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

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

by

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INTRODUCTION

The analysis here of 100 artifacts produced from obsidian indicates a very diverse provenance assemblage a result of the diverse temporal contexts from which the artifacts were derived, similar to the previous studies. Seven 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). 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, 2005; 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, Th, 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, 2005; see also http://www.swxrflab.net/swobsrcs.htm, particularly for updated source standard data).

RESULTS AND SUMMARY

Combined with the previous studies (Shackley 2006; Shackley and Daehnke 2004), this is one of the largest obsidian studies of its type in central Arizona. I would say, just looking at the source provenance itself and ignoring the projectile point styles, that the assemblage represents a mix of pre-Classic and Classic context (Tables 1 and 2, Figure 3; Shackley 2005).

A few comments are worthwhile here. This particular collection was dominated by many small samples and those that could be characterized as angular debris rather typical in assemblages dominated by bipolar reduction. For XRF analyses, a minimum size of 10 mm is necessary for confident source assignment (Davis et al. 1998). This can include samples that may be greater than 10 mm in largest diameter, but are so angular that it is difficult to present a minimum 10 mm side to the beam. So, those samples noted by an asterisk in Table 1 are those that are outside the range of elemental concentrations for that source, but exhibit megascopic or other characteristics in addition to similar chemistry that suggest that source assignment.

A number of artifacts were produced from vitrophyric or perlitic glass, that could be from any number of sources including those that do not exhibit artifact quality glass (i.e. samples 3622, 8580, 9552, 9702, 10101). These vitrophyric glasses are common in western North America, and seem to uncommonly occur in artifact assemblages. They typically vary widely compositionally, and cannot be assigned to any specific source.

Interestingly, there were a number of pea sized marekanites in the collection that are generally too small to reduce through bipolar reduction (i.e. samples 9800, 9827, 9949). Indeed, given the spherical nature of the specimens it was difficult to assign them to source, although their nearly clear character suggests Superior (Picketpost Mountain), the nearest source to GRIC sites. These can be found in the Queen Creek alluvium nearly to the Gila River and may be present in the Gila River alluvium in the Gila River Community area, or could just have been collected for any number of uses prehistorically. They have a gem-like quality when held up to transmitted light.

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Table 1. Elemental concentrations for the archaeological samples. Sample cluster by submitted bags. All measurements in parts per million (ppm).

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
1353	822	517	5475	106	8	25	78	45	Superior
1648	1291	381	8348	135	59	36	156	30	Sauceda Mts
2109	1070	364	8547	131	61	29	162	21	Sauceda Mts
2800	608	546	5692	107	4	22	79	29	Superior
2912	1248	367	8714	148	61	27	166	19	Sauceda Mts
2926	1167	426	8922	140	67	33	180	14	Sauceda Mts
3024	1144	390	8548	134	59	35	163	18	Sauceda Mts
3140	461	403	7575	191	4	39	92	19	Blue/SF River
3220	1037	384	8451	133	56	29	174	20	Sauceda Mts
3245	1211	412	9237	158	67	37	190	20	Sauceda Mts
3271	1264	421	9474	151	70	38	198	22	Sauceda Mts
3281	683	562	5915	109	16	27	80	27	Superior
3437	1048	406	8865	139	65	29	179	25	Sauceda Mts
3446	1602	533	8553	97	32	26	84	30	too dirty
3509	290	477	7065	90	59	21	68	43	Government Mtn
3817	1328	362	8324	124	50	28	150	15	Sauceda Mts
3622	458	507	5235	144	28	27	66	30	vitrophyre
3866	378	399	5930	72	47	11	50	48	unknown
4122	625	504	5674	102	7	22	81	36	Superior
4147	610	521	5854	106	11	26	84	25	Superior
4164	869	395	6502	117	27	18	106	23	Superior
4204	1297	348	8067	124	56	27	146	24	Sauceda Mts
4226	1068	370	7114	107	46	27	128	0	Government Mtn*
4265	1438	431	9401	149	76	28	188	28	Sauceda Mts
4328	840	481	6538	104	11	21	79	32	Superior
4362	1323	429	9181	139	59	27	148	33	too small
4408	1483	486	9818	155	73	32	191	27	Sauceda Mts
4423	477	381	7176	206	5	33	96	25	Mule Cr-AC/MM
4436	1110	387	8738	140	59	36	171	26	Sauceda Mts
4456-1	1195	365	8268	130	50	28	159	21	Sauceda Mts
4456-2	1035	366	7983	142	56	28	167	15	Sauceda Mts
4459	1378	419	9246	146	69	31	176	19	Sauceda Mts
4480	861	354	7941	127	52	30	164	19	unknown
4637	971	344	8028	120	52	26	145	13	unknown
4473	433	543	7467	102	68	23	70	55	Government Mtn
4512	358	480	6813	88	60	23	69	35	unknown
4561	1475	373	7749	127	48	30	148	17	too small
4582	637	219	10933	213	6	60	170	28	Los Vidrios*
4600	1073	388	9149	147	66	31	174	22	Sauceda Mts
4675	1284	399	8831	141	61	34	176	22	Sauceda Mts
4759	1340	433	9534	152	67	36	189	28	Sauceda Mts
4798	478	482	5243	103	4	18	73	33	Superior
4874	1074	385	8029	127	55	33	163	22	Sauceda Mts
4907	1233	406	8191	131	67	30	164	15	Sauceda Mts
5500	379	613	7831	99	75	26	76	54	unknown
5703	901	350	6144	109	26	20	103	11	Superior
5779	553	513	5156	103	2	26	70	16	Superior
6221	460	463	6427	81	56	22	64	54	Government Mtn*
6224	915	419	6817	128	30	19	107	17	Vulture

