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Author

Shackley, M. Steven

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BERKELEY ARCHAEOLOGICAL
XRF LAB

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

SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM THE FLORIDA MOUNTAINS SITE (LA 18839) SOUTHERN NEW MEXICO

by

M. Steven Shackley, Ph.D.
Director

Report Prepared for
Jeremy Pye
Department of Anthropology
University of Oklahoma, Norman

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INTRODUCTION

The analysis here of 40 artifacts from the Late Pithouse period Mimbres site west of the Florida Mountains exhibits a very diverse obsidian source provenance including sources from northern Chihuahua, western New Mexico, and the Rio Grande Quaternary alluvium. Additionally, at least one artifact produced from vitrophyre is similar in composition to the Florida Mountains vitrophyre submitted for analysis.

ANALYSIS AND INSTRUMENTATION

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 EDXRF 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. 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 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™ 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 zinc (Zn), (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), and thorium (Th). 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 obsidian is available in Shackley (1992, 1995, 2004; also Mahood and Stimac 1991; 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, and Ga were measured, but these are rarely useful in discriminating glass sources and are not generally reported.

The data 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 the specific run of source standard RGM-1 is included in Table 1. Source nomenclature follows Baugh and Nelson (1987), Glascock et al. (1999), and Shackley (1988, 1995, 1998a, 1998b, 2004). Further information on the laboratory instrumentation and source nomenclature can be found at: http://www.swxrflab.net/ and Shackley (1998a). Trace element data exhibited in Table 1 are reported in parts per million (ppm), a quantitative measure by weight.

SUMMARY AND CONCLUSION

The vast majority of obsidian sources present in the assemblage suggests considerable contact or procurement to the south in northwestern Chihuahua (Sierra Fresnal and Los Jaguëyes), and secondarily western New Mexico (Mule Creek and the Blue/San Francisco River alluvium; Tables 1 and 2 and Figures 1 through 3 here). The Chihuahuan sources, particularly Sierra Fresnal have been found in alluvium considerably north of the primary domes almost to the international border, so the obsidian used to produce these artifacts could actually be nearly "local" in origin. Similarly, the artifact produced from Mount Taylor glass, could have been procured in the Rio Grande alluvium just to the east of Florida Mountains toward Las Cruces (see Church 2000). The Antelope Wells obsidian is not distributed in secondary deposits, so had to be originally procured from the area near the source at El Berrendo, Chihuahua or immediately north of the border.

The Florida Mountain vitrophyre (perlitic glass) submitted for analysis exhibits an elemental composition very similar to Sierra Fresnal obsidian. Given the lack of artifact quality obsidian that has been recovered from the Florida Mountains, I assign these artifacts to the Sierra Fresnal source, except for the one piece of vitrophyre "debitage" in the collection that more closely resembles the elemental concentrations of the Florida Mountain source samples (Tables 1 and 3). If artifact quality glass is discovered in the Florida Mountains, although doubtful, then additional analyses will have to be performed to discriminate these two sources. The artifacts that appear to be produced from Sierra Fresnal obsidian are also megascopically similar to the source specimens sampled from the source. Additionally, aphyric obsidian marekanites found in perlite or vitrophyre sources rarely compositionally matches (Shackley 1995, 2004). A more careful survey of the rhyolite domes in the Florida Mountains is warranted.

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Table 1. Elemental concentrations and source assignments for archaeological samples. All measurements in parts per million.

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
1.1.6	1123	338	8937	273	50	53	156	34	Sierra Fresnal [1]
11.1.5	846	696	8221	463	13	82	133	220	Mount Taylor
11-1-5-A	939	770	7847	409	11	71	119	124	Mule Cr-N Sawmill Cr
11-4-2-2	1367	415	9629	286	44	54	145	39	Sierra Fresnal
11-4-8-2	1379	277	9298	285	40	59	147	37	Sierra Fresnal
11-6-10-1	1220	326	8262	250	35	57	150	45	Sierra Fresnal
1-2-13-2	1222	545	7771	218	13	27	147	21	Mule Cr-AC/MM
5.1.13	1974	1546	37462	350	21	225	2094	166	Los Jaguëyes
5.3.15	2092	1380	36376	330	27	239	2080	164	Los Jaguëyes
5-2-12-2	24118	288	8108	262	39	62	143	43	Sierra Fresnal
5-2-12-A	1178	412	10031	300	43	66	162	33	Sierra Fresnal
5-2-14-2	1195	351	8833	267	32	60	156	27	Sierra Fresnal
5-4-10-3	1238	317	9166	287	43	62	166	28	Sierra Fresnal
5-5-7-2	1661	969	19179	289	18	116	1072	86	Antelope Wells
5-5-8PED	1219	368	8311	238	43	59	138	27	Sierra Fresnal
8.1.2	978	476	9053	240	18	40	109	23	Mule Cr-AC/MM
8.1.9	1193	332	9644	292	44	63	163	38	Sierra Fresnal
8.3.1	1252	380	9121	268	33	65	154	36	Sierra Fresnal
8.3.2	1550	458	11692	301	48	64	159	36	Sierra Fresnal
8.4.5	916	479	8851	234	19	41	106	22	Mule Cr-AC/MM
8-1-12-5	1502	910	22339	230	15	135	1249	119	Antelope Wells
8-1-4-A	1069	310	8708	248	39	65	159	33	Sierra Fresnal
8-1-4-B	1215	351	9224	285	38	61	160	32	Sierra Fresnal
8-1-4-C	1152	378	9280	281	40	56	165	33	Sierra Fresnal
8-1-9-C	1167	348	8986	266	35	64	155	19	Sierra Fresnal
8-2-12-A	1183	358	9325	285	42	57	159	43	Sierra Fresnal
8-2-12-B	1169	324	9350	282	40	62	160	37	Sierra Fresnal
8-2-4-3	29935	842	17592	298	15	120	1132	84	Antelope Wells

