincinnati MA student Venicia Slotten was another great addition to our project this year. Her paleobotanical research has already contributed to our understanding of ancient Cerén plants and her enthusiasm for archaeology was appreciated. We were very fortunate to have had the soon-to-be graduate student Rocio Herrera return for a second season with our Cerén project. Rocio showed great commitment to the project, contributed significantly to our excavations, stepped into a leadership position when we needed. Her light-hearted spirit and humor were much appreciated. Thank you also to Michelle Toledo, who assisted with our research this summer and ably contributed to the ceramic analysis for the project. An enormous thank you is owed to the amazing group of Salvadorian workers, without who we could not have achieved as much as we were able. We were fortunate to have so many returning men whose excavation expertise, hardwork, and positive attitudes are truly inspiring. My deep gratitude is also expressed to the Garcia Family who have continued to provide me with a home away from home year after year, particularly Elena, who help keep the project running on a day-to-day basis. Finally, I am very grateful to my parents, my Nanny, my siblings and their families for their continued love and support. I am especially thankful to my wife, Lauren, who has supported me in yet *another* field season, who was able to participate in the project once again, and for whom I am forever grateful. I would like to dedicate my work this year in loving memory of my grandmother, Veronica “Reme” Weiler, who passed away while I was in the middle of this field season but whose love and support I still feel with me now.

Chapter 4 The Fertility of Cerén; Analyzing the Ancient Soils

Rachel Egan and Alexandria Halmbacher

Introduction

One of the primary objectives of the 2013 archaeological research was the continued documentation of agricultural production adjacent to the sacbe. In the course of this study we sought to understand the motivations behind the farmers' cultivation decisions. Previous research at the site has recorded fields that were rotated between seed with root crops, changes made to the microtopography of agricultural fields, and areas where farmers chose to leave fallow (Sheets 2007, 2009; Sheets and Dixon 2011). Through the analysis of soil composition and chemistry, we aim to document potential motivations for such farming decisions at Cerén. In order to explore these questions six soil samples out of the eight operations were chemically analyzed to identify edaphic conditions of fertility, friability, and moisture and drainage. The comparison of edaphic conditions within varying agricultural fields at Cerén is a productive means for studying ancient Maya farming knowledge. Intensive maize and manioc fields have been found at Cerén and the edaphic requirements for each vary significantly (Cock 1982). Manioc is very drought-tolerant, but not high water saturation tolerant, and grows well in less fertile and more acidic soils. Alternatively, maize flourishes in dense soils and is very vulnerable to drought. These crops also require different nutrients in the soils; maize is highly nitrogen-demanding and manioc is mildly phosphorous and potassium-demanding (Rehm and Espig 1991).

The chemical-physical-edaphic results acquired though the agronomists at Centro Nacional de Tecnologia Agropecuaria (CENTA), provide the background for future comparisons of microtopographic cultivation decisions, such as choices made to use or not use ridges, the size of ridges to use, if ridges were planted perpendicular or parallel to ground-slope, the degree of soil density in a field, and the planting decisions related to variation in ground-slope. These results afford the opportunity to identify correlates between physical and chemical conditions; thus allowing us to better understand the degree of involvement these factors had in agricultural decisions regarding the fallowing of fields, rotation of crops, and changes in microtopography.

Unfortunately, the 2013 archaeological excavations did not yield any fallowed fields thus rendering a comparison between those in cultivation and those left fallow impossible. In addition, of the six soil samples collected only three have currently been analyzed as of this writing, therefore any conclusions regarding the edaphic conditions of the Cerén soils are only preliminary and require further research.

Methods

This chapter addresses the results of the soil analysis in regards to soil fertility with the goal of providing a reference for further analysis and interpretation. Samples were collected from six of the nine operations (Table 4-1). In order to determine pertinent differences between agricultural fields, one collection of soil was sampled per field. In the 2013 excavations there was often more than one maize field present in each operation, as multiple operations recorded agricultural fields on either side of the sacbe. When this occurred, samples were taken from each respective field and labeled according to their position in relation to the feature. Using a trowel, samples were collected from one specific area within each field. The trowel was cleaned before sampling in order to reduce the possibility of contamination. Unfortunately, the delicacy of Cerén required that we take samples after the archaeological investigation process was complete in each operation. While the likelihood of contamination from foot traffic and surface exposure in the operations is minimal, it cannot be altogether ignored. To mitigate this and other potential contamination, we scraped the upper-most surface of the TBJ to the side before taking the sample. As a preliminary study, it has become clear that future research will require the refinement of methodologies in order to reduce error; such as standardized cleaning process of the trowel and the collection of samples by professionals towards to the early part of exposure of TBJ.

Operation	Location of sample(s)
AE	East field
AF	East field, West field
AG	East field, West field
AH	East field, West field
AI	East field, West field
AJ	East field

Table 4-1. List of operations samples.
Samples were taken from and location and their location within each operation

CENTA tested the samples for the following: Texture, pH, phosphorus (P), potassium (K), zinc (Zn), magnesium (Mg), iron (Fe), copper (Cu), Organic material, calcium (Ca) interchangeable, Mg interchangeable, K interchangeable, sodium (Na) interchangeable, Base sum, acidity, CICE, Base saturation, CA to Mg Ratio, Mg to K ratio, Ca and Mg to K ratio, and Ca to K ratio. The main purpose of the soils lab at CENTA is to assess the natural fertility of agricultural fields and based on the results, make fertilizer recommendations for various crops in order to help improve the performance of the agricultural sector within EL Salvador.

Additional samples were collected from Operated AH and sent to a lab in San Salvador to be tested for Nitrogen levels. Nitrogen levels can inform on maize production. The results for the Nitrogen levels came back at 0.21 % (Figure 4-1). The present day soils here are typically at .2% or higher. The samples were collected from a maize ridge and an inter-ridge. The identical results indicate that either the text failed or there were no discernable differences in soil chemistry between ridges and inter-ridges.

There are two not mutually exclusive explanations for the low Nitrogen levels from Op. AH. First, the low N can be explained by the age of the soil; the close date between the Ilopango TBJ eruption and the Loma Caldera eruption mean the soil would have been relatively young in age and therefore low Nitrogen levels would be expected. Second, the very hot tephra that was deposited on top of the soils from the Loma Caldera eruption were likely very destructive in regards to Nitrogen, and consequently this low number may be inaccurate.

PROCAFE

LABORATORIO DE SERVICIOS ANÁLITICOS

SECCIÓN SUELOS

RESULTADOS DE ANALISIS DE SUELOS

LSA Laboratorio de Servicios Analíticos PROCAFE

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12/07/2013
10:17:47                FUNDACION PROCAFE                  Pag. #  1
                             S.I.I.T.T.
                    MODULO DE SERVICIOS ANALITICOS
                   RESULTADOS DE ANALISIS ESPECIALES
                   ********************************

     N o m b r e   A n á l i s i s                  Valor    Clasificac.
============================================================================

Código Informe :  452
Código Finca   :  18827   SITIO ARQUEOLOGICO
Propietario    : SHEETS PAYSON

                          Muestra #      :  1633
Código Tablón  :   1     OP AH INTER RIDGE
Profundidad    : 0-20           Sitio Muestreo : Banda

NITROGENO TOTAL (%)                               0.021

                          Muestra #      :  1634
Código Tablón  :   2     OP AH MAIZE RIDGE
Profundidad    : 0-20           Sitio Muestreo : Banda

NITROGENO TOTAL (%)                               0.021
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DEPTO. LABORATORIO SERVICIOS ANALITICOS PROCAFE

VER METODOLOGÍA DE ANÁLISIS AL REVERSO

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Figure 4-1. Results of Nitrogen analysis.

Data

The following table shows the results for each field sampled from the 2013 operations (Table 4-2). By merging the data into one table the researchers hope to increase the readability of the results and facilitate the comparison between each of the fields. Samples were collected from operations AE, AF, AG, AH, AI and AJ. Samples were not collected from Op. AL or AM because these were not excavated to TBJ. Samples were also not collected from operations AK and AN due to time restrictions.

<u>The samples</u>

Of the samples taken, analyses only from AF, AG, and AH were received at the time of writing this report. From these three operations two soil samples were taken from each excavation. In each operation, one soil sample was collected from the maize field east of the sacbe and the other soil sample was collected from the maize field west of the sacbe. This resulted in a total of six soil samples from Ops. AF, AG, and AH (Figure 4-2, Figure 4-3, Figure 4-4).

Analysis/Interpretation

During a previous study of the soils of the Zapoititan Valley Olson (1983) concluded that organic matter can be used to determine soil profile variations, pH indicates soil cations and weathering levels, Mn and Fe are affected by types of minerals and weathering, soluble salts are indicators of seepage, and organic material indicates usage and erosion (Olson 1983:57). The samples from this previous Zapotitan Valley survey were analyzed in a fashion similar to the analysis provided by CENTA. We found ourselves in a similar position for the current results therefore the data highlighted as pertinent by Olson will serve a guide for our analysis.

The 1983 soil survey concluded that the soils at Cerén following the Ilopango eruption were fertile, but not as good quality in regards to physical and chemical properties as the earlier Preclassic soils in the region (Olson 1983:56). The 2009 soil test results suggested a similar conclusion; that the Cerén soils were fertile, but not unusually fertile.

Looking to the data, we see the soil had a texture of sandy loam with the exception of the west maize field in AF, which was sandy. The average pH was 6.97 (neutral) with the exception of the west maize field in AF, which was slightly acidic, possibly due to weathering. For other elements within the soil we see average levels of 155 (very high) for phosphorous, 88.64 (high) for potassium, 4.93 (low) for zinc, 24.87 (very high) for iron, 1.04 (high to very high) for copper, and 0.39 (low) for percentage of organic material. The results showed a range for magnesium levels present in the soil samples; for op. AF both fields showed high Mg, while for op. AG Mg both fields had low, and for op. AH Mg was high in the east field and low in the west. Typically, Mg levels reflect soil pH, with high pH equal to increased availability of Mg. Mg is one of the key nutrients needed by crops; low levels therefore indicate a slightly poorer soil health.

.

Op	AF		AG		AH	
Field Type	Maize	Maize	Maize	Maize	Maize	Maize
Location	West	Central	East	West	East	West
Texture	Sand	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
pH	6.4 Slightly acidic	6.6 Neutral	7.3 Neutral	7.2 Neutral	7.1 Neutral	7.2 Neutral
P (mg kg^-1)	165 Very high	168 Very high	158 Very high	148 Very high	154 Very high	140 Very high
K (mg kg^-1)	91.11 High	81.24 High	70.56 High	80.19 High	114.81 High	93.93 High
Zn (mg kg^-1)	0.905 Low	1.54 Low	0.91 Low	1.01 Low	1.01 Low	0.89 Low
Mg (mg kg^-1)	5.13 High	5.16 High	4.59 Low	4.53 Low	5.4 High	4.74 Low
Fe (mg kg^-1)	31.18 Very high	25.51 Very high	23.91 Very high	22.84 Very high	20.89 Very high	24.86 Very high
Cu (mg kg^-1)	2.71 High	4.07 Very high	4.3 Very high	4.31 Very high	6.37 Very high	4.48 Very high
Organic material (%)	0.69 Low	0.27 Low	0.69 Low	0.14 Low	0.27 Low	0.27 Low
Ca interchangeable (cmol kg^-1)	1.18 Very low	2.53 Low	1.77 Very low	1.61 Very low	2.15 Very low	1.73 Very low
Mg interchangeable (cmol kg^-1)	0.92 Low	1.5 Low	1.11 Low	1.1 Low	1.23 Low	1.22 Low
K interchangeable (cmol kg^-1)	0.23	0.21	0.18	0.21	0.29	0.24
Na interchangeable (cmol kg^-1)	0.23	0.34	0.3	0.3	0.36	0.29
Base sum interchangeable (cmol kg^-1)	2.56 Low	4.57 Low	3.37 Low	3.21 Low	4.03 Low	3.48 Low
Acidity interchangeable (cmol kg^-1)	0 Low	0 Low	0 Low	0 Low	0 Low	0 Low
CICE (cmol kg^-1)	2.56 Low	4.57 Low	3.37 Low	3.21 Low	4.03 Low	3.48 Low
Base saturation (%)	100	100	100	100	100	100
CA to Mg Ratio	1.29 Low	1.68 Low	1.59 Low	1.46 Low	1.75 Low	1.42 Low
Mg to K ratio	3.94 Average	7.2 Average	6.15 Average	5.35 Average	4.17 Average	5.06 Average
Ca and Mg to K ratio	9.01 Low	19.33 Average	15.96 Average	13.18 Average	11.47 Average	12.25 Average
Ca to K ratio	5.07 Average	12.13 Average	9.81 Average	7.83 Average	7.31 Average	7.18 Average

Table 4-2. Results of soil analysis by CENTA.

