BERKELEY ARCHAEOLOGICAL XRF LAB

Department of Anthropology

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

SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM CERRO POMO, COX RANCH PUEBLO, AND A SAMPLE SURVEY, WESTERN NEW MEXICO

by

M. Steven Shackley
Professor and Director
Archaeological XRF Laboratory
Department of Anthropology
University of California, Berkeley

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Dr. Andrew Duff
Department of Anthropology
Washington State University
Pullman, Washington

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INTRODUCTION

The analysis here of 47 artifact samples from Cerro Pomo, Cox Ranch Pueblo, and a sample survey, exhibits an obsidian assemblage with source provenance very similar to the previous analysis at Cox Ranch Pueblo and Cerro Pomo (Shackley 2006a, 2006b). The discussion is essentially the same with some minor comments.

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™ 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 Kα-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, 1998, 2005). 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 Figure 1).

DISCUSSION

The WSU Analysis

Given that the obsidian sources dominant in the assemblage were from eastern Arizona/western New Mexico, a word about the similar chemistry is in order (see Shackley 1995, 2005; Tables 1 and 3, Figure 1). These Tertiary Period sources, particularly Cow Canyon, Mule Creek, Gwynn/Ewe Canyon, and Red Hill are derived from similar crustal material (Mogollon-Datil Province) and, by definition, exhibit similar chemistry (Elston et al. 1976; Shackley 2005:54-55). With regard to the Gwynn/Ewe Canyon source, this is the only obsidian source in the Mogollon Highlands, and during the Classic Period was probably "controlled" by the Cibola branch, while the Mule Creek sources were "controlled" by the Mimbres branch. What was happening in the post-Classic is not clear. The sheer quantity of Mule Creek material is much greater than Gwynn/Ewe Canyon obsidian, and has eroded west at least 100 km (Shackley 2005). The Gwynn/Ewe Canyon source appears to not have eroded into the San Francisco River system, and therefore must have been originally procured at or near the primary domes. Valle Grande (Valles Rhyolite) in the Valles Caldera of the Jemez Mountain in northern New Mexico similarly has not eroded outside the caldera, and had to have been originally procured at Cerro del Medio or in the caldera proper (Shackley 2005).

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2006a Source Provenance of Obsidian Artifacts from Cerro Pomo and Cox Ranch Pueblo, Western New Mexico. Report prepared for Andrew Duff, Washington State University, Pullman.

2006b Source Provenance of Obsidian Artifacts from Cerro Pomo, Cox Ranch Pueblo, and The Blue J Community, Western New Mexico. Report prepared for Andrew Duff, Washington State University, Pullman.

