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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM DUTCH CANAL AND LAS ACEQUIAS IN THE LOWER SALT RIVER VALLEY, ARIZONA

by

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INTRODUCTION

The analysis here of 87 stone artifacts from Classic contexts at Dutch Canal and Las Acequias in the Lower Salt River Valley, central Arizona, while indicating a very different obsidian source provenance assemblage than the pre-Classic contexts in this area, is remarkably similar to other Classic and Late Classic contexts in the Lower Salt River Valley (Shackley 2995, 2006). A dominance of local Sonoran Desert sources and a de-emphasis on the Coconino Plateau in the late period is a primary difference in procurement between the two periods. In this case, the proportion of Coconino Plateau sources is higher than at Pueblo Salado (Shackley 2006).

LABORATORY SAMPLING, ANALYSIS AND INSTRUMENTATION

This assemblage was analyzed on a Spectrace/Thermo *QuanX* energy-dispersive x-ray spectrometer at the Archaeological XRF Laboratory, Department of Earth and Planetary Sciences at the University of California, Berkeley. All samples were analyzed whole with little or no formal preparation. 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 spectrometer is equipped with an electronically 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^{TM} reduction software. The x-ray tube is operated at 30 kV, 0.14 mA, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity $K\alpha$-line data for elements titanium

(Ti), manganese (Mn), iron (as Fe^T), 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 (1992, 1995, 2003; 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, and JR-1 and JR-2 obsidian standards from the Japan Geological Survey (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 both systems 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. An analysis of RGM-1 analyzed during each run is included in Table 1. Source nomenclature follows Shackley (1988, 1995, 1998a, 2005a). Further information on the laboratory instrumentation can be found at: http://www.swxrflab.net/. Trace element data exhibited in Table 1 are reported in parts per million (ppm), a quantitative measure by weight (see also Figures 1 and 2).

This assemblage, unlike some of the others, contained a number of samples that were near the smallest size that can be reliably analyzed with EDXRF (see Davis et. al. 1998; Table 1 here). Those sources marked by "small" or "?" are somewhat outside the range of elemental concentrations for these sources, but close enough to assign to source. Nevertheless, the general pattern seems consistent with Classic and Late Classic obsidian source provenance in the Lower Salt River Valley.

DISCUSSION

Recent research of pre-Classic Hohokam obsidian procurement indicates that three of the "tool traditions" elucidated by Hoffman (1997) produced obsidian artifacts from very different sources (Shackley 2005). In the "Solares Tool Tradition" area that includes those pre-Classic sites along the Lower Salt River and surrounding areas, obsidian projectile points and other artifacts were produced from a nearly even mix of Vulture and Coconino Plateau (Government Mountain, RS Hill, Partridge Creek) sources. Indeed, some of the projectile point types were nearly identical to those produced on the plateau, and were all produced from Government Mountain obsidian (Shackley 2005:167-168). In the late period assemblage here from Dutch Canal and Las Acequias, similar to Las Colinas and Pueblo Salado, about 29% of the obsidian artifacts were produced from Coconino Plateau sources while the remainder (70.6%) were produced from western Arizona-Sonoran Desert sources Los Vidrios, Sauceda Mountains, Vulture, Superior, Tank Mountains, and Burro Creek (Tables 1 and 2; see Shackley 2005b). Certainly, the procurement "direction" changed dramatically between these two periods in the Lower Salt, potentially due to changes in the relationship with groups on the Coconino Plateau and continuing control of the Sonoran Desert territories. This "control" may have involved the continued relationship with the Patayan (proto-Yuman) groups in western Arizona, here recalling the "Patayan Barrio" reported at Las Colinas in the pre-Classic (McGuire 1992; Shackley 1998b, 2004, 2005; Shaul and Andresen 1989).

Parenthetically, I am concerned that the Coconino Plateau samples were indeed all originally from these late contexts. It is possible that at least some of the Coconino Plateau obsidian in this assemblage could be scavenged from pre-Classic trash or other contexts, although with over ¼ of the assemblage from Coconino Plateau sources it seems possible that at least some of the obsidian from the plateau was procured during this time period. These two sites do have more plateau obsidian than the other Late Classic contexts in the Lower Salt River Valley.