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San Andrés, 18 de julio de 2013

CARTA No. 20369

NOMBRE DEL AGRICULTOR: PAYSON SHEETS CANTON: JOYA DE CEREN MUNICIPIO: SAN JUAN OPICO DEPARTAMENTO: LA LIBERTAD

No. Laboratorio	Muestra No. 20935	Muestra No.20936
Identificación de la muestra	**SAMPLE #1** **OP – AF** **MAIZE – RIDGE** **WEST – SIDE** **27 DE JUNIO 2013**	**SAMPLE #2** **OP – AF** **CENTRAL MAIZE** **RIDGE** **EAST – SIDE** **27 DE JUNIO 2013**

RESULTADO DEL ANALISIS

Textura		ARENA		FRANCO ARENOSO	
pH en agua 1:2.5		6.4 LIGERAMENTE ACIDO		6.6 NEUTRO	
Fósforo	(mg kg^{-1})	165	MUY ALTO	168	MUY ALTO
Potasio	(mg kg^{-1})	91.11	ALTO	81.24	ALTO
Zinc	(mg kg^{-1})	0.905	BAJO	1.54	BAJO
Manganeso	(mg kg^{-1})	5.13	ALTO	5.16	ALTO
Hierro	(mg kg^{-1})	31.18	MUY ALTO	25.51	MUY ALTO
Cobre	(mg kg^{-1})	2.71	ALTO	4.07	MUY ALTO
Materia Orgánica	(%)	0.69	BAJO	0.27	BAJO
Calcio Intercambiable	(cmol kg^{-1})	1.18	MUY BAJO	2.53	BAJO
Magnesio Intercambiable	(cmol kg^{-1})	0.92	BAJO	1.50	BAJO
Potasio Intercambiable	(cmol kg^{-1})	0.23		0.21	
Sodio Intercambiable	(cmol kg^{-1})	0.23	NO SODICO	0.34	NO SODICO
Suma de Bases Intercambiable	(cmol kg^{-1})	2.56	BAJO	4.57	BAJO
Acidez Intercambiable (H+Al)	(cmol kg^{-1})	0.00	BAJO	0.00	BAJO
CICE	(cmol kg^{-1})	2.56	BAJO	4.57	BAJO
Saturación de Bases	(%)	100.00		100.00	
Relación Calcio/Magnesio		1.29	BAJO	1.68	BAJO
Relación Magnesio/Potasio		3.94	MEDIO	7.20	MEDIO
Relación Calcio+Magnesio/Potasio		9.01	BAJO	19.33	MEDIO
Relación Calcio/Potasio		5.07	MEDIO	12.13	MEDIO

Detalle: (mg kg^{-1}) = ppm (cmol kg^{-1}) = meq/100 g suelo

Figure 4-2. Results for Op. AF.

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CARTA No. 20371

NOMBRE DEL AGRICULTOR: PAYSON SHEETS CANTON: JOYA DE CEREN MUNICIPIO: SAN JUAN OPICO DEPARTAMENTO: LA LIBERTAD

No. Laboratorio	Muestra No. 20939	Muestra No.20940
Identificación de la muestra	**OP – AG** **EAST – FIELD** **2 DE JULIO 2013**	**OP – AG** **WEST – FIELD** **2 DE JULIO 2013**

RESULTADO DEL ANALISIS

Textura		FRANCO ARENOSO		FRANCO ARENOSO	
pH en agua 1:2.5		7.3 NEUTRO		7.2 NEUTRO	
Fósforo	($mg\ kg^{-1}$)	158	MUY ALTO	148	MUY ALTO
Potasio	($mg\ kg^{-1}$)	70.56	ALTO	80.19	ALTO
Zinc	($mg\ kg^{-1}$)	0.91	BAJO	1.01	BAJO
Manganeso	($mg\ kg^{-1}$)	4.59	BAJO	4.53	BAJO
Hierro	($mg\ kg^{-1}$)	23.91	MUY ALTO	22.84	MUY ALTO
Cobre	($mg\ kg^{-1}$)	4.30	MUY ALTO	4.31	MUY ALTO
Materia Orgánica	(%)	0.69	BAJO	0.14	BAJO
Calcio Intercambiable	($cmol\ kg^{-1}$)	1.77	MUY BAJO	1.61	MUY BAJO
Magnesio Intercambiable	($cmol\ kg^{-1}$)	1.11	BAJO	1.10	BAJO
Potasio Intercambiable	($cmol\ kg^{-1}$)	0.18		0.21	
Sodio Intercambiable	($cmol\ kg^{-1}$)	0.30	NO SODICO	0.30	NO SODICO
Suma de Bases Intercambiable	($cmol\ kg^{-1}$)	3.37	BAJO	3.21	BAJO
Acidez Intercambiable (H+Al)	($cmol\ kg^{-1}$)	0.00	BAJO	0.00	BAJO
CICE	($cmol\ kg^{-1}$)	3.37	BAJO	3.21	BAJO
Saturación de Bases	(%)	100.00		100.00	
Relación Calcio/Magnesio		1.59	BAJO	1.46	BAJO
Relación Magnesio/Potasio		6.15	MEDIO	5.35	MEDIO
Relación Calcio+Magnesio/Potasio		15.96	MEDIO	13.18	MEDIO
Relación Calcio/Potasio		9.81	MEDIO	7.83	MEDIO

Detalle: ($mg\ kg^{-1}$) = ppm   ($cmol\ kg^{-1}$) = meq/100 g suelo

Figure 4-3. Results for Op. AG.

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DEPARTAMENTO: LA LIBERTAD

LABORATORIO DE SUELOS CENTA

No. Laboratorio	Muestra No. 20937	Muestra No.20938
Identificación de la muestra	**OP – AH EAST – FIELD 3 DE JULIO 2013**	**OP – AH WEST – FIELD 3 DE JULIO 2013**

RESULTADO DEL ANALISIS

Textura		FRANCO ARENOSO		FRANCO ARENOSO	
pH en agua 1:2.5		7.1 NEUTRO		7.2 NEUTRO	
Fósforo	(mg kg^{-1})	154	MUY ALTO	140	MUY ALTO
Potasio	(mg kg^{-1})	114.81	ALTO	93.93	ALTO
Zinc	(mg kg^{-1})	1.01	BAJO	0.89	BAJO
Manganeso	(mg kg^{-1})	5.4	ALTO	4.74	BAJO
Hierro	(mg kg^{-1})	20.89	MUY ALTO	24.86	MUY ALTO
Cobre	(mg kg^{-1})	6.37	MUY ALTO	4.48	MUY ALTO
Materia Orgánica	(%)	0.27	BAJO	0.27	BAJO
Calcio Intercambiable	(cmol kg^{-1})	2.15	MUY BAJO	1.73	MUY BAJO
Magnesio Intercambiable	(cmol kg^{-1})	1.23	BAJO	1.22	BAJO
Potasio Intercambiable	(cmol kg^{-1})	0.29		0.24	
Sodio Intercambiable	(cmol kg^{-1})	0.36	NO SODICO	0.29	NO SODICO
Suma de Bases Intercambiable	(cmol kg^{-1})	4.03	BAJO	3.48	BAJO
Acidez Intercambiable (H+Al)	(cmol kg^{-1})	0.00	BAJO	0.00	BAJO
CICE	(cmol kg^{-1})	4.03	BAJO	3.48	BAJO
Saturación de Bases	(%)	100.00		100.00	
Relación Calcio/Magnesio		1.75	BAJO	1.42	BAJO
Relación Magnesio/Potasio		4.17	MEDIO	5.06	MEDIO
Relación Calcio+Magnesio/Potasio		11.47	MEDIO	12.25	MEDIO
Relación Calcio/Potasio		7.31	MEDIO	7.18	MEDIO

Detalle: (mg kg^{-1}) = ppm (cmol kg^{-1}) = meq/100 g suelo

Figure 4-4. Results for Op. AH.

Conclusion

The soil analysis from the Cerén agricultural fields documented this season recorded a general pattern of a neutral pH level, high levels of phosphorus, potassium, iron and copper, low levels of zinc and organic material, and mixed levels of Magnesium. The west field of Op. AF showed the only clear difference in that it appears to have been slightly less fertile and more weathered than the others as evidenced by the lower pH and low Mg. In the case of Joya de Cerén, this preliminary investigation suggests that the previous conclusions regarding the ancient soil were correct; the soil was young and fertile, but less so than those during the Preclassic and Early Classic periods prior to the eruption of Ilopango Caldera.

While informative, the results indicate a need to further research the effects of time, context, and the archaeological process on the composition of ancient soils. Soil formation processes are determined by a multitude of factors including parent rock material, climate, topography, biological factors, and time. While the cultural level has been preserved in a unique way creating a “stable” landscape, the soils would have nonetheless been subject to continual transformation. It is also possible that the nature of the tephra, both before and after the cultural level, could have continually influenced the soils. Furthermore, the sampling techniques employed this field season have the potential to influence the results. Factors such as heat, time of exposure, and contamination through the excavation processes need to be considered in future studies.

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Alexandria

Chapter 5 Paleoethnobotanical Studies, 2013 Season, Joya de Ceren

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Introduction

Sacbeob were not only loci for ritual activities, but these causeways also served economic functions by facilitating transportation (Chase & Chase 2001: 277-279). Because of this commercial activity, it seems likely that the plant products being transported would be routinely, if inadvertently, deposited along the route. Along other sacbeob in the Maya area plant remains have been lost to the ravages of time, exposure, and microbial activity. The unique preservation properties of Joya de Cerén, with activity surfaces preserved beneath multiple meters of Loma Caldera tephra, affords an opportunity to study the botanical evidence that might have been present on the surface of the sacbe. Because of the extraordinary preservation and the research activities of other aspects of the archaeological project, the focus of this season's paleoethnobotanical investigation concentrated on the implementation of a systematic and intensive plant retrieval strategy for the botanical remains on the sacbe and in the surrounding fields. This chapter examines the methods used to recover the archaeological plant remains present on the surface and sides of the sacbe, as well as from the agricultural fields that border it.

The main focus of our plant retrieval effort was the recovery of macrobotanical remains and also of plaster casts of plants whose impressions were preserved from the ashfall. Macrobotanical remains were collected by the excavators when encountered on the Classic period activity surface, almost five meters below the modern ground surface. These carbonized plant materials were carefully placed in vials by the excavators as soon as possible. Each archaeologist was supplied with a soil collection kit to ensure the macrobotanical remains could be collected in a timely manner and the plant remains could be appropriately transferred to storage containers in the field before being carefully transported back to the lab. The collection kits contained 120 ml cups, 20 ml glass vials, gelatin capsules, two-liter collection vessels for flotation samples and cotton for pading. The storage containers will protect the fragile carbonized remains on their long journey from the field site back to the University of Cincinnati Paleoethnobotanical Laboratory. Carbonized plant remains recovered in this manner are in general the most effective samples for successful identification of plant species because of their size, so their collection is a highly valuable component of this project.

In addition to the trowel-recovered macrobotanical remains collected during excavations, two-liter soil samples designated for the flotation process were collected, as well. It would be impossible to collect all of the plant remains present at the Classic period ground surface based strictly on visual observation. There are small seeds and other carbonized plant remains that even an experienced excavator may not be able to see with the naked eye. Trowel recovery is visually biased towards larger items and is often spatially uneven (Pearsall 1989:16), so additional samples were collected and designated for processing in the flotation device (Figure 5-1). The flotation device was designed to consistently and reliably recover any small seeds or other small plant remains that were preserved beneath the ash from the Loma Caldera eruption.

Water flotation is generally the best method of recovery for plant remains in archaeological soils, but it can be too forceful with some charcoal remains (Pearsall 1989: 17). Luckily the soil samples from Ceren are largely comprised of ash and pumice, so the separation process is not as difficult as paleoethnobotanical flotation processing at most other sites. The paleothnobotanical sampling strategy at Joya de Cerén this field season was purposefully chosen to retrieve plant remains that align with the goals of the excavations.

To ensure a maximum recovery rate with meaningful cultural provenience, we expanded the sample size to 20 liters per archaeological operation, with even more samples taken from the larger units. Two-liter samples were collected from each context throughout each operation in purposeful locations. Four varieties of samples were collected from the excavations: sacbeob, canals, agricultural ridges, and also inter-ridges in fields when present. If possible, soil samples were collected from either side of, and at different points, on the sacbe itself in each individual operation with attention given to having a north and a south sample when possible.

