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THE OBSIDIAN ARTIFACTS OF QUELEPA, EL SALVADOR

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Abstract

Nearly 600 obsidian artifacts dating from about 200 B.C. to A.D. 950 at Quelepa, El Salvador, are assigned to geological source areas using visual criteria and an abbreviated neutron activation analysis (NAA) technique. This combined methodology affords highly accurate results, is inexpensive, and allows large collections to be sourced. Results of lithic analyses describe the evolution of procurement and production strategies at the site. Despite the location of the site on the far southeastern periphery of Mesoamerica, the lithic analyses indicate that Quelepa participated in a Mesoamerican rather than Central American transference network.

The study of prehistoric production and distribution systems has been an important focus of recent archaeological theory and research (e.g., Brumfiel and Earle 1987; Earle and Ericson 1977; Ericson and Earle 1982; Sabloff and Lamberg-Karlovsky 1975). The development of extensive trade or transference networks plays an important role in the evolution of civilizations, although the nature of that role is widely debated. But transference networks also indicate spheres of communication and other forms of interaction. In exchange relationships, particularly in precapitalist societies, information and material goods are inseparable (Renfrew 1975:6). An economy can therefore be said to be "embedded" within broader cultural systems (Polanyi 1957). Hence the study of transference systems necessarily provides social information. Furthermore, exchange, at whatever level of intensity, reinforces social relationships. A corollary is that more cohesive social groups tend to have more frequent and larger-scale exchange interactions. In some cases, the peripheries of transference networks may be coterminous with political or alliance boundaries, and may indicate divisions between cultural or ethnic groups.

In Mesoamerican archaeology, as Jackson and Love (1991) point out, obsidian has often been used as an indicator of long-distance exchange networks. The principal reasons for this are that obsidian artifacts preserve well, are nearly ubiquitous, are found at sites far from their geological origins, and can usually be given source-area attributions based on their characteristic elemental "fingerprints." But making chemical source attributions for artifacts is expensive. In this article we explore two relatively inexpensive alternatives to the techniques most commonly used by Mesoamerican archaeologists. One of these methods, visual sourcing, is not generally accepted as accurate and reliable. For this reason, our sourcing methodology, combining both visual study and abbreviated neutron activation analysis (NAA), is discussed in some detail. The goal of this study is to use source attributions, as well as typological and attribute data derived from obsidian collections, to make statements about transference networks, and by extension, about broader patterns of social and economic interrelationships and integration in northern Central America.

Given that important new information has been collected during recent excavations in both Honduras and El Salvador, it appears opportune to reevaluate the role of Quelepa, a site in eastern El Salvador that last saw extensive excavation and analysis 25 years ago.

New data are allowing us to refine older views about a number of topics, such as the fit or lack of fit between ceramic boundaries and linguistic or ethnic affiliations, the changing position of Quelepa in political hierarchies, and its role as a trading partner, i.e., its oscillation between independent decision maker and dependent member of a far-flung exchange network. At times Quelepa was the political center of a regional system and at others it appears to have been near the edge of a system. We now believe that our recent analyses of obsidian and its sources, as well as the ceramics, architecture, and linguistic data will permit us to situate Quelepa in its proper place during each phase of its occupation.

QUELEPA

Quelepa is located 8 km northwest of San Miguel, in eastern El Salvador (Figure 1). It is one of the largest sites in the far southeastern periphery of Mesoamerica, consisting of some 40 structures spread over about half a square kilometer along the north bank of the Río San Esteban (Andrews 1976:4). Although small compared to many Lowland Maya or highland Mexican sites (its largest mound is only 10 m high), it is important as one of the two easternmost ceremonial sites in Mesoamerica containing buildings arranged around plazas and along terraces, including a ballcourt (Andrews 1976, 1977; Longyear 1944; Stone 1959).

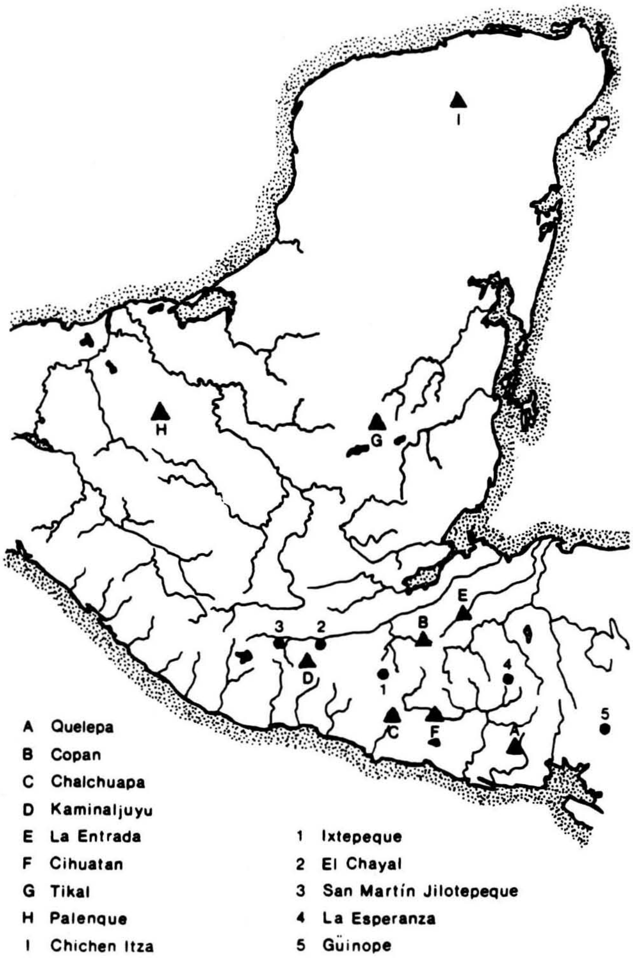

Figure 1. Archaeological sites (triangles) and obsidian source areas (circles) in southeastern Mesoamerica.

The site, although long known (e.g., Peccorini 1913; Spinden 1915), saw its first significant exploration from 1967 to 1969 (Andrews 1970, 1972a, 1976, 1977). During this period, Andrews excavated 14 test pits, four of the largest structures, and several terraces and their access ramps, selected to sample the apparent spatial, architectural, and chronological diversity at the site. The most important result of this research was the establishment of an archaeological sequence for eastern El Salvador from the Late Formative through the Terminal Classic periods. To place the results of the present obsidian analysis in perspective, it is necessary to review and update some of Andrews's (1976, 1977) conclusions.

Uapala Phase (200 B.C.–A.D. 200)

The earliest evidence of occupation dates to the Late Formative period. Almost all the excavated remains of this period are in the East Group, well above the Río San Esteban. The only certain structure known is a dry-fill platform, about 1.2 m high, its mud-plaster and crushed pumice surface 4 m below the modern surface. Uapala-phase ceramics continued 2 m below this platform to bedrock. Manos, metates, and comales indicate that these earliest settlers were maize farmers. Uapala ceramics consist mostly of Izalco Usulutan (about 60% of the decorated pottery), a red-slipped group (Placitas Red), and a plain group, with Black-browns and Fine Reds imported from western El Salvador or highland Guatemala. Similar and contemporaneous pottery is known from sites in Honduras, e.g., the Late Formative at Copan, Lo de Vaca II and Yarumela II in the Comayagua Valley, Edén I at Los Naranjos, and the Ulua Bichrome complex at Santa Rita. These ceramics indicate closer ties with western El Salvador, Copan,[1] central and northwestern Honduras, and the Guatemalan highlands than in any later period and led Andrews (1976:180–181) to propose a Uapala ceramic interaction sphere for much of western Honduras and eastern El Salvador and to argue that the boundary of Mesoamerica, or at least the zone of strongest Mesoamerican cultural tradition, lay in the Late Preclassic at the eastern edge of the Uapala sphere. This suggestion appears to be supported by new data (Demarest 1986:174–175; Robinson 1987).

Using comparative linguistic evidence, Andrews (1972b, 1976, 1977) further suggested that these people may have been Proto-Lenca speakers, closely related to Mayan or Proto-Mayan speakers in highland Guatemala, and that the spread of the Uapala ceramic sphere involved a possible Proto-Lenca migration from the west. This argument, which equated the spread of a ceramic complex, and especially of one major type, Izalco Usulutan, with the spread of a linguistic group, has met with less enthusiasm (Demarest 1986:174–175; Sheets 1984:94), because linguists (e.g., Campbell 1976; Suárez 1983) generally have not been willing to accept a genetic relationship between Lenca and Mayan languages, and also because the adoption of Usulutan pottery along the Mesoamerican periphery may be explained without recourse to a spread of one linguistic group into western Honduras and El Salvador. We agree with these criticisms, but continue to believe that the distribution of native populations in late pre-Hispanic times, as well as the archaeological evidence, still points to the Lenca as the most likely candidates for identification with the Uapala sphere.

Usulutan pottery was a distinctive feature of Late Formative ceramic complexes in the southern Maya Highlands of Guatemala and western El Salvador, with deep roots in this area (Demarest and Sharer 1982). The rapid spread and popularity of Izalco Usulutan and related types into the Lenca area to the east and south are more likely to reflect the emulation and adoption of a decorative style and vessel forms closely associated with large and powerful Maya sites to the west, such as Chalchuapa and Kaminaljuyu, than it is the movement of large groups of people, who would have brought with them other features of Mesoamerican culture.

Several known sites in western Honduras were occupied hundreds of years earlier than Quelepa, and the absence to date of Middle Formative remains in eastern El Salvador suggests Quelepa was settled from the north by maize farmers moving down the Río Lempa drainage. The similarity of Izalco Usulutan at Quelepa and Chalchuapa, the presence of other trade wares from western El Salvador, and the participation of Quelepa in a Mesoamerican obsidian exchange network, how-

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[1] The 1993 Tulane University/Copan Acropolis Archaeological Project excavations in Group 10L-2, south of the Acropolis at Copan, have produced an unmixed Late Formative ceramic assemblage very similar to the late Uapala complex at Quelepa. This Copan complex includes several vessels with mammiform supports and is dated by two radiocarbon determinations to the first century A.D.

ever, show that commercial, and probably other relationships, existed mostly with sites to the west, rather than the north.

