Title
Source Provenance of Obsidian Artifacts from Cerro Pomo, Cox Ranch Pueblo, and the Blue J Community, Western New Mexico

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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM CERRO POMO, COX RANCH PUEBLO, AND THE BLUE J COMMUNITY, WESTERN NEW MEXICO

by

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Report Prepared for

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INTRODUCTION

The analysis here of obsidian artifact samples from Cerro Pomo, Cox Ranch Pueblo, and Blue J Chacoan Era communities, exhibits an obsidian assemblage with source provenance very similar to the previous analysis at Cox Ranch Pueblo and Cerro Pomo (Shackley 2006). The data base from that previous analysis is combined here with the large sample (≈ 168 samples). 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 Tables 1 and 2 are reported in parts per million (ppm), a quantitative measure by weight (see also Figures 1 and 2).

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 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).

The Blue/SF River “source” is actually a secondary source. Eroding into the San Francisco and Gila Rivers from some point near Mule Creek, the primary domes for this source have never been located. As you can see, the chemistry is similar to the Antelope Creek and Mule Mountain (AC/MM) sources, and is likely magmatically related (Figure 1). It occurs in relatively high proportions in the alluvium of the San Francisco River, downstream from the junction with the Blue River in eastern Arizona, and western New Mexico (Shackley 2005).

The Blue J Community

A few comments about this site are necessary (see Tables 2 and 4, and Figure 2). The dominance of obsidian source provenance from northern New Mexico (Mount Taylor and the Jemez sources) is expectable given the more northern location in the study area. Red Hill still occurs, likely due to relationships with contemporaneous communities to the south. The one artifact produced from Superior, while an uncommon occurrence, has been noted in sites in the Zuni region.

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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
CERRO POMO									
CP-1	1117	550	5715	134	12	25	54	37	Red Hill
CP-10	961	716	6328	148	13	28	59	49	Red Hill
CP-11	842	801	6898	179	18	30	67	52	Red Hill
CP-12	875	604	6087	154	8	28	58	49	Red Hill
CP-13	720	152	2726	3	6	-3	26	2	not obsidian
CP-14	832	644	6090	159	13	36	59	55	Red Hill
CP-15	1570	420	8746	216	26	36	96	24	Blue/SF River
CP-16	1447	475	7879	210	21	27	140	28	Gwynn/Ewe Cnyn
CP-17	1123	758	8013	168	12	43	65	52	Red Hill
CP-18	984	607	7680	149	11	36	64	38	Red Hill
CP-19	1260	502	8477	231	13	38	105	45	Mule Cr/AC-MM
CP-2	776	879	6992	210	9	54	69	55	Red Hill
CP-20	971	384	8037	228	15	48	108	27	Mule Cr/AC-MM
CP-21	815	652	6061	150	14	34	58	30	Red Hill
CP-22	1163	484	7149	182	22	30	86	15	Blue/SF River
CP-23	971	694	6321	161	17	44	58	43	Red Hill
CP-24	896	664	6341	148	10	34	62	45	Red Hill
CP-25	934	398	8375	231	18	42	106	22	Mule Cr/AC-MM
CP-26	797	635	5985	159	18	35	63	58	Red Hill
CP-27	995	430	8681	232	23	34	118	27	Mule Cr/AC-MM
CP-28	1001	358	8114	231	17	41	103	26	Mule Cr/AC-MM
CP-29	1000	394	8358	232	22	32	112	25	Mule Cr/AC-MM
CP-3	904	649	6586	158	14	37	64	39	Red Hill
CP-30	883	406	8200	232	16	41	107	29	Mule Cr/AC-MM
CP-31	893	407	8096	231	15	34	106	26	Mule Cr/AC-MM
CP-32	948	442	8336	226	20	37	116	26	Mule Cr/AC-MM
CP-33	896	338	7894	220	17	41	105	25	Mule Cr/AC-MM
CP-34	726	598	6253	160	17	28	67	47	Red Hill
CP-35	831	675	6239	169	6	40	66	60	Red Hill
CP-36	979	445	8302	223	15	40	107	32	Mule Cr/AC-MM
CP-37	864	363	7826	228	21	40	111	32	Mule Cr/AC-MM
CP-38	1053	428	9090	232	18	43	110	17	Mule Cr/AC-MM
CP-39	830	542	3300	3	19	0	20	0	not obsidian
CP-4	844	592	5736	143	10	28	61	70	Red Hill
CP-40	964	397	7500	219	18	35	107	23	Mule Cr/AC-MM
CP-41	648	20823	2915	3	19	4	9	1	not obsidian
CP-42	975	368	7788	224	13	34	96	30	Mule Cr/AC-MM
CP-43	1044	373	7393	205	17	40	103	9	Mule Cr/AC-MM
CP-5	1949	677	12895	142	18	40	70	46	Red Hill
CP-6	1227	629	8178	153	12	30	70	36	Red Hill
CP-7	896	708	7124	161	13	41	64	40	Red Hill
CP-8	836	653	6512	156	13	34	60	57	Red Hill
CP-9	1003	450	8437	227	20	43	108	24	Mule Creek AC/MM
COX RANCH PUEBLO									
CRP-1	896	842	7181	210	13	53	69	55	Red Hill
CRP-10	1397	538	7122	145	92	14	87	19	Cow Canyon?
CRP-11	1252	848	6991	184	5	34	61	58	Red Hill
CRP-12	1213	393	7816	216	20	41	97	16	Blue/SF River

Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
CRP-13	888	672	6668	168	12	34	63	54	Red Hill
CRP-14	1633	407	8339	216	15	28	88	19	Blue/SF River
CRP-15	901	406	8266	234	15	42	113	23	Mule Creek AC/MM
CRP-16	994	379	8308	224	20	42	110	23	Mule Creek AC/MM
CRP-17	1069	438	8447	236	14	38	108	30	Mule Creek AC/MM
CRP-18	826	648	6329	162	15	38	60	50	Red Hill
CRP-19	837	740	6277	171	17	34	63	50	Red Hill
CRP-2	929	422	8668	236	22	47	113	29	Mule Creek AC/MM
CRP-20	1408	348	6954	176	15	28	91	7	Blue/SF River
CRP-21	824	656	6067	156	11	34	66	42	Red Hill
CRP-22	1097	728	6719	169	11	46	67	53	Red Hill
CRP-23	1716	362	7006	175	9	32	81	25	too small
CRP-24	1046	386	7740	221	19	43	97	21	Blue/SF River
CRP-25	1621	474	7995	124	114	20	108	9	Cow Canyon
CRP-26	1194	484	7315	196	11	28	141	11	Gwynn/Ewe Cnyn
CRP-27	968	387	7875	198	18	31	104	20	Blue/SF River
CRP-28	675	147	2779	3	12	4	15	-1	not obsidian
CRP-29	1046	576	6619	149	17	38	64	47	Red Hill
CRP-3	923	455	8794	254	19	39	114	28	Mule Creek AC/MM
CRP-30	906	683	6891	168	17	31	63	54	Red Hill
CRP-31	945	383	8295	158	9	41	162	54	Valle Grande
CRP-32	862	862	7153	209	9	47	63	70	Red Hill
CRP-33	917	628	6671	152	15	35	57	43	Red Hill
CRP-34	923	471	7744	206	28	43	97	34	Blue/SF River
CRP-35	1053	636	6454	174	14	33	61	49	Red Hill
CRP-36	906	509	5435	129	19	28	57	44	too small
CRP-37	796	697	6480	180	16	40	66	53	Red Hill
CRP-38	850	628	6386	159	18	37	60	54	Red Hill
CRP-39	726	508	5260	127	17	32	56	48	Red Hill
CRP-4	1089	664	6678	157	16	31	65	46	Red Hill
CRP-40	909	339	8335	221	19	46	118	23	Mule Creek AC/MM
CRP-41	972	607	6629	161	12	39	62	53	Red Hill
CRP-42	949	412	8164	152	12	34	159	54	Valle Grande
CRP-43	1086	486	8807	222	14	46	113	24	Mule Cr/AC-MM
CRP-44	1088	677	7730	169	17	39	64	52	Red Hill
CRP-45	784	413	7701	210	19	39	101	24	Mule Cr/AC-MM
CRP-46	863	636	6255	161	12	37	63	44	Red Hill
CRP-47	1144	466	8784	234	19	39	103	32	Mule Cr/AC-MM
CRP-48	894	405	8040	225	22	39	108	16	Mule Cr/AC-MM
CRP-49	855	835	7143	168	10	36	72	50	Red Hill
CRP-5	873	656	6189	157	13	32	70	50	Red Hill
CRP-50	1054	458	8439	199	22	34	95	31	Blue/SF River
CRP-51	880	673	6233	154		36	62	41	Red Hill
CRP-52	755	642	5736	139	10	33	60	49	Red Hill
CRP-53	826	391	7185	201	23	32	105	25	Mule Cr/AC-MM
CRP-54	883	405	8283	231	18	35	113	28	Mule Cr/AC-MM
CRP-55	838	418	8325	151	7	43	156	56	Valle Grande
CRP-56	988	510	6394	137	88	18	84	18	Cow Canyon
CRP-57	1279	487	8151	132	136	18	121	13	Cow Canyon
CRP-58	1053	420	8207	146	15	37	165	50	Valle Grande
CRP-59	782	684	6237	159	18	35	64	50	Red Hill
CRP-6	943	501	9181	255	20	45	124	26	Mule Creek AC/MM
CRP-60	783	604	6250	168	7	35	62	54	Red Hill
Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source

