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A PRE-COLUMBIAN OBSIDIAN SOURCE IN SAN LUIS, HONDURAS

Implications for the relationship between Late Classic Maya political boundaries and the boundaries of obsidian exchange networks

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Abstract

Recent archaeological and geological surveys, combined with a neutron activation analysis, have located a new obsidian source in San Luis in the Department of Santa Bárbara of Western Honduras. From the Early Preclassic through Late Classic periods, the ancient inhabitants of the neighboring region of La Entrada acquired obsidian from San Luis and Source Y directly from outcrops and nearby streams in the form of small cobbles. These cobbles, due to their small size, were employed exclusively for the unspecialized production of percussion flakes, using a bipolar technique, for household consumption. Political boundaries played an important role in the distribution of certain imported commodities having a high exchange value: among others, Ixtepeque obsidian. It is our belief that political control over the distribution of Ixtepeque obsidian was confined more to smaller spatial configurations than to the suggested territorial political control of the segmentary states in the Maya lowlands. The distribution of goods with lower exchange values, such as the San Luis and Source Y obsidian, may have escaped political control. Small obsidian cobbles from San Luis and Source Y were apparently not distributed over long distances, but were rather essentially local resources.

The development of extensive exchange networks has often been considered one of the major variables in the evolution of complex societies (Brumfiel and Earle 1987; Earle and Ericson 1977; Ericson and Earle 1982; Sabloff and Lamberg-Karlovsky 1975). Marcus (1983:477–479) discussed three varieties of exchange, i.e., intraregional, interregional, and long-distance exchange. In Mesoamerican archaeology, most research efforts have studied long-distance exchange networks. In particular, archaeologists have often used obsidian artifacts to better understand the degree and nature of long-distance exchange because of the practicality of precise geochemical analyses that can determine the sources of archaeological obsidian (e.g., Dreiss and Brown 1989; Drennan et al. 1990; Hammond 1972; Healy et al. 1984; Moholy-Nagy et al. 1984; Pires-Ferreira 1975; Sidrys 1976). Intraregional and interregional exchange networks, on the other hand, have received far less attention. This paper presents empirical evidence on intra and interregional exchange networks and examines the relationship between Late Classic Maya political boundaries and the boundaries of obsidian exchange networks.

One of the most important objectives of the La Entrada Archaeological Project (PALE) centered around the search for new obsidian sources that were originally documented in data analyses reported by Aoyama and Glascock (1991) and Glascock et al. (1991). These reports described the analysis of 100 obsidian artifacts from the region of La Entrada in Western Honduras (Figure 1). Among the 100 obsidian artifacts, the 33 artifacts, found in two groups (known as Source X and Source Y), possessed chemical fingerprints different from all previously known obsidian sources in Mexico, Guatemala, and Honduras. Furthermore, the following observations were made:

1. The 33 artifacts were not of the core-blade industry.
2. A high percentage (more than 70%) of the artifacts included a cortex.
3. The cortex of some artifacts had been eroded by water action.
4. The artifacts were most densely clustered in the northeastern extremity of the La Entrada region and the neighboring Quimistán Valley.

Consequently, Aoyama (1994) surmised that this obsidian may have been obtained from outcrops and streams in the form of small cobbles that were not useful for the specialized production of prismatic blades. In 1992, in the surrounding region of La Entrada, Aoyama and Tashiro proceeded to search for sources of obsidian cobbles that might represent the Sources X and Y reported in Aoyama and Glascock (1991) and Glascock et al. (1991). During this search, obsidian cobbles from two areas (in the south and east of the Quimistán Valley) were collected and later submitted to Glas-

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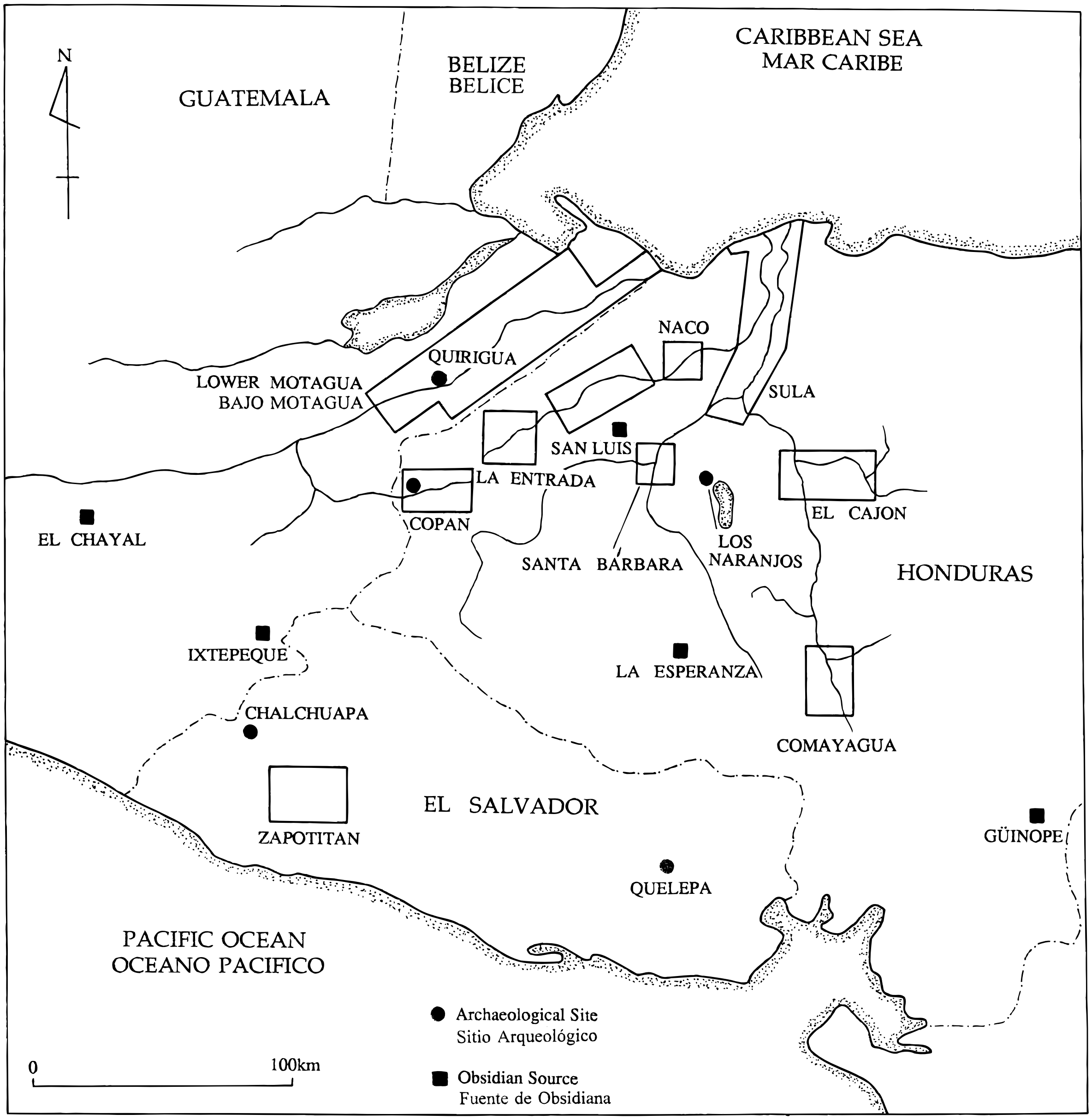

Figure 1. Map of the Southeast Maya lowlands and neighboring regions showing the location of the region of La Entrada, major archaeological sites, obsidian sources, and major rivers (after Aoyama 1994:Figure 1).

cock for characterization by neutron activation analysis (NAA). As a result, a third pre-Columbian obsidian source in Honduras was discovered at San Luis in the Department of Santa Bárbara, in addition to the ones previously identified at La Esperanza in the Department of Intibucá, and Güinope in the Department of El Paraíso (Sheets et al. 1990; Sorenson and Hirth 1984).