The Uapala phase was originally dated from about 500 or 400 B.C. to A.D. 150. Its beginning date now appears too early. Calibration of the two Uapala radiocarbon determinations (Andrews 1976:42) gives later calendar dates than first reported: cal B.C. 150 (B.C. 1) A.D. 110 (FSU-337; 2020 ± 110 B.P.); and cal B.C. 200 (B.C. 50) A.D. 100 (FSU-338; 2055 ± 130 B.P.), both at two sigma, rounded to the nearest decade. Santa Tecla Red and Copinula Graphite-painted trade sherds from the west assigned to the Late Providencia phase may date to the late portion of this phase, which is currently placed at 400–100 B.C. (Demarest 1986:Table 4). The Quelepa Jaguar Altar (Andrews 1976:Figure 183), which lacks stratigraphic context, was also placed in the late Providencia phase on stylistic grounds but may also be as late as 100 B.C. A beginning date before 200 B.C. for Uapala thus seems unlikely. An ending date of about A.D. 200, corresponding to the end of the Miraflores ceramic sphere (Demarest 1986:Table 5), is an estimate based partly on the limited presence of mammiform supports in late Uapala and their increase in number and variety in the Shila phase.

Shila Phase (A.D. 200–750)

The Shila phase at Quelepa is a very long span that will one day probably require division. It was characterized by the construction of extensive high terraces in the East and West Groups, the purpose of which seems to have been to level off the sharply sloping terrain. Platforms were built near the edges of the terraces, and much of the visible construction at Quelepa probably dates to the Shila phase. Near the center of the East Group, at the edge of one of the highest terraces, lay the two largest stepped platforms. Both structures were accessed by long, paved ramps, and the terrace face just south of them had two larger ramps, each centered in front of one of the platforms (Andrews 1976:Figures 11–20). The facing of the terrace and of the largest structure is of huge squared blocks of *talpetate* that recall the massive stones used at Late Classic Copan and other Maya sites. The ramps are paved with comparable but thinner stones.

Undated terraces similar to those at Quelepa are known from Tehuacan, west of the lower Lempa River. Early Classic platforms with ramps have been excavated at Los Naranjos, on Lake Yojoa (Baudez and Becquelin 1973), at other sites in central Honduras (Schortman 1984), and at the site of Florida, near La Entrada, Copan, Honduras (*Guía temática del Museo Arqueológico La Entrada* 1994).

Shila remains were distributed widely over the area investigated, but Shila sherds formed only 13% of the total identified, compared to 43% and 44% for the Uapala and Lepa complexes, respectively. If these figures roughly represent the number of vessels used in each phase, they present a picture different from that suggested by terrace and platform construction, which would indicate a great amount of activity in this phase, as would the predominance of Shila-phase ceramics in private collections from the San Miguel Valley. The two radiocarbon determinations from Structure 4, one of the two largest Shila platforms, are late in the suggested span of this phase, and occupation at Quelepa may have been discontinuous, with a decline sometime during the years corresponding to the Early Classic period in the Maya area.

The Classic-period Shila ceramic complex is clearly derived from the Uapala complex, consisting primarily of plain, red-slipped, and Usulutan groups, but its types are easily distinguishable from Uapala, with different forms, decorative modes, slips, and pastes. Much of the Usulutan group, forming about 62% of the Shila sample, had red-painted rims or designs, modes never present in Uapala, and the resist decoration is indistinct. The slips and pastes are soft. Although the Shila complex indicates continuity of local ceramic traditions in this part of eastern El Salvador, the ease with which its vessels can be distinguished from those of the preceding Uapala complex, and the scarcity of ceramics that appear transitional between the Late Formative and Classic complexes, also raise the possibility of a demographic decline sometime in the Early Classic period. Arguing against this, however, is the fact that many Shila ceramic modes are found elsewhere in Early Classic complexes.

The Shila phase seems to represent a regional florescence, with substantial construction indicating that the labor force was substantial. Although a regional survey has yet to be conducted, a number of sites with mounds far smaller than the largest at Quelepa have produced quantities of Shila-phase ceramics, suggesting a hierarchy in site size in the San Miguel drainage of two or three levels during this span. Architectural similarities indicate continued contacts with western El Salvador and Honduras, and ceramic links at this time are also clearly with Mesoamerica, rather than to the south. The Quelepa polity was probably the most powerful in eastern El Salvador, controlling labor and exchange.

A few carved legs of metates or seats, pecked-stone balls in sets of three, and small carved jade beads showing stylized human faces, similar to beads found in Costa Rica, indicate contact with lower Central America in the Shila phase. These artifacts of Central American origin suggest greater interaction with polities to the south than in later years, but ceramic exchange with Greater Nicoya, in contrast, seems to have been stronger in the following Lepa phase.

The dates originally estimated for the Shila phase, A.D. 150–625, may be too early. Charcoal from a sealed dedicatory cache at a corner of Structure 4 dates to cal A.D. 420 (610) 740 (FSU-353; 1460 ± 180 B.P.), and burned sticks in fragments of burned daub by the basal terrace of this platform date to cal A.D. 640 (730) 920 (FSU-354; 1285 ± 140 B.P.). The second sample resulted from the burning of the perishable superstructure on Structure 4 and the probable shift in focus of settlement at Quelepa to the West Group. Dates are rounded to the nearest decade, and both have one-sigma ranges. The current placement of the end of the Shila phase at about A.D. 750 relies on these two internally consistent determinations. If this dating is correct, the typologically Early Classic Shila ceramic complex would span both the Early Classic and much of the Late Classic periods.

Lepa Phase (A.D. 750–950)

The Late and Terminal Classic Lepa-phase occupation was originally interpreted as the replacement of the local (Lenca?) population by an immigrant Mesoamerican population from the west (Andrews 1976:183–186), and a reconsideration of the evidence leads to the same conclusion. A new, tightly focused group of more than 15 masonry structures, including an I-shaped ballcourt, was built around a small *plazuela* in the West Group, just north of the Río San Esteban. This arrangement contrasts markedly with the Shila-phase placement of buildings at intervals along the edges of terraces. Facing walls were of roughly squared stones mixed with some unshaped river cobbles, much smaller than the huge blocks used in Shila-phase buildings. A few reused Shila stones in these later platforms emphasize the change in masonry. A long tenon from this group (Andrews 1976:Figure 164s) suggests that some platforms may have displayed sculpture.

Burial and cache practices appear to have changed from the Shila to the Lepa phase. Shila burials have been found in large numbers south of the Río San Esteban, indicating a cemetery or a residential area (not excavated) separate from the masonry platforms on the terraces north of the river. Lepa burials are concentrated near the West Group *plazuela*, associated with domestic remains. Shila dedicatory caches were common, located on axial lines of buildings or at platform corners. No Lepa ceramic caches were found.

The Lepa ceramic complex was as distinct from its predecessor as were Lepa ideas of how to arrange and construct buildings in the center of a site. Vessel forms show little continuity from one complex to the next, and the late Usulutan and mottled orange pottery of Shila disappeared abruptly to be replaced by a thin, fine-paste, almost temperless group of white monochromes, red-on-white bichromes, and polychromes. No similar ceramics have been reported in El Salvador or Honduras at an earlier date.

The fine-orange pottery of late Quelepa is related to Terminal Classic fine-orange pottery of the Maya Lowlands, but the latter is generally unslipped and has vessel forms and decorative modes different from those at Quelepa (Adams 1971; Sabloff 1975). The closest similarities (Andrews 1976:122–123) still appear to be with the Gulf Coast, where the tradition of fine-paste ceramics extends back into the seventh century, and with central Veracruz, where slips, decoration, and vessel forms provide similarities in the Classic period.

Several other Mesoamerican artifact types were introduced in the Lepa phase, all of which are associated with southern Veracruz or Tabasco. These include yokes, *hachas*, and *palmas*, ritual ballgame objects found together for the first time in one cache at Quelepa; wheeled toys; and variable-pitch flutes or ocarinas with rolling pellets (Andrews 1971, 1973, 1976:154–156, 169–173, 184–185). The two *palmas* show a feathered serpent and a depiction of Quetzalcoatl as Ehecatl, the Aztec wind god. Many artifacts of these types have been reported from the San Miguel Valley and neighboring areas, and it is likely that they were distributed to smaller communities from Quelepa.

The Late and Terminal Classic Lepa phase evinces little contact with western El Salvador, highland Guatemala, or highland Chiapas. Since fine-orange pottery, *palmas*, wheeled figurines, and rolling-pellet flutes are rare or absent in these areas, Andrews (1976) suggested contact with the Gulf Coast by sea was more likely.

Fine-orange pottery is now known from Travesía (Sheehy 1982), Cerro Palenque (Joyce 1986), and other sites in the Ulua Valley of northwestern Honduras, where it appears to replace Late Classic Ulua polychromes. This new pottery probably derived from the southern Maya Lowland Terminal Classic fine-orange tradition, best known at Altar de Sacrificios and Seibal, and it is unlikely to be related, except in the most general way, to the white-slipped fine-paste group at Quelepa.

Joyce (1986:319–320) has convincingly demonstrated that several vessels strikingly similar to Quelepa Delirio Red-on-white have been found in "Postclassic" deposits on the Copan Acropolis, at Travesía, at Cerro Palenque, and even at Seibal; in all cases Delirio Red-on-white was associated with fine-orange pottery of the Terminal Classic period. This cross dating provides a strong argument for dating the Quelepa fine-paste tradition to the Terminal Classic (ca. A.D. 830–930), although its appearance in eastern El Salvador may have been earlier. The presence of these trade vessels from the Quelepa area at so many distant sites in the southern Maya area and the southern periphery also suggests the value of this ceramic as an elite status marker and the existence of an interelite exchange network.

Lange et al. (1992:155, 231, Figure 6.8c–e) have recently reported sherds of Delirio Red-on-white recovered from three sites in Pacific Nicaragua on the southern shore of Lake Managua and the northern shore of Lake Nicaragua, but not farther south. Several of these sherds have been confirmed by chemical characterization to have been imports from El Salvador, possibly Quelepa. Sites in the province of Granada (Salgado González and Zambrana Hernández 1993) have also produced trade sherds of Delirio Red-on-white. Quelepa fine-paste pottery seems to have been traded more often to the south, along the Pacific corridor, than it was to the west and north.

Ceramics and other artifacts indicate that the initial and strongest ties of Late Classic Quelepa lay to the north, along the Gulf Coast of Mexico. The origin of Lepa-phase obsidian in the highlands of Guatemala; the appearance of Delirio Red-on-white in the Ulua Valley, Copan, and Seibal (Joyce 1986); the deposit of Lolotique Spiked censers in a postdynastic collapse context at Copan (Andrews 1976:111); and the presence of Classic Veracruz carved objects related to the ball game and of musical instruments and wheeled toys inspired by the same area, leave little doubt that Quelepa participated in several Terminal Classic Mesoamerican trade and elite interaction networks that extended into the southern Maya Highlands and to the Gulf Coast as well as into northwestern Honduras and the Peten. The Pacific coastal distribution of the dominant white-slipped fine-paste group reinforces the argument that Lepa-phase Quelepa represents a movement down the Central American coast, avoiding parts of the Chiapas, Guatemala, and western El Salvador highlands.