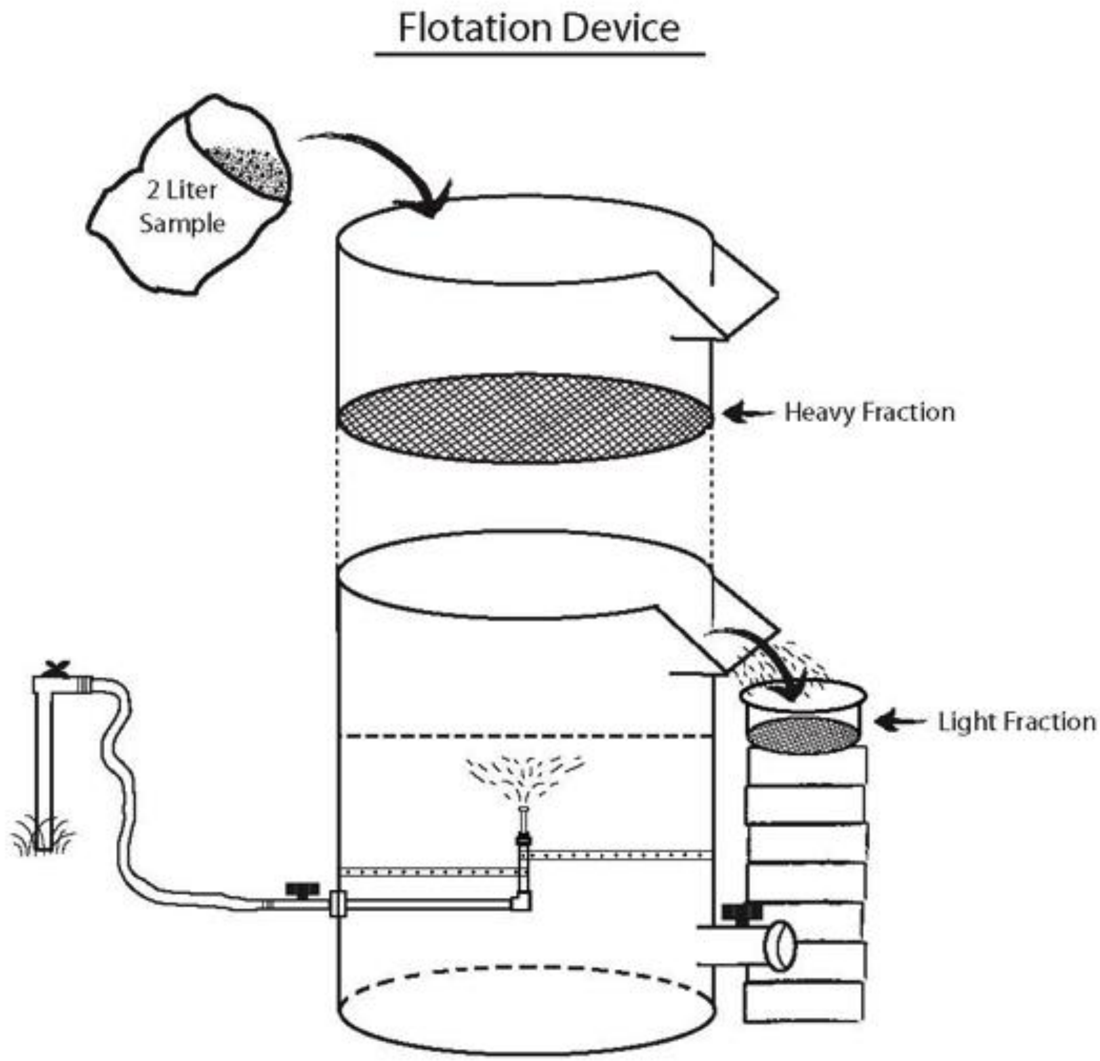

Figure 5-1. Flotation device built for the Ceren project to separate plant remains from soil matrices.
Drawn by Venicia Slottem.

Using the flotation device, each soil sample from the cultural zones was submersed in water to separate the light fraction (the carbonized plant remains) from the heavy fraction (rocks, soil, etc.). We used a modified Ankara water flotation system to process our samples (Pearsall 1989: 33). Water flowed continuously into the 55-gallon tank, with the water inlet placed directly underneath the mesh-lined basket to create a constant flow and to apply an active agitation to the soil. When the tank is filled with water the overflow cascades into a geological sieve lined with a fine mesh fabric (150 µm) to catch the light fraction. In this way, any burned seed remains present in the sample will float up to the surface and exit through the top opening and get caught in the fabric. To minimize the handling and maximize the retrieval of tiny seeds, this cloth and all of its contents were immediately hung up on a clothesline to dry. The heavy fractions which fell to the bottom of the basket on the inside the tank were captured a fine mesh hardware cloth (0.2 mm) that lined the bottom. This ensures that any archaeological plant remains present in the sample that may sink to the bottom will be saved. After a flotation sample was fully processed and the light fraction was hung on the line to dry, we emptied the heavy fraction into a separate fine mesh nylon cloth and hung that on the clothes line to dry in the shade. In the evening, the light and heavy fractions were moved indoors to complete the drying process which took anywhere from twelve hours to six days. Both fractions were inspected and sorted in the lab when they were substantially dry.

Once a fraction dried, it was closely inspected under a microscope with sufficient light to sort out the delicate plant remains present in each sample. Any suspected plant remains were extracted and stored in vials to be further examined at the Paleoethnobotanical Laboratory at the University of Cincinnati. All contents of the light fraction were stored in 20 ml glass vials and the heavy fraction was sub-sampled using 100 g portions. Contents of the heavy fraction were stored in 120 ml vials. The sub-samples of the heavy fraction required an estimated one to three hours to sift through, whereas the light fractions required substantially more time, ranging from five to twelve hours for each sample. Any charred remnants and suspected archaeological plant remains found in the samples were sorted by size and shape. Samples were sorted into three groups: items less than two millimeters in size, those between two millimeters and five millimeters, and those greater than five millimeters. The remains were further subdivided by species, if a distinct seed or other plant part could be identified.

Preliminary Results

The flotation process has been quite successful this field season in producing archaeological plant data. Once the flotation device was completed, 100 carbonized poppy seeds (*Papaver somniferum*) were added to a soil sample and were run through the flotation process as a test of its efficiency. Ninety-five of these seeds were found in the light fraction, revealing that the flotation device yields a 95% recovery rate. This is an extremely high rate of efficiency when compared to the rates of other projects.

During the 2013 field season at Ceren, we collected 61 macrobotanical samples and 80 flotation samples. The latter samples were divided into both light and heavy fractions producing a total of 160 samples from the flotation process. Given our emphasis on the collection of paleoethnobotanical samples while in the field, we have only had minimal time for analysis of the findings. Thus, a more detailed analysis is forthcoming once we have been able to conduct more thorough investigations of the plant materials. The flotation process “allows recovery of all size classes of botanical material preserved in a sediment sample, making quantitative analysis possible” (Pearsall 1989:19). Quantities of each size or shape grouping were recorded for each sample that has been processed thus far.

Some preliminary results are provided based on the data collected in the 2013 field season. Generally, the samples from the canals of the sacbeob contained few plant remains, while the samples from the inter-ridges of the fields have more plant remains than any other location in this year's excavations. Ridgetops and the sacbe surfaces contained intermediate levels of plant remains retrieved. Curiously, the quantity of seeds becomes noticeably more abundant in contexts closer to the site center. Most of the plant remains recovered were less than two millimeters in greatest dimension and will require further analysis using light and electron microscopic evaluation for further identification.

Figure 5-2. Spilanthes cf. acmella achenes recovered from Operation AI North East Sacbe

Initial screening has revealed a diverse assortment of seeds throughout the operations, but macro-remains were heavily dominated by *Spilanthes* cf. *acmella*, a widely distributed flowering herb in the Asteraceae (Figure 5-2). In nearly every sample, *Spilanthes* cf. *acmella* achenes were found, so those remains were separated into their own vials. Flotation samples from the agricultural fields contained as many as 800 of these fruits in the light fraction. Ethnographic accounts state that the plant's roots have a medicinal history of acting as a local anesthetic on tongue and mucus membranes. It can also be used as a remedy for toothaches (Lentz and Dickau 2005). Additional study of the paleobotanical evidence collected during the 2013 field season will provide more detailed analyses. Given the advancement of our data collection system and methods for recovering paleobotanical remains from Cerén, it is likely such results will continue to inform our understanding of the rich botanical setting of this Classic period community.

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Chapter 6 Ceramics

Rocío Herrera and Michelle Toledo

Introduction

The 2013 field season recovered ceramic artifacts from both the Classic and Post-Classic Periods, separated by approximately 5 meters of volcanic ash from the Loma Caldera eruption (c. AD 630). This chapter will address the ceramic find from eight of the operations from the 2013 field season (AE, AF, AG, AH, AI, AJ, AK, AN).

This analysis utilizes the previous the ceramic typology established for the Zapotitán Valley. This typology was first started in 1983 by Marilyn Beaudry. Beaudry was in charge of the first ceramic study from the Zapotitán Valley; she then went on to provide a detailed analysis of the ceramics from Joya de Cerén. Beaudry´s analysis of the Zapotitán Valley and at Cerén included new ceramic groups and types that were not found in Sharer´s (1978) earlier ceramic study of Chalchuapa. Included in Beaudry´s ceramic typology were descriptions of Classic Period ceramics, such as those found at Joya de Cerén. These Classic Period ceramics were part of the phases Vec, Xocco y Payu, established by Robert Sharer in 1978. The Cerén Post-classic ceramics from units 14 and 15 were part of the Matzin and Ahal phases. For this season the ceramic types included in this chapter are the same ones established by Beaudry 1983, 2002 and Sharer 1978. This season´s ceramics includes: Gumero Red-Slipped, Guazapa Scraped Slip, Cashal Cream-Slipped, Copador Polychrome, Gualpopa Polychrome, Arambala Polychrome, Guarumal Painted Ring and Dot, Marihua Red-on-Bluff, Cozatol and Sensipa Roughened (Table 6-1). In addition, many of the ceramic sherds found this season were classified as un-diagnostic due to degradation and/or small size. A total of 641 ceramic sherds were documented this field season, 39 of which were Post-classic and 602 of which were from the Classic Period (Table 6-2). There were 494 of undiagnostic sherds recovered and 147 sherds that were able to be sorted by type and style (Table 6-3).

Type	Identifying Attributes
Gumero Red-Slipped	Red to dark red slip on a grey-brown surface and slip streaky polished. (Beaudry, 1983:167)
Guazapa Scraped Slip	Thick cream slip that has been wiped or Scraped to form Swirls or waves revealing paste surface and a reddish to buff dense paste. (Sharer, 1978:49)
Cashal Cream-Slipped	Overall cream slip on both surface of bowls, same paste as Guazapa scraped slip. (Beaudry, 1983:172)
Copador Polychrome	Specular hematite red, black and usually orange paint on a cream or orange-tinted slipped background, most common motifs are glyphic elements and have a distintive fine, soft cream paste. (Sharer, 1978:53)
Gualpopa Polychrome	red and black motifs outlined on an orange to orange-cream background and a distintive fine, usually untempered light buff to cream paste. (Sharer, 1978:51)
Arambala Polychrome	Dull red, black and occasionally orange paint on an orange slipped background, the motifs are usually outlined in black and often red-filled and a hard reddish paste. (Sharer 1978:56)
Guarumal Painted Ring and Dot	White painted outline circles and white-painted dots on red-painted surface, zoned areas white-slipped, zoned red paint. (Beaudry, 1983:173)
Marihua Red-on-Bluff	Specular red paint in simple zones or desings on both interior and exterior of hemispherical tripod bowls. (Sharer, 1978:63)
Cozatol	Interior and exterior vessel walls slipped red (specular or non-specular hematite), interior and exterior bases unslipped and distintive flat-based shallow bowls with tripod supports. (Sharer, 1978:62)
Sensipa Roughened	unslipped surfaces beige to brown in color, intentionally roughened zones from part way down the vessel onto the bottom of the vessel. (Beaudry, 1983:175)

Table 6-1. Ceramic identifying attributes

Ceramic Counts								
Op.	Period	Context	Bodies	Rims	Base	Handles	Support	Total
AE	Postclassic							
	Classic	On TBJ	219	20	1			240
AF	Postclassic	Unit 14 and 15	1	1				2
	Classic	On TBJ	69	7				76
AG	Postclassic							
	Classic	On TBJ	58	1				59
AH	Postclassic	Unit 14 and 15	9	9				18
	Classic	On TBJ	33	1		2		34
AI	Postclassic	Unit 14 and 15	6	4		2		10
	Classic	On TBJ	36					36
AJ	Postclassic	Unit 14 and 15	8	1				9
	Classic	On TBJ	8					8
AK	Postclassic							
	Classic	On TBJ	122	12		1	1	134
AN	Postclassic							
	Classic	On TBJ	15					15
Total								641

Table 6-2. Ceramic found in 2013 season separated by period and operation

Type	AE	AF	AG	AH	AI	AJ	AK	AN	Total
Gumero Red-Slipped								1	1
Guazapa Scraped Slip	20	7	5	2	14	5	11		64
Cashal Cream-Slipped		2	8	2					12
Copador Polychrome	13	7	1				4		25
Gualpopa Polychrome				1			3		4
Arambala Polychrome	1			1					2
Guarumal Painted Ring and Dot	1								1
Cozatol				1					1
Marihua Red-on-Bluff				7	2				9
Sensipa Roughened					3				3
No decorated	8	2		3	1	1	11		26
Totals	42	18	14	17	20	6	29	1	148

Table 6-3. ***Ceramic types found in 2013 season***

This chapter functions to provide a summary of the ceramic analysis for each operation excavated in the 2013 field season. The majority of the excavations in the 2013 field season documented the Cerén sacbe with canals along its eastern and western edges, and maize fields to the east and/or west of these canals. Excavators recorded the ceramic sherd count from each of these different contexts in order to identify potential patterns of ceramic deposition (Table 6-4)

Overall Counts									
Op.	AE	AF	AG	AH	AI	AJ	AK	AN	Totals
East Ag. Field	71	9	4	20	14		21	15	154
East Canal	2	17	9	1	5	1	13		48
Sacbe	153	30	39	14	11	7	74		328
West Canal		4	1		4		41		50
West Ag. Field		3	6	2	2		1		14
Exit Canal							1		1
Platform							2		2
									597