CRP-61	1097	762	6745	181	5	36	69	52	Red Hill
CRP-62	1591	574	7376	389	11	66	108	176	Mule Cr/N Sawmill Cr
CRP-63	832	681	6477	176	11	31	63	48	Red Hill
CRP-64	923	732	6417	162	16	31	60	58	Red Hill
CRP-65	880	441	8321	235	21	39	107	27	Mule Cr/AC-MM
CRP-66	932	407	7829	231	17	35	111	26	Mule Cr/AC-MM
CRP-67	1008	380	8071	214	18	35	111	27	Mule Cr/AC-MM
CRP-68	835	707	6863	174	13	37	65	52	Red Hill
CRP-69	694	86	5612	3	20	-3	10	7	not obsidian
CRP-7	1015	482	9191	166	7	45	168	53	Valle Grande
CRP-70	1103	489	7458	125	132	19	118	17	Cow Canyon
CRP-71	981	415	7977	222	18	33	111	17	Mule Cr/AC-MM
CRP-72	848	405	7984	208	17	45	97	38	Blue/SF River
CRP-73	796	768	3348	3	21	-3	21	-1	not obsidian
CRP-8	912	656	6042	158	12	35	58	50	Red Hill
CRP-9	1304	495	8197	133	134	14	120	13	Cow Canyon
<u>SURVEY</u>									
Survey 1	948	456	8435	232	29	33	104	30	Mule Cr/AC-MM
Survey 10	937	453	9072	233	20	40	106	22	Mule Cr/AC-MM
Survey 11	831	420	8087	229	15	39	104	30	Mule Cr/AC-MM
Survey 12	923	423	8561	229	19	41	110	20	Mule Cr/AC-MM
Survey 13	952	399	8723	227	17	45	104	17	Mule Cr/AC-MM
Survey 14	1085	475	8484	238	14	39	100	24	Mule Cr/AC-MM
Survey 15	840	738	7202	392	9	78	103	119	Mule Cr/N Sawmill Cr
Survey 16	923	402	7971	220	15	39	106	30	Mule Cr/AC-MM
Survey 17	887	411	8004	208	17	36	114	28	Mule Cr/AC-MM
Survey 18	1371	439	7954	207	7	30	93	25	Mule Cr/AC-MM
Survey 19	902	438	8617	233	18	40	115	30	Mule Cr/AC-MM
Survey 2	855	867	6984	194	8	53	79	59	Red Hill
survey 20	966	681	8889	458	9	86	133	215	Mount Taylor
survey 21	782	587	5859	148	11	28	64	50	Red Hill
survey 22	1125	434	9988	211	23	36	114	25	Mule Cr/AC-MM
survey 23	1058	435	9032	234	15	47	115	29	Mule Cr/AC-MM
survey 24	830	656	6844	155	8	29	56	34	Red Hill
survey 25	898	586	6524	156	15	29	63	49	Red Hill
survey 26	858	630	6208	157	17	40	56	48	Red Hill
survey 27	648	97	2547	3	7	-3	8	-1	not obsidian
survey 28	1091	677	7633	154	13	34	69	40	Red Hill
survey 29	846	497	5603	123	12	41	65	49	Red Hill
Survey 3	1031	704	7698	168	14	37	71	58	Red Hill
survey 30	838	655	6559	154	15	37	63	41	Red Hill
survey 31	1019	606	7602	158	9	32	67	42	Red Hill
survey 32	1023	355	7555	205	20	41	108	16	Mule Cr/AC-MM
survey 33	1014	409	8023	221	13	38	108	33	Mule Cr/AC-MM
survey 34	906	596	6474	151	16	31	60	49	Red Hill
survey 35	1184	497	7943	126	128	17	119	11	Cow Canyon
survey 36	818	560	6173	153	15	29	62	39	Red Hill
survey 37	750	834	6658	204	8	49	66	60	Red Hill
survey 38	1095	483	7287	210	22	25	142	20	Gwynn/Ewe Cnyn
Survey 39	900	683	6585	171	13	36	60	52	Red Hill
Survey 4	899	685	7392	410	11	71	107	120	Mule Cr/N Sawmill Cr
Survey 40	802	611	7943	108	78	22	76	53	Government Mtn