The nature of relations with the Gulf Coast of Mexico during the Lepa phase remains problematic, although the beginning of the phase almost certainly involved an intrusive population. The position of Quelepa at the southeastern extreme of what Parsons (1969:154) called the "Peripheral Coastal Lowlands" suggests links with Veracruz and the Pacific Coast of Guatemala through interelite trade, as do numerous items of material culture noted above. The appearance of ballgame symbolism and paraphernalia in other areas of the Peripheral Coastal Lowlands in the Late Classic period, particularly the Cotzumalguapan zone, is an important component of this sphere (Braswell 1993; Popenoe de Hatch 1987, 1989; Zeitlin 1993).

The beginning date of the Lepa phase remains uncertain. Although the fine-paste pottery points to the Terminal Classic, as do the local contexts of Delirio Red-on-white trade vessels at the northern and western sites mentioned above, the two calibrated radiocarbon dates cited here suggest construction of the East Group Shila center at about cal A.D. 424 (613) 736 and its demise at cal A.D. 635 (726) 916. This limited evidence is consistent either with a beginning of the Lepa phase in the Terminal Classic or perhaps one hundred years earlier, and the issue cannot yet be settled.

An additional argument for dating the Lepa phase to the Terminal Classic (i.e., after about A.D. 830) is that Copador Polychrome of western El Salvador and the Copan area was completely absent and that Ulua-Yojoa Polychrome vessels of northwestern and central Honduras were not found in direct association with vessels of the fine-paste, white-slipped group. Although Ulua-Yojoa Polychrome sherds were assigned to the Lepa complex, of which they constituted about 1%, no intact burial or cache vessels were found, and this group, as well as Copador Polychrome, may have preceded the introduction of fine-paste pottery. Neither group was present during the Shila phase.

A further possibility suggested by the Quelepa ceramic stratigraphy is that there was a temporal gap between the Shila and Lepa ceramic complexes. If Ulua-Yojoa Polychromes did not form part of the Lepa complex as trade items, but preceded it, one part of the ceramic record is documented only in mixed contexts, without associated architecture.

Whatever the chronological relationships of Ulua-Yojoa Polychromes at Quelepa, their presence as trade vessels indicates interaction with central Honduras in the Late Classic. The absence of Copador Polychrome, in contrast, argues that this site had very limited contact, direct or indirect, with much of western El Salvador and the Copan polity during the Late Classic.

The abandonment of the West Group and of the end of occupation at the site are indicated by the near absence of Postclassic markers (one surface sherd of Tohil Plumbate and perhaps a few other sherds) to have preceded the Postclassic period. The 1967–1969 excavations produced no sherds that could be linked to the Early Postclassic Pipil intrusion into western and central El Salvador (Fowler 1989:41). A few sherds suggested by Andrews (1976:137) to have been Postclassic Nicoya Polychrome of northwestern Costa Rica or Las Vegas Polychrome of the Comayagua Valley were incorrectly identified (Lange 1986:169) and can probably be identified with the Tenampua class of Ulua Polychromes, dating roughly to the Terminal Classic (Joyce 1986:321; Viel 1978).

Two ritual deposits indicate that abandonment of the West Group happened during the lifespan of the Lepa ceramic complex. Piles of broken Lepa-phase Lolotique Spiked censers lay beside and at the base of the stairs of Structures 23 and 29, the two fully excavated platforms in the West Group, directly overlying the latest surfaces associated with the use of the buildings and underlying the collapse debris of the disintegrating platform walls (Andrews 1976:23–24, 26–27, 111). These typically Mesoamerican termination rituals suggest that the abandonment of the West Group elite ceremonial center was abrupt and total.

Ethnic Affiliations of the Lepa Phase

Ethnohistoric documents from the colonial era suggest that several languages were spoken in or near eastern El Salvador. Two Lencan dialects were spoken in San Miguel province, as well as Ulva, a language with Lower Central American affiliations related to Matagalpa, Miskito, and Sumu (Healy 1984; Lehmann 1920; Ponce 1873; Stone 1957, 1966). Longyear (1966:1314) wrote that Matagalpa speakers were present in the extreme northeastern corner of El Salvador, but he may have confused Ulva with this related language. Little is known of the Ulva as an archaeological culture. The spatial distribution of the language at the time of the Spanish conquest suggests that Ulva speakers settled in eastern El Salvador, southeastern Honduras, and western Nicaragua before later Chorotegan and Pipil migrations. The clear Mesoamerican affiliations of the Lepa phase, however, make it virtually certain that these people did not speak Ulva.

To the east, on the Gulf of Fonseca, Chorotega-Mangue, an Oto-Manguean language, was spoken (Healy 1984; Stone 1957, 1966). There is some evidence that Chorotegans, originally from Chiapas, Oaxaca, or Guerrero, entered lower Central America about A.D. 800 (Healy 1980:335). The clearest account of the origin of these people is given by Torquemada (1723), who writes that they came from inland Xoconocho (Seconusco), an area between Tehuantepec and Soconusco (Healy 1980:22). Although Healy (1980:335–337) emphasizes Maya contacts, these people may have come from, or passed through, the Peripheral Coastal Lowlands of Mexico.

Chorotegan greenstone effigy-pendants, all with "duck bills" like that of the large palma from Structure 29, Cache 24, have been attributed to Quelepa (Longyear 1944:14, Plate XII, No. 18; 1966:152). Longyear argued that these pendants were closely related to examples from the Nicoya Peninsula, but he believed they dated to the Postclassic, and by this time Quelepa was abandoned. Many artifacts from this general area of eastern El Salvador have been attributed to Quelepa, probably erroneously, because the site has long been the best known in the country east of the Lempa River. No good evidence exists at present to link the Lepa phase to Chorotegan speakers.

Two Lenca groups, the Potón and the Taulepa, lived in the province of San Miguel during the Colonial period (Roys 1932; Stone 1957:84–86, 1966:213). The Taulepa, named after Lake Yojoa, Honduras, were a heavily Mesoamericanized group (Squier 1860), although it is not known when this acculturation occurred. The Potón, in contrast, are characterized as "non-Mayanized" (Stone 1966:213). It is tempting to link the Taulepa, newly arrived from Honduras, with the Lepa-phase occupants of Quelepa and to suggest that they replaced an earlier Potón population in the San Miguel Valley, but evidence for doing so is weak. A Taulepa intrusion from central Honduras in the Terminal Classic might fit with the strongly renewed Mesoamerican ties of this phase, but it would not explain the most striking aspects of this change in ceramics, architectural arrangement, and imported elite artifacts, which are strongly Mexican, probably from the Gulf or Pacific coasts.

Quelepa Obsidian

Approximately 600 pieces of obsidian were recovered from excavated and surface contexts dating from the Late Formative Uapala phase to the Terminal Classic Lepa phase (Andrews 1976:Figure 163, Appendix VI). The finest projectile points (Andrews 1976:Figure 163a–c, g–h, m) and nearly all nonlithic artifacts were deposited at the Museo Nacional "David J. Guzmán" in San Salvador. Most of the obsidian (N = 577, mass = 1,568.3 g), however, was brought to the United States, with official permission, and is now curated at the Middle American Research Institute (MARI) at Tulane University.

In September 1991, the MARI collection was sorted according to a typology developed for the Tulane University South Acropolis Project of the Proyecto Arqueológico Acrópolis Copán in Group 10L-2 at Copan (Andrews and Fash 1992), and for Ri Rusamäj Jilotepeque, an archaeological project in San Martín Jilotepeque, Guatemala (Braswell 1993, 1994; Braswell and Braswell 1994). Measurements of length, width, thickness, and mass were made for all pieces, and total cutting edge was measured for all blade fragments. Information on cortex, retouch, and platform treatment was encoded, as were several characteristics peculiar to prismatic blades. Finally, an attempt was made to identify the geological sources of the artifacts using both visual criteria and compositional data.

OBSIDIAN-SOURCING TECHNIQUES

Because of the characteristic chemical composition of obsidian flows, trace-element analysis is an accurate method of attributing an ancient obsidian tool to a particular geological source. Trace-element analysis techniques that have been used for source-attribution purposes include particle induced X-ray emission (PIXE) (e.g., Sheets et al. 1990), optical emission spectroscopy (e.g., Hallam et al. 1976), atomic absorption spectroscopy (e.g., Michels 1982), inductively coupled plasma emission spectroscopy (e.g., Stevenson and McCurry 1990), X-ray fluorescence spectroscopy (XRF), and NAA.

Although NAA (e.g., Andrews et al. 1989; Asaro et al. 1978; Braswell and Glascock 1992; Cobean et al. 1991; García Chávez et al. 1990; Glascock et al. 1990; Hammond et al. 1984; Healy et al. 1984) and XRF (e.g., Andrews et al. 1989; Healy et al. 1984; Jackson and Love 1991; Moholy-Nagy and Nelson 1990; Nelson 1985) are widely used to determine the geological source of Mesoamerican obsidian artifacts, these and other trace-element methods have several disadvantages; they require expensive equipment, the cost per artifact is usually quite high, and some techniques are destructive. For these reasons, it is practically unheard of to use trace-element analysis to source entire collections (cf. Hester et al. 1971; Johnson 1976). However, if models of prehistoric obsidian trade (e.g., Hammond 1972; Nelson 1985) are to be tested and refined, large, statistically meaningful samples need to be analyzed.

What is required, then, is a rapid and reliable source-attribution technique that is inexpensive, easy to learn, and can be used in the field. Two methods of source attribution were employed in the analysis of the Quelepa obsidian; an abbreviated NAA procedure that can cost as little as U.S. $5.00 per sample, and visual source attribution, which fulfills all the above criteria.[2]

Abbreviated NAA

Archaeologists are usually interested in questions such as "where does this artifact come from?" and not "how much hafnium and strontium are in this prismatic blade?" While it is best to characterize geological sources of obsidian using compositional data for as many elements as possible (e.g., Braswell and Glascock 1992), assigning an artifact to a particular source may require compositional data for only a few elements. Artifacts made of El Chayal, Ixtepeque, and San Martín Jilotepeque obsidian (Figure 1), for example, can usually be distinguished from each other using only manganese and sodium concentrations (Asaro et al. 1978). Compositional data for more elements, however, are required to adequately distinguish several obsidian sources in Hidalgo, Mexico (Cobean et al. 1991; Glascock 1992; Glascock et al. 1988).

