

# The Settlement Pattern of el Ujuxte, Guatemala

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## *The Regional and Temporal Context of el Ujuxte*

The Soconusco is a region along the South Pacific coasts of Mexico and Guatemala which has become particularly important in the study of the early development of regional economic and political centers in Mesoamerica. Sites in the region reveal widespread cultural contacts from the Gulf coastal plain of Veracruz to perhaps as far south along the Pacific coast as Ecuador.

The widespread distribution of a distinctive ceramic decorative technique during the Ocós phase (ca. 1500-1350 BCE) of the Early Preclassic suggests cultural contacts along the Pacific coast from as far away as the coast of Ecuador. Ocós pottery is distinctively rocker-stamped with the edge of a marine shell and painted with an iridescent red paint. In the following phases of the Early and Middle Preclassic similarity in certain ceramic figurines suggests contacts between the Soconusco and the Olmec area marked on the map by the sites of San Lorenzo and La Venta on the Gulf coastal plain.

The use of the Long Count form of the calendar in Mesoamerica is very strongly correlated with dynastic histories. It is to be expected that its use would emerge in areas that developed regional polities early. The oldest examples of the use of the Long Count form of the calendar are dated in the Late Preclassic (ca. 300 BCE - 300 CE). Of the oldest seven known calendric inscriptions that appear on a monument sufficiently massive that it is unlikely to have been moved far from the place where it was carved, three are found in the Olmec area of central Veracruz, three were found in the Soconusco, two at Abaj Takalik and one at El Baúl, and the remaining inscription was found in the Grijalva Depression between the two areas.

Along the western portion of Pacific Coastal Guatemala the Middle Preclassic Period, 900-600 BCE., saw the emergence of the region's first large regional polity, centered on the site of La Blanca. Soon after the collapse of La Blanca, around 600 BCE, the site of el Ujuxte, 13 kilometers to the southeast became its immediate successor as a regional focus. Later, about 400 BCE, Izapa, some 36 kilometers north of La Blanca also rose to prominence. A bit later still the site of Abaj Takalik, 42 kilometers to the east of La Blanca emerged as a regional center. These centers have overlapping chronologies and it is likely that the boundaries of their spheres of influence were dynamic.



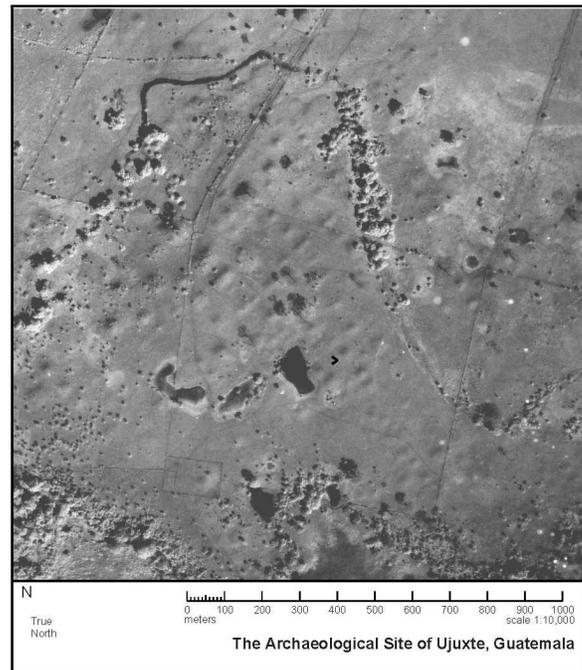
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## ***History of Archaeological Research at el Ujuxte***

The site of el Ujuxte (uh-hush-te) is the largest Preclassical site to be discovered in Pacific coastal Guatemala. The site includes approximately two hundred earthen mounds spread over some 200 hectares (494 acres) of farmland. It is located twelve kilometers from the Pacific in the far western corner of Guatemala. The site is of particular importance because there has been no pre-classical site of comparable size and period of occupation excavated in this region. The site was founded most likely about 600 BCE and was occupied until about 200 CE

Edwin Shook identified the site of el Ujuxte from the air in 1972. He visited the site and made surface collections in 1979. Michael Love visited the site and also made small surface collections in 1983 and 1985. Marion Hatch, Professor of Archaeology at the Universidad del Valle in Guatemala City also visited the site several times during the 1980's.

The Ujuxte Archaeological Project was begun in 1993 by Dr. Michael Love, then Adjunct Professor of Anthropology at the University of California, Santa Barbara, in order to amplify data on the Early and Middle Preclassic periods along the Pacific coastal



plain of Guatemala and to investigate the key questions of regional prehistory following the collapse of La Blanca. The research at el Ujuxte is centered on the study of the growth and collapse of early states in the region.

During a one-month season in 1993 and a two-week season in 1994, Michael Love established the foundation for further archaeological research at el Ujuxte. During these seasons a regional survey was undertaken which located a number of secondary centers contemporary with el Ujuxte. He noted that one nearby secondary center, Chiquirines, had a focal grouping of mounds that replicated the principal grouping at el Ujuxte.

In these seasons Love also completed a systematic surface collection from over 200 mounds at el Ujuxte and from 40 at Chiquirines. Further, he completed a topographic survey of the central square kilometer of the site, including data on 110 of the major mounds. During the 1993 and 1994 seasons Love was assisted by students from the Universidad del Valle in Guatemala City.

Analysis of the collections made in 1993 and 1994 revealed that occupation began at Ujuxte in the late Conchas phase toward the end of the 8th century BCE and that a large portion of the site was occupied during the immediate post-Conchas period, defined by Love as the Caramelo phase. These data indicate that Ujuxte began to be occupied prior to the collapse of La Blanca but had its major growth in population immediately following the collapse of La Blanca.

The Mesoamerican Archaeology Field School of Sonoma State University, under the direction of Dr. William Clay Poe, Professor of Archaeology, was invited by Love to participate along with students from the Universidad del Valle in the 1995 season.

During the 1995 season work continued on the topographic survey of the site and excavation was conducted for the first time on the site. Two locations were selected for preliminary excavation. One site, Mound 129 was selected because the surface collection on that mound included a number of sherds diagnostic of the earliest period of occupation of the site. The excavation of Mound 129 was directed by Dr. Margaret Purser, Associate Professor of Anthropology at Sonoma State University, with the assistance of Dr. Erin Browder of the University of San Diego.

The second site to be excavated was in the saddle between the two principal mounds of the Mound 2 platform and complex which forms the northeastern boundary of the central plaza of the site. The Mound 2 complex excavation was directed by Lic. Donaldo Castillo, Field Director of the Ujuxte Archaeological Project. At that site a large triangular stone, approximately 2 meters on a side and 75 cm. thick was found. The stone most likely was an altar.

While the overall thrust of the research design at Ujuxte remained focused upon the emergence of the site as a regional center, beginning with the 1995-96 field season and continuing through the 1996-97 field season Love has directed his research on the way in which that emergence is reflected in data collected from residential mounds and Poe has directed his research on the way in which the same process is reflected in the organization of the central mounds and plazas of the site.

Love began a field season in November of 1995 that continued until April of 1996 that involved excavation of a large number of the residential mounds at Ujuxte. His research design focused on an examination of the way in which the development of a stratified society and the emergence of an elite are reflected in the artifacts found in residential areas. He hypothesized that households would exercise less autonomy in the selection of raw materials and in the manufacture of artifacts as the society becomes stratified and inter-household cooperation and industrial specialization increase. This research seeks to pattern the effects of the emergence of an elite and the development of a polity on the autonomy of the residential units as measured by the sources of the artifacts used in the residential units.

