1992 Investigations at the Ceren Site, El Salvador: A Preliminary Report

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1992

DEPARTMENT OF ANTHROPOLOGY
UNIVERSITY OF COLORADO, BOULDER

PATRIMONIO CULTURAL

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NATIONAL SCIENCE FOUNDATION

CEREN PROJECT PRELIMINARY REPORT 1992
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Cover illustrations, top to bottom: vessel 295-1-128, inside, by T. Fitzke; artist's conception of Str 4 by K. Kievit; artist's conception of Str 12 by K. Kievit; design from vessel; vessel 295-2-280 by T. Fitzke

Chapter 1. INTRODUCTION

Payson Sheets,
University of Colorado

The exceptional preservation of the Ceren archaeological site, by sudden volcanic ash burial, warrants unusual conservation efforts. In 1992, for the first time, the National Science Foundation was willing to allow and fund a line item for on-site architectural conservation. That allowed ten workers to be hired to do earthen architecture conservation at Ceren alongside the ten workers who were doing excavations. For the first time, we also had a trained objects conservator on-site for the entire field season. Thus we were able to integrate objects and architectural conservation with the research program. During future field seasons we plan to continue such integration, and to improve it wherever possible.

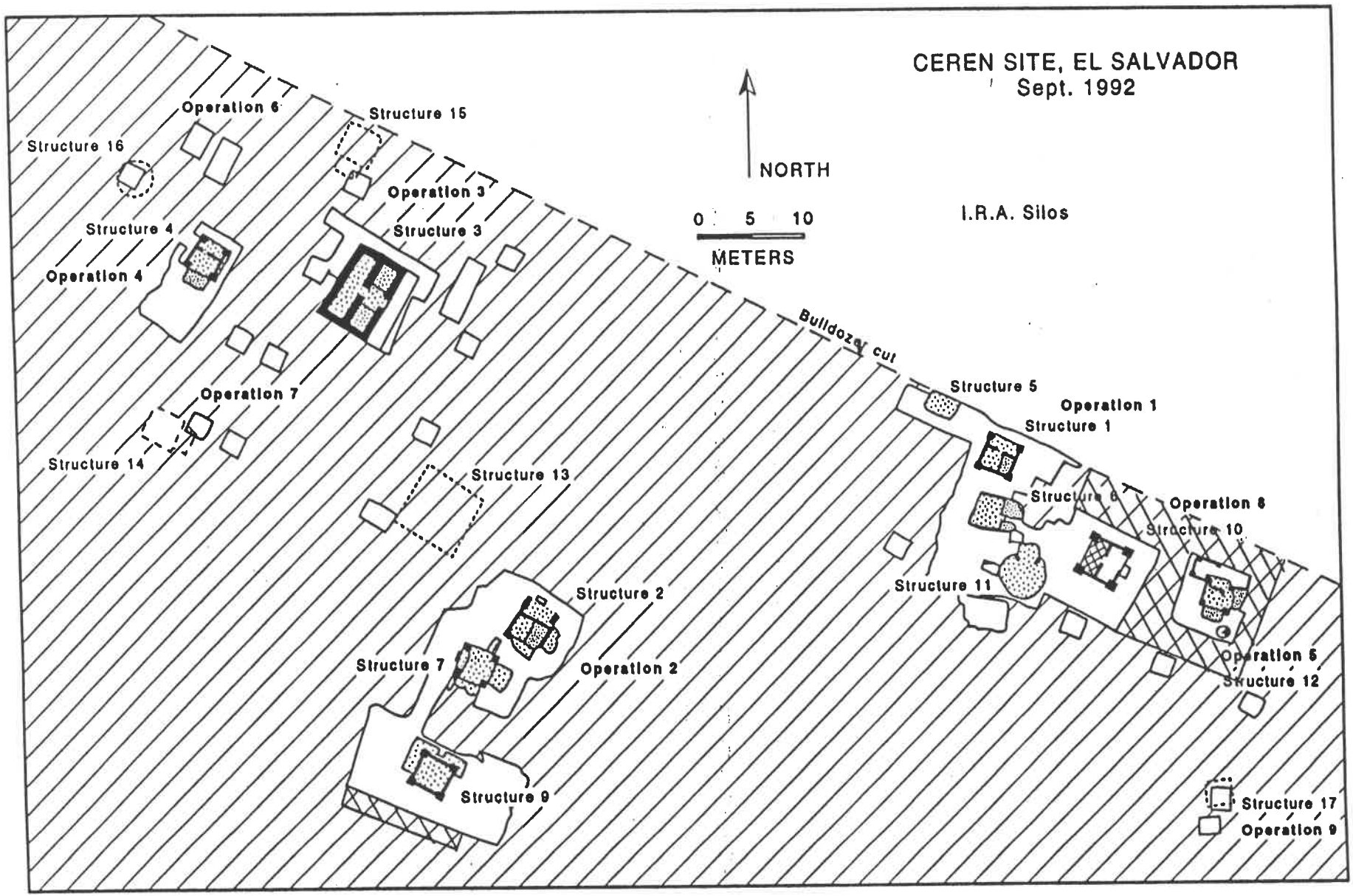
The Ceren project, supported by NSF grant BNS-9120716, was able to excavate the majority of one structure, continue with excavations in the midden and continue efforts of artifactual and architectural conservation. Unfortunately, the delays in the Ministry of Education in granting the project permission to conduct the research resulted in delays in the construction of protective roofing, which in turn delayed the research for slightly more than half of the time period in the country. In spite of those delays, however, the project was able to conduct the significant research that is reported herein.

It is unfortunate that El Salvador remains one of the few Latin American contries that does not have its own archaeologist. The Salvadorans continue to have to rely on the occasional visits of foreign, largely US, archaeologists to conduct research programs. In order to assist the development of archaeology, and archaeologists, in El Salvador we have included field and laboratory training of Salvadorans in our research. We have been able to train the four of our workers who have received their *bachilerato* degrees in advanced field techniques, including flotation, probability sampling, mapping with theodolites, geophysical exploration, field note taking, and other activities.

Dan Miller continued his volcanological research within the site, as reported in Chapter 2. He focused on the effects of the various early eruptive units on buildings, and on how buildings created dune formations of the units that were traveling at high velocities through the site. He recorded a number of stratigraphic sections to the north and east of the site, and became suspicious that Laguna Caldera volcano may not have been the source of the tephra units that buried Ceren. Detailed checking of tephra units in and near the site resulted in his concluding that the more likely source is Loma Caldera volcano, just south of Laguna Caldera volcano and located along the same active fissure. That fissure, which runs from Laguna Caldera southeastward, must be one of the most active in Central America, as it has erupted at least seven times in the past two thousand years.

Frank Miller and James Doolittle conducted geophysical survey within the site and extending to the south, which is reported on in Chapter 3. The radar unit did not penetrate very deeply, but it did discover some small anomalies to the south of Structure 10. (Karen Kievit describes the excavations in that area, which has been designated Operation 9.) Miller and Doolittle employed electromagnetic induction (EM) for the first time at Ceren, with some success. In a sense it is the inverse of resistivity, and it can be related to the resistivity database. The EM instrument penetrated much deeper than the radar.

In Operation 2, Brian McKee conducted excavations in four locations. Three of the four were for conservation purposes, to improve air ciruculation and thus help lower the humidity in previously-excavated structures. Excavation of a wedge of volcanic ash to the north of Structure 2 will assist in drying its porch area, and excavation of some ash to the south of Structure 9 will assist in its conservation. It is unfortunate that the delays resulted in our not being able to roof and then excavate an adequate amount to really assist this structure. Hopefully the remainder can be done in the near future. Excavations to the west of Structure 7 will assist in maintaining less intra-structural humidity in the Operation 2 area. The only



Map of the Archaeological Site of Joya de Ceren

excavations primarily for purposes of research were those in the midden to the southwest of Structure 9, which also had the salutary secondary effect of improving air circulation around that building. The midden excavations, limited because of the delays, did yield important information on the discard of artifacts. One surprise is the relatively good condition of the edges of obsidian prismatic blade fragments that were discarded into the midden. McKee makes his report in Chapter 4.

Structure 10 was the only building excavated during the 1992 season, and it is ideally located to become a part of the publically visible portion of the site when Ceren is opened to visitation in 1993. The excavations, under the direction of Andrea Gerstle and reported in Chapter 5, encountered an adobe column-and-*bajareque* structure that opens to the east. Because it shares an orientation of 20o east of north with Structure 12, as well as whitened walls and unusual artifactual content, the two probably are part of an architectural complex. Neither structure had artifacts characteristic of a domestic building. Structure 10 contained some artifacts that are probably best considered to be of a ritual nature. They include a deer skull headdress complete with two antlers; skull bones including the eye orbits, nose, and upper jaw; and the string used for attachment. It was stored high, with the rafters, above the inner doorway. A large ceramic vessel with a modeled alligator head also probably was used in ritual. Unusual clusters of artifacts were found inside and just outside the walls. Beyond the porch and the edge of the thatch roofs were two freestanding *bajareque* walls, a feature not seen at Ceren before.

In Chapter 6, Karen Kievit describes the excavations she directed in Operation 9, to the south of Structure 12, where a new structure (17) and maize field were discovered. Curiously, that building had three human molars in the thatch roofing. Only a part of the floor of the platform, and one corner with a solid adobe column, were excavated. No evidence of walls have been found. The function of the building remains completely unknown.

In Chapter 7, Andrea Gerstle addresses the results of the "test excavations" not aimed at exposing and excavating already-identified structures. Operation 3 exposed the Classic Period surface in front of and to the side of Structure 3. Operation 4 was meant to locate the domicile expected north of Structure 4, but instead showed that there is no structure in that vicinity. Operation 7 involved examining and overseeing the excavation of pits for the installation of support posts for new roofing, and insured that cultural remains were not endangered or overlooked during this necessary work.

As mentioned previously, the conservation of architecture and artifacts is integrated with the research of the project. We were fortunate to have an objects conservator, Mark Fenn, on-site for the entire field season, and to have his supervisor, Harriet "Rae" Beaubien, for the first part of the season. The report of the conservation team is included as Chapter 8. Trained objects conservators can handle exceptionally fragile and complicated artifacts, such as the badly fragmented deer skull headdress found in Structure 10, better than most archaeologists. The Conservation Analytical Laboratory of the Smithsonian Institution has assisted the Ceren project in numerous ways -- in objects conservation and in analysis of pigments and painted gourds.

We were pleased that David Lentz could join the research team as the ethnobotanist working with Maria Luisa Reyna de Aguilar in identifying and interpreting the expanding collection of seeds, fruits, plants, trees, and other botanical remains, as reported in Chapter 9. His extensive experience at Copan facilitates comparison.

Frank and Julie Saul conducted a detailed analysis of the three molars found in the thatch roof of Structure 17, as reported in Chapter 10. They think the teeth came from someone between 30 and 44 years of age. Numerous people in El Salvador have mentioned to us that it still is customary in traditional households to throw their loose teeth onto the roof of the house. I have no idea whether or not the teeth from the thatch roof at Ceren represent continuity in behavior from Prehispanic to contemporary times, but it is certainly interesting. The Sauls also analyzed the footprints that Andrea Gerstle discovered in her testpitting near Structure 3, and they estimate the height of the individual(s) to be between 160 and 172 cm (63-68") if male, and 157 to 170 cm (62-67") if female.

Marilyn Beaudry reports in Chapter 11 on the analyses of the ceramics from the 1992 season, and from earlier research. She is studying community organization as well as ceramic function. In addition to using ceramic vessels for food storage, cooking, and serving, people often saved parts of broken vessels for various other uses. The ceramic assemblage of Structure 10 does not match the assemblages from known domestic buildings.

Following the ceramic chapter, Chapter 12 describes the chipped stone and ground stone artifacts from the various operations. As obsidian blades have been recovered from four different contexts, we are beginning to better understand the condition of cutting edges in various contexts.

Finally, I offer my summary of the season in Chapter 13.

Acknowledgements

We wish to thank the National Science Foundation for funding to support the 1992 research program (BNS-9120716). We appreciate the assistance of the University of Colorado for matching the NSF funding for property and construction for the dig house in the nearby community of Joya de Ceren. We can now live with the local people, and now have a 3 minute commute walking instead of an hour commute driving to the site.

Our workers deserve recognition for all the work they did in hauling volcanic ash, doing the messy work with flotation, for fine excavations, and all the other things that need to be done at the site. They include Victor Manuel Murcia (foreman), Carlos Alberto Melgar, Alfredo Ismael Valladares, Jose Benito Bautista Canton, Jose Guadalupe Funes Canton, Lorenzo Lieva Bonilla, Jose Leonardo Ramirez Amaya, Rodrigo Hernandez Leon, Jose Adalberto Pineda, David Duarte Rivera, Osmin Elizandro Granados, Jose Humberto Pineda Portillo, Fidel Angonio Cortez Palacios, Alejandro Heriberto Granados Quintanilla, Rene Antonio Coca de Paz, Jaime Eliseo Quintanilla, Jose Cesar Cordova Bonilla, Santos Ines Ramiraz Amaya, Pedro Ramirez Galdamez, Carlos Nelson Leiva Jaimes, Jose Adalberto Quintanilla Carabantes, and Melvin Rivera Orellana. We all have tremendous respect for them as individuals, and admiration for their accomplishments.

I want to express my appreciation to the project scientific staff for their ceaseless efforts. They are Dan Miller, Marilyn Beaudry-Corbett, Andrea Gerstle, Brian McKee, Frank Miller, Jim Doolittle, Karen Kievit, Harriet "Rae" Beaubien, Mark Fenn, Frank and Julie Saul, and Robin DeLugan.

We all appreciate the efforts of the Ministry of Education, headed by Cecilia Gallardo de Cano, and in particular those of CONCULTURA, headed by Arq. Claudia Allwood de Mata, on behalf of the site and the project. In addition, we wish to thank Carlos Castro, Maria Isaura Arauz, Manuel Lopez, and the Museum-Patrimonio staff.

As usual, the Patronato pro-Patrimonio Cultural have been supportive of the site and the project in so many ways. In particular we would like to name Ana Vilma de Choussy, Mario Cristiani, Ricardo Recinos ("Yuca"), Neto Raubusch, Pio Calderon, and Juan Carlos Choussy for particular assistance.

The staff of the US Embassy, AID, and USIS have been helpful so many times. We want to mention by name Pamela Corey-Archer, Susan Elbow, and David and Beverly Kitson for special acknowledgement.

Chapter 2. SUMMARY OF 1992 GEOLOGICAL INVESTIGATIONS AT JOYA DE CEREN

C. Dan Miller,
US Geological Survey,
Cascades Volcano Observatory

Introduction

The purpose of my research from June 17 until July 3, 1992, at the Joya de Ceren, El Salvador, archaeological site was to 1) complete an isopach map (contour map of deposit thickness) of the Ceren eruptive sequence, which partially destroyed and now buries structures at Ceren; 2) determine the source vent(s) for the Ceren sequence; and 3) investigate stratigraphic relationships in pits and at structures excavated at Ceren since my last visit to the site in the fall of 1990. The preliminary results of my investigations are reported below.

Isopach Map of Ceren Deposits

Twenty-five distal localities within 2.5 km of the Ceren site were investigated to determine the presence, thickness and characteristics of the Ceren sequence. Deposits of the sequence were found at 17 of the localities visited (Figure 1). These data were combined with data from 3 distal sites S of Ceren, described previously (Miller 1990), and with data from excavated stratigraphic sections at the Ceren site to produce an isopach map of the Ceren sequence as a whole (Figure 1). The isopach map indicates that: 1) the logical source vent for the sequence is Loma Caldera, a low arcuate feature about 600 m N of the Ceren site; and 2) deposits of the Ceren sequence are dispersed primarily to the S of the source vent and have a "tail" that extends toward the NW of the site. Data are missing for much of the area E of the Loma Caldera vent because young deposits from post-Ceren eruptions at several vents have buried the Ceren sequence here.

There are at least two possible explanations for the peculiar shape of the thickness contours of the Ceren sequence: 1) High-level winds at the time of the eruption were blowing from N to S, while low-level winds were blowing from SE to NW. Such a wind pattern could explain the fact that most of the deposit is S of the vent, while a "tail" extends off the the NW. 2) Alternatively, the conduit in the Loma Caldera vent could have been inclined slightly toward the S during the eruption, depositing the bulk of the surge and tephra S of the vent, while the wind was blowing from SE toward the NW, producing the part of the deposit that tails off toward the NW. Textural differences between the "tail" and the "body" of the deposit might help to diferentiate these two possibilities, but such studies will have to wait for a future visit.

Source of the Ceren Sequence

Several lines of evidence suggest that Loma Caldera, and not Laguna Caldera, is the source of the deposits that bury the Ceren site. These include:

1) As noted above, the thickness contours of the Ceren sequence surround the Loma Caldera rather than other vents in the area (Figure 1). The Ceren sequence thins rapidly N of the Loma Caldera toward the Laguna Caldera vent and less rapidly toward to W, S and E. Thus, contours of thickness suggest that the Ceren sequence is not related to Laguna Caldera.

2) Thickness relations in the upper part of the Ceren sequence (Units 10 and 11), where it is exposed along the highway, indicate that the units are thickest immediately W of the W crater rim of the Loma Caldera vent (62 cm and 180 cm respectively), and that Units 10 and 11 thin toward the S toward the Ceren site and to the N toward Laguna Caldera.

3) Post-TBJ eruptive products from two other potential source vents for the Ceren sequence, Laguna Ciega and Boca Tronadora, both located E of the Rio Sucio, consist of juvenile scoria falls and basaltic spatter from magmatic eruptions rather than of phreatomagmatic deposits such as those that constitute a significant proportion of the Ceren

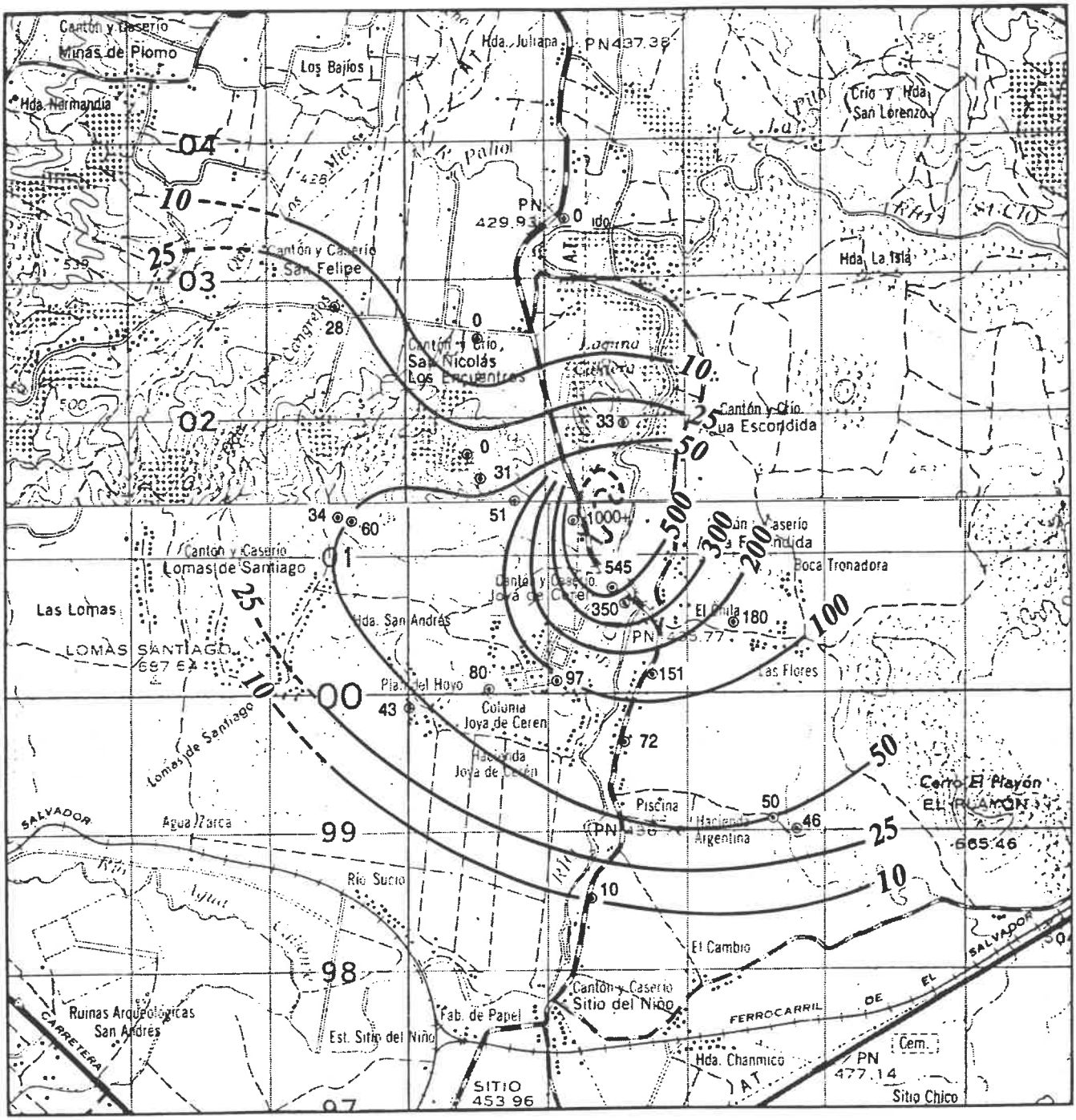


Figure 1. Isopach Map of the Ceren Sequence

sequence. Loma Caldera, located immediately adjacent to and in the flood plain of the Rio Sucio, is a more logical source of the phreatomagmatic deposits that dominate the Ceren sequence.

4) A quarry on the W side of the highway and about 100 m W of the W rim of Loma Caldera volcano displays a N-trending normal fault with a displacement (down to the E) of 2-3 m. Similar soil-profile development at the surface on both sides of the fault suggests that faulting occurred simultaneously with, or immediately after, deposition of the Ceren sequence. A logical explanation for this normal fault is that it is related to slumping of the W part of the Loma Caldera edifice as it collapsed into a large, deep, funnel-shaped explosion crater that was present at Loma Caldera at the close of the eruption.

Although it is still possible that one or more of the Ceren units below Unit 10 may have come from a source or sources other than Loma Caldera, the weight of the evidence suggests that the entire Ceren sequence came from Loma Caldera rather than from other nearby sources.

Loma Caldera Vent

The Loma Caldera vent is an inconspicuous arcuate, or "ear-shaped," ridge whose center is about 600 m N of the Ceren site (Figure 1). The caldera consists of a low ridge about 500 m long in a N-S direction and about 30-40 m high. The E half of the vent is missing due to erosion of that half of the edifice by the Rio Sucio. The morphology of the W half of the vent and its internal composition, as evidenced by exposures along the highway, indicate that the Loma Caldera edifice is a tuff ring. Tuff rings are depositional features that are formed around erupting vents by thick accumulation of debris erupted from the vent.

Other Work Completed During the 1992 Season

Post-TBJ Eruptive Activity

During investigations at distal sites in the vicinity of Joya de Ceren, it was determined that numerous volcanic vents in the vicinity of the site, particularly those along the SE fissure system that extends SSE from Laguna Caldera to El Boqueron, have been active during the past 1700 years. Stratigraphic relations of superposition reveal that the following volcanic vents have erupted since deposition of the AD 260 Tierra Blanca Joven (TBJ) tephra: Laguna Caldera, Laguna Ciega, Loma Caldera, Boca Tronadora, El Playon, vents at the N end of the El Playon chain, and El Boqueron. Additional as yet unidentified volcanoes may also have contributed tephra and surge deposits to the region.

Reconnaissance stratigraphic studies of a broad area E of the Rio Sucio further reveal that a number of these volcanic vents have erupted since deposition of the AD 590 Ceren sequence. Volcanic vents that erupted pyroclastic deposits that lie stratigraphically above the Ceren sequence include: Laguna Ciega, Boca Tronadora, vents at the N end of the El Playon chain, El Playon, and El Boqueron.

Ceren Site Located Near Inflection Point in Thickness Versus Distance Curve

Cross-site comparisons at the Ceren site were made of the thickness of the Ceren sequence from the N side of the pit at Operation 4, where the sequence is 545 cm thick, to the E wall of the pit SE of Operation 12, where the sequence is 350 cm thick. These data, together with the isopach map (Figure 1), indicate that the sequence increases in thickness very rapidly N of the site and decreases slowly toward the S. This relationship was noted during the 1990 field season (Miller 1990, Figure 3).

Evidence of Brief Pause in Eruption of Ceren Sequence

At a distal site exposed in a road cut about 1 km E of the Ceren site, evidence indicating a brief erosional episode following deposition of Unit 3 was found. The exposure reveals two small erosional channels, about 50 m apart, cut into the top of Unit 3. The channels are sinuous in form, undercut at the sides and average about 4 cm deep by 10 cm

wide. The morphology of the channels and their locations in slight depressions on the top of Unit 3 suggest that they were produced by running water.

A similar, but V-shaped, channel cut into the top of Unit 3 was noted by Hoblitt on the N side of Structure 5 (R.P. Hoblitt, personal communication 1992).

Water-cut channels in Unit 3 suggest that a rainstorm occurred at the close of, or shortly after, eruption of Unit 3. Heavy rains often accompany explosive eruptions, which can generate their own weather. The time represented by formation of small channels such as the ones found at the top of Unit 3 is thought to be a few hours or less. The absence of extensive erosion, soil-profile development and organic remains at the top of Unit 3 indicate that resumption of eruptive activity and deposition of Unit 4 occurred shortly after deposition of Unit 3. Channels cut into the top of Unit 3 are the only known indications of pauses or interruptions during emplacement of the Ceren eruptive sequence.

Stratigraphic Studies

Structure 2

Brief stratigraphic studies were conducted at Structure 2 in Operation 2. The stratigraphy of Units 1, 2 and 3 is well-exposed just N of the front porch. Roofing thatch, some burned and some not, is located just under the brown/gray/brown part of Unit 3, just above the top of Unit 2. Small pods, from 3-10 cm thick, of the anomalous "buff" unit are found at the contact between Units 1 and 2. Unit 1 is as thick as 48 cm, where it accumulated in the form of a base surge "dune" against the front porch of Structure 2. A similar dramatic thickening of Unit 1 against a thick front porch was observed at Structure 7.

Structure 12

Observations at Structure 12 suggest that the E wall of the SE room was knocked down early during the emplacement of Unit 3. About 39 cm of Unit 3, and units 4 and younger ones, are preserved on top of the fallen E wall. About 6 cm of the lower part of Unit 3 are exposed below the wall suggesting that the wall fell at about the time of deposition of the brown/gray/brown part of Unit 3. Units 2 and 1 are not exposed under the E wall due to backfilling of the floor of the excavation.

The S wall of Structure 12 was knocked down considerably later, about halfway through deposition of Unit 5. Under the S wall, Units 3 and 4 are normal in thickness, about 36 and 25 cm respectively. Unit 5, immediately under the S wall, is only 13-15 cm thick as compared to Unit 5 in the pit wall, where it is 2-30 cm thick. It is unknown if any Unit 5 was deposited on top of the S wall because the structure was excavated before I arrived.

Inside of Structure 12, "normal" thicknesses of Units 3, 4 and 5 are present. It was not possible to determine whether Units 1 and 2 are found inside Structure 12. The surge nature of Unit 5 is well-documented in the pit walls of Structure 12, where the thickness of Unit 5 varies from 3 cm (NW corner of pit) to 60 cm (NE corner of pit).

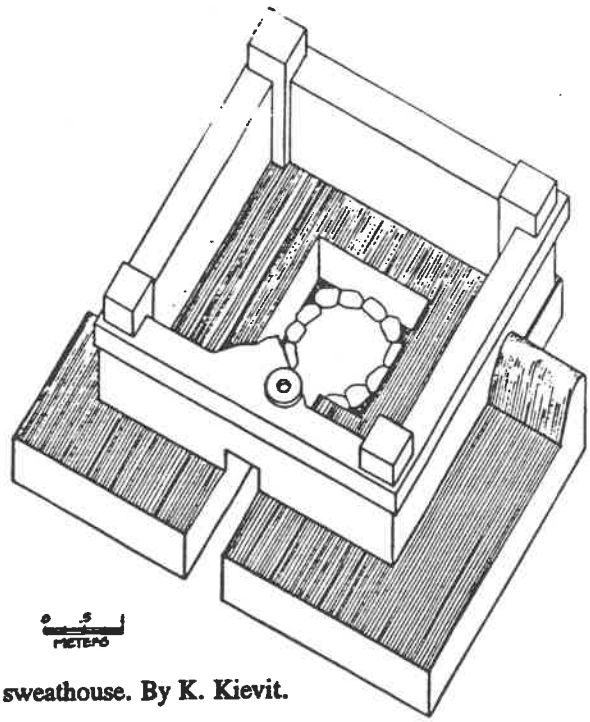
Stratigraphy of Pit P-5

Pit P-5, located at the SE corner of Operation 4, was described in detail because it displays a beautiful exposure of the entire section from the TBJ to the top of the Ceren sequence. The section from TBJ to the top of Unit 14 is 477 cm thick. Of particular interest is the fact that Units 10 and 11, 32 and 44 cm thick respectively, appear to be the same two units that were followed and observed to thin both N and S from their thickest exposures along the highway W of the Loma Caldera vent. Thus, Pit P-5 provided the critical locality that tied the exposures W of Loma Caldera to the Ceren site.

Recommendations About Terminology

It is my opinion that the most appropriate term for the sequence of deposits that buries the Ceren site is the "Ceren sequence." Furthermore, because the Ceren sequence appears to have erupted at Loma Caldera rather than Laguna Caldera, it is no longer appropriate to use the term "Laguna Caldera sequence" to describe the deposits.

Because as many as 5 nearby volcanic vents appear to hve erupted since emplacement of the Ceren sequence in about AD 590, I believe that it is very difficult to know for sure which volcanoes are responsible for volcanic units that overlie Unit 14 of the Ceren sequence at the Ceren site. In the absence of well-documented correlations of these tephras with their source vents, the most appropriate way to refer to these tephras is a "post-Ceren sequence deposits."



Isometric reconstruction of Str 9, the sweathouse. By K. Kievit.

Chapter 3. 1992 GEOPHYSICAL INVESTIGATIONS AT THE CEREN SITE, EL SALVADOR

James Doolittle and
Frank Miller, USDA-Soil
Conservation Service and
Mississippi State Univ.

Introduction

Geophysical instruments are increasingly being used to aid archaeological investigations. These devices afford medium to high resolution and continuous measurements or profiles of subsurface conditions. Geophysical instruments can provide rapid, cost-effective, and non-destructive means of artifact detection, identification, and location. In addition, these techniques provide more comprehensive information about a site and minimize the number of exploratory pits.

Since 1979, several geophysical methods have been used at the Ceren Site in efforts to locate structures buried beneath 4 to 6 meters of pyroclastic materials from the Loma Caldera eruption (circa A. D. 600). These methods included seismography, resistivity, and ground-penetrating radar (Loker 1983, Sheets et al. 1985, Spetzler and Tucker 1989, Spetzler and McKee 1990). Interpretations of traces from seismic-refraction surveys provided no evidence that this tool could distinguish structural features buried within depths of 6 meters. Results from resistivity and ground-penetrating radar (GPR) surveys were more encouraging and indicated the effectiveness of these tools for locating archaeological features.

The 1992 field season involved an integrated approach using both electromagnetic induction (EM) and ground-penetrating radar (GPR) techniques. These complimentary geophysical techniques are non-intrusive and provide rapid means to cover large areas at different levels of intensity and resolution. It was anticipated that the use of these tools would provide more site information than a single method by increasing areal coverage, reducing field time, and facilitating excavation strategies. In addition, it was proposed that the following questions posed by previous investigations would be addressed:

1. what is the effective depth of penetration of GPR in the soils/substrata at the Ceren Site;

2. what is the capability of geophysical techniques to resolve subsurface features buried at depths of 3 to 6 meters; and

3. how do the results of EM compare with resistivity techniques?

Descriptions of Systems

Ground-Penetrating Radar

Ground-penetrating radar is an impulse radar system designed for shallow subsurface site investigations (Daniels et al. 1988). Compared with other geophysical techniques, GPR surveys are generally less time consuming and can provide higher resolution of subsurface features. The radar unit used in this study was the Subsurface Interface Radar (SIR) System-8 manufactured by Geophysical Survey Systems, Inc. [1] Components of the SIR System-8 include the model 4800 control unit, ADTEK SR 8004H graphic recorder, ADTEK DT 6000 tape recorder, power distribution unit, transmission cable (30 m), and the model 3205 (120 MHz) antenna with the 705DA and 705DA2 transceivers. The system was powered directly

1. Use of trade names in this report is for identification purposes only and does not constitute endorsement by the authors or their institutions.

from a 12-volt vehicle battery. The operation of the SIR System-8 has been described by Doolittle (1987).

Results from radar surveys are site specific and interpreter dependent. In some areas, conductive soil conditions limit profiling depth and the applicability of GPR. Ground-penetrating radar is best suited for shallow (3 to 10 meters) investigations in electrically resistive mediums (i.e. dry, sandy soils). Successful interpretations depend on the experience of the operator, complexity of soil or geologic conditions, quantity and quality of independent observation data, and the system and antennas used. In many terrains, unless mounted in a suitable vehicle, the equipment is heavy and cumbersome to move and operate. Ground-penetrating radar has been used to locate and map buried structures, buried artifacts, and graves (Bevan and Kenyon 1975; Bevan 1984, 1991; Doolittle and Miller 1991; Imai et al. 1987; Vaughan 1986).

Electromagnetic Induction

This technique generates electromagnetic fields to measure the bulk or apparent conductivity of underlying earthen materials. Apparent conductivity is the weighted average conductivity measurement for a column of earthen materials to a specified penetration depth (Greenhouse and Slaine, 1983). The averages are weighted according to the depth response function of the meter (Slavich and Petterson, 1990). The depth of penetration is dependent upon the intercoil spacing, transmission frequency, and coil orientation relative to the ground surface. Table 1 lists the anticipated depths of measurements for the EM meters with different intercoil spacings and coil orientations.

The electromagnetic induction meter used in this study was the EM34-3 manufactured by GEONICS Limited.[1] A 10 meter intercoil spacing was used and measurements were obtained in both the horizontal and vertical dipole modes. Values of apparent conductivity are expressed in milliSiemens per meter (mS/m). The operation of the EM34-3 meter has been described in detail by McNeill (1980).

TABLE 1

Depth of Measurement
(all measurements are in meters)

Meter	Intercoil Spacing	Depth of Measurement Horizontal	Vertical
EM31	3.7	2.75	6.0
EM34-3	10.0	7.5	15.0
	20.0	15.0	30.0
	40.0	30.0	60.0
EM38	1.0	0.75	1.5

Because of the ease and efficiency of operation, EM can be used to rapidly survey large areas. Interpretations of EM results are based on the identification of spatial patterns in the data set appearing on two-dimensional contour plots or cross sections. Analysis of EM data provides stratigraphic information about a survey area and may reveal the location of buried cultural features. However, with increasing exploration depths and coarser resolution, detection is often limited to large buried structures or prominent stratigraphic features. As only the EM34-3 meter was available for this survey, there were concerns about the capability of this instrument to resolve structural features buried at depths of 4 to 6 meters. This

technique is, however, well suited to reconnaissance surveys requiring continuous, moderate resolution data. The EM methods have been used to locate and map buried structures, artifacts, mounds, and tombs (Bevan 1983, Dalan 1991, Frohlich and Lancaster 1986).

Field Procedures

A large proportion of the field time was spent surveying grid lines across the study areas. At the time of the survey, only lots 189A and 189B were uncultivated and cleared of vegetation. Lots 190, 191 and 192 were in sugar cane or corn. The cane was closely planted, and over 2 m in height. Rows were narrow, winding, broken along field boundaries, and often impassible in areas of wind-thrown cane. These conditions precluded the use of GPR. The use of the GPR was restricted to Lot 189A and a cleared portion of Lot 192 near the road to Joya de Ceren.

Radar calibration studies were conducted along an exposed face of a cut bank near Operation 14. The 120 MHz was pulled adjacent to a 20 m section of the exposed face. Horizontal holes were augered into the exposure at depths of 60 and 100 cm, respectively, and metallic auger handles were placed in each hole. Because of multiple, closely spaced layers of pyroclastic materials, the embedded reflectors were difficult to discriminate with a high degree of confidence.

Additional radar scans were conducted on a line at right angles to the exposed face. Along this traverse, a paint can with a diameter of 15 cm was buried at a depth of 75 cm. Repeated passes were made with the antenna across this buried anomaly with ranges of 50, 100, 200, 300, and 400 nanoseconds on the control unit. Positive identification of the buried can was made on each pass. On the basis of the depth to this buried anomaly, each radar profile was depth scaled and a dielectric constant of 12 for the overlying soils was estimated.

Radar surveys were conducted at three additional sites. These surveys covered an area of about 1020 m^2. Two of these sites were located within Lot 189A. One area was adjacent to a test pit near Operation #4 and the other area was located near Operation #5. A 900 m^2 site was surveyed with GPR on summit of a hill near the road to Joya de Ceren. This site was located in an area where the Ceren sequence was between 200 and 300 cm thick (C.D. Miller 1992). Grids were established at each site with either a 1 or 5 m grid interval. The antenna was pulled by hand along parallel grid lines to produce the radar profiles.

Portions of lots 189B, 190, 191, and 192 were surveyed using the EM34-3 meter. A total of 930 measurements were collected within the survey area. Grid interval was 10 m along lines which closely followed rows between the sugar cane and corn. A transit was used to triangulate the locations and elevations of each grid intersect from a base line tied to a site control point. At each grid intersect, measurements were made with the EM34-3 meter in both the horizontal and vertical modes.

Results and Discussion

Figure 1 is a representative radar profile from the Ceren Site. This profile was processed through RADAN software. The horizontal and vertical scales are in meters. The segmented vertical lines represent referenced positions which were impressed on the radar profile as the antenna was pulled passed the marked locations.

The Ceren Site is covered by volcanic deposits which have been separated into 15 major stratigraphic units (Miller 1992). Units vary in thickness, texture, induration, and stratification. These strata create interfaces or boundaries which are detected by GPR. In Figure 1, the dark, horizontal lines represent these strata. High-amplitude reflections are produced by abrupt or strongly contrasting interfaces; low-amplitude reflections are produced by gradational or weakly contrasting interfaces. Individual units and layers create similar, sub-parallel signatures which are difficult to separate and identify on radar profiles without extensive auger observations. Many layers were too thin to be resolved with the 120 MHz antenna.