A short irradiation procedure greatly reduces the cost of NAA. Elemental composition, however, can be measured only for Ba, Cl, Dy, K, Mn, and Na. In order to test the usefulness of an abbreviated NAA strategy using just these elements, the multielement NAA data base of Mesoamerican obsidian at the Missouri University Research Reactor (MURR) was consulted. The source of each specimen in the data base was predicted using only the six elements measured in the abbreviated NAA procedure. A specimen was considered properly sourced if its compositional makeup fell within the 95% probability ellipsoid for one and only one source. Results indicate that 90–95% of Mesoamerican obsidian artifacts can be correctly sourced using the abbreviated procedure (Glascock 1992; Glascock et al. 1992:Table 2, 1994). In cases where abbreviated NAA does not assign an artifact to one and only one source, the full, long irradiation procedure must be used.

Source Attribution According to Visual Criteria

Because of the reasons outlined above, many Mexican and Central American scholars have been using visual criteria to source their obsidian artifacts, often with great success (e.g., Carpio Rezzio 1994). Visual sourcing has not proved as successful for most other archaeologists (e.g., Jackson and Love 1991; Moholy-Nagy and Nelson 1990), although there are some notable exceptions (e.g., Aoyama 1988; Braswell 1990; Clark 1988; Clark and Lee 1984).

The failure of visual sourcing in the past has been caused by several factors. First, researchers have tended to be familiar with only some of the obsidian types found in their collections; it is not surprising that minority sources have not been easily recognized. Jackson and Love (1991:51) note that they were initially unable to distinguish San Martín Jilotepeque (SMJ) source obsidian from either El Chayal (CHY) or Ixtepeque (IXT). But subsequent reevaluation indicates that they now can differentiate SMJ from CHY and IXT using only visual criteria.

Second, few workers have been familiar with the full range of visual criteria that categorizes a particular source. Moholy-Nagy and Nelson (1990:71) observe "that the optical variability of El Chayal obsidian is impressive. We confused it with obsidian from Ixtepeque, San Martín Jilotepeque, and sources in central Mexico."

Third, and related to the two previous problems, most researchers have worked without an adequate reference collection of either worked or natural obsidian. Sourcing by visual criteria is similar to classifying ceramics; it can be difficult to assign a tool to a particular source without a comparative reference collection. Furthermore, it is essential to visit each source that may be represented in a collection and to retrieve nodules that exhibit the full range of visual variability present at the source. When faced with a difficult attribution decision, it is often nec-

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[2] Abbreviated NAA is not the only reliable and inexpensive compositional analysis technique. The accuracy of source attributions made by XRF has greatly increased over the past two decades, in part because analyses now typically include data for 20 or more elements. A particularly accurate and fairly economical method is a combination of XRF and abbreviated NAA (e.g., Asaro et al. 1978; Fowler et al. 1987; Michel et al. 1983; Stross et al. 1983).

essary to knap flakes from these nodules for comparison with the artifact.

Fourth, some sources of obsidian are more difficult to identify visually than others. At one extreme, obsidian from the Pachuca, Hidalgo source (PAC) can easily be distinguished because of its greenish gold color. On the other hand, the optical characteristics of CHY and IXT obsidian overlap considerably. In parts of Belize where both CHY and IXT obsidian constitute large portions of the assemblage (e.g., Dreiss and Brown 1991), sourcing by visual criteria may prove difficult.

Fifth, adequate and diverse lighting conditions are necessary. While bright incandescent or natural light have most often been used (e.g., Jackson and Love 1991; Moholy-Nagy and Nelson 1990), they can make different colors indistinguishable. It is best to use a variety of light sources and intensities. Fluorescent and even ultraviolet light are often most useful for sourcing purposes.

Finally, pieces that are small, thin, lustrous, and perfectly clear are generally difficult to source, as are pieces that are totally opaque.

SOURCING METHODS AND RESULTS

Sourcing the Quelepa obsidian involved three separate procedures. First, visual sourcing was attempted. Second, each visual category was tested for source homogeneity and attribution using the abbreviated NAA procedure. Artifacts sourced by NAA, therefore, were not randomly selected from the collection. Third, error estimates were made for the portion of the collection sourced only by visual means.

A nonrandom sampling strategy for abbreviated NAA was chosen for several reasons. Because NAA could be used to source only a small number of artifacts, we feared that a random sample would miss minor sources present in the collection, a problem that can lead to biased prehistoric transference models and erroneous conclusions (McKillop and Jackson 1988). The probability of missing minor sources when a small sample is analyzed is surprisingly large. For example, if only 10 of the 577 Quelepa artifacts come from sources other than IXT, the probability that only IXT will appear in a sample of 49 members is 40.9%.[3]

Related to this, a nonrandom sample that emphasizes minor and more difficult visual categories allows a more realistic estimate of the accuracy of visual sourcing. By favoring difficult source assignments, the apparent error rate of visual sourcing is maximized. Simply put, the nonrandom sampling strategy employed here is conservative, as it uses abbreviated NAA to check the visual source attributions that are most likely to be incorrect.

A random sample of meager size may also exclude certain minor artifact classes. If obsidian from different sources was used preferentially for different tool types, important aspects of prehistoric industry may be overlooked. The sequin, a very rare artifact type at Copan, provides an example. While sequins make up only about .03% of the obsidian assemblage, all sequins were made of PAC obsidian and imported from Mexico. It is highly unlikely that random sampling would reveal significant patterns such as this.

Our choice of a nonrandom sampling strategy is far from unique; we strongly suspect that most Mesoamerican archaeologists who have used NAA or XRF have selected pieces that are somehow of particular interest (e.g., rare artifact types and objects from special contexts), or judged to be expendable and of no interest (e.g., prismatic-blade fragments from surface, fill, or collapse contexts). Special finds, of course, are much less likely to have been sourced using destructive NAA.

Small samples and deliberate bias greatly reduce the confidence we can have in Mesoamerican transference models (e.g., Hammond 1972; Nelson 1985). By sourcing an entire collection by visual inspection, and using a thorough, albeit nonrandom, sampling strategy for abbreviated NAA, data on minor sources, artifact classes, and the relationship between the two can be generated. The trade-off, of course, is in accuracy. While advances in sourcing techniques such as long irradiation NAA and XRF virtually guarantee that a given artifact will be successfully assigned to a particular source, the combined approach advocated here reduces error to a margin that should be acceptable to most archaeologists.

Phase 1: Visual Sourcing (Table 1)

The first step in visual sourcing was an initial sort into two categories. Incandescent, fluorescent, and natural light were all used. It was realized early in the analysis that the majority of the artifacts appeared homogenous. All pieces that clearly belonged to this visual category, Group A, were set aside. The remaining pieces (N = 32) were then sorted into two more visual categories, Groups B and C. The artifacts in these categories were resorted until a reproducible pattern emerged. During these repeated sorts, it was decided to remove one member of Group B and define a new category, Group D. The Group A artifacts were resorted next by comparing them with Groups B, C, and D. Only three pieces were reassigned to new groups; one artifact from Group A was ascribed to Group B (Table 2, Sample 9), and two to Group C (Table 2, Samples 11 and 19). The defining characteristics of each visual group and a tally of their final memberships are presented in Table 1.

We realize that the descriptions in Table 1 are highly subjective. The purpose of testing visual-group hypotheses through abbreviated NAA is not to deny the subjectivity of visual sourcing, but to see if subjectively generated categories have objective meaning, and if a combined strategy of visual sourcing and abbreviated NAA can yield accurate results.[4]

The visual groups in Table 1 do not necessarily define one or more geological source. They are attempts to form clusters within the range of variation found in a particular archaeological collection. Although it was hoped that all members of a particular visual group came from the same source (termed source homogeneity), it is not assumed that each group came from a *different* source. It is also possible that a particular source represented by a visual group in an archaeological assemblage may

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[3] $$p = \prod_{k=0}^{48} \left(\frac{567 - k}{577 - k} \right).$$

[4] We do not deny that an attempt should be made to frame more precise and objective visual group descriptions for different obsidian sources. The Munsell system could be used to classify colors, and refractive indexes could be measured. Most importantly, precise mineralogical descriptions could be given. Because of the extreme range of optical variability present at each source, however, such characterizations would need to be statistical in nature, and would likely be difficult to formulate and ponderous to use.

Table 1. Frequencies and descriptions of visual groups of Quelepa obsidian

Group	Characteristics	Tested by NAA	Total
A	Translucent; brandy colored; no particulate inclusions; often with fine, dark-gray linear banding or more diffuse light-gray banding; surface is highly lustrous and smooth	14	542
B	Mostly translucent; dark brandy to dark grayish brown colored; many charcoal colored, large, grainy inclusions; no banding; surface lacks luster and is marred irregularly by sand-grain-size pockmarks	22	22
C	Translucent to opaque, tends to diffuse light; light to medium gray in color when opaque, thin pieces which are more translucent are light gray with a rose-colored tone; particulate present, and tends to be fairly diffuse and darker gray than the base color; surface ranges from flat when opaque to fairly lustrous when translucent and is always smooth with a soap-stone-like feel	12	12
D	Fairly opaque; dark gray to black, some brandy color present, color is dependent on density of dusty inclusions; dark gray, fine, dusty particulate inclusions present; diffuse, dark-gray banding created by clouds of dusty inclusions; surface is flat and is marred by dense, small pockmarks	1	1
Total		49	577

Table 2. Concentrations of elements measured in obsidian artifacts from Quelepa

Sample	Ba (ppm)	Cl (ppm)	Dy (ppm)	K (%)	Mn (ppm)	Na (%)
1	751	690	2.30	3.86	446	2.82
2	866	734	1.99	3.04	660	3.13
3	693	721	1.57	3.86	446	2.81
4	654	710	1.75	3.57	432	2.71
5	761	744	2.63	4.01	437	2.74
6	785	693	2.22	4.05	444	2.82
7	785	632	2.04	3.60	441	2.79
8	800	811	2.04	3.48	441	2.77
9	951	841	2.50	4.15	462	2.74
10	1,026	798	2.15	3.69	461	2.96
11	1,030	805	2.29	3.60	473	3.00
12	727	653	1.61	3.75	432	2.70
13	698	659	2.35	3.93	438	2.60
14	816	743	2.21	3.68	651	3.06
15	826	837	1.82	3.90	445	2.77
16	706	684	2.10	3.84	459	2.80
17	680	776	2.06	3.69	438	2.78
18	1,015	778	2.22	3.91	472	2.86
19	926	754	1.78	3.64	454	2.81
20	869	638	1.78	3.58	658	3.09
21	832	783	1.92	3.97	449	2.83
22	704	792	2.34	3.50	675	3.17
23	1,073	767	2.10	3.64	522	2.61
24	651	718	2.07	3.67	422	2.75
25	951	781	1.76	3.36	659	3.12
26	786	637	2.03	3.87	433	2.76
27	742	711	2.32	3.33	659	3.13
28	746	736	1.53	3.56	430	2.73
29	805	650	1.89	3.69	437	2.77
30	938	715	1.89	3.88	444	2.81
31	995	822	2.53	3.37	670	3.17
32	801	715	2.19	3.80	440	2.79
33	736	737	1.98	3.77	442	2.80
34	1,000	669	2.14	3.24	654	3.11
35	776	712	1.85	3.69	433	2.76
36	777	636	2.00	3.89	433	2.74
37	729	653	1.77	3.56	436	2.76
38	1,046	717	2.05	3.68	663	3.15
39	1,168	828	2.01	3.80	468	3.02
40	1,147	813	2.20	3.77	452	2.91
41	1,077	772	1.95	3.55	471	3.03
42	1,184	752	1.52	3.38	449	2.91
43	1,167	795	1.71	3.33	458	2.97
44	1,097	779	2.18	3.59	462	2.98
45	1,137	788	1.65	3.59	464	3.00
46	1,035	769	2.02	3.71	454	2.95
47	951	663	1.91	3.77	460	2.98
48	967	772	1.71	3.73	452	2.92
49	1,214	786	2.69	3.31	467	3.01

have other clusters of visual characteristics not present in that collection.