Survey 41	868	864	6794	202	11	49	72	66	Red Hill
Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
Survey 42	903	677	6632	163	13	35	63	56	Red Hill
Survey 43	929	865	7329	215	5	40	70	67	Red Hill
Survey 44	981	409	8730	234	18	42	108	31	Red Hill
Survey 45	758	200	2617	3	12	-3	8	-1	not obsidian
Survey 46	821	863	6914	203	12	42	70	72	Red Hill
Survey 47	879	751	6519	169	18	36	66	51	Red Hill
Survey 48	842	920	6967	206	9	48	67	63	Red Hill
Survey 49	1066	862	6945	468	15	67	105	168	Mount Taylor
Survey 5	823	658	6587	161	20	40	62	58	Red Hill
Survey 50	893	687	6334	147	16	34	62	50	Red Hill
Survey 51	877	457	9012	241	16	40	117	25	Mule Cr/AC-MM
Survey 6	955	448	8878	220	17	38	109	34	Mule Cr/AC-MM
Survey 7	877	646	6367	154	15	37	64	50	Red Hill
Survey 8	749	581	5912	151	14	33	59	44	Red Hill
Survey 9	936	417	8557	238	15	41	109	30	Mule Cr/AC-MM
RGM1-S1	1486	325	13338	156	112	23	223	10	standard
RGM1-S1	1462	294	13182	147	112	30	223	4	standard
RGM1-S1	1486	313	13192	147	112	18	215	11	standard
RGM1-S1	1617	317	13006	147	111	24	219	7	standard
RGM1-S1	1690	304	13242	145	114	21	215	7	standard
RGM1-S1	1486	321	13119	146	108	20	219	8	standard
RGM1-S1	1654	308	13233	156	106	18	224	9	standard
RGM1-S1	1571	291	13276	151	113	24	224	7	standard
RGM1-S1	1642	306	12931	148	108	19	215	12	standard
RGM1-S1	1664	298	13012	149	108	25	221	4	standard
RGM1-S1	1548	291	13227	152	111	21	222	8	standard

Table 2. Elemental concentrations and source assignments for the Blue J archaeological specimens and source standards. All measurements in parts per million (ppm).

Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
BJ-1	1295	423	6150	116	5	26	104	55	Superior
BJ-10	971	576	9246	202	5	71	174	94	Cerro Toledo Rhy
BJ-11	1107	347	8160	135	8	39	149	49	Valle Grande
BJ-12	961	489	9084	149	13	47	162	38	Valle Grande
BJ-13	767	915	7075	516	5	74	107	196	Mount Taylor
BJ-14	698	999	7558	548	7	81	123	199	Mount Taylor
BJ-15	1039	851	5765	378	8	45	86	144	Mount Taylor
BJ-16	648	710	7841	456	12	91	127	228	Mount Taylor
BJ-17	757	907	6683	506	8	72	108	191	Mount Taylor
BJ-18	782	850	6747	485	12	71	109	195	Mount Taylor
BJ-19	728	96	3217	7	63	2	9	5	not obsidian
BJ-2	754	885	6570	472	5	81	97	189	Mount Taylor
BJ-20	794	896	6917	506	5	71	99	182	Mount Taylor
BJ-21	800	650	7405	442	11	84	123	222	Mount Taylor
BJ-22	877	349	7674	141	6	36	151	55	Valle Grande
BJ-23	1069	368	8183	151	6	35	151	49	Valle Grande
BJ-24	897	843	8813	436	12	66	116	203	Mount Taylor
BJ-25	713	1075	7537	557	10	77	106	209	Mount Taylor
BJ-26	849	683	8102	469	12	85	120	223	Mount Taylor
BJ-27	710	892	6962	516	8	72	108	193	Mount Taylor
BJ-28	898	498	8959	157	8	39	155	52	Valle Grande
BJ-29	18693	609	9251	210	12	62	182	108	Cerro Toledo Rhy
BJ-3	722	938	7033	517	6	74	121	192	Mount Taylor
BJ-30	987	653	8644	463	5	69	127	194	Mount Taylor
BJ-31	899	908	6834	479	12	67	109	193	Mount Taylor
BJ-32	748	923	6953	478	13	70	110	177	Mount Taylor
BJ-33	828	859	6851	490	7	77	99	182	Mount Taylor
BJ-34	1149	798	5978	419	5	60	94	163	Mount Taylor
BJ-35	1156	520	5448	118	14	32	61	38	Red Hill
BJ-36	714	897	7208	523	8	77	113	196	Mount Taylor
BJ-37	905	673	5775	388	9	42	87	159	Mount Taylor
BJ-38	740	913	7303	527	8	80	110	201	Mount Taylor
BJ-39	765	835	6485	478	5	75	109	173	Mount Taylor
BJ-4	766	714	5999	451	7	69	102	174	Mount Taylor
BJ-40	1239	669	9449	203	11	62	158	99	Cerro Toledo Rhy
BJ-41	763	594	7931	457	7	80	124	231	Mount Taylor
BJ-42	1035	439	9666	159	12	38	162	55	Valle Grande
BJ-43	1034	461	8796	156	14	40	162	58	Valle Grande
BJ-44	1107	961	6915	473	12	63	96	178	Mount Taylor
BJ-45	1145	610	10574	172	10	45	173	55	Valle Grande
BJ-46	966	390	8425	150	7	40	162	60	Valle Grande
BJ-47	853	746	8383	473	9	92	129	233	Mount Taylor
BJ-48	926	1015	6965	433	6	50	83	154	Mount Taylor
BJ-49	945	527	8924	191	6	70	147	96	Cerro Toledo Rhy
BJ-5	678	868	6844	508	10	69	110	185	Mount Taylor
BJ-50	1045	391	5450	130	10	20	52	49	Red Hill
BJ-51	694	820	6690	492	11	73	109	180	Mount Taylor
BJ-52	710	847	6838	500	10	75	109	194	Mount Taylor
BJ-53	967	94	3206	3	17	-3	11	0	not obsidian
BJ-54	767	836	7054	500	8	65	95	193	Mount Taylor

Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
BJ-55	761	727	8354	486	9	86	129	246	Mount Taylor
BJ-56	943	386	8051	151	7	34	148	55	Valle Grande
BJ-57	1000	425	8467	154	9	41	158	61	Valle Grande
BJ-58	932	352	7382	127	5	36	134	49	Valle Grande
BJ-59	698	697	7924	476	7	79	133	232	Mount Taylor
BJ-6	707	913	7236	520	8	82	114	193	Mount Taylor
BJ-60	658	557	6879	411	6	78	126	217	Mount Taylor
BJ-7	798	924	7060	507	6	80	99	181	Mount Taylor
BJ-8	897	825	6798	504	11	68	108	182	Mount Taylor
BJ-9	814	716	6326	440	8	80	105	176	Mount Taylor

Table 3. Crosstabulation of WSU site by obsidian source provenance (all 2006 analyses).