The soils at the Ceren Site are moderately attenuating to radar signals. Reflective loses occur as the radar signal intercepts each stratigraphic layer (see Figure 1). Finer-grained,

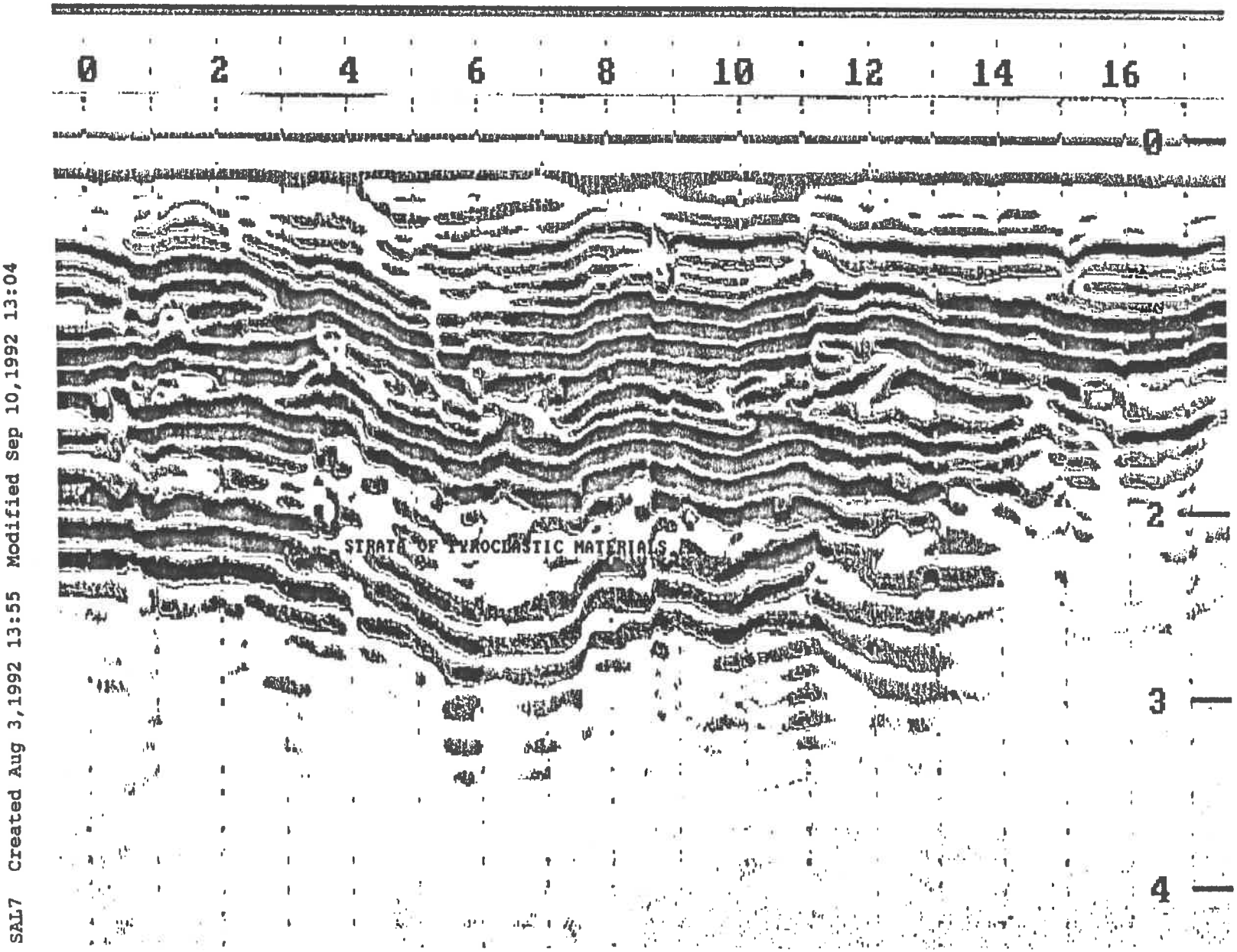


Figure 1. Representative Radar Profile from the Ceren Site

indurated beds of ash appeared to be most attenuating to the radar signal. The maximum consistent depth of profiling for discrimination of buried structures was restricted to 3.0 meters.

The size, electrical properties, and depth of an artifact affects discrimination. Large, electrically contrasting features tend to produce substantial electrical responses and anomalous patterns which are easier to detect and identify than smaller, less contrasting features with resistivity or electromagnetic induction methods. At the Ceren Site, a "typical" buried structure has dimensions of about 3.5 x 4.0 m with relatively thin (15 cm wide), 1.6 m high, fired clay or sun-dried adobe walls (B. R. McKee, personal communication). Structures were built on clay platforms, 50 to 70 cm high, resting on relatively thin deposits of Tierra Blanca Joven tephra over clayey, pre-Ilopango eruption soils. These structures were assumed to have higher electrical conductivities than the overlying, coarser textured, volcanic materials. These structures were constructed from, and are assumed to have electrical conductivities similar to, underlying buried soil materials.

At depths of 3.5 to 6 meters, many structures may not be sufficiently large or dielectrically contrasting for resistivity and electromagnetic induction techniques to detect. In order to profile these depths, relatively large electrode or intercoil spacings are required. At these spacings, because of the large volume of earthen materials contributing to the electrical response, electromagnetic induction and resistivity methods provide relatively coarse resolution. While it was felt that neither method would discriminate individual structures, it was speculated that these tools would provide valuable information on the pre-eruption stratigraphy and terrain. This information may be useful in determining the most probable sites of habitation and the extent of culturally disturbed lands. In addition, it was presumed that clusters of cultural anomalies could be distinguished from broad terrain patterns.

Figure 2 is a two-dimensional, one-meter contour plot of the area surveyed with EM. The contour interval is 1 meter. Relief was slightly greater than 17 meters. The land slopes towards the Rio Sucio which is located to the east of the study area. The Ceren Site is immediately north of the study area.

Two-dimensional contour plots of apparent conductivities were prepared from results of the EM survey. These contour plots present data obtained with EM34-3 meter in the horizontal (Figure 3) and vertical (Figure 4) dipole modes. In each of these figures, the contour interval is 2 mS/m.

Interpretation of the EM data are based on the identification of spatial patterns in the data set. Several inferences can be made from Figures 3 and 4. A comparison of the two figures reveals that values of apparent conductivity increase with soil depth. This relationship is believed to reflect the greater conductivity of the underlying finer-textured, buried soil materials than the overlying pyroclastic deposits, and increases in volumetric water content with depth. Generally, values of apparent conductivity decreased with elevation. This "terrain affect" results from changes in moisture contents and lithology. Points at higher elevations generally have drier soils with water tables at greater depths, and may be lithologically different than lower positions.

Within the upper 7.5 m (Figure 3), values of apparent conductivity appear to be uniform across the site with an absolute range of 15 mS/m. Figure 3 depicts an anomalous zone of low apparent conductivities (< 9 mS/m) on backslope areas near the border of lots 189B and 190. This zone of low apparent conductivities is located in an area reported (Spetzler and McKee 1990) as having anomalously high resistivity values. This may represent a pocket of deeper pyroclastic or more resistive materials. A slight anomaly (> 13 mS/m) occurs on the upper backslope and summit area of Lot 190. This may represent a deposit of more conductive materials, an eroded area with thinner layers of pyroclastic materials, or the presence of a cultural anomaly.

The effects of increased volumetric water content and the water table are evident in Figure 4. Values of apparent conductivity increase at lower elevations where the depths to the water table are less and soils conditions are generally wetter. In addition, at lower elevations the isolines more closely conform with slope contours. A distinct trough of higher apparent

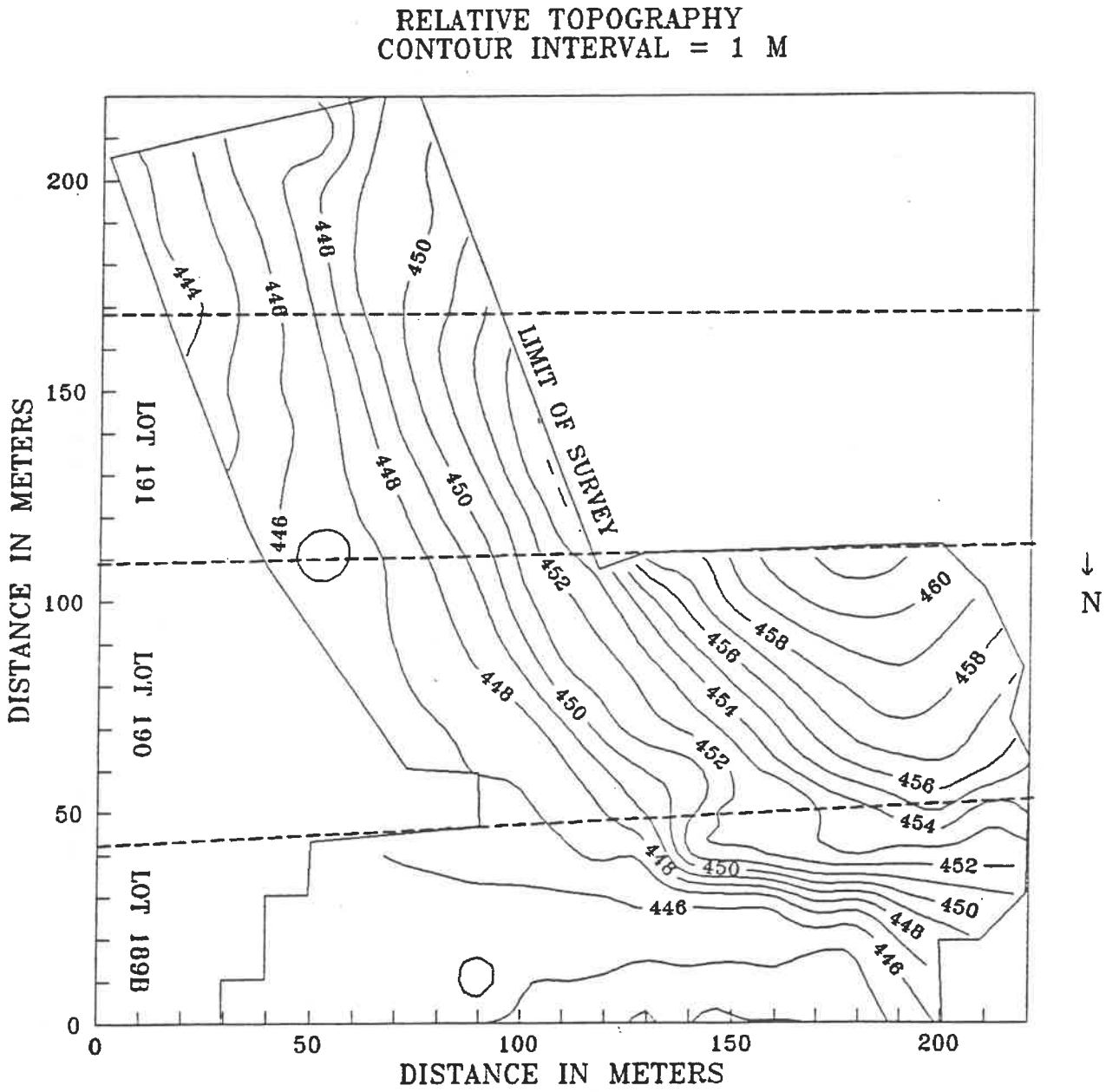


Figure 2. Two-Dimensional One-Meter Contour Plot of the Area Surveyed with Electromagnetic Induction (EM) at Ceren

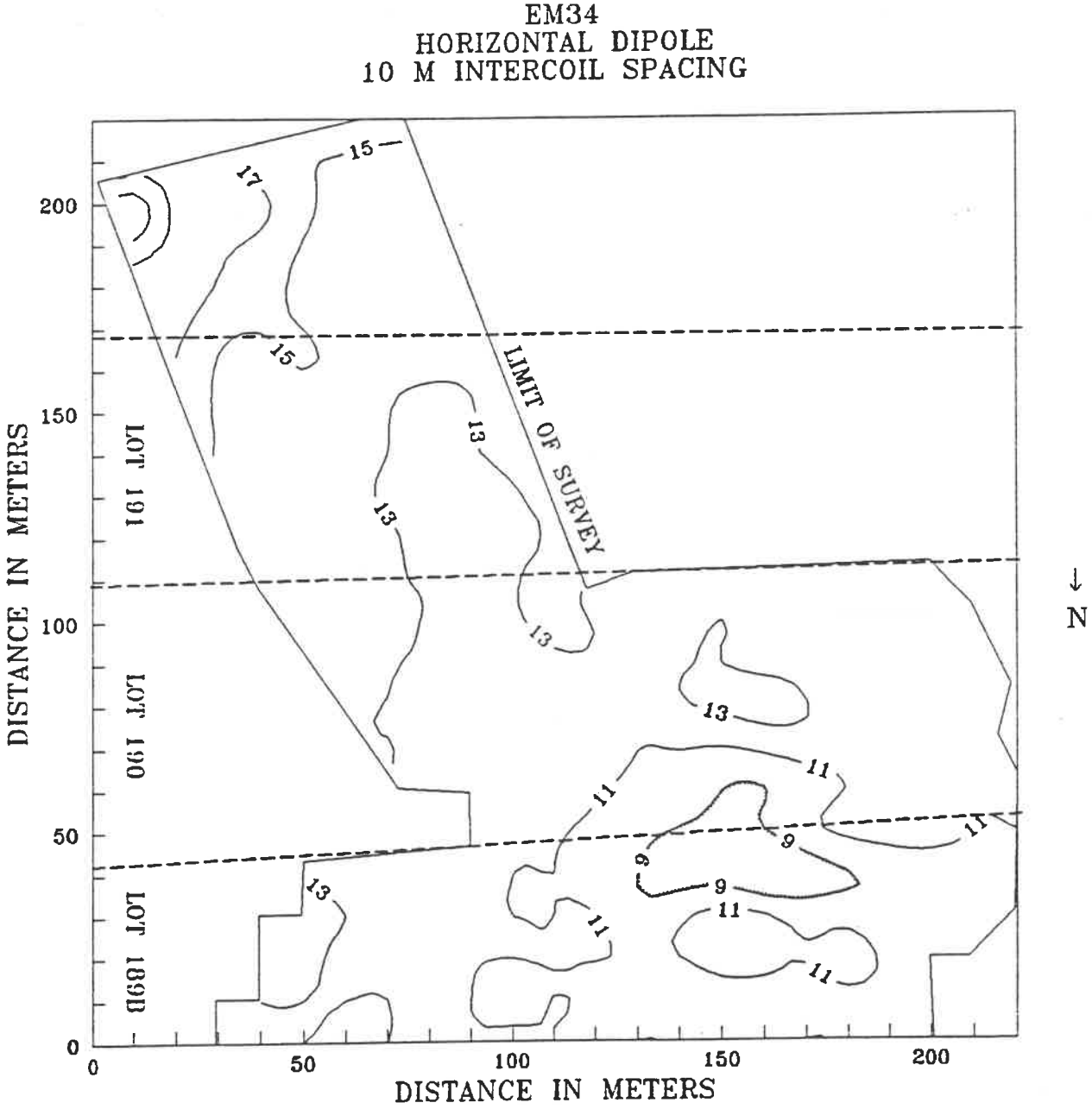


Figure 3. Two-Dimensional Contour Plot of Apparent Conductivity, EM34-3 Meter in Horizontal Dipole Mode

conductivity values extends upslope near the border of Lots 189B and 190. This is believed to represent an old drainageway or seepage area which probably existed prior to the eruption of Loma Caldera. Also in Figure 4, values of apparent conductivities are lower on the more sloping, upper backslope and summit positions. These lower values are believed to be a manifestation of terrain position. Higher-lying and more sloping areas are generally drier and less conductive than lower-lying areas. Several anomalous areas can also be identified (Figure 4). These areas are generally small and contrast only slightly with their surroundings.

Studies conducted by Arcone (1981) demonstrated the comparability of data collected with resistivity and EM. Resistivity was used at Ceren in 1979, 1980, 1989, and 1990. In these studies, a Wenner electrode configuration was used with either a 10 or 5 meter electrode spacing. These surveys resulted in the identification of several subsurface anomalies suspected of being cultural features. To verify interpretations, ten anomalies identified with resistivity were probed by core drilling. Coring revealed that only two of the ten anomalies represented cultural features and raised questions as to the suitability of resistivity for archaeological investigations at the Ceren Site.

In Figure 5, results from the electromagnetic induction and the 1990 resistivity surveys of Lot 189B are compared. Resistivity is inversely proportional to conductivity. The 1990 survey used a 5 meter electrode spacing, integrated resistivity over a 5 meter depth, and obtained more data points. The two-dimensional contour plot of resistivity values is base on 332 observation points with a contour interval is 40 ohm/meters. The EM survey used a 10 meter intercoil spacing, integrated apparent conductivity over a 7.5 meter depth, and is based on 91 data points with a 2 mS/m interval.

Although there are differences in the number of points and exploration depths, the results of the two methods are similar. In each plot, the earthen materials become more conductive (less resistive) at lower elevations towards the east. Earthen materials are more resistive (less conductive) on higher slope positions in the southwest corner of the survey area. In addition, anomalous values occur in the same general locations. As results are similar and the use of EM is many times faster than resistivity, EM appears to be a more efficient tool for reconnaissance surveys at Ceren.

Conclusions

The soils and substrata at the Ceren Site are moderately attenuating to radar signals. The finer-grained, indurated beds of pyroclastic materials appeared to be most attenuating features in the profile. Reflective losses occur as the radar signal is intercepted by each stratigraphic layer. Based on calibration trials, the maximum depth of consistent profiling with the 120 MHz antenna appears to be about 3 meter. Since the closest point that any part of a known buried structures approaches the present ground surface is about 3.6 m, the use of further reconnaissance investigations with GPR is discouraged at this site. However, GPR can be used to provide detailed stratigraphic information at Ceren during excavations to predict underlying anomalies, or in areas having cultural features buried at depths of less than 3 meters.

Structural features, found at depths of 3.5 to 5 m, are exceedingly difficult anomalies for resistivity and electromagnetic induction techniques to detect. To profile these depths, both methods require fairly large electrode or intercoil spacings. In order to profile depths of 5 to 7.5 meters, 5 to 10 meter electrode or intercoil spacings were used. These horizontal and vertical dimensions produce relatively coarse resolution of subsurface features. Both EM and resistivity techniques, however, provide vital subsurface stratigraphic information which may be used to reconstruct the pre-eruption land surface at Ceren. This information can indicate the most probable sites of habitation. In addition, several anomalies apparent in the data may indicate the location of major buried cultural features. In future studies, the use of an EM31 meter is encouraged. This meter is easier and quicker to operate than the EM34-3, and profiles depths of 2.75 and 6 meters.

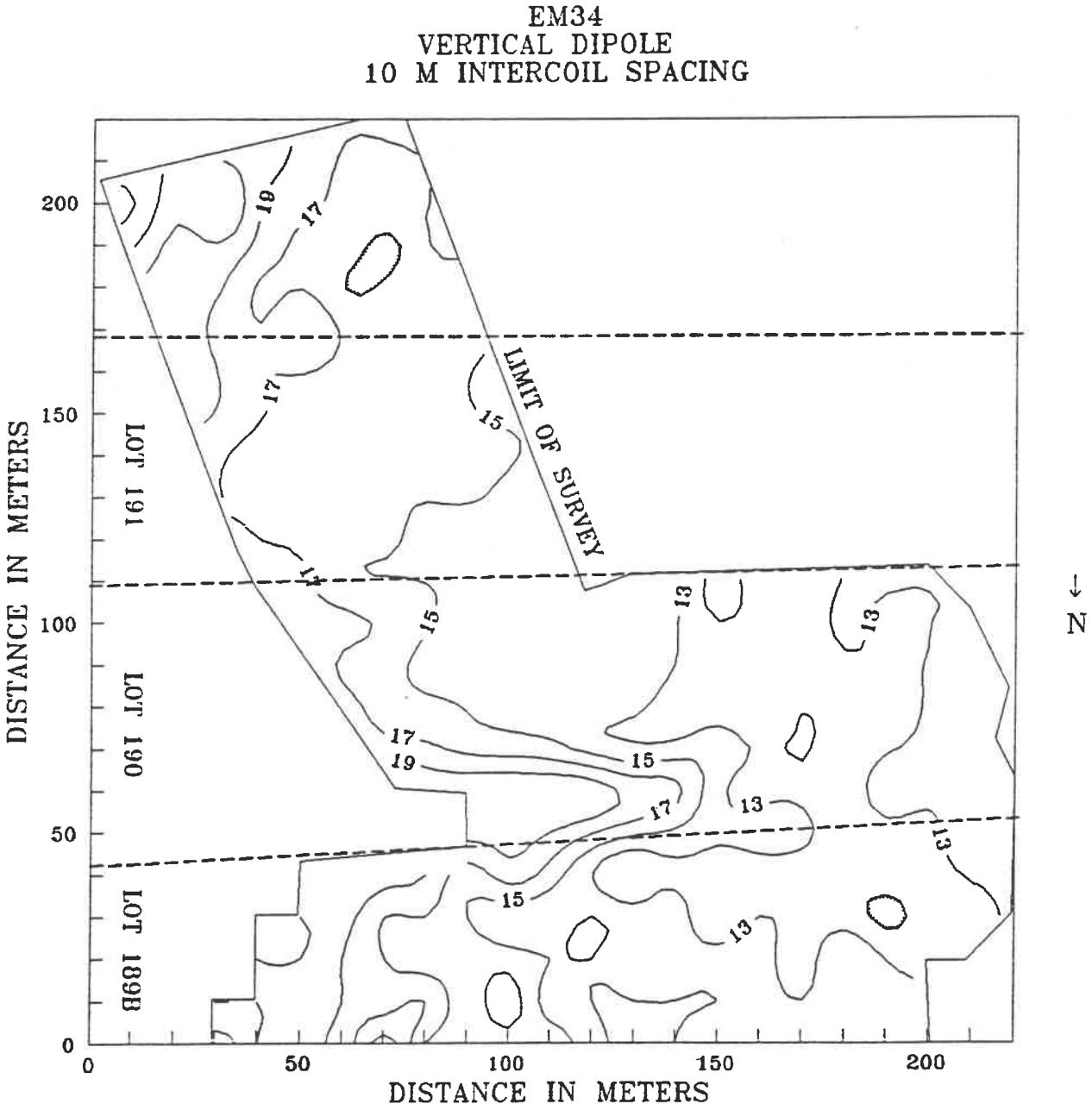


Figure 4. Two-Dimensional Contour Plot of Apparent Conductivity, EM34-3 Meter in Vertical Dipole Mode

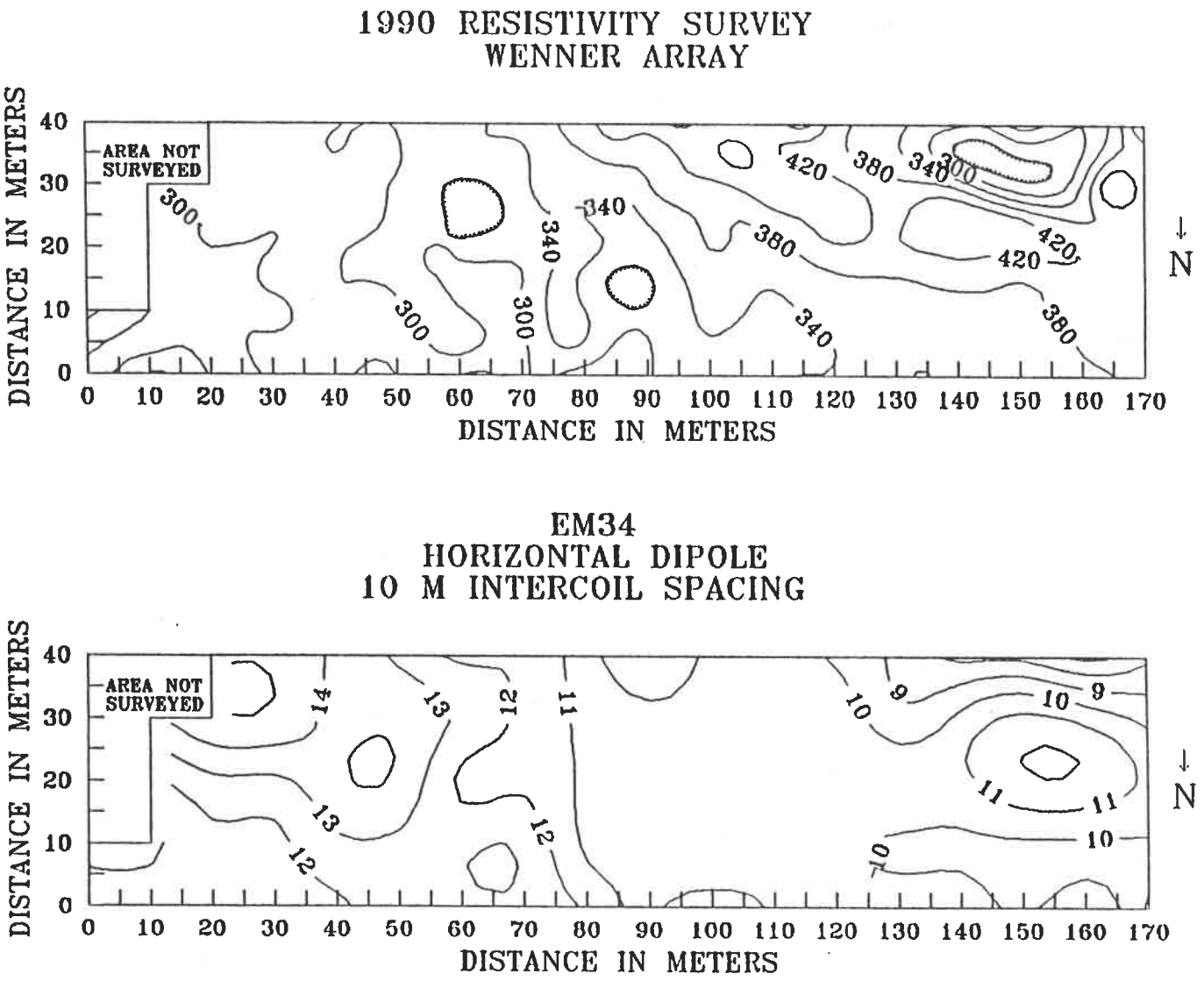


Figure 5. Comparison of Results from Resistivity and Electromagnetic Induction Surveys of Lot 189B, Ceren

Chapter 4. 1992 EXCAVATIONS IN OPERATION 2

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Introduction

Excavations were conducted in 4 areas of Operation 2 during the 1992 field season. Three areas -- north of Structure 2, west of Structure 7, and south of Structure 9 -- were excavated primarily to address conservation concerns, but they also added to our knowledge of the areas surrounding structures. Excavations in the final area, the midden west of Structure 9, were intended to increase our understanding of discard processes at the Ceren site. Earlier excavations in Operation 2 exposed Structures 2 (McKee 1989), 7 and 9, as well surrounding areas, a corn field and a midden (McKee 1990a, b).

Methods

The field methodology used north of Structure 2, west of Structure 7, and south of Structure 9 was similar to that used in previous seasons (McKee 1990a). All excavation was by hand, using shovels and picks in upper levels, and trowels and other hand tools when cultural materials were encountered. Excavation was by stratigraphic levels, using the sequence defined by Miller (1989). All materials were mapped in three dimensions in the grid established during the 1989 season (Tucker 1989), and the stratigraphic position and associations of all artifacts were recorded.

One difference in the field methodology was in the collection of samples for flotation and for pollen analysis. Collecting and processing methods were devised in consultation with David Lentz. A 100-200 ml sample was collected for pollen analysis and a 1 liter sample was collected for flotation from each square meter excavated. In the case of complete vessels, a 100 ml pollen sample was collected, and the remaining fill was measured and collected for flotation. The samples were collected by intially scraping to within .5 cm of the pre-eruption (referring to the Loma Caldera sequence) ground surface in the northeastern corner of each grid square. The final few millimeters above and including the surface were then scraped off with a clean trowel and pollen samples were placed in paper bags which were then sealed with tape and stored for later analysis. The flotation samples were placed in cloth bags.

Samples were floated in clean water in plastic tubs. Clay did not present any problems; therefore no defloculant was used. The samples were poured into the tubs filled with water, and all floating materials were skimmed off using a USDA #40 mesh screen. The sediments were gently agitated, and skimming was repeated until no further floating materials were encountered. The non floating fraction was then water-screened through 1/16 inch mesh window screen. The floated and heavy fractions were dried for several days in newsprint before being sealed in paper bags. Analysis of floated and heavy fractions is in process.

Excavations in the midden utilized different methods than those previously used at Ceren. The excavations were in 1 x 1 meter pits, in arbitrary 5 cm levels parallel to the pre-eruption ground surface. Maps of sediment distribution and artifact location were drawn at the base of each level. Pollen and flotation samples were collected from each level in the manner described above, except that two liters rather than 1 were collected for flotation. Field Specimen designations of pollen and flotation samples are shown in Table 1. The pollen specimen was assigned a suffix of -a after the FS number, the floated fraction a suffix of -b, and the heavy fraction a suffix of -c.

The Salvadoran field workers were more involved in field recording than was the case in previous seasons. Three excavators who worked in Operation 2, Ismael Pedro Giron, Moises Arturo Guevara, and Hector Armando Guevara, had completed Andrea Gerstle's course in field methods and had learned skills in mapping and other field techniques. These excavators took their own field notes and drew most of the field maps. They also completed forms that had been prepared for excavations in the midden. These records were supplemental

to my own field recording, and the resulting data quality is excellent. The continued training of Salvadoran field workers will help in future salvage excavations when sites are in danger of destruction due to construction or other factors.

TABLE 1. FLOTATION AND POLLEN SAMPLES COLLECTED IN OPERATION 2 IN 1992.

295-2-	Location
502	8S, 51W
503	7S, 50W
504	7S, 49W
505	8S, 48W
506	8S, 47W
507	9S, 47W
508	9S, 46W
510	Fill 295-2-509
532	23S, 64W, L.1
537	23S, 64W, L.2
541	23S, 64W, L.3
543	23S, 64W, L.4
550	23S, 64W, L.5
552	23S, 64W, L.6
556	23S, 64W, L.7
559	23S, 64W, L.8
562	23S, 64W, L.9
565	19S, 60W
566	18S, 60W
567	18S, 61W
568	17S, 60W

295-2-	Location
569	17S, 59W
570	16S, 60W
571	16S, 59W
572	15S, 60W
573	15S, 59W
574	14S, 59W
575	14S, 58W
576	13S, 59W
577	13S, 58W
578	12S, 58W
583	23S, 66W, L.1
585	23S, 66W, L.2
588	23S, 66W, L.3
615	23S, 64W, L.10
619	23S, 66W, L.4
621	23S, 66W, L.5
623	23S, 64W, L.11
629	23S, 66W, L.6
630	23S, 64W, L.12
634	23S, 66W, L.7
635	23S, 64W, L.13
637	23S, 66W, L.8

Excavations North of Structure 2

A narrow strip was excavated to the north of Structure 2 to improve air circulation and lower the relative humidity in this area. The initial excavation of Structure 2 in 1989 ended just north of the structure (McKee 1989). The resulting environment had extremely high humidity, leading to plant growth that complicated conservation of the structure. The northward extension was excavated to the level of the pre-eruption ground surface. The strip excavated measured 0.5-1.0 meters wide by approximately 6 meters long (Figure 1). These excavations also served to decrease the slope of the volcanic deposits to the north of the structure, lowering the likelihood of collapse in the event of an earthquake.

Excavations were conducted in two stages. The initial phase consisted of removing the volcanic deposits to the level of the roofing thatch. A detailed 1:10 scale map of the excavation area at the level of the roofing was drawn (Figure 1). All thatch and voids from either tree branches or roofing members were sketched. The thatch was relatively thin (0.5-3.0 cm thick) in this area, and represents the northernmost extension of the Structure 2 roof. Two voids left by decomposing tree branches were cast in dental plaster using methods described by Murphy (1989), and one probable roofing beam was mapped. One fragment of *bajareque* which probably was knocked from the top of the western wall of Structure 2 was also mapped. All roofing materials were found very low in Unit 3, and the majority were carbonized, indicating that the roof burned and was weakened during the Unit 2 tephra fall,

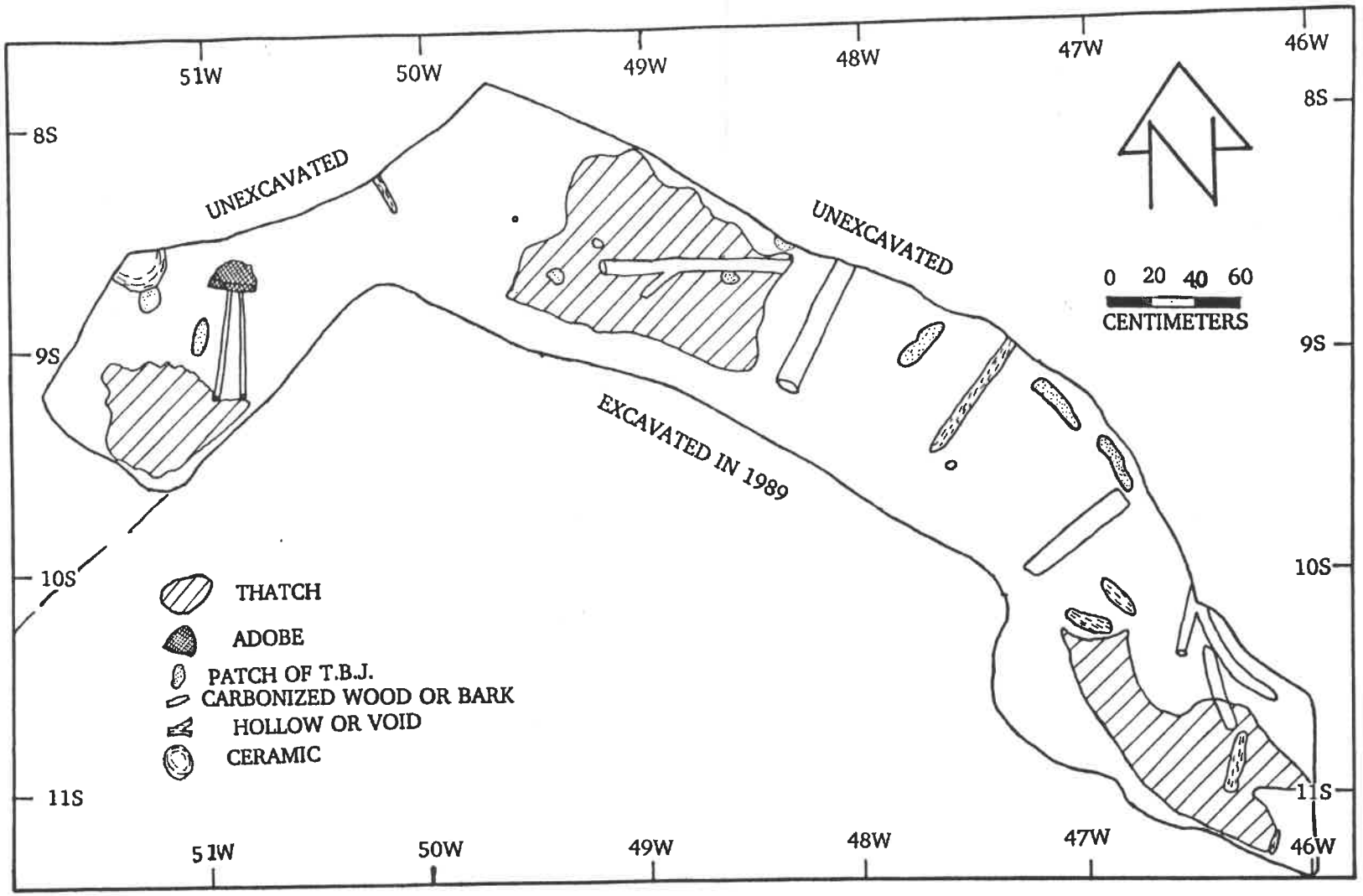

Figure 1. Plan of Excavations North of Structure 2 at the Level of the Fallen Roofing

and fell due to the weight of early base surge deposits in Unit 3. Unit 1 was greatly thickened in this area, to over 30 cm, probably as surge clouds packed into the porch area.

Following detailed recording by mapping and photography, excavations proceeded to about 1 cm above the prehistoric ground surface. We collected 100 ml pollen samples and 1 liter flotation samples from the the northeast corner of each 1 x 1 meter grid square as described above. After sample collection, we excavated to the ground surface of the Ceren occupation (Figure 2). This surface was quite compact in this area, and relatively free of artifacts. The surface was reddish in many areas, possibly due to the presence of iron oxide precipitated out of ground water passing through the Loma Caldera tephra sequence (C. Dan Miller, personal communication 1992). Fourteen sherds, one obsidian blade, one ceramic vessel (FS-509), and 6 voids were found on the ground surface in the approximately six square meter area (Table 2). The majority of the voids were probably from seeds that decomposed following the eruption. These voids were cast with dental plaster. The ceramic vessel (FS-509) was the most visually impressive artifact recovered. It is a medium sized jar with modeled and appliqued features of a human figure on the neck. The face and two arms are present.

TABLE 2. ARTIFACTS NORTH OF STRUCTURE 2

295-2-	Description	Location
500	Tree Branch (Plaster)	9.27S, 46.55W
501	Tree Branch (Plaster)	9.39S, 46.33W
509	Ceramic Vessel	7.63S, 51.32W
511	Bajareque Frag. (discarded)	7.68S, 50.87W
512	Seed (Cast in Plaster)	9.84S, 46.40W
513	Seed (Cast in Plaster)	9.78S, 46.71W
514	Obsidian Blade Fragment	8.96S, 46.72W
515	Sherd	8.43S, 46.89W
516	Seed (Cast in Plaster)	9.79S, 47.17W
517	Sherd Lot (2)	8.50S, 92.28W
518	Sherd	7.91S, 47.84W
519	Seed (Cast in Plaster)	7.69S, 48.48W
520	Sherd Lot (2)	8.50S, 48.50W
521	Sherd Lot (2)	8.50S, 49.50W
522	Sherd Lot (3)	7.50S, 49.50W
523	Seed (Cast in Plaster)	7.70S, 49.32W
524	Seed (Cast in Plaster)	7.90S, 49.06W
525	Sherd Lot (2)	7.50S, 50.50W
526	Sherd	8.22S, 50.72W
527	Paint Fragments	8.06S, 51.31W
528	Seed (Cast in Plaster)	7.60S, 51.40W
529	Laja Fragment (Unmodified)	7.42S, 49.96W

Excavations to the north of Structure 2 achieved their primary purpose of increasing air circulation around that structure and isolating the walls of the structure from surrounding sediments. This should help to lower the soil and air humidity in areas immediately surrounding the structure. The excavations also provided some insights into the nature of the original use of that area. They revealed the northernmost extension of the roofing from Structure 2, and showed that the area in front of the structure was kept clear of debris,

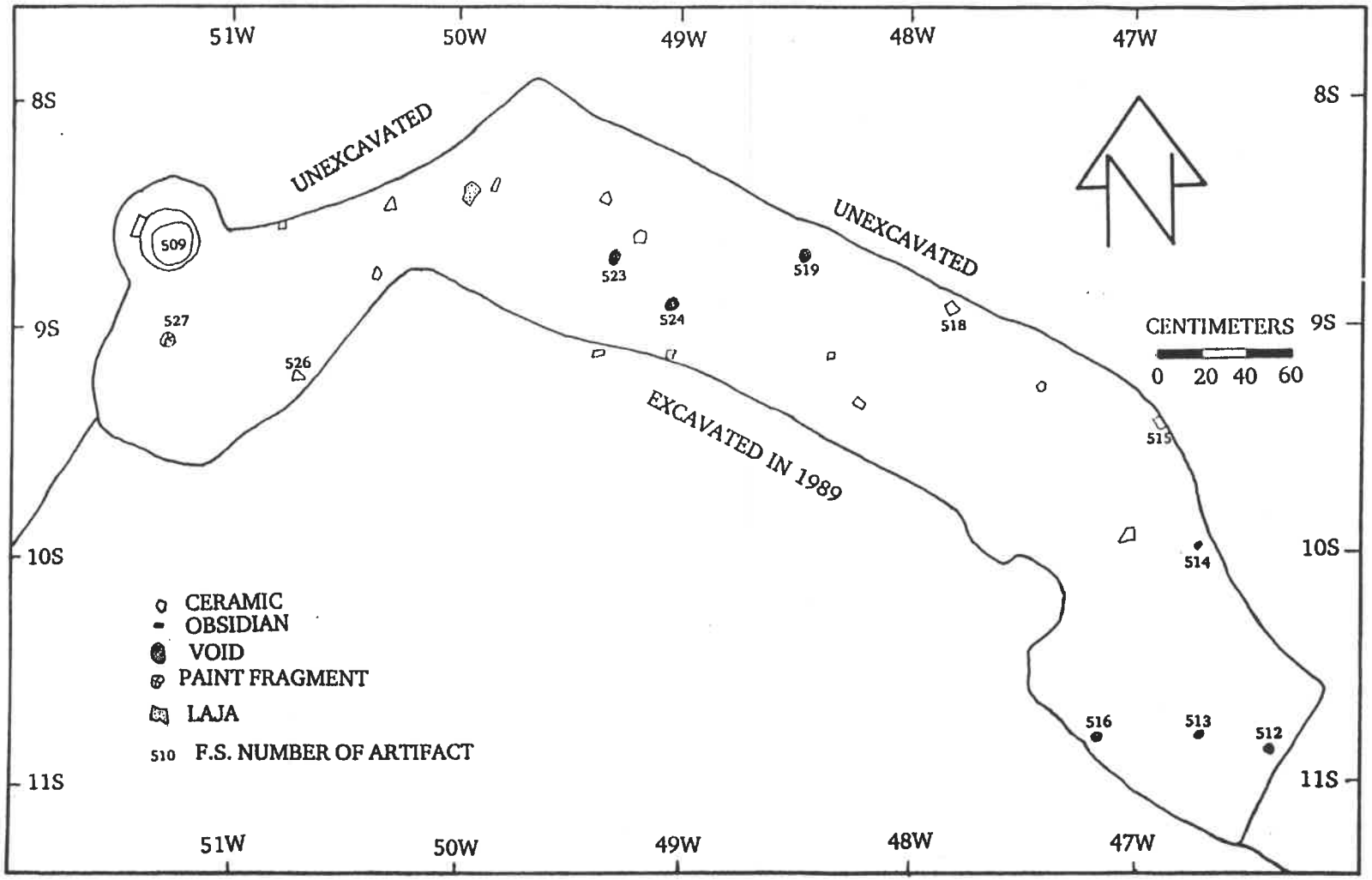

Figure 2. Plan of Excavations North of Structure 2 at the Pre-Eruption Ground Surface

presumably for use as a walkway or other as yet unknown activity. Heavy foot traffic may also be the reason for the compaction of the surface in this area, lending support to the interpretation as a walkway. These excavations allowed for the first systematic collection of pollen and flotation samples on the site. The analysis of these samples could provide further insights into the nature of the use of this area. The presence of the ceramic vessel (FS-509) in this area is somewhat puzzling. It was directly in contact with the pre-eruption ground surface, indicating that it was either resting on the ground surface at the time of the eruption or fell from a higher position very early in the eruption. The vessel was broken in one area, but the breaks appear to be fresh. Several sherds from the broken area are missing. Because the vessel was encountered at the edge of the excavations, we do not know if the sherds are still buried beyond the limits of the excavations or if the vessel had broken prior to the eruption and those sherds were discarded elsewhere. If the vessel was unbroken at the time of the eruption, and was in its present position, then it is the first time that we have encountered a complete vessel outside of roofed areas.