Using data from the topographic survey conducted by the Field School in January of 1995 and his analysis of a computer-enhanced aerial photograph, Poe identified the main axes that defined the site organization. Poe also tentatively identified some possible solar, stellar and geographic alignments that might have explained certain organizational features of the site. The Field School excavated in the vicinity of the intersection of the site axes in its January 1996 season uncovering a number of caches of vessels buried as offerings under the hard packed dirt floor of the central plaza. The most dramatic find was a pair of large vessels buried lip to lip. This set of finds confirmed that the builders of the site regarded this center as important and that Poe's identification of the axes was accurate.

Based upon the finds of the January 1996 season, wishing to define the orientation of the site with the greatest precision possible, and faced with the eminent conversion of the site into a banana plantation, Poe applied to Trimble Navigation Limited of Sunnyvale, CA for the use of Global Positioning System receivers for very precise mapping of the site axes and for mapping several dependent sites in the region. Trimble provided six of their newly released mapping receivers and a survey grade receiver for use by the January 1997 edition of the Field School. Sam Shaw, a technical engineer for Trimble, played an important role in the design of the research strategy for the mapping project and was with the Field School for its first week in Guatemala to assist in the initial configuration of the equipment.

Love's 1997 field season began in January and continued until April. He continued the research design of his 1995-1996 field season, excavating and collecting data from residential mounds.

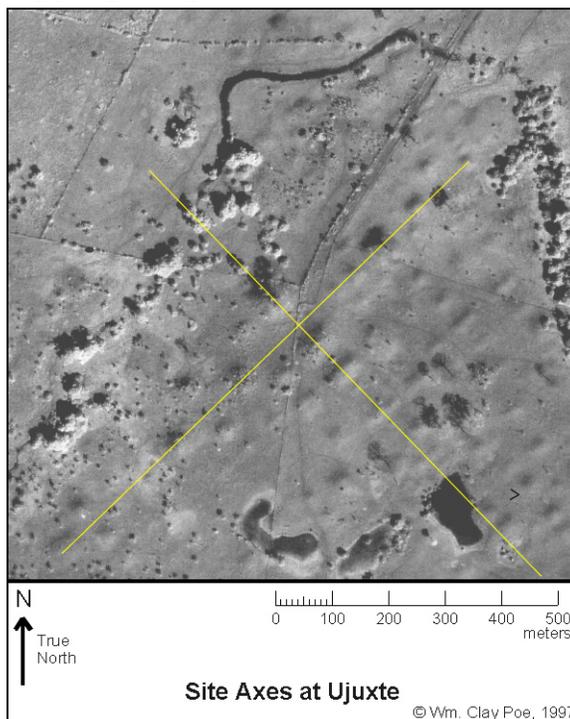
The January 1997 field season of the Mesoamerican Archaeology Field School was devoted to the GPS mapping of the site of el Ujuxte and of several sites in the vicinity of el Ujuxte that are believed to be likely dependencies of el Ujuxte. At el Ujuxte the locations of 9 benchmarks, important for tying in previous year's topographic surveys, were mapped and corrected with phase processing techniques to a horizontal accuracy of 10 cm. The locations of the top centers of 150 mounds were mapped and corrected with code processing techniques to a horizontal accuracy of 30 cm. There were 58,000 positions logged for the construction of a topographic map of the site. These GPS data refined the identification of the alignment of the site axes. The lip-to-lip cache, excavated in the January 1996 season, is now known to have been located only 1.28 meters from the currently computed intersection of the site axes. The mapping has also confirmed that the two main mound complexes on the site are aligned with reference to the summer solstice sunrise seen to be emerging from a volcano that is the most prominent mountain on the horizon of el Ujuxte. The mapping also determined that two smaller nearby sites have central zones with architecture that mimics that of el Ujuxte. A complete description of the analysis of GPS mapping data at el Ujuxte and the nearby sites of Chiquirines and Cuatunco/Los Enquentros is found below.

Archaeological field research at Ujuxte has ended. The site, on private farmland, has become a banana plantation.

## **Research Design and Methodology of GPS Mapping at Ujuxte**

The image to the right is based upon a 1965 aerial photograph of the area in which the site of el Ujuxte is located. The photograph was taken early enough in the day that the mounds are clearly marked by the highlights and shadows created by the relatively low angle of the sun in the east. This photograph was critical to the analysis of the alignment of the mounds and the organization of the site. There is fence line visible on the photograph running in an arc from the upper right to the center bottom. To the west of that fence line is the farm known as Finca Mojarras, to the east is Finca Caramelo.

In recent years parts of Finca Caramelo have variously been planted in sesame or corn, used as pasture, or left fallow. From the beginning of archaeological investigation at Ujuxte, Sr. Enrique Font, the owner of Finca Caramelo, graciously provided space and facilities for the base camp that has jointly served the Ujuxte Archaeological Project and the Mesoamerican Archaeology Field School. The mounds on Finca Caramelo are particularly distinctive in the midst of a field of sesame. The mounds are constructed of a silty clay and the sesame will not grow there. The mounds are obviously easy to recognize, map, and access for excavation where they are in a pasture or a fallow field. The larger mounds are covered in light brush and weeds.



On Finca Mojarras, however, the situation is quite different. For a number of years a banana plantation has occupied the area to the west of the fence. With the exception of Mound 1, the large mound near the center of the image, the remaining mounds on that portion of the site are very difficult to recognize and to map on the ground. The banana coverage is quite dense. Either from a light plane flying low or from the high points of Mounds 1 and 2 some hint of the contours underlying the bananas is discernable. On the ground, however, under the bananas, the dense planting, the guy wires, and the automatic sprinkler irrigation system contrive to dissuade one from the notion of traditional archaeological mapping with transit, tapes and stadia rods.

The photograph was scanned and the image was enhanced by computer manipulation of the gray scale response, the contrast and the brightness. Features mapped during the January 1995 topographic survey which were also recognizable on the aerial photograph were used as a basis for determining an approximate scale for the aerial photograph. The area under investigation subtends a small arc of the lens coverage in the photograph that errors due to the geometry of photography are minimal and were ignored for mapping purposes.

It is very clear that a number of groups of mounds are aligned along a northeast to southwest axis. Using the aerial photographic together with the data from the January 1995 topographic survey of Mounds 1 and 2, a point in the main plaza was identified that was the intersection of the northeast - southwest axis of the site with a line perpendicular to that axis and through the top center of Mound 1. It was hypothesized that were the axes in fact a part of the site design then the intersection of those axes marked the focal point of the site in the plan of the builders and might have been marked in some special way. In order to test this hypothesis the point identified as the intersection of the axes was located on the ground and systematic excavation was conducted in the vicinity of the intersection. Four 2-meter by 2-meter excavation units, one later expanded to 2 meters by 3 meters, were opened in a checkerboard pattern around the intersection of the axes.

Remnants of the hard packed dirt floors of the plaza from the Middle to Late Preclassic transitional period, ca. 300 BCE, through the middle of the Late Preclassic Period, ca. 100 BCE, were uncovered. Buried beneath the floors at the near the axis intersection were caches of whole vessels, including a lip-to-lip

cache, shown here being excavated by Poe, created by two similar large vessels with wide mouths being buried one on top of the other, lip to lip. These caches are well documented at later sites and are probably associated with the building of a monument, in this case most likely Mound 1. It is particularly of note that excavation units not in proximity to the axis intersection had few or no vessels found.