			Site/Sample (all 2006 WSU analyses)			
			Cerro Pavo	Cox Ranch	Survey	Total
Source	Blue/SF River	Count	2	8	0	10
		% within Source	20.0%	80.0%	.0%	100.0%
		% within Site/Sample	5.0%	11.8%	.0%	6.4%
		% of Total	1.3%	5.1%	.0%	6.4%
	Cow Canyon	Count	0	6	1	7
		% within Source	.0%	85.7%	14.3%	100.0%
		% within Site/Sample	.0%	8.8%	2.0%	4.5%
		% of Total	.0%	3.8%	.6%	4.5%
	Government Mtn	Count	0	0	1	1
		% within Source	.0%	.0%	100.0%	100.0%
		% within Site/Sample	.0%	.0%	2.0%	.6%
		% of Total	.0%	.0%	.6%	.6%
	Gwynn/Ewe Cnyn	Count	1	1	1	3
		% within Source	33.3%	33.3%	33.3%	100.0%
		% within Site/Sample	2.5%	1.5%	2.0%	1.9%
		% of Total	.6%	.6%	.6%	1.9%
	Mount Taylor	Count	0	0	2	2
		% within Source	.0%	.0%	100.0%	100.0%
		% within Site/Sample	.0%	.0%	4.1%	1.3%
		% of Total	.0%	.0%	1.3%	1.3%
	Mule Cr/AC-MM	Count	17	17	17	51
		% within Source	33.3%	33.3%	33.3%	100.0%
		% within Site/Sample	42.5%	25.0%	34.7%	32.5%
		% of Total	10.8%	10.8%	10.8%	32.5%
	Mule Cr/N Sawmill Cr	Count	0	1	2	3
		% within Source	.0%	33.3%	66.7%	100.0%
		% within Site/Sample	.0%	1.5%	4.1%	1.9%
		% of Total	.0%	.6%	1.3%	1.9%
	Red Hill	Count	20	30	25	75
		% within Source	26.7%	40.0%	33.3%	100.0%
		% within Site/Sample	50.0%	44.1%	51.0%	47.8%
		% of Total	12.7%	19.1%	15.9%	47.8%
	Valle Grande	Count	0	5	0	5
		% within Source	.0%	100.0%	.0%	100.0%
		% within Site/Sample	.0%	7.4%	.0%	3.2%
		% of Total	.0%	3.2%	.0%	3.2%
Total		Count	40	68	49	157
		% within Source	25.5%	43.3%	31.2%	100.0%
		% within Site/Sample	100.0%	100.0%	100.0%	100.0%
		% of Total	25.5%	43.3%	31.2%	100.0%

Table 4. Crosstabulation of site by obsidian source provenance (Blue J and this WSU analysis).

			Site/Sample (9/2006 analysis)				
			Blue J	Cerro Pavo	Cox Ranch	Survey	Total
Source	Blue/SF River	Count	0	1	2	0	3
		% within Source	.0%	33.3%	66.7%	.0%	100.0%
		% within Site/Sample	.0%	4.3%	6.7%	.0%	1.9%
		% of Total	.0%	.6%	1.3%	.0%	1.9%
	Cerro Toledo Rhy	Count	4	0	0	0	4
		% within Source	100.0%	.0%	.0%	.0%	100.0%
		% within Site/Sample	6.9%	.0%	.0%	.0%	2.5%
		% of Total	2.5%	.0%	.0%	.0%	2.5%
	Cow Canyon	Count	0	0	3	1	4
		% within Source	.0%	.0%	75.0%	25.0%	100.0%
		% within Site/Sample	.0%	.0%	10.0%	2.0%	2.5%
		% of Total	.0%	.0%	1.9%	.6%	2.5%
	Government Mtn	Count	0	0	0	1	1
		% within Source	.0%	.0%	.0%	100.0%	100.0%
		% within Site/Sample	.0%	.0%	.0%	2.0%	.6%
		% of Total	.0%	.0%	.0%	.6%	.6%
	Mount Taylor	Count	39	0	0	2	41
		% within Source	95.1%	.0%	.0%	4.9%	100.0%
		% within Site/Sample	67.2%	.0%	.0%	4.1%	25.6%
		% of Total	24.4%	.0%	.0%	1.3%	25.6%
	Mule Cr/AC-MM	Count	0	16	10	18	44
		% within Source	.0%	36.4%	22.7%	40.9%	100.0%
		% within Site/Sample	.0%	69.6%	33.3%	36.7%	27.5%
		% of Total	.0%	10.0%	6.3%	11.3%	27.5%
	Mule Cr/N Sawmill Cr	Count	0	0	1	2	3
		% within Source	.0%	.0%	33.3%	66.7%	100.0%
		% within Site/Sample	.0%	.0%	3.3%	4.1%	1.9%
		% of Total	.0%	.0%	.6%	1.3%	1.9%
	Red Hill	Count	2	6	11	25	44
		% within Source	4.5%	13.6%	25.0%	56.8%	100.0%
		% within Site/Sample	3.4%	26.1%	36.7%	51.0%	27.5%
		% of Total	1.3%	3.8%	6.9%	15.6%	27.5%
	Superior	Count	1	0	0	0	1
		% within Source	100.0%	.0%	.0%	.0%	100.0%
		% within Site/Sample	1.7%	.0%	.0%	.0%	.6%
		% of Total	.6%	.0%	.0%	.0%	.6%
	Valle Grande	Count	12	0	3	0	15
		% within Source	80.0%	.0%	20.0%	.0%	100.0%
		% within Site/Sample	20.7%	.0%	10.0%	.0%	9.4%
		% of Total	7.5%	.0%	1.9%	.0%	9.4%
Total		Count	58	23	30	49	160
		% within Source	36.3%	14.4%	18.8%	30.6%	100.0%
		% within Site/Sample	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	36.3%	14.4%	18.8%	30.6%	100.0%