Excavations West of Structure 7

The second area of excavation in Operation 2 was located to the west and southwest of Structure 7. The primary purpose of this excavation was the same as that of the area north of Structure 2, to improve air circulation around the structure and to isolate the structure from sediments beside it that could introduce moisture through capillary action. The excavations also connected the area containing Structures 2 and 7 with excavations around Structure 9. The trench will serve to direct any water that enters the excavations away from the structures and into the midden area south and west of Structure 9.

The area excavated measured approximately 1.5 meters northwest-southeast by 8.5 meters northeast-southwest, for a total of approximately 13 square meters (Figure 3). The majority of the area had been excavated below the top of stratigraphic unit 3 during previous seasons.

The area was excavated in June and July of 1992. The first part of the work consisted of removing backfill. The sediments were removed to about the middle of Unit 3, where a number of holes were encountered. Because of the possibility that these holes represented the locations of decomposed plants, we decided to fill all holes in vertical or near vertical positions with dental plaster. After excavation around the casts, we realized that nearly all were holes left by decayed tree branches. All voids and molds were mapped at 1:10 scale. The molds were removed and collected for future analysis by David Lentz. The sediments were then excavated to 1 cm above the pre-eruption ground surface.

Samples were collected for pollen analysis and flotation from the northeastern corner of each square meter as described above. Following the collection of samples, the remaining sediments were excavated to the level of the pre-Loma Caldera ground surface. All artifacts were mapped to the nearest centimeter in three dimensions, and were collected in lots for each square meter (Figure 3).

The overall artifact density in this area was relatively low, possibly reflecting its location in an area of potentially heavy foot traffic between structures 2, 7 and 9. The ground surface slopes steeply away from Structure 7 at a distance of about 1.5 meters west of the structure. The beginning of this steep slope probably represents the dripline of the thatched roof. A large piece of fallen clay was found southwest of the structure, resting in sediments from the Loma Caldera eruption, and may be a part of the fallen southern wall of Structure 7. Artifacts recovered from this area (Table 3) included ceramic sherds, plaster molds of voids in the volcanic ash, several pieces of *laja* (exfoliated andesite), and one large stone that may have been used for milling. Two *laja* slabs were found in upright positions southwest of the structure, and may be related to other upright andesite slabs found west of Structure 9 (McKee 1990b).

The large number of voids found in this area is probably from branches stripped from trees during the Unit 3 base surges. This type of eruption sends out lateral blasts of hot steamy clouds at speeds of up to 200 km/hr (Miller 1989), which would be well capable of

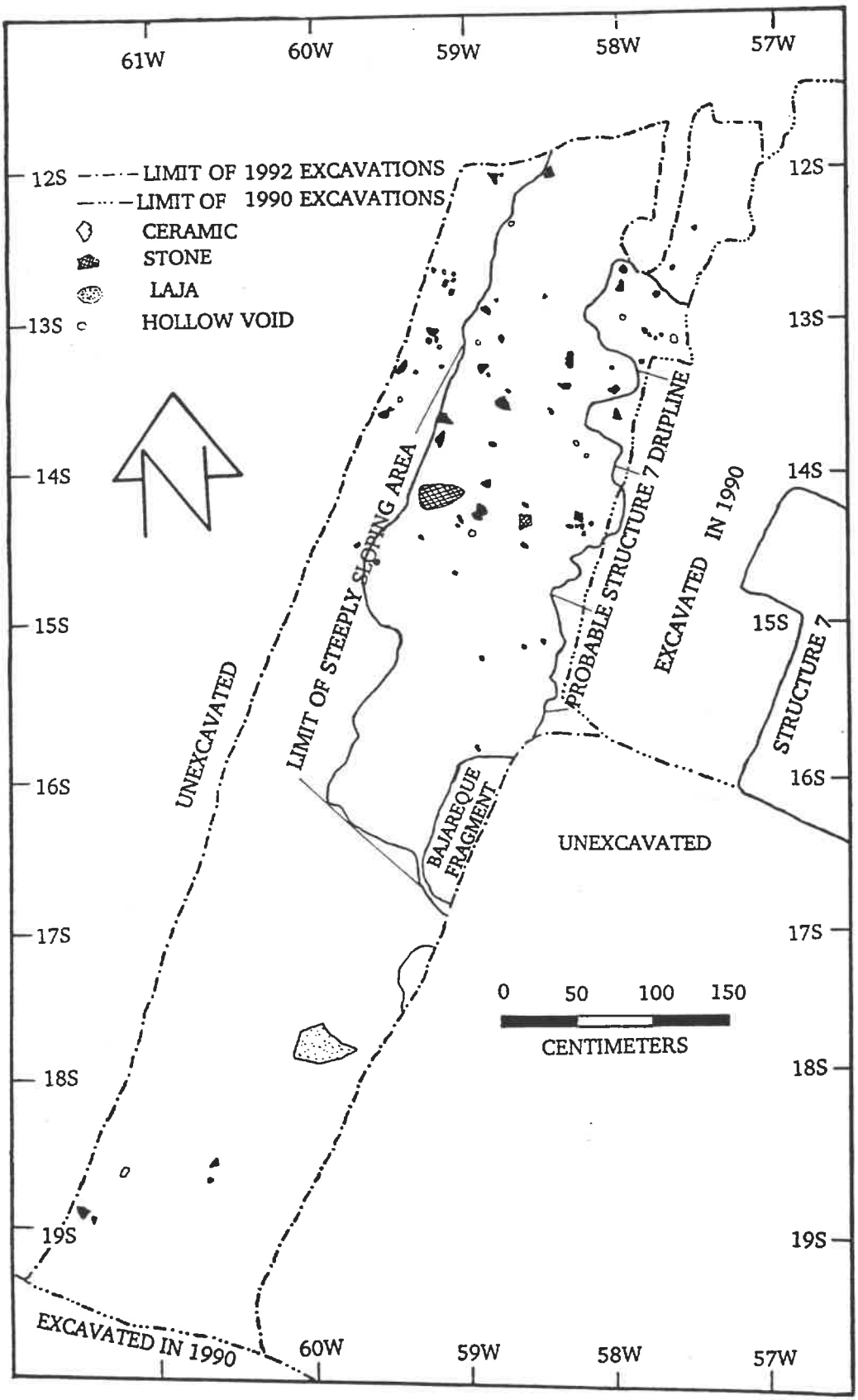

Figure 3. Plan of Excavations West of Structure 7 at the Pre-Eruption Ground Surface

breaking even large tree branches. Large vertical hollows probably representing the locations of tree trunks have been found to the west of this area, and were likely the source of these branches. The prehistoric use of this area is not entirely clear, but the low artifact density and relatively compact surface may indicate that it was used as a footpath for access between structures 2, 7 and 9, particularly in the area beyond the steep slope (Figure 3).

TABLE 3. ARTIFACTS WEST OF STRUCTURE 7

295-2-	Description	Location
531	Tree Branch (Plaster)	18.95S, 61.54W
536	Tree Branch (Plaster)	18.06S, 60.98W
540	Tree Branch (Plaster)	17.44S, 60.87W
542	Possible Seed (Plaster)	17.04S, 60.65W
554	Tree Branch (Plaster)	18.75S, 60.98W
561	Tree Branch (Plaster)	13.08S, 58.35W
596	Sherd Lot (3)	18.50S, 60.50W
597	Sherd Lot (2)	18.50S, 61.50W
598	Plaster Mold (Seed?)	18.50S, 61.50W
599	Sherd Lot (4)	15.50S, 58.50W
600	Sherd Lot (6)	14.50S, 59.50W
601	Ground Stone	14.18S, 59.15W
602	Sherd Lot (13)	14.50S, 58.50W
603	Plaster Mold (Seed?)	14.41S, 58.95W
604	Sherd Lot (10)	13.50S, 59.50W
605	Plaster Molds (2)	13.50S, 59.50W
606	Sherd Lot (14)	13.50S, 58.50W
607	Plaster Mold (Seed)	13.15S, 58.95W
608	Sherd Lot (4)	13.50S, 57.50W
609	Laja	13.12S, 57.73W
610	Sherd Lot (5)	12.50S, 59.50W
611	Sherd Lot (6)	12.50S, 58.50W
612	Plaster Mold (Seed)	12.36S, 58.69W
613	Sherd Lot (4)	12.50S, 57.50W
614	Plaster Mold	12.40S, 57.50W

Excavations South of Structure 9

The third area excavated was located to the south of Structure 9. Two small blocks were excavated to increase air circulation around Structure 9, and to isolate that structure from surrounding volcanic deposits. Unfortunately, due to time constraints, we were unable to complete excavation to the pre-eruption ground surface in this area. The excavation did serve to improve lighting and air circulation in Operation 2, and will simplify excavations in future seasons. The only artifacts recovered from these excavations were a small sherd lot and one obsidian blade (295-2-591, and -592) recovered from the post-eruption ground surface in the western block. Other evidence of the occupation of the site in the Late Classic or Postclassic has been noted by McKee and Tucker (1989), and Gerstle (1990).

Midden Excavations

The final area of excavation in Operation 2 was in the midden (McKee 1990b). Two exploratory pits were excavated in this area. All sediments were screened through 1/8 inch hardware cloth, and 100 ml pollen samples and 2 liter flotation samples were collected from

the northeastern corner of the units for each level (Table 1). Excavations were recorded the completion of each level on forms that include data on depth, sediments, artifacts recovered, and other observations as well as include space for field notes.

Two 1 x 1 meter units were excavated in the midden area. Both were located in the vicinity of preliminary test pits excavated in 1991 (McKee 1990b), and were intended to improve our understanding of the depth, stratigraphy, and artifact content of the midden. Exposed midden deposits are located near the upper edge of a large depression south and west of Structure 9. The depression may represent the edge of a natural drainage, or may be the edge of a large borrow pit for clay used in construction of the buildings. The southwestern corner of the first unit was located at 24 South, 65 West, near the edge of the steep slope downward into the midden area. The second was located at 24 S, 67 W in the extreme southwestern corner of the excavations. This pit was located in a steeper area, and may give us more detailed information regarding deposits in deeper areas of the midden.

We did not reach the bottom of the midden in either pit due to time constraints. The artifact density had dropped markedly in 23-24 S, 64-65 W by 65 cm below the pre-eruption ground surface, at the lower limity of the excavations. The artifacts recovered from the excavation units are listed in Tables 4 and 5, and the mass of ceramic artifacts recovered is shown in parentheses following the FS designation as a rough approximation of the relative artifact density in each level. It is clear that for both units, the artifact density is highly variable, indicating a variety of cultural and non-cultural formation processes at work. The stratigraphy was also complex, with varying amounts of wood ash, clay, and volcanic ash (*TBJ*) from the earlier Ilopango eruption. A heavy concentration of wood ash near the surface in 24S, 64W may represent cleaning of the firebox from Structure 9, interpreted as a sweatbath (McKee 1990b). Future excavations that reach the bottom of the midden and provide us with a larger sample will allow more detailed inferences regarding formal discard processes at Ceren.

TABLE 4. FS DESIGNATIONS OF MATERIALS RECOVERED FROM 24S, 64W

Level	Ceramics	Obsidian	Plaster	Faunal	Other
Surf.	530 (860)	-	-	-	-
1	533 (1611)	-	-	-	645
2	534 (125)	-	535	-	642
3	538 (310)	-	539	-	-
4	555 (742)	544	545	546-	547
5	549 (517)	-	548	-	-
6	553 (163)	-	-	-	-
7	557 (403)	558	-	-	-
8	560 (158)	-	-	-	-
9	563 (586)	-	564	-	-
10	616 (178)	617	-	-	643
11	627 (212)	-	625	-	628, 641
12	631 (92)	-	-	-	-
13	638 (12)	-	-	-	-

TABLE 5. FS DESIGNATIONS OF MATERIALS RECOVERED FROM 23S, 66W

Level	Ceramics	Obsidian	Plaster	Faunal	Other
Surf.	579 (268)	-	-	-	-
1	580 (1268)	581	-	582	-
2	584 (631)	587	-	586	644
3	589 (1307)	-	-	-	590, 647
4	593 (763)	594	618	-	640
5	620 (1791)	-	-	-	648
6	622 (1185)	626	-	624	639
7	632 (130)	633	-	-	-
8	636 (173)	-	-	-	-

Summary

Excavations in Operation 2 in 1992 helped to alleviate some conservation problems at Ceren, mainly those concerned with the high relative humidity and poor air circulation in the area. They also provided us with valuable new data regarding the occupation of this part of the site. We now know the northward extension of the roof of Structure 2, as well as the westward extension of the roof of Structure 7. The low artifact density in these areas and the compact ground surface indicate that foot traffic was likely relatively heavy in these areas, and possibly indicates that these locations were established footpaths.

Excavations in the midden provided some interesting glimpses into the nature of a formal discard area at the site, but still have not defined the horizontal or vertical extent of the midden. A larger sample will be necessary before we can make quantitative comparisons between areas of the midden, and between artifacts that were in use at the time of the eruption and those that were discarded prior to the eruption. These excavations have also helped to correct a bias toward the excavation of structures that has occurred at Ceren, and will help us to better understand the full range of behavior of the inhabitants of the site.

Miniature vessel from Operation 2, 295-2-213. Drawn by T. Fitze, from slides and field drawing by D. Tucker.

Chapter 5. 1992 EXCAVATIONS AT STRUCTURE 10, JOYA DE CEREN (OPERATION 8)

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Introduction

The excavation of Structure 10 and its surrounding area is called Operation 8. The structure is located between Structures 11 and 12 (Figure 1). Str 10 was discovered during earth-moving operations in 1990, when parts of three *bajareque* walls were exposed. These included the west structure wall and parts of the north structure wall and central dividing wall. Directly over Str 10, the volcanic ash overburden was removed to the level of Unit 8 tephra and in some areas to Unit 6 or below, causing exposure of and some damage to the upper portions of the north and west structure walls. The overburden immediately north of the structure was largely intact and unroofed because of a previous effective property boundary. Postclassic deposits were removed as part of Operation 7 (Gerstle 1992). Upon completion of the roof extension, this overburden was removed to Unit 8 tephra, at which level the structure and surrounding area were united for continued excavation. Approximately 70 sq m were excavated to Unit 3 tephra.

Although the 1992 field season was scheduled for the months of June and July, Operation 8 excavations were delayed by the need to extend protective roofing over a larger area. Excavations started on 26 June and lasted until 30 July. Due to the short time available, only the east room in the structure and a narrow strip around the north, east and south sides of the structure were excavated. These surrounding strips helped isolate the structure from the humid surrounding soil and improved the air circulation. Excavation of the west room and an ample area around the structure are planned for the next field season.

Excavations were conducted by a team of 6 to 10 skilled and experienced Salvadoran excavators, with myself as director. Excavation techniques were essentially the same as in previous seasons (see Sheets and McKee 1989, 1990), with the addition of systematic soil sampling on original floor and ground surfaces. As recommended by Dr. David Lentz, project paleoethnobotanist, both flotation and pollen samples were taken from every square meter on these surfaces (Figure 2). Hector Armando Guevara was responsible for collecting these soil samples.

Horizontal provenience control was maintained by extending the site-wide metric grid into the Operation 8 area. A local elevation datum was established to maintain vertical control. The arbitrary site elevation datum of 100.00 has a real elevation of 447.15 meters above mean sea level. Provenience records, notes, drawings and photographs were made of architectectural and artifactual features during the course of excavations. A catalog of collected specimens, including artifacts, organic materials, and soil and other samples, was maintained concurrently. The materials are labelled as follows: 295-8-specimen number, with 295 referring to the site, 8 to the operation, and the final sequential number to the specimen.

Numerous people assisted with documentation and other tasks, including Karen Kievit, Hector Armando Guevara, Arturo Moises Guevara, Robin de Lugan, Evelin Guadalupe Sanchez, Rodolfo Francisco Molina, Mark Fenn, Valerie Connor, Frank Saul, Julie Saul, Ben Connor, Brian McKee, and Payson D. Sheets. Victor Manuel Murcia, site conservator, assisted with advice and recommendations for promoting structure conservation. The investigations were financed by grants to Payson D. Sheets (principal investigator) from the University of Colorado and the National Science Foundation, and a Fulbright Research Fellowship and Academic Specialist Grant to Andrea Gerstle (the latter for David Lentz's paleoethnobotanical research), and supported by the following Salvadoran governmental and non-governmental organizations: CONCULTURA, Patrimonio Nacional, Patrimonio Cultural, and Patronato pro-Patrimonio Cultural.

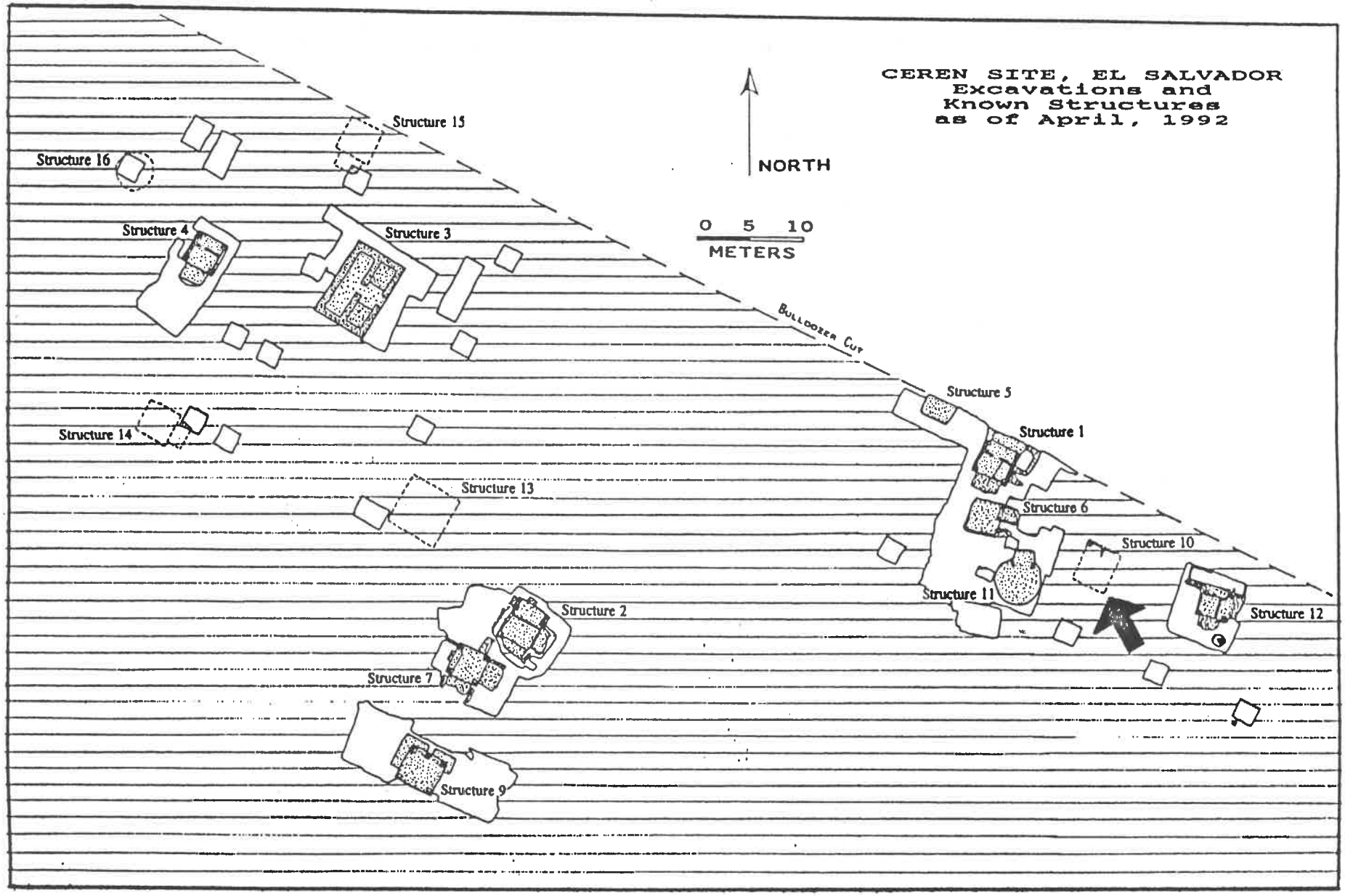


Figure 1. Location of Structure 10

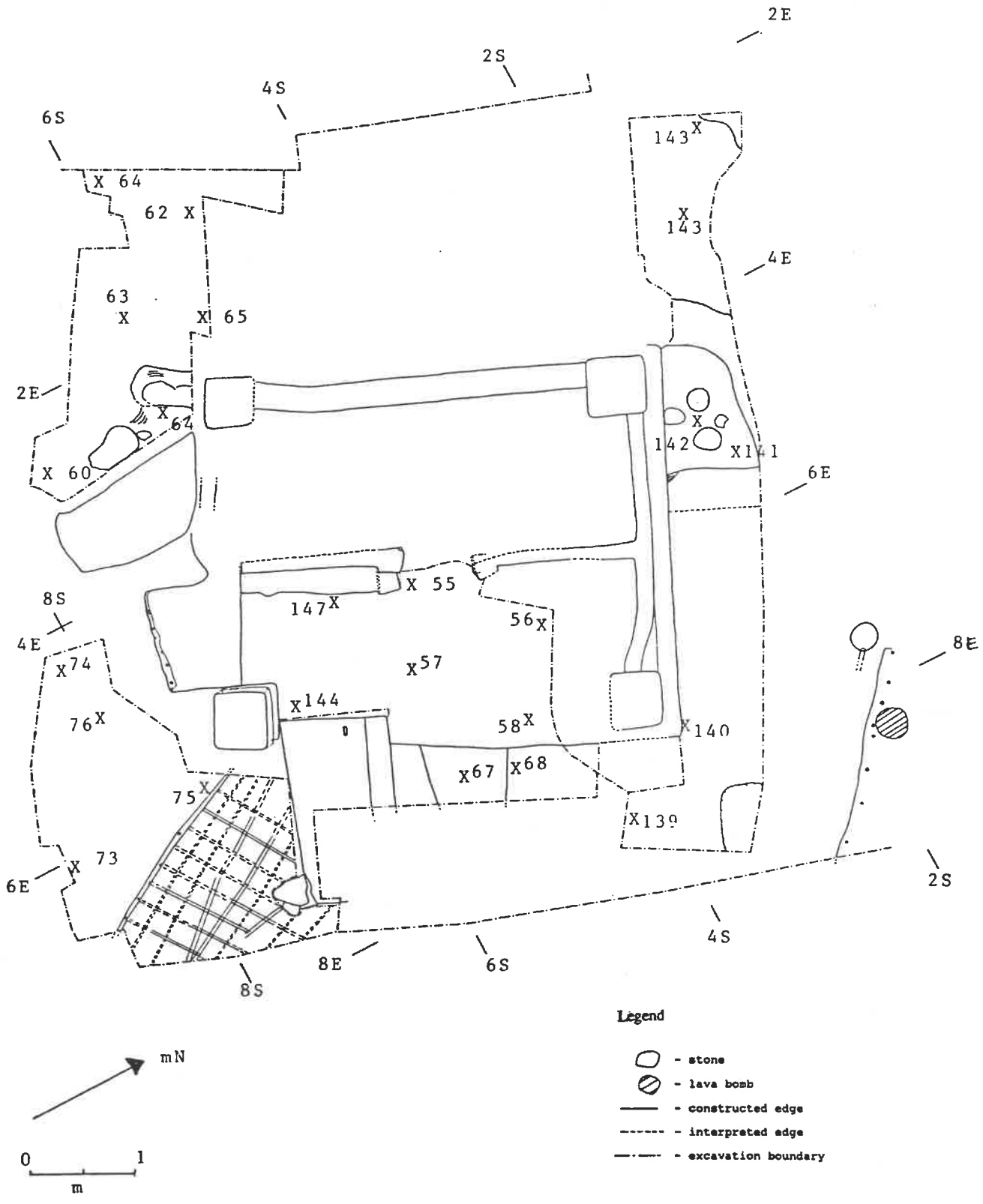


Figure 2. Structure 10: Locations of Soil/Pollen Samples

The excavation results are presented in the remainder of this report. The architecture and permanent features are described first, followed by the artifacts and other portable materials. Brief comparative and interpretive comments on the form and function of the structure, especially as it relates to other structures nearby, are included. These comments are based on incomplete data and should be taken as tentative; conclusive results await completion of the excavation and further laboratory and data analysis.

Architecture

Structure 10 (Figure 3) is a two-room wattle-and-daub, or *bajareque*, structure with a thatch roof, erected on a platform about 3.7 m square. Maximum exposed height of the structure is about 2.2 m. The structure is oriented about 22-24 degrees E of magnetic N and has its entrance on the east side. To facilitate description, the structure is considered in four parts: 1) the substructure and associated features; 2) the superstructure including columns, walls, and rooms; 3) the roof; and 4) surrounding areas. Observations on construction techiques and the preservative and destructive effects of the volcanic eruption are included here; artifacts and other materials are described in the following section.

Substructure

The substructure is an elevated square platform measuring 3.7 m on a side. Maximum observed platform height was 70 cm at the NW corner, where only a thin clay paving abutted the structure. At the NE corner, the platform projected 49 cm above the adjacent elevated clay paving. The platform was not exposed on the south or east sides.

The vertical and horizontal surfaces of the platform were smooth and the edges were straight and just slightly rounded. A thin (.5-1 cm) layer of finishing clay had been applied to all surfaces. In some areas where this finish was damaged by the heat of the volcanic explosion and is cracking and peeling, the clay core is exposed; it is also smoothly finished. The interior fill of the platform itself was not observed.

Superstructure

Solid clay columns and *bajareque* walls define the two-room superstructure. These were placed on top of the platform and inset approximately 16 cm from each edge, creating a narrow ledge around the building (exposed only on the north side but probably present on the west and south sides as well). Irregularities in ledge width, which currently varies between 12-16 cm, are due to blistering of the surface finish on the platform and walls from the volcanic explosion.

Four columns, one at each corner of the structure, are connected by *bajareque* walls on the south, west and north sides. A wall encloses the southern part of the east side; the northern part is open for structure access. An interior dividing wall with a centered doorway separates the east and west rooms.

Columns and walls were erected as separate units and are not structurally integrated. The exterior wall faces are aligned with the exterior column faces, and these surfaces along with the joins were coated with a smooth finish layer of clay less than 1 cm thick.

Columns

Four columns were placed on the platform, one at each corner. These are large, measuring approximately 50 x 50 cm in section, and up to 1.47 in height (Table 1). They are not decorated. The two western columns are broken; the NW column was damaged by heavy equipment and the SW column may have been broken off by the force of the volcanic explosion. The two eastern columns are fractured but complete and the tops of both were probably modified to accept E-W oriented wooden roof beams. The top of the NE column is exceptionally well preserved. Its top is flat and the beam it supported was incorporated into its upper interior corner rather than resting on top of the column.

The broken surface of the SE column yielded good evidence of the column manufacturing technique (Kievit 1992). The horizontal breakage pattern along with finger and

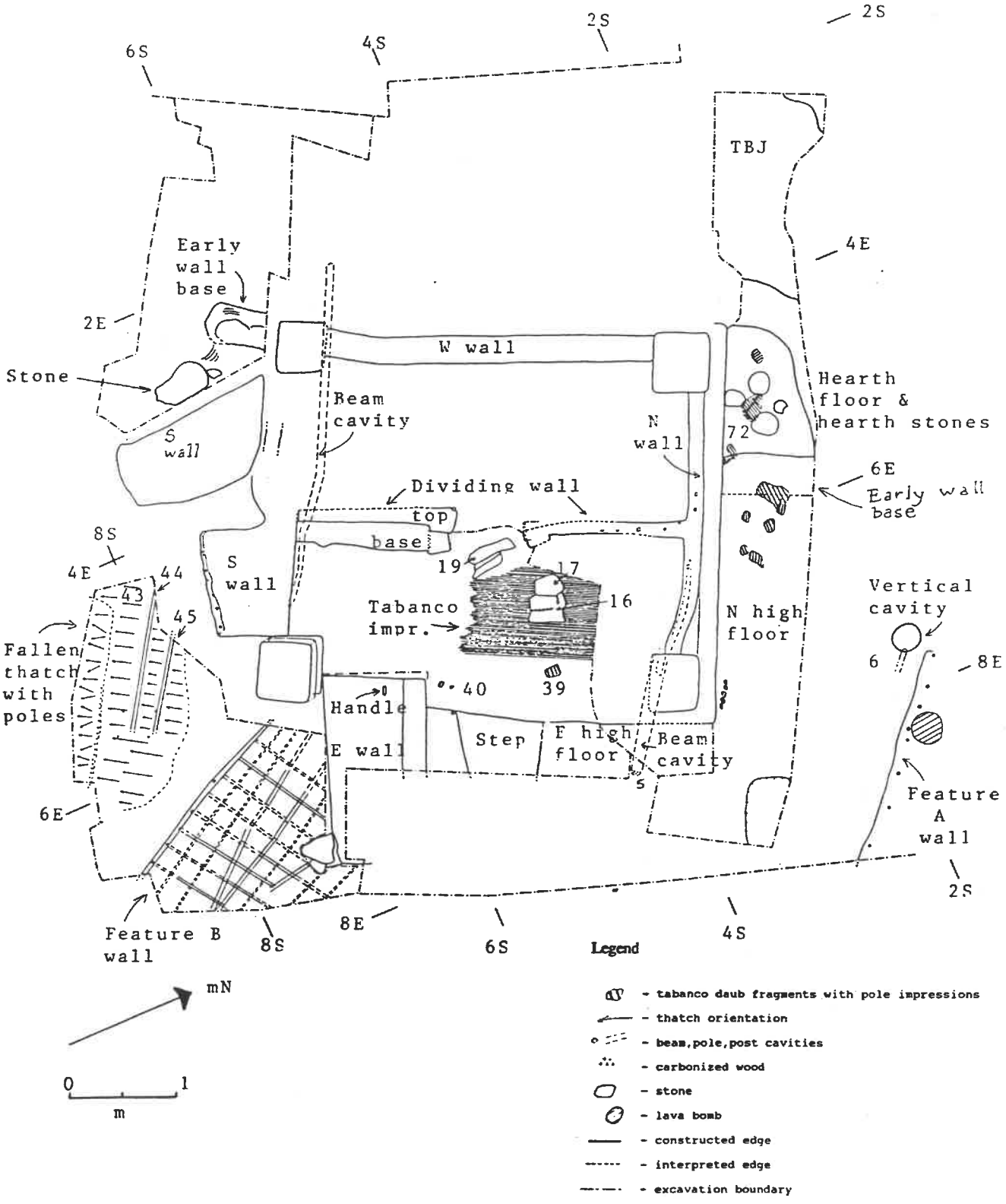


Figure 3. Structure 10: Architectural Features

knuckle impressions indicate that the columns were molded in layers by hand, using the puddled adobe technique.

The two southern columns are fractured at the point where they are abutted by tephra Units 4 and 5. Unit 5, a "pyroclastic-flow and (or) pyroclastic-surge deposit" (Miller 1989:10) apparently arrived with enough force to snap the unsupported southern columns (the northern columns were supported by the accumulation of Units 3 and 4 tephra behind them). The top part of the SW column probably fell to the south of the structure: it has not been recovered yet. The top part of the SE column was displaced only a few cm and remains standing but tipped. This column may have been jolted by a large lava bomb that landed less than a meter to its NW during tephra Unit 4 or 5 emplacement.

Table 1. Str 10 column dimensions.

	Width N-S	Width E-W	Maximum Height
Northwest:	53 cm	51 cm	n/a
Southwest:	49 cm	51 cm	n/a
Northeast:	50 cm	4 cm	1.47 m
Southeast:	53 cm	46 cm	1.46 m (tilted)

Walls

All of the superstructure walls are of *bajareque*. The north wall is close to vertical and well-preserved except for machinery damage to the top of the west end and cracking and displacement at the top of the east end. The west wall remains vertical although the top was removed by heavy machinery; it has not been exposed. The south wall collapsed outward to the south in several pieces. The east wall also fell outward to the east; it is cracked and bowed but intact. The interior dividing wall is still standing; it has a centered doorway connecting the front (E) and back (W) rooms. On the S and N sides of the doorway, it is tilted to the E and W respectively. The E face of the S half is badly blistered and peeling as a result of the volcanic eruption. Table 2 presents the thicknesses and preserved heights of each of the walls above the platform.

Table 2. Str 10 wall thicknesses.

	Thickness	Preserved Height
North wall	15 cm	1.52 m incomplete
West wall	16-17 cm	Unknown
South wall	15-16 cm	Unknown
East wall	15-18 cm	1.76 cm complete
Interior Dividing wall	10 cm	1.44 cm incomplete

North Wall. The north structure wall was exposed for its entire length along its exterior (N) face. Cavities of some of the vertical poles of its internal framework were exposed along the walltop. These are approximately 2-4 cm in diameter and spaced approximately 15 cm apart. Not all of the cavities have been exposed, so the regularity of this spacing is still unknown.

Horizontal pole cavities were invisible. The exterior face of the wall is coated with a thin layer of smooth clay that also covers the joints with the NE and NW columns, which it abuts.

The upper part of the wall was modified to receive a beam crossing from E to W. This beam was inset into the upper interior edge of the NE column and probably also the NW column. It extended at least 60 cm beyond (east of) the NE column on the front side of the building. Between the columns, the beam was incorporated into the top of the wall and coated with clay to form an interior cornice. A relatively thick layer of clay on top of the beam raised the wall top about 5 cm above the top of the NE column. As reconstructed from the preserved beam cavity in and W of the NE column, the height of the cornice was approximately 15 cm and its projection from the interior wall face at least 10 cm. The vertical poles extended upward on the outside of the beam for an unknown distance.

West Wall. The west wall has not been exposed except along the machine-damaged upper edge, which exposed some of the vertical pole cavities in the wall. These are up to 22 cm apart and 3-4 cm in diameter. The horizontal pole cavities are not visible. The conformation of the wall top is unknown.

South Wall. The south wall is severely fragmented and has fallen outward (south) in several sections. The eastern section is tilted to the south and covered with upper Unit 3 and later tephra. The upper part of the western section broke early in Unit 3 emplacement and is lying to the south of the building in lower Unit 3 tephra.

In the eastern section, the vertical pole cavities are preserved in a 95 cm length of wall. The majority of the poles were 3 cm in diameter, with a few being 2 or 4 cm in diameter. Spacing was irregular and ranged from 4 cm to 15 cm. The majority were spaced approximately every 10-13 cm. The arrangement of horizontal poles is unknown; no cavities are visible in the wall end that separated from the SE column.

A beam ran E-W between the two southern columns; it fell against the interior side of the SW column. It is best preserved in the form of a cavity and some carbonized wood along its western half, where it is about 7 cm in diameter. Assuming that the beam was not shifted longitudinally, it probably extended about 55-60 cm beyond the SW column.

The top edge of the fallen south wall is too damaged to determine if the beam was encased in clay to form a cornice along its upper interior edge. However, assuming symmetry with the north side, it probably did have a cornice. Likewise, the southern columns were probably modified to recieve the beam on their interior upper edges, in the same manner as on the north side.

East Wall. The east wall fell outward (east) early in the Unit 3 tephra emplacement. Although cracked and bowed, it is relatively intact. The base of the wall is resting on the platform surface; apparently the wall broke off at or near the base, flipped up, and covered its own attachment area on the platform. The upward-facing basal part of the interior wall face, the entire southern edge up to the wall top, and a south-projecting extension at the top of the wall was exposed.

The wall is 95 cm long, extending N from the SE column. The opening that is the structure entrance between this wall and the NE column is 2.15 m wide. This short facade wall is more than 20 cm higher than the north structure wall and about 30 cm higher than the eastern columns because of an added section at the top that hooks over the SE column. Although no direct evidence was observed, this upper portion may have concealed a roof beam or been molded into a cornice.

The N end of the wall has a vertical pilaster on its interior surface. This pilaster is carefully squared and smoothed. It is 23-25 cm wide, with a projection of 8 cm near the base and 10 cm about 60 cm up.

A broken jar handle was embedded in the interior wall face about 14 cm from its base and 37 cm from the jamb edge (12 cm from the pilaster). The handle is about 9 cm long and 2.5 cm wide and oriented vertically. A worn zone on the pilaster at the same height suggests

that the handle was used to secure a cord that crossed the pilaster, probably part of a door arrangement. Given the lack of an opposite door jamb, the door must have been fixed to the NE column, which has not been exposed on its south or east side.

There was no sign of paint or other decoration on the exposed portions of the wall. The spacing and size of the internal pole framework of this wall are unknown, as are the characteristics of the exterior wall face and wall top.

Interior Dividing Wall. The interior dividing wall is thinner than other walls by several centimenters. Its top edges are crumbled due to impact from lava bombs and tephra emplacement. A doorway is centered in the wall. Aside from the top edges of both wall halves, only the east face of the southern half was exposed. Because dimensions on the two wall halves are symmetrical, other attributes are also assumed to be symmetrical.

The northern and southern parts of the divider wall are each 1.35 m long. The doorway, 68 cm wide, is framed with molded pilasters. The south pilaster varies in width from 20-21 cm at the base to 18 cm at the top, and projects 4-6 cm from the east face of the wall.

Probably a N-S oriented beam resting on the north and south structure walls formed the top of the dividing wall and lintel of the doorway and was covered with clay to form a molded cornice. Fallen pieces of the upper north jamb (295-8-16, 17) include part of this horizontal cornice; it projects 8-10 cm from the wall face and 4-5 cm beyond the pilaster face. The height of the cornice and door lintel is unknown, but was more than 1.3 m above the floor. Probably it was around 1.45-1.55 m above the floor if the beam was resting on the north and south walls.

The east face of the divider walls, pilasters, and cornices were coated with a thin (less than 1 cm) layer of finishing clay. These surfaces were covered with red paint. On the pilasters only, this red paint was then covered with a soft white paint, at least on their lower portions. The white paint coated all corners and sides of the pilasters but does not extend onto the wall face. Both layers of paint were severely damaged by the volcanic explosion, as was the thin layer of finishing clay. A paint sample (295-8-4) was collected for material identification.

The vertical pole cavities in the dividing wall were exposed along the damaged wall tops; these are between 15 and 25 cm apart and have diameters around 3-4 cm. The horizontal pole configuration is unknown. The south end of the dividing wall is smooth and flat; it abutted the south structure wall without any structural integration. Cavities of the horizontal poles were not visible.

Rooms and Room Features

Two rooms are present on the platform: the east (front) room and the west (back) room. The entrance to the front room is on the east. The back room is accessible only through the front room, via the doorway in the dividing wall.

