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APPENDIX C

The Sources of Copan Valley Obsidian

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One hundred thirty-nine obsidian samples from the Copan Valley were subjected to neutron activation analysis at Brookhaven National Laboratory (BNL) (analyzed specimens are listed in table C-1).[1] The samples were prepared by cutting small wedges with a diamond saw, then labeling, washing, weighing, and packaging them in aluminum foil. Sixteen packages and six standards were included in each irradiation. Irradiation in the BNL High Flux Beam Reactor was for 7 1/2 hours (nominal) at a flux of 1.8×10^{14} n/cm^2 sec. Samples were allowed to decay for 16 days (nominal), after which gamma-ray counting for 2,000 seconds per sample was carried out using a Ge(Li) detector with 1.7 KeV resolution at 1332 KeV. The gamma spectra were reduced to elemental concentration data using standard BNL techniques (Abscal-M, Harbottle, and Sayre 1974; Harbottle 1976; Bieber Jr. et al. 1976).

Obsidian sources from Mesoamerica have been characterized by a number of different laboratories using several techniques (e.g., Hammond 1972). Over 1,800 samples from Mesoamerica have been analyzed by neutron activation at BNL (Boksenbaum et al. 1987; Hammond, Neivens, and Harbottle 1984; Spence, Kimberlin, and Harbottle 1984; Neivens, Harbottle, and Kimberlin 1983). These data are now housed both at BNL and in the Smithsonian Archaeometric Research Collections and Records (SARCAR) data base. Previous statistical analysis of the Mesoamerican obsidian artifacts and source samples has produced reference groups representing many of the sources, including Ixtepeque, San Martin Jilotepeque, and El Chayal, the three sources closest to the Copan Valley and therefore most likely to be represented in the analyzed sample (see map, fig. C-1).

Reference groups for most obsidian sources are characterized by extremely high correlations among the elements. Due to these extreme correlations, the dimensionality of the data can be reduced dramatically without significant loss of information. Thus, in a data set consisting of all reference group specimens from the three Guatemalan sources, nearly 90 percent of the total variation in the 14-dimensional data set can be represented in just two dimensions (the first two principal components). Furthermore, as shown in figure C-2, the reference groups are completely separable in these two dimensions alone. As indicated by the principal component coefficients listed in table C-2, component 1, which clearly separates the source groups, is attributable primarily to difference in Cs values, with moderate contributions from Fe, Gd, Hf, and Se. Component 2 is a positive interelemental correlation vector, on which all elements have positive coefficients of roughly the same magnitudes (see table C-2). The ellipses drawn on the plot (fig. C-2) enclose the 95 percent confidence region for each group in the two-dimensional

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principal components space, as calculated using Hotelling's T^2.

When the 139 obsidian samples from the Copan Valley are projected into the principal component space defined by the source reference groups (fig. C-3), the affiliations of all specimens are easily inferred by visual inspection alone. All but seven apparently pertain to the Ixtepeque source, the seven remaining showing El Chayal affiliation. A number of specimens fall outside the 95 percent confidence ellipse for the Ixtepeque source, but there is little doubt that they fall on the same correlational axis. When the full dimensionality of the data is taken into account by calculating Hotelling's T^2 based on all 14 dimensions of the data, all but 14 of the putative Ixtepeque specimens from the Copan Valley show above 5 percent probability of membership in the Ixtepeque reference group (table C-1). The low-probability specimens probably reflect a slight bias in the Ixtepeque reference group as originally formulated. With the new Ixtepeque specimens from the Copan Valley, some of this bias in our reference group is eliminated.

Table C-3 lists the elemental concentration means and percent standard deviations for the three reference groups, along with those for the Copan Valley specimens attributed to El Chayal and Ixtepeque, respectively.

As anticipated, the overwhelming majority of obsidian recovered in the Copan Valley comes from the closest source, Ixtepeque. Of the seven El Chayal specimens, four pertain to CV-43 and three pertain to CV-20. These data provide no evidence of a difference between the two localities in external obsidian exchange relations. Thus, we find no grounds for questioning the assumption that the minor quantities of El Chayal obsidian that reached the Copan Valley were distributed through the same channels responsible for distribution of the more common Ixtepeque obsidian.

Note

1. The authors wish to acknowledge the analytical work of Jerome Kimberlin and Mary Neivens. Neivens's work resulted in the original definition of reference groups for the three Guatemalan sources.