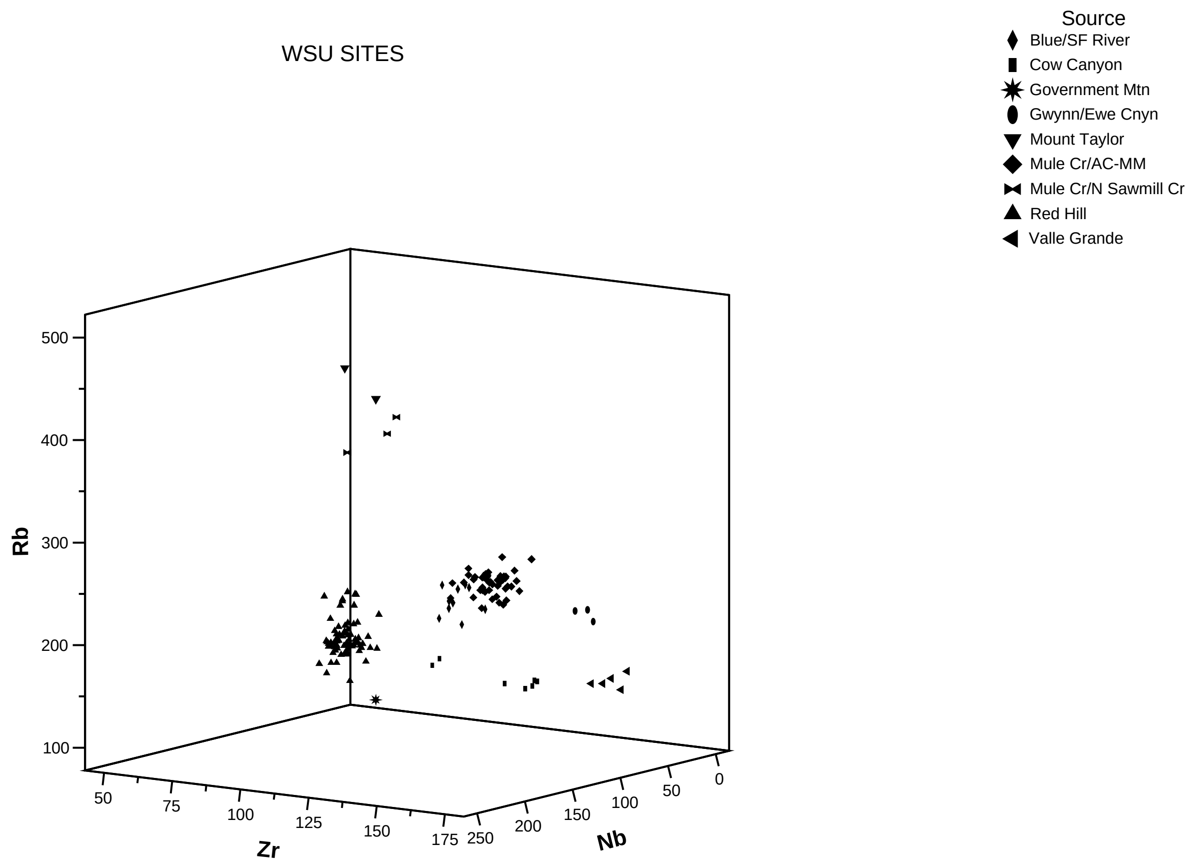

Figure 1. Rb, Zr, Nb three-dimensional plot of the elemental concentrations for the WSU archaeological specimens. The Antelope Creek and Blue/SF River, Mule Creek Source area samples difficult to separate at this resolution (see text).