East Room. The east (front) room measures 3.3 m N-S x ca 1.25 m E-W (east facade wall to dividing wall). The NE and SE columns project into the room about 32-34 cm at each of these two corners. Within the wall alignments, floor area is about 4.13 sq m. Additional floor area is provided by the absence of half of the east facade wall; this adds a strip about .25 x 1.7 m to the floor area. Total floor area is about 4.55 sq m.

The entrance to the east room is a wide space between the short east facade wall attached to the SE column, and the NE column. This space is 1.7 m wide; it may be considered a wide doorway, given the evidence of a fixture to secure a curtain or door (see East Wall above).

An adobe block step is located in front of this opening, although not centered with respect to it or to the structure. This step is described and discussed below in the section on Surrounding Areas: East Side.

Elevated Shelf (Tabanco). The east room probably had an elevated shelf, or *tabanco*, at least in its northern portion. Although none of it was preserved in its original location, it fell

very early during the emplacement of Unit 1 tephra, leaving its impression in the fine ash directly covering the room floor.

The shelf was made of small poles (1.5-2.5 cm diameter) laid parallel and adjacent to each other and tied together with string. Inside the room, the poles were apparently bare. Its north extension outside the room may have been covered with clay daub.

The impressions of the shelf in the Unit 1 ash are well-preserved in the northern half of the east room, extending as far south as the north end of the east facade wall. The poles were oriented N-S. The easternmost pole impression is about 58 cm from the platform edge. The shelf was probably at least as high as the walltops - otherwise the entrance would have been blocked - and was probably supported on the walltops and/or high beams. The tops of walls surrounding the shelf area are too damaged to retain evidence of pole impressions.

It seems unlikely that the shelf extended all the way to the south wall. If it did, it would have been almost completely inaccessible except by reaching over the dividing wall from the back room. No impressions of fallen shelf poles were found in the south half of the room, although this area was severely disturbed by multiple volcanic bombs. Several large fallen beam fragments were found in the central room area; one of these may have supported the south end of the shelf.

If the shelf extended only as far south as the edge of the front doorway and was supported on an E-W beam crossing the room from the front facade wall, then access to it would have been from the south part of the room. Many of the items that fell into the S half of the room were probably located on that end of the shelf.

It is highly likely that the shelf extended northward beyond the north room wall. Outside this area, the poles were apparently coated with wet-laid clay to provide a smooth solid surface; fragments of these were found primarily outside the structure, although a few were found inside the north end of the room . Many vessels probably stored on this shelf extension fell outside the structure.

West Room. Only the tops of the walls defining the west or back room have been exposed. The room dimensions are 3.3 m N-W x 1.48 m E-W. Total room area is about 4.9 sq m, slightly larger than the front room. The SW and NW columns project into the room about 32-34 cm in their respective corners.

Elevated Shelf (Tabanco). A *tabanco* may have spanned this room. On the north side of the structure adjacent to the room, abundant fragments of fallen daub with parallel pole impressions were found in Unit 2/lower Unit 3 tephra. These fragments were several cm thick, with a smooth surface on one side and, on the other side, impressions of adjacent poles 1.5-2.5 cm in diameter. One fragment (295-8-72) also retained the impression of the string binding the poles together. The daub fragments are concentrated within 1 m of the platform, so the shelf probably extended no more than that distance from the structure.

Future excavation will provide information on other architectural features such as benches, embedded jar handles, wall decoration, and others.

Roof

Str 10 was roofed with thatch, apparently grass or tule. It collapsed in the early Unit 3 phase of the eruption. In addition to uncarbonized and carbonized thatch, some pole and beam elements of the roof support framework were preserved either in carbonized form or as hollow cavities.

Roof Elements. The roof thatch was found in all excavated areas inside the structure as well as around its exterior. The thatch was generally preserved in uncarbonized form, but in many areas both inside and outside the structure, the lower surface of the thatch layer was charred or carbonized. This is probably because wood underneath the thatch (beams and rafters) was ignited prior to the actual collapse of the roof. Presumably, continued ash fall doused the fire

before it consumed all of the thatch, which may also have been moist from rainfall at the time of the eruption (see Gerstle 1992 for comments on seasonality).

Under the layer of fallen roof thatch, many of the wooden elements of the roof support structure were preserved. East-west oriented beams that were inserted into the clay columns were preserved near the columns. These apparently projected at least 55-60 cm beyond the columns on the east and west sides of the structure (see above) and may have been about 4.3 m long originally. The southern beam, about 7 cm in diameter, was preserved for about 3.1 m. The northern beam was probably 12-14 cm in diameter; over 2 m of its cavity was preserved.

Many fallen pole and beam fragments were recovered inside the east room and along the north side of the structure. These range from 2-14 cm in diameter and up to 2 m in length. The longest pieces (four pieces with 1-2 m of preserved length) were found along the north side of the structure, oriented approximately parallel to it, and were 4 cm or more in diameter.

Off the NW corner of the structure, one beam cavity with a 10 cm diameter and oriented N-S was located about 1.1 m NW of the structure. All fallen thatch was east of the N-S beam, and all of the fallen beam cavities seen along the N side of the structure were also to the E of this N-S oriented beam. Likely, the N-S beam indicates the W limit of the roofed area.

Inside the E room, the majority of wood pieces were small-diameter sticks, although some pieces were up to 14 cm in diameter. These thicker pieces were concentrated in the central part of the room and may have helped to support the *tabanco* located there (see above). In one area, three carbonized sticks with similar 3-cm diameters were found in a relationship suggesting their original association: they were parallel to each other and separated by about 1 cm. These were probably poles tied to the rafters.

On the south side of the structure, excavations adjacent to the structure were impossible because of the tipped and fallen south wall. However, south of the fallen wall near the SE structure corner, an extraordinarily well-preserved segment of roof was exposed in a 1.1 x 2 m area. The roof segment is embedded in lower Unit 3 ash and consists of several layers of thatch and their associated rafters. Total thickness of the deposit is less than 10 cm.

The lowest thatch layer is unburned and also somewhat disorganized in that the fibers are not consistently aligned. Immediately above this is a thin layer of burned thatch. The highest layer of thatch is unburned and highly consistent in N-S orientation. This is topped by two still-attached rafter poles, also unburned and consistently oriented E-W. There is no sign of poles or beams in or below the lower two thatch layers.

It seems likely that the lowest two thatch layers originated from one segment of roof and that the upper thatch layer and poles originated from another segment. Probably an entire section of roof was folded and flipped over; the two attached poles currently on top of the thatch were originally underneath it.

The two poles are approximately parallel to each other and are separated by 16-19 cm. They are 3.5-4 cm in diameter; up to 1.4 m of their length was exposed. They are perpendicular to the orientation of the thatch. Because of their unburned condition, the very fibrous wood of the poles was very fragile. Some possible pieces of binding fiber, possibly vine, bark, or string, were associated with the poles.

The layer of thatch, in addition to its very consistent orientation, exhibited a bunching pattern, with each "bunch" or bundle about 13-15 cm wide. The bundles were adjacent, but are identifiable from the surface topography of the layer. In some areas, the bundles merged and the division between them was unclear. These bundles probably reflect the method used for binding the thatch to the rafters: the cord was passed through the thatch for attachment to the rafter pole every 13-15 cm.

Total Roofed Area. Total roofed area is difficult to calculate given the limited excavations conducted around the structure and the apparently violent detachment of the roof from the structure. On the N and E sides of the structure, only 90 cm or less of the surrounding ground surface was exposed; these areas are clean, paved, and well-trodden and were undoubtedly roofed. On the south side of the structure, excavation reached up to 1.5 m from the platform,

but relatively little area was exposed and no obvious driplines or other floor features were exposed that would indicate the location of the roof edge. The west side of the structure was not cleared. However, at the NW corner of the structure, the paved clay surface begins a sharp slope down about 75 cm west of the platform corner, suggesting that the roof edge was about that far from the platform on the west side. The fallen roof beams suggest that it may have extended more than 1 m.

Assuming that the roof extended at least 90 cm beyond the platform on the north and south sides of the structure, and at least 75 cm beyond the platform on the west and east sides of the structure, minimal total roofed area would have been 28.6 sq m (5.5 m N-S x 5.2 m E-W). Very likely the roof extension on all sides was greater.

Total platform area was about 13.7 sq m, leaving at least 14.7 sq m of roofed area outside the structure. Interior room space totals 9.45 sq m. Clearly, roofed area outside the structure was larger than the roofed area inside the structure.

Surrounding Areas

As noted above, excavation outside of Str 10 was confined to narrow strips on the north, east and south sides of the structure. Deposits on the west side of the structure were not excavated below Unit 3 tephra. Clay-paved floors and a hearth were found along the north side of the structure. On the east side, a step was exposed. Two *bajareque* walls were discovered, one at the SE corner of the structure and the other to the NE of the structure. Clay paving and other features were exposed on the south side of the structure.

North Side. A narrow (90 cm wide) trench 6.9 m long exposed the entire north side of the structure. It extended 2.1 m west of the NW platform corner and 1.1 east of the NE platform corner. Several different floors and features were exposed within this area, including a high clay floor edge edged by a possible early wall base, a lower clay floor with a hearth, and the TBJ ground surface.

High Clay Floor. The platform is abutted on its N and E sides by a smooth raised clay paving. The W edge of the paving is located 2.5 m west of the platform NE corner. Other limits of the pavement were not exposed, although it does extend at least 90 cm N and 1.1 m E of the platform.

The W edge of the raised clay paving is marked by a 26-28 cm high step, the edge of which is perpendicular to the platform. The upper edge of the step adjacent to the platform is eroded as if from foot traffic, similar to the front terrace of Str 3 (Gerstle 1989). The raised floor is not perfectly horizontal, but slopes slightly down to the east. Near the NE platform corner, the floor is approximately 10 cm lower than at its W edge. Approximately .9-1.2 m NE of the NE platform corner, the floor dips another 4-5 cm lower; this irregular rounded depression was only partially exposed. On the E side of the platform, the floor level is 3-4 cm lower than on the N side.

Possible Early Wall Base. At the W end of the raised floor, a ridge 36 cm wide is 5-6 cm higher than the same floor farther to the E. The E edge of this ridge is straight and parallel to the W edge, and is rounded in section. This ridge suggests the presence of an earlier free-standing wall abutting the N side of the platform. The raised floor level may have been created by infilling to the E of the low wall. The infilling was approximately level with the top of the wall, but differential settling or compaction left the top edge of the wall visible. The original height of the wall is unknown, but possibly it was a low wall base for a higher perishable wall. This wall base would have been as high as the step it later formed: 26-28 cm high. A similar feature was discovered in front of Str 4 (Gerstle 1992).

Low Clay Floor and Hearth. Adjacent to the NE corner of the platform, a lower-level clay floor is present. It measures ca 1.15 m E-W x 60-85 cm N-S. This paving extends from the NE corner of the platform E to the higher paving/wall base. Its west and north edges are

rounded and irregular, bounded slopes rather than vertical edges. Despite this, the floor is well-defined and carefully prepared. It is smooth and horizontal (only 1 cm variation) except for a rise of 4 cm adjacent the step/wall that defines its eastern edge.

This lower clay floor supported a hearth. Three large stones and a smaller fourth stone were placed on this floor to support a cooking vessel (see section on Artifacts below). They are unmodified roughly spherical river cobbles (the fourth smaller stone is broken). The three larger stones are 16-25 cm in diameter and are placed 10-16 cm apart from each other. One stone was adjacent to the platform wall. The area between the stones contained carbonized wood and ash (295-8-141). The smaller broken stone is about 13 cm in diameter and slightly off to one side. Near it and outside the hearth proper, the floor was stained with probable wood ash.

The area immediately surrounding the W and N sides of the paved hearth floor is a sloping clay surface, somewhat irregular in configuration. Very little of it was exposed to the N. On the W, it slopes down 18 cm over a distance of 40 cm.

TBJ Ground Surface. West of the hearth floor, the ground surface is unpaved TBJ. It continues to slope down the W for another 35-50 cm beyond the clay paving (20 cm drop-off), then becomes flatter (total drop-off is 30 cm over a distance of 1.7 m). The edge of the sloping clay is irregular and clay fragments and stains are present on the nearby TBJ, as if introduced by erosion and foot traffic. The TBJ surface is smooth and compacted, and connects smoothly with the TBJ ground surface in front of the Household 1 kitchen (Str 11) and storehouse (Str 6) (see Sheets and McKee 1989,1990).

In the extreme NW corner of the trench, about 2.15 m from the NW platform corner, a small part of a raised surface of TBJ was exposed. This surface is approximately horizontal and about 5-6 cm higher than the surrounding TBJ ground surface. The short exposed edge is irregular in plan but fairly abrupt in section.

East Side. On the E side of the structure, an area 50-60 cm wide E-W and about 1.8 m long N-S was excavated to the N of the fallen facade wall. In this area, a clay surface was exposed, continuous with the high clay floor exposed around the NE corner and N side of the platform. The E limits of this clay floor are unknown, but it does extend at least 1.1 m E of the NE platform corner (see above).

Adobe Step. An irregular adobe step was discovered against the E side of the platform. Its north and south edges are not parallel to each other; the north edge is perpendicular to the platform but the south edge angles off to the NE. Adjacent to the platform, the step is about 82 cm wide N-S, but 50 cm out from the platform, it is only 65 cm wide N-S. The step is at least 50 cm wide E-W; its front edge has not yet been exposed. The exposed edges are straight in outline and rounded in section. The step appears to be solid adobe. It is unclear whether it was brought in as a block or manufactured in situ.

The surface of the step varies within 8 cm of horizontal; the NW corner is the highest and SE corner is the lowest. In general, the step surface adjacent to the platform is about 5 cm higher than the surface 50 cm away from the platform. Therefore, the height of the step is variable, ranging from 12 to 21 cm above the adjacent floor. From the step to the platform is a rise of approximately 30-32 cm.

In addition to having an irregular shape, the step is not centered with respect to the structure or with respect to the wide doorway opening. It is offset about 15 cm to the S with respect to the opening and about 32 cm to the N with respect to the structure.

A post cavity was exposed in the corner formed by the S step edge and E platform wall. This may have been a roof support post; it was about 3.5 cm in diameter and oriented vertically. No corresponding cavity was preserved on the N side of the step.

South Side. On the S side of the structure, irregular areas around the fallen S wall segments were excavated up to a maximum distance of 1.5 m from the structure. To the S of

the fallen E wall, the excavated area extended about 1.6 m E of the SE platform corner. Several features were exposed: a high clay-paved floor and a lower ground surface, a large cobble and projecting clay ridge feature near the SW structure corner, and a fallen *bajareque* wall near the SE structure corner (Feature B). Because the ground surface around the S side of the structure was not continuously exposed, it is more difficult to identify separate floors.

High Clay Floor. Near the SE structure corner, the ground surface appears to be a solid clay paving. In this area, it has the same elevation as the clay paved floor immediately S of the front step (see above). On the S side of the structure, the floor is not horizontal but slopes down from a high near the SE structure corner. In the approximately 1.6 m distance exposed to the SE of the structure, the floor level slopes down about 12 cm. The slope to the S is steeper, dropping about 18 cm in a distance of ca 1.6 m. To the W, the slope is steeper yet, dropping over 25 cm in a distance of 1.3 m, alongside the structure platform.

In the area S of the SE structure corner, there is no indication of a formal boundary to the high clay-paved floor. A formal boundary may exist more than 1.6 m S of the structure, or it may slope down and merge gently with the maintained ground surface farther south (Pit P-19; Gerstle 1992).

Near the SW structure corner, two floor levels are apparent. The higher floor here is probably continuous with the floor exposed near the SE structure corner and described above; its elevation is within 2 cm of that floor near the middle part of the platform. Apparently this floor paving is virtually horizontal adjacent to the W half of the platform (S side) but slopes upward farther to the E.

Possible Early Wall Base. The W limit of the high clay floor is defined by an irregular ridge of clay that was partly exposed near the SW platform corner. It is an elongated raised area, projecting S from the platform (probably about 60 cm long; this section of the platform itself was not exposed) and rising about 9 cm above the high paved floor. It has poorly defined rounded and irregular edges except for its E side, which is fairly straight and abrupt in section. The S end and W side of this ridge slope down in two parts and, although steep, do not exhibit finished edges or regular outlines. The upper surface is flat and approximately horizontal.

At its W end, the S edge of the high clay-paved floor may be defined by a large river cobble. Only about 28 cm separates this cobble from the S end of the clay ridge. This cobble is about 50 x 30 cm in area and its highest point is some 6 cm above the level of the high clay floor. The long "inner" (NE) side of the rock is more-or-less vertical and is abutted by the clay paving; the "outer" (SW) side slopes down more gradually. Between the clay ridge and the cobble, the clay slopes down from the level of paved floor on the north to the lower floor level on the S; it appears to be eroded from foot traffic.

Lower Ground Surface. A lower ground level was exposed near the SW structure corner, outside of the clay ridge and cobble that form the W boundary of the high clay-paved floor. Near the clay ridge and cobble, this ground level is about 14-19 cm lower than the high paved floor. Only about 50 cm of this lower floor was exposed to the S of the cobble; it slopes down as much as 13 cm in this distance. To the W, the slope is gentler, dipping 17 cm over a distance of 1.6 m from the clay ridge.

The lower ground level is stained with clay in the area near the structure. To the W, it becomes cleaner until it blends smoothly into the TBJ ground surface near the Household 1 kitchen (Str 11). The clay stains probably resulted from foot traffic off of the high clay-paved floor near the structure.

Features A and B. Features A and B are *bajareque* walls located outside Str 10 near its NE and SE corners respectively. Feature A, a standing wall, does not appear to be physically connected to Str 10 and may be part of another structure. Feature B, a collapsed wall, probably abutted the SE corner of Str 10, separating its E (front) and S sides.

Feature A: Standing Bajareque Wall. Feature A is a standing *bajareque* wall located about 2 m N of the NE corner of Str 10. About 2 m of the wall have been identified; its W end remains buried. The top of the wall is just barely covered by the top of Unit 3 tephra. The western part of the wall parallels the N side of Str 10 for about 1.0 m and extends at least 1 m farther E than Str 10. Only the top edge of the wall and the top few cm of its S face have been exposed. It may be part of a structure located to the NE of Str 10.

The extent to which the wall has been displaced is unknown; its original orientation may not parallel Str 10. A lava bomb (28 cm diameter) landed almost on top of the wall about 60 cm from its W end in Unit 4 tephra and may have displaced this end of the wall to the south. A large vertical cavity near its W end and a beam cavity running along its top edge were also discovered.

Nine vertical pole cavities were discovered along the 2 m length of exposed wall. These have diameters of 2.5-3 cm and are spaced 10-33 cm apart. Very likely, as-yet undiscovered pole cavities were located between the more widely spaced cavities. Several of these cavities were first exposed in Unit 6 tephra 5-7 cm above the *bajareque*. A tenth cavity of similar diameter and sub-vertical orientation was found in Unit 6 tephra about 25-30 cm above the wall and about 50 cm from its E end but does not appear to be continuous with any the of cavities exposed in the *bajareque*. It is also a few more cm to the south than the alignment of cavities in the wall. Wall thickness is not known.

Wall height can be estimated in a preliminary fashion. Assuming that the high clay paving adjacent to the NE corner of Str 10 continues as far N as the wall, then the *bajareque* wall is at least 1.2 m high and possibly higher.

The W end of the wall is about 10 cm N of a large diameter (24 cm) vertical cavity exposed at the top of the Unit 3 tephra. The cavity was formed either by an extremely large post or by a tree trunk. The latter seems more likely, given the presence of a smaller (3 cm diameter) tilted cavity exposed in the Unit 6 tephra 40 cm above that was linked to it, probably a branch. As yet, there is no link between the large vertical cavity and the wall that suggests a structural relationship.

A straight approximately horizontal cavity with some preserved wood in it (295-8-6) was found with its east end just above the large vertical cavity. It was in upper Unit 3/lower Unit 4 tephra, oriented parallel the wall. About 30 cm of the cavity was exposed but it continues at a downward slant to the E in Unit 3 tephra. It has a diameter of about 4 cm. It may be a broken branch or a beam from the wall fallen to the S.

Feature B: Collapsed Bajareque Wall. Feature B is a collapsed *bajareque* wall that projected SE from the SE corner of Str 10. It fell to the NE early during Unit 3 tephra emplacement. Shortly thereafter, the east structure wall fell outward on top of its upper part; less than 10 cm of lower Unit 3 tephra separate the two fallen walls. The SW face of the wall was partly uncovered along with some of its foundation where the wall broke off at ground level.

Four of the pole holes in the clay-paved ground surface are visible along the line of the wall foundation. These are about 2-3 cm in diameter and spaced 18-22 cm apart. The level at which the wall broke is 1-2 cm below the level of the clay-paved floor to its SW. Possibly the floor was repaved subsequent to wall construction, however it seems more likely that use-loosened clay simply accumulated against the base of the wall.

The exposed SW face of the fallen wall was damaged when the wall fell, revealing the framework of poles within the clay daub. The resistance of the interior poles caused most of the daub and smoothed facing clay to pop off when the wall fell. The vertical poles are spaced as indicated by the pole holes in the ground, without intervening poles. The horizontal poles were spaced closer together and more irregularly, with thinner poles used between thicker ones. These were placed on both sides of the vertical poles although apparently not woven into them. Probably they were tied.

Wall thickness can be estimated although no edge was exposed in section. Daub with a preserved surface adjacent to internal pole cavities indicates a half-thickness of 7-8 cm.

Assuming a similar thickness of daub on the opposite side of the pole cavity, the wall would have been about 16 cm thick.

The wall base itself was perfectly horizontal within 1.5 m of the Str 10 SE corner. In the 30 cm distance exposed beyond this, the wall base drops off in elevation as does the adjacent clay-paved surface. Clearly, the wall extended beyond the edge of the horizontal clay paving adjacent to the SE corner of the structure.

The Feature B wall was at least 2 m long and at least 1.5 m high. Complete dimensions are unknown because its SE end/edge and top edge remain buried. Its placement defines a S boundary of the entrance zone E of Str 10 and physically separates the front from the S side of the building.

Summary and Discussion of Architecture

Although only partially excavated, it is clear that Str 10 was a thatch-roof, two-room *bajareque* structure on an elevated platform. The front room was bench-less but had an high pole shelf, or *tabanco*. There were raised clay floors abutting the front and part of the sides of the structure. In these general characteristics and in size, it is similar to domestic structures found elsewhere in the site.

However, numerous features of Str 10 do not appear in any of the domestic structures excavated to date and the divergence suggests a non-domestic function. The features include the following: an orientation markedly different from 30-32 degrees E of magnetic N, especially thick columns and walls, a red and white-painted interior dividing wall, a centered doorway into the second room, a half-facade wall forming a wide off-set entrance, an off-center and irregular-shaped front step, and an exterior *bajareque* wall that partially encloses the area in front of the structure. Some of these features are unique to Str 10 and some appear only in special-use structures. They suggest a non-domestic function for the structure, although it is also possible that some domestic/residential activities took place there.

There are some interesting formal/stylistic similarities between Str 10 and Str 12, a special-use structure located immediately E of Str 10 (Sheets and Sheets 1990). These include the "odd" orientation, red and white wall paint, and walls defining the entrance area. Although these features are not identical in detail, they may constitute parallels of design and construction. Along with the proximity of these two structures, and the location of the Str 10 entrance facing Str 12, these similarities suggest that the two structures are part of a functional complex.

The centered doorway into the second room of Str 10 is reminiscent of Str 3, a large public/communal structure (Gerstle 1989). However, the outstanding differences between Str 3 and Str 10 suggest major functional differences as well. The architectural attributes that are unique to Str 10, such as its thick columns and *bajareque* walls and its wide off-set entrance arrangement, presumably relate to the function of the structure in some as-yet poorly understood manner.

Artifacts, Portable Features and Organic Materials

The description and discussion of the contents of Str 10 that follows is presented by area but these do not necessarily correspond to specific activity areas. In situ and fallen materials are briefly described for each area (Fig. 4, 5). M. Beaudry made all of the ceramic identifications presented here (Beaudry, personal communication 1992). Sheets (this volume) describes the chipped and ground stone artifacts. All items and locations are listed in the Operation 8 field specimen list.

The east room is the only excavated area inside the structure although some materials from the west room have been observed. Outside the structure, the areas correspond to excavation boundaries or changes in floor level. These exterior areas include: the north side low floor, north side hearth floor, north side high floor, east side high floor, and the floors adjacent to the southeast and southwest structure corners.

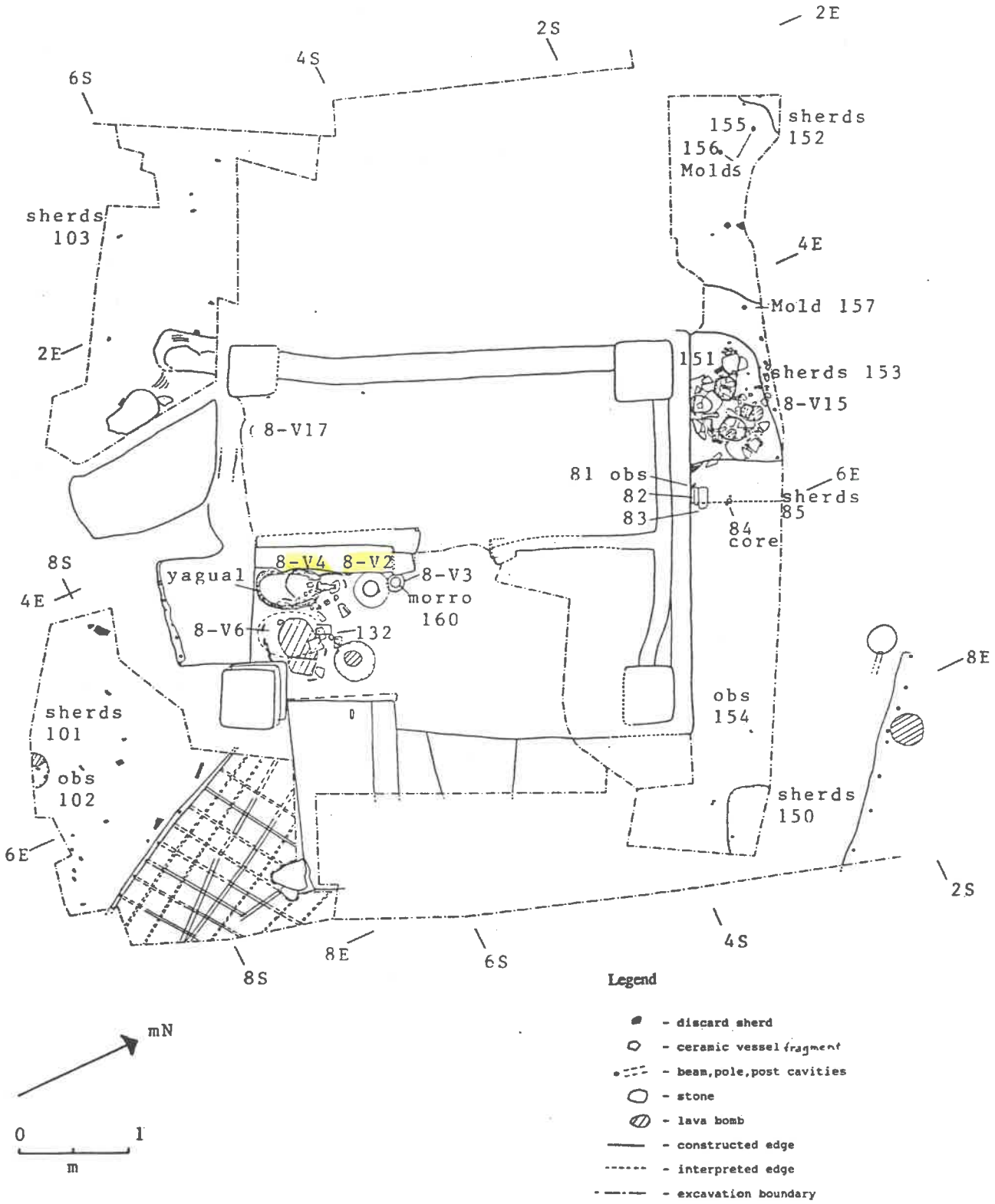


Figure 4. Structure 10: <u>In situ</u> Artifacts

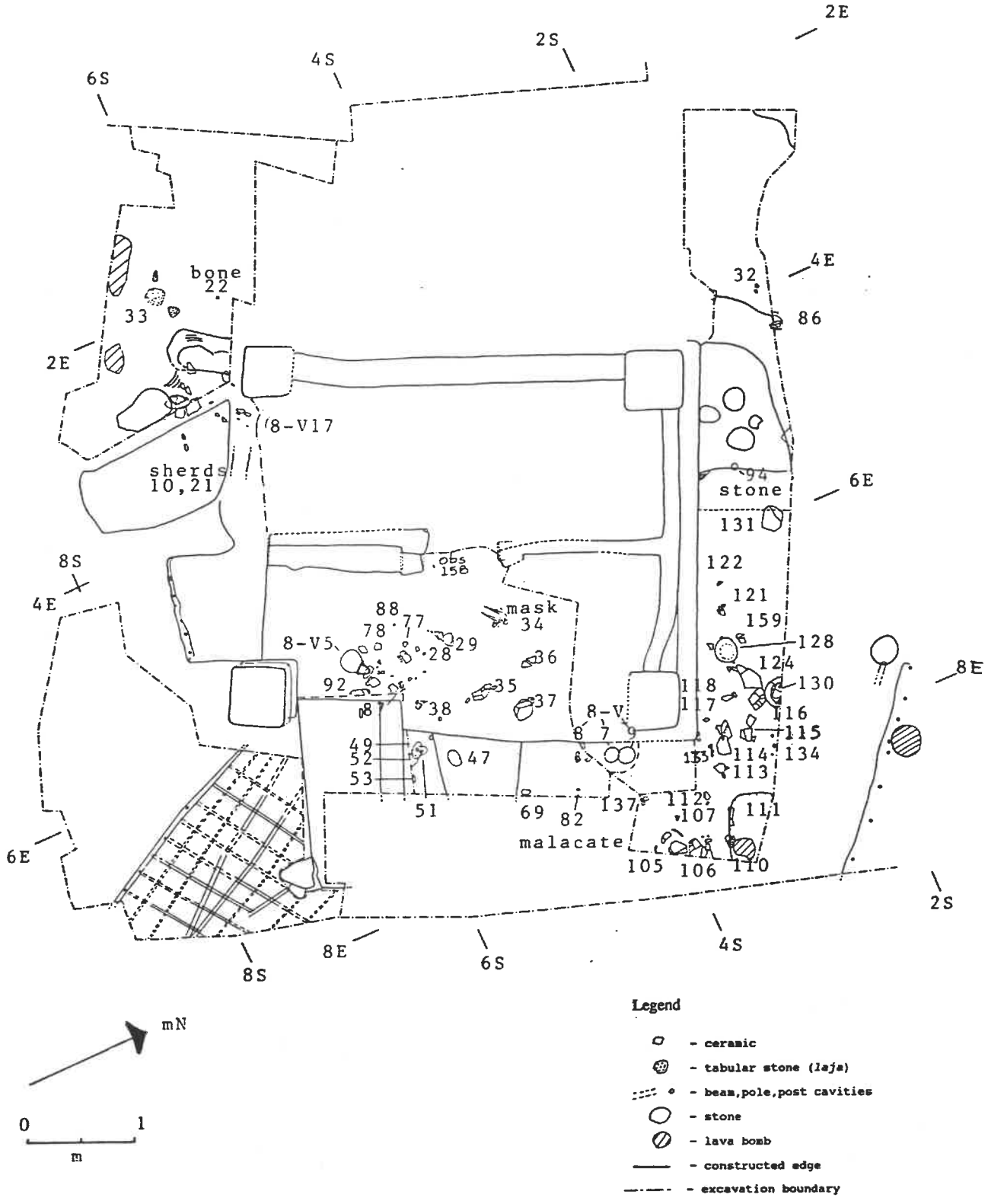


Figure 5. Structure 10: Fallen Artifacts

East Room

Numerous artifacts were found in the east room of Str 10. Some were in their original locations on the room floor; some had fallen from the *tabanco* that spanned at least the north part of the room.

In Situ Items

All of the items found in situ in the east room were in the south half of the room, including a painted calabash (*morro*) and four pottery vessels, one on an oval fiber ring pot-support (*yagual*). The four ceramic vessels include three jars and one ring-base. The *morro* is a bowl. All were placed against the south and west room walls, leaving the interior floor space unoccupied. The excavated north part of the room floor was clean but artifacts may remain in the volcanic ash left against the dividing wall and north structure wall.

In the southeast room corner was a large Guazapa jar (Vessel 8-V.6) with a ridged neck. It was severely damaged by a volcanic bomb that landed directly on it. No visible contents were preserved.

In the southwest room corner, resting on a *yagual*, was a large jar with a "caiman" modelled on its neck and upper body (Vessel 8-V.4). This was also badly damaged by the falling roof and volcanic bombs. This vessel was full of an as-yet unidentified seed, possibly achiote (295-8-120 to 123,127). Stains of some small bean-shaped seeds were present on the interior and exterior of the vessel, principally on its upper body and neck. These appear to be seeds fallen from some nearby location.

The *yagual* itself consists of uncarbonized fibers perserved around most of the circumference. In one well-preserved section, it is clear that the fibers were twisted as a mass. It is oval in form and rests on the floor in the SW corner of the room. Its long axis is parallel with the interior dividing wall, which it abuts. Its exterior dimensions are 46 x 35 cm. The interior opening is 35 x 25 cm. It was apparently not made for the round "caiman" vessel that rested on it at the time of the volcanic eruption. Possibly it was made originally for an oval or shoe-shaped vessel such as Vessel 8-V.10, found on the N side of the structure (see below). *Yaguales* of this shape are made today specifically for use with non-round vessels (R. Coca de Paz, personal communication).

Near the "caiman" jar and against the interior dividing wall was a somewhat smaller Guazapa dimple-base jar (Vessel 8-V.2; 295-8-79). Seeds were preserved inside this vessel (295-8-89,90); but the species is not yet identified.

The painted *morro* (295-8-160) was adjacent to the dimple-base jar and against the south door jamb of the dividing wall. The interior is painted plain red; the exterior has a multi-colored design (paint fragments: 295-8-18). Its rim was not preserved but maximum preserved diameter was 16 cm and maximum preserved height was about 4 cm.

An inverted ceramic ring base (Vessel 8-V.3) from a polychrome vessel was carefully placed exactly in the center of the *morro*. This ring base was clearly being recycled for use as a small cup-like vessel; it was trimmed to sit flat. No visible contents were preserved.

Fallen Items

Several items had fallen into the east room from original high locations, probably from the *tabanco*. These include an obsidian blade fragment, two ceramic vessels, and a deer-antler headdress or mask. Sherds from vessels fragmented and dispersed by volcanic bombs were also recovered.

The obsidian blade fragment (295-8-158) was found in the doorway between the front and back rooms, on Unit 1 volcanic ash. It probably fell together with the high *tabanco*, upon which it presumably had been placed.

One fallen vessel was a Guazapa wide-mouth jar with a handle that crossed the opening from rim to rim in basket-like fashion (Vessel 8-V.5). Small crude human effigy faces were modelled in the two places where the handle joins the rim. This vessel fell into the south half of the room and was almost undamaged. It probably had been resting on the high *tabanco* rather than being dislodged from a low location, as it was resting on top of Unit 1 ash and

above a Unit 2/3 volcanic bomb. A crusty residue inside the vessel (295-8-91) suggests that it had liquid contents.

The second vessel was a low-necked Guazapa jar that was badly broken and scattered throughout the room (Vessel 8-V.1), probably by the same lava bomb that broke the upper north half of the dividing wall and landed on Vessel 8-V.4, described above. The sherds were concentrated on and above Unit 1 ash. No vessel contents were identifiable.

The deer-antler headdress or mask (295-8-34) had fallen into the north half of the room near the north door jamb of the dividing wall. It was directly on top of Unit 1 ash with impressions of *tabanco* poles, and was covered with fragments of clay from the dividing wall and thatch and wood from the roof. Apparently it was resting on the *tabanco* and came down with it.

The headdress consists of a deer skull with both antlers still attached. The antlers are about 20 cm long and have two points each. The frontal and possibly some of the nasal bones of the skull are present but the maxilla has been removed as well as the mandible. Carbonized fragments of very thin single-strand twisted string (295-8-42) were preserved around the base of the antlers and traces of red paint and possibly white paint were present on the antlers and skull. This unusual artifact was badly fractured and is still undergoing cleaning and repair.

West Room

The west room of Str 10 was excavated only to the top of Unit 3 tephra, which fills the room almost to the level of the wall tops. Just inside the south wall of the room, a single Guazapa group jar (Vessel 8-V.17) was revealed from the side. It is buried in upper Unit 3 tephra. It is unclear whether it is in situ or displaced. The upper portion of the vessel was broken by a volcanic bomb; the sherds (295-8-21) were scattered in the upper Unit 3 ash above the fallen upper wall section and in the adjacent ash south of the vessel.

North Side Low Floor

The lowest floor exposed on the north side of the structure extends from the NW structure corner to the west and is a TBJ ground surface stained with clay from the paved floors to the east. About 1.5 square meters was exposed.

In Situ Items

The TBJ floor surface was fairly clean, with only a few sherds (295-8-152) and two small casts (295-8-155,156) recovered. A third small cast ((295-8-157) was recovered on the adjacent clay slope up to the mid-level hearth floor. The sherds were small and medium-sized (most less than 3 cm across, few up to 8 cm across) and pressed into the ground surface; they were probably trampled discards. The two casts on the low floor were on the TBJ; the third on the slope was embedded in the clay. At least one of these casts was a stripped corn cob.

Fallen Items

The majority of fallen materials found in this area were roofing materials, especially roof beams that had left cavities in the Unit 2/lower Unit 3 tephra units (see above). There were no fallen roofing materials or artifacts beyond about 1.1 m W of the structure.

A fallen and broken vessel (295-8-86; Vessel 8-V.14) was about 75 cm from the NW structure corner in Unit 2/lower Unit 3 tephra. It is a Suquiapa or Delirio recurved bowl; it must have fallen from the walltop or roof near the NW corner of the structure. Several sherds (295-8-32) were also recovered nearby from the same stratigraphic context; these may be from vessels that remain unexcavated.

North Side Hearth Floor

The north side hearth floor is a mid-level clay-paved surface about .5 sq m in area and irregularly shaped. Four cobbles form a hearth adjacent to the platform; carbonized wood and ash were on the floor among the stones. This floor is located against the north side of the platform near its back (NW) corner.

In Situ Items

An unusually large Guazapa jar (Vessel 8-V.15) was resting on the hearth stones. No visible contents were recovered from the jar.

A single small sherd (295-8-151) was recovered near the hearth on the flat floor; two other small sherds were located on the sloped edge of the clay floor. These sherds (295-8-152) had evidently been discarded and trampled into the floor.

Fallen Items

The in situ vessel on the hearth was broken by volcanic bombs, abundant fallen adobe fragments from the *tabanco* (see above), roofing timbers, and thatch. Among the debris in Unit 2 tephra was a small ovoid ball (9 x 7 cm) of unidentified white stone (295-8-94). It presumably fell with the *tabanco*, where it probably had been stored.

North Side High Floor

A high clay-paved floor wraps around the NE corner of the platform, extending approximately 2.5 m W from the NE platform corner. Numerous in situ and fallen items were found on and above this floor on the north side of the structure.

In Situ Items

Most in situ items on the floor were located within 35 cm of the western edge of the floor, over the postulated early wall base (see above) near the hearth. Three items were clustered together adjacent to the platform: an obsidian macroblade (295-8-81), a worked stone (295-8-82), and a *mano* (295-8-83). About 35 cm N of the platform, a conical flaked chert core (295-8-84) and two small sherds (295-8-85) were on the floor surface.

The obsidian macroblade was half embedded in the clay floor adjacent to the platform and the two sherds appear to have been trampled into the surface. They were probably discards. The other items were resting on the floor surface and may have been still-functioning tools, although it is unclear if they were found in their actual use-location.

An isolated obsidian blade (295-8-154), probably a discard, was pressed into the floor about 55 cm N of NE platform corner. No other in situ material was found in this area.