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TABLE C-1
Copan obsidian sources

Analytical I.D.	*Context*	*Description*	*Probability of Membership in El Chayal Core*	*Probability of Membership in Ixtepeque Core*	*Source**
JK1571	CV-43	Bladelet	0.00000	74.77106	Ixtepeque
JK1572	CV-43	Bladelet	0.00000	90.19050	Ixtepeque
JK1573	CV-43	Bladelet	0.00000	72.23039	Ixtepeque
JK1574	CV-43	Bladelet, proximal end	0.00000	60.02236	Ixtepeque
JK1575	CV-43	Bladelet	0.00000	58.22679	Ixtepeque
JK1576	CV-43	Bladelet	0.50846	0.00000	El Chayal*
JK1577	CV-43	Core fragment	0.00000	92.18464	Ixtepeque
JK1578	CV-43	Bladelet	85.39511	0.00000	El Chayal
JK1579	CV-43	Bladelet, proximal end	0.00000	95.21930	Ixtepeque
JK1580	CV-43	Bladelet	0.00000	5.99356	Ixtepeque
JK1581	CV-43	Bladelet	0.00000	0.00325	Ixtepeque*
JK1582	CV-43	Bladelet	0.00000	0.00000	Ixtepeque*
JK1583	CV-43	Bladelet, flake	0.00000	0.00001	Ixtepeque*
JK1584	CV-43	Bladelet, proximal end	0.00000	84.32801	Ixtepeque
JK1585	CV-43	Bladelet, proximal end	0.00000	87.47293	Ixtepeque
JK1586	CV-43	Bladelet	0.00000	98.29251	Ixtepeque
JK1587	CV-43	Bladelet	0.00000	82.87660	Ixtepeque
JK1588	CV-43	Bladelet	0.00000	87.52565	Ixtepeque
JK1589	CV-43	Bladelet	0.00000	68.68499	Ixtepeque
JK1590	CV-43	Bladelet, proximal end	0.00000	0.00000	Ixtepeque*
JK1591	CV-43	Bladelet	0.00000	95.85444	Ixtepeque
JK1592	CV-43	Bladelet	0.00000	96.18010	Ixtepeque
JK1593	CV-43	Bladelet	0.00000	40.82624	Ixtepeque
JK1594	CV-43	Bladelet	0.00000	97.85866	Ixtepeque
JK1595	CV-43	Bladelet	0.00000	78.90781	Ixtepeque
JK1596	CV-43	Bladelet	79.45616	0.00000	El Chayal

*Asterisk following entry for "source" indicates that specimen showed lower than 5% probability of membership in all source reference groups. In these cases, specimens are assigned to the reference group for which Mahalanobis distance from specimen to centroid is minimized.

TABLE C-1 (continued)
Copan obsidian sources

Analytical I.D.	Context	Description	Probability of Membership in El Chayal Core	Probability of Membership in Ixtepeque Core	Source*
JK1597	CV-43	Bladelet, proximal end	0.00000	79.93271	Ixtepeque
JK1598	CV-43	Bladelet, flake	0.00000	54.87824	Ixtepeque
JK1599	CV-43	Bladelet	0.00000	12.62694	Ixtepeque
JK1600	CV-43	Bladelet	0.00000	61.96738	Ixtepeque
JK1601	CV-43	Flake	0.00000	0.40591	Ixtepeque*
JK1602	CV-40	Debris	0.00000	82.16896	Ixtepeque
JK1603	CV-43	Flake	0.00000	48.15933	Ixtepeque
JK1604	CV-43	Flake	0.00000	15.09087	Ixtepeque
JK1605	CV-43	Flake	0.00000	42.64914	Ixtepeque
JK1606	CV-43	Flake	0.00000	0.00000	Ixtepeque*
JK1607	CV-43	Flake	0.00000	72.35548	Ixtepeque
JK1608	CV-43	Flake	0.00000	86.28487	Ixtepeque
JK1609	CV-43	Flake	0.00000	77.86607	Ixtepeque
JK1610	CV-43	Flake	0.00000	0.00000	???—bad data
JK1659	CV-43	Exhausted? Broken core	0.00000	0.00000	Ixtepeque*
JK1660	CV-43	Broken exhausted core, distal end	0.00000	33.01946	Ixtepeque
JK1661	CV-43	Broken exhausted core	0.00000	73.20115	Ixtepeque
JK1662	CV-43	Exhausted core, distal end	0.00000	85.22125	Ixtepeque
JK1663	CV-43	Bladelet, proximal end	0.00000	45.87993	Ixtepeque
JK1664	CV-43	Bladelet, proximal end	0.00000	70.78660	Ixtepeque
JK1665	CV-43	Bladelet, proximal end	0.00000	14.87786	Ixtepeque
JK1666	CV-43	Bladelet	67.90371	0.00000	El Chayal
JK1667	CV-43	Bladelet	0.00000	26.00464	Ixtepeque
JK1668	CV-43	Bladelet, flake	0.00000	0.25296	Ixtepeque*
JKW472	CV-20, Op. 19(C), Level 2, Structure A	Bladelet, distal end	0.00000	62.13664	Ixtepeque
JKW473	CV-20, Op. 19(B)	Bladelet, proximal end	0.00000	81.63631	Ixtepeque
JKW474	CV-20	Bladelet, proximal end	0.00000	93.42985	Ixtepeque
JKW475	CV-20, Op. 19(A), Structure A	Bladelet clearing structure addition	0.00000	82.79619	Ixtepeque
JKW476	CV-20, Op. 20(A), Level 5, Structure D	Bladelet	0.00000	27.69419	Ixtepeque
JKW477	CV-20, Op. 5(B)	Bladelet, proximal end	0.00000	8.59598	Ixtepeque