BACKGROUND

The study area of PALE is located 40 km from the major Classic Maya site of Copan. This area constitutes a portion of the southeastern periphery of the Maya lowlands (Figure 1). Its surface extends over some 150 km^2 and includes the adjoining valleys of La Venta on the east and La Florida on the west, along with natural corridors that lead to adjacent regions (Figure 2). The floor of these valleys is located in the upper part of the Chamelecón River and reaches elevations of 380–550 m asl.

Prior to the inception of this project, no systematic archaeological investigation had ever been undertaken in that area. The First Phase of PALE (Inomata and Aoyama 1996; Nakamura et al. 1991), carried out from 1984 through 1989, was part of a program of international cooperation between the Instituto Hondureño de Antropología e Historia and the Japan Overseas Cooperation Volunteers. The purpose of PALE was to investigate and preserve the archaeological sites of the region and relate them to archaeological data from Copan, and supposedly non-Maya regions of the southeastern Mesoamerica, such as the lower

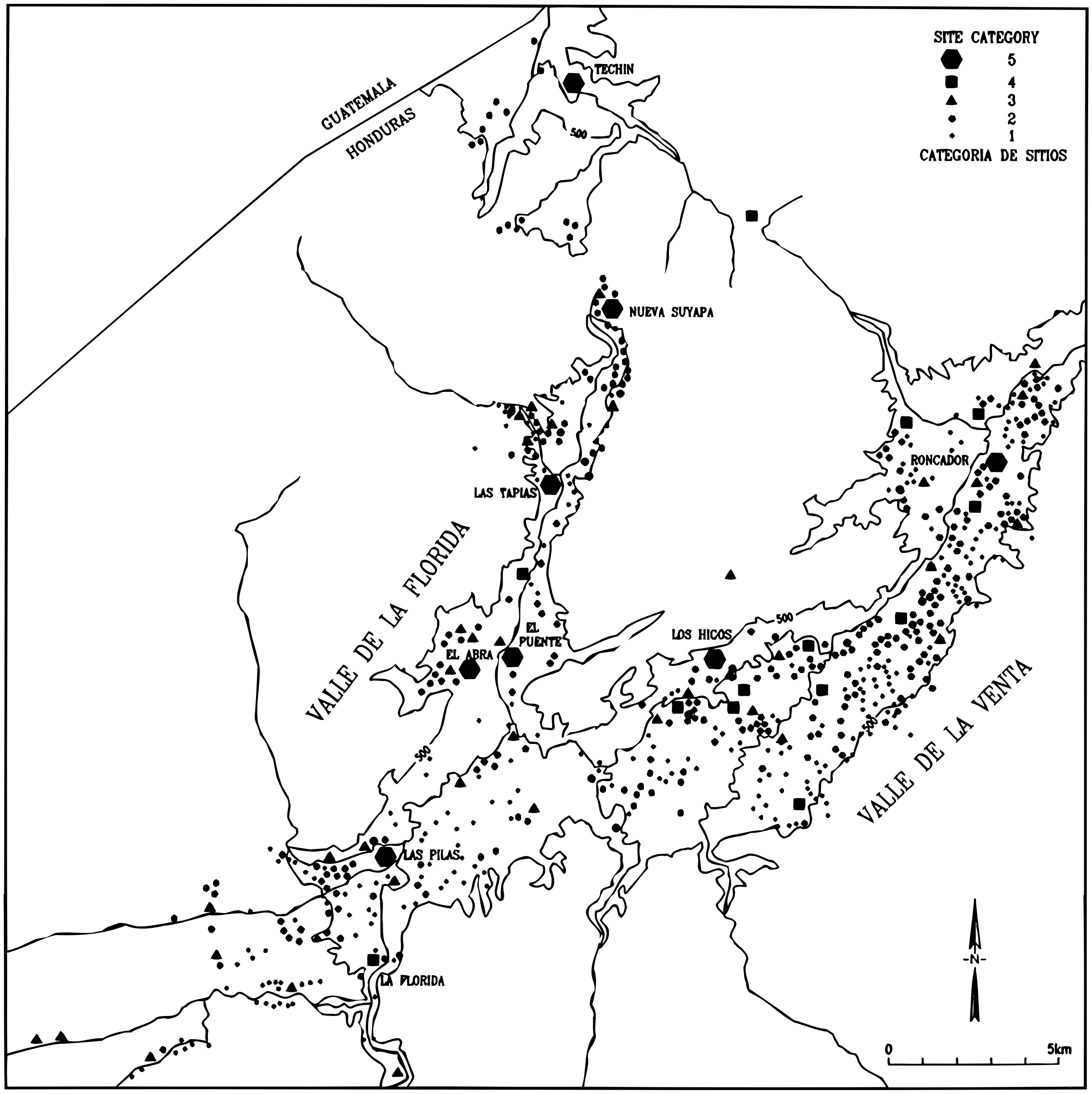

Figure 2. Map locating archaeological sites in the region of La Entrada (data from Nakamura et al. 1991).

Motagua Valley, Naco Valley, Sula Valley, the central Santa Bárbara area, the Los Naranjos area, the El Cajon region, and the Comayagua Valley (see Boone and Willey 1988; Fowler 1991; Pahl 1987; Robinson 1987; Urban and Schortman 1986).

The investigations of the First Phase of PALE included survey, mapping, test-pitting, and artifact analyses. Our survey located a total of 635 pre-Columbian sites in the region (Figure 2). Test excavations were conducted at 37 sites, each of which was selected by a stratified random sampling strategy. Subsequently, we extended our survey toward neighboring regions, such as the Quimistán Valley. These sites were classified into six categories: Category 1, sites without visible structures; Categories 2–5, sites with visible structures (Category 2 being the smallest and Category 5 the largest); and a "special category," sites with special characteristics such as caves (Figure 3).

The Second Phase of PALE (1990–1993) adhered to a multidisciplinary research method which included large-scale excavations and restoration of the site of El Puente (Category 5) in the La Florida Valley and geological, ecological, and botanical studies at the regional level.