Fallen Items

Most of the fallen artifacts on the north side of the structure probably fell from the *tabanco* or roof that extended beyond the north wall of the front room (see above). In the hearth area, a white stone ball was recovered (see above).

Over the high paved floor, all fallen materials were ceramic vessels and sherds. At least five vessels were recovered along with a number of fragmented partial vessels and sherds. Many of the vessels were broken and scattered over a fairly large area and were collected in several lots. Table 3 lists the vessels by number along with their field specimen numbers, type identifications, and form.

All of the ceramics were in upper Unit 1/Unit 2 tephra, indicating that they fell early in the eruption sequence. Along the N side of the building outside the E room, adobe fragments with pole impressions from the *tabanco* were abundant both among and above the ceramics. Originally, the vessels were probably on the *tabanco* or hanging from the roof. These materials were completely covered with fallen roof thatch and timbers. This correlates well with the ash/artifact stratigraphy within the E room (see above).

The fallen vessels recovered to the E of the NE platform corner were located 45 cm or more from the building and had no associated *tabanco* daub fragments. In this area, the excavation exposed only about .3 sq m, located about .45-1.15 m E of the NE platform corner. These vessels may have been hung from the roof extension.

Table 3. Fallen ceramics over North Side High Floor.

Vessel 8-V.#	FS Nos. 295-8-#	Type	Form
10	105,106,114,137	Undetermined	Jar, shoe-shape
11	106,110,111,112,113, 114,117,133,150	Cashal Cream	Jar
12	114,115,116,118, 121,124	Guazapa Miltatlan variety	Open basin
13	130	Copador	Tripod plate
16	128	Undetermined	Open basin

East Side High Floor

The clay-paved floor on the east or front side of the structure is continuous with the N side clay floor. Two clusters of artifacts were recovered from this area. One cluster includes ceramic artifacts located against the E platform wall about .5-1 m north of the front step. The second cluster consists of stone artifacts associated with the step. Several small artifacts were found outside of these two clusters. All of the artifacts appear to have fallen or been dislodged from their original locations.

The cluster of ceramics north of the step consists of three whole vessels. These were found adjacent to each other, lined up against the E platform wall. All were resting on a thin (1-2 cm) layer of Unit 1 tephra; one was tipped and broken, one was inverted, and one was tipped. It is likely that they are not in their original positions, but it also appears that they did not move very far. Possibly they were on the platform surface and rolled off the edge. Table 4 lists these by vessel number, field specimen number, type, and form.

One small sherd (295-8-70) and a spindle whorl (295-8-71) were located within 30 cm of the southern-most vessel in the cluster and within 40 cm of the platform. A second small sherd (295-8-69) was found 10 cm N of the front step and 45 cm E of the platform. These were all in or on Unit 1 tephra, so must have fallen from a higher but unknown location.

Table 4. Ceramic cluster on East Side High Floor.

Vessel 8-V.#	FS No. 295-8-#	Type	Form	Position
8	135	Cashal Cream	Small jar	S-most, broken
7	138	Gualpopa	Recurved bowl	Center, inverted
9	145	Copador	Recurved bowl	N-most, tipped

The stone artifacts were clustered near the step and include three perforated or "donut" stones (295-8-47,49,51), one worked cobble (295-8-52), and one unworked cobble (295-8-53). One perforated stone (295-8-47) was found between layers of folded roof thatch above the step. The other stones were on the S side of the step, where an area only 20-30 cm wide was

excavated; all were within the Unit 2/lower Unit 3 strata and associated with fallen roofing material. One of the perforated stones on the S side of the step was on top of the other one. The upper stone (295-8-49) had carbonized wood (295-8-50) inside the perforation, possibly from a stick or pole inserted through it. The other two stones fell within 20 cm beyond them. It seems possible that they were on or hung from the roof and came down with it. They may have functioned as roof weights, perhaps sliding toward each other if the roof over the step came down first.

South Side, Southeast Corner

A *bajareque* wall (Feature B) abutted the southeast structure corner (see above). About 2 sq m of floor surface was exposed in the area SW of the wall.

In Situ Items

Twenty-three sherds (295-8-101) and one obsidian blade fragment (295-8-102) were found directly on the floor surface. Most of the sherds are small but some are up to 15 cm long. The larger sherds tend to be on the high flat surface; on the southern sloped portion of the floor, the sherds tend to be small. These are probably discards that accumulated in the area behind the Feature B wall.

Fallen Items

The major fallen item was the well-preserved segment of thatch roof, described above. Numerous fragments of fallen wall adobe were also present. No artifacts were found in the volcanic ash.

South Side, Southwest Corner

More than 2 sq m of the clay-paved floor was uncovered south and west the SW structure corner, including a possible wall base projecting south from the SW structure corner (see above).

In Situ Items

Seven sherds (295-8-103) were recovered from the floor surface to the west of the possible wall base. These were small (up to 6 cm long) and pressed into the surface. Presumably they were discards trampled from foot traffic.

Fallen Items

Numerous fragments of fallen wall adobe were present in Unit 2/lower Unit 3 volcanic ash. An apparently unworked bone fragment (295-8-22) was also found in lower Unit 3 ash near the SW structure corner W of the possible wall base. Sherds (295-8-21) from the jar (8-V.17) inside the west room fell out together with the south room wall and were scattered in upper Unit 3 ash just south of the vessel.

Summary and Discussion of Artifacts

Structure 10 contains an interesting assemblage and distribution of artifacts. In some respects the assemblage resembles a domestic assemblage but in others appears quite distinctive, more like the nearby special-use Str 12. These two structures each have a deer-antler mask or headdress, and some uncommon ceramic vessels.

Artifact Distribution and Context

The distribution of artifacts in Str 10 suggests that different areas were used for various activities. Some of the items were probably in storage, most obviously those that fell from high locations such as the *tabanco*, roof or wall tops. Inside the front room, these include the deer-antler mask or headdress, a jar, and an unusual basket-handle ceramic vessel. A spindle whorl and obsidian blade also may have been on the *tabanco* inside. Numerous vessels and a

small white stone were apparently in storage on the *tabanco* extension N of the structure or hanging from the roof extension NE of the structure.

It seems likely that the vessels located on the floor in the S half of the front room were in storage. Jars are often storage containers and two of the jars, including the "caiman" jar, contained seeds. The recycled ring base inside the *morro* presents a configuration that has no obvious functional association but would save storage space.

A jar visible in the W room of the structure also suggests potential storage in that less accessible back room.

No materials were found in the center of the N half of the front room, although only a small area has been excavated. Perhaps materials were kept against the walls, or else the space was kept clean. The three small vessels found slightly displaced against the front of the platform outside the N half of the room suggest no specific activity except possibly food or drink consumption. Given their location in an open and accessible area, it seems unlikely that they were in storage.

Some of the items in high original locations may have functioned in those positions. At least some of the perforated and other stones that fell on the E side of the structure may have been roof weights, a practice that is occassionally seen today on thatch-roof houses in Mesoamerica (David Tucker, personal communication). However, it is also possible that they were in storage near the structure entrance; at least one of the perforated stones had a stick through it, suggesting that it may have been leaning against the structure.

The large jar on the hearth against the N side of the structure was clearly in its use location. This vessel presumably was used to cook large quantities of some as-yet unknown food or drink. A stripped corn cob not too far from the hearth suggests intermittent food-processing activities in that area.

The assemblage of small tools near the hearth, particularly the *mano* and worked stone, and possibly also the flaked chert core, may represent a tool kit for some activity that took place near the hearth. The activity would not necessarily be related to food preparation, but perhaps the cook engaged in it while watching the pot.

Except for the hearth and associated jar and tools, and materials kept near the structure entrance, exterior roofed areas appear to have been primarily walkways rather than activity areas. Small ceramic and obsidian fragments were dispersed and trampled into these prepared clay floors, but they were otherwise kept clean.

Vessels

A total of 18 vessels (17 ceramic and one *morro*) was found. All of the ceramic vessels were analyzed by the project ceramicist (data here from M. Beaudry, personal communication, this volume) and some are currently being restored. No evidence of baskets, bags, or other organic containers was observed.

The majority of vessels were in storage contexts inside the structure (13; 72% or 14; 78%). Of the four vessels that may have been in active use, all were found outside the structure, but the group of three serving vessels may have been used in the N end of the front room. A large jar was in use on the exterior hearth.

Half of the vessels are jars (9; 50%). Six of them were in clear storage contexts, half on the floor of the front room and half in a high original location. A seventh jar in the back room may also be in a storage context. Most of these are Guazapa utilitarian jars in common sizes, but two are unusual. One of the three jars on the front room floor is modelled and painted with a caiman head and forelegs; this contained possible achiote seeds. One of the jars stored on high was an unusual shoe-shape. At least some of these jars were storage containers; other jars and the *morro* bowl and modified ring-base were apparently in storage themselves.

Of the two jars in use-locations, one was extremely large and was used as a cooking vessel on the hearth. The other was unusually small and associated with two recurved bowls; it may have been a serving vessel.

The other half of the vessel assemblage is made up of a variety of non-jar vessel forms, including two open basins, one basket-handle restricted-neck vessel, one tripod plate, three

recurved bowls, one modified ring-base, and one *morro* bowl. All except for two recurved bowls were in storage contexts, principally in high locations on the N *tabanco* extension or roof overhang. The basket-handle vessel, possibly with liquid contents, was kept on the *tabanco* or hung inside the room, and the ring-base and *morro* bowl were stored on the room floor.

Of the six vessels that fell to the N or NE of the structure and were probably stored on the N *tabanco* extension or NE roof extension, two were jars (one shoe-shaped), two were open basins, one was a recurved bowl, and one was a plate. No contents were observed in any of these vessels, although all broke and scattered when they fell, so original contents may have been lost. They may have been in storage themselves rather than being used to store contents. The high percentage of open vessels (4; 67%) supports this notion, assuming that these functioned primarily as serving vessels.

Tools

Various tools were recovered in and around the structure, including a spindle whorl, obsidian blades, a chert core, ground or pecked stone tools, and worked and unworked stones. These are described and interpreted above (see Sheets, this volume, for the stone artifacts).

Most of the obsidian pieces found were discards, although one piece was found in a probable storage context inside the structure. Its high original location on the *tabanco* or in the roof thatch is not surprising, but its location well inside the structure is unusual.

The cluster of five perforated and unperforated stones near the front step of the structure is also unusual, both for the quantity and for their association with each other. They suggest a possible tool kit or functional assemblage, although their functions are not immediately apparent. They may have been in temporary storage near the structure entrance, or possibly were roof weights that collapsed together.

Similarly, a functional assemblage is suggested by the *mano*, worked stone and possibly the flaked chert core, near the outside hearth. As mentioned above, these may form part of a tool kit that was used in that location. Although the *mano* suggests grinding, an associated *metate* has not been found. Perhaps the *mano* was being recycled as a hammerstone, or the *metate* is located in an as-yet unexcavated area.

A single spindle whorl that fell to the front of the structure indicates possible spinning activities, although the artifact was probably in storage prior to the eruption. The use or origin of a fragment of bone that fell near the SW corner of the structure is unknown.

Food Remains

Few examples of the most commonly found food items - corn, beans, and chiles - were found. One stripped corn cob was found near the hearth and the stains of small bean-like seeds that had spilled inside the front room were observed. A large quantity of possible achiote seed material was stored in the very distinctive "caiman" jar and may not have been used as food but perhaps as pigment or for some other use. Other seeds stored in a second jar have not yet been identified.

Discussion

The variety of materials and their contexts show that distinct spaces were used differently. Activities and storage functions took place, but the storage function seems to have been especially important.

The majority of items found were apparently in storage. Inside the front room, the high shelf, or *tabanco*, was used to store relatively few items but these were generally one-of-a-kind. In the south part of the room both vessels and perishables in vessels were stored on the room floor; these items are also relatively uncommon. By contrast, the N extension of the *tabanco* outside the structure held many items, especially ceramic serving vessels.

The contrast between interior and exterior assemblages suggests they were materials from different kinds of activities. Domestic or maintenance activities and materials seem to be

concentrated outside the structure. More esoteric items seem to be concentrated inside the structure.

Outside activities are indicated by the cooking hearth and possible stone tool kit on the N side of the structure. Together with the serving vessels stored on the outside *tabanco* extension, these materials suggest an important food preparation area. The unusually large size of the cooking jar and many of the serving vessels, and the fact that this "kitchen" is not a separate structure, may indicate that the food preparation occurred in a non-residential context and in large quantities.

The non-residential interpretation is supported by the lack of stored foods either inside or outside the structure, and by the apparently non-domestic artifact assemblage stored inside the structure. The deer-antler headdress or mask, the basket-handle vessel with modelled faces, and the "caiman" jar with possible achiote seeds are very suggestive of some special and presumably non-domestic activities. Exactly what these activities were and where they took place is unclear, but the equipment and supplies may have been stored inside Str. 10.

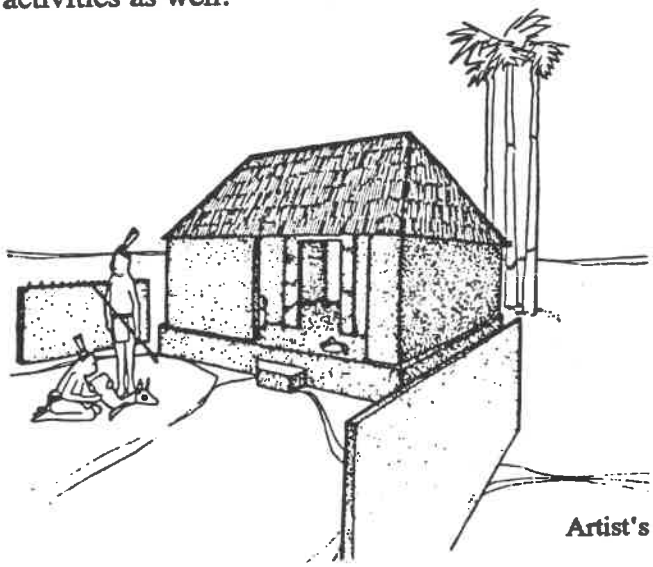
Some activities probably took place in or in front of Str 10. The cluster of serving vessels suggests food or beverage consumption, but whether this was in a quotidian or special context is unknown. The cluster of stones by the entrance may also indicate some activity, but its nature and whether it took place near the structure are unclear.

Preliminary Interpretation

The architecture and artifacts of Str 10 present a unique combination of features that suggest a non-residential function for the structure. Architecturally, the structure is unlike known residences in terms of orientation, layout, decoration, and some details of construction. The structure contents also are distinctive, especially in terms of the variety and quantity of unique and apparently non-domestic artifacts. Apparently the building served an important storage function, especially for goods that probably were used in non-domestic activities.

The kinds of activities that took place inside the structure are unknown, although food or beverage consumption may have been one of them. There was an important food preparation area on the N side of the structure under the roof eaves, but the associated cooking and serving vessels are not typically residential.

Str 10 is associated with Str 12, a special-use, possibly ritual, structure. There are links between these two in terms of proximity, orientation, building decoration, and artifact assemblage. Very likely, these two buildings functioned together as a compound for some non-domestic, possibly ritual, activities. The unusual features of Str 10 suggest that the building itself may have been the place where special equipment was kept and where preparations took place, such as large-scale food preparation. Possibly it was the venue of some of the special activities as well.



Artist's conception of Str 10. By K. Kievit.

Chapter 6. 1992 PRELIMINARY REPORT ON OPERATION 9

Karen A. Kievit,
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In November of 1990, as the excavation season drew to a close, equipment moving volcanic ash in the area approximately 16.5 meters south of Structure 12 collapsed a cavity below the ground surface at the volcanic ash Unit 8 level upon which it was operating. (See C.D. Miller 1989, 1990 for details on the Ceren ash sequence.) Salvadoran workers recovered three human teeth from within that cavity, at approximately the level of the Unit 3/4 interface. After lifting the teeth, the crew covered the hole with canvas, backfilled the area to the Unit 8 level and staked the area for investigation at a later date, when experts on human remains would be present.

In July of 1992, with forensic anthropologists Frank and Julie Saul (Ohio Medical College) on hand, the Ceren team reopened investigations in this area. A team of eight Salvadoran workers cleared an area 11 m x 12 m of vegetation and earth/ash to the top of Unit 8. Before further excavation, F. Miller and J. Doolittle conducted geophysical investigations using ground-penetrating radar in order to ascertain whether or not it might be likely that a structure or other cultural remains lay beneath the surface. Several anomalies were indeed detected during these investigations.

In consultation with Payson Sheets, I supervised a Salvadoran crew excavating in the newly named Operation 9. We laid out two separate excavation pits in the area that had been cleared south of Structure 12 (Figure 1). The first, Pit "A", measuring 2 m roughly east-west x 4 m north-south, was in the immediate area where the teeth had been discovered. The second pit, Pit "B", lay 1 m south of the first, and measured 2.5 m east-west x 3.25 m north-south. It took in the area where most of the anomalies had been detected by the geophysical explorations. The results of the excavations in Pits "A" and "B" are reported herein.

Ultimately, we were to discover a new structure, given the designation Structure 17, and another garden area. No further human remains were found. The teeth found in 1990, and reported upon by the Sauls in this volume, had apparently been deposited above the thatch layer, which was later preserved much as it fell on the structure floor. It is suspected that the teeth predate the eruption that buried Ceren, and that they may have been "tossed on the roof" for some purpose, perhaps for luck, just as teeth are apparently sometimes thrown upon the roof today in El Salvador (Andrea Gerstle, personal communication 1992).

Excavations in Pit "A"

After clearing the general area to the top of Unit 8, a 2 x 4 meter excavation pit was laid out and a protective roof was constructed for Pit "A". The excavation crew for Pit "A" consisted of two Salvadorans, who worked under my direction and the guidance of Payson Sheets.

Encountering a structure here was quite a surprise. No indication, such as a bowing of the tephra above, existed to lead us to expect a structure; but here was Structure 17 nevertheless. Unfortunately, field season time constraints prevented the enlargement of the excavation pit and required backfilling of the structure before much could be learned about it. Its limits and exact nature will have to be determined in another season.

Structure 17, as it is known at this time, is an adobe platform, approximately 58 cm high (Figure 2). It extends beyond the limits of the excavation pit on the north, east and west sides of the pit. A fallen column was found in what is presumed at this time to be the southeast corner of the platform, given the facts that columns at other structures generally appear at the outer corners of the platforms and that the only edge found to date for this particular platform is a portion of the south edge. The column had been recessed into the platform, as is evidenced by a round-bottomed depression left when the column fell. The edge of the platform had been damaged by a lava bomb, revealing a rather lumpy interior

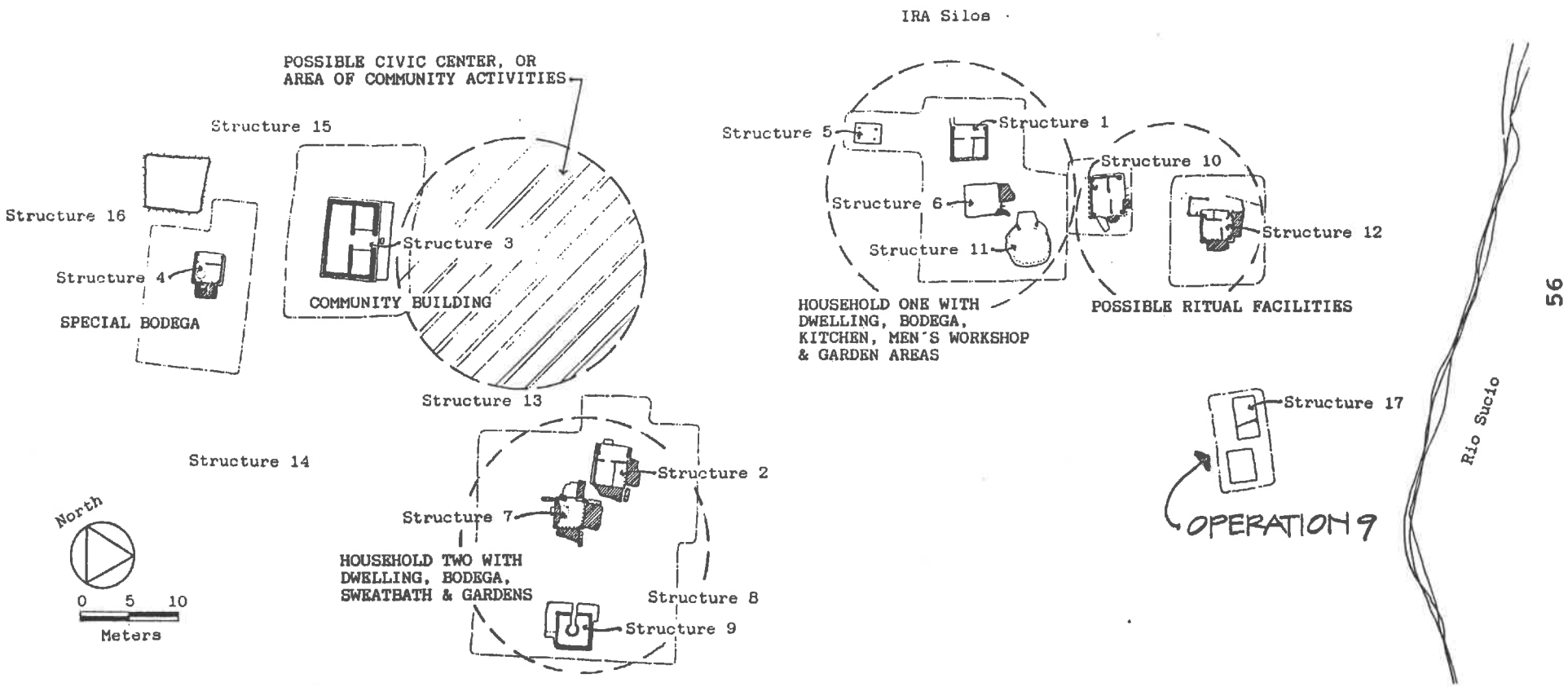


Figure 1. Map Locating Operation 9 South of Structure 12

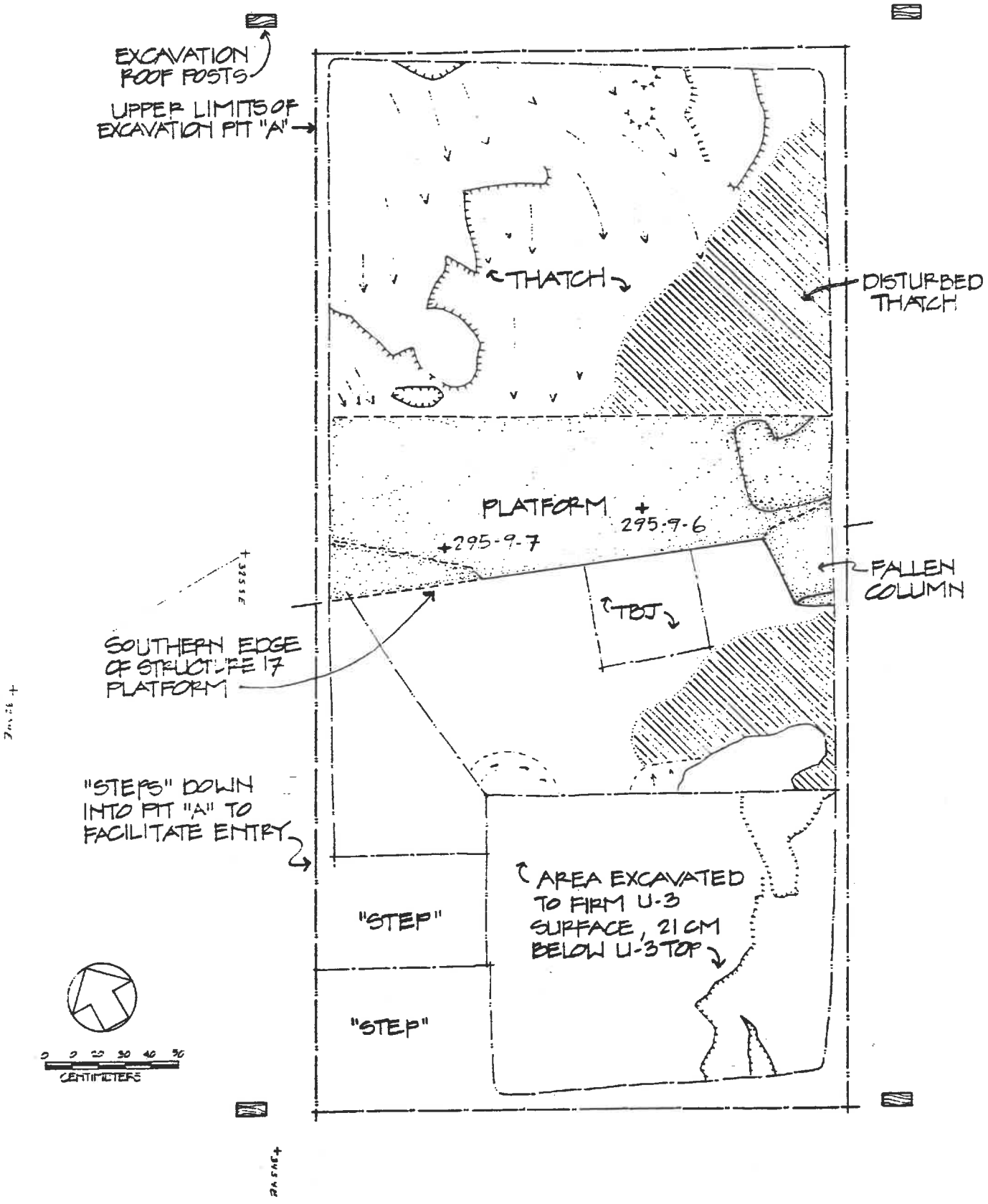


Figure 2. Pit "A", Operation 9: Evidence of Structure 17

construction for the platform, in keeping with puddled adobe construction. (Puddled adobe is suspected as the main construction method across the site for earthen elements such as platforms, columns and solid walls based upon my analysis of both the Structure 17 evidence and evidence recovered from the southwest column at Structure 10 during this field season.) No evidence of walls was found during this season's excavations at Structure 17.

Thatch overlays the platform above an ash deposit approximately 5-9 cm thick. The thatch was first encountered during the excavation at the level of the Unit 5/6 interface. The thatch layer is rather consistent across the platform, despite its being disturbed in areas. Most of the disturbance of the thatch can be attributed to the intrusion of rootlets from above. Where undisturbed, the direction of the thatch is generally north-south. The thatch was removed for a distance of approximately 50 cm back from the exposed south edge of the platform. The thatch was not removed across the entire platform within the excavation limits, but was left for the most part along the northern part of the platform for removal when the rest of the structure can be excavated.

Within the excavation limits to the immediate south of the platform edge, the volcanic ash was removed minimally to the Unit 3 surface, a surface that will at least maintain its integrity beneath the backfill. One small pit was dug to the TBJ (*tierra blanca joven*), or original pre-eruption ground surface, in order to ascertain the height of the platform. This surface was clean.

A number of hollows encountered during the excavation of Pit "A" turned out to be related to recent intrusions by such rootlets as those that disturbed the thatch layer. They had been allowed access when the volcanic ash was first removed to the Unit 8 level in 1990, and grasses and bushes were permitted to grow over the area. Unfortunately, the expected and hoped-for hollow, or cavity, that might have contained additional human remains never materialized. Only further excavation in Operation 9 will tell us whether or not the three teeth are the only human remains that will be found here.

The only artifacts recovered from Pit "A" during this field season were three *tiestos* (sherds) from the backfill that had been emplaced over the collapsed cavity in 1990, a small snail shell that was found on the platform surface (and which may be intrusive like the rootlets), and a small piece of carbonized string. A sample of thatch was taken.

Excavations in Pit "B"

At various times, three or four Salvadoran workers were engaged in removing the volcanic ash layer-by-layer within the Pit "B" area. At the top of Unit 3, we encountered the first of several vertical or almost vertical holes, approximately 2 cm in diameter, that we were to find in this pit. It was evident by the third day of excavation in this area that we had discovered a possible garden south of the presumed structure in Pit "A" (Figure 3). The subsequent finding of an ash impression of a maize leaf leads us to the conclusion that this area is most likely a corn garden, or *milpa*. A total of ten holes were cast with dental plaster and the pit was mapped.

Due to both time constraints and the difficulties encountered in preserving exposed plaster casts in the garden areas within Operations 1, 2 and 4, it was decided that further investigations in Pit "B" would be left for another season. A separator geotextile cloth was placed over the exposed surface, and the entire area was backfilled and staked for later identification.

No human-created artifacts were recovered from Pit "B" during this field season. Two small carbon samples and the one ash impression of a maize leaf were lifted and preserved.

Summary

A late start to excavations, the unexpected discovery of a structure, and conservation interests combined to leave us with a fragmentary picture of the nature of the structure and garden found in the Operation 9 area during the 1992 field season. Based upon the preliminary evidence, it is possible that we have found either a building under construction or still another type of structure at the Classic Ceren site: an unwalled and roofed platform, but

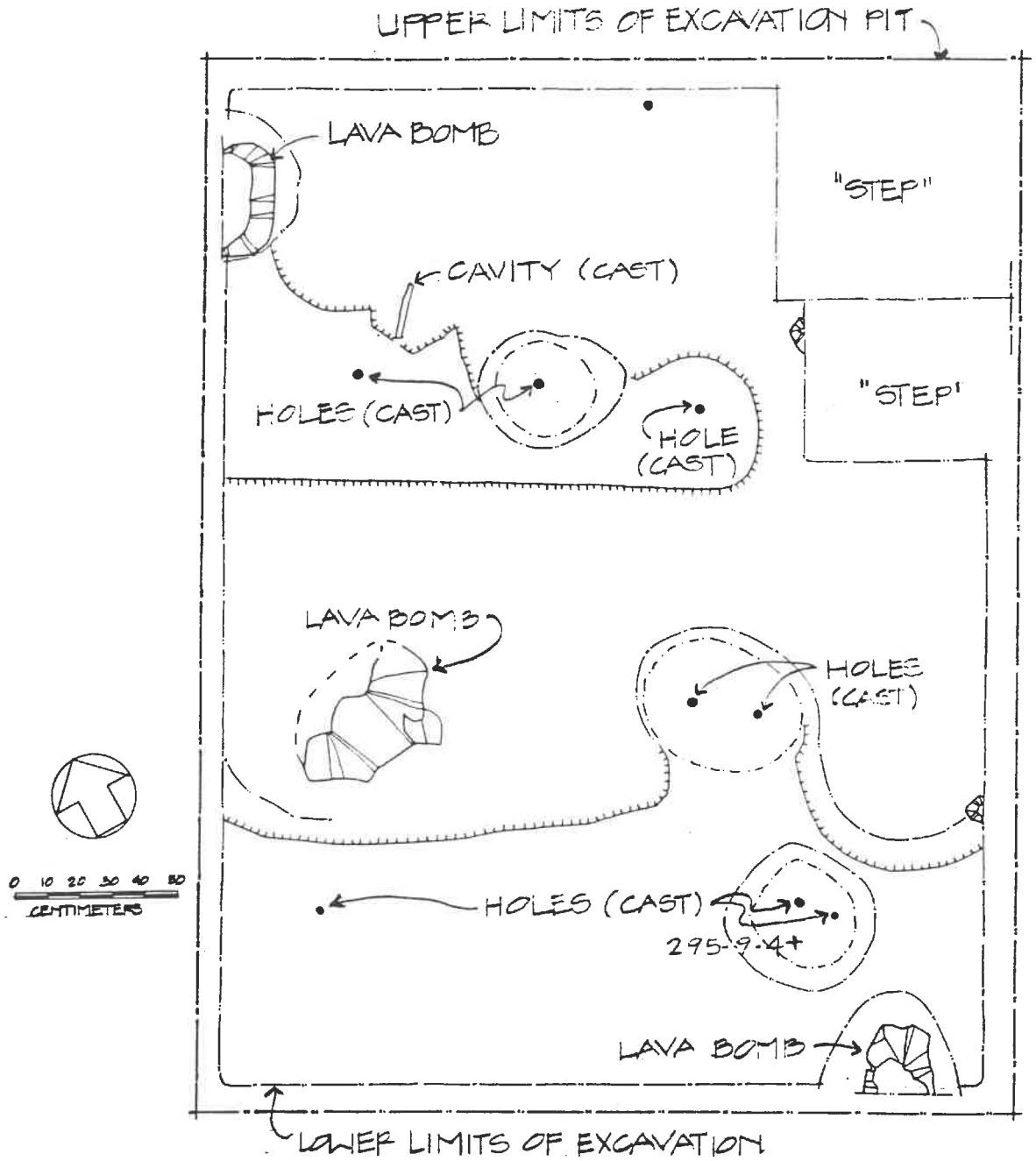
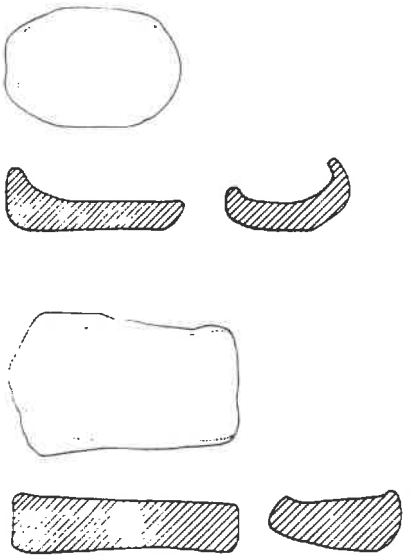


Figure 3. Pit "B", Operation 9: Evidence of Garden

with columns at the corners. The only other unwalled platform (Structure 5) does not have columns. The other structures with columns (Structures 1, 2, 4, 7, 9, 10, and 12) are far more substantial than Structure 17 appears to be at this time since they each have walls. Given its proximity to the enigmatic Structures 10 and 12, perhaps Structure 17 will prove to be related to these as part of a ritual complex. Only additional excavation and investigation in the Operation 17 area will provide a fuller picture.

Table One
Field Specimens Recovered from Operation 9

295-9-1	Three tiestos (sherds) from backfill
295-9-2	Carbon sample from U-5 ash in Pit "B"
295-9-3	Carbon sample from U-5 ash in Pit "B"
295-9-4	Ash impression of maize leaf, Pit "B"
295-9-5	Sample of paja (thatch) from Pit "A"
295-9-6	Snail shell from platform of Str. 17
295-9-7	Carb. string from platform of Str. 17



Examples of metates, 295-5-29 above, 295-4-220 below. Drawn by K. Kievit.

Chapter 7. SUMMARY OF TEST EXCAVATIONS IN JOYA DE CEREN, 1990-1992: OPERATIONS 3, 4, 6, AND 7

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Various excavations conducted in Joya de Ceren over the years 1990-1992 were not aimed at exposing identified structures. They include Operations 3 (1990), 4 (1990 initial, 1991), 6 (1991), and 7 (1991-1992) (Fig. 1, Table 1). All were directed by A. Gerstle and integrated with P. Sheets' research program. (Sheets and McKee 1989, 1990; this volume). Excavation and documentation procedures were the same as those used in previous investigations. Details may be found in Gerstle (1992).

Table 1. Dates, primary funding, location and purpose of test excavations

Operation and Dates	Primary Funding	Location and Purpose
Op. 3 (1990) Jun-Aug 1990	W. Michigan Univ., Nat. Endowment for Humanities	2 x 6 m test pit in front of Str 3, to determine use of area
Op. 4 (1990) initial Jun-Aug 1990	W. Michigan Univ., Nat. Endowment for Humanities	(2) 2 x 2 m test pits, to identify Str 4 location
Op. 4 (1991) Jul-Sep 1991	Fulbright Research Fellowship	Enlarge Op.4 pit, identify Str E, maguey & cacao cultivation limits
Op. 6 Jul-Sep 1991	Fulbright Research Fellowship	(2) test pit NW of Str 4, to test for structure
Op. 7 Nov 1991-Apr 1992	Patrimonio Cultural, Patronato pro-Patrimonio Cultural	(26) test pits +, preparation for roof construction
Archeobotany May 1991-ongoing	Academic Specialist Grant, USIS, El Salvador	Study of botanical material by Dr. D. Lentz, U. of Mississippi

Summary of Excavation Results

The excavations yielded material from the Preclassic, Classic, and Postclassic Periods. Tables 2, 3, 4, and 5 list the units and materials recovered for each period. Figure 1 shows the unit locations. Not all periods are represented in all of the excavation units.

Preclassic materials were in the dark red clay under the ubiquitous *Tierra Blanca Joven* (TBJ). They are sparse, generally small and eroded, and probably redeposited. No features were observed, although a very deeply buried pestle (Pit P-6) may indicate in situ remains. The excavation sample is very small.

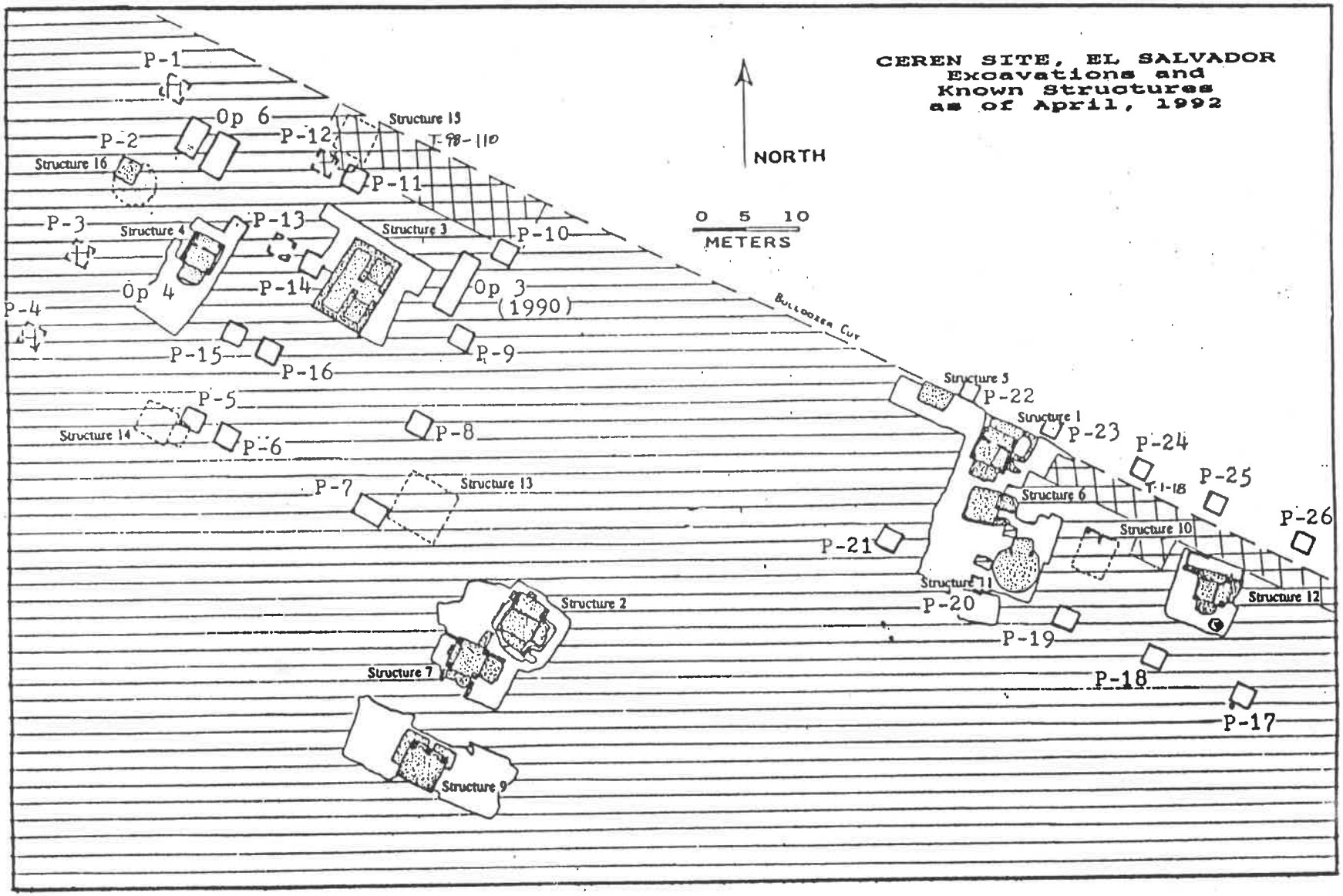

Figure 1. Location of test units for Operations 3 (1990), 4 (1990 initial, 1991), 6, and 7. Units labelled P-# or T-# are all Operation 7.