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Table 1. Elemental concentrations and source assignments for the archaeological specimens. All measurements in parts per million (ppm).

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
DC-001	1067	555	8091	332	7	71	93	37	Burro Creek
DC-002	1102	648	8791	99	88	13	73	37	Government Mtn
DC-003	1388	610	6687	113	20	25	97	18	Superior
DC-005	1098	603	7624	101	71	10	70	50	Government Mtn
DC-006	1456	472	9740	153	75	33	193	26	Sauceda Mts
DC-007	1364	466	8252	126	40	17	115	24	Vulture
DC-008	1460	492	10557	172	86	23	205	21	Sauceda Mts
DC-009	810	628	8263	104	83	15	87	55	Government Mtn
DC-012	1138	367	7346	130	60	30	158	13	Sauceda Mts
DC-015	1031	399	6843	137	41	13	124	23	Vulture
DC-018	1104	434	7034	129	38	14	118	18	Vulture
DC-020	1033	247	10691	229	14	65	212	34	Los Vidrios
DC-022	1306	470	9567	153	73	36	188	26	Sauceda Mts
DC-025	1161	437	6976	137	37	20	131	22	Vulture
DC-026	783	533	7762	252	5	37	94	50	Partridge Creek
DC-027	1005	634	6345	122	24	22	92	36	Superior
DC-029	1328	392	9258	161	71	32	198	24	Sauceda Mts
DC-030	854	627	8497	109	88	14	80	57	Government Mtn
DC-036	2377	351	5673	87	21	11	96	26	Superior
DC-044	1241	448	7266	189	8	24	95	40	Sauceda Mts (small)
DC-045	903	598	7730	107	79	11	74	57	Government Mtn
DC-047	1060	399	6938	134	39	19	130	28	Vulture
DC-049	1097	408	6809	143	42	11	129	17	Vulture
DC-051	1102	453	6985	132	41	21	126	24	Vulture
DC-053	1012	244	11008	233	18	63	218	33	Los Vidrios
DC-055	666	547	7910	100	76	20	70	54	Government Mtn
DC-058	1018	575	6175	127	20	19	97	31	Superior
DC-059	793	464	8374	145	139	15	120	19	Tank Mts
DC-063	1431	453	9591	167	69	31	195	29	Sauceda Mts
DC-064	980	236	10399	222	19	64	208	31	Los Vidrios
DC-069	862	569	7615	99	77	14	77	52	Government Mtn
DC-070	1092	420	6833	139	35	20	126	17	Vulture
DC-072	1756	393	9030	149	73	30	196	25	Sauceda Mts
DC-073	1405	469	6935	137	36	11	116	26	Vulture
DC-078	753	624	7892	103	77	16	77	50	Government Mtn
DC-079	1046	545	7323	100	72	12	67	44	Government Mtn
DC-080	1787	443	9484	148	79	27	197	25	Sauceda Mts
DC-081	1628	474	9505	153	69	29	176	39	Sauceda Mts
DC-083	1538	392	9289	155	72	29	197	15	Sauceda Mts
DC-084	1879	412	6603	116	35	11	115	30	Vulture
DC-088	795	601	7948	102	80	15	72	48	Government Mtn
DC-094	1418	399	9495	155	79	36	206	16	Sauceda Mts
DC-096	1435	404	9287	160	74	34	184	18	Sauceda Mts
DC-098	1865	355	8428	138	73	27	182	28	Sauceda Mts
DC-099	1601	441	8892	153	70	30	186	16	Sauceda Mts
DC-102	962	463	7207	225	7	34	90	60	Partridge Creek
DC-104	719	540	7683	107	74	14	73	53	Government Mtn
DC-105	1139	473	5563	93	21	26	83	23	Superior
DC-108	1290	348	8503	143	74	33	194	21	Sauceda Mts
DC-109	1292	427	6864	123	38	16	123	19	Vulture