Table 6-4. Ceramic counts for different context, 2013 season

Op AE

For Op. AE we recovered only ceramic material from Classic Period Joya de Ceren occupation. The two principal types of ceramics found in this operation were Guazapa Scraped Slip and Copador Polychrome. A total of 20 Guazapa Scraped Slip sherds and 13 sherds of Copador Polychrome were identified, the rims for the Copador Polychrome have rounded direct lips with convergent curve walls and some of these Copador Polychrome sherds show pseudo glyphs. (see figures 6-1 to 6-4)

Diagnositc Counts AE				
Type	East Ag. Field	East Canal	Sacbe	Totals
Guazapa Scraped Slip	8		21	29
Copador Polychrome	4	1	8	13
Arambala Polychrome	1			1
Guarumal Painted Ring and Dot	1			1
Not identified	6		2	8
Totals	20	1	31	52

Table 6-5. Op. AE ceramic counts for different context, 2013 season

Figure 6-1.Op. AE Ceramics
a. and b. are Copador Polychromes from East Field and c. and d. are Copador Polychromes from inside North end of agricultural field

Figure 6-2. Op AE Ceramics
Ceramics-various

Figure 6-3. Op AE Ceramics
Ceramics-various

Figure 6-4. Op AE Cermaics
a. is Copador Polychrome from East canal North side of trench, b. and c. are Copador Polichromes from the Sacbe and d. to i. are Copador Polychromes from Inside the Sacbe

Figure 6-5. Op AE.
a. is an Arambala Polychrome base fragment from inside North end of agricultural field, b. is a probable Guarumal painted ring-and-dot from East field, c. and d. are rims with no decoration from East field and e. to g. are rims with no decorations from inside North end of agricultural field. Description of the rims are 5 c. direct flattened edge with exterior thickening, 5 d. eroded direct round edge with exterior thickening, 5 e. direct flattened rim, 5 f. direct rim with outside curvature, 5 g. direct rim with modeling flanged lip

Figure 6-6, Op AE Cermaics
A. to d. are Guazapa Scraped Slip from inside North end of agricultural field and e. to h. are Guazapa Scraped Slip from East field

Figure 6-7, Op AE Ceramics

A. to j. are Guazapa Scraped Slip from inside the Sacbe and k. to m. are Guazapa Scraped Slip from Northwest Sacbe. The rims are: 7 b. slightly everted rim with exterior thickening and 7 k. direct rim, slightly everted rounded lip, and also presents 2 vertical orange-brownish lines from some sort of paint

Figure 6-8. Guazapa Scraped Slip from the Sacbe.
The rims in 8 a. everted rim and 8 b., c. and e. are direct flattened edge with exterior thickening

Op AF

Excavations of Op. AF recovered both Post-classic ceramics and Classic Period ceramics. One Post-classic ceramic was identified, that was a rounded everted rim without decoration.

Figure 6-9. Post-classic rim found between unit 14 and 15

63 Classic Period ceramics were identified in Op. AF and these were composed of: 7 Copador Polychrome Sherds, 7 Guazapa Scraped Slip sherds, 2 Cashal Cream-Slipped Sherds and 1 unidentifiable body sherds.

Diagnositc Counts AF				
Type	East Ag. Field	Sacbe	West Canal	Totals
Guazapa Scraped Slip	1	5	1	7
Cashal Cream-Slipped	1	1		2
Copador Polychrome	1	6		7
Not identified		1		1
Totals	3	13	1	17

Table 6-6. Op. AF ceramic counts for different context, 2013 season

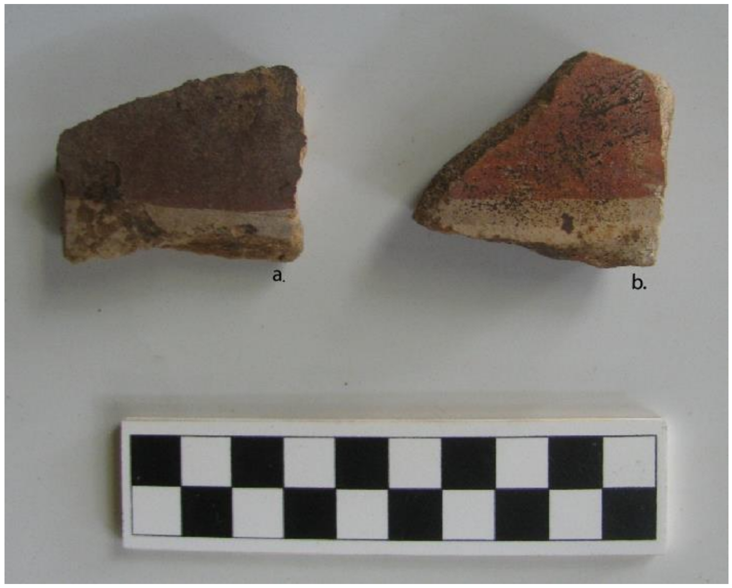

Figure 6-10. Cashal Cream-Slipped
a. from East field and b. from the Sacbe

Figure 6-11. Copador Polycrhome
a. from East agricultural field, b. from inside the Sacbe and c. to f. from the Sacbe

Figure 6-12. Copador Polychrome

Figure 6-13. Guazapa Scraped Slip
a. from West canal, b. from East field, c. and d. from inside the Sacbe and e. to g. from the Sacbe

Op AG

Operation AG found only Classic Period ceramics, 8 from Cashal Cream-Slipped, 5 of Guazapa Scraped Slip and 1 of Copador Polychrome.

Diagnositc Counts AG				
Type	East Canal	Sacbe	West Ag. Field	totals
Guazapa Scraped Slip	1	3	1	5
Cashal Cream-Slipped		8		8
Copador Polychrome		1		1
Totals	1	12	1	14

Table 6-7. ***Op. AG ceramic counts for different context, 2013 season***

Figure 6-14. Op AG ceramics
a. Copador Polychrome from Sacbe, b. to h. Cashal Cream-Slipped also from the Sacbe

Figure 6-15. Guazapa Scraped Slip
a. from West agricultural field, b. from East canal and c. and d. from the Sacbe

Op AH

Operation AH had 18 ceramic sherds from Post-classic Period and 34 from the Classic Period.The Post-classic ceramics found were 9 Cozatol Ceramics, 7 Marihua red-on-bluff and 1 undiagnostic ceramic sherd. The Cozatol Ceramic sherd shown above is from the variety Cozatol (Figure 6-16); it presents interior and exterior specular hematite-red paint with no other kind of decoration in the exterior part, but in the interior base it has a high relief, probably the decoration may have been made with a stamp because the interior between the high relief lines doesn´t show any signs of striations or lines of removal, based on this evidence it appears that a stamp was used to make this design. The Form of the sherds corresponded to a bowl with a flat base and curved walls and direct rounded lip. The ceramic presents the design in the interior, which indicates it possible use in a specialize context. This ceramic was found in unit 14 without any other kind of context to relate to it. Diameter of the vessel is about 24 cm and height is about 7cm.

Another ceramic type identified in this unit were two Marihua red-on-bluff (Figure 6-17.) both ceramics presents the red paint around the lip and has convergent walls. The principal characteristics of the Marihua ceramics is that are tripod bowls, in this case is not possible to know because the base is missing.

The last ceramic found in this unit 14 and 15 (Figure 6-18) was an unidentifiable ceramic sherd with no decoration of any kind. This sherd had a convex base with vertical wall and rounded lip.

Figure 6-16. Cozatol Ceramic Group, Variety Cozatol

Figure 6-17. Marihua Red-on-Bluff)

Figure 6-18. Ceramic not identified from Post-classic times

The classic ceramics found in this operation are: 1 Gualpopa polychrome, 1 Arambala Polychrome, 4 Guazapa Scraped Slip, and 2 undiagnostic ceramics.

Diagnositc Counts AH			
Type	East Ag. Field	Sacbe	Totals
Guazapa Scraped Slip	2	2	4
Gualpopa Polychrome		1	1
Arambala Polychrome		1	1
Undiagnostic	2		2
Totals	4	4	8

Table 6-8. Op. AH ceramic counts for different context, 2013 season

Figure 6-19. Op AH Ceramics
a. Gualpopa Polychrome from the Sacbe, b. and c. fragments of handles without decoration from East field and d. Arambala Polychrome from the Sacbe

Figure 6-20. Guazapa Scraped Slip
a. and b. from the Sacbe and c. and d. from East Field

Op AI

Operation AI recovered ceramics from both the Post-classic and Classic periods. From the Post-classic Period there were 10 sherds and 36 sherds from the Classic period.
Within the Post-classic period ceramic assemblage of this excavation we identified 2 sherds of Marihua Red-on-Bluff, 1 undiagnostic handle and 3 Sensipa Roughened sherds.

The ceramic picture below a rim fragment that has an attachment that looks like a handle. Given the small size of the handle it appears to be more decorative and likely did not function as a handle.

Figure 6-21. Op AI Ceramics
a. and b. are Marihua Red-on-Bluff, c. is a handle with remains of red paint and d. to f. are Sensipa Roughened ceramics

The ceramics from the Classic Period found in Op. AI were 8 sherds of Guazapa Scraped Slip .

Diagnositc Counts AI						
Type	East Ag. Field	East Canal	Sacbe	West Canal	West Ag. Field	totals
Guazapa Scraped Slip	2	2	1	2	1	8

Table 6-9. Op. AI ceramic counts for different context, 2013 season

Figure 6-22. Guazapa Scraped Slip
a. from West agricultural field, b. from Central Sacbe center and c. and d. are from East agricultural field

Figure 6-23. Guazapa Scraped Slip
a. and b. from East canal and c. and d. are from West canal

Op AJ

Operation AJ m revealed both Post-classic and Classic Period ceramics. There were found 9 Post-classic sherds and 8 Classic Sherds. Of the Post-classic ceramic sherds found, one was a red direct rim with an external flattened lip. There were no stylistic diagnostic characteristics of the sherd. (figure 24)

Diagnositc Counts AJ			
Type	East Canal	Sacbe	Totals
Guazapa Scraped Slip	1	4	5

Table 6-10. Op. AJ ceramic counts for different context, 2013 season

Figure 6-24. Ceramic not identified

For the Classic period ceramic we have found 5 sherds of Guazapa Scraped slip.

Figure 6-25. Guazapa Scraped Slip ceramic
a. from East North canal and b. from North East Sacbe

Op AK

Only Classic period ceramics were found in operation AK. A total number of 153 Classic Period sherds were recovered, which included 13 Guazapa Scraped Slip sherds, 7 Copador Polychrome sherds and 6 undiagnostic sherds.

Diagnostic Counts AK							
Type	**East Ag. Field**	**East Canal**	**Sacbe**	**West Canal**	**Inter-ridge**	**Plaza**	**Totals**
Guazapa Scraped Slip	1	1	6	1	1	1	11
Cashal Cream-Slipped							0
Copador Polychrome	1		3				4
Gualpopa Polychrome			1	2			3
Undiagnostic	3	2	6				11
Totals	5	3	16	3	1	1	29

Table 6-11. Op. AK ceramic counts for different context, 2013 season

Figure 6-26. Gualpopa Polychrome ceramic
a. from the Sacbe and b. and c. from West Canal; Copador Polychrome ceramic:
d. from East field and e. from the Sacbe

Figure 6-27. Back side of Gualpopa and Copador polichromes

Figure 6-28. Non identifiable ceramics
a. direct flattened rim with no decoration, b. direct rounded rim with a sublabial ridge [found one before in season 2011, see report] and d. small bottom support

Figure 6-29. uazapa Scraped Slip ceramics

a. from East Field, b. and c. and e. from East Canal, d. from the plaza feature, f. from South East Inter-ridge

Figure 6-30. Guazapa Scraped Slip ceramics
a. to e. from the Sacbe and f. and g. from West canal

Op AN

Operation AN had the least amount of ceramics found in all the 2013 excavations. No Post-classic Period ceramics were identified in this excavation and 15 sherds of Classic period were found. These sherds were found in the maize field and on the cleared, flattened platform of the operation. The diagnostic ceramic found is a Gumero red-slipped and the ceramic sherds appears to be a squash form with red paint in the body.

Diagnositc Counts	
Type	Ag. Field
Gumero Red-Slipped	1
Totals	1

Table 6-12. Op. AN ceramic counts for different context, 2013 season

Figure 6-31. Gumero Red-Slipped

Conclusions

The most common ceramics found in 2013 season were Guazapa Scraped Slip with 64 sherds, Copador Polychrome with 25 sherds and Cashal Cream-Slip with 12 sherds. The places that ceramics were found principally are the sacbe with 328 sherds and the east agricultural fields with 154 sherds.

There were 124 decorated ceramics sherds, 26 sherds that were not decorated but whose types could be identified and there were 494 sherds that could not be identified to type. The majority of the decorated ceramic sherds were found in the sacbe (63 sherds) and in the east agricultural field (23 sherds). The presence of so many decorated sherds on the sacbe is not surprising given the likely heavier foot traffic in this region. Analysis of the 2013 ceramic assemblage continues to inform our understanding of the Classic Period community.

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Acknowledgements from Michelle Toledo

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Acknowledgements from Rocío Herrera

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A big thank you to all the workers that were with us this year, they did such a big and wonderful work and especially to Elena for always taking care of us.