Love continued the excavation in one of the units following the end of the Mesoamerican Archaeology Field School season and discovered further caches at lower levels. During Love's 1997 season the area excavated on the plaza was expanded. A more extensive section of the plaza floor was exposed. And there were further discoveries of vessel caches in proximity to the intersection of the site axes.

The discovery of the caches confirming the importance of the intersection of the site axes, it became very important to define the azimuth of the site axis with as great a degree of precision as was possible.



## ***Research design for GPS mapping***

### ***Alignment of settlement patterns in Mesoamerica***

There has been considerable discussion devoted to the question of the alignment of Mesoamerican sites. In general, the focus has been upon the relationship of architectural features to celestial phenomena that were important for calendric reasons, probably related to agriculture. The central principles that governed the most common features of both forms of the Mesoamerican calendar may very well have been developed in sites of the south coastal plain of Guatemala and neighboring Chiapas, Mexico. Stelai with the earliest known Long Count dates come from this general area.<sup>1</sup>

The solar events that Mesoamerican peoples noted most frequently in their architecture were the solstices and the zenith transit days. A number of researchers believe that the 260-day length of the *tzolkin* is defined by a 260 day period from one zenith transit of the sun until the next. In the zone between the Tropics of Cancer and Capricorn there are days on which the sun passes directly overhead at local noon. Vertical objects at that time cast no shadow. On the Tropic of Cancer there is a single such day, June 22, the summer solstice. On the Tropic of Capricorn the day is December 22, the winter solstice. On the equator the zenith transits of the sun divide the year into two equal halves. Between the equator and the Tropic of Cancer, the zenith transits of the sun divide the year into a longer portion with the sun transiting to the south of the zenith, and a shorter portion with the sun transiting to the north of the zenith. The zenith transit days are always equidistant from the summer solstice. A 260-day zenith transit interval occurs at a latitude of 14°47'21", just thirty kilometers north of the latitude of Ujuxte. It has been suggested that Copan, only five kilometers north of the 260-day transit might be the origin to this count. The transit dates are April 30 and August 13. That August 13 is one of the classic Maya creation days lends credibility to this interpretation.

The zenith transit days may have been circumstantially significant for agriculture along the south coast of Guatemala. The April 30 zenith transit occurs just before the beginning of the rainy season. Farmers in the region presently plant their corn at the end of April or early in May. The August 13 zenith transit approximates the time of the harvest of the dried corn.

As is the case with a number of other preclassical and classical sites in Mesoamerica the site of Ujuxte shows evidence of careful alignment and placement of mounds with reference to a number of solar and perhaps some stellar events. This determination was initially made based on a study of an aerial photograph and upon topographic survey data gathered by Poe in January of 1995. However suggestive the data was, a more precise measurement was needed. By the Spring of 1995 there were three different north references in use by the archaeologists at Ujuxte. Love's 1993 and 1994 topographic surveys were

<sup>1</sup> Malmstrom, Vincent H., *Cycles of the Sun, Mysteries of the Moon: The Calendar in Mesoamerican Civilization*, Austin: University of Texas Press, 1997, p125ff.

based upon a magnetic north reading made with a Brunton Pocket Transit. Poe's 1995 topographic survey was based upon a Polaris reduction sight by Poe in January of 1995. The third north was the edge of the aerial photograph. However, the exact heading of the plane when the photograph was made was not known since the reading on that particular gauge is not clear in the photograph.

An independent and more precise means of determining the locations of mounds on the site was needed. Knowledge of the absolute locations of certain key mounds, rather than their relative locations, became extremely important when the possibility of a site alignment based upon solstice feature emerged. The author was also concerned to establish an appropriate set of standards for publishing material to be used in the study of archaeoastronomy. Comparative study of other sites has often been compromised by the poor quality of the reported data. Archaeological data has often been published without citing the methods and standards used for mapping. There is therefore no basis for evaluating the quality of the data. Differences in field measurements significant to the interpretation of the data have been recorded.<sup>2</sup>

### ***Orientation and alignment of sites in the region of Ujuxte***

Of a number of smaller sites in the region, contemporary with Ujuxte only the one at Chiquirines had been mapped by Love. He noted there an arrangement of mounds around a central plaza that appeared to reflect the arrangement at Ujuxte. Such common architectural features shared between the principal site and secondary sites are at least reflective of a shared image of site organization and might be suggestive of a regional level of social organization. It was thus deemed important to extend the mapping project to other sites in the area to provide the basis for an initial study of their relationship to Ujuxte.

### ***Research method***

Non-trivial constraints in the implementation of the research design included the limited time and resources of the investigator, the fact that the site of el Ujuxte was scheduled to be converted into a banana plantation, the fact that even the benchmarks which are marked on the 1:50,000 map of the region typically cannot be found, and the fact that the smaller sites in the region are also all on private land and the author wished to be able to gather the data rapidly and with minimum intrusion.

The author presented a prospectus for GPS mapping at the site and in the region of el Ujuxte and Trimble Navigation Limited of Sunnyvale, CA, generously made available a number of pieces of Global Positioning System equipment that permitted the rapid and accurate gathering of the data. In addition, Sam Shaw, a technical engineer of Trimble Navigation Limited was a member of the project team, participated in the research design, and was on site for the initial configuration of equipment and training of the student participants.

A Trimble 4600 Survey Receiver was established as base station at the project's camp on Finca Caramelo, the farm on which is found the majority of the site of Ujuxte. The base station was approximately 1.7 km. from the center of the prehistoric site. Shaw determined the base station's reference position after the field season, differentially correcting with data from Sunnyvale. The specification for the accuracy of the reference position of the base station is sub-meter.

A number of Trimble ProXR receivers and a Trimble 4000 receiver were used as rovers, collecting the positions of features and in most instances out of feature positions as well for use in constructing a contour map of the site. A large number of out of feature positions were also collected for contour mapping by mounting an antenna on a four-wheel-drive truck and driving accessible portions of the site.

The positions of the top centers of over 150 mounds at Ujuxte were collected by Field School students identifying the top center point or circular mounds and the top center line of long mounds and recording them. The mounds are gently rounded and it is often difficult to define the top center of a mound more closely than within a half or three-quarters of a meter. In January of 1997 much of the land on Finca Caramelo was fallow or planted in still young and low sesame so that even small residential mounds that rise no more than a half meter or so above the surrounding area were clearly visible. In addition to the

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<sup>2</sup> Peeler, Damon E. and Marcus Winter, "Building J at Monte Alban: A Correction and Reassessment of the Astronomical Hypothesis," *Latin American Antiquity*, 6(4), 1995, pp. 362-369.

mounds and other relevant features, some 58,000 positions were collected for the construction of a contour map of the site.

Because of the difficulty of access to the mounds on Finca Mojarras a different method was adopted. Prior to the field season a 1:50,000 UTMG map of the area was scanned and laid over the digitized aerial photograph. Features common to the map and to the aerial photograph, such as road intersections, were used as a basis for a tentative georeferencing of the photograph. This permitted a UTMG location to be approximated for the base station location as well as for mounds on Finca Mojarras that were identifiable in the aerial photograph. The approximated locations were entered as waypoints into the Dataloggers. For the real time navigation the base station reference position was approximated by the same method used for approximating the mound locations. This was the equivalent of establishing a temporary site coordinate system to permit the real time navigation. In order to minimize the distances involved for radio transmission a secondary base station was established at a benchmark on Mound 2 and fitted with a Trimble TrimTalk radio transmitter. The location of this benchmark has been corrected with phase processing to an accuracy of  $\pm 10$  cm. A repeater station was established on Mound 1 and a ProXR was equipped with a Trimble TrimTalk radio as a rover. In most cases real time navigation led the operator to within a few meters of the top center of the mounds. Then an actual top center was identified and logged as a feature. then recorded as features. The locations of the mounds under the banana cover were approximated by overlaying the 1965 aerial photograph with a scan of the 1:50,000 UTM map of the area, using a computer.