Table 2. Preclassic Period Deposits and Cultural Materials

Pit No.	Red Clay, Approx. Volume Excavated	Cultural Materials Recovered
P-6	Exposed only	None
	Drill hole, -65 cm	Pestle
P-7	Exposed only	None
P-8	.08 m3	Sherds
P-9	.23 m3	Sherds, obsidian
P-10	.68 m3	Sherds, stone
P-11	Exposed only	None
P-14	Exposed only	None
P-15	Exposed only	None
P-16	Exposed only	None
P-17	.54 m3	None
P-18	.21 m3	Sherds, obsidian
P-19	.18 m3	Sherds, obsidian
P-20	.45 m3	None
P-21	.04 m3	None

Table 3. TBJ Deposits and Cultural Materials

Pit No.	TBJ Thickness	Approx. Volume Excavated (m3)	Cultural Materials Recovered (Buried)
Operations 3-4 Area:			
Op 3(1990)	exposed only	0.0	
Op 6	exposed only	0.0	
P-2	exposed only	0.0	
P-5	exposed only	0.0	
P-6	65-(70+) cm	1.05	Sherds, bone
P-7	(65)-75 cm	1.05	Sherds, obsidian
P-8	62 cm	0.93	Sherds
P-9	47 cm	0.71	Sherds
P-10	18-19 cm	0.29	Sherds, stone
P-11	63-74 cm	1.00	Sherds, stone
P-14	39-44 cm	0.63	Sherds, stone
P-15	67-72 cm	1.00	Sherds, stone
P-16	56-62 cm	0.90	Sherds
Operations 1-5 Area:			
P-17	33-43 cm	0.57	Sherds
P-18	48-58 cm	0.80	Sherds, bone
P-19	48-51 cm	0.75	Sherds
P-20	38-48 cm	0.80	Sherds, obsidian, bone
P-21	10-60+ cm	0.54	Sherds, obsidian

Table 4. Classic Period Deposits and Cultural Materials

Pit No.	Cultural Materials Recovered (major features only)
	Operations 3-4 Area:
P-2	Str 16 and contents; exterior ground surface
P-5	Str 14; exterior ground surface; milpa
P-6	Exterior ground surface; clay paving; buried midden
P-7	Str 13 and fallen artifacts; exterior ground surface; clay paving
P-8	Exterior ground surface
P-9	Exterior ground surface
P-10	Exterior ground surface with footprints
P-11	Str 15; exterior ground surface; clay paving; buried pit feature
P-12	Str 15
P-14	Exterior ground surface; clay paving
P-15	Exterior ground surface; maguey patch
P-16	Exterior ground surface
Op. 3 (1990)	Exterior ground surface
Op. 4 (1990, (1991)	N side: Exterior ground surface, wall base and pole wall, clay deposit, old posthole; S side: maguey, bushes, etc., drain channel
Op. 6 (1991)	Exterior ground surface
	Operations 1-5 Area:
P-17	Fallow field
P-18	Exterior ground surface
P-19	Exterior ground surface
P-20	Garden; buried posthole and small hole
P-21	Young milpa

Postclassic remains were in the strata above the Loma Caldera tephra. In the area near Operations 1/5/8, they were sparse and sometimes mixed with historic or recent debris. By contrast, material was abundant and relatively undisturbed in the area Operation 3/4 area and includes middens of ceramic and obsidian debris, a partial cobble paving and ceramic feature. The material appears domestic and *artesanal* (handcrafted) in character.

This rest of this summary focuses on the abundant and well-preserved Classic Period remains of Joya de Ceren. These were in and on the TBJ and buried by the Loma Caldera tephra. Four new structures were exposed in the Operations 3/4 area, including one solid-earth structure (Str 13), two *bajareque* structures (Str 14, Str 15), and one pole-wall structure (Str 16). Three and possibly four cultivation areas were discovered including one or two fallow fields and two cultivated *milpas*. Artifactual material was found in all areas. Modification of the original ground surface and buried features suggest a dynamic site history. New data are reported by area, with reference to previously excavated structures when possible. Comparative data are drawn from reports in Sheets (1983), Sheets and McKee (1989, 1990), and this volume, except where noted.

Str 4 and Surroundings

Expansion of the Str 4 excavation pit (Operation 4) revealed that the front side of Str 4 was surrounded with a pole wall set into a low clay wall base (Fig. 2). The clay-paved enclosure thus formed was roofed with thatch and had a wide front doorway leading north to a

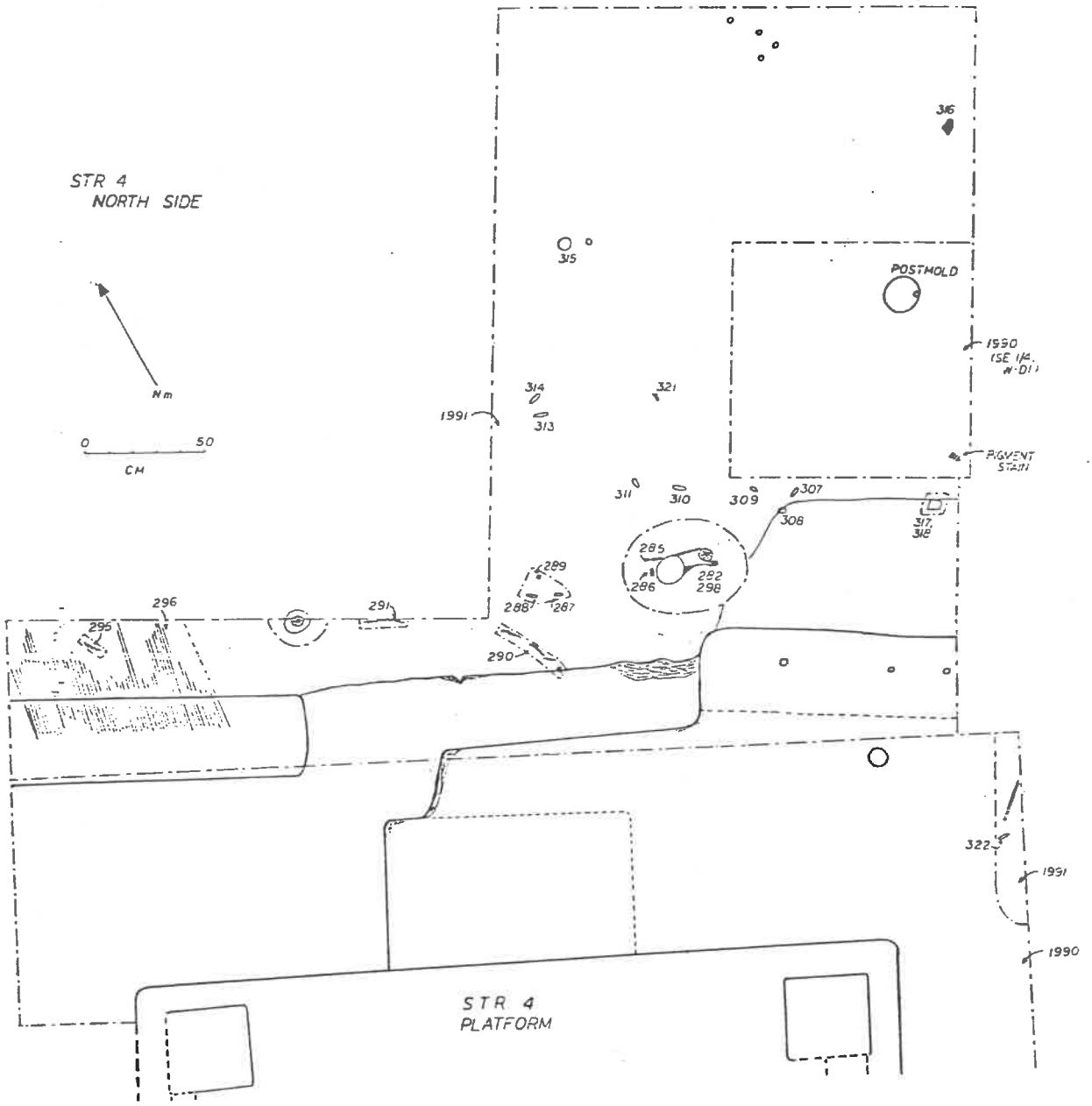

Figure 2. Operation 4 (1991): N side of Str 4.

smooth clean TBJ ground surface. Several obsidian blades were stored in the roof eaves. A pile of raw clay outside the enclosure suggests on-going construction activity. Stripped corn cobs, some trash sherds, a painted calabash(?) fragment, and a red pigment stain were scattered outside the doorway. Very likely, Str 4 was a multi-purpose domestic structure for storage, food preparation, eating, and possibly sleeping (previously, it was viewed primarily as a storehouse, with the expectation that a domicile was located nearby).

Northwest of Str 4 (Operation 6), the ground surface was fairly clean and level, with a few trees including nance and scattered weeds as well as some artifactual detritus, especially in the W pit. This may be part of the Str 4 residential compound.

A guayaba tree was growing near the SW corner of Str 4 (Fig. 3). The size of the fruits, which were knocked off the tree by the eruption, suggests a late August or early September date for the eruption. To the SW of Str 4, numerous small trees and bushes were growing. Some of the trees may be cacao; paleoethnobotanical analysis by D. Lentz is continuing.

The maguey garden S of Str 4 extends E almost to Str 3 (Pit P-15). Between these two structures, there is an abrupt shift from irregular cultivated ground to a hard-packed, smooth, and clean ground surface near Str 3. South of the maguey garden, a shallow channel draining to the SE was built (cf. Conyers 1992). A clean but bumpy ground surface S of the channel suggests a fallow field that had been walked over many times.

Str 13 and Str 3: A Possible Public Compound and Plaza

Str 13 is located SE of Str 3. Only the SW corner of Str 13 was exposed (Pit P-7), and it is virtually identical to the SW corner of Str 3. Both have high platforms, high solid-clay walls, a wide cornice, and the same orientation. It may form the south side of a public plaza bounded by Str 3 on the west.

The ground surface in the "plaza" area E of Str 3 and N of Str 13 is smooth and clean and covered with a thin layer of hard-packed red sand. The plaza was apparently formed by extensive cut and fill activity, with cutting on the north side (Pit P-10) and filling on the south side (Pit P-7, possibly also P-8,9). The plaza would have 480 sq m or more. The northern part of the plaza was muddy; preserved adult footprints indicate N-S travel (see Saul and Saul, this volume).

An unusual number and variety of artifacts fell from the SW roof or walls of Str 13, including two jars, a restricted-mouth bowl, a turtle carapace, a stone ball, red pigment, and possibly a worn obsidian blade. This assemblage contrasts strongly with Str 3 which was almost empty, and also with domestic assemblages from residential structures. If it was part of a public compound with Str 3, then it was used for somewhat different specific purposes than Str 3.

Str 14, 15, 16: New Residential Compounds?

Three other structures (Str 14,15,16) were found near Str 3 and 4 but their interpretation is still uncertain. Based on the limited exposure of architecture, artifacts, and features, they appear to be residential in nature. Their orientations and the distances between them suggests separate compounds.

Structure 14

Str 14 is a *bajareque* structure located about 15 m S of Str 3 and 4 (Pit P-5). The fallen E wall was partly uncovered; the entrance location is unknown. The S edge of a *milpa* with large, probably mature, corn was uncovered less than 2 m N of the structure. Bits of trash on the surrounding TBJ ground surface were recovered.

Less than 2 m E of Str 14 (Pit P-6), a small disused midden deposit with dense charcoal and ceramics had been partly covered by a clay paving. The paving extends E and S beyond the pit, suggesting the presence of an undiscovered structure nearby (clay pavings are associated with structures). Numerous bushy plants were growing near and through the edge of

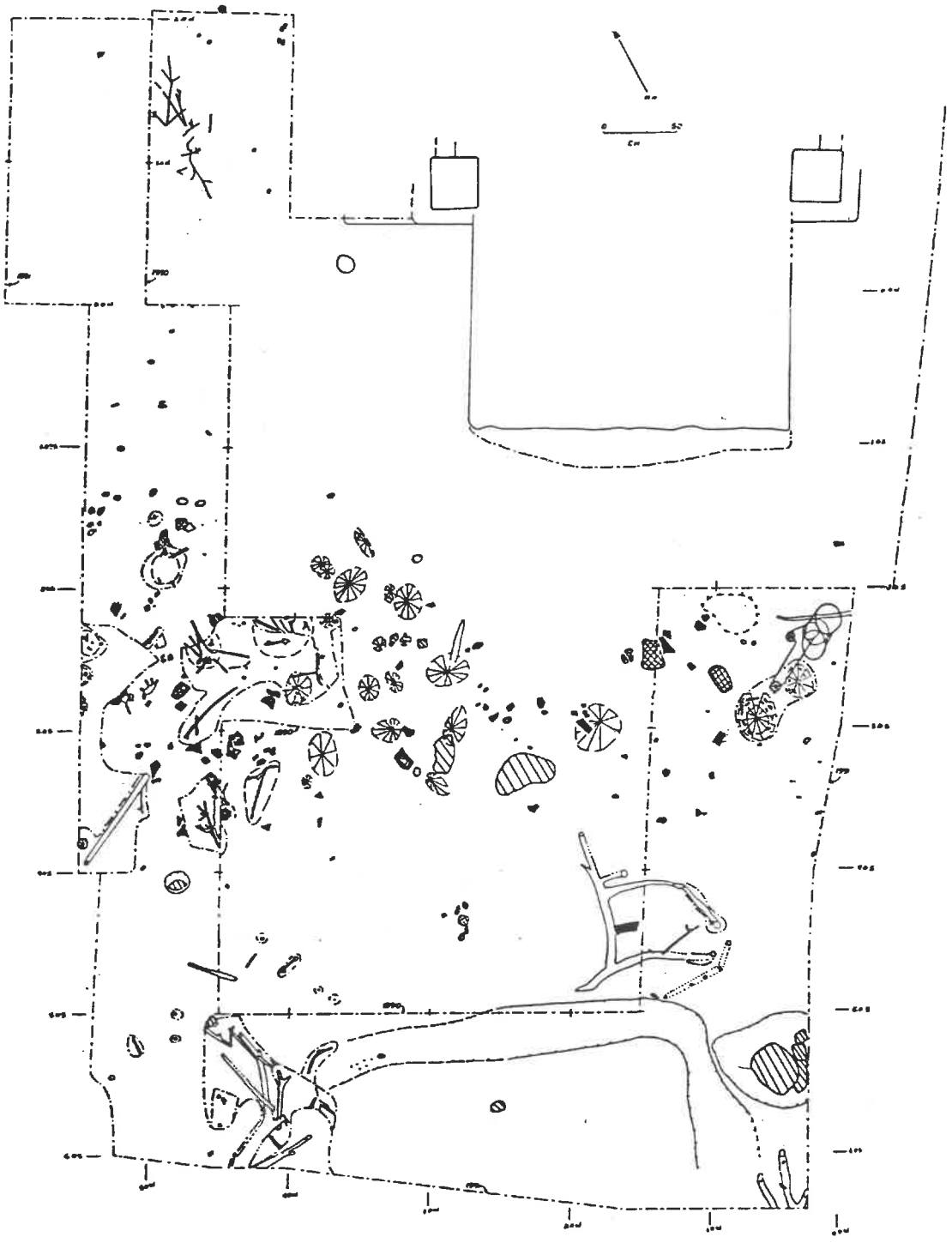

Figure 3. Operation 4 (1991): S side of Str 4.

the clay paving, but without apparent order or intentional cultivation. Almost no artifact debris was on top of the clay paving.

Structure 15

Str 15 is a *bajareque* structure located 8 m NW of Str 3. The fallen S wall extends from Pit P-11 to Pit P-12 (exposed only in P-11) and is about 3.5 m long. The entrance is

Table 5. Postclassic Period Deposits and Cultural Materials

Pit No.	Condition of Deposits	Area (m2)	Materials Recovered
	Operations 3-4 Area:		
P-1	Intact	4.0	Artifacts
P-2	Intact	4.0	Artifacts
P-3	Intact	4.0	Artifacts
P-4	Intact	4.0	Artifacts
P-5/6	Intact	11.8	Artifacts (95% of ceramics in west half; 99% of obsidian in east half)
P-7	Disturbed, partly removed	6.0	Artifacts
P-8	Disturbed, mostly removed	4.0	Artifacts
P-9	Entirely removed	4.0	--
P-10	Disturbed, mostly removed	4.0	None
P-11	Disturbed	4.0	Artifacts
P-12	Disturbed	3.0	Artifacts
P-13	Not excavated		--
P-14	Entirely removed	6.0	--
P-15	Disturbed	4.0	Artifacts
P-16	Disturbed	4.0	Artifacts
T-98-110	Mostly intact	10.0 ea	Artifacts
Op. 4 (1990, 1991)			
	Mostly intact	[illegible]	Cobble paving, partial vessel on paving, artifacts
	Operations 1-5 Area:		
P-17	Intact	4.0	Artifacts
P-18-26	Entirely removed	4.0 ea	--
T-1,2	Disturbed	3.0 ea	Artifacts
T-3-?	Disturbed	7.0 ea	Artifacts
T-?-?	Disturbed	2x? ea	Artifacts

probably on the W, E, or N side. The clay-paved surface nearby had some trash sherds and red pigment stains on it. An abrupt rise in the floor ca 1 m E of Str 15 suggests the presence of another structure or architectural feature nearby.

About 1.5 m S of the structure was an early cilindrical pit dug into the TBJ and subsequently buried. No original pit contents were visible. The pit was refilled and covered with TBJ, topped with a flat stone slab and *mano* fragment, then covered with midden debris rich in charcoal and burned unshelled corn cobs, and finally with the clay paving. Str 15 presumably was erected on the clay paving.

Structure 16

Str 16 is located about 9 m NNW of Str 4 (Pit P-2). It resembles Str 11, a kitchen, in various attributes: it has a slightly raised TBJ floor, pole walls, very thin thatching, a circular outline, a diameter of about 4 m, and contains domestic equipment including a mounted *metate*, a ceramic jar, and a large sherd. The *metate* is mounted on supports of stacked cobbles, not wooden forked posts. Some red pigment was in or fell with the ceramic jar. Several large river cobbles are set into the floor of the structure. Ceramic debris and carbon stains are abundant, especially outside the structure. Based on the distribution of debris, the entrance to the structure may be to the SW.

A Prepared Plaza in the Str 10/12 Ritual Complex?

Two pits (P-18,19) located south of the Str 10/12 ritual complex may be in a highly maintained exterior area, possibly a formal plaza. In both of the pits, the flat smooth ground surface was covered with a thin layer of hard-packed red sand, similar to the Str 3/13 plaza area (see above). The area was virtually free of weeds and trash. The TBJ stratigraphy suggests artificial raising and levelling of the ground surface with layers of clay and charcoal stained TBJ fill.

Cultivation Fields

In addition to the *milpa* uncovered near Str 14 and a possible fallow field S of Str 4 (see above), a young *milpa* and a fallow field were discovered near the Operation 1/5 area. Buried features were discovered in the Household 1 kitchen garden.

The fallow field is located ca 8 m SE of Str 12 (Pit P-17). The ridges and furrows are oriented approximately E-W, draining to the E. They are relatively straight and parallel, even in width and equally spaced. The ridges present a rough appearance as if soil had recently been turned or plants uprooted. The soil in the base of the furrows is flat and compacted as if frequently walked on. Although six plant cavities were discovered, these are irregularly distributed on ridges and furrows, and are not corn plants. Several fragments of ceramic and obsidian debris were recovered.

The young *milpa* is located west of Household 1 (Pit P-21), beyond the specialty or kitchen garden and probably not continuous with the "north garden" *milpa*. The ridges and furrows are oriented approximately E-W, with drainage to the west. The ridge crests and furrow bases tend to be rounded. Ridge width and separation are variable; they are parallel but slightly sinous rather than straight.

Twenty-eight corn plants were recovered, all with small stem diameters and many with small to medium size immature cobs. Almost all were rooted near the ridge crests, in clusters of 2 to 4 plants. The clusters were spaced either 40 cm or 60 cm apart. A few unidentified plants, probably weeds, were growing in the furrows. Artifact debris, including fragments of obsidian, a figurine, sherds, and a stripped corn cob, was scattered throughout the *milpa*.

Excavation in the kitchen garden near Str 11 (Pit P-20) revealed two buried features. A postmold about 14 cm diameter and 45 cm deep may have been in use prior to or during initial garden cultivation. A small pit containing large sherds was refilled with TBJ indistinguishable from the surrounding cultivated soil. It probably predates the garden. These features suggest changes in the use of the area within the Household 1 residential compound.

Discussion and Conclusions

The test excavations provided much new data on the distribution of structures and activity areas.

The clay-paved area in front of Str 4 was roofed and enclosed by a pole wall inserted into a clay wall base. The room thus formed should be considered an integral part of the structure although it is not on top of the platform. Probably a variety of domestic activities took place in and around the structure. The unpaved but clean ground surface in front of this front room may extend N into the Operation 6 area where fruit trees were cultivated. Fruit trees, maguey and cacao were cultivated within a limited zone behind the structure. Beyond this area, *milpas* were planted, either by the Str 4 household or other neighbors (Str 14).

Str 13 and Str 3 may form part of a formal compound. Architectural and artifactual evidence suggests that both had non-residential functions. If so, they and the artifically levelled, clean, weed-free plaza they surround may have been primarily for public or even ceremonial use. A similarly built and maintained area may have been located S of the Str 10/12 ritual complex.

The discovery of four new structures suggests that structure density throughout the known site area was very high. As many as three new household compounds were identified, but without more extensive excavation the social/functional links among the structures can only be hypothesized.

The identification of three and possibly four new *milpas* verifies the notion that unbuilt space was often used for food production. These fields may have served to separate household compounds, whereas the space within compounds was used for specialty crops such as the Household 1 kitchen garden and the Str 4 maguey garden. Probably at least two corn crops a year were harvested. By comparison with modern guayaba, the immature fruits preserved in the tephra suggest a late August or early September date for the eruption. Assuming scheduling similar to the modern planting cycle, this determination is supported by the fallow fields and young *milpas*, as well as the mature dry Operation 2 *milpa* and the absence of evidence of bean interplanting. Mature corn is often left to dry in the fields from late August and November. The new crop is sowed during those same months. Beans usually are not planted until much later.

In general, one can distinguish four or five different functional categories of "space": structures and their surrounding roofed areas, clean exterior ground surfaces, poorly maintained areas of trash accumulation, cultivated fields, and midden areas.

Roofed areas, often paved, tend to be very clean and smooth, with only a few small artifact fragments trampled into the surface. These were probably walkways and frequently cleaned activity areas. The clay deposit in front of Str 4 may have been in temporary storage under the roof eaves, where it could be kept dry. Stripped corn cobs and mounted *metates* indicate food preparation was one of the common activities.

Clean unroofed areas are associated with public or special-use structures such as the Str 3/13 and Str 10/12 complexes. They may also be found in residential compounds such as in front of Str 4. They were probably heavily used and well-maintained, i.e. swept and weed-free.

Poorly maintained areas of trash accumulation are found on the margins of the clean, heavily-used spaces, e.g. the N edge of the Str 3/13 plaza area, the W edge of the Str 10/12 "plaza" and the W pit of Operation 6 NW of Str 4. The discarded material is usually small, possibly the sweepings from the maintained areas. Vegetation is small, probably mostly grass and weeds, although sometime trees (including fruit trees) are present. These probably were not areas of continuous activity.

Cultivated areas are often the location of trash accumulation, probably because most of the excavated fields are close to the structures. The fragments seem to be larger than those found near or in maintained areas, and trash density may also be higher near the edges of fields closest to domestic structures. Aside from trash disposal, these areas probably were used only for cultivation-related tasks.

Midden areas resulted from intentional cumulative trash deposition (in contrast to incidental sweepings). One disused midden area was discovered E of Str 14; another is located SW of Str 9.

Various features indicate changing activities within the community. These include buried features such as pits, middens and postmolds. Extensive modification of local topography for construction of plazas and structures is evident. Some structures, e.g. Str 4 and Str 3, may have been remodelled shortly before Loma Caldera erupted. These data indicate changing use of areas, undoubtedly related to the growth of individual households and the community itself, and a moderately long settlement history.

Vessel 295-4-137. Drawn by T. Fitzke.

Chapter 8. ARTIFACT CONSERVATION DURING THE 1992 FIELD SEASON

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Introduction

In 1991, the Smithsonian Institution's Conservation Analytical Laboratory (CAL) inaugurated a postgraduate level fellowship in archaeological conservation which would provide a combination of conservation experience on-site and analytical opportunities at CAL to the recipients of the fellowship. The Ceren Archaeological Project was designated as one of the field laboratory sites based on the importance of the archaeological work being carried out, the extensive preservation of artifacts, and the enormous benefit to be derived from an on-going conservation presence in terms of information retrieval and collections care. This selection was a natural outgrowth of previous work carried out by the author in conjunction with the project, including longterm treatment and analysis at CAL of a painted organic artifact excavated in 1989, and conservation assistance provided in two on-site visits during the 1990-1991 season.

The 1992 field season was the first one in which a conservator specializing in archaeological materials was present for the entire field operation. The laboratory was staffed principally by Mark R. Fenn, recipient of CAL's postgraduate fellowship, with the author serving as supervisory conservator at the outset of the season. During the course of the season the conservation staff worked both in the Museo Nacional David J. Guzman and on-site, benefitting in their efforts from collaboration with museum personnel and the Ceren archaeological project team members.

Conservation Activities in the Museo Nacional

In the interim between the 1990-91 and 1992 field seasons, artifacts temporarily stored in several second-floor rooms of the Museo Nacional David J. Guzman were relocated to a newly partitioned section of the museum's main storeroom that was designated for Ceren storage. During the 1992 season, a considerable amount of time was invested in addressing the storage issues of artifacts excavated in previous seasons.

Organization of the collection in storage

The collection was organized in order to facilitate retrieval of individual items for study or display, to minimize damage caused by excessive handling, and to permit accurate inventories to be taken. The artifacts were arranged on metal shelving units and in wooden cabinets, first by material type and then by operation. The material categories chosen were ceramics, ground stone, lithic materials (including obsidian), bone, teeth, shell, painted organic objects (including *morros*) and paint samples, other organic materials (such as fibrous matting or wood) and miscellaneous small finds. The ceramic materials, occupying the majority of the space, were further subdivided by clustering the reconstructed vessels separately from the sherd lots.

Each shelf was labeled with a card identifying the operation number and material category for the items stored on that shelf. All containers were prominently labeled with the field specimen (FS) numbers of their contents, and generally contained only objects from the same operation and material category. In the case of reconstructed ceramic vessels and ground stone, which were not otherwise boxed, the FS number of each individual object was listed on the shelf card.

The plaster of paris plant casts, carbonized wood and other unworked botanical materials were carefully packed and transferred to the Jardin Botanico, which by prior arrangement holds the majority of these objects in temporary storage.

Packing the collection for safe storage

During the reorganization of the storeroom many of the artifacts were rehoused. The goals for this process were: to provide physical support for fragile or awkward artifacts, to improve the longevity of both the artifact and its housing by using stable or inert materials where possible, to minimize misplacement of artifacts (particularly small ones), to allow the artifact to be viewed easily while minimizing direct handling, and to utilize the storeroom's limited space efficiently.

For all materials except ground stone and ceramics, rehousing entailed providing boxes appropriate to the size and condition of the objects and replacing foil, cotton and toilet paper padding or wrapping with Ethafoam (closed cell polyethylene foam sheet) and/or acid-free tissue. Large boxes, constructed of cardboard, were designed with an integrated lid and secured with strapping tape or Acryloid B-72 on the sides. For especially large, heavy and awkward objects, the boxes were made with drop fronts to make access easier.

Small objects were housed, either individually or in groups, in light-weight, colorless rectangular polystyrene boxes (brought from the U.S.) and food storage boxes (assumed to be polyethylene or polypropylene, acquired locally). These modular containers were sufficiently sturdy to provide physical protection and could be stacked easily. Whenever appropriate, each item was also enclosed in a ziplock bag, labeled with excavation information.

With regard to ceramics, unreconstructed sherds were stored as before in plastic bags within readymade cardboard boxes. Low-grade plastic bags which showed signs of deterioration were replaced, and bags and boxes were checked for proper labeling. Reconstructed pots requiring support were packed in open cardboard boxes or padded plastic tubs. Stable reconstructed pots were placed directly on shelves which had been covered with Ethafoam sheeting, as were the ground stone artifacts.

To prevent shelf contents from falling in the event of an earthquake or other disturbance, 3" canvas strips were wrapped around each level of shelving in the metal units and sewn to the perforated struts with light nylon string.

Treatments

Reorganization and rehousing of the collection gave the conservation lab personnel an opportunity to review the condition of materials excavated in previous seasons. Those in need of conservation attention were treated in the Ceren storeroom.

Ceramics. Thirteen ceramic vessels were treated because poor or incomplete reconstruction made them unstable or because additional sherds were located. Previous joins were disassembled with acetone; pieces were adhered using Acryloid B-72.

Areas in the bases of 26 whole and partial vessels, sampled for paste analysis by ceramics specialist Marilyn Beaudry-Corbett, were filled and inpainted to improve their appearance. The fills were made of plaster of paris and inpainted with watercolors or acrylic paints; a dilute B-72 solution was applied as an initial isolating layer on the ceramic surface and then as a sealant on the fill.

Stone. Acryloid B-72 adhesive was used to reassemble two stone artifacts, a perforated grinding stone [FS 2-410] and a paving stone [FS 3-24]. For the reassembly of two stone mortars or *metates* [FS 1-46 and FS 1-265], Acryloid B-48N was selected because of its greater resistance to softening at high temperatures and the considerable weight of the objects (estimated at 30 lbs. and 50 lbs. respectively). To maintain the joins in compression during the drying of the adhesive, each *metate* was tightly clamped with a band clamp for at least a week, then propped vertically. They were stored in this position to minimize stress on the adhesive join.

Other. Two shells [FS 1-28 and FS 2-49] and many fragments of burned woven matting [FS 2-360] were consolidated with dilute Acryloid B-72, applied with an eyedropper. Fragments of a bone implement [FS 2-60] were joined with B-72 adhesive.

Inventory

With the collaboration of archaeologist Karen Kievit, a complete inventory was conducted to establish an initial record of the Ceren storeroom contents. Each item was checked against the project's computerized list of field specimens. Its entry was reviewed for accuracy and updated to include FS number, description, provenience information, the museum's registration number (for artifacts which have been accessioned into the collection) and other special notes. From this, a computer-generated inventory list of the storeroom can be produced.

During this process, artifacts whose FS numbers were illegible or missing were renumbered.

Conservation Activities On-site

The on-site conservation laboratory was set up for efficient usage by project personnel, and a complete inventory of supplies and equipment was taken. The lab's primary focus was the conservation of newly excavated material: providing assistance in the field with excavation of problematic artifacts, carrying out individualized treatments for stabilization or research purposes, and contributing to the technical interpretation of artifacts based upon information gleaned from immediate inspection and treatment.

Finds processing system

In conjunction with the archaeologists, the conservation staff developed a finds processing system for newly excavated material. Shelves were designated in the laboratory which clearly identified the treatment stage for the artifacts placed there. Once an object was lifted and recorded with an FS number, it was brought to the conservation lab. The conservation staff was responsible for overseeing its progress through several stages: initial examination, treatment, final review by the archaeologists, packing, and transfer to storage.

Finds entering the laboratory were sorted to one of the shelves labeled as follows: items to be washed (sherds and plant casts), objects requiring conservation attention, samples for flotation, or objects requiring examination by specialists prior to treatment (such as lithic materials). Those samples and artifacts not requiring conservation were placed directly on the appropriate Operation shelf -- 2, 8 or 9 -- for final examination and analysis by the archaeologists.

When objects requiring conservation had been completed, they were placed on the Operation shelves for the archaeologists' review.

Once this analysis was completed, items were packed and transferred to either the Museo Nacional (for all non-botanical materials) or the Jardin Botanico (for unworked botanical materials and plaster casts of plants, seeds, fencing, etc.). No items were to be stored in the on-site laboratory after the close of the season because of its accessibility to pests and susceptibility to environmental changes.

Treatments

Conservation staff carried out treatment primarily on materials which were excavated and brought to the lab by the archaeologists. These treatments are described below, by material.

Ceramics. After the pieces had been cleaned by the procedure documented below, two ceramic vessels [FS 2-509 and FS 7-123] were reassembled by the conservator using Acryloid B-72 adhesive.

Because of the quantity of sherd material, the archaeologists were generally responsible for their washing and numbering, with the involvement of the conservator only as needed.

Sherds were examined carefully prior to washing as several were found to retain traces of post-firing paint. Those without paint were washed in water, cleaned with tooth brushes and air dried. Sherds were numbered with India ink in an unobtrusive area which had been sealed with a strip of dilute B-72; the number was protected with another application of dilute B-72. This method was used in numbering other artifacts; in the instance of obsidian fragments, White-Out Correction Fluid was substituted for the first layer of B-72 for visibility.

Impressions and casts. A large collection of plaster of paris casts of plants, fencing, seeds, etc., stored in the lab from previous seasons, showed some evidence of pest damage and dirt accumulation. They were cleaned using soft brushes and a blower bulb, and housed appropriately in cardboard or polystyrene boxes.

Freshly excavated plaster of paris casts were washed in water, using a tooth brush when necessary, to remove adherent ash without altering the surface texture of the cast. They were then air dried and labeled as described above for ceramic sherds.

Some casting was carried out using Dow Corning E RTV silicone rubber in order to reproduce very fine detail, specifically impressions of seeds, twine and suspected fingerprints left in soil, ash or adobe. These surfaces were first sealed and strengthened with dilute Acryloid B-72. The silicone rubber was then poured and allowed to set overnight. The cast was removed and given the same FS number as the object from which it was taken.

A piece of ash retaining the impression of a leaf, probably maize, was consolidated with Acrysol WS-24, applied with an eyedropper.

Adobe fragments. Storage mounts were prepared for two large irregular fragments of painted adobe which had fallen from the doorway of structure 10 [FS 8-16 and FS 8-17]. The mounts were cast in plaster of paris to conform closely to the reverse side of each fragment, using polyethylene sheet as a separating layer. Those plaster surfaces which were to be in contact with the adobe were sealed with Acryloid B-72. Each adobe fragment was stored on its mount in a sturdy cardboard box.

Bone and teeth. Several other artifacts were carefully cleaned in the lab: an incised bone piece [FS 2-546], a tooth pendant [2-547], and numerous bone fragments [FS 2-582] which additionally required consolidation with Acrysol WS-24.

The following items were too fragile to be lifted without damage and required special conservation attention in the field before they could be brought to the laboratory for further cleaning, stabilization and packing; all were from Structure 10:

Deer skull. A red-painted deer skull [FS 8-34], crushed and partially burned, was too fragile to remove from its find spot without conservation intervention. Uncertainty as to what lay beneath precluded block lifting, therefore it was partially cleaned in situ with a soft paint brush and consolidated with Acrysol WS-24. It was then lifted piece by piece and removed to the conservation lab for further treatment. A small piece of carbonized string [FS 8-42], found next to one of the antlers, was lifted and consolidated separately with dilute Acryloid B-72. In the lab, ash which had been unavoidably consolidated onto the object was removed with acetone-dampened swabs and bamboo skewers, taking care to leave all traces of paint. Another piece of carbonized string, still adhering to the base of the second antler, was consolidated in place with dilute B-72. Fragments which were still fragile were reconsolidated with dilute B-72 and reassembled where possible with B-72 adhesive. All the fragments were boxed in groups reflecting their approximate in situ locations, and the boxes were packed together with a drawing of the object in situ.

Paint deposit. A fragile deposit of paint fragments in a concave configuration was found in the east room [FS 8-160]. It was composed of two thin back-to-back layers which probably had been applied to a now decomposed organic substrate, such as a gourd (*morro*).

After the ash had been excavated from the interior, the exposed paint fragments were consolidated with dilute Acryloid B-72, applied with a small brush. To serve as a backing, two layers of Japanese tissue, torn into small pieces (approximately 1cm x 1cm), were adhered to the fragments using dilute B-72. With a thin polyethylene sheet serving as a separating layer, plaster of paris was poured to form a cast of the interior which would later serve as a mount. The plaster cast was sealed with dilute B-72, replaced in the object, and the assemblage blocklifted. Once in the lab, the block was inverted and the backed paint fragments were temporarily anchored to the mount with tabs of Japanese tissue and methyl cellulose adhesive. Ash adhering to the exterior paint surface was partially removed mechanically and with acetone-dampened swabs. The object, on its mount, was housed in a drop-front cardboard box.

Fiber ring. The remnants of a fiber ring (*yaguâl*) were found in the southwest corner of the east room. These were left in situ, consolidated with a generous amount of Acrysol WS-24.

Condition Review of Artifacts in situ

Several other fragile items left in situ from previous seasons' work were checked for condition. The corn crib in Structure 4 appeared largely unchanged from 1991; slight damage on one wall probably resulted from previous removal or replacement of the protective wooden box. Cloth bags containing ash continue to provide support to the fragile side walls.

Two partially exposed ceramic vessels, left in situ beneath the fallen west wall of Structure 7, had been filled with ash-containing cloth bags in 1991 to provide support and an environmental buffer. The bags were adjusted in one of them to prevent undue pressure against the exposed ceramic wall.

The fragmentary fibrous remains of several bags and fiber rings, documented in situ in Structure 11 but too deteriorated to lift during the 1990 season, were still somewhat visible despite considerable loss of material and accumulated dirt from exposure. However, consolidation tests carried out in 1991 with Acrysol WS-24 did not appear to be successful, and without physical protection, these remains can not be expected to survive.

Finally, the wall painting in Structure 12, protected by backfilling, appeared stable in the one area where the white surface was exposed.

Conservation Priorities for Future Seasons

Collections care

The artifacts conservation laboratory will continue to place a strong emphasis on collections care, specifically addressing the housing and storage issues of the artifact inventory so that these materials will be available over the long term for research and display. These activities require adequate supplies of packing materials such as modular containers, fitted boxes, stable plastic bags and padding, ample shelving to avoid overcrowding, and attention to security measures against earthquake damage. This responsibility is one which should be shared by the project and Museo Nacional personnel.

Treatment

The laboratory will continue to respond to the conservation needs of newly excavated material, beginning with in situ stabilization and lifting interventions as needed and continuing in the laboratory. Individualized treatments will be carried out to stabilize the artifacts, to support the research interests of project specialists, and/or to prepare materials for museum display.

Structure 10 has been designated for further excavation and is expected to yield materials that will require conservation attention. With its unusual inventory of artifacts partially uncovered in 1992, both in situ and laboratory treatments should be anticipated. Ceramic vessels are likely to require careful reconstruction, as prioritized by the project's

ceramics specialist Marilyn Beaudry-Corbett. Other unusual items found in 1992, such as the deer skull and painted *morro*, should be fully treated in order to complete the assemblage.

Research

Artifacts which show evidence of painting or contain colorant materials have been excavated since 1989 and provide a unique opportunity to study pigments available at Ceren. The technical analysis of these materials is being carried out at the Conservation Analytical Laboratory, and will include samples from the current excavation.

The plaster of paris plant casts, both in situ and in storage, are a resource whose preservation deserves full attention. While the plaster material may be stable in storage, it is not a durable material over the long term for casts left in situ. Replacement of these casts with others made of a more permanent material will require careful investigation of materials and replication methods. This should only be carried out with professional involvement and the assistance of the conservation laboratory. Inexpert use of untested materials and techniques could lead to the loss of many valuable specimens.

Training

With the ongoing development of the field laboratory's capabilities, it is expected to be a training resource for conservators from CAL's archaeological conservation internship program, for participating archaeologists and for Salvadoran colleagues.