Chapter 7 Lithic Artifacts

During the 2013 season, excavations were aimed at further documenting and understanding the earthen sacbe and adjacent agricultural fields discovered in 2011. Eight operations were excavated to the Cerén Classic period horizon and from these a total of five lithic fragments were identified. These five lithic fragments were all obsidian and are discussed in detail in this chapter.

Background

Lithic artifacts found at Joya de Ceren have been studied since 1979. They encompass a wide range of forms, materials, types, and functions. Groundstone tools such as manos, metates, and donut stones have been found in all households, and one household was manufacturing them. Fine groundstone tools, such as jade axes, were found in all households as well, but only one per household. Jade axes probably were the single most "expensive" item that a household needed to obtain, presumably by surplus production of food in one of the approximately dozen marketplaces in the Zapotitan Valley. Additionally, one household had a necklace of jade beads.

Chipped stone artifacts were also found in every household. Each household had a few obsidian prismatic blades put into daily use, and stored in the thatch roof of a structure at a predicable location. Each household also had a cache of blades yet to be put into use, stored higher up in the thatch at a more inaccessible location. Each household had an obsidian scraper or two, and often a percussion macroblade. There was no evidence found inside the ancient Maya village of manufacture of any of these obsidian artifacts. The only evidence found to date of deliberate fracturing of obsidian consists of the percussion flake debitage from resharpening scrapers found by Structure 5, on the west side of Household 1. Therefore, the evidence supports the interpretation that obsidian artifacts were pre-made tools imported into the Ceren community.

Lithic Artifacts found during 2013 Research

Compared to other project seasons, the 2013 research season discovered relatively few chipped stone artifacts. They are described, interpreted, and illustrated below. The five artifacts were found in only two Operations, AE and AK, both located at the northern end of the research during 2013, and closer to the village center.

Operation AE

Operation AE was a 4x7 meter excavation that documented the sacbe in the western section of the operation and a large portion of a maize field to the west. Three obsidian artifacts were recovered from this large operation (Figure 7-1Figure 7-2), that encompassed a segment of the sacbe and a large portion of maize field to its east.

The first artifact is a proximal fragment of a prismatic blade, recovered 23 July 2013, measuring 4.7 x 1.7 x 0.3 cm. A moderate amount of the platform overhang left by the series of blades removed from the core was removed by a scraping motion (as differentiated from the pressure flaking done in the Preclassic), a characteristic of lithic manufacture during the Late Classic in the southern Maya area. The platform surface was striated moderately, also a common Late Classic Maya technique, probably to decrease surface tension of the super-cooled liquid and to improve friction of the tool used to apply the force for fracture. (Technically, obsidian is a super-cooled liquid glass.)

A fairly large zenolith (foreign rock particle), 2mm in diameter, was intersected by the ventral fracture, leaving prominent gull wings, but not interfering with the controlled fracture. The blade edges have sustained quite a bit of micro-nicking, sub-millimeter in size, from use and from post-discard factors. It still retains rather sharp edges, that still could be used to cut softer materials. It is highly vitreous and has a slight brown hue, both characteristic of the Ixtepeque source just north of the Salvadoran border in Guatemala.

Figure 7-1. Dorsal Faces of Obsidian Artifacts, Joya de Ceren, 2013.
In order: 1. Proximal Fragment, Prismatic Blade, Operation AE. 2. Medial segment, Prismatic Blade, Operation AE. 3. Small Percussion Flake, Operation AE. 4. Small chunk of obsidian, Operation AK. 5. Scraper Resharpening Flake, Operation AK. All are arranged so the point of force application was at the top. Scale in cm.

The second artifact recovered from Op. AE is a medial segment of a prismatic blade, measuring 1.8 x 1.4 x 0.3 cm. It was found inside the sacbe while trenching in the northern portion of the operation. It has considerable patination on the dorsal side, which must have been exposed to capillary groundwater and drying. The ventral side has almost no patination, and must have been facing the other direction, before the artifact got included with Tierra Blanca Joven construction material. The edges are moderately micro-nicked from use, and the more projecting portions of the edges were used in such a way to generate a fine abrasive wear resulting in a light polishing. The luster and color point toward Ixtepeque as the source.

The third artifact from Operation AE is a small percussion flake measuring 2 x 1.1 x 0.3 mm. It has a concave single-facet platform. Its ventral side has a small bulb of force and a slight amount of platform crushing from the blow. It terminated in a hinge fracture, and that termination is the thickest part of the flake. It is clearly a manufacturing error. The dorsal side is slightly concave both parallel and perpendicular to the force, and therefore was a difficult flake to create. One wonders about the lithic abilities of the knapper, because of the misjudgments that resulted in these problems. It is not a flake from core-blade technology, nor is it a flake from scraper resharpening. What it is from is unknown and perhaps is the result of a novice knapper.

Figure 7-2. Ventral Faces of Obsidian Artifacts, Joya de Ceren, 2013. In order: 1. Proximal Fragment, Prismatic Blade, Operation AE. 2. Medial segment, Prismatic Blade, Operation AE. 3. Small Percussion Flake, Operation AE. 4. Small chunk of obsidian, Operation AK. 5. Scraper Resharpening Flake, Operation AK. Scale in cm. Point of force applications at top of each.

Operation AK

Op. AK was located northeast of Household 2 and southwest of Household 1. The excavation documented the sacbe through the center of the operation with canals and maize fields to the east and west. There was also a third canal found intersecting the western canal and a very small portion of a constructed platform in the southwest corner of the operation.

Two artifacts of obsidian were found in this operation. The first is a small and very battered chunk of obsidian measuring 2.7 x 1.1 x 0.9 cm. It is too thick to transmit light and thus a suggestion as to its geological source is not made here. It has no fracture surfaces characteristic of known tool/artifact types, so its nature is unclear.

The second obsidian fragment is a small percussion flake measuring 1.9 x 1.4 x 0.4 cm. It was found in the large lava bomb sag at the northern portion of the sacbe. It was severed longitudinally by excessive force, and some of the platform crushed from a blow that was too hard. The ventral surface is quite smooth and highly patinated. Enough scraper use wear remains on the platform to clearly indicate this is a scraper resharpening flake. Although excessive force was used, the resharpening in this instance was successful in sharpening the scraper edge, at least at this point. This flake is highly similar to those found in 1979 near Structure 5, a ramada-like building associated with Household 1 (Sheets 1992: 56). It exhibits all the attributes of obsidian from Ixtepeque.

Summary

The Joya de Ceren residents traveling to one of the approximately dozen marketplaces and exchanging their surplus production presumably obtained the two prismatic blades during their travels. No evidence has ever been found that core-blade technology was performed in Joya de Ceren or any other of many similar-sized villages in the Zapotitan Valley. This finding should not be surprising, as it takes a larger community to support an occupational specialist making such skilled products.

The other artifacts do not exhibit a high skill in manufacture, as many errors were detected during the analysis. However, at least one scraper resharpening flake was removed without damaging the scraper, even though excessive force was used.

Overall, this small collection is representative of the lithics recovered from Joya de Ceren during the past four decades. The small number of lithic flakes discarded on or near the sacbe and its associated canals and fields is unsurprising given the danger that such debitage can pose. Cerén occupants took care to store and dispose of these sharp artifacts.

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Chapter 8 ¡Qué Cerén, Cerén![1]

Nancy Gonlin, Ph.D. (Bellevue College)

Introduction

As an archaeologist, I have always wanted to be transported back in time to see first-hand how others lived and made a living so that I could better understand the past. Sites with extraordinary preservation, resulting from a variety of reasons (Inomata and Sheets 2000), offer the opportunity to enhance the archaeological imagination (Shanks 2012). One such site, Joya de Cerén, El Salvador is located on the periphery of the Mesoamerican culture area in Southeastern Mesoamerica (Evans 2013:61; Sheets 2006:10), adjacent to the Intermediate Area (Evans 2013:61) (Figure in introductory chapter). Thus, the inhabitants of Cerén were subject to multiple influences throughout the region's prehistory.

From an educator's perspective (Gonlin 2011), many anthropology students are introduced to the Cerén site early in their collegiate careers and the site often serves to fuel great enthusiasm for archaeology. Cerén is famously featured in leading introductory archaeology textbooks because of its uniqueness, especially in discussions of transformation processes (e.g., Ashmore and Sharer 2014:70, 73, 102; Renfrew and Bahn 2010:49, 190). This site has also been made accessible to the public by being featured in *Archaeology* magazine on several occasions and as a "Case Studies in Archaeology" publication, one of two that focuses on the Classic Maya (Sheets 2006; Webster et al., 2000). Cerén provides a prime example of *in situ* remains that are so fabulous, that archaeologists who do not work at Cerén may very well experience "Cerén-Envy" (Gonlin 2013) or "Cerenvy" (Sheets, personal communication 2013). The Loma Caldera eruption (Sheets 2006:1) occurred about 1,400 years ago, to the horror and agony of the occupants, but to the delight of 20th and 21st century scientists. The spectacular preservation of this Late Classic village provides eye candy for the professional and layperson alike, as the prehistoric remains today are a major tourist destination for local travelers in, and foreign travelers to, El Salvador.

I have productively used the work at Cerén on many occasions to interpret and illuminate the excavations of Classic Maya commoner residences at other sites, particularly eight sites from Copan, Honduras that were excavated under the Rural Sites Project of Dr. David Webster from Penn State (Gonlin 1993, 2004, 2007, 2012; Webster et al. 2000; Webster and Gonlin 1988) (Figure 8-1). Thus, my interpretations are rather Copan-centric, and I refer to this position often throughout this chapter. In fact, many comparisons have already been made by Webster, the author, and Dr. Payson Sheets (Webster, Gonlin, and Sheets 1997). The insights that were published in the aforementioned article explored theoretical and methodological issues. I am even more captivated than before, now that I have had a chance to see Cerén first-hand and to do research there. I take this opportunity to reflect and add to the initial comparisons.

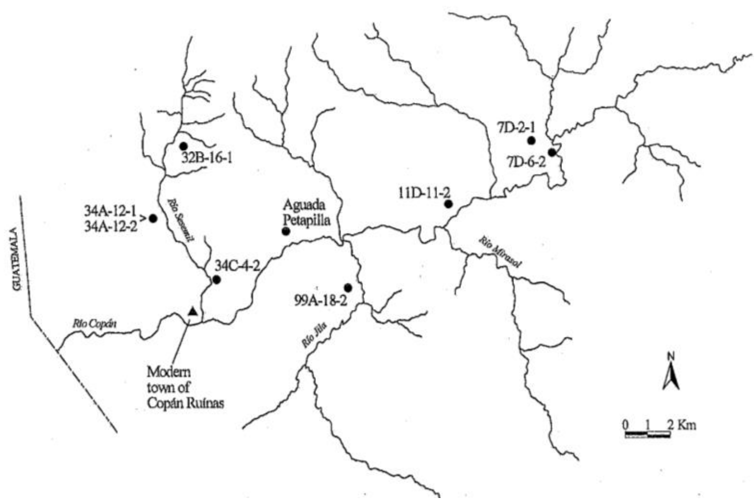

Figure 8-1. The Copan Valley, Honduras
The map illustrates the locations of eight Classic Maya commoner sites excavated by David Webster's Rural Sites Project, 1985-1986. Webster, Freter, and Gonlin 2000.

First and foremost, Cerén provides an example of well-documented commoner remains, and thus serves as one of many ancient sites that is useful for performing comparative anthropological research on Classic Maya commoners. This site also helps us to dispel myths (Marcus 2004) about Classic Maya commoners by exhibiting the richness of culture that surely existed at other locales. From early excavations of small structures (e.g., Wauchope 1934), the number of humble Maya housemounds that have been excavated has grown tremendously over the years (e.g., Robin 2012). This development has allowed robust comparisons across the Maya Lowlands, including those on the Southeast periphery, and thereby has enabled us to envision and explain the diversity that existed.

There is a great advantage in excavating the rural sites of the Classic Maya (Iannone and Connell 2003) as well as all major ancient polities across the globe (Schwartz and Falconer 1994). This bottom-up approach is highly valued by a number of Mesoamerican archaeologists (e.g., Hirth 2013), but this stance has not always been the norm. The village of Cerén is located about 5 kilometers from the contemporaneous elite site of San Andrés, a regional capital of the Zapotítan Valley (Sheets 2006:11); thus, Cerén is an outpost of the polity, but is clearly within walking distance to the center. The degree to which San Andrés rulers dominated and controlled the rural inhabitants is a controversial subject. Recent work by Christine Dixon (2013a; 2013b) supports autonomy in decision-making, particularly in regard to choices related to agricultural management likely achieved through non-royal governance at the site (Dixon 2013; Sheets 2009). Such self-sufficiency has been posited for other Classic Maya rural farmers as well (Gonlin 1994:195, 2012:82; Robin 2012), but never has the evidence been more convincing than at Cerén. [The terms 'self-sufficiency' and 'autonomy' are not to be confused with lack of interaction or participation in larger spheres ranging from the community, polity, local market, and long-distance trade networks. See Sheets (2002) for how the Cerén households provisioned themselves.]