Field experience at Copan and Volcán Ixtepeque suggested that Group A obsidian most probably came from the IXT source. Group B also closely resembles worked material from Copan and geological samples from Volcán Ixtepeque, so was also guessed to be IXT. Group C was guessed to be CHY, and Group D was presumed to be from the SMJ source. Although we were quite sure of the source homogeneity of Group A, as well as its source assignment, we felt somewhat less secure about the source homogeneity of Groups B and C and of the source assignment for the single member of Group D.

Phase 2: Abbreviated NAA

Because Groups B, C, and D have few members, we decided to source every artifact in these visual groups using abbreviated NAA. Fourteen artifacts were chosen at random from Group A, and also analyzed. Thus 49 samples were chemically sourced at MURR (Table 1).

All 49 obsidian artifacts submitted for analysis were given source assignments using the abbreviated NAA technique. Their elemental compositions are presented in Table 2. Figure 2 shows the Mn and Na elemental compositions of these artifacts, as well as the 95% confidence ellipses (derived from geological samples and previously analyzed artifacts) for the three Guatemalan sources to which the artifacts were assigned. Two specimens, one from IXT and one from SMJ, fall far outside and below the ellipse when the element Na is considered (Figure 2; Samples 13

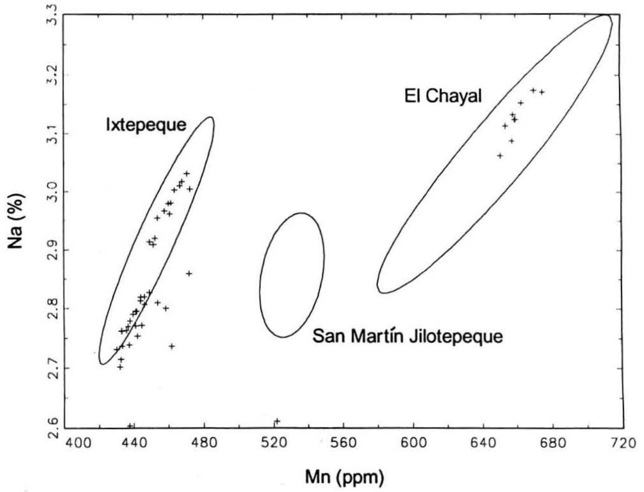

Figure 2. Mn and Na compositions of obsidian artifacts from Quelepa, El Salvador (including 95% probability ellipsoids for the IXT, SMJ, and CHY source areas).

and 23 in Table 2). On the other hand, the K concentrations of these samples are substantially higher than normal for obsidian from these sources. Apparently, K and Na concentrations are somewhat interchangeable. Measurements for Ba, Cl, and Dy, although of lower precision, support the assignment of these two anomalous pieces to IXT and SMJ. Tables 3 and 4 compare the results of visual and chemical sourcing. The data presented in Tables 3 and 4 are neither representative of the Quelepa collection as a whole, nor of the entire population of obsidian at that site; the 49 samples chosen for NAA were not selected at random.

Comparing Phase 1 and Phase 2

There are only three mismatches for the 49 samples sourced according to both visual and chemical criteria (Table 3). The visual-sourcing technique gives correct results for 93.9% of the cases. In addition, source homogeneity is demonstrated for two of the three nontrivial visual groups (Table 4). Group C, guessed to be from the CHY source, has a source homogeneity of only 75% (9 out of 12 cases). While three IXT artifacts were wrongly attributed to the CHY source by visual sourcing, no CHY artifacts were wrongly attributed to the IXT source. This suggests two things. First, the optical characteristics used to define Group C are too broad rather than too narrow. It may be possible to further restrict the criteria used to judge inclusiveness in Group C. Second, the chances are rather low of finding a significant amount of CHY obsidian in either visual Group A or B collections from Quelepa.

Because the visual sourcing of Group A to IXT was verified by NAA in each of 14 cases, and because of the high accuracy of visual sourcing for the other three groups that were considered less secure (91.4%, or 32 out of 35 cases), the assumption that the 528 artifacts in Group A that were not sourced by NAA are also made of IXT obsidian seems supported. Table 5 presents the full results of the visual and chemical sourcing of Quelepa obsidian.

Phase 3: Estimating Accuracy

How accurate are the results in Table 5? Ignoring visual sourcing completely, we can be sure at the 95% confidence level that at least 78.6% of the Group A cases that were not sourced by NAA are also IXT (this is derived from the sample of 14 artifacts from this group that were tested by NAA). Taking into account the other 35 chemically sourced artifacts, an accuracy of 80.0% is established at the 95% confidence level.

But the NAA data suggest that visual sourcing *is* quite accurate, giving correct results for 46 of 49 cases. Extrapolating a 93.9% accuracy rate to the 528 pieces of Group A obsidian that were not tested by NAA, an overall projected accuracy rate of 94.4% is derived for the results presented in Table 5. This value is highly conservative because the sample sourced by NAA was not random; 35 of the 49 members of this sample were considered the most difficult artifacts in the entire collection to source by visual inspection.

A less conservative estimate is based on an average of the accuracy rates of visual sourcing for Group A and all other groups as determined through NAA. Here an accuracy of 95.7% is extrapolated for the 528 pieces of Group A obsidian that were not tested by NAA, yielding an overall projected accuracy rate of 96.1%.

Suspecting that the true accuracy of the data presented in Table 5 probably lies between these two conservative and less conservative estimates, we propose an accuracy rate of 95%. With two significant figures, this value is equivalent to both the conservative and less conservative estimates.

TYPOLOGICAL AND ATTRIBUTE ANALYSES

Typology

The typology used in the analysis of Quelepa obsidian is based on a behavioral model developed by Sheets (1972, 1975), but has been substantially modified. While the full typology as used at Copan and San Martín Jilotepeque contains 24 basic categories of artifacts, only six of these were found in the Quelepa assemblage. These taxa are macroblades, small percussion blades, prismatic blades, projectile points (made on macroblade blanks), flakes, and chunks. Descriptions of these categories can be found in Clark (1988), Sheets (1972, 1975), and Hester (1972). Not all of these artifact classes need be products or byproducts of a prismatic-blade industry. Flakes, for example, can also be produced by casual core, bifacial, or bipolar industries. When flakes or chunks were found to be products of a particular industry, this was recorded. The results of the typological analysis are presented in Table 6.

Uapala Phase

Because only 19 obsidian artifacts were recovered from Late Formative contexts, very few meaningful statements can be made about obsidian procurement and use during this early period of occupation. Table 7 presents a cross tabulation of artifact type by source for Uapala-phase contexts.

Fully 79% (N = 15) of the Uapala-obsidian artifacts are prismatic blades. It is clear that a prismatic-blade tradition was well established at Quelepa in the Late Formative period, despite its

Table 3. Visual and NAA source identifications of Quelepa obsidian

Sample	Visual Group	Guess	Actual Source
1	A	IXT	IXT
2	C	CHY	CHY
3	B	IXT	IXT
4	B	IXT	IXT
5	B	IXT	IXT
6	B	IXT	IXT
7	A	IXT	IXT
8	B	IXT	IXT
9	B	IXT	IXT
10	B	IXT	IXT
11	C	CHY	IXT
12	B	IXT	IXT
13	A	IXT	IXT
14	C	CHY	CHY
15	B	IXT	IXT
16	B	IXT	IXT
17	B	IXT	IXT
18	C	CHY	IXT
19	C	CHY	IXT
20	C	CHY	CHY
21	B	IXT	IXT
22	C	CHY	CHY
23	D	SMJ	SMJ
24	B	IXT	IXT
25	C	CHY	CHY
26	B	IXT	IXT
27	C	CHY	CHY
28	B	IXT	IXT
29	B	IXT	IXT
30	B	IXT	IXT
31	C	CHY	CHY
32	B	IXT	IXT
33	B	IXT	IXT
34	C	CHY	CHY
35	B	IXT	IXT
36	B	IXT	IXT
37	B	IXT	IXT
38	C	CHY	CHY
39	A	IXT	IXT
40	A	IXT	IXT
41	A	IXT	IXT
42	A	IXT	IXT
43	A	IXT	IXT
44	A	IXT	IXT
45	A	IXT	IXT
46	A	IXT	IXT
47	A	IXT	IXT
48	A	IXT	IXT
49	A	IXT	IXT

Note: CHY = El Chayal, Guatemala, source area; IXT = Ixtepeque, Guatemala, source area; and SMJ = San Martín Jilotepeque, Guatemala, source area.

Table 4. Frequencies of visual groups by chemical groups

Visual	CHY	IXT	SMJ	Total
A	0	14	0	14
B	0	22	0	22
C	9	3	0	12
D	0	0	1	1
Total	9	39	1	49

location far to the southeast of other important Formative Mesoamerican sites.

The relative quantity of CHY obsidian (10%, N = 2) is higher during the Uapala phase than in any later period. Despite the small size of the Uapala sample, there is only an 18.4% chance that the relative quantities of CHY in the Uapala and Shila phases are the same. This probability drops to .05% when Uapala and Lepa phases are considered.

The presence of a chunk of CHY obsidian, in this case debitage, suggests that at least some obsidian artifacts were made locally. It is interesting that no bipolar flakes or cores were found in Uapala-phase contexts; the bipolar tradition was very important at other Formative-period Mesoamerican sites (e.g., Clark 1988). But this may be a product of sampling strategy and sample size.

