Title
Source Provenance of Obsidian Artifacts from Various Contexts on The Gila River Indian Community Land, Central Arizona

Author
Shackley, M. Steven

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BERKELEY ARCHAEOLOGICAL XRF LAB

232 Kroeber Hall
University of California
Berkeley, CA 94720-3710

SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM VARIOUS CONTEXTS ON THE GILA RIVER INDIAN COMMUNITY LAND, CENTRAL ARIZONA

by

M. Steven Shackley, Ph.D.
Director

Jon Daehnke
Graduate Lab Assistant

Report Prepared for
Gila River Indian Community
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INTRODUCTION

The analysis here of 142 artifacts produced from obsidian indicates a very diverse provenance assemblage a result of the diverse temporal contexts from which the artifacts were derived. Fourteen separate sources are present in the assemblage.

ANALYSIS AND INSTRUMENTATION

All archaeological samples are analyzed whole. The results presented here are quantitative in that they are derived from "filtered" intensity values ratioed to the appropriate x-ray continuum regions through a least squares fitting formula rather than plotting the proportions of the net intensities in a ternary system (McCarthy and Schamber 1981; Schamber 1977). Or more essentially, these data through the analysis of international rock standards, allow for inter-instrument comparison with a predictable degree of certainty (Hampel 1984).

The trace element analyses were performed in the Archaeological XRF Laboratory, Department of Earth and Planetary Sciences, University of California, Berkeley, using a Spectrace/ThermoNoran™ QuanX energy dispersive x-ray fluorescence spectrometer. The spectrometer is equipped with an air cooled Cu x-ray target with a 125 micron Be window, an x-ray generator that operates from 4-50 kV/0.02-2.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTrace™ reduction software. The x-ray tube is operated at 30 kV, 0.16 mA, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity Kα-line data for elements titanium (Ti), manganese (Mn), iron (as Fe^T), thorium (Th), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). Weight percent iron ($Fe_2O_3^T$) can be derived by multiplying ppm estimates by 1.4297(10-4). Trace element intensities were converted to concentration estimates by employing a least-squares calibration line established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology (NIST), the US. Geological Survey (USGS), Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). Further details concerning the petrological choice of these elements in Southwest obsidians is available in Shackley (1995, 2004; also Mahood and Stimac 1990; and Hughes and Smith 1993). Specific standards used for the best fit regression calibration for elements Ti through Nb include G-2 (basalt), AGV-1 (andesite), GSP-1, SY-2 (syenite), BHVO-1 (hawaiite), STM-1 (syenite), QLO-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), TLM-1 (tonalite), SCO-1 (shale), all US Geological Survey standards, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). In addition to the reported values here, Ni, Cu, Zn, and Ga were measured, but these are rarely useful in discriminating glass sources and are not generally reported.

The data from the WinTrace software were translated directly into Excel for Windows software for manipulation and on into SPSS for Windows for statistical analyses. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. RGM-1 is analyzed during each sample run to check machine calibration (Table 1).

Trace element data exhibited in Table 1, and Figures 1 and 2 are reported in parts per million (ppm), a quantitative measure by weight. Source nomenclature is from Shackley (1988, 1995, 2004; see also http://www.swxrflab.net/swobsrcs.htm).

RESULTS AND SUMMARY

This is certainly one of the largest obsidian studies of its type in central Arizona. While the contexts are sometimes mixed, and mainly from the surface, a number of inferences could be derived. No attempt has been made to pair technology with source provenance given the surface context here. Source provenance was crosstabulated with assigned time period and area, and a short discussion of these results is included.

Source Assignment

In an assemblage this size, after assigning each artifact to source by comparison to the database, multivariate statistical analysis (cluster to discriminant) is performed as a pattern search technique to separate the sources and detect misassignment, then biplots are employed to plot the artifacts for further discrimination (Daehnke 2004; Shackley 2004; Glascock et al. 1998; Figures 1 and 2 here). The results of the multivariate analyses are not included here, but are available as SPSS files. Figures 1 and 2 exhibit the bivariate plots of the data.