My short stint as part of the 2013 project at Cerén, funded by the National Science Foundation, has enabled me to better reflect upon this ancient site and how it has shaped interpretations of ancient Maya commoners. The exceptional experience of 'living' Cerén is something that all archaeologists should have a chance to do because it is a transformative one. True to form, however, like many other archaeological projects of which I have been a part, I managed to sustain an injury. My broken foot served to cut short my stay, but I take away a greatly enhanced knowledge of the past, and in particular, of the ancient village of Cerén.

Ethnicity

The decipherment of ethnicity in an archaeological context is particularly riddled with complications (Díaz-Andreu et al., 2005; Jones 2002; Shennan 1994). The Zapotítan Valley may have incorporated several ethnic groups, as has been proposed for the Copan Valley of Honduras (Gerstle 1988; Gonlin 1993:696-700; Gonlin and Landau 2013; Manahan and Canuto 2009; Schortman 1986; Urban and Schortman 1987), creating complex and overlapping spheres of signatures.

When one first sees the remains of Cerén, the architecture is visually striking: built upon fired earthen platforms, adobe columns were incorporated into wattle and daub walls, producing smooth exteriors of elegant structures topped with thatched roofing. This building style was not found throughout the Late Classic Maya landscape, where stone platforms predominated across all statuses (Figure 8-2). Sheets (2006:117-118; 2009) has evaluated the ethnicity of the ancient inhabitants and has found the material remains to be closer to "Maya" than any other Mesoamerican or Intermediate Area group. He convincingly argues that, apart from the adobe components, the domestic architecture is similar to contemporary sites at Copan (Sheets 2009:71-72). If one considers the artifact assemblage at Cerén in isolation of the architecture (Sheets 2009:73-75), one would arrive at the same conclusion (Figure 8-3).

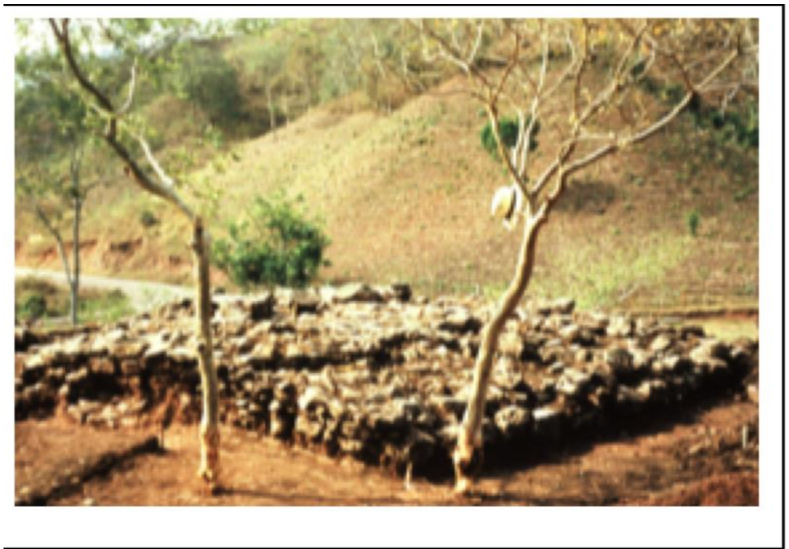

Figure 8-2. Example of a stone platform foundation commonly found throughout the Maya Lowlands.
Pictured here is Structure 2 of Site 99A-18-2 in the Copan Valley, Honduras. The plan map of the site shows two stone platforms that were completely excavated. Photo by N. Gonlin, 1986, and original plan map by David Webster.

Figure 8-3. Photograph of one of the many complete Classic Maya vessels recovered from Cerén that is on display at the site museum.
Photo by N. Gonlin, 2013.

The variation that is seen at Cerén may be perceived as falling along the continuum of diversity in material expression for the Southeast Maya, a significant point to keep in mind as the sample of recovered remains across the region expands our knowledge of this mixed group. The ethnic identification of "Maya" has been largely determined by elite characteristics, particularly for the Classic Period. However, earthen architecture is not unknown archaeologically. Whether the adobe structures underneath the Classic Period Acropolis of Copan (Bell et al., 2004) and the earthen constructions in the Copan Valley (Canuto 2004; Maca 2002; 2009) signaled ethnic differences or earlier building styles is not settled, as more information is needed to resolve this issue. Furthermore, how many sites such as Cerén might have existed throughout Mesoamerica but lacked the serendipitous (for the archaeologists of course) eruption that preserved the details of the site? What vestiges of Cerén would have survived if it had been subjected to the usual natural and cultural transforms?

Methods, Preservation, and Behavioral & Transformational Processes

Cerén is affected by behavioral and transformational processes as much as any other site, but they are indeed *different* (McKee 2007). The key to understanding these remains is to find out how the particular record was formed, i.e., the behaviors that created the archaeological record at Cerén in the first place, "before the volcano erupted" (Sheets 2002). The "Pompeii premise" in archaeology (Binford 1981) is actually an incorrect assessment of processes, whether for Copan sites that are "typical" of tropical ruins, or those covered by volcanic ash, such as Pompeii or Cerén (Webster et al., 1997:43). From recent analyses, Sheets (2006) has determined that the villagers had warning about the impending eruption, which may very well be one reason why no victims have been recovered. My reconsideration of Cerén's behavioral cycle of "acquisition, manufacture, use, and deposition" (Ashmore and Sharer 2014:66), so well drilled into introductory archaeology students, rests upon the accurate determination of how much time inhabitants would have had to evacuate. What did they take with them, when clearly so much has been left behind? Natural transformational processes are far better understood due to the amount of investigation of volcanic eruptions in El Salvador (Dull et al., 2001; McKee 2007; Miller 2002) and the lack of human agency in these particular environmental events. Though the Loma Caldera eruption resulted in the detailed preservation of the site, it also resulted in the destruction of some evidence, such as areas where lava bombs impacted the living surface, or the high heat of the eruption that likely destroyed phytoliths and altered the paleobotanical and soil remains at the site.

The spectacular preservation at Cerén facilitates analysis of artifacts, ecofacts, and architecture. As mentioned above, the survival of architecture in its near entirety is astonishing. It really is mind boggling to place oneself literally nearby the ancient structures. This feeling is unlike any other that I have experienced in digging or visiting other sites. Not to diminish any other fieldwork in which I've participated, but there is something decidedly eerie about standing so close to someone's intact house where the beans are in the pots and the grinding stones are set to be used, but no one has been home for 1,400 years.

The ceramics from Cerén deserve special mention here, not because they are unique in terms of types (Guazapa, Copador, and other types are found), but because of the size and details of the sherds. I marveled at the large painted pieces that were recovered from within the *sacbe* and agricultural fields. Had this degree of preservation been present at the rural Copan sites, particularly those in the Río Amarillo area of the Copan Valley where rainfall exceeds that of other areas, the reconstruction of chronology and function would have been easier and more accurate. At least 10% (Gonlin 1993:Tables 4.4 and 4.8) of sherds were unidentifiable as to ware (fine or utilitarian), or vessel form. My preconception of painted fine wares as special occasion dishes needs to be reconsidered since it appears that the Cerénians commonly used such place settings on a daily basis and for as storage containers in bodegas.

It is estimated that Cerén was occupied for at least a few generations, so the behaviors that led to the site's configuration can provide insights into community development and growth. Factors that inhibit this understanding are: the amount of overburden (at least a few meters), the restrictions on trenching into buildings, and the amount of the site that has already been destroyed by modern development. This season's find of a sacbe within a sacbe within a sacbe (see Chapter 2 on the sacbe) underscores the need to decipher the evolution of the site as we currently see it, literally and figuratively. For obvious reasons, trenching is limited at the site to the final occupation, and the preservation of the architecture and features is paramount. This constraint places limitations on the question of community development, as stated above, but also on the determination of cultural practices such as ancestor veneration (McAnany 1995). Did the Cerénians bury their dead on site as did many Mesoamerican groups, or as in rural Copan (Gonlin 1994:193; 2007:93-95), was this practice uncommon? Excavations at Cerén are not the only ones that face limitations, however, so one can hypothesize several plausible scenarios without excavating everything.

At Cerén, air holds the key to excavations in agricultural fields. The vacuum of what was once there, rather than the object itself, is like finding an invisible artifact and then creating a record of it by pouring plaster into its space. Just as standing close to someone's ancient house aroused an eerie feeling in me, this method evoked an odd sense of capturing the past out of thin air. With repeated pourings, the sensation dissipates. This molding process, along with the careful and thorough documentation of the end result, is the best way to ensure the durability of the archaeological record for future generations (Figure 8-4). The plaster casts are not self-supporting once the matrix has been removed and they are cleaned, photographed, catalogued, and stored for safe-keeping (Figure 8-5). To leave them in the field would risk their destruction from water seepage since additional liquid would affect the plaster casts by damaging or destroying them altogether. Because of their necessary removal though, this process does not produce for the visitor an agricultural field with visible plants. This reason is why the areas surrounding the houses seem barren, even though kitchen gardens were numerous and maize fields even more so.

Figure 8-4. Various stages of the process of re-creating a plant from thin air. Rocio Herrera mixes the plaster with water to the right consistency, and then fills the vacuum to create a mold. After waiting a sufficient time for the plaster to completely dry, Chris Dixon uses a bamboo scraper to carefully remove the surrounding matrix and expose the plaster ‘plant.’ Photos by N. Gonlin, 1983.

Figure 8-5. The cleaning process.
After the plaster plant cast has been excavated from its matrix, it is cleaned to remove dust (Alexandria Halmbacher, Rachel Egan, and Venicia Slotten) and then photographed by Dr. Payson Sheets and stored for safekeeping. Photos by N. Gonlin, 2013.

Some of the usual practices of excavation cannot be performed at Cerén for a variety of reasons. In some cases, the recovery of three dimensions makes it difficult for mapping with 1x1 meter grids, as would be the usual practice. However, the payoff is that since the agricultural fields are not flat surfaces, but have ridges (*surcos*) and canals and plants sticking up a meter or more, a truly 3-D picture of the past emerges on the landscape (Figure 8-6).

Figure 8-6. Plant casts create a 3-D record of the past at Cerén. This maize field was close to the village center. Photo by N. Gonlin, 2013

The trenches dug at Cerén are far deeper (3-4 meters or more) and bigger (3 x 3 m or larger) than most test-pits used to uncover the remains of commoner households in Mesoamerica. I was intimidated by their depth, but simultaneously impressed by the fine techniques the excavators used to ensure smooth vertical walls the entire way down. With an interest in the energetics of construction (Abrams 1994; Carrelli 2004), I watched the back-filling of one of these large trenches. I did not have the opportunity to accurately record the event from beginning to end, but I see the potential of the recording of such data for construction estimates.

Cultural Practices

The use of space at Cerén intrigues me on several levels. First, there is more compartmentalization of interior space than I would have expected for small buildings. Perhaps the Copan rural houses were as internally divided, but indications of such practices are nearly non-existent. The common use of adobe benches found at Cerén reassures me that rural Copan commoners may have had benches as well, albeit perishable ones. The doors of the structures of a household do not open to face a central courtyard or plaza onto which all other structures faced, as I have presumed was the case for most rural homesteads in the Copan Valley. At Cerén I expected the domicile to open into the same area as the storehouse and kitchen (e.g., Household 1), but it does not. The amazing preservation of walkways allows one to see how residents accessed buildings, and which structures were tied to each other. It appears that privacy may have been a concern when constructing the buildings. Though the domiciles are small in size, the thick bajareque walls likely kept interiors cool and contained affairs within when desired.

The roofed-over space at Cerén extends well beyond a structure's wall limits, a fact that is difficult to figure into calculations of populations (following Naroll's 1962 formula) or reconstructions of activity areas at sites like Copan. The extant roofs create a different feeling by closing in spaces between buildings and shading a greater portion of courtyard areas. This configuration also blurs the line between interior and exterior space - an ambiguity to which Westerners are prone, but those who live in the tropics are more comfortable with this spatial liminality.

There is great overlap in building size and shape for many of the special purpose structures at Cerén, which, for the archaeologist, confounds interpretations of the ancient record at sites like Copan where interiors have not been preserved. But the determination of structure function remains a goal, implicitly or explicitly, of archaeologists for numerous reasons (Gonlin 2004). However, sweatbaths appear to be distinctive architectural forms. Archaeological recovery of sweathouses in rural areas of the Maya region is not unknown. Webster recovered one at Piedras Negras, Guatemala (Child 2006; Webster 2001), Norman Hammond documented a Preclassic Maya sweatbath at Cuello, Belize (Hammond and Bauer 2001), and cave sweatbaths have been recorded by Holley Moyes (2005) in Belize. The sweatbath at Cerén (McKee 2002), the other communal buildings (Brown and Gerstle 2002; Gerstle 2002; Simmons and Sheets 2002), and the sacbe (Dixon 2011c, 2013; Sheets 2013) speak to the socio-political organization of this village. A major difference between Cerén and Copan rural commoner sites is that the Copan ones are relatively isolated and may have a few structures on average in contrast to Cerén where a number of structures with clear and different functions are grouped together. We cannot state for certain that the same activities occurred in rural Copan because the archaeological record does not support it. However, we can look at the material record of Cerén to see what behaviors may have occurred for which material evidence does not present itself at Copan.

Population estimates often take into account differences in building use and the cycle of disuse of structures (Webster and Freter 1990), so it is notable that all of the structures at Cerén were contemporaneous. At first, this use seems striking, but not when one considers that each household erected buildings for different purposes, all of which were essential, and that the community structures were utilized by all.