The pre-Columbian occupation of the region of La Entrada probably began during the Early Preclassic period (1400–900 B.C.). The region, apparently, underwent accelerated political and demographic growth during the first half of the Late Classic period (A.D. 600–950). The apogee of the polities in this region could be represented as a "crossroads" straddling the Maya and non-Maya areas during the Late Classic period. Analyses of different archaeological data suggest that the region of La Entrada was governed not by a united political power, but by several polities of similar power (Inomata and Aoyama 1996). The three largest centers, El Abra, Los Higos, and Techín, are roughly 18 km apart (Figure 2). Based on ceramic chronology and obsidian hydration dates (Aoyama and Freter 1991:Table VI–59), it appears the region of La Entrada was completely abandoned by A.D. 950.

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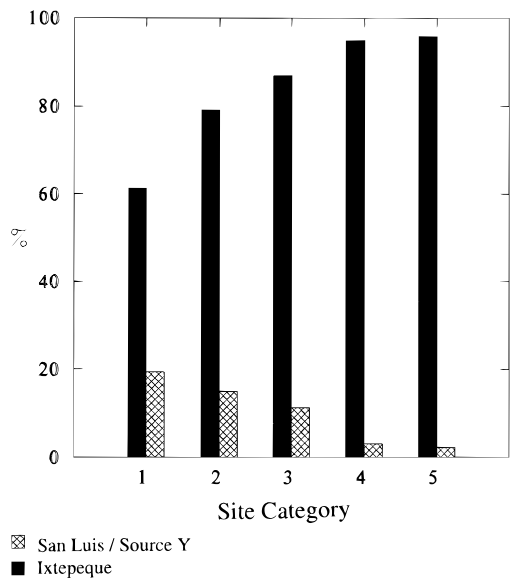

Figure 3. Obsidian sources represented in different categories of sites in the La Florida Valley and the hypothesized sustaining area of Los Higos in the Late Classic period. The numbers of obsidian artifacts for each site category are 41 for Category 1, 127 for Category 2, 285 for Category 3, 263 for Category 4, and 3,140 for Category 5.

Combining technological analysis and source analysis, Aoyama (1996, 1999) studied a total of 91,916 chipped stone artifacts recovered from extensive and limited excavations, alike, in the urban core of Copan as well as from the rural hamlets in the southeast Maya lowlands. Of these, 16,382 chipped stone artifacts were recovered from the region of La Entrada: 8,661 chipped stone artifacts were manufactured from obsidian, and remaining samples were made from chert and other local material. Aoyama (1996) classified these obsidian artifacts into 12 taxonomic entities (Table 1). Among the taxa, "general debitage" is referred to as a broad category consisting of refuse from a variety of manufacturing techniques, including unidentified shatter and other miscellany (Sheets 1983a:200). To identify possible obsidian sources, Aoyama (1996:80–83) employed visual analysis on all obsidian artifacts, comparing them with samples from the pre-Columbian obsidian sources of Pachuca in Mexico; Ixtepeque, El Chayal, San Martín Jilotepeque, Jalapa, Media Cuesta, and Shetumal in Guatemala; and La Esperanza–Intibucá, and Güinope–El Paraíso in Honduras. These sources were surveyed by Aoyama in 1986, 1987, and 1989. Table 2 summarizes the criteria of visual analysis: dividing obsidian into such categories as the color, texture and cortex. As with Braswell et al. (1994:Table 1), these criteria may be highly subjective but do have objective meaning. Visual analysis of large, statistically meaningful samples allows us to study exchange networks more explicitly than chemical source analysis of

Table 1. Technological and visual analysis of obsidian chipped stone artifacts from 29 sites of the region of La Entrada, Late Classic period

	Obsidian Sources					
Artifacts	IG	SL	CG	EH	UI	Total
Prismatic blades	3,233	0	7	13	1	3254
%	85.7	0	38.9	76.5	20	77.2
Macroblades	27	0	0	0	0	27
%	.7	0	0	0	0	.6
Exhausted polyhedral cores	33	0	0	0	0	33
%	1	0	0	0	0	.8
Prismatic blade points	2	0	0	1	0	3
%	.1	0	0	5.9	0	.1
Bifacial points	10	0	0	1	1	12
%	.3	0	0	5.9	20	.3
General debitage	408	344	7	2	2	763
%	10.8	86.2	38.9	11.8	40	18.1
Scrapers	37	29	2	0	0	68
%	1	7.3	11.1	0	0	1.6
Notched flakes	7	9	0	0	0	16
%	0.2	2.3	0	0	0	.4
Denticulates	8	0	0	0	0	8
%	.2	0	0	0	0	.2
Drills	1	2	0	0	0	3
%	.03	.5	0	0	0	.1
Flakes cores	3	15	0	0	0	18
%	.1	3.8	0	0	0	.4
Eccentrics	5	0	2	0	1	8
%	.1	0	11.1	0	20	.2
Total	3774	399	18	17	5	4213
%	100	100	100	100	100	100

Note: IG = Ixtepeque; SL = San Luis/Source Y; CG = El Chayal; EH = La Esperanza; UI = Unidentified sources.

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Table 2. Criteria of visual analysis for the determination of obsidian sources

Ixtepeque source	
Color	Principally grayish brown; very lustrous as well as translucent; some specimens do not have any banding but others show dark gray or light gray banding often with a milky color; some specimens are light and opaque gray; as Sheets (1983b:91) mentioned, other specimens have a combined mahogany-colored red with black.
Texture	Smooth and very fine; no dusty particulate inclusions. Some specimens have large, grainy inclusions.
Cortex	Either generally thin and relatively smooth or slightly frothy in appearance. Some have an irregular frothy and perlitic surface.
El Chayal Source	
Color	From black to dark gray and light gray; some specimens are translucent while others are rather opaque; some specimens are grayish brown but not as either lustrous or translucent as those of Ixtepeque; dark gray or light gray banding is frequently present; some specimens have matted brown and opaque brown spots.
Texture	Basically smooth; some specimens have fairly diffused particulate inclusions.
Cortex	Generally thin and relatively smooth. Some specimens have a frothy and very large faceted appearance.
San Martin Jilotepeque source	
Color	From black to dark gray; some specimens are fairly opaque; its black is lighter than that of El Chayal and it does not possess a strong luster; some specimens have dark-gray banding; other specimens reddish brown spots.
Texture	Not smooth but rather marred by dense, small pockmarks; its particulate inclusions are finer and denser than those of any other obsidian sources.
Cortex	Relatively thin but with an irregular frothy appearance.
Jalapa source	
Color	Basically opaque black, some specimens are opaque gray and light gray with a medium luster; other specimens present dark-gray banding.
Texture	Basically smooth. Some specimens are marred by diffused small pockmarks.
Cortex	Relatively thin; non-faceted and quite frothy in appearance.
Media Cuesta source	
Color	Not translucent; light gray without any strong luster; gray banding is present.
Texture	Not very smooth; grainy appearance.
Cortex	From a thin and slightly frothy surface to a faceted frothy appearance.
Puente Shetumal source	
Color	From dark and opaque gray to light and translucent gray; gray banding is present.
Texture	Mostly smooth. Some are marred by diffused, large pockmarks.
Cortex	Very large faceted appearance.
San Luis source	
Color	From bluish gray to opaque gray and relatively translucent black; dark gray or light gray banding is present.
Texture	Relatively smooth, not grained.
Cortex	Either generally thin and smooth or slightly frothy in appearance.
La Esperanza source	
Color	From light black to gray, very translucent; some specimens are grayish brown or opaque gray; other specimens have dark gray or light gray banding.
Texture	Grained and irregular; its particulate inclusions are fairly diffused but larger than those of any other obsidian sources; its fissures are longer than those of any other obsidian sources.
Cortex	Either generally thick or with an extremely irregular frothy and perlitic surface. However, some specimens have a rather thinner and less frothy cortex.
Guinope source	
Color	Basically black, its black is darker than that of any other obsidian sources; but some specimens are light or transparent gray, opaque gray, and grayish brown; however, its grayish brown is not as lustrous or translucent as that of Ixtepeque; dark gray or light gray banding is present.
Texture	Smooth, not grained.
Cortex	Generally thin and relatively smooth or with a faceted frothy appearance.