The GPS accuracy specifications for the corrected positions of these features are  $\pm 30$  cm. in the horizontal component and  $\pm 46$  cm. in the vertical component with reference to the site base station.

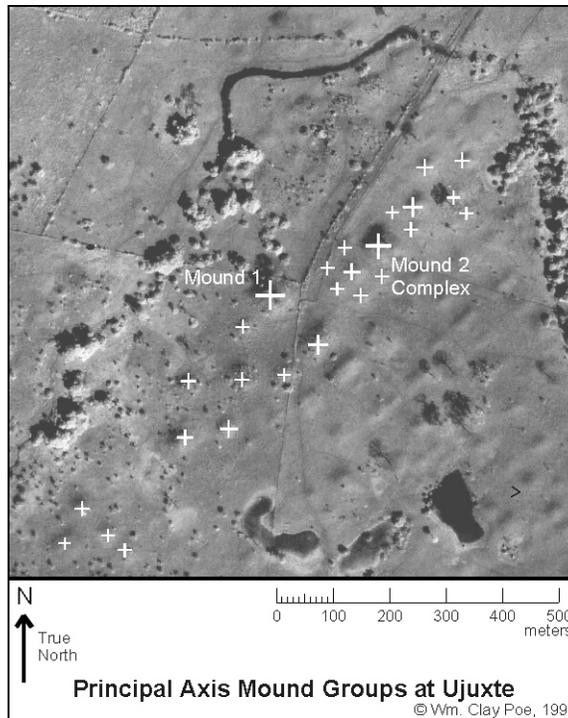
For nine control points that could be used to tie together the previously surveyed components of the site phase data was also recorded over a fifteen minute period for each control point. The expected RMS of the phase-processed positions was in six cases  $<10$  cm. and for three cases was  $<20$  cm.

### ***The Evidence for Urban Planning at el Ujuxte***

The central zone of el Ujuxte is laid out along a distinct northeast to southwest axis focused upon a central plaza. The groups of mounds that define the axis to the northeast of the central plaza are distinct. The southwestern most mounds along the line lie on the neighboring farm, Finca Mojarras. From the aerial photograph the azimuth of this principal axis of the site is  $226.24^\circ$ .

The largest of the mounds, Mound 1, forms the northwest boundary of the central plaza. It rises some twenty meters above the plain and required more than 60,000 cubic meters of earth for its construction. The second largest mound, Mound 2, is the northeast boundary of the central plaza. It is the focal point of a complex that involves at least six smaller mounds, all arranged on a platform. This grouping and its platform required around 63,000 cubic meters of earth for its construction.

The terrain around el Ujuxte is very flat. Small streams and seasonal drainages cut and abandon channels in the heavy summer rains. Occasionally the eruption of one of the volcanoes may cause a larger scale realignment of watercourses. In 1902 Volcan Santa Maria covered the area with a huge amount of pumice. The material dammed many rivers causing widespread flooding. When the dams broke, the river often cut a new channel. In most of the area covered by the site the soil is a silty loam, easy to work both for the archaeologist and for the farmer. The



mounds, however, are constructed of clay quarried from old drainage basins in the area.<sup>3</sup> Even when the current farmers plow and plant the low residential mounds in their fields with sesame, the crop simply will not grow on the mounds. The soil is presumably too dense a clay. Some of the areas that might have served as quarries can be seen as the three dark areas near the bottom of the aerial photograph.

The very existence of such large mounds on a site is evidence of the builders' ability to organize and direct the labor required for their construction. That the mounds are organized in patterns and along a particular axis is evidence of a large-scale plan that guided the construction and the ability to realize that plan on the ground. If similar features are shared at other sites it is evidence of communication and shared ideas beyond the confines of the particular settlement.

### ***Alignment of the site axis at el Ujuxte***

Nine mounds, themselves the centers of groups, define the principal axis of the site of Ujuxte. Eight of these mounds are in the central zone of the site. The ninth is the focal mound of a small group called Valle Lirio almost three kilometers southwest of the center of Ujuxte. The eight central zone mounds are shown in the accompanying figure along the northeast to southwest principal axis. A least squares linear regression analysis was used to obtain the trend line that represents the site's principal axis. The Pearson product moment correlation coefficient<sup>4</sup> was computed for several data sets, including and excluding the Valle Lirio mound and including and excluding the most southwest of the mounds in the central zone, the mound most distant from the regression line.

Group	Pearson's $r^2$	Azimuth
All nine mounds	0.9994426	226.241991°
Excluding the southwest mound of the central group.	0.9999035	226.303831°
Excluding the principal mound in the Valle Lirio group	0.9987712	224.009990°

The correlation coefficient is very high and compelling for all of the groupings of the data set. The azimuth of the site axis is in all cases between 224° and 226.34°. The direction of the alignment is based upon the architecture of the Mound 2 complex. This complex clearly faces southwest, not northeast. Since the reason for this particular alignment still eludes the investigators there are no external data that would tend to favor one of the above alignments over another. There being no clear argument, other than a very slight improvement in fit, for excluding any of the mounds from the data set, the definition of the principal axis adopted for this analysis is the least squares linear regression analysis trend line defined by all nine of the mounds identified. The principal axis thus has an Azimuth of 226.241991° (226°14'31") and is defined by the formula  $x - 0.957560y - 935342.53 = 0$  where the units are meters and 'x' represents the easting and 'y' the northing of the coordinate system which is UTM Zone 15 WGS84 datum,

The intersecting axis is defined as the line that is perpendicular to the principal axis and passing through the top center of Mound 1. That line has an Azimuth of 136.241991° (136°14'31") and is defined by the formula  $x + 1.04432y + 2282691.63 = 0$ .

The intersection of the axes is thus at UTM E603939.59, N1607505.21. This location is approximately 1.28 m. from the lip to lip vessel cache found in the January 1996 excavations.

If the site axis alignment is based on a near horizon astronomical observation then solar, lunar and planetary phenomena can be excluded since the ecliptic is never near either axis.

<sup>3</sup> D. Freidel, personal communication

<sup>4</sup> The Pearson product moment correlation coefficient,  $r^2$ , is a dimensionless index that ranges from -1.0 to 1.0 inclusive and reflects the extent of a linear relationship between two data sets, -1.0 and 1.0 representing a perfect correlation and zero representing no correlation.

Of fifty-six Mesoamerican sites that have alignment directions reported by Aveni, all but three have an alignment that is between  $06^\circ$  west of north and  $30^\circ$  east of north,<sup>5</sup> or between the azimuths of  $174^\circ$  and  $210^\circ$  if the axis is thought to be aligned to the south rather than to the north. The only reported alignment that is similar to the alignment of Ujuxte is that of Building J at Monte Alban near Oaxaca, Mexico. At Monte Alban the site itself and the buildings are aligned basically with the cardinal points. Building J on the main plaza, however, is oriented very differently. The building is an irregular pentagon. If one interprets the southwestern corner of the building as a pointer, as have some, the bisector of that pointer has been recently measured as  $223^\circ 47'$ .<sup>6</sup> The significance of that alignment is not clear and its meaning continues to be debated in the literature.