*Asterisk following entry for "source" indicates that specimen showed lower than 5% probability of membership in all source reference groups. In these cases, specimens are assigned to the reference group for which Mahalanobis distance from specimen to centroid is minimized.

JKW478	CV-20, Op. 20(A), Level 5, Structure D	Bladelet, proximal end	0.00000	98.20371	Ixtepeque
JKW479	CV-20, Op. 19(C), Level 3, Structure A	Bladelet, proximal end	0.00000	95.58413	Ixtepeque
JKW480	CV-20, Op. 4(R)	Bladelet, proximal end	0.00000	22.62532	Ixtepeque
JKW481	CV-22, Op. 14(A), Level 2	Bladelet, proximal end	0.00000	56.65648	Ixtepeque
JKW482	CV-20, Op. 4(F)	Bladelet, proximal end	0.00000	71.43965	Ixtepeque
JKW483	CV-20, Op. 6(C)	Bladelet, distal end	0.00000	99.38989	Ixtepeque
JKW484	CV-20, Op. 6(N)	Bladelet	0.00000	13.56430	Ixtepeque
JKW485	CV-20, Op. 19(C), Level 5, Structure A	Bladelet, proximal end	0.00000	99.99820	Ixtepeque
JKW486	CV-20, Op. 6(M)	Bladelet, proximal end	0.00000	68.74116	Ixtepeque
JKW487	CV-20, Op. 19(B)	Bladelet	0.00000	89.10064	Ixtepeque
JKW488	CV-20, Op. 2(H)	Bladelet	0.00000	20.98605	Ixtepeque
JKW489	CV-20, Op. 19(C), Level 4, Structure A	Bladelet, proximal end	0.00000	11.92953	Ixtepeque
JKW490	CV-20, Op. 1(A), surface	Bladelet, proximal end	0.00000	96.93866	Ixtepeque
JKW491	CV-20, Op. 2(C)	Bladelet	0.00000	6.51298	Ixtepeque
JKW492	CV-20, Op. 6(J)	Bladelet	0.00000	1.02498	Ixtepeque*
JKW493	CV-20, Op. 19(B)	Bladelet, proximal end	0.00000	0.00013	Ixtepeque*
JKW494	CV-20, Op. 6(H)	Bladelet, proximal end	0.00000	56.18511	Ixtepeque
JKW495	CV-20, Op. 4(D)	Bladelet	0.00000	93.76178	Ixtepeque
JKW496	CV-20, Op. 20(A), Level 3, Structure D	Bladelet	0.00000	49.18015	Ixtepeque
JKW497	CV-20, Op. 6(C)	Bladelet	0.00000	92.16227	Ixtepeque

*Asterisk following entry for "source" indicates that specimen showed lower than 5% probability of membership in all source reference groups. In these cases, specimens are assigned to the reference group for which Mahalanobis distance from specimen to centroid is minimized.