small samples selected by inappropriate sample methods. The accuracy of Aoyama's visual analysis was confirmed by a blind test of 100 obsidian artifacts from the region of La Entrada using Glascock's NAA results. The results of this blind test indicated a 98% accuracy rate. The results of the neutron activation analysis for the 100 obsidian artifacts were the following: 61 from Ixtepeque; 4 from El Chayal; 2 from La Esperanza; 25 from Source X; and 8 from source Y (Aoyama and Glascock 1991; Glascock et al. 1991).

GEOLOGICAL AND ARCHAEOLOGICAL SURVEYS

In 1991, Tashiro conducted a geological survey in an area of approximately 980 km^2 in the upper Chamelecón drainage. This area included both the La Venta and La Florida Valleys. The survey revealed an absence of obsidian outcrops in this area. When the Metal Mining Agency and the Japan International Cooperation Agency (1978), however, undertook an intensive geological survey in the mountainous areas to the south and east of the Quimistán Valley in the Department of Santa Bárbara, they reported 24 obsidian outcrops. In 1992, Aoyama and Tashiro carried out source surveys and collected small obsidian cobbles of suitable size for percussion-flake production at five locations. In addition, a small quantity of obsidian artifacts (i.e., percussion flakes and flake cores) was collected near the obsidian outcrop of Agua Helada (AH).

Aoyama and Tashiro submitted a total of 21 natural obsidian cobbles from the five locations for neutron activation analysis. Five specimens were selected from the outcrop of Agua Helada, five stream cobbles from the Quebrada Agua Helada (QAH), five specimens from the outcrop of Terreno Negro (TN), and one from the outcrop of El Paraíso (EP). All of these are located near the city of San Luis in the Department of Santa Bárbara, immediately south of the Quimistán Valley. The remaining five specimens were gathered from the outcrop of Agua Sucia (AS) located in the city of Quimistán in the Department of Santa Barbara, to the east of the Quimistán Valley in the southwestern extremity of the Naco Valley. The straight line distance from the outcrop of AS to the La Venta Valley is approximately 50 km.

NEUTRON ACTIVATION ANALYSIS

All specimens were prepared by Glascock for analysis using the procedures reported in earlier works by Glascock et al. (1988), Graham et al. (1982), and Vogt et al. (1982). The chemical analysis of neutron activation analysis was performed by employing SRM-278 Obsidian Rock and SRM-1633a Flyash as reference standards. A total of 27 elements was measured in each sample using three different counting procedures.

In general, it was observed that the different source groups were relatively similar. One exception was a sample from Terreno Negro that contained much lower values of rare earth elements (Ce, Dy, Eu, La, Lu, Nd, Sm, Tb, and Yb) than its companion samples from Terreno Negro. It was also noted that the compositions of the four remaining samples from Terreno Negro and the five samples from the Quebrada Agua Helada produced a single group fingerprint. As a result, the nine specimens were combined into a single reference group and designated as "San Luis" (see Table 3). Table 3 shows means and standard deviations for the specimen groups.

A comparison of the four new source groups and the sources reported in Aoyama and Glascock (1991) and Glascock et al. (1991) showed that these were significantly different from all previously

Table 3. Elemental abundances of obsidian from San Luis and nearby sources in Western Honduras (element abundances are in ppm except where otherwise indicated)

	San Luis (N = 9)	Agua Helada (N = 5)	Agua Sucia (N = 5)	El Paraíso (N = 1)
Ba	387 ± 75	189 ± 7	631 ± 58	658
Ce	57.3 ± 1	62.6 ± 10.4	61.8 ± 3	81.9
Cl	743 ± 54	765 ± 43	768 ± 47	435
Co	.382 ± .063	.21 ± .00	4.124 ± .007	1.48
Cs	3.16 ± .07	3.4 ± .04	2.6 ± .1	2.75
Dy	2.93 ± .26	3.1 ± .47	3.92 ± .24	9.91
Eu	.319 ± .034	.213 ± .003	.604 ± .079	1.86
Fe (%)	.751 ± .035	.634 ± .004	.795 ± .044	1.3
Hf	4.57 ± .18	3.99 ± .05	5.08 ± .31	6.7
K (%)	4.17 ± .1	4.26 ± .16	3.99 ± .3	4.69
La	31.8 ± .6	34.3 ± 4.8	32.2 ± 1.1	138
Lu	.348 ± .005	.352 ± .01	.474 ± .012	.617
Mn	372 ± 4	360 ± 2	697 ± 29	312
Na (%)	2.83 ± .04	2.69 ± .13	3.15 ± .04	1.95
Nd	19.4 ± .7	20.5 ± 4	24 ± .7	69.5
Rb	137 ± 2	145 ± 2	108 ± 4	129
Sb	.452 ± .005	.481 ± .007	.533 ± .011	.342
Sc	2.22 ± .03	2.08 ± .02	2.94 ± .09	3.68
Sm	3.7 ± .02	3.69 ± .05	4.71 ± .1	10.3
Sr	52.3 ± 21.7	19.4 ± 5.3	84.6 ± 26.5	201
Ta	1.36 ± .03	1.46 ± .02	1.58 ± .05	1.5
Tb	.491 ± .019	.487 ± .016	.673 ± .023	1.39
Th	13.4 ± .3	14.5 ± .1	10.5 ± .4	10.6
U	4.55 ± .17	4.59 ± .15	4.37 ± .26	3.72
Yb	2.21 ± .03	2.24 ± .04	3.04 ± .05	4.29
Zn	31.6 ± .6	30 ± .2	49.5 ± 2.9	44
Zr	158 ± 5	133 ± 7	179 ± 18	284

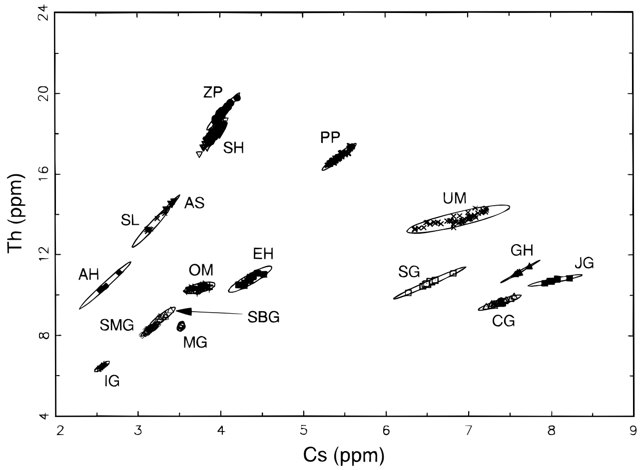

Figure 4. Cesium and thorium scatterplot for obsidian sources in Mesoamerica. The sources located in Honduras are: AH = Agua Helada; AS = Agua Sucia; EH = La Esperanza; GH = Güinope; and SL = San Luis. The sources located in Guatemala are: CG = El Chayal; JG = Jalapa; MG = Media Cuesta; IG = Ixtepeque; SBG = San Bartolomé Milpas Altas; SMG = San Martín Jilotepeque; and SG = Sansare. The sources located in Mexico are: OM = Otumba, State of Mexico; PP = Paredon, Puebla; SH = Sierra de Pachuca, Hidalgo; UM = Ucareo, Michoacan; and ZP = Zaragoza, Puebla. Confidence ellipses are plotted at the 95% confidence level for the individual groups.