### **Organization of the site**

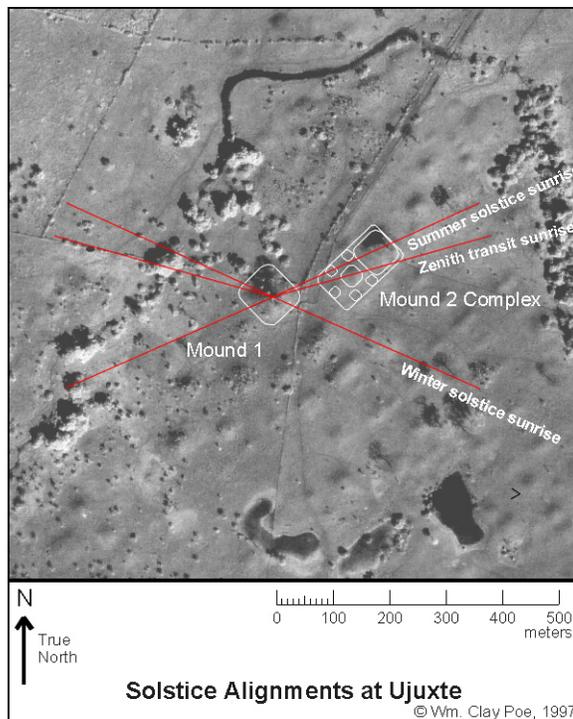
Many of the mounds along the principal axis are clearly organized into groups. The Mound 2 group is the largest and most complex of these groups, but there are also triplets of mounds arranged symmetrically around the axis and at each end of the axis in the central zone is a triplet of mounds with an additional mound offset to the southeast. The locations of the principal mounds on the maps above and directly below are defined by the GPS positions..

This obvious grouping and the symmetry of the arrangement certainly imply architectural planning on the scale of the site itself and the ability to realize that planning.

### **Principal solar alignments at el Ujuxte**

Three of the solar events known to have been of interest to Mesoamerican peoples are well documented in the alignment of several of the principal mounds at el Ujuxte. These are the lines that mark the horizon points of sunrise, or less likely, sunset on the summer solstice, the winter solstice, and the days on which there will be a zenith transit of the sun, May 4 and August 19, at el Ujuxte. Given the topography of the area the author believes it more likely that the observation is a sunrise observation made from the top of Mound 1 looking over Mounds 2, 5 and 6 rather than a sunset observation made from Mounds 2 and 6 over Mound 1. The zenith transit of the sun observation must be made from Mound 1 over Mound 6. There is no mound to the west of Mound 1 that provides a sunset alignment on those days.

The parallelism in the functions of Mounds 2 and 5 in marking the summer and winter solstice sunrise locations may be reflected in their symmetric placement with reference to Mound 1. They are essentially equidistant from Mound 1. The top center of Mound 2 is 210.54 meters from the top center of Mound 1 and Mound 5 is 204.77 meters from Mound 1. An implication of this symmetry is that the line connecting the top centers of Mounds 2 and 5 is close to a north-south line. The bearing of Mound 2 From Mound 5 is  $1^\circ 16' 00''$ . The author suspects that this is an artifact of the intent to treat Mounds 2 and 5 as symmetrical with respect to Mound 1 rather than an intended north-south alignment. It must be noted, however, that Mound 5 is a platform complex. Its contours are difficult to interpret and it is hard to determine just what one should consider the top center of the mound to be.



<sup>5</sup> Aveni, Anthony F. "Astronomy in Ancient Mesoamerica," in E. C. Krupp, ed., *In Search of Ancient Astronomies*, Doubleday & Company, Inc., Garden City, New York, 1977, p. 179.

<sup>6</sup> Peeler, Damon E. and Marcus Winter, "Building J at Monte Alban: A correction and reassessment of the astronomical hypothesis, *Latin American Antiquity*, 6(4), 1995, p. 363.

	Mound 2	Mound 6	Mound 5
Bearings from Mound 1	65°33'56"	74°03'01"	113°22'31"
Summer solstice sunrise	65°16'32"		
Zenith transit sunrise		74°41'39"	
Winter solstice sunrise			114°17'38"
Differences	0°17'24"	-0°38'38"	-0°55'07"

### ***Geographic alignment***

Most of the horizon viewed from el Ujuxte is very flat. However, to the north of the site the skyline is dominated by a range of volcanoes, among them Tajumulco, at 4221 meters the highest mountain in Central America, Tacaná (4094 m.) and Santa Maria (3789 m.). Because of the differences in the distances of the volcanoes from Ujuxte, the angular altitude of Santa Maria, 03°44'42", is greater than that of Tacaná, 02°59'25", and almost that of Tajumulco, 03°57'45". From the perspective of Ujuxte, both Tajumulco and Tacaná are in the midst of a high range and Santa Maria is somewhat separate, quite distinctive, and is the easternmost promontory of the range visible from the site. The bearing of the summit of Santa Maria as seen from Mound 1 at Ujuxte is 64°48'10". This is a different from the bearing of Mound 2 by 00°45'46" and different from the bearing of the summer solstice sunrise by 00°24'14". The sunrise azimuth cited above for the summer solstice at an altitude of 0°. Because of the altitude of the volcano, the sun will first be visible just slightly to the east of the summit at an azimuth close to 66°.

Vincent Malmstrom has recently noted a number of sites in Mesoamerica, and particularly in the Pacific coastal plain of Guatemala and neighboring Chiapas, which are situated such that the sun rises over the most prominent mountain on the horizon at the summer solstice. The site of Izapa has such a geographic relationship to Volcan Tajumulco, Abaj Takalik to Volcan Santa Maria, and El Baul to Volcan Agua. He notes other sites that are located so that the most prominent mountain on their horizon is on the winter solstice sunrise line, and several sites for which the alignment is with the sunset position.<sup>7</sup>

### ***Evidence for the Dependency of Cuatunco/Los Enquentros and Chiquirines***

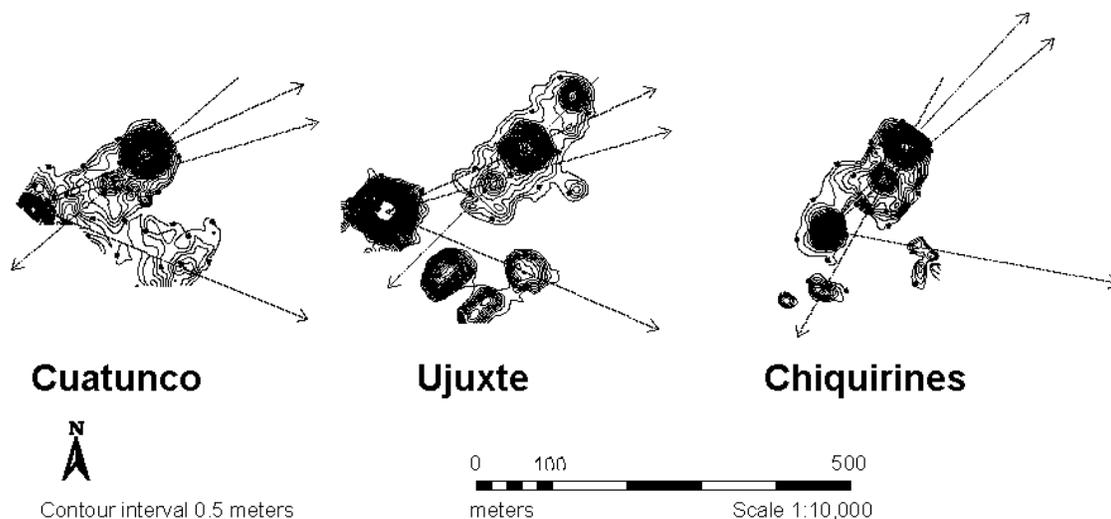
One of the objects of the January 1997 field research was to study the architectural relationship between el Ujuxte and some of the smaller sites in the area. At the site of Chiquirines, 5.3 kilometers to the northwest of el Ujuxte, Love had previously noted and mapped a mound complex that replicated the pattern of the Mound 1 and Mound 2 grouping at el Ujuxte. He hypothesized a dependency relationship on the part of Chiquirines marked by the mimicry of the dominant architectural feature of el Ujuxte.