TABLE C-1 (continued)

Copan obsidian sources

Analytical I.D.	*Context*	*Description*	*Probability of Membership in El Chayal Core*	*Probability of Membership in Ixtepeque Core*	*Source**
JKW498	CV-20, Op. 1(B), surface	Bladelet, proximal end	0.00000	87.71144	Ixtepeque
JKW499	CV-20, Op. 19(C), Level 4, Structure A	Bladelet, proximal end	0.00000	23.91326	Ixtepeque
JKW500	CV-20, Op. 4(L)	Bladelet, proximal end	0.00000	99.29378	Ixtepeque
JKW501	CV-20, Op. 19(C), Level 4, Structure A	Bladelet, proximal end	0.00000	99.00968	Ixtepeque
JKW502	CV-20, Op. 19(C), Level 4, Structure A	Bladelet	0.00000	93.64178	Ixtepeque
JKW503	CV-20, Op. 18(A)	Bladelet, proximal end	0.00000	55.40459	Ixtepeque
JKW504	CV-20, Op. 2(B)	Bladelet	0.00000	26.54039	Ixtepeque
JKW505	CV-20, Op. 4(N)	Bladelet	0.00000	14.79697	Ixtepeque
JKW506	CV-20, Op. 7(F), Structure B	Bladelet, proximal end	0.00000	58.58039	Ixtepeque
JKW507	CV-20, Op. 6(I), Structure A	Bladelet, proximal end	0.00000	6.71915	Ixtepeque
JKW508	CV-20, Op. 18(A)	Bladelet	0.00000	57.98833	Ixtepeque
JKW509	CV-20, Op. 21(A), Level 2, Structure B	Bladelet	0.00000	69.81519	Ixtepeque
JKW510	CV-20, Op. 12(B), Structure H	Bladelet, proximal end	0.00000	47.23931	Ixtepeque
JKW511	CV-20, Op. 19(H), Structure A	Almost whole bladelet, proximal end	0.00000	99.01902	Ixtepeque
JKW512	CV-20, Op. 6(M), Structure A	Whole bladelet, proximal end	0.00000	74.99703	Ixtepeque

*Asterisk following entry for "source" indicates that specimen showed lower than 5% probability of membership in all source reference groups. In these cases, specimens are assigned to the reference group for which Mahalanobis distance from specimen to centroid is minimized.

JKW513	CV-56, Op. 17(A)	Whole bladelet, proximal end	0.00000	10.29276	Ixtepeque
JKW514	CV-20, Op. 19(A), Structure A	Bladelet, proximal end	0.00000	30.12034	Ixtepeque
JKW515	CV-13, Op. 11(A), Level 2	Bladelet, proximal end	0.00000	1.73081	Ixtepeque*
JKW516	CV-13, Op. 11(A), Level 3	Bladelet, proximal end	0.00000	59.16899	Ixtepeque
JKW517	CV-20, Op. 1(A), surface	Bladelet, proximal end	0.00000	3.29805	Ixtepeque*
JKW518	CV-20, Op. 4(M), Structure D	Bladelet	0.00000	19.49713	Ixtepeque
JKW519	CV-20, Op. 5(O), Structure C	Bladelet	0.00000	40.19181	Ixtepeque
JKW520	CV-20, Op. 7(F), Structure B	Bladelet, proximal end	0.00000	84.81014	Ixtepeque
JKW521	CV-20, Op. 1(A), surface	Bladelet	0.00000	59.09388	Ixtepeque
JKW522	CV-20, Op. 5(M), Structure C	Bladelet	0.00000	81.09756	Ixtepeque
JKW523	CV-20, Op. 20(A), Level 5, Structure D	Bladelet, proximal end	0.00000	61.98290	Ixtepeque
JKW524	CV-20, Op. 6(J), Structure A	Bladelet	0.00000	79.63562	Ixtepeque
JKW525	CV-20, Op. 4(M), Structure D	Bladelet, proximal end	0.00000	98.87136	Ixtepeque
JKW526	CV-20, Op. 19(C) Level 3, Structure A	Bladelet, proximal end	0.00000	99.13959	Ixtepeque
JKW527	CV-20, Op. 20(A), Level 4, Structure D	Bladelet	0.00000	62.91702	Ixtepeque
JKW528	CV-20, Op. 5(H), Structure A	Bladelet, proximal end	0.00000	60.14785	Ixtepeque
JKW529	CV-20, Op. 19(D), Structure A	Bladelet, proximal end	0.00000	59.42862	Ixtepeque

*Asterisk following entry for "source" indicates that specimen showed lower than 5% probability of membership in all source reference groups. In these cases, specimens are assigned to the reference group for which Mahalanobis distance from specimen to centroid is minimized.