Table 4. Technological and visual analysis of obsidian chipped stone artifacts from four sites of the region of La Entrada, Middle Preclassic period

Artifacts	San Luis/Source Y	Ixtepeque	Total
Prismatic blades	0	8	8
%	0	5.8	1.7
General debitage	286	118	404
%	84.9	86.1	85.2
Scrapers	13	8	21
%	3.9	5.8	4.4
Notched flakes	0	1	1
%	0	.7	.2
Denticulates	2	0	2
%	.6	0	.4
Flakes cores	36	2	38
%	10.7	1.5	8
Total	337	137	474
%	100	100	100

identified obsidian sources in Mexico, Guatemala, and Honduras (Figure 4). Figure 5 shows a Cesium vs. Thorium scatterplot that compares the three new source groups (AH, AS, QAH+TN) with the 33 La Entrada artifacts from Sources X and Y. It is interesting that the three new sources plot along a similar correlation line, suggesting a geochemical relationship between their parent magmas. The ellipses shown represent a 95% confidence interval for each source group. From this scatterplot, it is quite clear that the artifacts from Source X are near-perfect matches with the combined Quebrada Agua Helada and Terreno Negro source group. It is also evident that the artifacts from Source Y do not belong to any of the newly characterized sources. Therefore, we have provenienced the 25 artifacts identified with Source X to the cobbles originating in the QAH+TN area. Henceforth, we will refer to Source X as "San Luis," given the source's proximity to the city of San Luis. On the basis of geological observation and the presence of some common chemical elements, it is quite likely that Source Y is located near San Luis. Aoyama classified the obsidian from the San Luis source and, supposedly, nearby Y sources together as one obsidian source group in his visual analysis (see Tables 1, 4, 5).

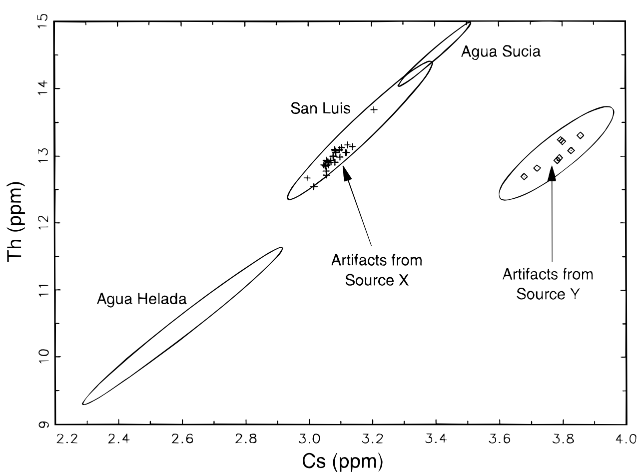

Figure 5. Cesium (Cs) and thorium (Th) scatterplot comparing 95% confidence ellipses for obsidian sources at San Luis, Agua Sucia, and Agua Helada with the 33 obsidian artifacts from Sources X and Y. We conclude that the Source X artifacts are from San Luis.

Table 5. Visual analysis of obsidian chipped stone artifacts from the region of La Entrada, Late Classic period

	Valley			
Obsidian source	La Florida	La Venta (South)	La Venta (North)	Total
Number of sites	11	15	3	29
Ixtepeque	3,054	619	101	3774
%	96.8	88.3	28.3	89.6
San Luis/Source Y	74	72	253	399
%	2.3	10.3	70.9	9.5
El Chayal	11	4	3	18
%	.3	.6	.8	.4
La Esperanza	13	4	0	17
%	.4	.6	0	.4
Unidentified source	3	2	0	5
%	.1	.3	0	.1
Total	3155	701	357	4213
%	100	100	100	100

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GEOLOGICAL DESCRIPTION

The San Luis obsidian source (Terreno Negro) is located on the west slopes (700–1100 m asl) of the Cerro Cantiles, to the south of the Quimistán Valley, in the middle Chamelecón drainage (Figure 6). The straight line distance from this source to the La Venta Valley is approximately 30 km.

The pyroclastic rock of the Tertiary period is rhyolitic and contains obsidian cobbles ranging from 1 to 60 mm in diameter. This rock also contains cobbles of spherulite, quartz, and feldspar, but it does not have any phenocrysts. All components of the rock, except the obsidian cobbles, are susceptible to weathering and are easily transformed into clay, as the matrix is quite porous. The obsidian cobbles, however, are found densely clumped together among the layers. In fact, some roads and paths on the obsidian source are completely covered with obsidian gravel. The obsidian cobbles represent, at most, about 10% of the volume of this parent rock. We estimate that the layers containing obsidian cobbles are 10–20-m thick and are in the shape of discontinuous lenses.

The obsidian cobbles are easily detached from their parent rock by water erosion and carried downstream. We collected obsidian cobbles not only in rocky streams, such as the Quebrada Agua Helada near the obsidian source, but also in the lower courses of the Tapalapa River near the village of Chumbagua (Figure 6). In the latter case, however, obsidian cobbles were too small to be of any use in percussion-flake production.

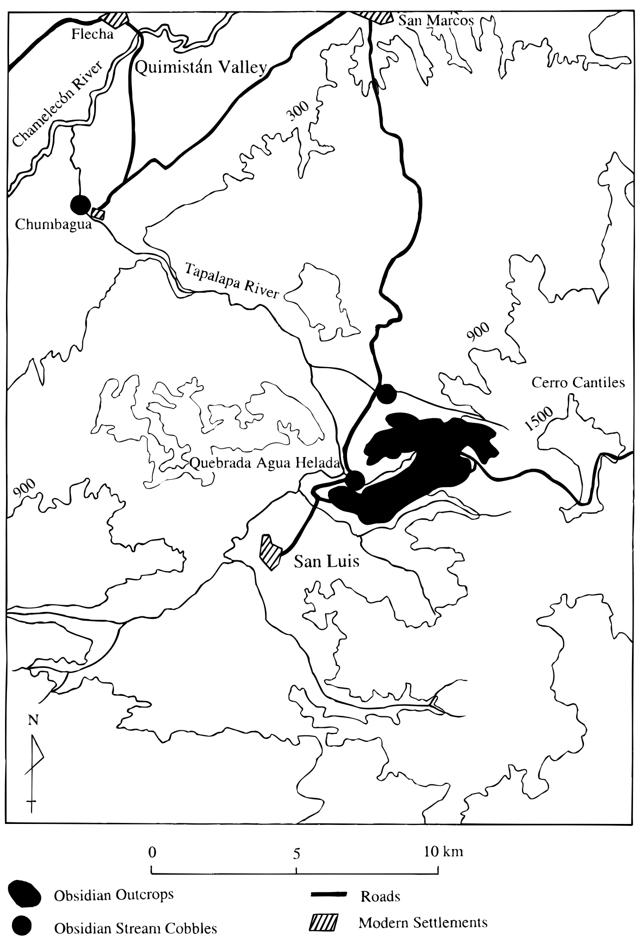

Figure 6. Map of San Luis and surrounding areas showing the location of obsidian outcrops (Terreno Negro), Quebrada Agua Helada, major rivers, roads, and modern settlements.