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
7207	571	520	5410	105	7	25	73	25	Superior
7449	913	209	5055	26	46	15	35	8	not obsidian
7800	1352	407	8632	130	60	25	148	9	Sauceda Mts
7808	1433	389	8386	140	54	23	144	23	Sauceda Mts
8385	811	367	7184	200	11	43	87	25	Blue/SF River
8580	717	501	5474	147	65	24	74	34	vitrophyre
8793	622	498	5039	89	2	20	74	29	unknown
8816	610	452	5235	96	4	14	74	20	Superior
9289	561	464	5137	96	4	22	75	17	Superior
9426	714	506	5553	95	4	23	71	23	Superior
9552	670	487	5277	123	32	27	62	25	unknown
9702	775	614	6120	152	49	31	75	33	vitrophyre
9716	280	698	8451	109	78	20	73	57	Government Mtn
9727	673	540	5647	101	4	25	79	33	Superior
9800	757	514	5233	94	6	26	70	25	Superior*
9827	503	498	5334	94	8	19	80	30	Superior*
9907	260	614	8122	106	67	16	74	36	Government Mtn
9949	651	448	5108	85	3	23	66	20	unknown
10101	545	462	5702	119	34	20	63	14	vitrophyre
10163	1179	291	9009	134	87	27	151	20	Sauceda Mts
10316	843	367	6484	93	25	21	89	12	Superior
10383	1303	336	8524	121	84	18	129	16	Sauceda Mts
10447	693	598	6260	127	10	21	91	27	Superior
10687	737	583	6406	121	14	30	88	30	Superior
10713	867	513	5462	106	7	26	80	27	Superior
10735	719	532	5613	103	23	25	75	14	Superior
10776	1067	576	7841	119	21	28	89	30	Superior
1091	1125	340	7803	128	56	39	152	26	Sauceda Mts
1248	1311	441	9323	149	69	40	192	18	Sauceda Mts
3012	1407	450	9636	150	63	34	174	19	Sauceda Mts
4122	562	523	5569	104	13	20	81	23	Superior
4242	915	550	5828	103	11	24	74	19	Superior
4254	274	482	6951	91	61	14	69	46	unknown
4288	951	387	7980	130	56	30	162	18	Sauceda Mts
4322	669	487	5405	104	9	30	81	29	Superior
4395	1135	370	8887	145	56	30	166	11	Sauceda Mts
4459	1080	352	7478	118	56	32	154	25	Sauceda Mts
4498	1200	295	7520	116	50	28	133	6	too small
4624	1109	359	8345	125	55	30	153	14	Sauceda Mts
3207	831	368	5902	103	83	14	90	2	Government Mtn
5347	1354	482	9861	159	79	36	194	27	Sauceda Mts
5641	775	466	5598	79	5	19	60	19	unknown
6745	768	424	4649	78	32	23	58	8	burned
6794	441	357	6908	275	1	65	114	193	unknown
8135	1213	407	8566	143	60	24	171	14	Sauceda Mts
7042	1360	393	10103	160	105	27	179	26	Sauceda Mts
8200	1529	318	9659	149	99	23	154	8	Sauceda Mts
8721	728	613	5962	115	21	21	87	30	Superior
9717	594	643	6141	124	9	29	92	32	Superior
9760	715	557	5771	108	16	33	76	28	Superior
10874	907	517	5419	102	9	19	73	22	Superior