Discussion

Reference to the crosstabulation of area (Table 2) and time (Table 3) by source is somewhat enlightening. The most common single source in the assemblage overall is Sauceda Mountains (47.9%), a source generally more common in the Classic than Preclassic in the Middle Gila region from well dated contexts (Bayman and Shackley 1999; Peterson et al. 1997; Shackley 2004; Shackley and Bayman 2004). While Sauceda Mountains obsidian does occur in Sacaton Phase contexts and earlier, it is usually in the form of projectile points more common in the Lower Gila sites such as the Gatlin Site according to the Hoffman (1997) typology (Shackley 2004). Superior, the second most common source overall (18.3%) is typical of the Sacaton Phase sites in the Middle Gila, but very rare in Classic sites (Shackley 2004). Territoriality, probably enforced by the Salado, and easy access to other sources such as Sauceda Mountains during the Classic is the most likely reason for this procurement pattern. While the sample is small, this pattern seems reversed in the “Preclassic” sites here, and I wonder if the time assignment is always correct (Table 3 and Figure 3). For the Classic the pattern seems to hold with 50% Sauceda and 14% Superior.

The Historic period sites seem to follow the Classic pattern, dominated by Sauceda Mountains, but some eastern Arizona and western New Mexico sources also occur. All the other time periods have such small samples, it’s difficult to say much.

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Table 1. Elemental concentrations for the archaeological samples. All measurements in parts per million (ppm).

Specimen	Site	Period	Area	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
145.1	660	Multiple	7	1601	326	9663	141	98	26	163	21	Sauceda Mts
894.1	931	Classic	6	1355	603	26938	149	18	82	735	52	AZ Unknown A
1001.1	1153	Multiple	9	1088	443	6990	127	39	20	125	25	Vulture
920.1	1120	Post-Archaic	8	1174	549	5786	100	12	10	71	34	Superior?
1963.1	1139	Historic	9	1145	466	7364	128	42	17	122	13	Vulture
608.1	693	Preclassic	8	1249	714	10702	172	13	34	259	33	Sand Tanks
1170.1	1120	Post-Archaic	8	1389	276	9918	145	98	25	175	35	Sauceda Mts
2134.2	1094	Unknown	10	1032	480	5466	109	19	20	93	31	Superior?
518.1	684	Classic	8	1478	433	9347	157	72	24	199	22	Sauceda Mts
1226.1	1120	Historic	8	1446	371	8704	141	73	29	191	17	Sauceda Mts
261.3	613	Multiple	1	959	580	6276	125	16	23	92	33	Superior
1959.1	1139	Historic	9	1146	420	7011	128	43	13	120	27	Vulture
254.1	493	Classic	6	1445	534	9454	160	75	32	198	19	Sauceda Mts
944.1	445	Multiple	3	1531	479	9777	150	70	38	160	31	Sauceda Mts
657.1	815	Historic	8	991	248	10878	229	12	63	205	37	Los Vidrios
1015.1	744	Multiple	6	793	602	8119	109	81	15	77	56	Government Mtn
4918.1	1167	Preclassic	5	1033	680	6093	121	24	25	89	28	Superior
361	660	Multiple	7	1338	451	8104	128	42	12	128	26	Vulture
1500.1	1127	Multiple	8	1414	423	9080	163	77	22	203	26	Sauceda Mts
128	660	Multiple	7	1131	415	7557	131	39	22	120	28	Vulture
1081.1	909	Historic	6	1288	325	8941	153	104	22	170	28	Sauceda Mts
995.1	909	Historic	6	1486	411	10035	160	112	21	178	13	Sauceda Mts
1259.1	909	Historic	6	1469	364	9652	154	99	26	177	12	Sauceda Mts
1367.1	485	Multiple	6	1163	356	8634	144	63	23	192	28	Sauceda Mts
434.1	1112	Preclassic	10	929	564	5855	109	14	27	83	35	Superior?
12.1	911	Historic	2	887	563	6134	114	20	21	85	27	Superior?
463.1	909	Historic	6	1454	331	9446	152	99	18	182	30	Sauceda Mts
84.1	122	Historic	9	1611	324	9533	15	103	17	18	25	Sauceda Mts