OBSIDIAN ARTIFACTS FROM THE COPAN VALLEY AND THE LA ENTRADA REGION

The ancient inhabitants of the Copan Valley obtained obsidian from at least six sources, i.e., Ixtepeque, El Chayal, and San Martin Jilotepeque in Guatemala; La Esperanza in Honduras; and Pachuca and Ucareo in Mexico (Aoyama 1996). During the entire pre-Columbian period, however, a predominance of obsidian came from its closest source, Ixtepeque. The ancient Copanecs appear to have had direct access to this source. It is located considerably closer to Copan (80 km) and the La Entrada region (115 km) than to most Maya lowland areas. Ixtepeque is a source area that yields high-quality obsidian suited for specialized prismatic blade production. During the Preclassic period (1400 B.C.–A.D. 50), but Ixtepeque obsidian was largely imported in the form of large flake spalls or small nodules for the unspecialized production of informal percussion flakes in both the Copan Valley and the region of La Entrada.

Over time, the ancient inhabitants of the region of La Entrada seem to have participated more intensively in the Ixtepeque obsidian exchange system, a system in which the inhabitants of Copan were more heavily involved (Aoyama 1996). Gradually, this network of growing interaction with the ancient inhabitants of the Copan Valley resulted in the increased importation of Ixtepeque obsidian into that area. The peak was reached in the Late Classic period. This contrasts with the decreasing usage of San Luis and Source Y obsidian. During the Middle Preclassic period, for example, it is worthwhile noting that 71.1% (337 samples) of the obsidian was obtained from San Luis and Source Y, whereas only 28.9% (137 samples) was derived from Ixtepeque. Table 4 presents the results of the technological and visual analysis of 474 obsidian artifacts from unmixed Middle Preclassic midden deposits of four sites in the region of La Entrada.

In contrast, a majority of the obsidian (3,774 samples, 89.6%) came from Ixtepeque and only 9.5% (399 samples) came from San Luis and Source Y during the Late Classic period (Aoyama 1996:306). Only 40 (.9%) samples of obsidian artifacts originated at El Chayal (N = 18), La Esperanza (N = 17), and other unidentified sources (N = 5). Table 1 shows the results of the technological and visual analysis of 4,213 obsidian artifacts from unmixed Late Classic deposits at 29 sites. These included the following: three Category 1 sites, nine Category 2 sites, six Category 3 sites, four Category 4 sites, and seven Category 5 sites. The Late Classic obsidian artifacts were recovered from several different contexts, such as middens, construction fill, and caches. The total number of obsidian artifacts recovered from each site was limited since the majority of obsidian came from construction fill and Aoyama eliminated artifacts that did not adhere clearly to this time period. Consequently, in order to study the Late Classic assemblages at the regional level, all of the samples from each site were treated in a synchronic manner.

Ixtepeque obsidian was imported to the region of La Entrada mainly as polyhedral cores (e.g., Clark and Bryant 1997:113) in contrast to the small cobbles imported from San Luis and Source Y during the Late Classic period (Aoyama 1996:307). The simultaneous occurrence at Classic Period sites of specialist-produced obsidian prismatic blades from imported preformed cores as well as ad hoc obsidian flake industries from locally procured stream pebbles have also been noted at Teotihuacan (Spence 1981:776), Kaminaljuyu (Michels 1979:182), and Quirigua (Sheets 1983b:96–97). The importation of Ixtepeque obsidian preformed cores and the local production of prismatic blades began as the result, rather than as the cause, of sociopolitical development in both the Copan Valley and the region of La Entrada (Figure 7). During the Late Classic period, the local rulers of the centers in the southern part of the region of La Entrada, such as El Abra and Los Higos, maintained a high degree of interaction with the Copan state and seem to have obtained Ixtepeque obsidian through direct exchange with Copan. This city appears to have been a distribution center for Ixtepeque obsidian polyhedral cores in the southeast Maya lowlands (Aoyama 1996: 358).

Apparently, all households had access to finished prismatic blades made from Ixtepeque obsidian in both the Copan Valley and the region of La Entrada during the Late Classic period. The great majority of these blades were used for domestic purposes; far fewer were used in ceremonial contexts. The results of the microwear analysis, with a high-powered microscope, indicate that Ixtepeque obsidian prismatic blades were used for a variety of tasks: cutting or sawing, whittling and grooving wood or other plants; cutting and scraping meat or hide; cutting or sawing and whittling shell, bone, or antler (Aoyama 1996:297–298). In other words, Ixtepeque obsidian prismatic blades were not luxury commodities, but rather they were mostly utilitarian commodities. Some of the prismatic blades, in which no use-wear was identified, however, occur in very small quantities at both elite and non-elite caches, suggesting possible use in household rituals.

Obsidian prismatic blade production workshop dumps dating to the Late Classic period in the La Entrada region have yet to be recovered. Although the presence of exhausted polyhedral cores or fragments cannot constitute direct evidence for on-site manufacturing of prismatic blades, their presence at all categories of sites suggests that no single center controlled the production of Ixtepeque obsidian. Not all households, however, had access to Ixtepeque obsidian polyhedral cores or could produce prismatic blades.

The results of the neutron activation analysis, along with geological and archaeological evidence, have confirmed that the ancient inhabitants of the La Entrada region obtained small obsidian