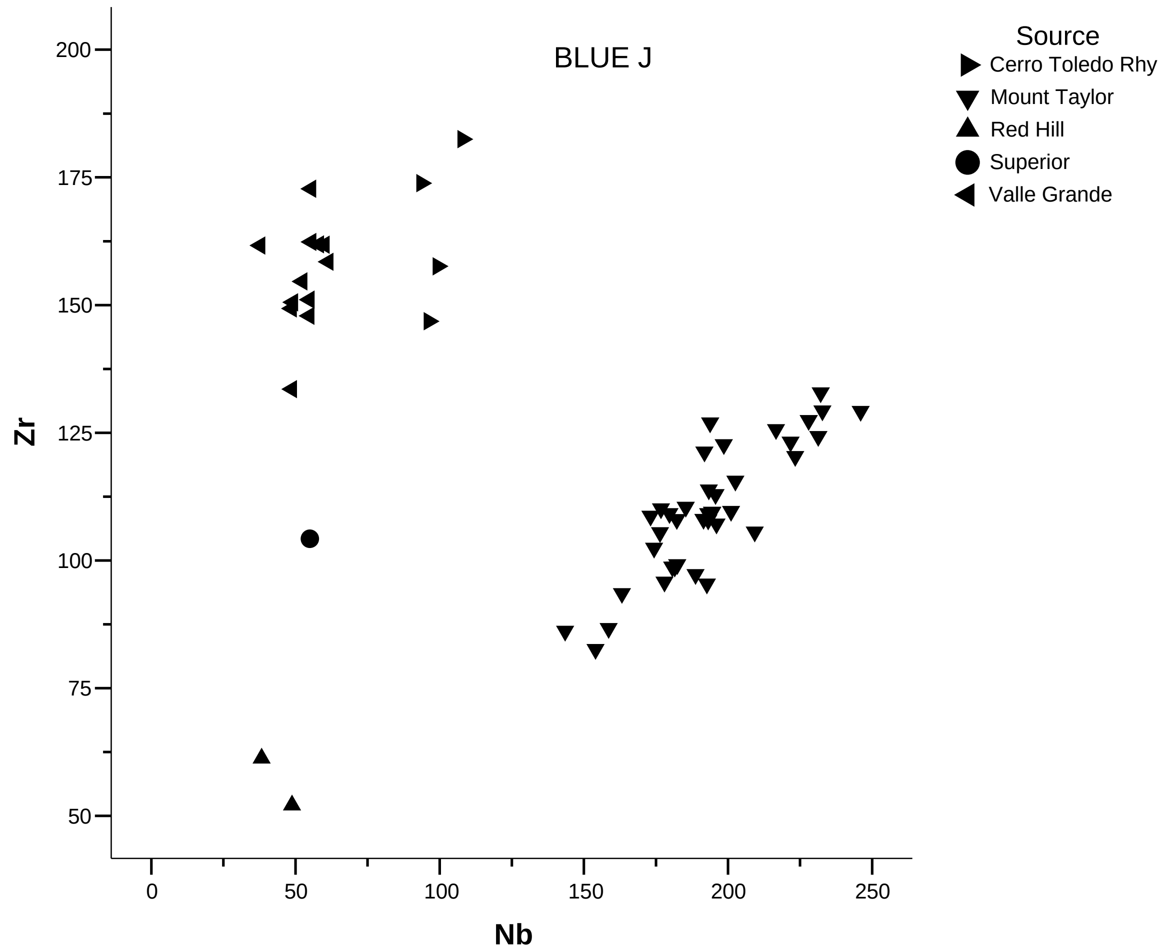

Figure 2. Zr versus Nb biplot of the elemental concentrations for the Blue J samples.