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195.2	895	Preclassic	9	986	562	6142	120	18	20	92	25	Superior
828.1	909	Historic	6	1283	408	8815	152	71	29	191	17	Sauceda Mts
936.1	909	Historic	6	1370	366	8912	149	68	24	183	18	Sauceda Mts
890.1	909	Historic	6	1505	348	9436	155	110	23	186	15	Sauceda Mts
2248.1	787	Preclassic	6	1631	303	9960	157	107	25	179	20	Sauceda Mts
107.1	441	Historic	3	821	639	6749	391	11	57	95	121	Mule Cr/N Sawmill Cr
1314.1	485	Multiple	6	1314	326	9691	154	109	22	188	24	Sauceda Mts
964.1	909	Historic	6	1350	276	9231	154	96	17	181	11	Sauceda Mts
977.1	909	Classic	6	1456	299	9607	150	109	27	170	21	Sauceda Mts
160.2	894	Classic	9	1097	489	7201	139	42	15	123	18	Vulture
139.3	893	Classic	9	1458	464	8680	144	66	22	174	17	Sauceda Mts
186.3	895	Classic	9	1424	457	9198	153	64	36	177	10	Sauceda Mts
195.3	895	Classic	9	1404	473	9448	153	72	32	196	33	Sauceda Mts
149.2	894	Preclassic	9	1329	394	9634	157	78	29	213	22	Sauceda Mts
978.1	909	Historic	6	1447	465	8774	150	74	26	187	28	Sauceda Mts
82.1	915	Classic	4	896	449	8385	231	14	28	112	18	Mule Cr AC/MM
342.1	1242	Classic	7	793	465	8398	353	5	81	151	248	RS Hill/Sitgreaves
1229.1	485	Multiple	6	1363	388	8546	139	69	30	190	17	Sauceda Mts
27.1	1112	Classic	10	1520	268	9463	151	108	28	175	18	Sauceda Mts
351.1	1112	Classic	10	1419	368	9035	150	79	19	206	12	Sauceda Mts

Specimen	Site	Period	Area	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
377.1	1112	Classic	10	1041	551	6057	127	22	16	86	35	Superior
1618.1	743	Classic	6	1516	328	10467	168	112	22	196	16	Sauceda Mts
76.1	743	Classic	6	1356	362	10135	156	107	19	177	15	Sauceda Mts
1528.1	743	Classic	6	1420	442	9751	167	79	29	198	25	Sauceda Mts
1620.1	743	Preclassic	6	773	543	7693	98	76	17	82	58	Government Mtn
1744.1	743	Preclassic	6	1340	361	8777	149	71	23	188	20	Sauceda Mts
979.1	909	Historic	6	916	232	11221	234	16	62	221	25	Los Vidrios
119.1	744	Multiple	6	1227	463	7189	140	39	20	131	22	Vulture
607.1	1057	Preclassic	10	1283	409	8740	138	75	28	195	29	Sauceda Mts
552.1	105	Preclassi	10	1481	350	9836	14	104	30	17	16	Sauceda Mts