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
DC-116	771	631	8435	104	84	23	72	54	Government Mtn
DC-117	1152	436	7452	145	44	14	135	23	Vulture
DC-118	1344	424	9539	159	74	35	199	28	Sauceda Mts
DC-119	1094	419	6163	69	61	14	53	49	Government Mtn?
DC-122	804	476	7549	232	8	38	87	58	Partridge Creek
DC-124	718	546	7360	100	79	14	63	50	Government Mtn
DC-129	1064	457	8911	140	141	15	114	21	Tank Mts
DC-131	978	236	11534	246	16	68	219	31	Los Vidrios
DC-134	1375	412	8966	154	76	29	190	21	Sauceda Mts
DC-135	685	555	7617	101	81	17	69	48	Government Mtn
DC-139	1265	381	6670	130	42	12	133	28	Vulture
DC-140	751	560	7688	102	80	10	76	56	Government Mtn
DC-143	1040	419	7003	138	40	8	130	20	Vulture
DC-149	807	640	8539	117	79	5	84	51	Government Mtn
DC-151	1124	272	6192	116	31	4	113	29	Vulture
DC-152	785	542	7825	242	10	36	86	64	Partridge Creek
DC-154	1435	438	9540	157	77	35	190	23	Sauceda Mts
DC-156	1379	423	6852	137	43	18	127	25	Vulture
DC-157	1403	443	9985	172	84	32	213	20	Sauceda Mts
DC-159	735	606	7567	100	77	18	75	51	Government Mtn
LA0-025	1452	451	9743	161	77	35	205	26	Sauceda Mts
LAO-004	1280	427	9251	162	76	28	197	28	Sauceda Mts
LAO-005	1842	512	11186	177	79	31	202	28	Sauceda Mts
LAO-006	1393	450	9950	169	79	26	194	21	Sauceda Mts
LAO-009	805	476	7368	100	69	10	71	48	Government Mtn
LAO-012	1260	433	9346	159	76	29	201	24	Sauceda Mts
LAO-016	802	571	7371	102	79	17	78	55	Government Mtn
LAO-020	978	263	11516	246	16	71	217	37	Los Vidrios
LAO-027	1120	541	7484	126	128	17	116	7	Black Tank?
LAO-031	1248	378	9091	149	75	28	190	27	Sauceda Mts
LAO-032	1431	376	9570	154	77	29	201	21	Sauceda Mts
LAO-033	827	263	11189	227	14	68	209	38	Los Vidrios
LAO-034	1382	399	9684	160	75	30	193	32	Sauceda Mts
LAO-036	831	614	8222	104	80	16	80	57	Government Mtn
LAO-037	1013	238	11669	243	15	72	225	29	Los Vidrios
LAO-038	1211	469	7628	145	43	19	136	24	Vulture
LAO-040	1358	425	9147	159	76	26	192	21	Sauceda Mts
RGM-1-S3	1502	329	13293	147	110	24	221	4	standard
RGM-1-S3	1528	322	13426	152	118	24	224	9	standard
RGM-I-S3	1637	327	13378	156	114	18	229	3	standard
RGM-I-S3	1641	304	13292	150	114	28	219	13	standard
RGM-I-S3	1668	280	13246	151	111	19	224	9	standard

Table 2. Crosstabulation of obsidian source provenance in late period contexts at Dutch Canal and Las Acequias.

			Sample		
			Dutch Canal	Las Acequias	Total
Source	Sauceda Mts	Count	19	9	28
		% within Source	67.9%	32.1%	100.0%
		% within Sample	27.9%	52.9%	32.9%
		% of Total	22.4%	10.6%	32.9%
	Vulture	Count	16	1	17
		% within Source	94.1%	5.9%	100.0%
		% within Sample	23.5%	5.9%	20.0%
		% of Total	18.8%	1.2%	20.0%
	Tank Mts	Count	2	0	2
		% within Source	100.0%	.0%	100.0%
		% within Sample	2.9%	.0%	2.4%
		% of Total	2.4%	.0%	2.4%
	Burro Creek	Count	1	0	1
		% within Source	100.0%	.0%	100.0%
		% within Sample	1.5%	.0%	1.2%
		% of Total	1.2%	.0%	1.2%
	Superior	Count	5	0	5
		% within Source	100.0%	.0%	100.0%
		% within Sample	7.4%	.0%	5.9%
		% of Total	5.9%	.0%	5.9%
	Los Vidrios	Count	4	3	7
		% within Source	57.1%	42.9%	100.0%
		% within Sample	5.9%	17.6%	8.2%
		% of Total	4.7%	3.5%	8.2%
	Government Mtn	Count	17	3	20
		% within Source	85.0%	15.0%	100.0%
		% within Sample	25.0%	17.6%	23.5%
		% of Total	20.0%	3.5%	23.5%
	Partridge Creek	Count	4	0	4
		% within Source	100.0%	.0%	100.0%
		% within Sample	5.9%	.0%	4.7%
		% of Total	4.7%	.0%	4.7%
	Black Tank?	Count	0	1	1
		% within Source	.0%	100.0%	100.0%
		% within Sample	.0%	5.9%	1.2%
		% of Total	.0%	1.2%	1.2%
Total		Count	68	17	85
		% within Source	80.0%	20.0%	100.0%
		% within Sample	100.0%	100.0%	100.0%
		% of Total	80.0%	20.0%	100.0%