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

Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
COX74	868	436	8319	225	25	40	113	21	Mule Cr/AC-MM
COX75	957	557	5649	141	11	27	59	47	Red Hill
COX76	939	375	8172	230	18	41	110	30	Mule Cr/AC-MM
COX77	955	582	8965	199	5	62	171	107	Cerro Toledo Rhy
COX78	762	647	6064	163	12	36	57	48	Red Hill
COX79	844	735	6477	170	19	32	72	57	Red Hill
COX80	1031	438	7862	224	22	35	111	21	Mule Cr/AC-MM
COX81	848	645	6063	162	11	21	61	46	Red Hill
COX82	969	547	6876	175	11	20	120	40	Mule Cr/AC-MM
COX83	1043	480	9585	260	20	37	112	29	Mule Cr/AC-MM
POMO44	1019	472	8939	160	10	46	159	58	Valles Rhy (CDM)
POMO45	898	544	5720	141	12	30	60	46	Red Hill
POMO46	777	594	5775	155	14	34	61	48	Red Hill
POMO47	794	713	6462	168	14	35	70	51	Red Hill
POMO48	805	747	6541	165	16	30	72	50	Red Hill
POMO49	798	668	6178	166	9	38	63	53	Red Hill
POMO50	946	551	9040	200	11	58	158	104	Cerro Toledo Rhy
POMO51	1286	557	8148	135	131	12	129	16	Cow Canyon
POMO52	734	792	6502	193	6	46	66	73	Red Hill
POMO53	1039	487	8898	237	17	40	111	22	Mule Cr/AC-MM
POMO54	836	655	6402	162	11	35	65	53	Red Hill
POMO55	822	600	5938	155	10	32	66	40	Red Hill
POMO56	884	452	8652	248	22	38	108	29	Mule Cr/AC-MM
POMO57	814	617	5779	148	16	36	61	56	Red Hill
POMO58	764	710	6538	169	13	40	65	60	Red Hill
POMO59	793	930	6991	213	10	50	70	71	Red Hill
POMO60	1147	479	8212	211	22	27	137	18	Mule Cr/AC-MM
POMO61	802	943	7307	216	9	49	72	66	Red Hill
POMO62	824	950	7437	213	7	51	76	70	Red Hill
POMO63	890	447	8120	231	16	41	110	25	Mule Cr/AC-MM
POMO64	809	861	6825	200	8	50	66	61	Red Hill
POMO65	1031	609	6306	150	16	37	64	46	Red Hill
POMO66	1013	687	7068	394	7	69	101	106	Mule Cr/N Sawmill Cr
POMO67	936	478	8881	241	16	46	111	34	Mule Cr/AC-MM
POMO68	909	683	6522	164	15	29	65	48	Red Hill
POMO69	753	638	5800	156	18	34	54	50	Red Hill
POMO70	866	672	6422	167	19	35	59	46	Red Hill
POMO71	704	3464	2632	3	27	-3	10	2	not obsidian
SUR52	941	475	8875	250	20	40	113	33	Mule Cr/AC-MM
SUR53	1049	430	8598	243	21	35	119	18	Mule Cr/AC-MM
SUR54	769	707	6493	175	14	35	63	44	Red Hill
SUR55	1193	490	7936	133	136	19	121	9	Cow Canyon
SUR56	712	595	5956	159	13	40	59	47	Red Hill
SUR57	886	813	7032	199	10	47	60	63	Red Hill
SUR58	737	823	6592	197	11	55	70	63	Red Hill
SUR59	839	597	6045	144	13	37	54	45	Red Hill
SUR60	779	734	6636	174	15	43	69	56	Red Hill
RGM1-S3	1553	323	13437	149	108	23	223	5	standard
RGM1-S3	1678	286	13320	148	112	22	231	10	standard

Table 2. Crosstabulation of site by obsidian source provenance.

			Site/Sample			
			CERRO POMO	COX RANCH	SURVEY	Total
Source	Cerro Toledo Rhy	Count	1	1	0	2
		% within Source	50.0%	50.0%	.0%	100.0%
		% within Site/Sample	3.7%	10.0%	.0%	4.3%
		% of Total	2.2%	2.2%	.0%	4.3%
	Cow Canyon	Count	1	0	1	2
		% within Source	50.0%	.0%	50.0%	100.0%
		% within Site/Sample	3.7%	.0%	11.1%	4.3%
		% of Total	2.2%	.0%	2.2%	4.3%
	Mule Cr/AC-MM	Count	5	5	2	12
		% within Source	41.7%	41.7%	16.7%	100.0%
		% within Site/Sample	18.5%	50.0%	22.2%	26.1%
		% of Total	10.9%	10.9%	4.3%	26.1%
	Mule Cr/N Sawmill Cr	Count	1	0	0	1
		% within Source	100.0%	.0%	.0%	100.0%
		% within Site/Sample	3.7%	.0%	.0%	2.2%
		% of Total	2.2%	.0%	.0%	2.2%
	Red Hill	Count	18	4	6	28
		% within Source	64.3%	14.3%	21.4%	100.0%
		% within Site/Sample	66.7%	40.0%	66.7%	60.9%
		% of Total	39.1%	8.7%	13.0%	60.9%
	Valles Rhy (CDM)	Count	1	0	0	1
		% within Source	100.0%	.0%	.0%	100.0%
		% within Site/Sample	3.7%	.0%	.0%	2.2%
		% of Total	2.2%	.0%	.0%	2.2%
Total		Count	27	10	9	46
		% within Source	58.7%	21.7%	19.6%	100.0%
		% within Site/Sample	100.0%	100.0%	100.0%	100.0%
		% of Total	58.7%	21.7%	19.6%	100.0%

