Title
Source Provenance Of Obsidian Artifacts from the Honey Bee Village (AZ BB:9:88 ASM) and Sleeping Snake (AZ BB:9:104 ASM) Sites, Tucson Basin, Arizona

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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM THE HONEY BEE VILLAGE (AZ BB:9:88 ASM) AND SLEEPING SNAKE (AZ BB:9:104 ASM) SITES, TUCSON BASIN, ARIZONA

by

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INTRODUCTION

The analysis here of obsidian artifacts from these two Hohokam Sedentary period sites in the Tucson Basin is quite diverse including sources from the Sonoran Desert, the San Francisco Volcanic Field and the eastern Arizona/western New Mexico region. The mix of sources is similar to other obsidian assemblages from this period in the Tucson Basin.

LABORATORY SAMPLING, 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 Geoarchaeological XRF Laboratory, Department of Anthropology, University of California, Berkeley, using a ThermoScientific *Quant'X* energy dispersive x-ray fluorescence spectrometer. The spectrometer is equipped with a ultra-high flux peltier air cooled Rh x-ray target with a 125 micron beryllium (Be) window, an x-ray generator that operates from 4-50 kV/0.02-1.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTrace™ 4.1 reduction software. The spectrometer is equipped with a 2001 min^{-1} Edwards vacuum pump for the analysis of elements below titanium (Ti). Data is acquired with a pulse processor and analog to digital converter. This is a significant improvement in analytical speed and efficiency beyond the former Spectrace 5000 and *QuanX* analog systems (see Davis et al. 1998; Shackley 2005).

For Ti-Nb, Pb, Th elements the mid-Zb condition is used operating the x-ray tube at 30 kV, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity Kα_1-line data for elements titanium (Ti), manganese (Mn), iron (as Fe^T), cobalt (Co), nickel (Ni), copper, (Cu), zinc, (Zn), gallium (Ga), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), lead (Pb), and thorium (Th). Not all these elements are reported since their values in many volcanic rocks is very low. Trace element intensities were converted to concentration estimates by employing a least-squares calibration line ratioed to the Compton scatter 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). Line fitting is linear (XML) for all elements but Fe where a derivative fitting is used to improve the fit for iron and thus for all the other elements. When barium (Ba) is acquired, the Rh tube is operated at 50 kV and 0.5 mA in an air path at 200 seconds livetime to generate x-ray intensity Kα_1-line data, through a 0.630 mm Cu (thick) filter ratioed to the bremsstrahlung region (see Davis et al. 1998). Further details concerning the petrological choice of these elements in Southwest obsidians is available in Shackley (1988, 1990, 1992, 1995, 2005; also Mahood and Stimac 1991; and Hughes and Smith 1993). A suite of 17 specific standards used for the best fit regression calibration for elements Ti-Nb, Pb, and Th, include G-2 (basalt), AGV-2 (andesite), GSP-2 (granodiorite), SY-2 (syenite), BHVO-2 (hawaiite), STM-1 (syenite), QLO-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), BCR-2 (basalt), TLM-1 (tonalite), SCO-1 (shale), all US Geological Survey standards, BR-1 (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France, and JR-1 and JR-2 (obsidian) from the Geological Survey of Japan (Govindaraju 1994).

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 when necessary

(Figure 1). 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 for obsidian artifacts to check machine calibration (Table 1). Other appropriate standards from the above list are used for other volcanic rocks. Source assignments made by reference to Archaeological XRF Lab standards as reported in Shackley (1995, 1998, 2005). One sample from Honeybee Village (189) was burned and incorporated too much depositional matrix to obtain reliable elemental concentrations and could not be assigned to source (Table 1).

DISCUSSION

The mix of sources in the Sedentary Period sites is rather typical of contemporaneous sites in the region (Shackley 2005; Tables 1 and 2 here; Figure 1). Coconino Plateau sources so common in contemporaneous sites in the Lower Salt River basin is rare in the Tucson Basin and is reflected in this collection. More surprising, but not that rare, is the presence of Tank Mountains obsidian from Yuma County in this collection. Coupled with the dominance of Sauceda Mountains obsidian from western Maricopa County, this does not seem that out of place.