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595.1	1057	Preclassic	10	1295	374	8849	141	78	29	183	31	Sauceda Mts
835.1	1057	Preclassic	10	959	650	6260	120	21	25	101	36	Superior
687.1	1057	Preclassic	10	1541	340	9577	156	103	28	181	23	Sauceda Mts
644.1	1057	Preclassic	10	1501	343	9967	156	112	14	190	17	Sauceda Mts
692.1	1057	Preclassic	10	1521	422	9901	158	72	27	201	29	Sauceda Mts
478.1	1129	Multiple	10	1187	349	7966	140	66	31	173	23	Sauceda Mts
717.1	1057	Preclassic	10	1137	405	6632	129	39	12	119	25	Vulture
287.1	909	Historic	6	1256	247	8509	150	103	22	174	14	Sauceda Mts
296.1	467	Preclassic	8	1127	491	7563	136	134	22	121	19	Cow Canyon
438.1	774	Multiple	10	1641	606	26619	147	13	83	735	45	AZ Unknown A
51	915	Classic	4	1068	616	6797	123	20	23	97	29	Superior
1656.1	516	Preclassic	7	1461	418	9529	163	80	34	199	27	Sauceda Mts
151	460	Multiple	7	882	451	7404	199	21	22	84	54	Red Hill
146.1	744	Multiple	6	1495	484	10081	166	76	26	207	24	Sauceda Mts
492	1252	Multiple	7	841	747	8462	110	82	6	70	48	Government Mtn
5523.1	1207	Multiple	5	1407	355	9966	165	111	24	180	20	Sauceda Mts
61.1a	608	Preclassic	1	1005	523	5972	121	21	18	90	26	Superior
61.1b	608	Preclassic	1	947	527	5895	116	15	28	89	27	Superior
15.1	936	Undefined	9	1587	454	9999	155	82	26	200	18	Sauceda Mts
61.1c	608	Preclassic	1	990	583	5907	111	20	23	88	23	Superior
61.1d	608	Preclassic	1	1005	537	6014	120	16	23	94	27	Superior
298.1	613	Multiple	1	967	511	5928	116	19	24	93	31	Superior
201.1	320	Multiple	2	1253	389	8727	154	73	27	190	19	Sauceda Mts
347.1	1188	Archaic	2	1095	411	6834	124	43	18	126	16	Vulture
309.1	613	Multiple	1	1023	549	6171	118	22	23	92	33	Superior
568.1	710	Multiple	2	1394	388	8890	153	69	32	190	19	Sauceda Mts
205.1	320	Multiple	2	1086	423	6991	134	39	25	133	35	Vulture
273.1	613	Multiple	1	906	574	6077	121	17	20	92	29	Superior
202.1	320	Multiple	2	1162	509	7629	139	43	29	125	17	Vulture
925.1	909	Historic	6	1416	399	8969	156	72	27	191	23	Sauceda Mts
108.2	377	Preclassi	7	962	198	1125	24	5	68	22	34	Los Vidrios

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5521.1	1207	Multiple	5	1131	368	8395	139	63	25	189	14	Sauceda Mts
934.1	445	Multiple	3	1349	464	9243	161	73	29	190	18	Sauceda Mts
5504.1	1207	Multiple	5	1496	462	10378	166	75	25	201	27	Sauceda Mts
5508.1	1207	Multiple	5	1429	432	9585	158	76	29	199	22	Sauceda Mts
897.1	445	Multiple	3	1389	433	9186	158	78	30	202	33	Sauceda Mts
1501.1	445	Multiple	3	1333	402	8842	149	73	27	187	21	Sauceda Mts
768.1	423	Preclassic	4	1477	386	9453	163	70	32	185	20	Sauceda Mts
1858.1	311	Preclassic	2	958	599	6186	117	15	22	97	27	Superior
399.2	355	Multiple	4	1276	382	8780	155	67	27	198	14	Sauceda Mts
1064.1	909	Historic	6	1358	450	9755	169	80	26	186	7	Sauceda Mts
340.1	353	Historic	4	911	689	6276	122	19	24	91	29	Superior
286.1	347	Post-Archaic	4	1057	611	6240	124	18	30	97	28	Superior
Specimen	Site	Period	Area	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
292.1	347	Multiple	4	904	594	5944	120	23	21	91	33	Superior
366.1	355	Multiple	4	1455	434	9688	162	79	41	195	26	Sauceda Mts
5214.1	1175	Classic	5	1153	432	7182	143	40	21	126	19	Vulture
4047.1	1157	Multiple	5	1454	451	9576	162	81	29	210	19	Sauceda Mts
2877.2	1157	Multiple	5	958	605	5976	120	19	26	90	35	Superior
4053.1	1157	Preclassic	5	1432	459	9738	156	75	34	202	19	Sauceda Mts
3046.1	1157	Preclassic	5	842	560	5946	114	20	21	84	31	Superior
4026.1	1157	Multiple	5	1390	306	9261	138	95	20	173	18	Sauceda Mts
358.1	355	Multiple	4	1380	358	8900	155	79	31	197	19	Sauceda Mts
3817.1	1157	Multiple	5	1427	380	9589	164	72	27	204	19	Sauceda Mts
3806.1	1157	Multiple	5	800	590	8092	106	87	17	77	55	Government Mtn
6483.4	522	Classic	3	948	609	6489	124	20	18	95	19	Superior
6483.5	522	Classic	3	1420	421	9505	165	69	28	200	31	Sauceda Mts
6501.1	522	Classic	3	1579	400	9137	160	74	26	185	24	Sauceda Mts
6483.6	522	Historic	3	1202	308	8773	132	92	12	165	0	Sauceda Mts?
6483.7	522	Historic	3	1231	611	7946	138	99	15	121	15	Cow Canyon
876.3	442	Classic	1	1219	431	7874	119	63	11	161	29	unknown
7596.2	115	Historic	5	926	445	8498	24	18	38	10	27	Mule Cr AC/MM