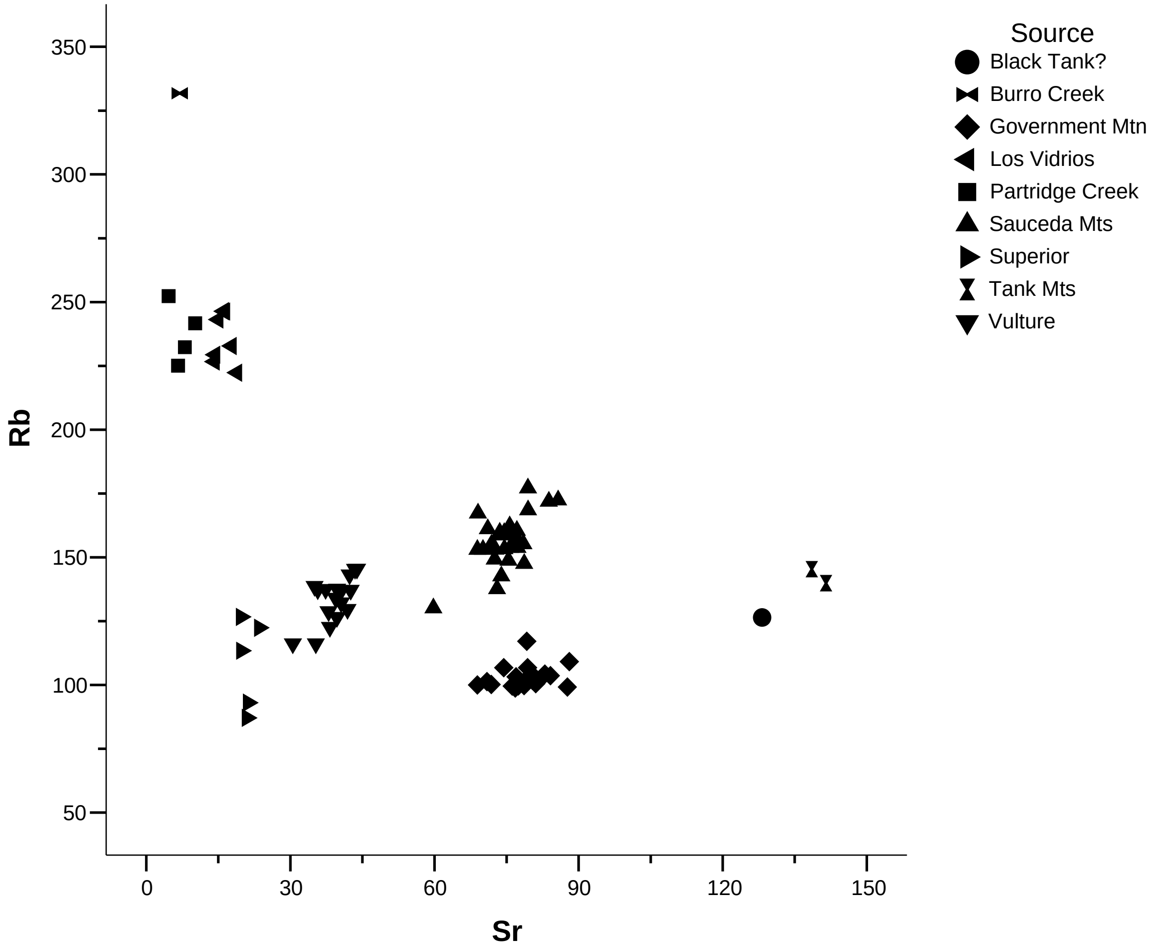

Figure 1. Rb versus Sr, plot of the elemental concentrations for the archaeological specimens.