A Note on the Painted *Morro* from Structure 2

The first paint deposit found at Ceren was discovered in a niche in the south room of Structure 2 during the 1989 season. Based on the initial hypothesis that it was a "possible codex," its poor condition and problematic interpretation led to its official transfer to the Conservation Analytical Laboratory for analysis and treatment. Extensive work carried out by the author at CAL now suggests that it was a painted calabash or gourd (*morro*). At the beginning of the 1992 season the reconstructed artifact was returned to the Museo Nacional David J. Guzman, with a special mount provided for museum display and containers for safe storage and transport. The analysis and treatment work carried out at CAL has greatly influenced the interpretation of similar paint deposits found in subsequent seasons, and has led to improved techniques for recovering and treating such deposits in the field.

Principal conservation materials utilized in treatments

Acryloid B-72 (Rohm & Haas): copolymer of ethylmethacrylate and methylacrylate, dissolved in acetone for consolidation and adhesion; reversible in acetone

Acryloid B-48N (Rohm & Haas): copolymer of methylmethacrylate and butyl acrylate, dissolved in toluene and acetone for adhesion; reversible in acetone

Acrysol WS-24 (Rohm & Haas): an acrylic colloidal dispersion in water, used for consolidation

Dow Methocel A15C methylcellulose: a cellulose ether, gelled in water, used for temporary adhesion; reversible in water

Japanese tissue: tengujo mulberry paper, used for backing

Note: Detailed conservation laboratory reports for the 1989, 1990-1 and 1992 field seasons at Ceren, as well as treatment documentation and analytical data connected with the painted morro are on file at the Conservation Analytical Laboratory, Smithsonian Institution. Duplicates are also kept at the Department of Anthropology, University of Colorado and at CONCULTURA, Ministry of Education, El Salvador.

Chapter 9. PRELIMINARY REPORT ON PALEOETHNOBOTANICAL INVESTIGATIONS AT THE CEREN SITE, EL SALVADOR, JUNE 1992

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Between the 4th and the 17th of June, 1992, I worked with the botanical remains recovered from the Ceren archaeological site. The purpose of the study was to ascertain prehistoric subsistence patterns of the site inhabitants. During the initial phase of research, I conducted a preliminary investigation of remains retrieved during the last three years of excavations at the Ceren site. I had the good fortune to be able to work with Lic. Maria Luisa Reyna de Aguilar, a former botanist at the Botanical Garden Plan de la Laguna, and will continue the research together with her.

In general, the objective of the study has three components:

1) to observe the remains of plants in a preliminary manner to identify them and select samples for scanning electron microscope analysis in the United States,
2) to recover modern plants or herbarium specimens to be used for reference materials to assist the identification of ancient plants, and
3) to establish a flotation system to recover small carbonized plant remains from Ceren site archaeological strata.

Various carbonized plant remains and plaster molds were examined as part of the preliminary analysis and several economic plant species were identified. These include: squash (*Curcurbita* sp.), cacao (*Theobroma cacao*), avocado (*Persea americana*), peppers (*Capsicum annuum*), three or four species of beans (*Phaseolus* spp.), a race of maize (*Zea mays*) from Mexico called Chapalote-Nal-Tel, guava (*Psidium* sp.), maguey (*Agave* sp.), and nance (*Byrsonima crassifolia*). Also there are numerous tree species represented and many other plant species yet to be identified. The microscopic analysis to be completed in the United States will permit the identification of wood and seed species that exhibited no diagnostic features in the preliminary analysis.

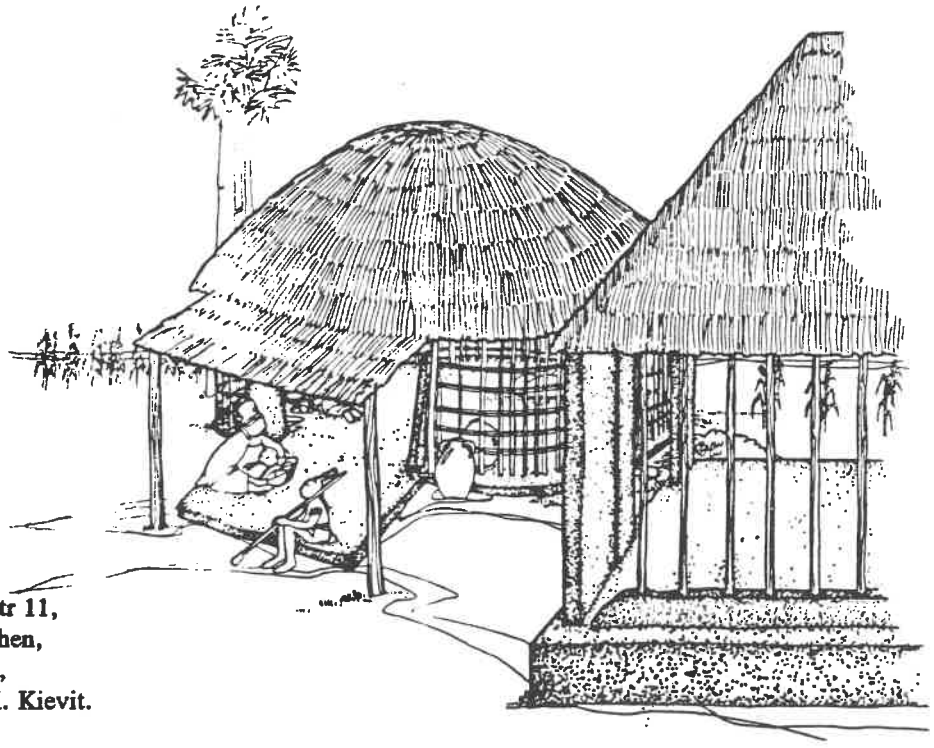
During the preliminary analysis of ancient plant remains, small sub-samples selected for subsequent high resolution analysis were placed into plastic bags. There are approximately 100 of these samples. In almost all cases, only a small fraction of the total sample amounts collected have been separated out for further study. It is necessary to send these samples to the United States where examination and identification can be completed using scanning electron microscopy. The samples will be returned to the Patrimonio Cultural within a year of their being received in Mississippi.

Herbarium specimens of modern plants were collected to serve as a reference collection to aid in the identification of ancient plant remains. Accompanied by members of the Ceren project and from the technical sections of the Botanical Garden Plan de la Laguna, I was able to collect indigenous specimens from the areas of Cerro Verde, Laguna Caldera volcano and the Rio Sucio. Duplicates of all herbarium sheets prepared as part of the Ceren study will be sent to the Botanical Garden where they can be archived as part of the permanent collection.

While in residence at the Ceren site, I trained North American archaeologists and Salvadoran excavators in how to process archaeological soil samples using flotation techniques. The process is designed to recover plant microfossils of the size that generally would not be collected by usual archaeological excavation procedures. This technique will be incorporated

into the standard excavation procedures of the Ceren project beginning with the 1992 field season.

The archaeobotanical work done in El Salvador in 1992 was preliminary. Further study should reveal a wealth of data on the plant use practices of the prehistoric Ceren occupants. The condition of the botanical remains is excellent, and it should be possible to learn much more about the species that grew in the area and about prehistoric subsistence patterns if ethnobotanical studies are continued in future field seasons. I appreciate the opportunity to contribute to this important aspect of the Ceren site investigations.



Artist's conception of Str 11, the Household One kitchen, with Str 6, a storehouse, in the foreground. By K. Kievit.

Chapter 10. NOTES ON THE HUMAN REMAINS FROM JOYA DE CEREN

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Definite human body molds (voids) and skeletal remains of the Classic inhabitants of Ceren have not yet been encountered, but three teeth and several bare footprints (impressions) were recovered during the 1990-1991 season. These were examined in 1992 and are briefly described below, along with our preliminary observations regarding some Post Classic skeletal remains.

Dental Remains

Our examination of the dental remains (consisting of three teeth when recovered) reveals the following:

Condition

1. Very, poor -- fragments appear to have undergone substantial post mortem degradation.
2. Of the three teeth recovered, only one crown (a third molar?) is substantially intact; the other teeth are now commingled fragments as a consequence of post recovery changes.

Species and type of teeth

The intact crown and two groups of fragments are consistent with human molars in regard to:

1. Size and general configuration.
2. Cusp contours available for examination.
3. Enamel thickness.
4. Type and location of antemortem attrition (wear) of the occlusal surfaces.

Three teeth appear to be present, as follows:

Third Molar (?). The previously mentioned relatively intact crown with breakage in the root area may be an upper third molar, inasmuch as third molars are very variable in form and are sometimes "barrel shaped" as in this case. Both size and shape are consistent with upper third molars. The occlusal surface shows relatively little antemortem attrition. However, this is not unusual, as third molars may not occlude with other teeth, and in any event are the last molars to erupt.

Second Molar (?). Eight fragments that we have grouped by color, amount of attrition, surface texture, and possible associated break surfaces may represent a second molar. It cannot be assigned to upper or lower jaw. This tooth shows more attrition than the "third molar."

First Molar (?). Four additional fragments that we have grouped by color, amount of attrition, surface texture, and possible associated break surfaces may represent a first molar. It cannot be assigned to upper or lower jaw. This tooth shows more attrition than the possible second and third molars.

Age and sex of individual

The age at death is very difficult to estimate using dental remains, even when they are in good condition; but the degree of attrition present is consistent with young/middle adult age (30-45 years).

The sex of the individual cannot be determined from these dental remains.

Footprints/Impressions

Six bare foot impression casts were examined:

Pie A (295-7-30, P-10) Right
Pie B (295-7-35, P-10) Left (slid in mud?)
Pie C (295-7-29, P-10) Right
Pie D (295-7-36, P-10) Left
Pie E (295-7-36, P-10) Left partial
Pie G (295-7-22, P-10) Right (no toe definition)

Method

Foot lengths of the impressions were measured using an approximation of the technique used in the living, e.g. from heel to tip of longest toe.

Of the six impressions listed above, only "Pie A" was considered sufficiently well-defined to yield a reasonably accurate foot length. It measured 244 mm. All of the impressions, with the exception of the partial impression of "Pie E," however, were measured. All appear to be of approximately the same length and configuration, suggesting that they were produced by a single individual.

Stature Estimation

Stature estimation based on foot length is considered to be potentially inaccurate for a variety of reasons, including the need to base the formula on the appropriate population, which is not possible in this case. Bearing these cautions in mind, the most recent sex related formulae available for forensic purposes (Giles and Vallandigham 1991) yield the following stature estimates:

If Male = 166.3 cm +/- 6.6 cm (range = 159.7-172.9 cm)
If Female = 163.2 cm +/- 6.5 cm (range 156.7-169.8 cm)

Possible Sex of Individual

The only available data on foot length in a modern Maya population appears to be that obtained by Steggerda (1932) from 50 males and 51 females who lived in the vicinity of Chichen Itza, Yucatan, Mexico.

The Ceren foot length of 244 mm most closely approximates the mean foot length for Yucatecan males, 247.10 +/- .89 mm (as opposed to 224.50 +/- .00 mm for Yucatecan females).

Furthermore, both the male and female stature estimates, based on the Ceren foot length as presented above, are more consistent with the ancient Maya estimated male stature from Altar de Sacrificios (Saul 1972, Genoves Mexican Formula) mean of 162.7 cm (range 156.0-170.8 cm) as opposed to the Altar female mean of 151.0 cm (range 147.9-156.5 cm).

Post Classic Skeletal Remains (295-99-3)

Although a few cranial and long bone fragments are present, their condition dictated that they be carefully cleaned and conserved before they could be examined. As our time was limited, we deferred this to a later date, and concentrated on the maxillary teeth, which could readily and safely be partially cleared of soil.

The stage of dental development and amount of attrition suggest that this individual is an adult, probably a young adult.

The shovel shape of the incisors is normal among the Maya (and other Amerindians).

No dental decoration in the form of filing of the "biting" edge is present, but labial surfaces of all anterior teeth could not be cleaned at this time for inspection for decorative inlays or carvings.

Chapter 11. CERAMIC ANALYSIS, JOYA DE CEREN: 1992 SEASON

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Background and Objectives

The majority of the time in archaeology, we only find ceramics that had been broken and discarded (sherds informally deposited in middens or used as construction fill) or removed from circulation as offerings (in burials, caches). Only rarely do we have vessels which were in actual use or being conserved for a secondary use in prehistoric time. Thus, it is difficult to determine with much confidence the exact conditions of function or use.

In the case of ceramics from Ceren, the situation is different. Because the village was destroyed and the site abandoned very rapidly, objects were left in the structures in their original systemic context. Thus we have a better idea of the vessel inventory for each domestic compound: which pots were in current use or storage before the eruption, which were being saved for a secondary use, etc. Consequently, the ceramic analysis program of the Ceren project can focus with a greater degree of confidence than many archaeological investigations on reconstructing aspects of the community organization as reflected in the ceramic material record.

The overall ceramic assemblage is made up of several sub-sets:

1. Vessels -- whole and partial -- that were in use or being conserved within structures.
2. Broken pottery that had been reused or was being saved for reuse at the time of the eruption.
3. Broken pottery that had been discarded at the time of the eruption, either scattered as part of informal disposal or deposited in formal midden areas.

Prior to the 1992 season the emphasis of the ceramic analysis had been on sub-set 1, whole or partial vessels, and secondarily on sub-set 2. With the 1992 season work, the analysis program is expanding to process information from sub-set 3. This report will summarize the work begun in El Salvador during the 1992 field season and being continued in the United States. Three sets of analyses are currently underway:

1. Inventories of whole and partial vessels located in or adjacent to structures. Pottery inventories are derived by grouping ceramic containers by size and shape per structure. The grouped data are compared for structures within the same household and then among different households. From this type of analysis we can learn about household status, family size and stage of the family cycle, and the nature of household activities including craft specialization or other distinguishing roles in the community.
2. Composition of the fired ceramic paste of pots recovered in an "in-use" context. Composition is determined through instrumental neutron activation analysis (INAA) of powdered samples removed from each vessel, followed by multivariate analysis of elemental data. This work is being done in collaboration with Dr. Ronald L. Bishop of the Conservation Analytical Laboratory (CAL) of the Smithsonian Institution. The samples are irradiated at the National Institute of Standards and Technology (NIST) and the statistical data set is generated at CAL. Interpretation of the results is the responsibility of the author. From this analysis we can learn about the supply sources for pottery at the household and community levels. The extent to which pottery is made of clay from different resources lets us hypothesize about specialized producers and provides direction for investigating trade and exchange linking the Ceren community to other settlements.

3. Patterns of discard and household maintenance. These data are derived from tabulation of sherd lots recovered from various extra-mural contexts, reflecting casual as well as planned discard. From this analysis we can learn about community standards of disposal, important for future work in this settlement and for application to other more standard archaeological projects. (Both David Tucker and I are working with this data set. His analysis will be presented apart from this report.)

Methods

Household inventories

Whole and partial vessels recovered during the 1992 field season were processed and described to incorporate them into the ongoing investigation. After being washed and numbered, each fragmented vessel was examined to ascertain if all the pieces are present and to determine the value and difficulty of reconstruction. Shape, decoration, and measurements were recorded onto a standardized form and profiles were drawn. Selected information was then entered onto a spreadsheet for continued analysis. Vessels are assigned to a standard type-variety classification system established in 1978 (Beaudry 1983) and used in preceding field seasons at Ceren (Beaudry 1989, 1990). If new units (ceramic variety, type, group) are discovered, a description is written for the grouped material. No new units were determined for the 1992 ceramics. Several vessels with unusual decoration were recovered in Structure 10 and are mentioned later. For now, they are considered part of the large Guazapa Group, not assigned at the type level[1].

Ceramic Paste Composition

Certain vessels recovered in previous seasons were reexamined to correlate stylistic features with preliminary data about clay resource utilization. A spreadsheet was prepared to use in interpreting the results of the multi-variate cluster analysis of the elemental data. Pottery from this field season was sampled for inclusion in the INAA sample.

Discard Patterns

Sherd lots have been recovered from varied extra-mural contexts. Effort has been directly mainly toward lots from a midden-like deposit in Operation 2 W of Structure 9 (see McKee, this volume). The lots have been coded in the following way: Sherds from each collection unit were counted and separated by size and the lot was then weighed. Rims and handles were recorded along with the frequency of several key types (scraped slip and bichrome/polychrome). Additional notes and measurements were made as appropriate.

Results of Analyses

Household Inventories

Structure 10 was partially excavated during the 1992 field season (see Gerstle, this volume). The inner, western room has not been uncovered and the northwest exterior of the structure has not been exposed, therefore our knowledge of the pottery inventory is incomplete. However, the vessels already recovered are reviewed and compared with those from other structures.

Vessels from Structure 12 (Sheets and Sheets 1990) were excavated after the Ceramic Chapter of the 1990 report was prepared. They were studied during a work period at the National Museum in San Salvador in July 1991, but had not previously been reported on as a part of the inventory analysis. They also are reviewed here (Table 1).

Structure 10.

The function of this structure is still unknown. Nevertheless, a tabulation of the number and classes of whole vessels suggests more similarity with the ceramic inventories

[1]Clearing operations northwest of Structure 2 uncovered an incomplete jar with an appliqued face on the neck, FS295-2-509. It too is assignable to the Guazapa Ceramic Group.

from storerooms (Structures 6 and 7; perhaps Structure 4) than for domiciles (Structures 1 and 2). The absence, so far, of utilitarian bowls, however, seems less in keeping with the storeroom pattern.

On a qualitative basis, the Structure 10 pottery is somewhat different from that recovered in other structures. There are some similarities with the overall Ceren pottery corpus: use of red paint and white slip for decoration, a paste with mixed temper, several standard jar and bowl shapes. However, the recovery of a number of unusual vessels differentiates this inventory, emphasizing individuality and interest in the aesthetic. A brief description of the more unique vessels will demonstrate this point:

FS 8-80 (8-V5): Guazapa Group jar with an unusual over-the-rim handle. The jar is

TABLE 1
CERAMIC VESSEL INVENTORY

	Structure 10	Structure 12
Utilitarian Vessels		
Jars		
Necked with handles		
Small (< 12 cm rim dia)	1	0
Small-medium (12-15 cm)	1	1
Medium (16-19 cm)	1	0
Med-large (20-27 cm)	1	0
Large (>27 cm)	2	0
Necked without handles	2	2
Bowls		
Open with handles		
Small (20 cm and less)	0	0
Large (21 cm and more)	0	3
Painted Serving Vessels		
Round sided bowls	0	0
Recurved bowls	3	0
Cylinder vases	0	0
Dishes (tripod)	1	0
Other vessels		
Miniatures	0	1
TOTAL WHOLE VESSELS	12	7
Partial vessels		
Utilitarian, horizontal section	1	1
Utilitarian, vertical section	2	3
Base, Campana polychrome	1	0
TOTAL PARTIAL VESSELS	4	4
GRAND TOTAL	16	11
Painted vessels by Type		
Copador	2	0
Gualpopa	1	0
Campana	1	0
Suquiapa	1	0

decorated with appliqued faces where the handles attach to the rim. Had fallen in east room.

FS 8-108 (8-V4): Guazapa Group jar with very carefully detailed appliqued caiman head and limbs on the neck and shoulder. Was on a support on the floor in the east room.

FS 8-105 (8-V10): Guazapa: Miltitlan jar with an unusual asymmetrical shoe shape. Found outside, north of the structure in the eastern area.

FS 8-130 (8-V13): Copador polychrome variant tripod dish. Found outside, north of the structure, just east of the hearth.

It would appear that some domestic activities (at least food preparation) are associated with the structure since a large scraped slip jar was located on a hearth outside the structure and some pottery components are equivalent to those recovered from other household structures. Nevertheless, the unique vessels, along with other unusual objects such as the deer skull, raise the possibility of the structure or its occupants having a different role within the community.

Structure 12.

This structure has some unique architectural features not found elsewhere at Ceren and a non-domestic function has been postulated (Sheets and Sheets 1990). Several aspects of the ceramic inventory also point to a non-domestic use.

Only seven whole vessels have been recovered to date (Table 1). Part of the interior has not been excavated, nor have exterior areas adjacent to the structure been cleared. Consequently, the assessment of the quantity and characteristics of the inventory may need to be reevaluated when the assemblage is complete. For now, the number of vessels is low when compared with domestic structures; only Structure 2, a domicile, had fewer (3) vessels. Two non-domestic structures also had fewer vessels: Structure 3 had 3 whole pots, limited excavation inside Structure 9 has produced none.

Additionally, the composition of the inventory by shape and size was distinctive. The seven whole vessels consisted of three jars (two with modeled faces on the necks), three large open bowls and one miniature paint pot. There were no painted serving vessels at all nor any containers that would be appropriate for storage or food preparation. The large open bowls do fit into the category of probable cooking containers even though other utilitarian components are missing.

Given the physical proximity of Structures 10 and 12, along with the fact that the Structure 10 door faces toward Structure 12, it is tempting to group together the pottery assemblages for comparison with other "households." When that is done and the combined inventory is compared against the combined data for domicile and storeroom structures of Household 1 (Structures 1 and 6) and of Household 2 (Structures 2 and 7), some differences still are apparent in the Structure 10-Structure 12 inventory: 1) only one medium sized necked jar with handles; 2) no round-sided painted serving bowls but three recurved bowls; 3) no *incensario*, or censer.

At this point it is difficult to assign meaning to these differences since the inner room of Structure 10 remains unexcavated, as do parts of Structure 12. It seems obvious that Structure 12 does not contain a standard domestic ceramic inventory and that elements of the inventory from Structure 10 also are out of the ordinary. The resolution of these issues has to await the completion of the excavations in and around these two structures.

Ceramic Paste Composition

INAA has been completed on 154 ceramics from Ceren and an initial dendrogram (Figure 1, parts 1 and 2) has been generated based on the concentrations of 15 elements. The procedural details of this type of analysis have been thoroughly presented (Blackman 1986) and will not be repeated here. As mentioned, this analysis is being done in

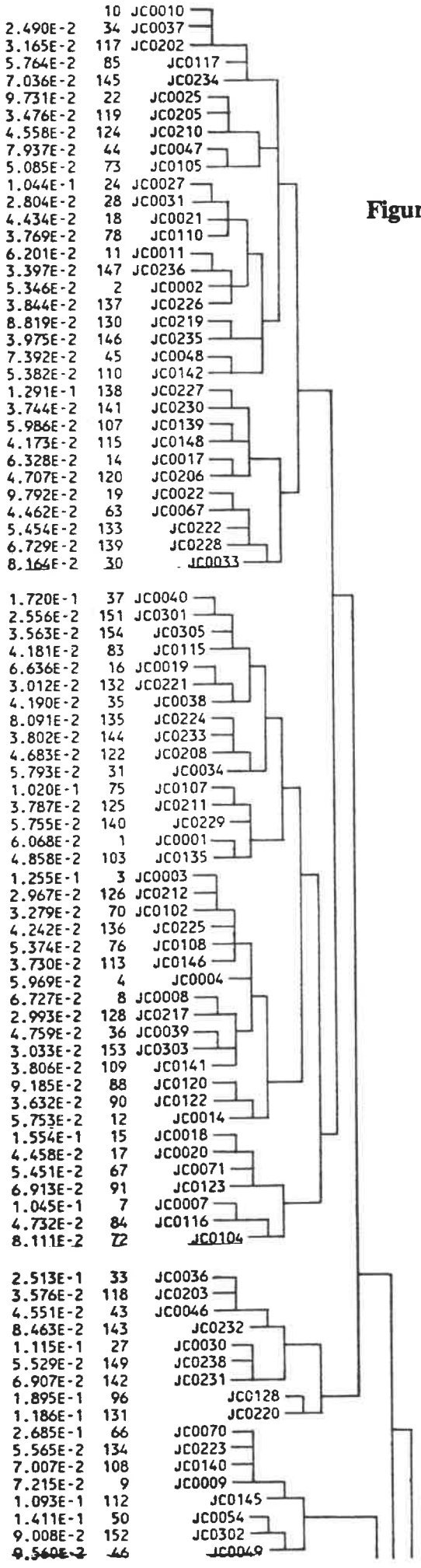

Figure 1, part 1. Dendrogram

Figure 1, part 2. Dendrogram

collaboration with Dr. Bishop. The work is ongoing, with samples submitted at the close of each field season in El Salvador. At present, approximately 25 additional samples have yet to be irradiated at NIST. As new cases are added to the database, compositional clusters change, reflecting the influence of the additional samples on the multi-dimensional space. Because of the "in process" nature of the analyses, this report includes only some general observations about the emerging picture of clay resource utilization. These preliminary statements will be refined or altered as the work continues. A full report of the INAA will be prepared by the author and Dr. Bishop at a later stage of the investigation.

At this time, seven compositional groups can be distinguished. An additional ten cases do not cluster with other specimens. The groups have been marked on the dendrogram (Figure 1), and the composition of the clusters in terms of classified types is shown in Table 2.

Four of the groups (A-D) contain domestic utilitarian pottery as well as the Mocal *incensarios*. The large group E contains the painted serving vessels, mainly the cream paste

TABLE 2

CLASSIFIED TYPES IN COMPOSITIONAL CLUSTERS

Ceramic Type	Dendrogram Cluster							
	A	B	C	D	E	F	ungrpd	Total
Guazapa Group[a]								
Guazapa: Miltitlan	24	29	9	7	0	0	2	71
Guazapa not Miltitlan variety				1				1
Obraje Red Painted Obraje			1					1
Cashal Cream: Caldera	6	4						10
Tazula Black[a]	2							2
Sacazil Bichrome[a]			1					1
Zuluniche Painted[a]							1	1
Mocal Modeled Applique[b]		3	1					4
Chichontepec[b]						1		1
Copador Polychrome[c]					20			20
Gualpopa Polychrome[c]					11		1	12
Either Copador or Gualpopa[c]				1	7			8
Suquiapa red-on-orange[c]					1		1	2
Campana Polychrome[c]						2		2
Figurine Fragment		1						1
Unclassified	1	1	5		3	3	4	17
TOTAL	33	38	17	9	42	5	10	154

a = utilitarian jars and bowls
b = incensarios
c = painted serving vessels

Copador and Gualpopa types plus several unclassified pieces and a Suquiapa bichrome. The small F group contains the two Campana polychromes in the sample and three unclassified painted pieces.

Several additional observations can be made about the four utilitarian type clusters. First of all Guazapa: Miltitlan pieces are found in all four of the compositional groups but the smaller frequency types within the Guazapa Group (Obraje and Guazapa: variety unspecified) are found only in Clusters C and D. The other small but distinctive type within Guazapa, Cashal Cream, separates out into Clusters A and B.

The Mocal Modeled Applique censer type separates by form with the three ladle-handled examples all in Cluster B and the one pedestal base example in Cluster C. The relatively small Cluster C (N=17) is interesting in that 12 specimens are incomplete partial vessels. Four of the five whole vessels were located in storerooms and the other one was in

TABLE 3
DISTRIBUTION OF COMPOSITIONAL CLUSTERS BY
HOUSEHOLD OR STRUCTURE BY FUNCTIONAL GROUPINGS

Household/Structure	Dendrogram Cluster A	B	C	D	E	F	ungrpd	Total
Household 1								
Utilitarian jars & bowls	19	22	7	4			2	54
Incensarios/miniatures	1	2			1			4
Painted serving vessels					14	1		15
Household 2								
Utilitarian jars & bowls	5	6	3			1	3	18
Incensarios/miniatures							1	1
Painted serving vessels					15	2		17
Structure 3								
Utilitarian jars & bowls	1	1	2	1				5
Incensarios/miniatures								
Painted serving vessels					1			1
Structure 4								
Utilitarian jars & bowls	6	3	2	3			2	16
Incensarios/miniatures		1						1
Painted serving vessels					9			9
Structure 12								
Utilitarian jars & bowls	1	2	2				1	6
Incensarios/miniatures								
Painted serving vessels						1		1
Other (test pit/midden)								
Utilitarian jars & bowls			1					1
Figurine		1						1
Non-provenienced								
Painted				1	2		1	4
TOTAL	33	38	17	9	42	5	10	154

Note: Classified types allocated to groups according to the legend on Table 2. Unclassified types assigned by shape and/or decoration.

Structure 12, a presumed non-domestic building. These proveniences are somewhat removed from active circulation, places where one might expect pottery to last longer, being less subject to breakage. Thus, it is possible that Cluster C resource represents slightly earlier production than the more prevalent pottery from Resources A and B.

The data were then examined by provenience and by general function rather than by classified types (Table 3). The proveniences were the two households (HH1 and HH2), structures not assigned to "households," i.e. Structures 3, 4 and 12, and other proveniences (test pits, midden). Four vessels owned by an individual and said to have been removed from the bulldozed area near Structure 1 are shown as "non-provenienced." The three functional divisions are: a) utilitarian jars and bowls representing vessels of shapes and sizes appropriate for food storage, processing, and preparation; b) painted serving vessels with shapes and decoration indicating that they were not appropriate for the functions just cited; c) *incensarios*, miniatures and a figurine fragment suggesting a specialized function that could be craft-related or ritual (e.g. a miniature vessel with pigment that could have been for application to craft objects or to the body for ritual purposes).

A few variations are noticed at this level of analysis. First of all, none of the HH2 utilitarian vessels group in small Cluster D. Since Group D vessels are not distinctive in terms of shapes or sizes, this cluster probably represents either a small producer or one whose products were not widely distributed to the Ceren community.

Additionally, of the few objects representing specialized functions, four of them (the three ladle-handled *incensarios* and the figure fragment) group in Cluster B which is dominated by utilitarian material, undoubtedly made at or very near the Ceren community. The one small cup *incensario* from HH2, on the other hand, is among the ungrouped cases, indicating either import or use of a clay resource not yet encountered in other vessels sampled.

A more detailed view of the dataset was obtained by examining only the utilitarian vessels by shape by compositional cluster (Table 4). This tabulation showed slightly more jars than expected in compositional Cluster A and more open basins than expected in Cluster B. Because of the inclusion of partial vessels in the sample, it was not feasible to separate jars with and without handles. Nevertheless, if this tentative distinction holds up with additional cases it could indicate production specialized by vessel shape or the use of a slightly different recipe for the two formal categories.

TABLE 4
ALL PROVENIENCES COMBINED, UTILITARIAN VESSELS
IN COMPOSITIONAL CLUSTERS BY FORM

Shape		Dendrogram Cluster							
		A	B	C	D	E	F	ungrpd	Total
Jars									
	With handles	20	13	4	6			1	44
	Without handles	4	7	2				3	16
	Handle unknown	4	4	4					12
	Small jug			1				1	2
Bowls									
	Large open basin	3	10	1	2				16
	Smaller: open, recurved, incurved, with handles	4		2		1	1		8
Total		35	34	14	8	0	1	6	98

A final tabulation was made of the utilitarian jars versus bowls just for HH1 and HH2, the domestic groups with more complete material inventories, i.e. those represented by two or more structures (Table 5). Some tentative variations between these two households are noted.

TABLE 5
DISTRIBUTION OF UTILITARIAN VESSELS
COMPOSITIONAL CLUSTERS BY FORM
HOUSEHOLDS 1 AND 2

Household	Jars	Bowls	Total
Household 1			
Cluster A	16	3	19
Cluster B	15	7	22
Cluster C	6	1	7
Dluster D	2	2	4
Cluster E	0	0	0
Cluster F	0	0	0
Ungrouped	2	0	2
Total	41	13	54
Household 2			
Cluster A	2	3	5
Cluster B	6	0	6
Cluster C	2	1	3
Dluster D	0	0	0
Cluster E	0	0	0
Cluster F	0	1	1
Ungrouped	2	1	3
Total	12	6	18

In HH1, jars are equally likely to have been made from Cluster A and Cluster B clay resources. More bowls, on the other hand, are made from clay resource B. Parenthetically, there seems to be a slight tendency for clay resource B to be used in larger sized vessels. This possible size-resource correlation will be investigated more fully as the work continues. The sample size for HH2 is smaller than that for HH1 but half of the jars in HH2 structures are made from Resource B.

Summary

In general the Ceren community was obtaining utilitarian and special function pottery made from four somewhat different clay resources. Several resources were widely used; small ones may represent more distant producers and/or an earlier "recipe." More detailed analysis suggests some concentration by shape within the compositional groups and some preference by household as well. However, products from the different clay resources were not restricted to certain households or structures; they were available throughout the settlement.

There appears to have been one general resource used for the majority of painted serving vessels. This finding is interesting because the decoration varies considerably in craftsmanship. Variations in terms of design elements, design layout and other stylistic attributes are not traceable to resource variation, at least not at the broad level at which the INAA data currently are being assessed.

The presence of ungrouped pieces hints at import or other variation which will be explored in later analyses.

Discard Patterns

During the 1992 season, two 1x1 meter pits were excavated in the *basurero* found in Operation 2 during the 1990 field work. (See McKee 1990 and this volume for details of the excavation procedures.) One of the pits was excavated to 65 cm below the surface; the other to 40 cm below the surface. In neither case were sterile sediments reached although cultural material was very scarce in the final arbitrary 5 cm levels (two sherds in one; five sherds in

the other). Thus the main part of the trash deposit in these two pits seems to have been recovered.

My objective in analyzing the pottery from the midden is to hypothesize from characteristics of the sherds in these two areas what this trash area represents and thus begin to understand how the Ceren community organized their formal trash discard. The two pits are located at different positions vis-a-vis the slope of the eruption-period ground surface with Pit 24S-67W being further downslope than 23S-65W. Thus, a series of attributes -- depth of sherd concentration; size, weight, and density of ceramic material; frequency of rims and distinctive pottery types -- were examined to evaluate similarities and differences between the two excavation units.

The pottery lots from the two pits were tabulated as described in the Methods section. Quantitative comparisons of the two samples will be presented followed by some general summarizing remarks.

Comparison of Midden Pits

Concentration of Materials. In the downslope pit almost 3/4 of the sherds were found between 5 cm and 30 cm below the surface. In the upslope pit at the equivalent depth interval only slightly more than 1/3 of the material was concentrated. Concentration in the levels above and below the 5-30 cm depth was equally varied between the two pits (Table 6). The significance of this difference in terms of deposition pattern has not been determined. The excavator notes that considerable wood ash, probably from Structure 9, had been dumped above the main sherd concentration in the upslope area.

TABLE 6
CONCENTRATION OF SHERDS

Depth	Upslope pit (N=431)	Downslope pit (N=373)
Surface to 5 cm	35.9%	23.6%
5 cm to 30 cm	36.6	71.6
30 cm to bottom	24.3 (65 cm)	4.8 (45 cm)

Size and Weight Difference. Sherds were divided into four size categories: small = surface area no larger than 9 cm^2 (3x3, 3x2, 4x2, etc.); small-medium = surface area 10-15 cm^2 (5x3, 4x3, etc.); medium = surface area 16-25 cm^2 (5x4, 6x3, 7x3, etc.); large = more than 25 cm^2 surface area (7x4, 5x5.5, etc.) Each lot was divided by size and counted. Then the entire lot was weighed. These two variables were examined for the combined data from all the arbitrary levels of each pit (Tables 7 and 8). The upslope pit produced a larger

TABLE 7
SIZE DISTRIBUTION OF SHERDS
(% OF TOTAL SHERDS IN CATEGORY)

Slize	Upslope pit	Downslope pit
Small size	53.6%	39.7%
Large size	4.6	12.3

TABLE 8 AVERAGE WEIGHT PER CHERD (TOTAL WEIGHT/FREQUENCY OF SHERDS)	
Upslope pit	13.83 gm
Downslope pit	20.13 gm

percentage of small size sherds and a lower average weight, possibly reflecting trash dumping practices. If the trash had been scattered or thrown from near the upslope pit, heavier and/or larger pieces might have landed farther away from the "dumping" spot. The size/weight difference could also relate to post-depositional transformations. Trampling or disposal of heavy materials on top of the originally discarded pottery would produce smaller sherds. However, attempted refitting (to be discussed below) did not produce evidence for this type of alteration.

Density. The density of sherds per cubic meter is higher in the downslope pit than in the upslope one, reflecting the shallow nature of the downslope unit (Table 9).

TABLE 9 DENSITY OF DEPOSIT (FREQUENCY OF SHERDS/VOLUME EXCAVATED)	
Upslope pit	663 per cu m
Downslope pit	933 per cu m

Presence of Rims and Classified Types. The downslope pit contained marginally more bichrome/polychrome sherds and more rims than the upslope pit. However, the two pits were equivalent in terms of the percentage of recognizable Guazapa Group materials (Table 10). Reasons for these observed patterns cannot be hypothesized without additional data.

TABLE 10 PRESENCE OF RIMS AND DIAGNOSTIC TYPES (% OF TOTAL SHERDS)		
Classification	Upslope pit	Downslope pit
Scraped slip	29.5%	33.2%
Bichrome/polychrome	15.5	22.3
Rims	7.0	12.6

Evaluation of the Nature of The Midden

Refitting was attempted but very few pieces from the same vessel were found. The fitting sherds were either in the same arbitrary level or collected just one level apart. Only one case was noted of sherds from the two pits belonging to the same vessel.

These characteristics suggest that this midden does not contain discarded whole but broken vessels. Rather, it might represent a secondary deposit where previously discarded objects were redeposited after having been collected and transported from different primary discard contexts. Once deposited here there was little disturbance or further mixing.

The type of ceramics discarded was varied. The presence of serving vessels, utilitarian vessels and partial sherd disks indicates that the objects came from a variety of functional contexts. The collection of sherds with elaborate post-firing decoration (*yeso*, blue paint, stucco) and parts of a figurine hints at the inclusion of rare or specialized objects as well as more ordinary domestic refuse. (See also McKee, this volume, for information on incised bone, a drilled dog tooth and other artifacts from these deposits.)

Summary

A quantitative review of the ceramics from the two Operation 2 *basurero* pits showed differences between the units in terms of the depth where the greatest concentration occurred as well as variations in sherd size, weight and density. The downslope pit was shallower with a very high concentration between 5 cm and 30 cm below the original ground surface. That pit also contained heavier/larger sherds with slightly more serving vessel sherds and rim sherds. A qualitative evaluation indicated that the overall midden was an area to redeposit trash previously discarded elsewhere in the community.

Final Observations

It is interesting to note that we have not found *comales* in the excavations at Ceren. Investigators have commented on the differential distribution of this cooking griddle in the highlands and the lowlands (Rands and Smith 1965; Kidder, Jennings, and Shook 1946). *Comales* have been cited as a highland form, one that is largely lacking in the Maya lowlands. This contrasting distribution has been attributed to differences in food preparation between the highland and lowland cultures. *Comales* are quite common in the ceramic complexes at Copanand Chalchuapa but are mentioned as an infrequent component in the various complexes at Quelepa. It would be valuable to determine more precisely the correlation between the use of *comales*, implying the consumption of tortillas, and attributes other than environment or ecological niche. It is possible that the *comal* could be associated with ethnic identity, linguistic affiliation or other cultural characteristics.

Another puzzling circumstance is the lack of calcareous deposits on the vessel interior basal sections. If a container had been used for boiling corn kernels in lime-rich water as part of the maize-preparation process, such evidence could be expected (Coe and Flannery 1967:81). Vessels used for this function at Ceren may be located in unexcavated areas, or perhaps the community used a somewhat different method for softening maize kernels.

Water storage jugs placed outside of houses also are absent from the Ceren inventories. Ethnoarchaeologists recently have noted that communities near water resources do not rely on ceramic water storage jars, substituting plastic and metal containers as lighter means for transport and storage (Nelson 1985 and David and Hennig 1972 cited in Arnold 1991:48). While Ceren occupants would not have had access to these other materials, perhaps the location of the village near the Rio Sucio precluded the need for significant water storage facilities.

When the Ceren ceramics are considered in comparison with pottery from other Late Classic sites in western El Salvador, some variations are noted. First, at Ceren there is very little Campana Fine Line Polychrome, a type that is quite common at other sites. The few pieces at Ceren attest to the fact that the eruption-period occupation coincided with the period when Campana was being made. At the present time, I can not explain this variation. Secondly, no Arambala Polychrome has been recovered at Ceren. Arambala is a polychrome

serving vessel type similar to Copador but with an orange paste and very cursive designs. The center of production was somewhere in the western part of El Salvador. It seems likely that manufacture of this type began later in time than the Ceren occupation.

Acknowledgments

Appreciation is expressed to Payson Sheets for his customary expertise in handling project arrangements and administration; to Andrea Gerstle for allowing me to share her "digs" during the 1992 field period; to all the project staff - foreign and Salvadoran - for their professional cooperation and personal friendship; to Ron Bishop for those endless sample irradiations and rapidly produced dendrograms; and to Brian McKee for thoughtful editorial comments on the initial draft. Muchisimas gracias por todo!