Three sites were selected for GPS mapping and architectural comparison with the central zone of el Ujuxte, Cuatunco/Los Enquentros, 3.65 km northeast of el Ujuxte, Chiquirines, 5.33 km. to the northwest of el Ujuxte, and el Refugio, 19.34 km. to the northeast of el Ujuxte.

The collection of ceramics from Love's surface survey of Chiquirines in 1993 shows it to be contemporary with el Ujuxte. No surface survey has been conducted at either Cuatunco/Los Enquentros or at El Refugio. At least some of the mounds at el Refugio were earthen cores faced with stone. This is typical of sites later than el Ujuxte. On this ground el Refugio would tentatively be dated later than Ujuxte.

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<sup>7</sup> Malmstrom, Vincent H., *Cycles of the Sun, Mysteries of the Moon: The Calendar in Mesoamerican Civilization*, University of Texas Press, Austin, 1997, pp. 81ff.



The mound groups that play the most important role in the solstice alignment at el Ujuxte are Mound 1, the Mound 2 complex and, with less compelling alignment, Mound 5. The following figures show the central grouping at Ujuxte, Cuatunco/los Enquentros, Chiquirines and El Refugio. El Refugio is similar in the general alignment of the site an azimuth of 235° to 238° while the site azimuth of Ujuxte is 226°. However, the site plan of el Refugio is somewhat different from Ujuxte. Cuatunco/los Enquentros and Chiquirines, however, have similar mound groupings in the central zone of the site. Both Cuatunco/los Enquentros and Chiquirines have a grouping like the Mound 2 complex at Ujuxte. Both sites also have a large mound to the southwest of their version of the Mound 2 complex, the equivalent of Mound 1 at el Ujuxte. In each case there is also a low platform or mound cluster to the southeast that may be the analog of Mound 5 at el Ujuxte. If the winter solstice alignment of Mound 5 at Ujuxte is less compelling than the other alignments, it is even less convincing at these other two sites. The analogous groupings at Cuatunco/los Enquentros and Chiquirines are very low and not prominent among their near neighbors. The size of the Mound 2 complex at Cuatunco/los Enquentros as well as the alignments and the dimensions of the individual mounds are almost identical to that at el Ujuxte. At Chiquirines the overall pattern is similar but the alignments and dimensions are not so similar.

Among the contour maps of the central ceremonial complexes at the sites that follow, it should be noted with regard to the Cuatunco map that the Mound 1 equivalent at Cuatunco/Los Enquentros is very steep and was heavily covered with brush. Only a single traverse up the northeast side of the mound was mapped and the top center of the mound was recorded. Thus only the contour lines on the northeast side of the map are accurate.

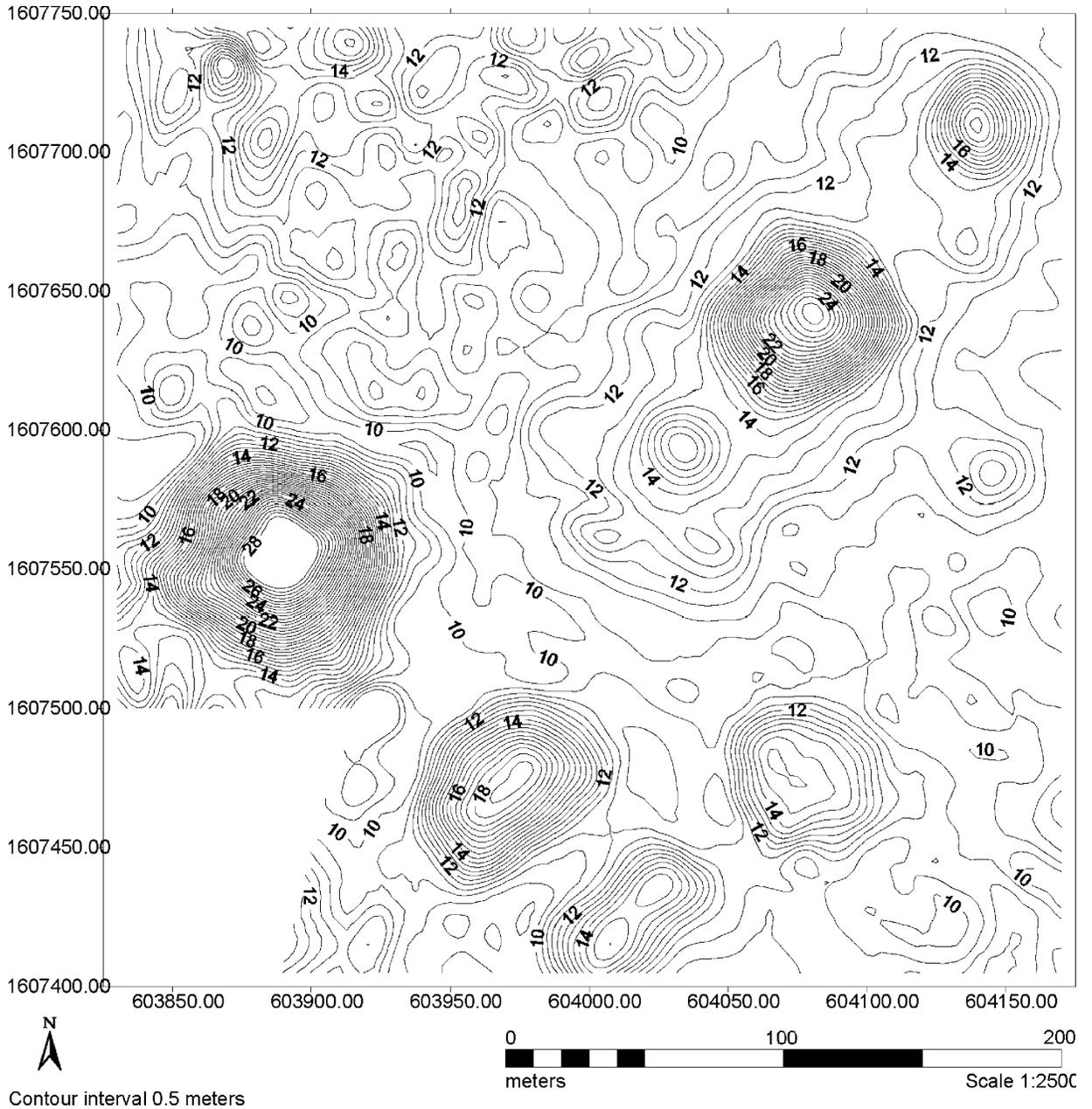
	<b>Cuatunco</b>	<b>Ujuxte</b>	<b>Chiquirines</b>
Azimuth M 1 > M 2	65°40'23"	65°33'56"	42°49'38"
Azimuth M 1 > M 6	73°25'34"	74°03'01"	49°49'34"
Azimuth M 1 > M 5	112°23'33"	113°22'31"	100°21'11"
Axis M. 2 complex	229°44'15"	224°58'27"	209°23'38"

The following are the distances from the principal mound in the Mound 2 complex, Mound 2 itself, to the smaller two mounds to the southwest. It is these mounds which mark the axis of the complex.