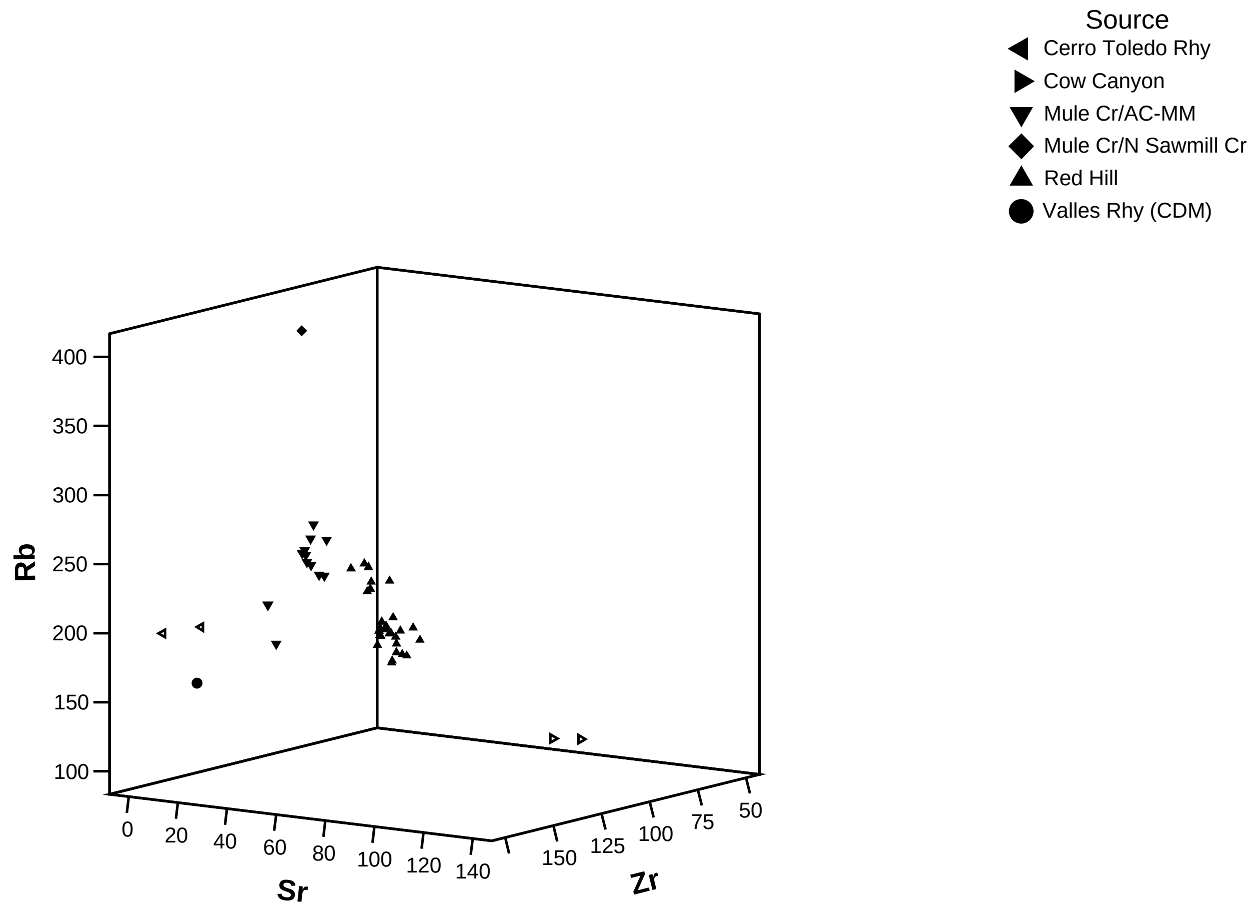

Figure 1. Rb, Sr, Zr three-dimensional plot of the elemental concentrations for the WSU archaeological specimens.