Shila and Lepa Phases

The Shila-phase sample is considerably larger, consisting of 158 obsidian artifacts (Table 8). Only one-third (2 of 6) of the CHY pieces from this assemblage are prismatic blades, compared to 81.6% (124 of 152) of the IXT artifacts. This difference is highly significant, with only a .4% chance that CHY and IXT were used equally, suggesting that IXT was favored for blade production. Since obsidian from both sources is of high quality, it seems likely that IXT was valued for reasons not related to its suitability for a prismatic-blade industry.

During the Lepa phase, CHY obsidian was less common at Quelepa (Table 9). Only one artifact, a blade, is made of CHY obsidian. The probability that the Shila and Lepa phases had the same relative quantity of CHY is quite low, about .9%. Thus we see that reliance on the IXT source increased steadily throughout time. A large flake of SMJ obsidian is also present in the Lepa-phase assemblage, perhaps suggesting a widening of trade networks toward the end of the history of Quelepa.

There is no evidence that CHY artifacts were produced at Quelepa during either the Shila or succeeding Lepa phase. No core fragments or debitage made of CHY obsidian are present in the collection, but this may be a product of decreasing sample size. There is evidence, however, of the local production of IXT prismatic blades, probably from imported large polyhedral

Table 5. Combined results of visual and NAA sourcing of obsidian artifacts from Quelepa, El Salvador

	CHY	IXT	SMJ	Total
N	9	567	1	577
Percent	1.6	98.3	.2	100.1

Table 6. Quelepa obsidian typology

	Prismatic Blades	Small Percussion Blades	Macroblades	Projectile Points	Flakes	Chunks	Total
N	468	13	5	1	80	10	577
Percent	81.1	2.3	.9	.2	13.9	1.7	100.1

cores or macrocores, during both Shila and Lepa times. One Shila chunk appears to come from a prismatic-blade core, as do two Lepa chunks. An apparently unused and unusable plunging blade was also recovered from a Lepa context. It seems unlikely that these useless artifacts would have been imported to the site in their present forms.

A parallel bipolar industry was also present at Quelepa during both the Shila and Lepa phases. Three bipolar flakes and one scalar core (a chunk) were excavated from Shila contexts, and one bipolar flake and three scalar cores (chunks) were associated with Lepa-phase ceramic material. It seems probable that the bipolar industry was more important during the Shila phase; there is only a 19.3% chance that both phases share the same relative quantity of bipolar artifacts. The bipolar industry, however, was never very important at Quelepa. Perhaps bipolar flakes were produced only on an as-needed basis from expended artifacts.

The percentage of artifacts that contain cortex can be an important measure of the state of obsidian when it reached a site. In a prismatic-blade industry, Clark (1988:Tables 152–155) has found that approximately 16.2% of the products and by-products of nodule reduction contain cortex, while only 6.9% contain cortex when a macrocore is reduced. Finally, only 1.6% of all artifacts contain cortex when a large polyhedral core is reduced. The cortex counts for Quelepa obsidian are presented in Table 10. Because the Quelepa collection is the result of several activities (the reduction of macrocores or large polyhedral cores into blades, the importation of finished prismatic blades, and the reduction of exhausted tools or debitage into bipolar flakes and scalar cores), a direct comparison with Clark's data is difficult. Nevertheless, it is probable that a greater proportion of Shila-phase pieces contain cortex than Lepa-phase artifacts. This is weakly supported by a Mann–Whitney test comparing cortex counts for the Shila and Lepa phases; there is only a probability of 23.1% that the Shila and Lepa samples share the same distribution. There is some evidence, then, that during the Shila phase, obsidian reached Quelepa in a comparatively less-prepared state than in Lepa times.

Are the relative proportions of different artifact types (Tables 8 and 9) the same or different during the Shila and Lepa phases? More specifically, is the difference in prismatic-blade percentages (79.7% of the total Shila assemblage and 82.0% of the Lepa-phase material) significant? Compositional analysis—a statistical procedure—suggests that the null hypothesis of equivalence cannot be rejected for any artifact category. If there were significant changes in the proportions of artifact types between Shila and Lepa phases, they have yet to be detected.

Measurements of length, width, thickness, and mass were made for all artifact taxa, and total cutting edge was measured for all three blade types, allowing the calculation of cutting edge to mass ratios (CE/Ms). Do these metric variables change significantly from the Shila to Lepa phases? Only prismatic-blade fragments are considered in the present discussion.

For many lithic analysts, the most interesting of these variables is CE/M. CE/M measurements were first proposed as a measure of the efficiency of material usage, related to resource scarcity (Sheets and Muto 1972). Since then, numerous CE/M measurements have been reported (e.g., Aoyama 1988; Clark 1982; Fowler et al. 1989; Sheets 1978, 1983). Unfortunately, researchers have seldom presented more than mean values. It is therefore difficult to judge if observed differences in these values are significant.

Mean CE/M values appear lower during the Uapala and Shila phases, and higher in the Lepa phase (Table 11). But the associated standard deviations for these measurements are quite high. Are the observed differences between Shila- and Lepa-phase mean CE/Ms significant? Figures 3 and 4 are histograms displaying the CE/M values measured for Shila- and Lepa-phase

Table 7. Uapala-phase artifacts and sources

	Prismatic Blades	Small Percussion Blades	Macroblades	Projectile Points	Flakes	Chunks	Total	Percent
CHY	1	0	0	0	0	1	2	10.5
IXT	14	0	0	0	3	0	17	89.5
SMJ	0	0	0	0	0	0	0	.0
Total	15	0	0	0	3	1	19	100.0
Percent	78.9	.0	.0	.0	15.8	5.3	100.0	

Table 8. Shila-phase artifacts and sources

	Prismatic Blades	Small Percussion Blades	Macroblades	Projectile Points	Flakes	Chunks	Total	Percent
CHY	2	0	0	0	4	0	6	3.8
IXT	124	3	0	0	21	4	152	96.2
SMJ	0	0	0	0	0	0	0	.0
Total	126	3	0	0	25	4	158	100.0
Percent	79.7	1.9	.0	.0	15.8	2.5	99.9	

prismatic blades, with normal curves having the same mean and variance superimposed. A quick glance establishes that neither distribution is normal. In fact, half the metric measurements made for prismatic blades were found to be non-Gaussian in distribution. Therefore, nonparametric statistical tests (Mann–Whitney, two-sample median, and Kolmogorov–Smirnov) were used when appropriate.

All three nonparametric statistical tests strongly suggest ($p \leq .022$) that mean CE/M values were greater during the Lepa phase than in Shila times. This seems to argue that obsidian was more scarce in the Late and Terminal Classic than in earlier phases. But the relative quantities of obsidian recovered from Uapala, Shila, and Lepa contexts suggest otherwise. Obsidian count to ceramic count, obsidian mass to ceramic count, and obsidian count and mass-to-volume-excavated ratios were all calculated. All lines of evidence demonstrate that the availability of obsidian remained relatively constant during the Uapala and Shila phases, and doubled during the Lepa phase. For this reason, it seems highly unlikely that the finer prismatic-blade fragments of the Lepa phase reflect an attempt to conserve material. Rather, it seems probable that this change reflects an increase in the skill of the craftsmen who prepared the blades used at Quelepa. This conclusion is further supported by data from Copan, presented below.

Descriptive statistics for other metric variables are presented in Tables 12 and 13. Lepa-phase prismatic-blade fragments are significantly longer and have greater total cutting edges (closely related to length) than their Shila-phase predecessors, but are significantly thinner and probably narrower. Average mass, however, seems not to have changed over time. Thus we can think of prismatic-blade fragments as proportionately longer and finer in the Lepa phase.

Comparing Lepa-Phase Quelepa with Coner-Phase Copan Obsidian

Is the obsidian assemblage at Quelepa somehow typical of southeastern Mesoamerica? To answer this, we compared the Quelepa Lepa-phase collection with Coner-phase obsidian recovered from Group 10L-2 of Copan, Honduras. All chronological evidence, except some obsidian-hydration dates, suggests that the Coner phase began by A.D. 650 and ended around A.D. 900.[5] Lepa and Coner, therefore, are overlapping phases. To date, 7,966 Coner-phase obsidian artifacts have been analyzed.

Results of visual sourcing demonstrate that 98.3% of the Coner-phase obsidian artifacts originate from the IXT source, 1.2% derive from CHY, and less than .1% from SMJ. Although three sources (PAC, Ucareo [Michoacan, Mexico], and La Esperanza [Honduras]) not found in the Quelepa sample are represented in the Copan collection, together they account for less than .3% of the entire sample. Compositional analysis suggests that there is no significant difference between Late Classic Copan and Quelepa obsidian-procurement patterns.

Evidence of a bipolar industry was also found in the Copan Coner assemblage. While 1.0% (N = 4) of the Quelepa Lepa sample were either bipolar flakes or cores, only .5% (N = 43) of the Copan Coner material can be classified as bipolar arti-

Table 9. Lepa-phase artifacts and sources

	Prismatic Blades	Small Percussion Blades	Macroblades	Projectile Points	Flakes	Chunks	Total	Percent
CHY	1	0	0	0	0	0	1	.3
IXT	313	9	5	1	48	5	381	99.5
SMJ	0	0	0	0	1	0	1	.3
Total	314	9	5	1	49	5	383	100.1
Percent	82.0	2.3	1.3	.3	12.8	1.3	100.0	

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[5] Webster and Freter (1990) used obsidian-hydration dates to argue that the Coner phase should be extended to ca. A.D. 1150 or 1200. This extension has not been accepted by all researchers at Copan, because Early Postclassic diagnostic ceramics are extremely rare, and there are no radiocarbon or archaeomagnetic dates later than about A.D. 900 for cultural contexts in the Copan area. All evidence from Group 10L-2 itself suggests that it was abandoned by A.D. 900 (Andrews and Fash 1992).

Table 10. Cortex counts for Quelepa artifacts

	Uapala (N = 19)	Shila (N = 158)	Lepa (N = 383)	All Phases (N = 577)[a]
N	1	5	6	13
Percent	5.3	3.2	1.6	2.3

[a] Seventeen artifacts of uncertain temporal context account for the discrepancy between the sum of the values presented in the first three columns and those presented in the final column.

facts. This difference is weakly significant, with a *p* value of .206.

Cortex counts for the Copan Coner and Quelepa Lepa samples, however, are more similar: 1.3% and 1.6% respectively. This difference is not statistically significant, suggesting that obsidian reached both Copan and Quelepa in approximately the same state of preparation.

Although the Copan Coner sample has been sorted into 14 typological categories, 99.2% (7,902 of 7,966) of the entire assemblage can be classified using the six taxa used to sort the Quelepa material (Table 14). Compositional analysis demonstrates that the differences between the Copan and Quelepa assemblage are slight; all but two types appear in equivalent proportions. The Copan Coner collection has significantly more flakes and less prismatic blades than the Quelepa Lepa sample.