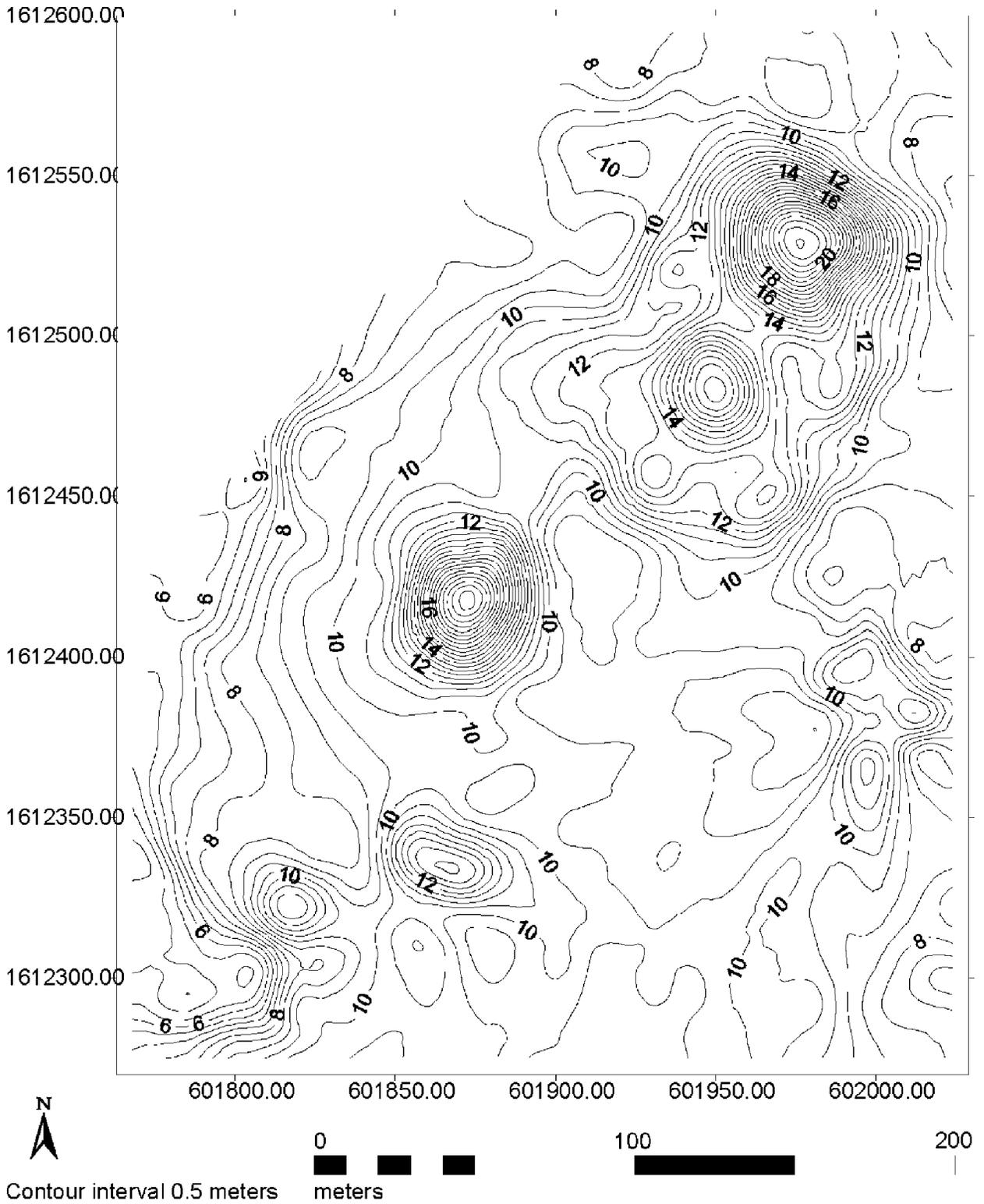
Distance M 2 > M 6	65.77 m.	61.48 m.	51.09 m.
Distance M 2 > M 22	105.51 m.	107.89 m.	89.35 m.

The central mound complex at Cuatunco is almost identical to that at Ujuxte, the bearings of the Mound 2 complex from Mound 1 vary no more than a degree and the distances between the mounds of the Mound 2 complex are very similar. The alignment of the complex itself is within five degrees. The bearings at Cuatunco could have been used like the bearings at Ujuxte to note the solstice and the zenith transit sunrises.

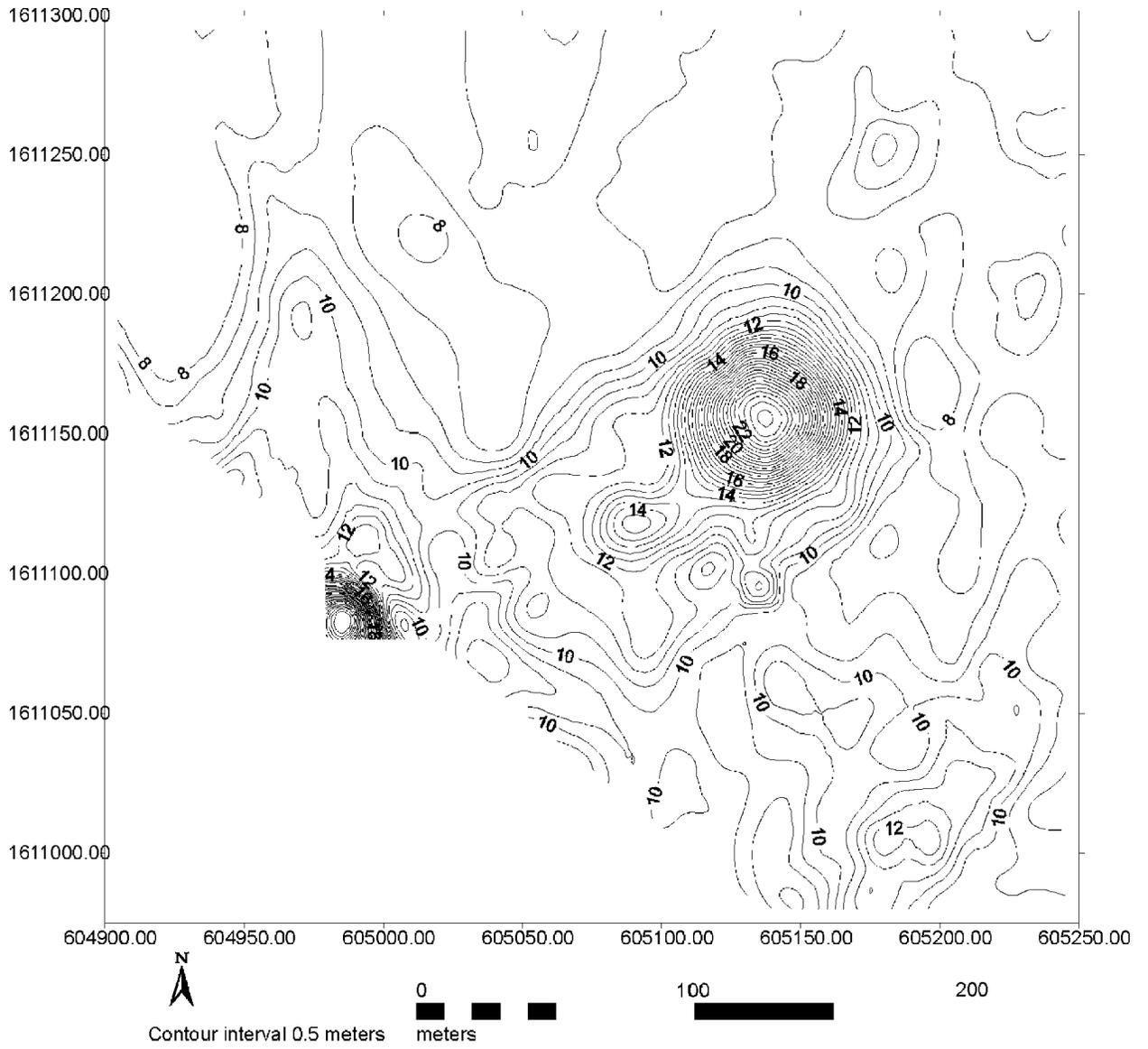
The organizational mimicry of Chiquirines and Cuatunco to Ujuxte is believed to demonstrate the dependency of these sites upon Ujuxte and therefore that Ujuxte was a regional center. The nature of the dependency is not known. However, given that the sites seem not to differ in available resources and that the mimicry is of what was surely a ceremonial center, the nature of the dependency was most likely not economic, but ceremonial and symbolic.