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3407.1	1157	Historic	5	963	649	6273	118	16	25	87	19	Superior
99.1	892	Preclassic	9	1357	354	9548	160	111	23	178	17	Sauceda Mts
4102.1	1157	Historic	5	930	471	8247	230	14	36	104	31	Mule Cr AC/MM
4070.1	1157	Historic	5	1142	441	6600	125	43	11	116	16	Vulture
6126.2	1157	Historic	5	917	515	5725	108	6	1	94	24	Superior
4614.1	1164	Classic	5	812	606	7816	113	71	20	72	51	Government Mtn
90.1	375	Historic	7	1100	716	10099	168	13	39	252	36	Sand Tanks
7601.1	1157	Preclassic	5	1557	463	9702	158	79	30	200	19	Sauceda Mts
7528.1	1157	Classic	5	1474	328	10212	153	115	28	183	8	Sauceda Mts
3879.1	1157	Historic	5	1152	622	6283	117	22	18	89	20	Superior
6136.1	1157	Classic	5	1079	457	6869	137	37	15	121	23	Vulture
6426.1	1157	Classic	5	960	604	6031	118	13	12	93	31	Superior
2148.1	807	Preclassic	4	912	592	5899	113	16	18	86	33	Superior
6014.1	1157	Classic	5	1045	429	7075	140	41	9	124	10	Vulture
7563.1	1157	Multiple	5	884	580	6155	121	18	22	95	29	Superior
4811.1	1167	Preclassic	5	1055	582	9729	161	166	16	129	26	Tank Mts
1654.1	516	Classic	7	998	409	7206	139	45	17	120	26	Vulture
876.2	442	Historic	1	1552	456	8843	143	70	34	184	15	Sauceda Mts?
1446.1	1127	Multiple	8	1150	403	6948	135	42	20	129	26	Vulture
2048.6	1139	Historic	9	1427	447	8601	149	66	24	180	34	Sauceda Mts?
810.1	922	Multiple	8	1252	587	7939	410	42	23	101	34	unknown
2020.1	1139	Historic	9	1497	368	8962	140	98	27	167	7	Sauceda Mts?
395.1	771	Historic	9	1420	400	9463	163	73	31	207	25	Sauceda Mts
RGM1-H1				1540	345	13032	154	113	24	219	11	standard
RGM1-H1				1529	314	12912	151	113	21	224	14	standard
RGM1-H1				1551	351	12972	152	109	30	226	1	standard
RGM1-H1				1521	319	12765	152	107	21	224	6	standard
RGM1-H1				1500	278	12956	147	110	22	224	7	standard
RGM1-H1				1586	316	13273	154	109	25	225	6	standard
RGM1-H1				1589	323	13174	153	112	23	221	10	standard