TABLE C-1 (continued)
Copan obsidian sources

Analytical I.D.	Context	Description	Probability of Membership in El Chayal Core	Probability of Membership in Ixtepeque Core	Source*
JKW530	CV-20, Op. 19(C) Level 4, Structure A	Bladelet	0.00000	64.94624	Ixtepeque
JKW531	CV-17, Op. 10(A), Level 3	Bladelet, proximal end	0.00000	97.27954	Ixtepeque
JKW532	CV-48, Op. 22(A), Level 1	Bladelet	0.00000	38.59661	Ixtepeque
JKW533	CV-20, Op. 19(C) Level 5, Structure A	Bladelet	0.00000	4.68300	Ixtepeque*
JKW534	CV-20, Op. 2(B), Level 2	Bladelet, proximal end	0.00000	3.03079	Ixtepeque*
JKW535	CV-20, Op. 12(A), Structure H	Bladelet	0.00000	30.87996	Ixtepeque
JKW536	CV-20, Op. 6(H), Structure A	Bladelet, proximal end	0.00000	17.81888	Ixtepeque
JKW537	CV-20, Op. 5(J), Structure C	Bladelet	0.00000	98.66329	Ixtepeque
JKW538	CV-20, Op. 24(A) Level 7, Structure C	Bladelet	0.00000	23.61385	Ixtepeque
JKW539	CV-20, Op. 6(K), Structure A	Bladelet, proximal end	0.00000	86.37277	Ixtepeque
JKW540	CV-20, Op. 2(C), Level 3	Bladelet	0.00000	88.64724	Ixtepeque
JKW541	CV-20, Op. 4(O), Structure D	Bladelet	0.00000	98.00695	Ixtepeque
JKW542	CV-20, Op. 19(A), Structure A	Bladelet, proximal end	0.00000	93.73450	Ixtepeque
JKW543	CV-20, Op. 15(A), Structure B	Bladelet, proximal end	0.00000	81.83134	Ixtepeque
JKW544	CV-20, Op. 5(H), Structure A	Bladelet, proximal end	0.00000	13.24560	Ixtepeque

*Asterisk following entry for "source" indicates that specimen showed lower than 5% probability of membership in all source reference groups. In these cases, specimens are assigned to the reference group for which Mahalanobis distance from specimen to centroid is minimized.

JKW545	CV-20, Op. 19(B), Structure A	Bladelet	36.54703	0.00000	El Chayal
JKW546	CV-17, Op. 10(A), Level 2	Bladelet	0.00000	39.70660	Ixtepeque
JKW547	CV-20, Op. 7(F), Structure B	Bladelet	0.00000	17.30260	Ixtepeque
JKW548	CV-20, Op. 2(L), Level 1	Bladelet	0.00000	99.83344	Ixtepeque
JKW549	CV-20, Op. 5(A)	Bladelet	0.00000	82.04976	Ixtepeque
JKW550	CV-20, Op. 1(A), surface	Bladelet	0.00000	29.86172	Ixtepeque
JKW551	CV-18, Op. 9(A), Level 3	Bladelet, proximal end	91.58026	0.00000	El Chayal
JKW552	CV-20, Op. 6(K), Structure A	Bladelet	0.00000	92.92833	Ixtepeque
JKW561	CV-20, Op. 13(C), Structure F	Core	0.00000	94.83098	Ixtepeque
JKW562	CV-20, Op. 4(H), Structure D	Core	0.00000	69.55615	Ixtepeque
JKW563	CV-20, Op. 20(A), Structure D	Core	0.00000	78.08021	Ixtepeque
JKW564	CV-20, Op. 8(B)	Core	0.00000	96.70832	Ixtepeque
JKW565	CV-20, Op. 1(A), surface	Core	0.00000	97.73327	Ixtepeque
JKW566	CV-20, Op. 2(A), Level 2	Bladelet	49.14712	0.00000	El Chayal
JKW567	CV-20, Op. 2(C), Level 5	Bladelet	0.00000	43.01041	Ixtepeque
JKW568	CV-20, Op. 2(C), Level 5	Bladelet	0.00000	81.13376	Ixtepeque

*Asterisk following entry for "source" indicates that specimen showed lower than 5% probability of membership in all source reference groups. In these cases, specimens are assigned to the reference group for which Mahalanobis distance from specimen to centroid is minimized.