As I've observed elsewhere, the sources from eastern Arizona (Cow Canyon/111 Ranch) and the Mule Creek sources of eastern New Mexico are available as secondary deposits at least as far west as Geronimo, Arizona in the Gila River Quaternary sediments (Shackley 1998, 2005). Given the size of artifacts produced from these sources, it is impossible to determine whether the raw material was procured from the primary sources or somewhere along the stream systems eroding those sources.

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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
Sleeping Snake									
6544	664	365	8856	244	18	40	110	26	Mule Cr/AC-MM
6950	5329	525	7127	126	19	25	95	31	Superior
1713	1441	273	9725	154	98	27	172	16	Sauceda Mts
4141	752	548	7242	131	20	24	95	32	Superior
1026	758	534	7217	129	16	26	96	30	Superior
Honey Bee Village									
1366	405	502	8601	110	78	20	78	51	Government Mtn
6396	1258	541	7251	127	21	25	91	28	Superior
11446	1263	472	8797	146	135	19	124	16	Tank Mts
287	1226	416	8512	143	132	21	121	14	Tank Mts
189	914	596	10535	169	25	36	236	28	burned
352-1	1037	484	7666	155	87	20	88	13	Cow Canyon
6663	2131	339	11896	179	112	28	183	19	Sauceda Mts
6790	1675	305	10882	166	112	27	185	20	Sauceda Mts
7611	731	496	6746	127	17	27	96	29	Superior
11643	756	382	9269	239	16	40	110	28	Mule Cr/AC-MM
7542	1607	391	9951	164	76	34	189	24	Sauceda Mts
7406	1642	431	10567	175	75	31	201	22	Sauceda Mts
6098	1762	284	9894	150	92	27	163	17	Sauceda Mts
1911	1677	312	10976	166	110	29	181	21	Sauceda Mts
1180	2143	378	10304	156	70	32	183	17	Sauceda Mts
7436	1916	308	10306	159	101	23	170	18	Sauceda Mts
6954	1763	324	11206	167	108	26	184	21	Sauceda Mts
645-1	1921	313	10788	171	110	28	180	18	Sauceda Mts
589	1627	361	10213	155	71	32	186	22	Sauceda Mts
6033	1775	287	10140	154	102	26	170	16	Sauceda Mts
7263	1572	297	9830	150	99	24	169	19	Sauceda Mts
645-2	1826	315	10970	172	104	24	182	17	Sauceda Mts
352-2	1572	302	10497	161	105	26	177	21	Sauceda Mts
7567	1854	314	10804	161	105	24	171	17	Sauceda Mts
7926	1605	367	9790	149	70	31	186	26	Sauceda Mts
195	816	543	7467	128	21	28	99	33	Superior
RGM1-S4	1533	303	12863	148	104	23	211	7	standard
RGM1-S5	1604	289	12905	150	106	25	212	10	standard

Table 2. Crosstabulation of source by site.

			Site		
			Honey Bee	Sleeping Snake	Total
Source	Cow Canyon	Count	1	0	1
		% within Source	100.0%	.0%	100.0%
		% within Sample	4.0%	.0%	3.3%
		% of Total	3.3%	.0%	3.3%
	Government Mtn	Count	1	0	1
		% within Source	100.0%	.0%	100.0%
		% within Sample	4.0%	.0%	3.3%
		% of Total	3.3%	.0%	3.3%
	Mule Cr/AC-MM	Count	1	1	2
		% within Source	50.0%	50.0%	100.0%
		% within Sample	4.0%	20.0%	6.7%
		% of Total	3.3%	3.3%	6.7%
	Sauceda Mts	Count	17	1	18
		% within Source	94.4%	5.6%	100.0%
		% within Sample	68.0%	20.0%	60.0%
		% of Total	56.7%	3.3%	60.0%
	Superior	Count	3	3	6
		% within Source	50.0%	50.0%	100.0%
		% within Sample	12.0%	60.0%	20.0%
		% of Total	10.0%	10.0%	20.0%
	Tank Mts	Count	2	0	2
		% within Source	100.0%	.0%	100.0%
		% within Sample	8.0%	.0%	6.7%
		% of Total	6.7%	.0%	6.7%
Total		Count	25	5	30
		% within Source	83.3%	16.7%	100.0%
		% within Sample	100.0%	100.0%	100.0%
		% of Total	83.3%	16.7%	100.0%