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
RGM-1	1456	318	13056	149	108	27	217	9	standard
RGM-1	1546	334	13082	146	106	27	217	7	standard
RGM-1	1509	311	12764	145	102	26	216	6	standard
RGM-1	1395	317	12901	153	108	24	211	8	standard
RGM-1	1526	332	13177	149	104	21	214	11	standard
RGM-1	1347	338	12958	144	104	25	216	6	standard

* These samples were too small for confident source assignment, but exhibited attributes that suggested these sources (see text; Davis et al. 1998).

Table 2. Frequency distribution of obsidian source provenance.

		Frequency	Percent
Source	Sauceda Mts	37	48.7
	Superior	28	36.8
	Vulture	1	1.3
	Los Vidrios	1	1.3
	Government Mtn	6	7.9
	Mule Cr-AC/MM	1	1.3
	Blue/SF River	2	2.6
	Total	76	100.0

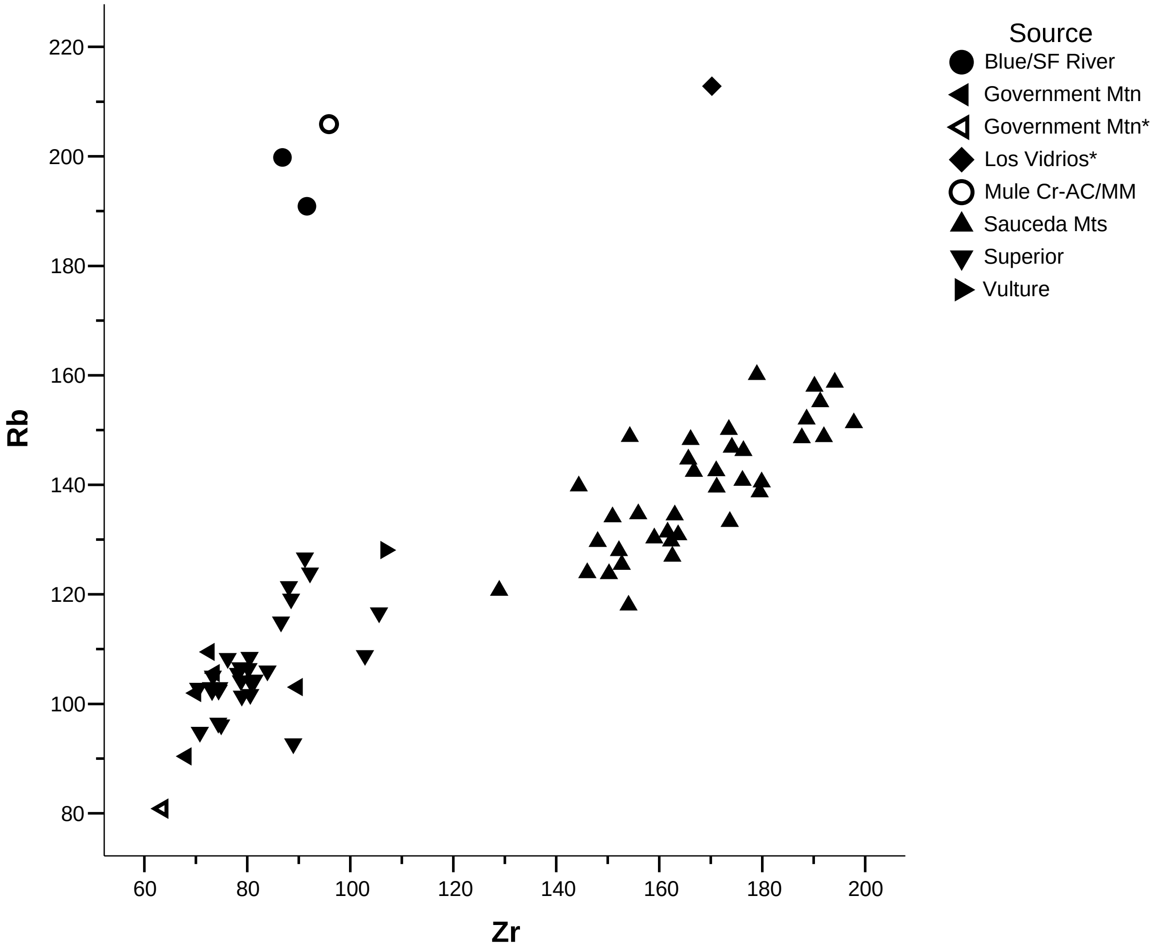

Figure 1. Rb versus Zr biplot of archaeological data. Asterisked data are those outside the range of source standards (see text).