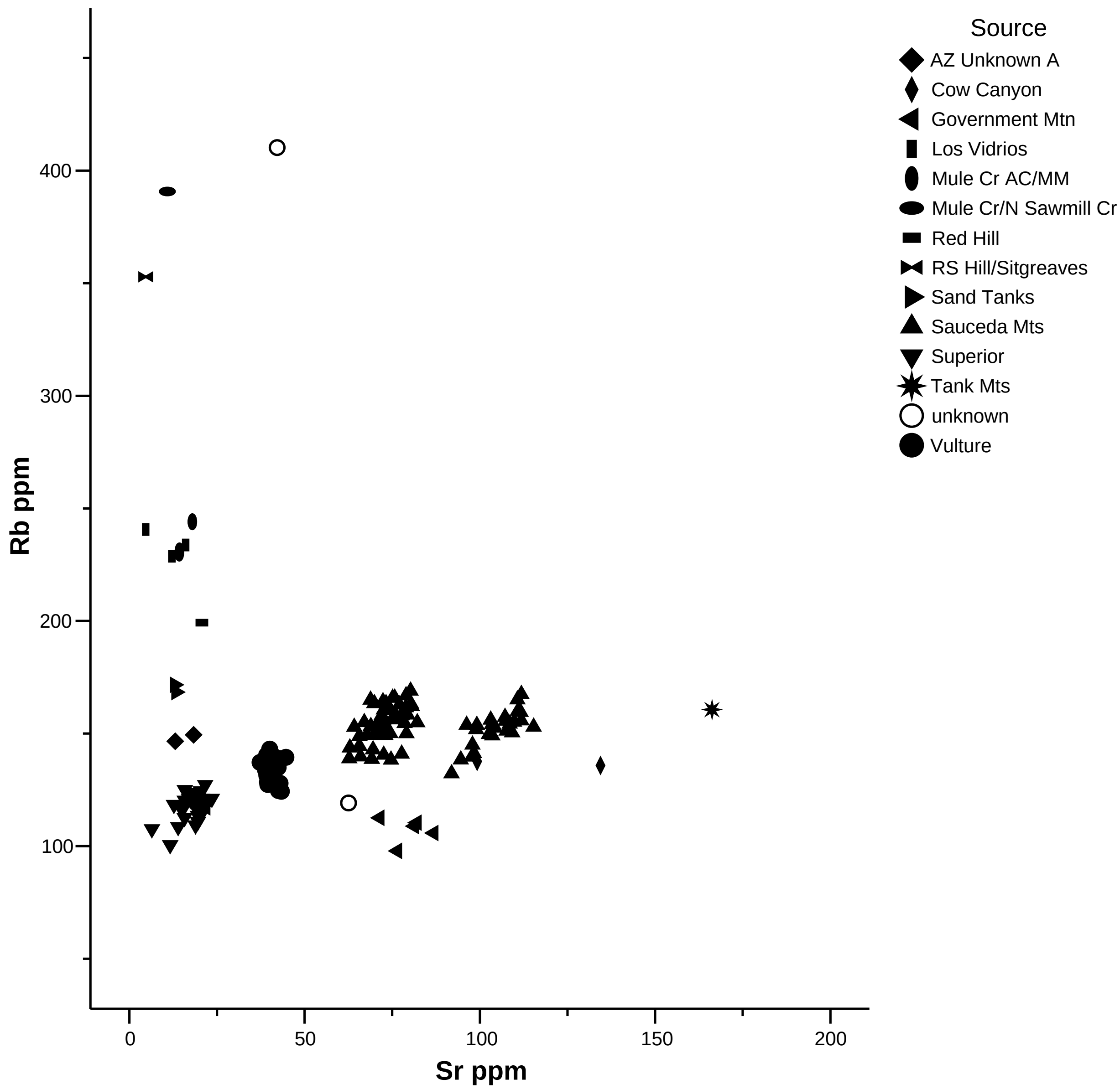

Figure 1. Rb versus Sr biplot of archaeological data.