Vessel 295-2-280. Drawn by T. Fitzke.

Chapter 12. CHIPPED AND GROUND STONE ARTIFACTS FROM JOYA DE CEREN, 1991-92

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This chapter describes and interprets the lithic artifacts excavated after the close of the 1990-1991 excavation season in January, 1991. It includes chipped stone and ground stone artifacts. Andrea Gerstle encountered numerous lithic artifacts while conducting a test-pit program preparatory to the installation of posts to support permanent large roofs. The NSF-sponsored 1992 season followed her research, and extended from June through the first week of August. The combined collection consists of 69 artifacts, including five ground stone artifacts. The individual importance of specific artifacts is sufficiently great at Ceren to warrant individual description of them, and they are presented at the end of this chapter, as Appendix A. The analysis of these artifacts has given us better understanding of artifact use and discard at Ceren. For instance, we now better understand the reasons why prismatic blades were discarded, and it is not what we expected.

Thirty seven obsidian artifacts were excavated by Andrea Gerstle during the test pitting (Operation 7) preparatory to the installation of the permanent posts. Because the posts need firm anchors in bedrock, the postholes penetrated through the *tierra blanca joven* ("TBJ") tephra from Ilopango that was deposited in the second century AD, and penetrated through the well-developed soil that underlies that tephra. They belong to the Formative period, probably the Late Formative. Most were discarded, apparently. It appears that obsidian implements were manufactured at this locality during the Formative period. In contrast, obsidian manufacture was rare to absent in the areas of the Classic period Ceren site excavated to date. However, in the Postclassic period, after soil and human recovery in the area following the Loma Caldera eruption, obsidian manufacture resumed in a vigorous fashion. In fact, the Postclassic witnessed the most on-site prismatic blade manufacture of any period. The paucity of obsidian manufacture in Classic Ceren is notable, and probably is a reflection of the centralized economic system in operation in the Zapotitan valley at that time. During the Classic period the valley was evidently under the economic domination of San Andres (Sheets 1983), the power center responsible for import of obsidian, and manufacture and distribution of implements.

Andrea Gerstle encountered six artifacts of obsidian, all prismatic blades, in operations 4 and 6, in investigations that occurred after January of 1991. Only one (295-4-286) was found in a structure. It was virtually complete, is in good condition, and apparently was in use, not in storage prior to being put into use. It was in the thatch of the extreme northern corner of Structure 4, the *bodega*, and thus would have been an easy arm's reach away from someone standing under the eaves at that corner. Two other blades (295-4-287) apparently broke during the eruption, and may have been parts of the same blade that was in daily use prior to the eruption. The other blades were short fragments, shorter than 2 cm, that evidently had been discarded. These fragments were short enough to be difficult to hold and still expose a sufficient cutting edge.

The excavations in and around Str. 10 (Operation 8) yielded 7 lithic artifacts: a prismatic blade and a macroblade of obsidian, a flake core-hammerstone of jasper, one *mano*, and three donut stones. These artifacts, individually and collectively, do not match the lithic assemblages found in the structures of known household buildings, but we must remember that the inner room of the structure has yet to be excavated. A *mano* without a *metate* certainly is not an efficient functioning artifact. Building a small macroblade into an earthern floor, standing on edge, does not seem to relate to any known domestic activity or feature. And, finding a jasper flake core that had been converted to a hammerstone, with no flakes from the core discovered to date, seems enigmatic. The above three artifacts (*mano*, obsidian macroblade, and jasper core-hammerstone) were found together in a tight grouping just outside

the north wall of the building, under the eaves, on and in the prepared earthen floor. Such a tight grouping amid the widespread array of ceramics suggests that they were deliberately clustered, but the reasons for that clustering are not known. The diversity of artifacts in the grouping is notable: a well-formed *mano* with a lot of use left yet no *metate*, an obsidian macroblade that is so used that it is well beyond any cutting functions, and a jasper core imported from a considerable distance that was converted to a hammerstone.

Only one chipped stone artifact was found in Structure 10 that was in a use or storage context similar to lithic artifacts from domestic structures. It is a long prismatic blade (295-8-158) that was stored in an elevated context just outside the doorway that connects the inner with the outer room. It apparently was in quotidian use as a cutting implement.

Two relatively short segements of obsidian prismatic blades were found outside that structure. Although neither clearly was discarded, both were rather short to be effectively held. Both retain relatively sharp cutting edges, so it is possible that they were still being curated for use in or near the structure.

A very unusual grouping of three donut stones were stored in a cluster high in the eastern side of Structure 10, under the eaves. They may have been together on top of the rafters, or perhaps more likely on top of the building's northeast column. The range of craftsmanship is striking, as one is very well shaped, one is well shaped and is decorated with shallow grooves, and the other is almost as irregular as could be imagined. None of the three retained visible organic incrustations.

Thirteen lithic artifacts were encountered in the excavations of the midden in Operation 2, to the southwest of the sauna. One is a percussion blade of obsidian, one is an andesite flake probably resulting from a percussion blow to a *laja* slab for purposes of shaping the *laja*, one is a lithic fragment so small that I am not certain what it is, and one is a fragment of an obsidian percussion blade. The rest are obsidian prismatic blade fragments. Most of these measure between 2 and 3 cm in length, and the surprise is that most retain sharp edges along at least one and generally two edges. Most of these blades still are quite sharp, and it appears that the most common reason for discard of a blade is not that it became too dull from use, but that it broke into a segment that was too short to hold effectively while cutting. Most archaeologists, and particularly most lithic analysts, would expect that edge dulling would be the dominant reason for discard. I suspect that comes from our sensitivity to edge attrition, as lithic microwear studies have become so important and sophisticated during the past three decades. Perhaps the magnitude of the use wear research effort has oversensitized us to think of edge dulling as the principal reason to discard a stone tool, and neglect other possible reasons.

As we examine the prismatic blades from the midden, it is useful to remember that prismatic blades have been found in four principal contexts at Ceren: curated in thatch roofing in a bundle and yet to be placed in use, curated in thatch in accessible locations, in the midden, and in active agricultural zones. The average sharpness of the prismatic blades follows that order, with the sharpest blades being the ones "fresh from the market place" that had yet to be put into service, followed by the ones that had been put into daily use. While the latter were not actually being used, they were placed in thatch roofing above doorways or above porches. Not surprisingly, the dullest blades were the ones that had been discarded and had ended up in agriculturally active zones, where tillage and trampling would result in edge damage after the blade was thrown away. In edge dullness these are comparable to the ubiquitous prismatic blade fragments found in construction fill, in fields, and on the surface of archaeological sites throughout Mesoamerica. What was surprising is that the edges of the prismatic blades in the midden are more similar to the edges of the in-use curated blades than they are to the blades in the *milpas*.

Two factors have revised my thinking about prismatic blade discard at Ceren, the relative sharpness of the blades in the midden, and their shortness. Because they generally are sharp and short, I think the most common reason for blade discard is not that they became too dulled by use, but that a portion broke off during use and was discarded. It is possible that the more distal ends of prismatic blades were used more, and as they become somewhat dulled

they could have been deliberately broken off and discarded into the midden. It is striking how much edge abrasion occurred on the blades that were discarded into milpas and gardens.

Only five ground stone artifacts were discovered in the 1992 season. A metamorphic polishing stone was found in the midden; it had been used on three facets probably to smooth and polish clay either of ceramic vessels or of earthen architecture. A well-formed and only slightly used *mano* was found just outside the northern wall of Str. 10, under the eaves, with the other lithics discussed above. It is curious that it was so tightly clustered with the other chipped stone, but was nowhere near a *metate*. Three donut stones were stored together in an elevated context at the front of Structure 10, perhaps on a column top. They are notable for the wide range of finishing, ranging from barely shaped to well-shaped and decorated.

Appendix A: Lithic Artifacts from 1991 and 1992 Investigations; Analytic Details

Artifacts from Operations 4, 6 and 7: (Note: all artifacts from Operation 4 here described are mid-Classic in date, and the same applies to the Operation 6 artifact. The test pits for the big roofs occasionally enountered artifacts below the *tierra blanca joven* tephra from the Ilopango eruption, from the clay-laden soil, and thus are Formative, probably Late Formative, in date.)

295-4-286, almost complete prismatic blade, 11.5 x 1.4 x .3 cm; 5.3 g. It probably is missing less than a cm of the distal end. Found in roof thatch at the extreme northern end of the Structure 4 roof. The roof would have been low at this point, making it easy to reach up and grab the blade. The platform is moderately striated, and measures 7 x 2 mm. The platform overhang was removed by the rapid scraping technique, not by the earlier individual flaking technique. No organic residues were detected. The fracture surface intersected a small zenolith, and carried it off with the blade. No usewear was detected; a few tiny nicks out of each edge could have come during use or during the collapse of the roof and burial under 5 1/2 meters of tephra.

295-4-287, two small prismatic blade fragments, each averaging 1.5 cm long; total 1.6 g. The fractures appear quite fresh, indicating that the blade broke in the eruption. No usewear seen. This likely was in use.

295-4-288, a small prismatic blade fragment, 1.8 x 1.2 x .3 cm; 1.1 g. Fresh breaks probably indicate that it broke during roof fall, but was in active service before the eruption. No use wear was found.

295-4-289, a proximal end of a prismatic blade, 1 x .8 x .3 cm; .3 g. Platform measures 3 x 2 mm. The platform shows light striation, and moderate overhang removal by scraping.

295-6-50, the proximal end of a prismatic blade, 4.2 x 1.5 x .3 cm; 2.4 g. This artifact is from Operation 6, the large test pits north of Structure 4. The edges still retain a relatively sharp edge, but they are irregularly nicked rather deeply. The platform was striated moderately, and measures 9 x 3 mm.

Test Pits for large roofs: Operation 7. The artifacts that were found in the clay-laden, well-developed soil below the *tierra blanca joven* tephra from Ilopango date to the Formative period, and are clearly identified below. The others are contemporary with the rest of the Ceren site.

295-7-33, a tiny fragment of a prismatic blade, 1.5 cm long; .6 g. This was badly battered along both edges, and very short, and probably was abandoned for both reasons. From the pre-TBJ soil, and thus is Formative in date.

295-7-37, a tiny flake with a maximum dimension of 1 cm; .2 g. It probably is an eraillure.

295-7-70, a small fragment of a polyhedral core, 3 x 2.4 x 1.1 cm; 6.5 g. It originally measured some 7 to 10 cm in diameter; the core was smashed by harsh percussion blows. It was in the top 5 cm of the TBJ. This might indicate some manufacture of macroblades and prismatic blades at the site, if there are accompanying substantiating data.

295-7-84, a percussion flake, 2.5 x 1.6 x .4 cm; .8 g. The technology, of which this was a part, is not known. From the clay soil below TBJ, dating to the Formative.

295-7-100, a prismatic blade 1.7 x 1.5 x .3 cm; 1.4 g. It is not known if this was recently broken and discarded. The edges are relatively sharp, but it is too short to be used very readily.

295-7-115, a prismatic blade, 3 x .9 x .2 cm; 1.3 g. Both of these edges are extensively use-nicked, and the ends are rounded. This is a very interesting blade because its condition does not seem to correspond with the context within which it was found. It was somehow connected with or associated with Structure 13. It was found in Unit 2 tephra from the Ceren sequence, with some small pieces of fragmented adobe construction material. Judging from its size and condition, however, it had been abandoned as a cutting implement, and had suffered considerable post-abandonment edge damage. All I can suggest to resolve this apparent contradiction is that it may have been an inadvertent inclusion in the construction material, in spite of the fact that Ceren residents were quite effective in not allowing such materials into their wall construction.

295-7-116, a small, thin flake with no identifiable dorsal surface, 1.6 x .8 x .1 cm; .2 g. It probably is an eraillure, the flake that often separates from the bulbar area of the core and blade during large percussion removals of macroblades and large flakes.

295-7-126, a proximal fragment of a prismatic blade, 5.3 x .8 x .3 cm; 3.8 g. It has quite battered edges, with a regular nicking use wear and microflaking along one edge, and irregular use wear on the other edge. Both edges are relatively dull, particularly when compared to other prismatic blades stored in thatch roofing at Ceren. The platform, lightly striated, measures 6 x 3 mm. This artifact apparently fell with the roof collapse of Structure 13; it was found in Unit 1/2 tephra, with roofing thatch and some adobe construction fragments.

295-7-186, a medial fragment of a prismatic blade, 4.8 x .8 x .2 cm; 1.3 g. Its edges are moderately use-nicked. It was found on the floor of a structure. Its length would not have obviated its continued use, but the edges are more dull than all thatch-stored prismatic blades at Ceren excavated to date. Thus, it is not clear if it was still in use, based on the blade itself. Its context does indicate it was still in use.

295-7-216 consists of two small battered prismatic blade fragments averaging 2.5 cm in length; total weight, 2.5 g. One is heavily patinated, and probably was on the surface for quite some time before it was buried under volcanic ash.

295-7-217, a very small percussion flake 1.5 cm in diameter; .7 g. It has a tiny Hertzian cone that clearly indicates percussion. The technology or procedures that resulted in this flake are not known.

295-7-259 contains two obsidian artifacts. One is a prismatic blade, 4.7 x .8 x .3cm; 3.0 g. Its edges are slightly use-nicked but still are relatively sharp. If it was discarded, it is not clear why, as its length still is suitable for use. The other artifact is a small edge fragment detached

from a macroblade, 1.5 cm long; 1.1 g. The macroblade was badly battered, and this edge fragment may have been detached by that harsh use.

295-7-261 includes 2 small prismatic blade fragments, averaging 2.3 cm long; 2.8 g total. Both have slight use-nicking. Both were discarded.

295-7-280, a medial segment of a prismatic blade, 4 x 1.5 x .3 cm; 2.2 g. The edges show a high degree of edge damage; there is no sharp portion of any edge left. This was found in a pit penetrating well into the sub-tbj soil, but the pit comes from the mid-Classic horizon, and this artifact probably is contemporary with the Ceren site.

295-7-282, the medial portion of a prismatic blade, 1.5 x 1.5 x .2 cm. Its edges still are relatively sharp, but it is too short to be used very effectively.

295-7-288, a medial segment of a prismatic blade, 2.1 x 1.3 x .2 cm; 1.2 g. One edge has two broad notches, and the other has a series of 6 small notches, giving a denticulate appearance to the artifact. All notching appears to have been deliberately done, based on the regularity of the flaking.

295-7-293 contains 4 prismatic blade fragments; 3 may be from the same blade, and two do connect to each other, but the other does not. They average 1.7 x 1.6 x .2 cm; total weight, 4.0 g. All have some edge wear by microflaking and a slight amount of abrasion. The result is that all edges are relatively dull. The platform was moderately striated on its surface, and measures 5 x 3 mm.

295-7-298, a medial fragment of a prismatic blade, 1.9 x 1.8 x .2 cm; 1.4 g. The edges are badly damaged; this evidently was abandoned because of its length, or its edges, or both.

295-7-302, a small battered fragment of a prismatic blade, 1.5 x 1 x .2 cm; .3 g. This is very damaged and is missing most of one edge; that edge was fractured away.

295-7-305 is composed of two obsidian artifacts; 5.0 g total. One is a proximal fragment of a prismatic blade, 5.2 x 1.5 x .3 cm. Both edges were lightly to moderately nicked, but still are useable for harsher cutting. The platform is lightly striated, and measures 6 x 3 mm. The other artifact is a distal fragment, with edges in the same condition as the above blade. It could be from the same blade, but it does not fit. It measures 3.5 x 1.1 x .2 cm.

295-7-328 consists of two tiny fragments of what may be percussion flakes, each with a maximum diameter of 1.1 cm; .6 g total. One is of obsidian and the other of fine grained basalt. Found in the clay-laden soil below the TBJ, thus dating to the Formative.

295-7-331 contains two obsidian artifacts. These may be wastage from local manufacture of obsidian implements. Unfortunately they are not sufficiently large or well preserved to indicate the nature of that manufacture. One is a percussion flake, 2.8 cm long, and the other is a percussion flake terminating in a hinge fracture measuring 2.2 cm in length. Both weigh 3.8 g. They were found below the TBJ, and thus can be dated to the Formative. (Note: all other Op. 7 obsidian artifacts described below were found in or above the TBJ, and thus are mid-Classic, contemporary with the rest of the Ceren site.)

295-7-346, a medial segment of a prismatic blade, 5.1 x 1.2 x .2 cm; 2.4 g. Its edges are only slightly use-nicked, and it would be effective as a cutting implement still. This was found on the floor of Structure 16.

295-7-356, a proximal segment of a prismatic blade, 1.8 x 1.5 x .3 cm; 1.3 g. Its platform measures 5 x 3 mm. Its edges are rather battered and it is relatively short. It may have been discarded for either or both reasons.

295-7-358, a very tiny piece of obsidian with a maximum dimension of 7 mm. It is a small portion of a prismatic blade; .2 g.

295-7-360 contains 2 obsisian artifacts. One is a flake that is so small that it is difficult to say much about it. Its maximum dimension is 9mm. It is a small percussion flake or possibly a pressure flake. The other is a percussion flake, 2 x 1.6 x .2 cm. It looks like a broken bifacial thinning flake. Together they weigh 1.4 g.

295-7-383, a battered prismatic blade with both edges long gone. It measures 2.9 x 1 x .2 cm; 1 g. It has deep and irregular edge nicking along both edges.

295-7-384, a proximal fragment of a prismatic blade, 2.8 x 1.2 x .3 cm; 1 g. The platform is moderately striated, and measures 4 x 2 mm. Its edges were very damaged by heavy use, and probably it has sustained significant post-discard abrasion.

295-7-395, a percussion flake of fine grained basalt, 3.4 x 1.8 x 1 cm; 5.1 g. Its platform crushed under the impact. It has neither sharp nor acute edges, and no edges show any use wear. How it may be a part of some lithic technology is not known.

295-7-428, a medial fragment of a prismatic blade, 2 x 1.8 x .2 cm; .9 g. Its edges are deeply gouged by flaking, and show some abrasion. It evidently is trash that probably sustained considerable edge damage after discard.

295-7-430, an irregular chunk of obsidian averaging 8 mm in diameter; .7 g. It is not clearly a part of core-blade or other technology.

295-7-434, a broad medial segment of a prismatic blade, 1.8 x 1.8 x .2 cm; .9 g. Its edges are lightly to moderately use-nicked. It is too short and somewhat too dull for efficient use. It probably was discarded for those two reasons.

The following six FS numbers contain chipped stone artifacts excavated during 1991 from two 1x1 m pits in the midden to the southwest of Structure 9, in Operation 2.

295-2-449 contains 3 pieces of obsidian prismatic blades. All three were not dulled beyond continued use, but all are short. I suspect in all cases their length was more important than their edge condition leading to discard. One is a proximal fragment 2.6 x 1.3 x .4 cm; 2 g. The platform is slightly striated, 9 x 4 mm. The edges were moderately nicked by use, primarily by flaking, with only some abrasive wear. The second is a proximal fragment 3.5 x 1.4 x .3 cm; 2.2 g. The platform is slightly striated, 7 x 2 mm. Both edges are slightly use-nicked, one more than the other. Handedness might have an effect on tending to use one edge more than another. The third piece is a medial fragment, 3.4 x 1.7 x .3 cm; 3.3g. Use nicking is light to moderate on both edges.

295-2-430, a medial fragment of a prismatic blade, 2.6 x 1.1 x .2 cm; 1.4 g. This is only slightly dulled from use; its edges still are quite sharp. It probably was discarded because it broke in use and was too small a segment to be used effectively.

295-2-425, a small flake 1.5 x .6 x .2 cm; .4 g. This is a small percussion flake, but from what kind of larger artifact is unknown.

295-2-443, one small andesite percussion flake 1.2 x 1.8 x .3 cm; .8 g. Possibly this was removed from an andesite *laja* as it was being shaped for some use. Shaped *laja* were used for various purposes in the site, including as portable nether grinding stones and as caps to ceramic storage vessels.

295-2-425, a tiny piece of obsidian .8 x .6 x .5 cm; .3 g. This is such a small piece that it is difficult to tell how it relates to a lithic technology.

295-2-439 contains 2 prismatic blade fragments. One blade is a proximal portion, 2.3 x 1.4 x .3 cm; 1.6 g. The platform is slightly striated, 8 x 3 mm. One edge is moderately use nicked, primarily by flaking wear. The other edge is lightly use nicked. Although it is more dull than most of the above-described blades from this midden area, it still could have been used. It probably was discarded because of short length. The other blade segment is a medial portion, 1.3 x 2.0 x .4 cm; 1.5 g. Both edges are moderately use nicked. This is a very short blade segment.

295-2-592, a percussion flake, 3.1 x 1.9 x .6 cm; 3.5 g. It is from a stratigraphic layer well above the Ceren site, on top of the tephra that buried Ceren deeply. It would date to the Postclassic, or possibly very Late Classic. This may have come from shaping the sub-platform edge of a macrocore. If that is correct, it would indicate core-blade manufacture on the site.

295-2-514, a proximal fragment of a prismatic blade, 1.9 x 1.5 x .4 cm; 1.4 g. The platform is moderately striated, 8 x 4 mm. The edges are badly damaged, and each edge has a deep gouge taken out of it. The gouges almost look like deliberate notching. Most edge attrition is by flaking. Found on the west side of Structure 7, and probably was discarded as too short and much too dull for further use.

295-2-558, a sheared percussion flake 4 x 5.1 x .9 cm; 13.5 g. This is a medial segment of a macroblade that was very harshly smashed. The platform was thoroughly crushed and is completely missing. Only one short (9mm) section of an edge remains, and it was heavily used. Use wear is almost entirely in the form of microflaking. It is not clear why a macroblade would be so harshly smashed.

295-2-544 contains 2 prismatic blade medial segments. The larger is 2.6 x 1.5 x .3 cm; 1.4 g. It has light to moderate use-nicking on one edge, and very light on the other. Both edges are still quite useable. It probably was discarded because of its length. The smaller piece measures .8 x 1.5 x .3cm; .5 g. It is a tiny fragment, with both edges being quite sharp.

Chipped stone artifacts from Structure 10:

295-8-81, a small macroblade, 7.8 x 3.5 x .8 cm; 14.2 g. It is from Str. 10, outside the north wall, and was apparently built into the floor. It was placed on edge, with its long axis perpendicular to the north wall of the structure, with its upper edge just buried by the uppermost clay surfacing layer of the floor. Its platform is not striated, and measures 11 x 5 mm. It was stemmed by a light percussion flaking of the proximal end, on both edges, for 2 to 2.2 cm, along one edge from the ventral side and the other edge from the dorsal side. It could have been for holding or for hafting; no evidence for hafting was found, either in the form of haft-wear or in a cavity for a handle. Both edges are dulled far beyond a usable condition. The edge damage is by irregular and occasionally large (3mm) flaking wear as well as extensive smooth abrasion. The rounding is very smooth; no clear striations were detected. This could have been used as an agave de-pulping tool, or if smaller, finer leaves were also used for fiber, this could have served well. The flaking wear both antedates and postdates the abrasive wear. This may be an exception to the pattern of a blade beind discarded due to breaking. Or, more likely, that pattern of breakage being the most common reason for discard

probably applies more to prismatic blades, and macroblades often serve other functions than fine cutting. If this was used for de-pulping, its dulled edge would be an asset rather than a liability.

295-8-84, a jasper flake core-hammerstone, diameter 6 cm, height 4 cm; 153 g. Its platform is the natural flat cortex surface of the stone, with some stream wear evident. At least 8 flakes were removed by percussion from that platform, and most flakes ranged between 3 and 4 cm in length and width. It can be considered a unidirectional core. One flake partially hinge-fractured, but did not cause great difficulties in continued flake removal. A greater problem is that a few internal flaws in the form of hidden fracture planes are in the material. Other than that, it is a good quality stone. We have not found flakes of this material at the site to date. One end is battered by use as a hammerstone, for chipped stone manufacture of for shaping vesicular andesite.

295-8-102, a medial segment of a prismatic blade, 2.8 x 1.2 x .3 cm; 1.9 g. It was found on the sloping subplatform mound of Structure 10, on its southeast side. It probably was a discarded blade fragment. Both edges are lightly use-nicked, and both edges are still quite serviceable for cutting purposes, but it is too short to hold effectively and use for cutting.

295-8-154, a proximal segment of a prismatic blade, 3.1 x 1.3 x .3 cm; 1.8 g. Its platform is 4 x 2 mm, lightly striated. This was found on the earthen floor north of the north wall of Structure 10, toward the eastern end of the building. Both edges are lightly use-nicked, and both edges are lightly abraded along their entire length, likely after it was discarded. Most rounding abrasion appears to have occurred after prismatic blades are discarded, probably as they are intermittently tumbled during agricultural, architectural or other activities. Their edges would be gradually abraded by contact with tephra particles, presumably.

295-8-158, a proximal segment of a prismatic blade, 6.6 x 1.8 x .3 cm; 4 g. The platform is lightly striated, 4 x 2 mm. This was found near the floor, in Unit 1 tephra, in the doorway separating the eastern from the inner room of Structure 10. As it was less than a cm above the floor, stratigraphically at the same position as the fallen tabanco, it probably fell at about the same time, and perhaps from about the same height. It may have been placed on top of the inner dividing wall, on top of the *tabanco*, or it might have been shaken loose from thatch above the doorway by the turbulence of the eruption. It fell well before the thatch roof collapsed. This clearly is a piece of curated quotidian obsidian. One deep nick in one edge near the platform may be from the roof and more tephra falling on top of it. Other than that, the edges are very sharp. Only occasional use-nicking is visible, and no edge rounding in the form of abrasion was detected.

Ground Stone Artifacts, 1992 season:

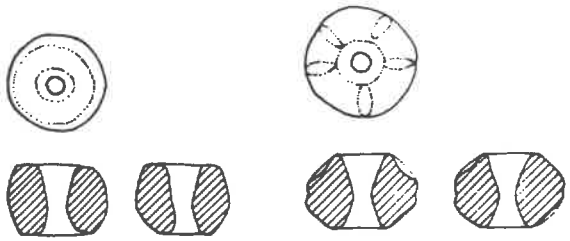
295-2-405, a polishing stone, 5.4 x 4.7 x 3.4 cm; 121 g. This stone has three grinding facets from the smoothing or polishing of something. It would have been useable as a pottery smoother or for smoothing finished earthen architectural surfaces. It is made of a dense metamorphic stone.

295-8-83, a *mano* found to the north of the north wall of Structure 10, on the prepared floor under the eaves, 18 x 8.5 x 5 cm. It is well shaped, and is a fairly short two-handed *mano*. The grinding and polishing from use was greater on its ends than its middle, on both sides, indicating that it had not been used long enough to uniformly conform to a *metate* surface completely. Either it had been manufactured fairly soon to the time of the eruption or it had been used only intermittently.

295-8-47, one of three donut stones stored together high on the eastern side of Structure 10. Their elevated storage could have been on the rafters, or more likely, on top of the structure's northeast column top. It measures 11 cm in height and 16.7 cm in diameter; the perforation begins at 6.2 to 6 cm in diameter and narrows down to about 2.4 cm. This one was used less than the other two, judging from the minimal abrasion at its point of maximum constriction. The abrasion does appear to be caused by motion parallel to the axis of the perforation. The stone is decorated with five grooves that carry from top to bottom. Curiously they are carved on only slightly more than half of the stone. They are so shallow that they are difficult to see.

295-8-49, one of the three donut stones stored together at Structure 10. Its maximum diameter was 18.8 cm, its minimum diameter was 15 cm, and its height averages about 8 cm. It is very irregular, and at first glance it appears to have been unfinished. One might think that the hole had been drilled, but the shaping not completed before it was put into use. However, there is more use wear in the perforation than the other two. That wear was parallel to the axis of the perforation. The more convex (upper) surface has a slight degree of polishing on the most protruding parts, which probably was connnected with its use. No organic incrustations were found on any of the three donut stones, other than some thatch adhering after the roof fell. This is the most irregular donut stone that I have ever seen.

295-8-51, a donut stone that was stored high on the east side of Structure 10, along with the other two described here. Its diameter was 14.5 cm, and its height was 9.9 cm. The perforations begin with diameters of 5 cm and taper down to 2.8 cm. This donut stone was very well shaped, and is quite smooth and round, but without decoration. The hole is slightly offset. The use wear, parallel to the axis of the perforation, is visible only at the point of greatest constriction. There is no evidence of the assymetrical wear seen on some other donut stones that may have functioned as perforated mortars.



Examples of donut stones from Operation 1, 295-1-123 on the left, 295-1-235 on the right. Drawn by K. Kievit.

Chapter 13. SUMMARY AND CONCLUSIONS

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Introduction

The 1992 research season of the Ceren project consisted of preparatory activities in the spring, field research during June-August, and laboratory and writing activities in the fall and winter. In spite of the delays in getting components of the research program underway, significant new data and interpretations are presented in this report. This chapter provides an overview of methods, results and interpretations of the season, as viewed by the principal investigator.

Volcanological Research

Probably the most notable of the results of Dan Miller's volcanological research is the discovery that many of the volcanic ash units, which previously had been attributed to Laguna Caldera volcano, more likely came from a source just south of that volcano called Loma Caldera volcano, and that perhaps all of them came from there. Until this question of the source of the eruption that buried Ceren is clearly resolved, it is preferable to refer to the volcanic units that buried the site as the "Ceren sequence." Miller continued his detailed studies of the relationships of volcanic ash units to the elements of architecture.

Geophysical Research

Jim Doolittle and Frank Miller employed two geophysical instruments at Ceren, a ground-penetrating radar (GPR) and an electromagnetic induction (EM34-3) instrument. The GPR detected a few anomalies at relatively shallow (2-3 m) depths in operation 9 (see Kievit chapter) which, based upon excavation results, probably were lava bombs and their impact craters. The GPR was limited in penetration, only to 3 or 4 meters, most likely in part due to high moisture content of the upper tephra units.

The EM instrument, using 10 meter coil spacing, penetrated much deeper, to 7.5 and 15 meters. Thus, it was penetrating too deep as we are particularly interested in structures and features buried by 4 to 6 meters of volcanic ash. A number of anomalies were detected with the EM instrument, however, some of which will be selected for test pit exploration in 1993 if funding and permissions are forthcoming. Some of these may be large, buried architectural features. It was decided that the EM31 instrument is the most appropriate for the particular conditions at Ceren, as it does not penetrate to the depth of the EM34.

Operation 8 (Structure 10)

Andrea Gerstle directed the excavations of Structure 10, which is located between Structures 11 (kitchen of Household 1) and 12. It opens to the east, toward 12, and shares some characteristics with that structure, including similar azimuth orientation, large columns, unusual artifacts, and red and white painted walls. Gerstle describes the architecture and artifacts in considerable detail. She identifies how differently certain spaces were utilized, particularly for storage purposes. The activity areas were also identified.

As with the rest of the site excavated to date, most artifacts here were found to have been placed in storage. The high shelf that ran along the interior dividing wall was used to store valuable and unique items, including the deer skull headdress. That shelf extended under the roof and beyond the north wall of the building, and held a large number of ceramic serving vessels. The artifacts stored outside the walls related more to food preparation and serving activities, and those stored inside the walls were more specialized, perhaps toward ritual. The lack of stored food, inside or outside the building, is notable. However, the unusually large cooking jar on a stone hearth north of the building, with the serving vessels above it on the extended shelf, may have been where a special liquid was prepared and dispensed. It is

possible that it was under the eves because the time period we are dealing with at the moment of burial is the rainy season. This function might have occurred out in the open, perhaps farther north of the building, in the dry season.

Operation 7 (Test Pits)

Andrea Gerstle also directed the research of Operation 7, which occurred after the close of the 1990-91 season and before the 1992 season began. She conducted a testpitting program to recover cultural data where the support posts of large roofs were going to be placed. The roofs are needed to protect the excavated structures and features.

She encountered a wide range of cultural materials including buildings, cultigens, human footprints, prepared plaza surfaces, and other items of considerable importance in understanding the Ceren site. The number of buildings she discovered indicates that we had underestimated structure density on the west end of the site. It would obviously be of benefit to the project to conduct more experiments with geophysical instrumentation, for some structures and structure complexes have been detected with geophysical instruments, while others have not.

Operation 2

Brian McKee directed excavations in Operation 2, most of which had conservation as their principal objective. The excavations north of Structure 2 and west of Structure 7 were to improve air circulation and thus the lowering of intra-architectural humidity. Walkways around structures, characterized by flat compacted surfaces kept free of artifacts, were found in both areas. The excavations to the south and west of Structure 9 were done to decrease humidity in the building, as well as to investigate the midden in the gully behind the building. The midden is the only formal discard area found at the site to date, and it is providing insights into artifact discard. For instance, most obsidian prismatic blades apparently were discarded because they were broken, as explained in more detail below and within the chapter on lithic material.

Operation 9 & Structure 17

Karen Kievit directed the excavations of Operation 9, where three human molars were discovered in 1990. Through her excavations the context of those molars was discovered: they were in the roofing thatch of a small building, Structure 17. How they got there is unknown, but it is intriguing to note that traditional household members in some areas of El Salvador toss their loose teeth over or onto the roof of their house. One wonders if this might be a custom with a long history.

Only the southern corner of Structure 17 was excavated, but it appears to be unusual in that its platform has a solid earthen column at the corner but no evidence of *bajareque* walls. Small geophysical anomalies detected by ground-penetrating radar to the south of the structure were excavated; they apparently were the loci where volcanic bombs fell and created bomb-sags in the stratigraphy. A juvenile maize milpa was found in this area.

Objects Conservation

Harriet "Rae" Beaubien and Mark Fenn, Smithsonian Conservation Analytical Laboratory, assisted the project in a wide range of artifact conservation activities. The painted object from the niche of Structure 2, at first thought to possibly be a codex but now identified as the collapsed remains of a polychrome painted gourd, was returned to El Salvador. The *bodega* of Ceren artifacts in the National Museum was reorganized and inventoried, and storage conditions were improved. Artifacts excavated in previous years were treated and their conditions improved.

The on-site artifact treatment and processing were also improved. The deer skull headdress from Structure 10 was too fragile to be lifted without special conservation treatment in situ. It was then lifted piece by piece and the process of reconstruction begun. A painted artifact in Str. 10, probably a gourd, was consolidated with B-72 and Japanese tissue, and then

filled with plaster atop a polyethelene separator. It was then block-lifted, inverted and treated in the lab. A fiber ring pot-support was consolidated in place on the floor.

Paleoethnobotany

A number of species were identified by paleoethnobotanist David Lentz, working with Maria Luisa Reyna de Aguilar. They include squash, cacao, avocado, peppers, at least three species of beans, maize (Chapalote-Nal-Tel from Mexico), guava, maguey, and nance. His research is continuing on samples he has on loan. He instituted a systematic sampling system for flotation and pollen samples, primarily directed toward recovery of relatively small plant microfossils.

Human Remains

Frank and Julie Saul analyzed the three molars from the roof of Str. 17 and found them to probably be from an adult, likely between 30 and 45 years old. The teeth show more attrition on what apparently is the first than the second molar, and very little on the third molar. They also analyzed six casts of the human footprints that Andrea Gerstle excavated in her Operation 7 testpitting program, and found them to be of people with statures ranging from 157 to 173 cm (62 to 68 in).

Ceramics

The ceramic collection is under intensive study by Marilyn Beaudry-Corbett. She has subdivided the collection into three groups: 1) vessels that were in storage and use, 2) vessels that had broken but been saved for reuse or were in reuse, and 3) vessels that had broken and had been discarded prior to the eruption. The vessels of Structure 10 are more similar to the ceramics of *bodegas* (especially Strs. 6 and 7) than other types of structures, except that there is a lack of utilitarian bowls. Structure 10 also had some unusual vessels, including a jar with an over-the-rim long loop handle with appliqued faces, an elaborate "alligator vessel" with an appliqued caiman head and legs, a shoe-shaped vessel, and a Copador tripod dish. It appears that some food preparation was done along the north side of the structure. The building probably belonged to someone with a special status or role in the community. I suspect that was a religious role, and that the person may have been a village shaman.

The Instrumental Neutron Activation Analysis by Beaudry-Corbett for 15 elements per vessel is yielding results, and she has detected seven compositional groupings within the total. They probably are different clay sources, with four containing domestic pottery and the *incensarios*. The groups are not uniformly distributed within structures and households, so she is beginning to see the relationships of households to clay sources and distribution of pottery within the community.

Lithics

The chipped stone from recent research came from four contexts: 1) stored high in thatch roofing prior to being put into everyday use, 2) stored low in thatch and accessible for everyday use, 3) discarded into the midden near Structure 9, and 4) discarded in gardens and milpas. The latter blade fragments have the extremely dulled, rounded edges so common in archaeological sites throughout Mesoamerica.

The surprise came from analyzing edges on blades from the midden. Those blades were surprisingly sharp, which brings up the question as to why they were discarded. The most likely reason for their discard is their shortness rather than their dullness from use. The blade segments in the midden are generally very short, and probably were discarded because a segment broke off the prismatic blade during use, making it too short to hold effectively while cutting.

The lithic analysis also included an unusual clustering of artifacts in a small area just north of the north wall of Str. 10, consisting of a *mano* and a jasper flake core-hammerstone on the floor and an obsidian macroblade embedded in the floor. Structure 10 also had one

obsidian blade in the thatch above the interior doorway, and three donut stones over the step up onto the porch.

Acknowledgements

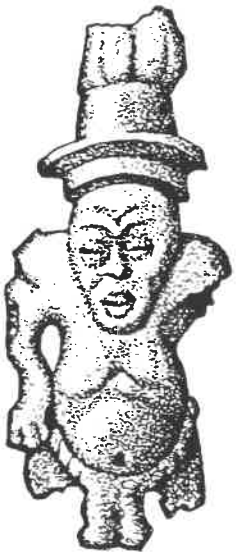
One of the most difficult things to do well in conducting international multidisciplinary research is to adequately thank all the people who have assisted the site, the conservation, the project, and us as researchers. So many people have given so graciously of their time, their materials and their efforts that it is difficult to thank them all. The research was funded by the National Science Foundation (BNS-9120716), with some matching funding from the University of Colorado toward construciton of a dig house in the town of Joya de Ceren.

The first people I wish to acknowledge are the conservation and excavation workers who really "did the work" of daily toil. They include Victor Manuel Murcia, Rene Antonio Coca de Paz, Pedro Ramirez Galdamez, Reyes Nelson Alvares, Lazaro Amaya Lopez, Salvador Rojas, Marco Tulio Chinchilla, Carlos Alberto Melgar, Alfredo Ismael Villadares, Jose Benito Bautista Canton, Jose Guadalupe Funes Canton, Lorenzo Lieva Bonilla, Jose Leonardo Ramirez Amaya, Rodrigo Hernandez Leon, Jose Adalberto Pineda, David Duarte Rivera, Osmin Elisandro Granados, Jose Humberto Pineda Portillo, Fidel Antonio Cortez Palacios, Alejandro Heriberto Granados Quintanilla, Jaime Eliseo Quintanilla, Jose Cesar Cordoba Bonilla, Santos Ines Ramirez Amaya, Pedro Ramirez Galdamez, and Nelson Rivera Orellana. We consider ourselves very fortunate to have the opportunity to work with such highly skilled and dedicated workers.

I really appreciate the hard work by the project staff, especially Dan Miller, Jim Doolittle, Frank Miller, Marilyn Beaudry-Corbett, Karen Kievit, David Lentz, Andrea Gerstle, Brian McKee, Harriet Beaubien, Mark Fenn, and others. Both of our "volunteers," Robin DeLugan and Valerie Conner, have provided invaluable assistance. Valerie will never forget the evening she invited me for dinner, and I left with the refrigerator.

I wish to express my appreciation to officials in the Salvadoran Ministry of Education, particularly Arq. Claudia Allwood de Mata, Arq. Maria Isaura Arauz and Manuel Lopez.. They have worked long and hard to protect the site and to open it to limited public visitation early in 1993. I am impressed with their dedication. The Patronato Pro-Patrimonio Cultural continue to be major supporters of the project, and particularly of the opening of the northern portion of the site to public visitation.

I want to express my special appreciation to my colleague Karen Kievit for her assistance on the project, her work in the field, her wonderful architectural drawings, and her outstanding efforts to bring this manuscript into this final form.



Carved bone figurine, 295-2-298, from Str 7. Drawn by T. Fitzke, from slides and field drawing by D. Tucker.

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