TABLE C-2

The first two principal components of the data set consisting of members of the Ixtepeque, El Chayal, and San Martin Jilotepeque reference groups

Element	*Principal Component #1*	*Principal Component #2*
Rb	-0.2851	0.1741
Cs	-0.7790	0.1524
Ba	0.0782	0.2250
Sc	0.0921	0.2049
Fe	0.3011	0.3056
Ce	-0.0749	0.2128
Nd	-0.1014	0.2435
Eu	-0.0614	0.2137
Gd	-0.2737	0.2323
Yb	-0.0595	0.3047
Zr	0.1236	0.3825
Hf	0.2055	0.3015
Os	-0.0660	0.2730
Se	0.2159	0.3895
Eigenvalue	0.0730	0.1012
% Variance Explained	77.8892	10.9142
Cumulative % Variance	77.8892	88.8034

TABLE C-3

Means and percent standard deviations for three reference groups and Copan specimens

	Ixtepeque Reference Group			El Chayal Reference Group			San Martin Jilotepeque Reference Group			Copan Specimens Assigned to Ixtepeque			Copan Specimens Assigned to El Chayal		
	Mean	*St. Dev. (%)*	*N*	*Mean*	*St. Dev. (%)*	*N*	*Mean*	*St. Dev. (%)*	*N*	*Mean*	*St. Dev. (%)*	*N*	*Mean*	*St. Dev. (%)*	*N*
Rb	103.425	6.458	142	146.971	8.232	469	118.763	9.949	22	98.897	10.545	131	142.890	8.279	7
Cs	2.804	6.455	141	7.684	10.133	468	3.635	22.428	22	2.703	10.827	131	7.531	8.118	7
Ba	1146.149	7.129	141	1010.142	9.146	468	1080.529	63.492	22	1111.458	10.972	131	1010.582	7.821	7
Sc	2.237	6.469	142	1.918	8.770	469	2.140	8.770	22	2.196	13.024	131	1.869	7.433	7
Fe	9681.209	9.005	142	6280.924	10.874	467	6937.888	8.412	22	9263.575	11.918	131	5984.117	7.414	7
Ce	40.699	7.598	142	43.382	8.985	469	45.252	8.991	22	37.793	11.562	130	41.020	8.071	7
Nd	22.742	11.963	141	25.486	10.614	468	24.006	11.671	22	20.653	12.723	131	23.659	6.976	7
Eu	0.616	6.624	142	0.650	8.619	469	0.577	35.434	22	0.593	10.907	131	0.650	5.102	7
Gd	1.598	9.721	141	2.228	10.266	468	2.017	18.705	22	1.474	12.420	130	2.080	7.576	7
Yb	2.257	8.712	140	2.320	9.799	468	1.864	14.205	22	2.095	12.692	131	2.178	9.628	7
Zr	161.311	11.978	140	132.459	14.217	469	120.352	13.684	22	145.953	14.262	131	115.649	6.245	7
Hf	4.298	6.191	140	3.115	8.351	469	3.159	8.877	22	4.094	10.632	131	3.006	8.217	7
Os	0.425	8.970	141	0.439	9.747	469	0.344	16.803	22	0.397	12.019	130	0.414	10.317	7
Se	2.852	8.941	141	2.038	10.468	469	2.043	9.926	22	2.623	11.402	130	1.858	9.073	7