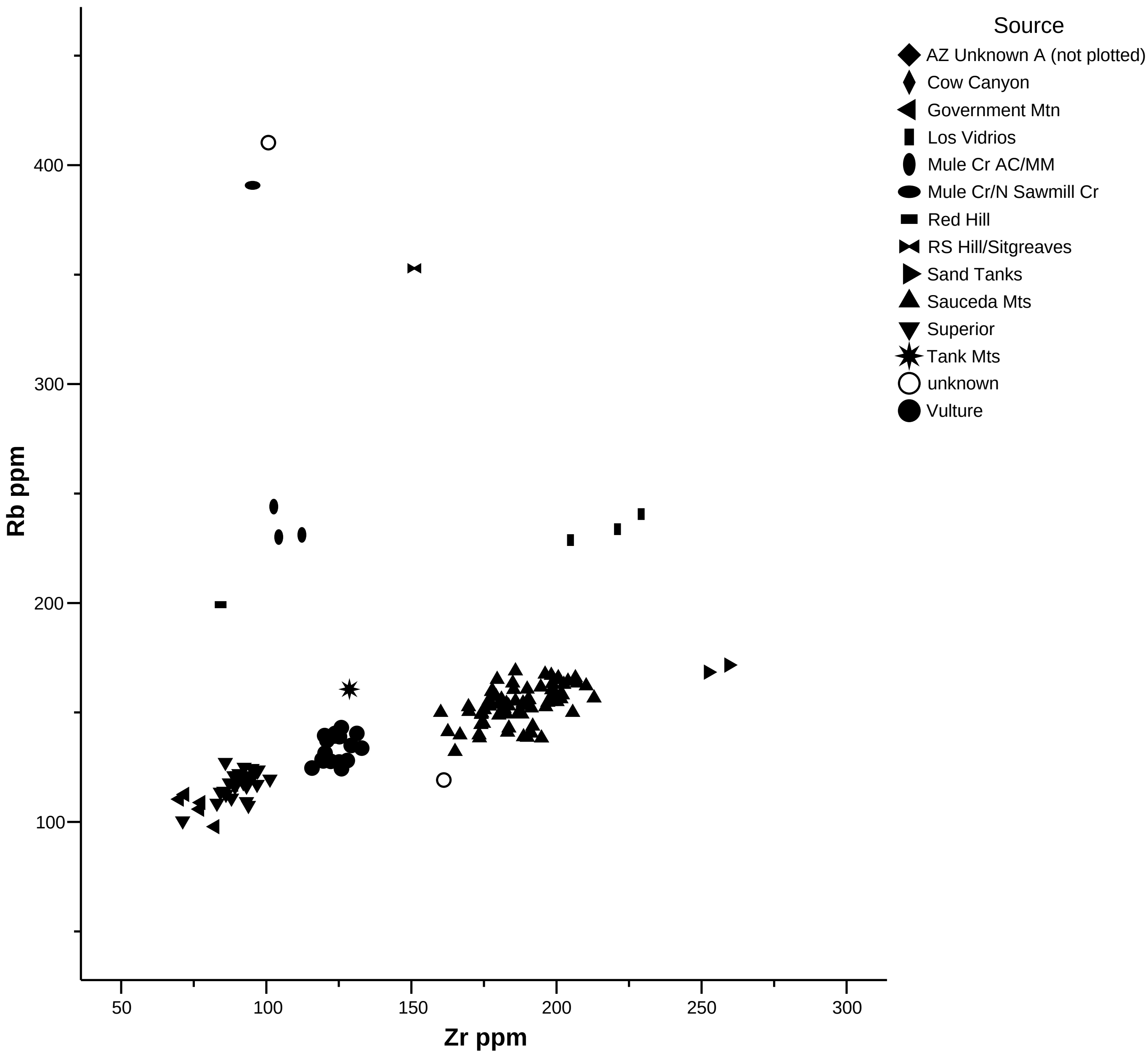

Figure 2. Rb versus Zr biplot of archaeological data.