What accounts for these differences? Fully 7.7% (N = 102) of the flakes from Coner contexts are by-products of biface production. Thinning flakes were not recovered from Quelepa. Thus while it is clear that bifacially flaked tools were produced at Copan, it is possible that all bifaces found at Quelepa were imported.

A clue to understanding the difference in prismatic blade-fragment proportions can be found by examining related debitage categories. While the ratio of blade fragments to core parts is 104.2 for the Quelepa Lepa sample, it is only 40.0 for the Copan Coner collection. A number of hypotheses were tested, and all were rejected except the possibility that some finished blades found at Quelepa were imported.

Descriptive statistics for metric variables of Copan Coner prismatic-blade fragments are presented in Table 15. Statistical analyses indicate that the Quelepa Lepa prismatic-blade segments are significantly longer, wider, more massive, and have longer total cutting edges than their Copan Coner counterparts. Copan Coner prismatic-blade fragments, on the other hand, have significantly greater CE/Ms. There is no significant difference in the thickness of Copan and Quelepa blades.

It is reasonable to assume that access to obsidian in Copan Group 10L-2 was greater than at Quelepa. Copan is much closer to Volcán Ixtepeque, and was a much larger, more important site than contemporary Quelepa. It seems highly unlikely that obsidian would be more carefully conserved in the elite residential zone of Copan. Yet CE/Ms and other measurements all suggest that prismatic-blade fragments are significantly finer at Copan than Quelepa. In this case, the only reasonable conclusion is that the artisans who produced the prismatic blades used at Quelepa could not or did not choose to make blades as fine as those produced and used in contemporary Copan. The notion that CE/M and other metric variables are always good measures of scarcity is therefore rejected. Furthermore, the related assumption that mean CE/M values always increase with distance from geological source should be reassessed.

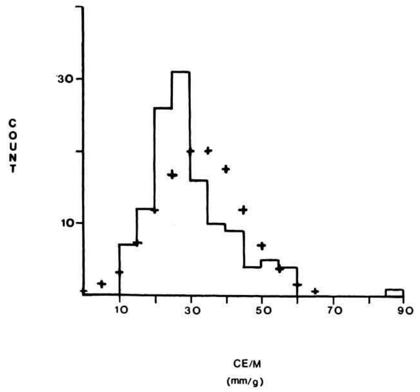

Figure 3. Cutting edge to mass ratios for Shila-phase prismatic blades (N = 126) (superimposed plus signs indicate a normal curve with the same mean and variance).

Table 11. Descriptive statistics for CE/M values of Quelepa prismatic blade fragments by phase

Phase	Mean	Standard Deviation	Minimum	Maximum	N
Uapala	30.7	15.7	13.0	78.8	15
Shila	30.2	12.0	10.2	87.2	126
Lepa	36.4	20.3	10.5	137.8	314

Note: Descriptive statistics in mm/g.

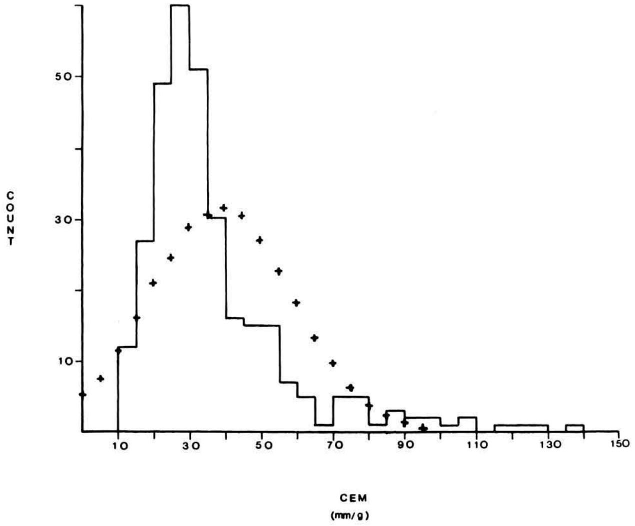

Figure 4. Cutting edge to mass ratios for Lepa-phase prismatic blades (N = 314) (superimposed plus signs indicate a normal curve with the same mean and variance).

Table 12. Descriptive statistics for Shila-phase prismatic-blade fragments (N = 126)

Variable	Unit	Mean	Standard Deviation	Minimum	Maximum
Length	mm	29.4	9.2	13.9	67.1
Width	mm	15.6	3.3	7.8	24.0
Thickness	mm	3.7	.9	1.9	6.5
Cutting edge	mm	54.2	19.4	22.6	127.8
Mass	g	2.0	1.1	.4	6.2
CE/M	mm/g	30.2	12.0	10.2	87.2

Can the CE/M measurements presented here be compared with those of other sites in southeastern Mesoamerica (Table 16)? As noted above, most researchers do not adequately report distributional data. Therefore, having stressed the need to use proper statistical tests, it is now necessary to violate this rule and use the one-sample t-test to compare Quelepa Shila, Quelepa Lepa, and Copan Coner samples with reported mean CE/Ms for other sites. To make matters worse, we must assume that these reported values are the true mean CE/Ms of their populations. While this assumption is reasonable for large samples, it is less so for smaller collections. With these caveats in mind, the Quelepa Shila sample appears significantly different from all mean CE/Ms in Table 16, and the Quelepa Lepa sample can easily be distinguished from all mean CE/Ms except the La Entrada Type IV settlement value. The Copan Coner sample is significantly different from all but the Type III settlement and total La Entrada values.

Although distinguishable from most mean CE/M data for southeastern Mesoamerica, the Quelepa values fall within the range reported for this area.

CULTURAL IMPLICATIONS OF THE RESULTS

The ancient inhabitants of Quelepa participated in a Mesoamerican, rather than Central American, obsidian transference network. All the source areas represented in the Quelepa collection are in Guatemala. Obsidian from the La Esperanza (ESP) and Güinope (GUI), Honduras, source areas, both near Quelepa (Figure 1), is not found at the site. While GUI material is not well suited for a prismatic-blade industry, ESP obsidian is, suggesting that utility and ease of access are not sufficient to explain ancient procurement patterns.

Table 13. Descriptive statistics for Lepa-phase prismatic-blade fragments (N = 314)

Variable	Unit	Mean	Standard Deviation	Minimum	Maximum
Length	mm	32.2	11.6	11.1	88.5
Width	mm	15.0	3.4	6.2	26.8
Thickness	mm	3.4	1.0	1.3	7.9
Cutting edge	mm	60.2	24.2	9.3	175.2
Mass	g	2.0	1.1	.2	6.5
CE/M	mm/g	36.4	20.3	10.5	137.8

We have already seen that Quelepa obsidian-procurement patterns were similar to those of Copan; these parallels extend to other sites in southeastern Mesoamerica. At Chalchuapa, El Salvador, IXT obsidian is assumed to constitute virtually the entire assemblage (Sheets 1978). Michel et al. (1983) analyzed 20 samples from the Cambio site in the Zapotitan Valley, El Salvador, and all of them were IXT. At a confidence level of 95%, then, the Cambio assemblage is at least 86.0% IXT. Fowler et al. (1987) report the results of XRF analyses of 20 artifacts from Cihuatan, El Salvador. Here, 60% were IXT, 35% were CHY, and 5% were SMJ obsidian. This sample was not drawn at random, therefore the results indicate only that IXT was the dominant source utilized, followed by CHY and SMJ. Seven samples from Late and Terminal Classic assemblages in the Sula Valley, Honduras, were all determined to be IXT obsidian (Pope 1987). Finally, in the La Entrada region of Honduras, Aoyama (1994) has found that 89.8% of the total Late Classic collection is IXT obsidian. In Type V and IV elite sites, however, IXT obsidian accounts for 95.6% and 94.3% of the total assemblage.

In marked contrast are central Honduran, Pacific Nicaraguan, and Costa Rican sites. In the El Cajón region, 123 Classic-period artifacts were analyzed using PIXE (Hirth 1987; Hirth and Coskren 1989; Sheets et al. 1990). Here ESP comprises 39.9% and GUI 24.4% of the assemblage. Of nine late Period V or early Period VI (related to the Mesoamerican Terminal Classic and Early Postclassic periods) artifacts from Ninderí, Nicaragua, two-thirds are GUI and one-third are IXT obsidian (Sheets et al. 1990). Three artifacts from northwestern Costa Rica (Río Sapoa Valley and the Vidor site) have been attributed to the GUI, SMJ, and IXT source areas (Stross et al. 1992).

Reported mean CE/M values for prismatic blades recovered from Classic-period sites in southeastern Mesoamerica range from 26.9 mm/g to 46.0 mm/g. In contrast, CE/M measurements from three sites (Tepetate, La Ceiba Sur, and Nindirí) in Nicaragua have an average value of 45 mm/g (Lange et al. 1992:166, Table 7.2), considerably higher than most southeastern Mesoamerican values (Table 16).

Although obsidian constitutes 96.7% of the chipped-stone artifacts from Quelepa (Andrews 1976:158, 160, 195), the relative quantity of obsidian found at sites to the southeast is much lower. In the Chinandega area (Lithic Zone 1) of northwest Nicaragua, 82% of lithic artifacts are made of obsidian. Near Lake Managua (Lithic Zone 2), obsidian accounts for 64.6% of the assemblage. Farther to the southeast, on the west side of Lake Nicaragua (Lithic Zone 3), only 18% of all chipped-stone artifacts are obsidian (Lange et al. 1992:Table 7.1). In the Rivas region of Nicaragua (the southern portion of Lithic Zone 3), 6% of the chipped lithics are obsidian (Healy 1980:284–285). To the east of Lake Nicaragua (Lithic Zone 4), just 1% of the assemblage is obsidian (Lange et al. 1992:Table 7.1). Finally, only .04% of the chipped-stone artifacts recovered from archaeological sites in Costa Rica are obsidian (Payson D. Sheets, personal communication 1991).

In the first millennium B.C., the prismatic-blade industry was established as the dominant form of Mesoamerican lithic production. Its spread in the Formative period has even been linked to the development of social complexity (Clark 1987). Prismatic

Table 14. Copan Coner-phase artifacts (using a reduced typology)

	Prismatic Blades	Small Percussion Blades	Macroblades	Projectile Points	Flakes	Chunks	Total Sample	Percent of Total
N	5,913	227	92	37	1,323	310	7,902	99.2
Percent	74.8	2.9	1.2	.5	16.7	3.9	100.0	

blades and related classes of artifacts and debitage constitute the majority of the Quelepa chipped-stone assemblage during all phases of occupation. Prismatic blades comprise 79% of the Uapala sample, and at least 82.3% of the Shila assemblage are the products or by-products of prismatic-blade production. This proportion rises to 86.4% during the Lepa phase.