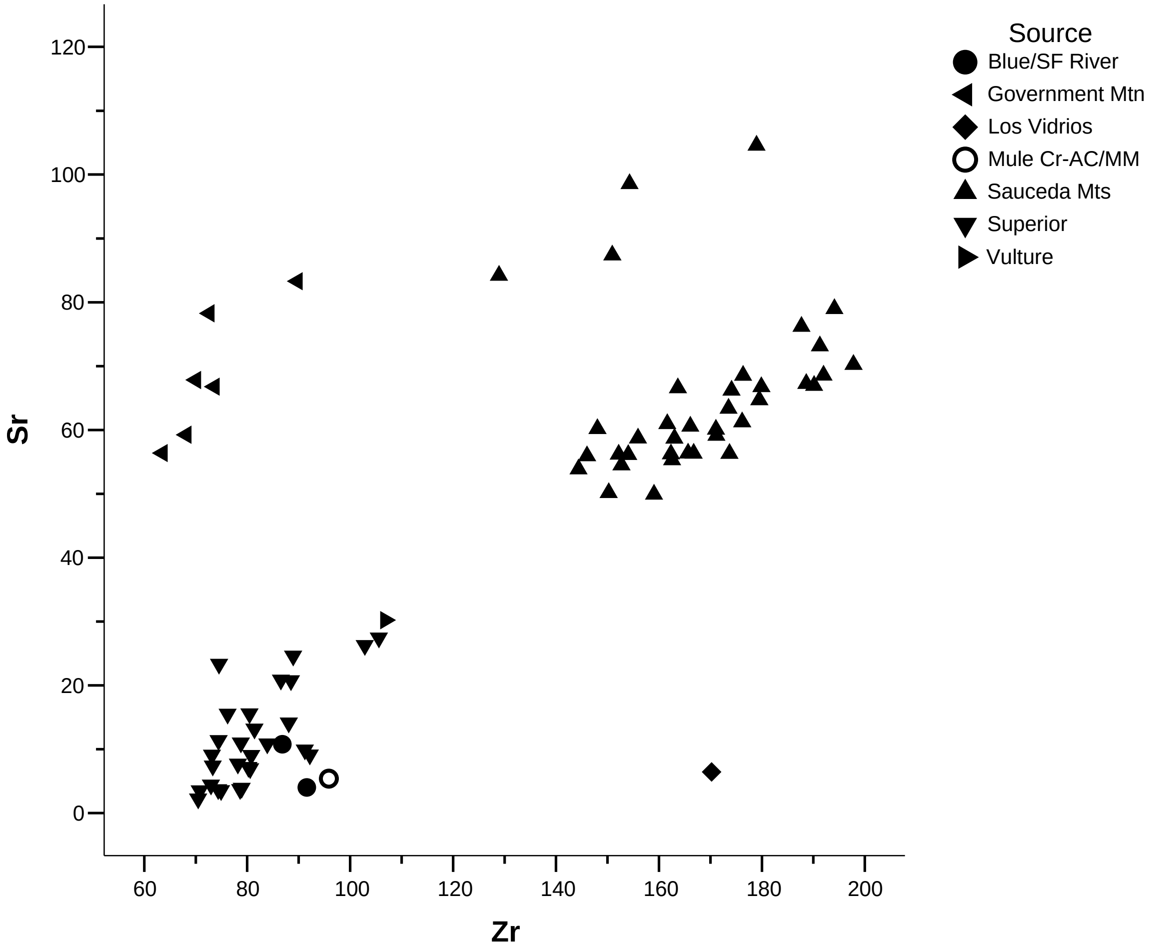

Figure 2. Sr versus Zr biplot of archaeological data collapsing questionable source assignments into