There is no doubt that Cerén is a planned community above the level of the household. As Sheets has noted several times, almost all structures and some of the agricultural fields have the same orientation as the nearby river, thirty degrees east of north (Sheets 2006:xviii). Questions come to mind: who was in charge of all of this re-working of the landscape and why? This season's fieldwork on the agricultural fields and the detailed study of the sacbe were designed to shed light on the answers. Want to see a prime example of an ancient "built environment"? Head to Cerén!

The people who lived at Cerén were tidy. One does not find deep middens against back walls of the houses, as one finds at Copan for example. Had they just cleaned up their village for expected visitors or did the eruption occur just after the weekly garbage pick-up? Or is trash hidden well within the TBJ layer upon which the settlement sits? (In fact, an example of this trash-concealing practice was found during the 2011 field season in Op. P, where a small midden was buried under a thin layer of TBJ.) The interiors of structures are well organized with dishes lined up on shelves, valuables safely stored, and fires contained within the hearths. As clean as the villagers were, the mice knew where to catch a good meal. The "mouse index" (Sheets 2006:16) is an accurate count of rodent remains and the amount of food stored in a structure. Oh to be a mouse at Cerén! The fact that such an index exists highlights the extreme differences in preservation between this site and most other sites in the world.

Artifacts and architecture at Cerén convey a wealth of information about Classic Maya commoners, but the agricultural remains at this site are phenomenal as well. The monocropping of maize so close to the village center documents the “infield” part of an infield/outfield system, common to many agriculturalists world-wide (Sheets and Woodward 2002:184-186). According to Sheets, the eruption of Loma Caldera in the month of August may help to explain why beans and squash are not found here as well. As maize begins to mature and provides a stalk upon which other plants can grow, these species will be planted, as has been noted in the historical and ethnographic record of numerous tropical groups (e.g., Wisdom 1940) and twenty-first century Cerénians (Lara M. and Barber 2002:193). However, the maize fields that were recovered were mostly mature and perhaps ready for harvest and though one squash was recovered in one field this year, multicropping was not apparent (see the chapter on the agricultural fields for details).The industriousness of the Cerénians is further evidenced in the recovery of intensive manioc fields (Dixon 2011a; 2011b; 2013a; 2013b; Gonlin and Dixon 2011; Sheets et al. 2011). Their existence has implications far beyond Cerén, and serves to remind us of the paucity of remains that are typically found and how archaeology really is a puzzle with most of the pieces missing. Other missing pieces of this agricultural puzzle have been recovered in kitchen gardens, where a plethora of species were grown, and from storage containers and storehouses (Lentz and Ramírez-Sosa 2002). The “food of the gods” nourished not only elite Maya but commoners as well, something I have always assumed. The presence of cacao at Cerén (Lentz and Ramírez-Sosa 2002:39-40) confirms commoner access to a supposedly-elite item, a point that needs reinforcing to many a Mesoamerican archaeologist. Maguey, a highland Mesoamerican plant, was unexpected (for me) at this site since it seems out of its usual habitat. Inhabitants used this species of agave (*Agave americana*) for fiber production, as reported by Sheets and Woodward (2002:186-188). The mention of just a few of the species reminds me of how little we recover in other types of excavations, even where screening is routine and preservation is decent (Lentz 1991).

I have reviewed the above points for a purpose. While most archaeologists would characterize the ancient inhabitants of Cerén and Copan as Classic Maya “commoners,” some may be tempted to homogenize this way of life. I visualize the lifestyle in each of these locations as drastically different from each other. Take for example, Site 11D-11-2 in the El Jaral pocket of the Copan Valley (Figure 8-7a) that was occupied during the span of the Late Classic. Here, residents built five structures over time, the largest of which may have belonged to the household head (Gonlin 1993; Haviland 1988; Hendon 1989). There is no obvious community center, sweatbath, or diviner’s building. The site is situated along the edge of the Quebrada Calera, a small tributary of the Río Copan, but is otherwise isolated (Figure 8-7b), as no other remains have been recorded nearby (Freter 1988). At a distance of 9 km from Copan’s Main Group, quotidian affairs would have proceeded as the families wished, with no neighbors within sight, let alone direct elite interference. At Cerén, I see a close-knit community where neighbors and relatives stop by frequently, lending a hand or perhaps interfering, and where one's productivity in the fields is visible to others. The overtly ideological character of the site's directionality and the divining house speak to other-worldly concerns that were of such importance as to be materially expressed in concrete ways. Cerén was a spiritual place, yet also a social place. Day to day interactions involved dozens of people, with the village's population estimated around a couple hundred, and possibly more people from other hamlets within sight (Sheets 2006:11). However, inhabitants of both sites shared far more than the differences highlighted here, which makes the Cerén data so suitable for understanding how people in the past lived their daily lives. Though we don't know exactly how the Copan sites were abandoned, Cerén will remain an inspiration for interpretation and understanding of the past.

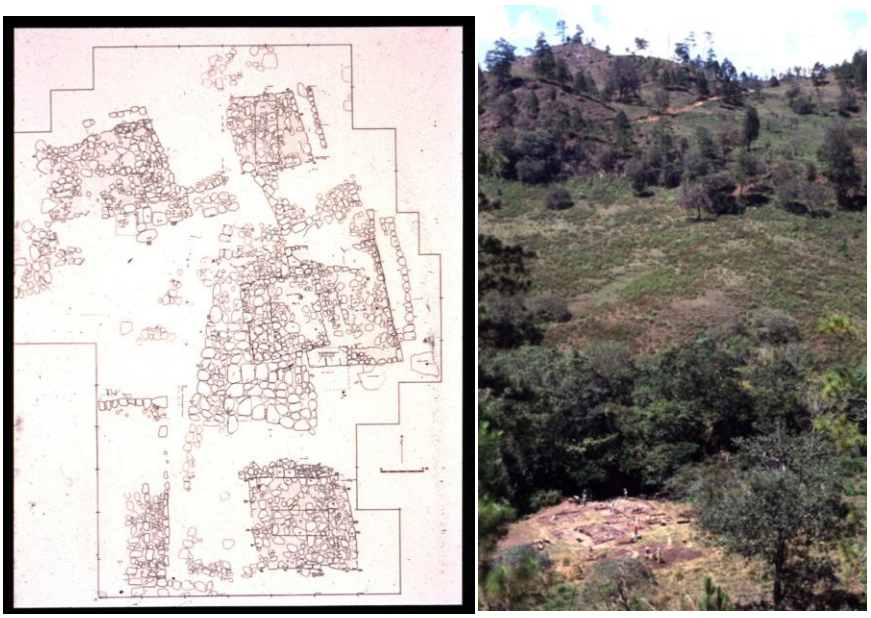

Figure 8-7. Plan map of Site 11D-11-2, Copan Valley, Honduras.
The Quebrada Calera runs along the east edge of the site. Photograph shows the isolated location of this Late Classic Maya commoner residence. Original plan map by David Webster; photo by N. Gonlin, 1985.

Thoughts for the Future

My work at Cerén has provoked many questions as its provocative nature must do in all who see these remains. While I now have a solid visual image of the site that I had only read about, I want to explore it further. How was this village of Cerén formed? If we view the site as a neighborhood (Arnauld 2012; Smith and Novic 2012:11-12) rather than a "village," with all of the positive and negative connotations that word contains, does this semantic change produce insightful interpretations, not otherwise possible? How 'rural' was Cerén - was there continuous occupation from San Andrés to Cerén? Did contemporaneous inhabitants at other locations have equally well-stocked pantries and neatly tended fields? Does the lack of *comales* signify ethnic differences from the Late Classic Lowland Maya culture? What happened to the Cerénians, or is this question a naïve one that archaeologists commonly have to answer about what happened to the Classic Maya? And just where does that sacbe go?!

Cerén continues to yield surprises which reveal more about our lack of understanding about ancient lifeways than they do about the settlement and its inhabitants per se: the wide inventory of household goods, elegantly and neatly built structures, interior compartmentalization of space, diversity of structures, the rural sweatbath, evidence of community planning, clear manifestations of ideological beliefs, maize fields with squash, kitchen gardens, intensive manioc fields, the sacbe. ¡Qué Cerén, Cerén!

Notes

[1]At the 2013 SAA meetings in Honolulu, Christine Dixon and I had the opportunity to talk with Dr. Stephen Kowalewski of the University of Georgia. As Chris was scheduled to defend her dissertation on Cerén at the University of Colorado the following week, she conveyed her concerns over the process. Had Chris had any difficulty in navigating her rite of passage, Steve advised her to tell her committee “Qué Cerén, Cerén!”

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.Figure 8-8. Payson Sheets at the Museum.

Payson is a tireless researcher and his excitement shows (Figure 8-8) whether it is his first or millionth time showing someone around (thanks for your patience!). Gratitude to Payson Sheets, Chris Dixon, Steve Kowalewski, and K. Viswanathan for comments on earlier drafts, and to Rachel Egan for compiling this informe.It was a pleasure to work with the stellar crew of Salvadorans, especially Mercedes Haydeé Ramírez de Garcia the lab assistant. Along with Chris, the houseful of women excavators, Rachel Egan, Alexandria Halmbacher, and Rocio Herrera Reyes, and aspiring paleoethnobotanist Venicia Slotten provided hours of off-duty lady-time and the best piña coladas I've ever had in the field (in fact, the *only* piña coladas I've ever had in the field!). Gratitude to our all-in-one cook, house cleaner, launderer, and dispenser of wisdom, the tolerant and kind Elena Garcia, who convinced me to have the spider bite checked out by a doctor rather than lose a foot.

Chapter 9 Summary and Conclusions.

Payson Sheets

The 2013 Cerén field season was aimed at continued documentation of the sacbe discovered in 2011 and its adjacent agricultural fields. Research questions were organized around the socio-political organization of maintenance, construction, and use of the sacbe. Cerén affords an important opportunity to investigate how one settlement was organized and the potential locus for decision-making at the site related to agricultural production (Dixon 2013) and the built landscape, including domiciles, public buildings, and the sacbe. The 2013 research project established ten excavations, eight of which were excavated to the Cerén TBJ (Tierra Blanca Joven) living surface. From these eight excavations we documented: 1) the location of the sacbe further south and north than previously identified, 2) the complex construction processes used for building the sacbe, 3) two earlier sacbeob beneath the sacbe present on the Cerén living surface at the time of the Loma Caldera eruption, 4) three drainage canals and water management at the site, 5) continued diversity of cultivation crops and techniques, 6) the soil chemistry and compositions of agricultural fields, 7) paleobotanical remains from the sacbe, canals, and agricultural fields, and 8) associated ceramic and lithic artifacts from each of these contexts. The results of these findings and a summary of this report are provided in this chapter.

Accomplishments of the 2013 Research Season

Chapter 1: Theory and Background

Chapter 1 presents the background for the research, the theoretical framework, and the research components to achieve these objectives. A primary objective was to investigate the sacbe, its adjacent canals, and the agricultural fields on both sides for patterns and variations in construction and maintenance. Once we documented both, we wished to try to understand them, and explore the level at which decisions were made. Who, at what level, organized the built environment that was Ceren? We wanted to detect features that indicated local autonomy by individual farmers, or features that resulted from some authority in the Joya de Ceren village, or higher authority from without, perhaps even San Andres to the south. These three options are not mutually exclusive, and data supporting the first two were encountered.

Chapter 2: The Sacbe

Chapter two, by Christine Dixon and Payson Sheets, focuses on the sacbe discovered in one excavation in 2011, and followed for almost 50 meters by excavating two more test pits. The finding of an earthen sacbe entering a commoner Maya village was beyond surprising, and the 2013 research successfully uncovered more of the sacbe as it heads into the village center, and as it heads farther south. Considerable progress was made in documenting and understanding both patterning and variation in the sacbe. The patterning, the organization, the commonalities, include the general nature, size, and shape of the sacbe and its canals on both sides, the use of the TBJ white tephra from the Ilopango eruption as the predominant construction and maintenance material, and the maintenance of the side slope of the sacbe surface to drain into the western canal. Some of the volcanic ash from a pre-Ilopango eruption, here called “tephra X”, was added to the construction material. That patterning speaks to cultural standards maintained at least at the village level, and we considered they could have been maintained at higher authority south of the village. The finding of earlier sacbeob below the final version, closer to the village and not to the south, indicates authority resided within the village and not to the south. The likely purveyors of that authority could have been the village elders, meeting in Structure 3, the political structure facing the central plaza. Certainly there would have been disputes and resistance, as people negotiated activities with desires and obligations, but some organizing authority would have had to be essential, and these data support the existence of such an authority. The boundaries of the sections of construction and maintenance would have had to be clearly demarcated, with the lineages, households, families, or individuals complying with their obligations within their section.

Considering the topic of variation in construction and maintenance, we were struck by how much we encountered, even over short distances of ten meters or so. Some sections were created by loads of tephra packed in lumps while others were spread out in thin horizons, and others were laid out in more thick beds. People varied in how they mixed in the “tephra X” and in one place it even was used in small amounts as the finishing layer of the sacbe. The central zone of the sacbe varied somewhat in its hardness, because of variations in deliberate packing. The side zones of the sacbe varied considerably in their hardnesses, as did the sloping portions going down into the canals. The sloping portions were renovated often, using the TBJ tephra, as could be seen from the sections, and some areas had not been well-packed prior to the Loma Caldera eruption.