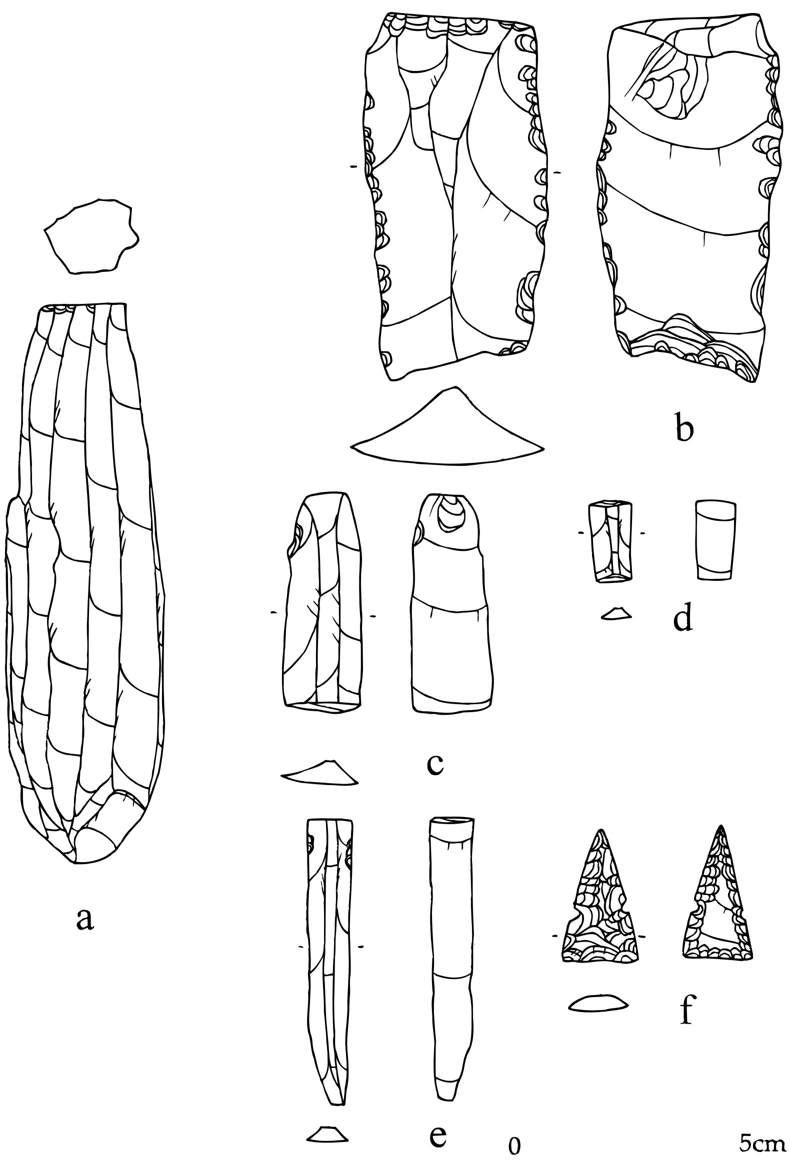

Figure 7. Ixtepeque obsidian artifacts from the region of La Entrada, Late Classic period: (a) exhausted polyhedral core; (b) macroblade; (c–e) prismatic blades; (f) prismatic blade point.

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cobbles, of up to 6 cm in diameter, from San Luis and Source Y. They obtained the cobbles from outcrops and streams near the obsidian sources from the Early Preclassic through Late Classic periods. These obsidian cobbles, due to their small size, were not useful for the specialized production of prismatic blades and were used exclusively for unspecialized production of percussion flakes using a bipolar technique and resulting in a great deal of small manufacturing debris (Figure 8, Tables 4 and 5).

LATE CLASSIC MAYA POLITICAL BOUNDARIES AND THE BOUNDARIES OF OBSIDIAN EXCHANGE NETWORKS

In the investigation of the relationship between Late Classic Maya political boundaries and the boundaries of obsidian exchange networks, the discontinuous distribution of Ixtepeque and San Luis/Source Y obsidian in the La Entrada region during the Late Classic period is of particular interest. A sharp decrease in Ixtepeque obsidian occurred roughly 60 km from the Principal Group of Copan. In other words, the core-blade industry using Ixtepeque obsidian dominated virtually the entire region except the northern extremity of the La Venta Valley, whereas the percussion-flake industry from San Luis and Source Y materials took precedence over the Ixtepeque obsidian core-blade industry (Table 5). This sharp decrease in the use of Ixtepeque obsidian likely resulted from political factors (Inomata and Aoyama 1996:304).

There has been considerable scholarly discussion about whether Classic Maya polities were regional states (Adams and Jones 1981; Culbert 1991; Martin and Grube 1995) or segmentary states (Ball and Taschek 1991; Demarest 1992; Houston 1993; Mathews 1991; Sanders and Webster 1988), or both (Marcus 1993). The 60-km distance from Copan to the point of drop-off in Ixtepeque obsidian is greater than the hypothesized mean radius (25 km) of Lowland Maya segmentary states during the Late Classic period, as proposed by epigraphers such as Houston (1993) and Mathews (1991). Rather, it corresponds to the hypothesized radius of Classic Maya regional states in the central lowlands (50–80 km) that Adams and Jones (1981:308–309) have suggested. Inomata and Aoyama (1996) have argued that the size of Classic Maya political units is a complicated issue since different variables may have been in operation on quite different spatial scales. The distribution of goods having a lower exchange value, such as low-quality local chert, appears

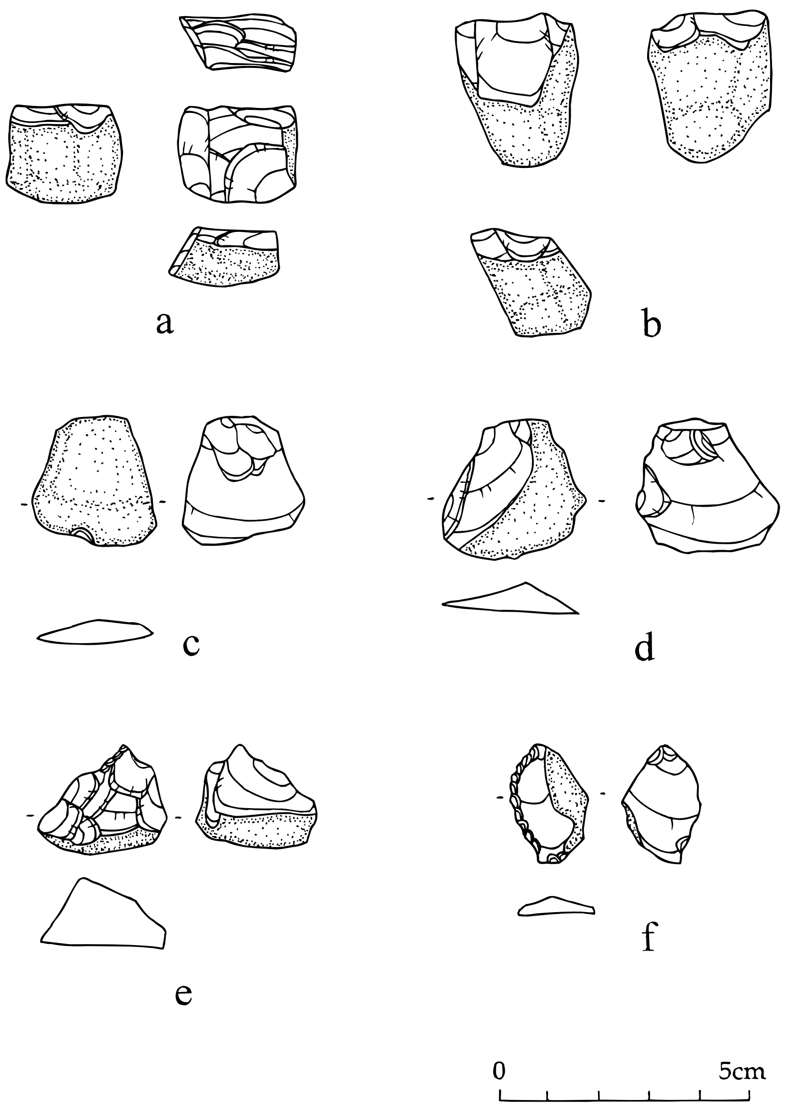

Figure 8. San Luis and Source Y obsidian artifacts from the region of La Entrada, Late Classic period: (a–b) flake cores; (c–d) flakes; (e) drill; (f) denticulate.