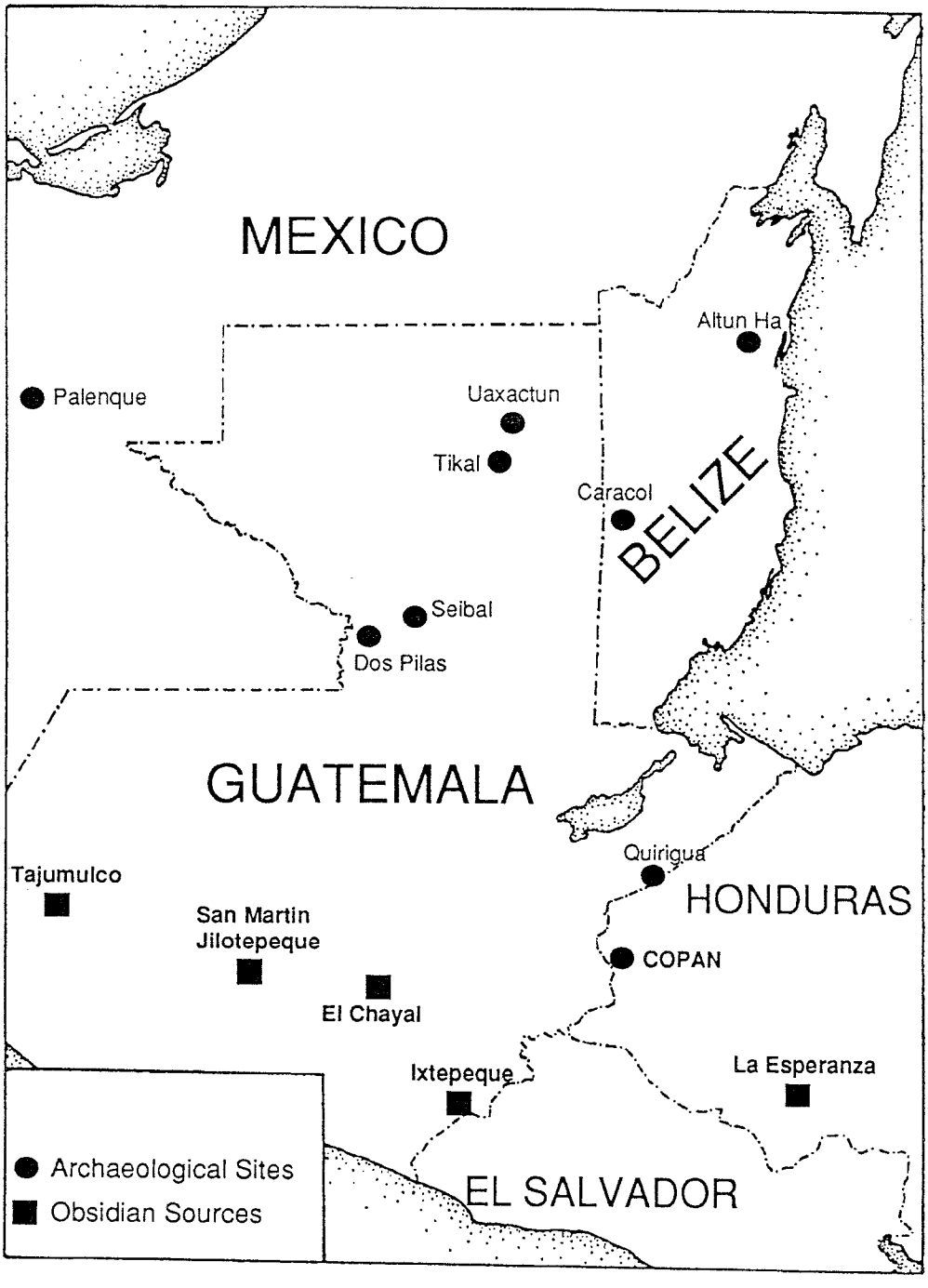

Figure C-1. Map showing the Guatemalan obsidian sources and Copan

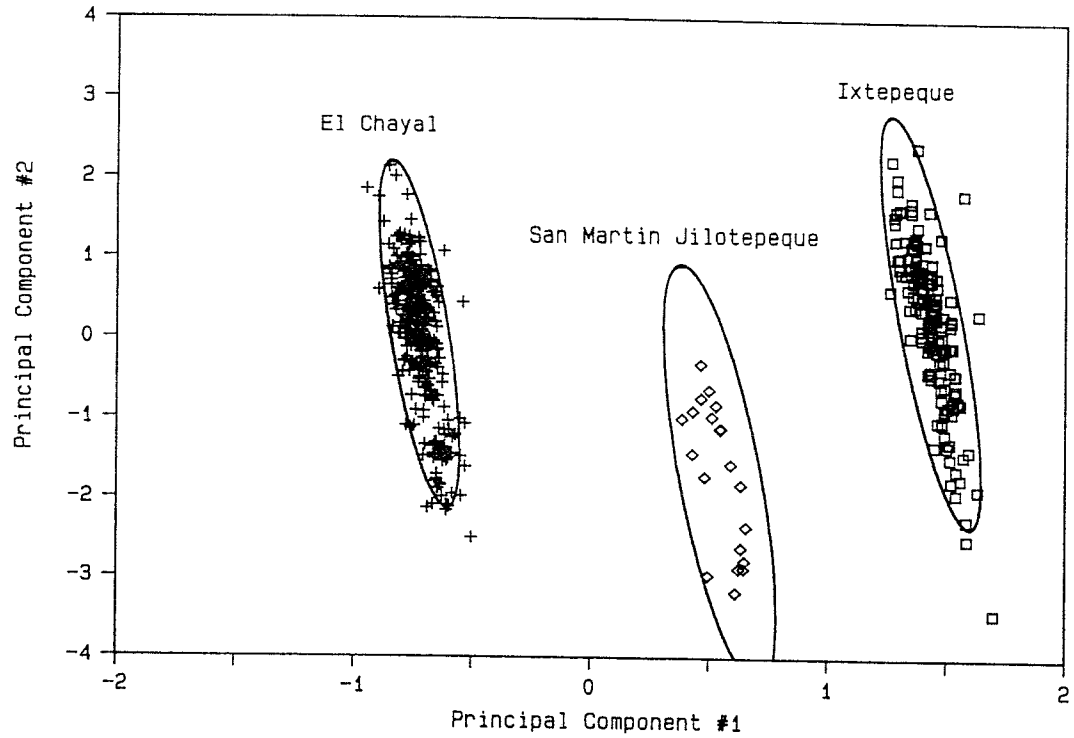

Figure C-2. Reference groups for three Guatemalan obsidian sources, with data points plotted relative to the first two principal components calculated for the data set consisting of specimens in all three reference groups. Ellipses indicate 95% confidence