Finding footprints along the sacbe edges is, of course, exciting. It is possible that one or some were made by people fleeing the village from the eruption. However, most probably are not, as footprints were made by people going in both directions, and even one person going perpendicular to the sacbe. As the length of a person’s foot is about 15% of their height, one can easily calculate an estimate of how tall each person was. It will be only a rough estimate, as these are not distinct footprints.

Another component of the 2013 field season was the construction of a sacbe replica, to study how long a sacbe would last in this environment with no maintenance and no protective covering such as volcanic ash or a flood deposit. Constructing the sacbe replica was educational. Of course dry TBJ tephra does not pack, nor does TBJ that is very wet. When slightly moist it was packed slightly by people stomping on it, somewhat better by shovels and azedones, but none of those techniques came close to the hardness recorded in the sacbe’s central zone. To get to that hardness a special heavy packing tool had to be used.

Different magnitudes of renovation were discovered, with the most dramatic discovered in Operation AE. Two earlier stages of construction and use of the sacbe were found, and each differed considerably from the others. It began about a third as wide as the final version, and grew with each major building phase. Because this was found at the village end, rather than toward the south end of our tracing it, it appears clear that it was initiated and continued to be organized from the Ceren village itself.

The sacbe component of the 2013 research was gratifyingly successful in the theoretical domain of political economy. The authority to make decisions resided not just at one level, but at two. One is at the sacbe segment, where the person or more likely people building or repairing it could decide their construction technique, and could add modest amounts of "tephra X" in different ways. Authority above them presumably had proscriptions about the boundaries of acceptability in their techniques and especially about the end product, and that probably resided in the village elders. They may have met in the back room of Structure 3, and announced their decisions or organizational schemes from the broad front porch, elevated above the formal town plaza. They probably adjudicated disputes from their symbols of power, the two large benches in the front room.

Chapter 3: Agriculture

The field season encountered considerable new agricultural data, plucked out of thin "air" as Nancy Gonlin so felicitously phrased it. As Christine Dixon describes in her Chapter 3, a previously undiscovered species at Ceren was found growing by a ridge in Operation AE, ayote (squash). The hollow cavity seemed to be rather large and round before casting, and researchers were gratified with the result. Near the ayote was an inter-ridge that might have been used for other crops. The inter-ridges received a lot of attention because we realized they were not a product of erosion of calles. Nor were they an inadvertent result of ridging for the maize plants. The paleoethnobotanical team is analyzing an abundance of small seeds that were found when samples from them went through the flotation process.

Many differences among different fields were noted along both sides of the sacbe, and are interpreted as a domain in which individual cultivators have authority to make decisions within their plots. Their authority ends at a field boundary, and the most likely interpretation is that the location of boundaries was decided and maintained by the non-royal governance emanating from Structure 3, presumably by the village elders. They too were the likely domain to which people would turn who could not resolve a dispute among themselves.

The finding of maize planted on field ridges spaced much farther apart than what is typical for maize is reasonably interpreted as having shifted from manioc to maize. Given that Ceren is an instant in time, like a photograph, it is challenging to get some indications of earlier processes or procedures. Ridge spacing provides evidence into the dynamics of Ceren's cultivated landscape (Dixon 2013).

Chapter 4: Soils

Soil sampling and professional analyses has a long tradition in the Zapotitan Valley and at Joya de Ceren. Rachel Egan and Alexandra Halmbacher add to that by presenting the initial results from the 2013 season, in Chapter 4. Nitrogen is strikingly low, and they suggest a variety of reasons. I believe the most likely reason is that the Loma Caldera tephra layers were so hot on initial deposition they were destructive to nitrogen. Tropical soils exposed to solar radiation for extended periods lose nitrogen, and the tephra layers were vastly hotter than that. Also, the documented high productivity of maize per unit area in so many milpas at Joya de Ceren indicates to me that the soils had sufficient nitrogen, presumably largely from fixation by legumes. Their suggested improvements in sampling will be followed in future projects. A puzzling analytical result is the fertility in the western maize field in Operation AF. It was notably less fertile than the other soils, but for what reason or reasons remains unknown. The overall results indicate that Ceren soils were fertile yet juvenile in development.

Chapter 5: Paleoethnobotany

Our paleoethnobotanical team of David Lentz and Venicia Slotten outline their research methods and some very preliminary results in Chapter 5. They devised a more sophisticated flotation device than had been employed at Joya de Ceren previously, and it is highly encouraging regarding its high recovery percentages. As of this writing, at the end of July 2013, they are still largely collecting botanical samples from flotation, and packing charcoal samples, all for detailed analyses at botany laboratories at the University of Cincinnatti, to begin in the fall. Their contributions are sure to clarify economic functions of the sacbe, as people carried various plant products along it and inadvertently dropped some seeds. They already have discovered a common plant along the sacbe canals and the small inter-ridges between the maize ridges was *Spilanthes*. The large quantity of seeds found suggests that it grew as a weed. The plant is known to provide an antidote to pain, and it is claimed that it functions as an aphrodisiac in laboratory mice. I should avoid speculation as to its potential role in the population expansion of the Late Classic Maya.

Chapter 6. Ceramics

Rocio Herrera and Michelle Toledo present detailed descriptions of all the types of ceramics encountered in and along the sacbe as well as in the agricultural fields. Their chapter is abundantly illustrated, therefore presenting the full range of undecorated and decorated ceramics characteristic of Classic period Joya de Ceren. They found the previous detailed ceramic analyses done at Chalchuapa, the Zapotitan valley, and for Joya de Ceren specifically were quite adequate in their type descriptions for the classification of the ceramics encountered during the 2013 research season. No new types needed to be defined and illustrated. The polychrome ceramics such as Copador continues to indicate the external connections that Ceren had with the Copan valley and probably with Chalchuapa. One pleasant surprise is finding much of a Postclassic bowl in the stratigraphic position above the Loma Caldera tephra, and below that of Playon volcano. It is a Cozatol type, and is very nicely decorated on the inside of the flat base with fillets of clay in an elaborate design.

Chapter 7. Lithics

Compared to other research seasons of the Maya Agriculture Project to the south of the Joya de Ceren village, the 2013 season encountered relatively few lithic artifacts. We found no groundstone artifacts at all. In the category of chipped stone artifacts we found only five, two of which were prismatic blade fragments. There is no evidence from any season that core-blade technology was performed in Joya de Ceren, or at any other village or small town anywhere in the Zapotitan valley. Core-blade technology, used to produce prismatic blades, is technologically demanding, and the specialists who do it are usually attached to elites at large settlements, most of which have markets. So these prismatic blades probably were obtained by Cerenians going to one of the approximately dozen large centers with markets, and exchanging some of their surplus production, likely food. The other flakes making up this season's collection may well have been produced locally, and they show a quite low level of sophistication in controlling fracture of obsidian. One is a flake from someone resharpening a scraper, an activity that had been discovered in the earliest research done at Joya de Ceren, in Household 1, specifically by Structure 5.

Chapter 8: Comparisons with Copan and other Insights and Observations

A fascinating thought piece is provided by Nancy Gonlin in the form of Chapter 8. Her years of experience at Copan are brought to bear in making comparisons with Joya de Ceren. I appreciate her insightful presentation of key issues such as self-sufficiency, autonomy, and interaction, as well as issues regarding preservation and research strategies. She contextualizes both archaeological sites in ways that stimulate speculation and re-evaluation. Her suggestion of similarities between Ceren and Chan, excavated by Cynthia Robin, could be taken farther. Cynthia mentioned to Payson (personal communication 2012) that Ceren's largest building, Structure 3, being principally a political building for resolving disputes and making village decisions re-oriented thinking in Belize and elsewhere. In the Southern Maya Lowlands, the largest structure (mound) had been routinely interpreted as a pyramid, but detailed excavations at Chan revealed it was much more similar to Ceren's Structure 3. Thus as Gonlin points out, there remain many domains in which comparisons between Ceren and other Maya settlements can be productive.

Nancy Gonlin brings up the question about how much time Cerenians had to evacuate their village. The focus is on the time between the first deafening noise from the magma contacting water some 600 meters north of the village, and the arrival of the hot Unit 1 tephra. We know of no way to accurately measure that, but it certainly was not long. We would love to know how many minutes or hours intervened, as it literally was a footrace between emergency evacuees and the Unit 1 tephra clouds blasting over the landscape. We are making some progress in estimating the time between the earthquake that occurred right before the Unit 1 tephra blast, and it is becoming more clear that was very short, just a few minutes at most. The overhangs of TBJ tephra on the sides of a few of the sacbe trenches would not support themselves for more than a few seconds in my opinion, and so the shaking dislodging soft TBJ tephra and the arrival of Unit 1 packing under and all around it had to have been almost simultaneous. As volcanologist Claus Seibe noted during his visit to the site in June, much has been learned about phreatomagmatic eruptions in the past few years, and we need to upgrade our knowledge as applied to the Loma Caldera eruption.

Gonlin is correct in stating that Cerenians regularly used their polychrome vessels. They used bowls for food serving and cylinder vessels for drink. Almost a fourth of their ceramic inventory of about 70 vessels were polychromes. Life as a Cerenian commoner was surprisingly rich. She ingeniously stated that "air" is one thing that makes Ceren important. She is referring to the hollow cavities of plants that were growing in kitchen gardens, milpas, and elsewhere. The plants decomposed shortly after being encased in the early tephra units, and almost miraculously those hollow spaces, the “air” where the plants were, preserved for some 14 centuries of earthquakes and tropical moisture filtering down. Is there such a thing as a “designer eruption” for archaeological objectives? She is insightful in observing that most archaeology is two-dimensional, but documenting finds at Ceren is three-dimensional and thus offers unusual challenges. Finally, we all agree with her assessment that Ceren was a tidy place, and a fascinating tight-knit community.

Conclusions

The continued exploration of the earthen sacbe and agricultural production at Cerén has resulted in important findings that have led us to new questions and further future research avenues. Our successful documentation of variation in sacbe construction techniques, as well as the likely socio-political implications for sacbe maintenance and construction profoundly inform our understanding of the organization of the site. Continued research as to the southern and northern extent of the sacbe will aid in further assessing the potential functions of this feature. Additionally, the small section of a platform exposed just west of the sacbe excavated in the site center requires study to more accurately assess if it is a section of the plaza, another intersecting sacbe, or some other features. These findings would have implications for our interpretations of the sacbe’s function or functions at the site. Finally, the identification of two earlier sacbeob in trenches of the sacbe in the site center reveals a possibility to study the origin and development of the site before the Loma Caldera eruption. The 2013 field season has greatly contributed to our understanding of the Cerén community and ancient Maya commoners.

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Deep appreciation is in order for Dr. Christine Dixon for her unrelenting pursuit of knowledge about the ancient inhabitants of the Joya de Ceren village. She is an inspiration for us all. Her recently approved doctoral dissertation has set a high standard for graduate students and professionals to follow. Her co-editing of this report has greatly improved it over my earlier version.

I have been impressed with the dedication of the graduate students on the project. They are Rachel Egan, Alexandria Halmbacher, Venicia Slotten, and Rocio Herrera. They formed the most focused, hardworking, and successful group of graduate students that has worked with me over all the years at the site.

Because of the industrious worker selection done by Oswaldo Martinez, we ended up with an extradordinarily fine group of 26 field workers. Fortunately, 17 of our 20 workers from the 2011 season returned to work with us, and they helped train the new workers. Their names are Juan Rivera, William Alvarez, Nelson Funes, Jesus Franco, Oswaldo Martinez, Ever Campos, Jose Amilcar, Geovanni Ceron, Jose Carabante, Marvin Martinez, Jose Ramirez, Alvaro Dias, Fetmi Montano, Juan Flores, Julio Moran, Jose Coca, Salvador Ortega, Jesus Franco, Gerardo Cea, Sal Lopez, Jose Canton, Jose Felix, Jose Aguino, David Gonzales, and Francisco Aguirre. I salute them all.

Of course this would be incomplete without mentioning Salvador Quintanilla ("Chamba"), the best friend any archaeological project could have. He is the foreman of the workers at the archaeological park, and is an unending source of ethnographic and cultural knowledge about the campo.

The permission to run the project by Arq. Gustavo Milan (Director de Patrimonio Cultural) is greatly appreciated, as well as the support of the head of archaeology, Shione Shibata.

Volcanologist Claus Siebe (UNAM, D.F., Mexico) visited during June and gave us some new perspectives and understanding of the phreatomagmatic eruption of Loma Caldera. His insights and suggestions are greatly appreciated.

What is impressive to me is that the accomplishments described in the chapters of this report were achieved in spite of an unusual number of unforeseen stresses. The worst is when four of the graduate student researchers came down with the Salmonella variety of Typhoid fever, had to be hospitalized for days, and recovery is slow and fitful. In spite of that they continued to do high quality research. Other stresses included unusually hot and humid weather, a double earthquake, lightning striking the dig house, a break-in and robbery, and a great variety of pestering insects, invertebrates, and vertebrates. Special commendation is due to those who not only survived, they excelled in documentation and interpretation.