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to have escaped political control. Chert nodules as large as 50 cm in diameter seem to have been available in abundance along the Chamelecón River. Individual households could have gathered local chert for manufacturing expedient tools, such as percussion flakes, scrapers, notched flakes, denticulates, drills, choppers and so on, as the need arose.

This paper presents one aspect of political economy. From a traditional core-centric perspective, the sharp drop-off of Ixtepeque obsidian in the La Venta Valley may indicate the limits of direct economic action of the Copan state. In other words, the decrease may represent the limits of the horizontal exchange networks between Copan's rulers and the local rulers of the centers in the southern part of the La Entrada region, such as El Abra and Los Higos. It should be emphasized that this possible horizontal economic interaction sphere also includes high frequencies of Copador Polychrome pottery, whose distribution center was Copan (Bishop et al. 1986). In contrast, in the northern extremity of the La Venta Valley, as well as in the adjacent Quimistán Valley where obsidian from San Luis and Source Y is dominant, this ceramic ware is virtually absent. Moreover, the limits of these horizontal exchange networks appear to have been roughly coterminous with Classic Maya cultural boundaries. That economic institutions, including exchange, were embedded in broader social and political institutions (Malinowski 1922; Polanyi 1957) is reflected in the Copan elite material culture, which local rulers of certain centers in the La Entrada region, such as El Abra and Los Higos, chose to emulate. Thus, we may note the stela and altar complex; elaborately carved stone monuments with hieroglyphic inscriptions; massive pyramidal substructures faced with cut stone; and masonry superstructures adorned with mosaic sculptures. In contrast, Roncador and the centers in the Quimistán Valley lacked these cultural elements and possessed a stronger cultural affinity to non-Maya areas to the east.

From the local perspective (e.g., Bermann 1994), however, the decrease may have been related to the political boundaries between the sustaining areas of the two local centers (Los Higos and Roncador). In other words, the allocation of high-quality obsidian might have been politically controlled within each sustaining area. In the hypothetical sustaining area of Los Higos, the percentage of Ixtepeque obsidian between sites varies from 61 to 100% (mean = 84.3, S.D. = 12.6; total = 15 sites). In the hypothetical sustaining area of Roncador, in contrast, all percentages are less than 61 (mean = 39.8, S.D. = 18.4; total = 3 sites), with Roncador having the highest proportion. A chi-square test indicates a very strong and extremely significant difference between the sustaining areas of Los Higos and Roncador ($\chi^2 = 403.56$, $p < .0005$, $V = .62$).

Moreover, in the hypothesized sustaining areas of Los Higos and regional centers in the La Florida Valley such as El Abra, which are regularly spaced with radii of about 9 km, Ixtepeque obsidian appears to have been supplied mainly through redistributive channels during the Late Classic period. The percentage of Ixtepeque obsidian is the highest in larger sites and reduces as site size decreases, while that of the obsidian from San Luis and Source Y increases from large to small sites (Figure 3). Because Ixtepeque obsidian prismatic blades were principally a utilitarian commodity available for all households, this pattern does not reflect a functional difference between the sites. Rather, this could indicate that Ixtepeque obsidian was more readily available to residents of higher-order sites in the settlement hierarchy, as opposed to obsidian from the closer San Luis and Source Y locations. A regression analysis for the Ixtepeque obsidian percentages and the site categories of settlements in the hypothesized sustaining areas of Los Higos and the centers of the La Florida Valley indicates a very strong and extremely significant correlation ($r = .758$, $p < .0005$; $Y = 6.521X + 65.557$). Hence, we suggest that political control over high-value exchange commodities was limited to smaller spatial configurations rather than to the suggested territorial political control of the segmentary states in the Maya lowlands.

SUMMARY AND CONCLUSIONS

During the Late Classic period, utilization of San Luis and Source Y obsidian appears to have operated on quite different social and spatial scales than that of Ixtepeque obsidian. Local rulers of the centers of the southern part of the La Entrada region, such as Los Higos and El Abra, seem to have obtained Ixtepeque obsidian through direct exchange with the Copan state. It was then distributed to smaller sites in the La Entrada region. The distribution patterns of Ixtepeque obsidian suggest that political boundaries had a significant impact on the allocation of certain imported commodities having high exchange values and that the size of economic spatial units in Late Classic Maya society was relatively small (Inomata and Aoyama 1996). The distribution of goods with lower exchange values, such as locally manufactured utilitarian pottery, *some* fine ware pottery (e.g., Beaudry 1984; Fry 1979; Rands and Bishop 1980; Rice 1987), San Luis and Source Y obsidian, and low-quality local chert, however, may have escaped political control.

Small obsidian cobbles from San Luis and Source Y were apparently not distributed over long distances but were rather essentially local resources. They never reached distant regions such as the Copan Valley (80 km to the southwest). Because of their close proximity to La Entrada, the ancient inhabitants of the La Entrada region may have had direct access to the San Luis and Source Y obsidian sources. The cobbles from these obsidian sources, due to their small size, were employed exclusively for the unspecialized production of percussion flakes for household consumption, using a bipolar technique. The unspecialized production of small percussion flakes from these small obsidian cobbles continued until the Late Classic period in the region of La Entrada, especially in the northern extremity of this region. In general, the residents of lower-order sites in the settlement hierarchy depended on small obsidian cobbles from San Luis and Source Y, to a greater degree than those of higher-order sites, as they were obliged to make up for the Ixtepeque obsidian which was less available to them.

RESUMEN

Recientes investigaciones arqueológicas y geológicas, combinadas con el análisis por medio de activación neutrónica, localizaron una nueva fuente de obsidiana en San Luis, Departamento de Santa Bárbara, en el Occidente de Honduras. Desde el Preclásico Temprano hasta el clásico tardío los antiguos habitantes de la región de La Entrada obtuvieron la obsidiana de San Luis y Fuente Y directamente de los afloramientos y las quebradas cercanas en la forma de guijarros pequeños. Dichos guijarros pequeños fueron exclusivamente usados para la producción no especializada de lascas a percusión usando la técnica bipolar, para el consumo doméstico. Los límites políticos tuvieron un impacto significante sobre las circulaciones de ciertos materiales de alto valor para el intercambio, así como la obsidiana de Ixtepeque. El control político sobre la distribución de la obsidiana

de Ixtepeque fue limitado a las configuraciones espaciales más pequeñas que el sugerido control territorial político de los estados segmentados en las tierras bajas Mayas. La distribución de materiales de bajo valor para el intercambio, tal como la obsidiana de San Luis y Fuente Y, no obstante, pudieron haber sido libres del control político. Aparentemente los guijarros pequeños de la obsidiana de San Luis y Fuente Y no fueron distribuidos a largas distancias, sino fueron esencialmente recursos locales.

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