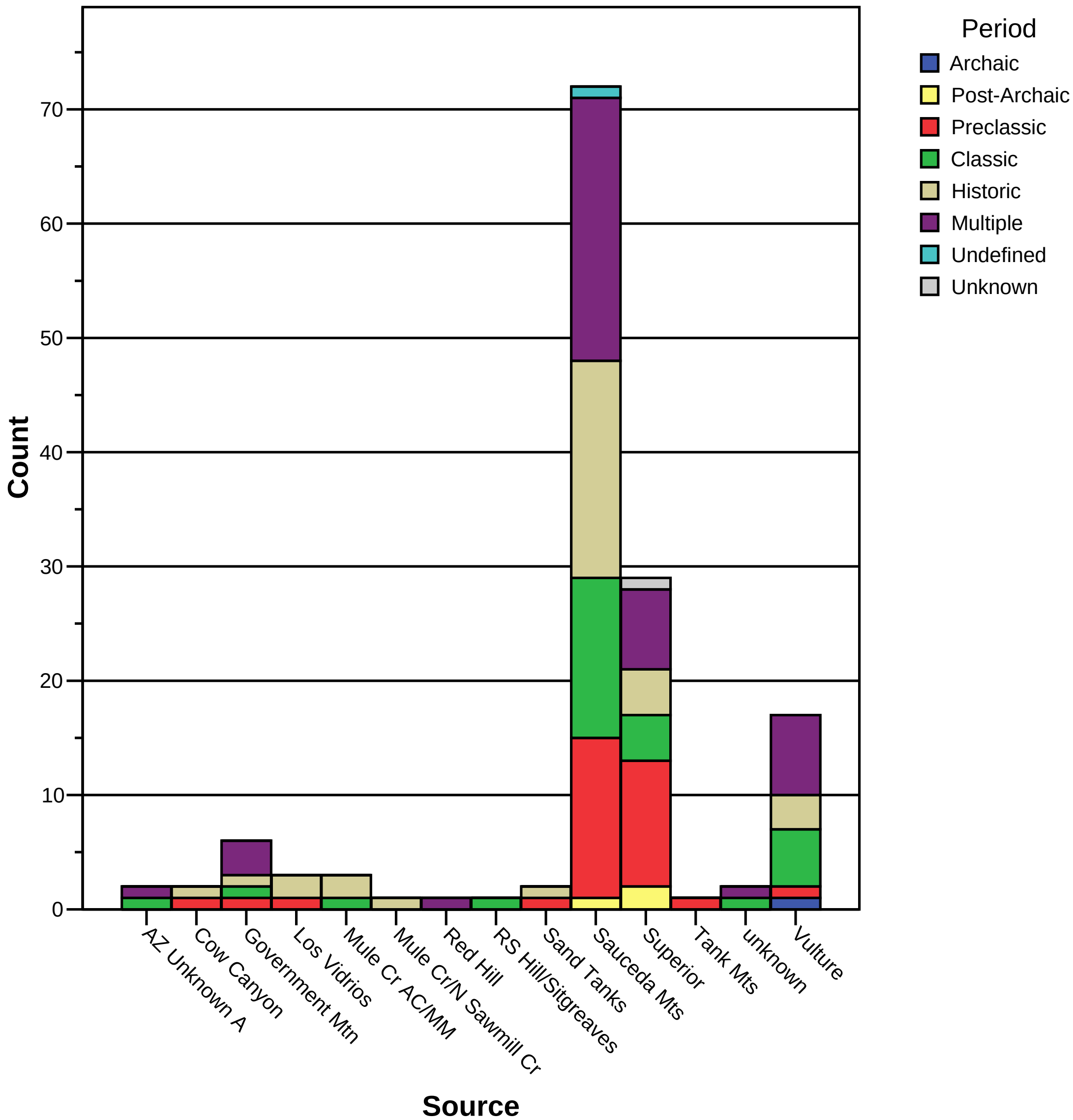

Figure 3. Distribution of obsidian source provenance by time period.