confident assignments from Figure 1.

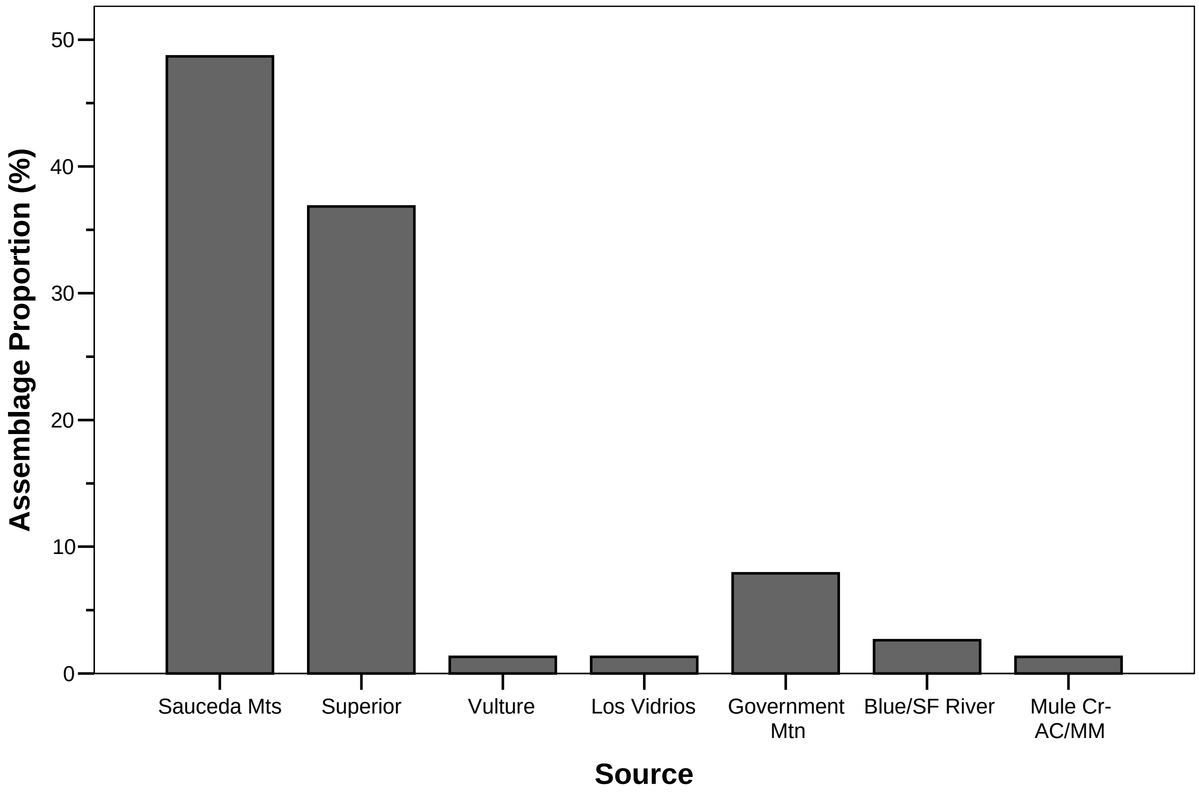

Figure 3. Distribution of obsidian source provenance by region.