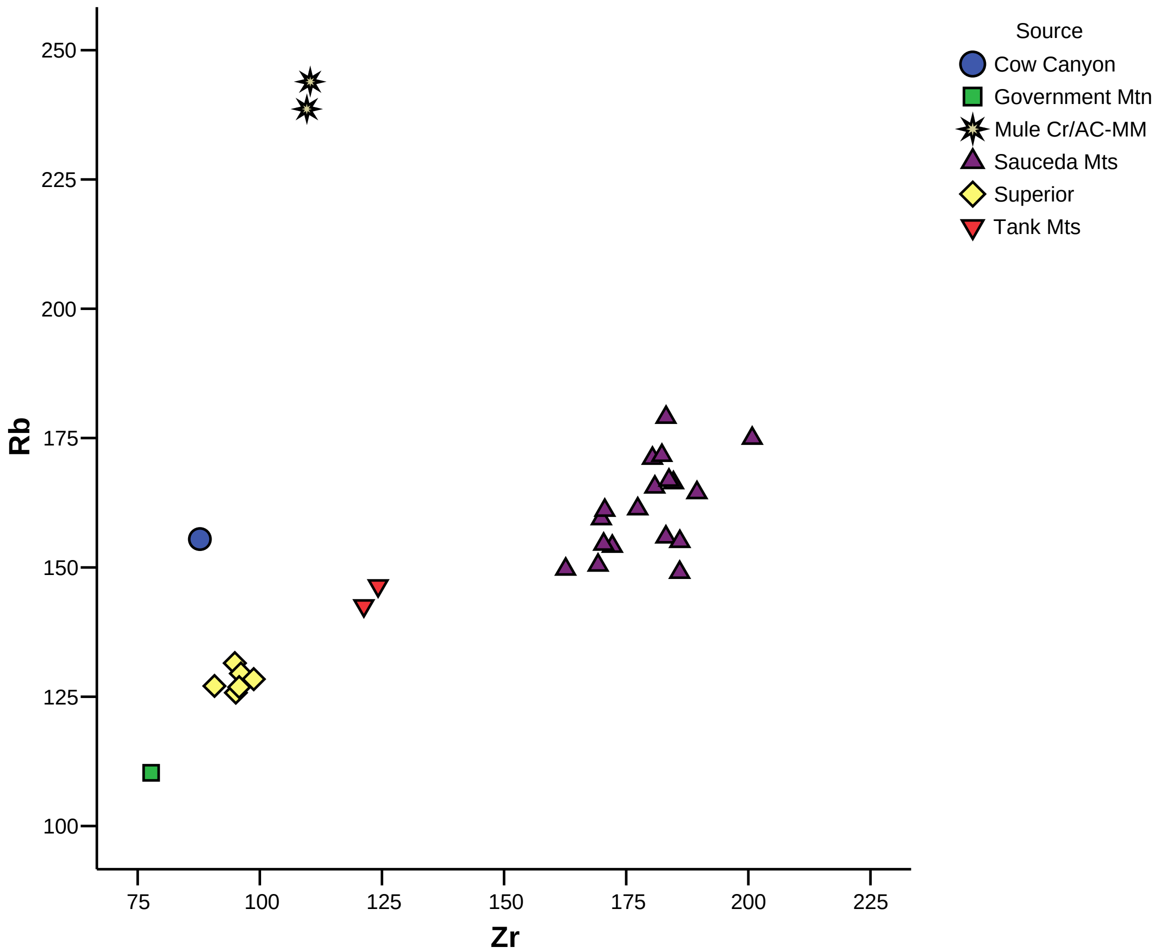

Figure 1. Zr versus Rb bivariate plot of the archaeological specimens.