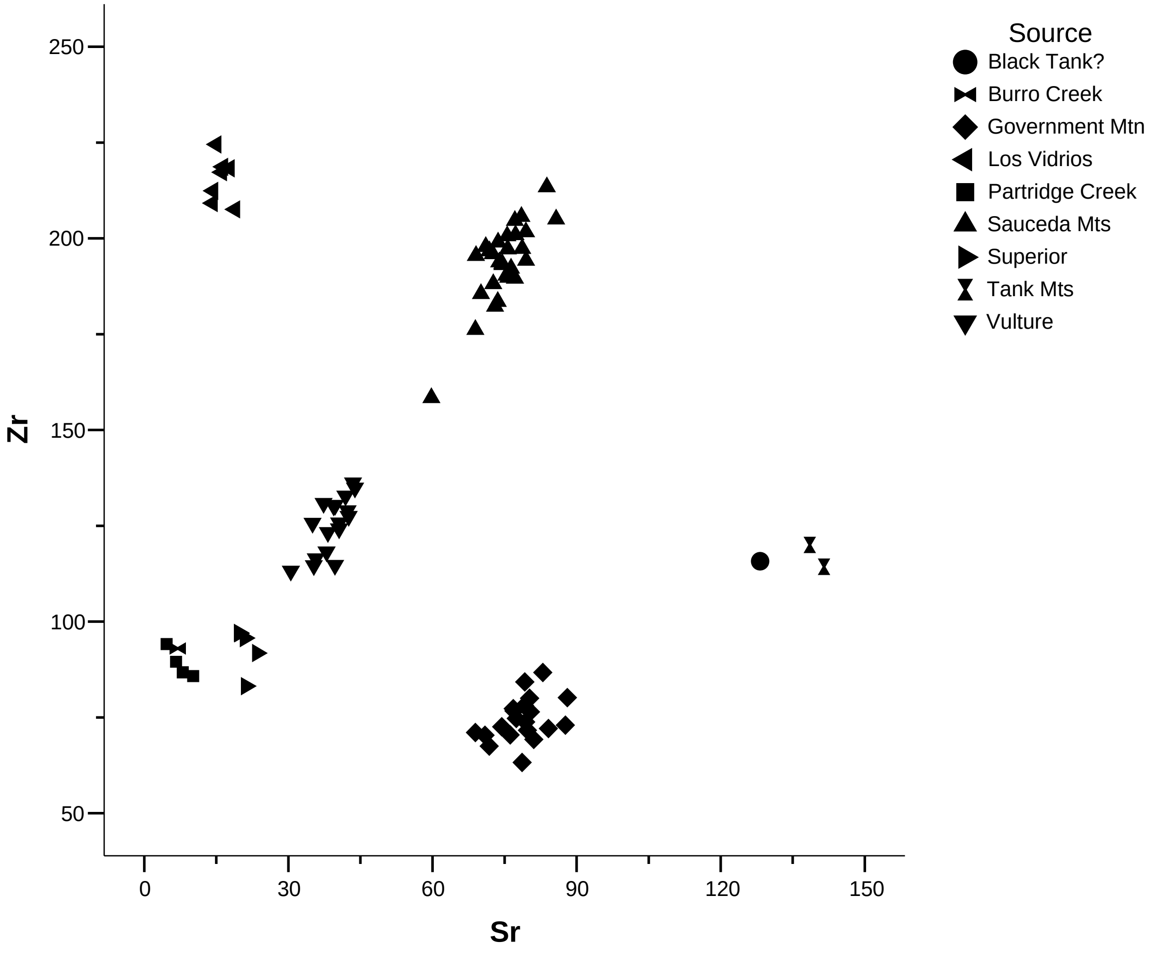

Figure 2. Zr versus Sr biplot of the elemental concentrations.