levels for each group in the two dimensions shown. Principal component coefficients, eigenvalues, and percentage of variance are explained in table C-2.

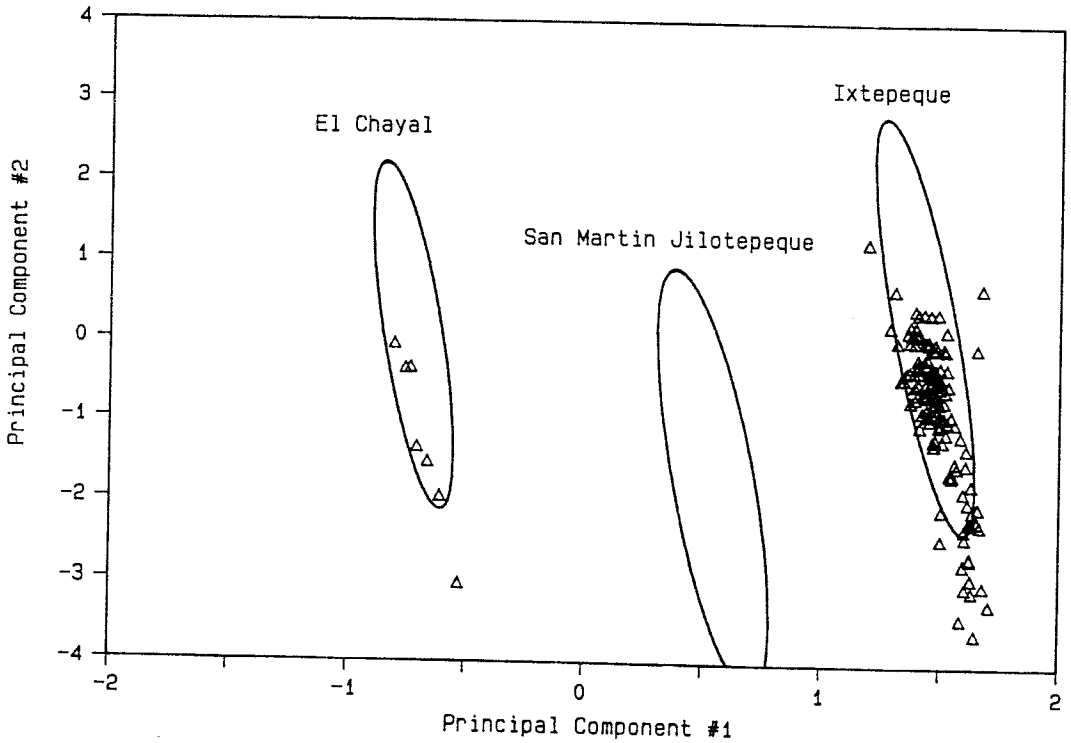

Figure C-3. One hundred thirty-nine obsidian artifacts from the Copan Valley plotted in the same principal component space shown in figure C-2. Ellipses are the 95% confidence levels for the three reference groups.