Although prismatic blades are found in Nicaragua, there is no evidence for local production until the arrival of the Nahua-speaking Nicarao (Lange et al. 1992:57, 264). A percussion flake industry was the dominant form of lithic production in Greater Nicoya (Lange et al. 1992:175–176). Limited numbers of obsidian blades, produced at sites like Quelepa, were traded into lower Central America. Meager quantities of prismatic blades and rapid drop-off imply that lithic transference networks linking Nicaragua and Mesoamerica were small scale and informal in nature.

Obsidian suitable for prismatic-blade production was not easily acquired in Pacific Nicaragua until the Postclassic period. Nodules from GUI, the nearest source area,[6] are small and of poor quality. It is likely that the Nicarao were the first inhabitants of Greater Nicoya to participate in a highly organized and centralized lithic transference network that facilitated the importation of high-quality IXT obsidian macrocores. Furthermore, there is little evidence of occupational specialization in lithic production until the Postclassic period (Lange et al. 1992:168–169).

This observation cannot be extended to central Honduras, where core-blade technology was an integral part of the prehistoric lithic industry. The presence of a high-quality obsidian source (ESP) within the area and direct interaction with Maya sites such as Copan may also have stimulated the development of a core-blade technology in central Honduras.

CONCLUSIONS

Despite previously reported problems (e.g., Jackson and Love 1991; Moholy-Nagy and Nelson 1990), the visual sourcing technique has great potential. A combined strategy of visual source attribution and abbreviated NAA provides an inexpensive means of sourcing entire collections and assessing the accuracy of source assignments.

John Clark (personal communication 1993) states "if someone is looking for an easy quick-fix . . . [visual sourcing] will continue not to work." We stress that consistently correct source identifications can be made only by researchers who are fully cognizant of the complete range of visual criteria that characterizes a source, that exhaustive comparative collections of both artifacts and source samples must be used when making source assignments, that accuracy increases with experience, and that the method works best when the sources represented in a given collection are relatively distinctive. While these caveats may discourage some archaeologists, we argue that visual sourcing is analogous to ceramic analysis, and should be approached with the same degree of preparation.

Our sourcing results demonstrate that Quelepa participated in a Mesoamerican obsidian transference network from its earliest occupation in the Late Formative Uapala phase. The presence of Usulutan resist decoration and western tradewares at Quelepa supports the position that goods and ideas moved eastward to the site in this early phase of occupation. In contrast, very few obsidian artifacts from this period have been found to the southeast, suggesting that the economic boundary of the Mesoamerican periphery was already established.

During the Classic Shila phase, obsidian, ceramic, and architectural data suggest cultural and economic ties with different areas. Although obsidian continued to be imported from the Guatemalan highlands, ceramic ties between Quelepa and sites in western Honduras and El Salvador attenuated. The architec-

Table 15. Descriptive statistics for Copan Coner prismatic-blade fragments (N = 5,913)

Variable	Unit	Mean	Standard Deviation	Minimum	Maximum
Length	mm	26.9	10.2	6.1	132.2
Width	mm	13.7	3.0	2.7	43.3
Thickness	mm	3.4	.8	1.1	13.1
Cutting edge	mm	50.2	20.9	.0	264.4
Mass	g	1.5	.9	.1	11.0
CE/M	mm/g	39.5	19.4	.0	306.0

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[6] Although trace-element data suggest the existence of a low-quality obsidian source on the shores of Lake Nicaragua, its exact location remains uncertain.

Table 16. Mean CE/M values reported for other sites and regions in southeastern Mesoamerica

Site or Region	Mean CE/M (mm/g)	N	Reference
Chalchuapa	26.9	–	Sheets (1978)
Cihuatan	43.8	7,790	Fowler et al. (1987)
Santa María	42.5	225	Fowler et al. (1987)
La Entrada (all types)	39.3	966	Aoyama (1993)
Type I	46.0	41	Aoyama (1993)
Type II	42.2	127	Aoyama (1993)
Type III	39.5	284	Aoyama (1993)
Type IV	35.9	263	Aoyama (1993)
Type V	42.7	251	Aoyama (1993)

tural style of Quelepa suggests the development of a local tradition. We view the Shila phase, then, as a period of growing local identity. Although some ideas and trade goods were entering Quelepa from Central America, the obsidian data suggest that most important external ties, from an economic perspective, were still with southeastern Mesoamerica.

Whoever they were, the Late and Terminal Classic elite of Quelepa found it advantageous to exploit and increase an existing transference network to meet their needs for obsidian. This more organized network, however, was not extended farther to the southeast. Obsidian provides evidence of a highly stable economic boundary between southeastern Mesoamerica and lower Central America, lasting from the Late Formative through the Late Classic period.

This network also included Copan, Chalchuapa, and other sites west of Quelepa. The transference network to which these sites belonged crosscut ethnic and linguistic boundaries. Although the identity of the Lepa-phase inhabitants of Quelepa is unknown, the site was connected with Lenca, Maya, and probably other polities through the transference of obsidian. Thus ethnic and linguistic differences cannot account for the failure of economic integration with Greater Nicoya. It seems more likely that the political institutions necessary for maintaining large-scale interregional interaction did not exist in lower Central America until the Mesoamerican Postclassic period.

Lepa-phase Quelepa may have been a colonial enclave established for economic purposes. Although the site participated in long-distance transference networks from Uapala times, only relatively small quantities of obsidian entered Quelepa before the Lepa phase. We can therefore infer that few goods moved westward from Quelepa. Transference was probably inefficient and infrequent, perhaps involving the redistributive behavior typically associated with chiefdom-level societies.

It has recently been suggested that pristine states tend to expand by establishing isolated outposts in peripheral areas where nonlocal resources can be found; there is no a priori reason this generalization cannot be extended to secondary states, provided that they share a border with less-complex societies. Algaze (1993) asserts that these strategically located, state-controlled trade colonies offer the most efficient way of organizing both the collection of peripheral resources and the distribution of core-produced prestige goods. Furthermore, these colonies are often located on preexisting trade routes. The history of Quelepa as a central place and its role as an important node on a well-established transference network are consistent with this model (Sharer 1984:72). Furthermore, the increase in obsidian and other foreign goods at the site during the Late and Terminal Classic period suggests that existing transference links were reorganized and strengthened.

The San Miguel Valley, dominated by Quelepa in ancient times, is rich in natural resources that would have attracted expansionist Mesoamerican states. Colonial documents list cotton, cloth, honey, wax, and fish as important resources of eastern El Salvador (Andrews 1976:185–186). But the principal product of the San Miguel Valley was probably cacao, a focal commodity of prehistoric Mesoamerican transference networks (Andrews 1976:185).

Changes in exchange, and possibly political relationships with the central Guatemalan highlands are mirrored in the Quelepa assemblage. Although Ixtepeque was always the most important source of obsidian used at Quelepa, the relative availability of El Chayal obsidian was highest during Uapala times and slowly declined through the Classic period. By the Lepa phase, virtually all the obsidian used at Quelepa came from the Ixtepeque source. Strong barriers may have developed between interaction spheres dominated by Kaminaljuyu and Copan or Chalchuapa. Although the evidence is weak, the dissolution of these barriers at the end of the Classic period may be reflected in the presence of a single piece of San Martín Jilotepeque obsidian in the Lepa-phase assemblage. In a symmetrical fashion, evidence of the resumption of interregional obsidian transference networks can be found in Guatemala. Ixtepeque obsidian first appeared in the highlands west of Kaminaljuyu at the end of the Late Classic, and eventually became the material of choice for projectile points at Chuisac, an Early Postclassic Kaqchikel site located only 3 km north of the quarries of San Martín Jilotepeque.

The relative quantities of different types of obsidian artifacts remained constant from the Shila to the Lepa phase at Quelepa, although pre-preparation (the amount of alteration before obsidian reached the site) may have increased. The Lepa-phase assemblage closely resembles its counterpart at Copan, but the production of bifacially flaked tools, including projectile points, was more important at the latter site. These bifaces may have been imported into Quelepa. Obsidian was imported into both sites in at least two forms during the Late Classic period: macroblades and large polyhedral cores or macrocores. Finished prismatic blades may also have been an important Lepa-phase import.

A bipolar industry was present at Quelepa, but it was never significant, and it declined in importance during the Lepa phase as greater quantities of obsidian were imported. The production of bipolar flakes also occurred at Late Classic Copan, but was of less importance, perhaps because of the greater abundance of obsidian at that site.

Although prismatic blades were probably produced at Quelepa from Late Formative Uapala times, a significant increase in the efficiency of material usage occurred only during the Lepa phase. This was not the result of scarcity, but the increasing adeptness of artisans in producing finer blades, although their accomplishments did not approach those of the Copan craftsmen.

Despite these differences, the obsidian assemblages of Quelepa, Copan, and other Salvadoran and western Honduran sites are similar enough to assert that they represent nodes of the same procurement, production, and transference system. In contrast, the ancient inhabitants of central Honduras and Greater Nicoya exploited different obsidian sources and participated in a less formalized, perhaps down-the-line, obsidian transference system. Finally, the prismatic-blade industry, an important facet of ancient Mesoamerican lithic technology, appeared in Pacific Nicaragua only after the arrival of Mesoamerican settlers.

These differences in procurement, transference patterns, and technology are significant. They correlate well with what we consider the southeastern boundaries of Mesoamerica during the Classic period. Sites in El Salvador and the westernmost river valleys of Honduras exhibit many cultural similarities with other parts of Mesoamerica; central Honduras, Nicaragua, and Costa Rica, in contrast, had less important cultural contacts with the Mesoamerican heartland throughout much of prehistory despite the presence by the Terminal Classic period of a fine-paste ceramic tradion identical to that of Quelepa. Unlike Greater Nicoya, an area that was never fully integrated into Mesoamerica, Quelepa participated in Mesoamerican obsidian-transference networks and lithic-production strategies from its settling in the Late Formative period.

RESUMEN

Quinientos setenta y siete artefactos de obsidiana de contextos formativos tardíos a clásicos terminales del sitio de Quelepa, El Salvador, son asignados a yacimientos geológicos por medio de análisis visual y una abreviación de la análisis por activación de neutrones (NAA). Este método produce resultados de alta precisión, es de costo bajo y permite la determinación del origen de colecciones grandes. Los resultados indican que a pesar de la ubicación del sitio en la frontera lejana sureste de Mesoamerica, Quelepa participó en una red de transferencia mesoamericana, en lugar de centroamericano.

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