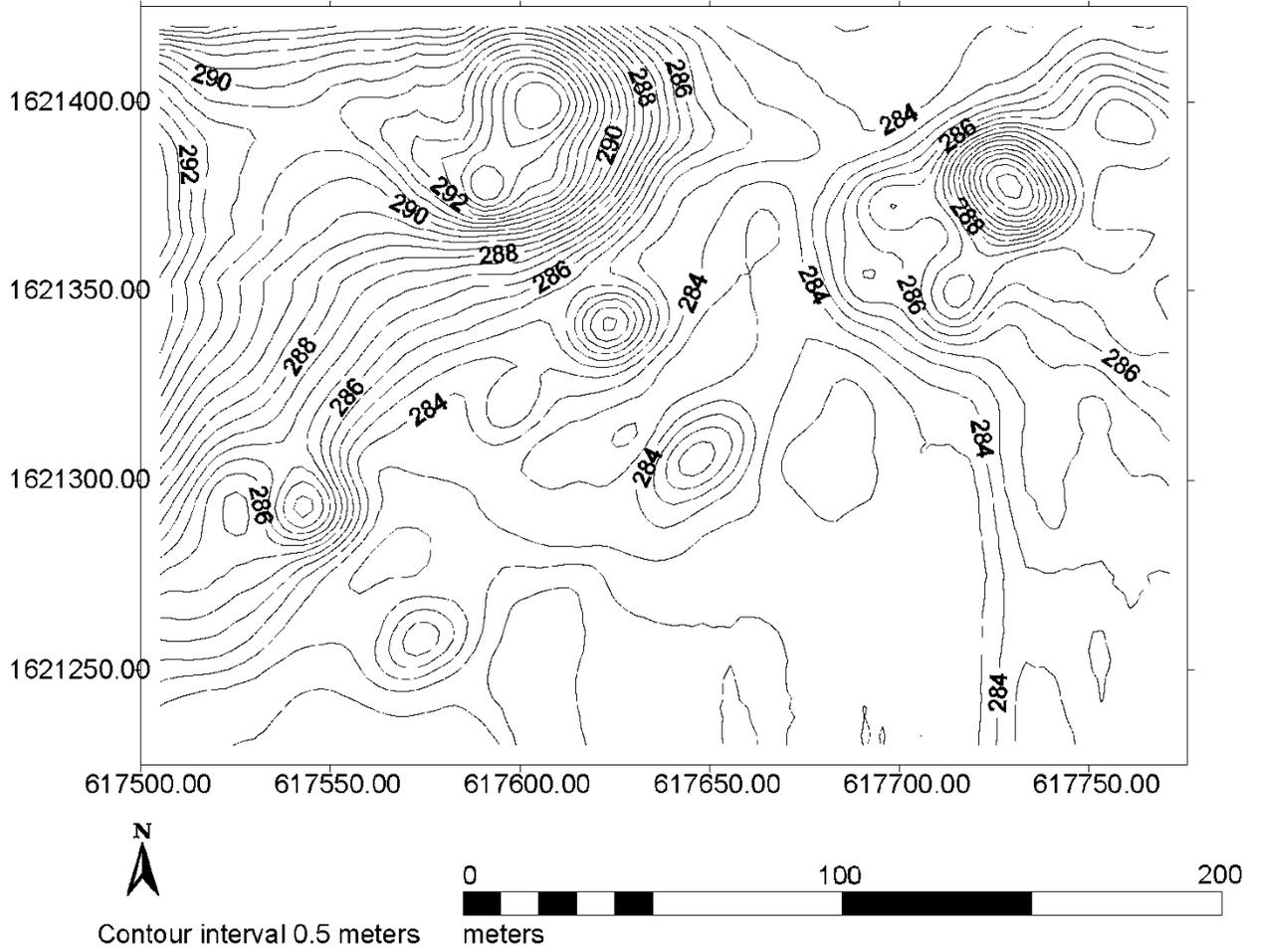
**Ujuxte, Mound 1, Mound 2 complex, Mound 5**



## Chiquirines, central mound complex



**Cuatunco, central mound complex**



**El Refugio, central mound complex**

## **Appendix**

### **Support**

Ruben Armiñana, President of Sonoma State University, provided funds for the initial feasibility study for the field school and for some of the initial equipment. The majority of the funds for the initial acquisition of equipment was from a RSCAP grant provide by Sonoma State University. In each year of the project financial support has also been provided by Robert Karlsrud, Dean of the School of Social Sciences at Sonoma State University and by the Department of History of Sonoma State University.

The bulk of the operating expenses of the Field School is provided by the course fees paid by the students.

For the January 1997 field season GPS equipment and software, Pathfinder Office, was made available to the director of the field school by Trimble Navigation Limited of Sunnyvale, CA.

Sam Shaw, a technical engineer at Trimble Navigation provided an immeasurable amount of assistance in planing the project, in specifying equipment appropriate to the task, in transporting some of the equipment, an most importantly in joining the project for its first week in the field to configure the equipment, help establish the operating procedures for the project, and in introducing the students to the theory and practice of GPS mapping. Mr. Shaw also contributed his travel costs.

### **GPS equipment**

The GPS equipment provided by Trimble Navigation Limited included:

A 4000 Survey Receiver, used as the base station

Five ProXR receivers, used as rovers

A 4600 receiver, used as a rover

Trim Talk radios, used for real-time navigation under the bananas

Tripods, monopods and associated support equipment

### **Data processing software**

GPS positions were corrected and initial data processing was completed using Trimble Navigation's Pathfinder Office™ software.

Benchmark positions were corrected using Trimble Navigation's Phase Processor™ software.

Data exported from Pathfinder Office was converted into surface and contour maps using Golden Software's Surfer™ program.

Further GIS analysis is being completed with ESRI's ArcView™ 3.0 program.