8-2-7-7	1184	309	9003	270	38	61	152	25	Sierra Fresnal
8-2-8-2	1121	300	8747	274	37	65	154	35	Sierra Fresnal
8-3-7PED	1119	453	8395	224	15	37	104	37	Mule Cr-AC/MM
8-4-4-2	1431	372	9157	249	41	55	154	30	Sierra Fresnal
8-4-5-3	876	428	7825	226	19	31	108	24	Mule Cr-AC/MM
8-4-7-3	1995	1111	21156	310	19	128	1161	98	Antelope Wells
8-4-8-6	897	541	5340	166	15	15	71	67	Blue/SF Rivers
8LOC1-9A	1068	483	7439	312	35	39	117	36	Florida Mts
8LOC1-9B	1213	311	8097	210	29	43	120	22	Mule Cr-AC/MM
N10W20-1	1207	338	10138	298	41	60	171	36	Sierra Fresnal
S15W20	922	388	8029	201	21	36	104	19	Mule Cr-AC/MM
S20E0	1253	293	8531	260	39	54	143	30	Sierra Fresnal
RGM1-H1	1569	341	12779	146	109	22	217	12	standard
RGM1-H1	1648	320	12768	146	110	21	220	5	standard
RGM1-H1	1539	330	12776	151	109	23	217	13	standard

[1] Some of the samples were small enough to be near the sample detection limits of the technique, and are therefore somewhat outside the varibility of the source standards (Davis et al. 1998).

Table 2. Distribution of source provenance in the assemblage.

		Frequency	Percent
Source	Antelope Wells	4	10.0
	Blue/SF Rivers	1	2.5
	Florida Mts	1	2.5
	Los Jagueyes	2	5.0
	Mount Taylor	1	2.5
	Mule Cr-AC/MM	7	17.5
	Mule Cr-N Sawmill	1	2.5
	Sierra Fresnal	23	57.5
	Total	40	100.0

Table 3. Elemental concentrations for three vitrophyric glass samples from Florida Mountians.

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
Perlite 1-1	845	387	6162	272	74	54	143	40	source

Perlite 2-1	1265	468	8060	303	44	52	154	35	source
Perlite 2-2	893	387	6407	312	52	56	158	38	source

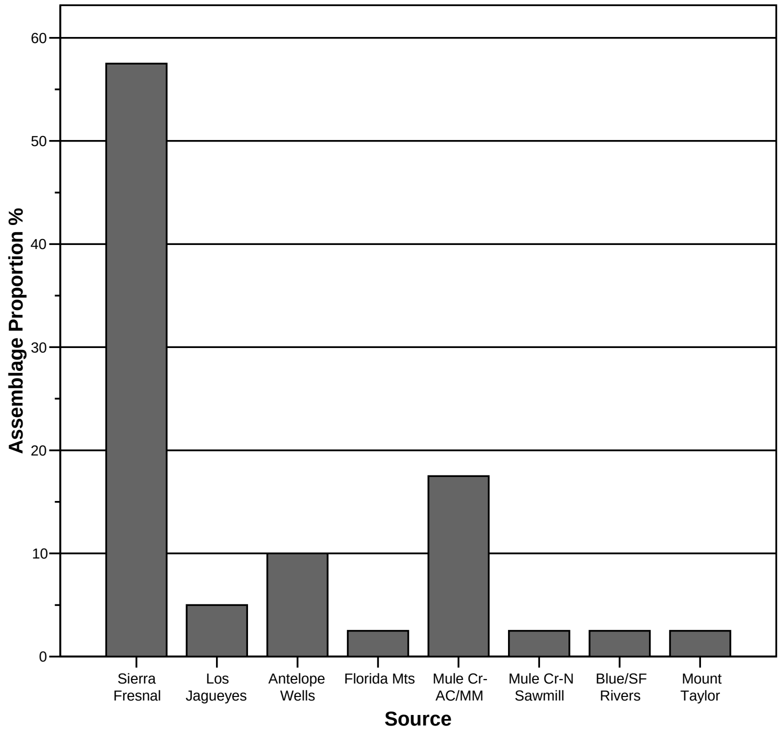

Figure 1. Distribution of obsidian source provenance in the assemblage.

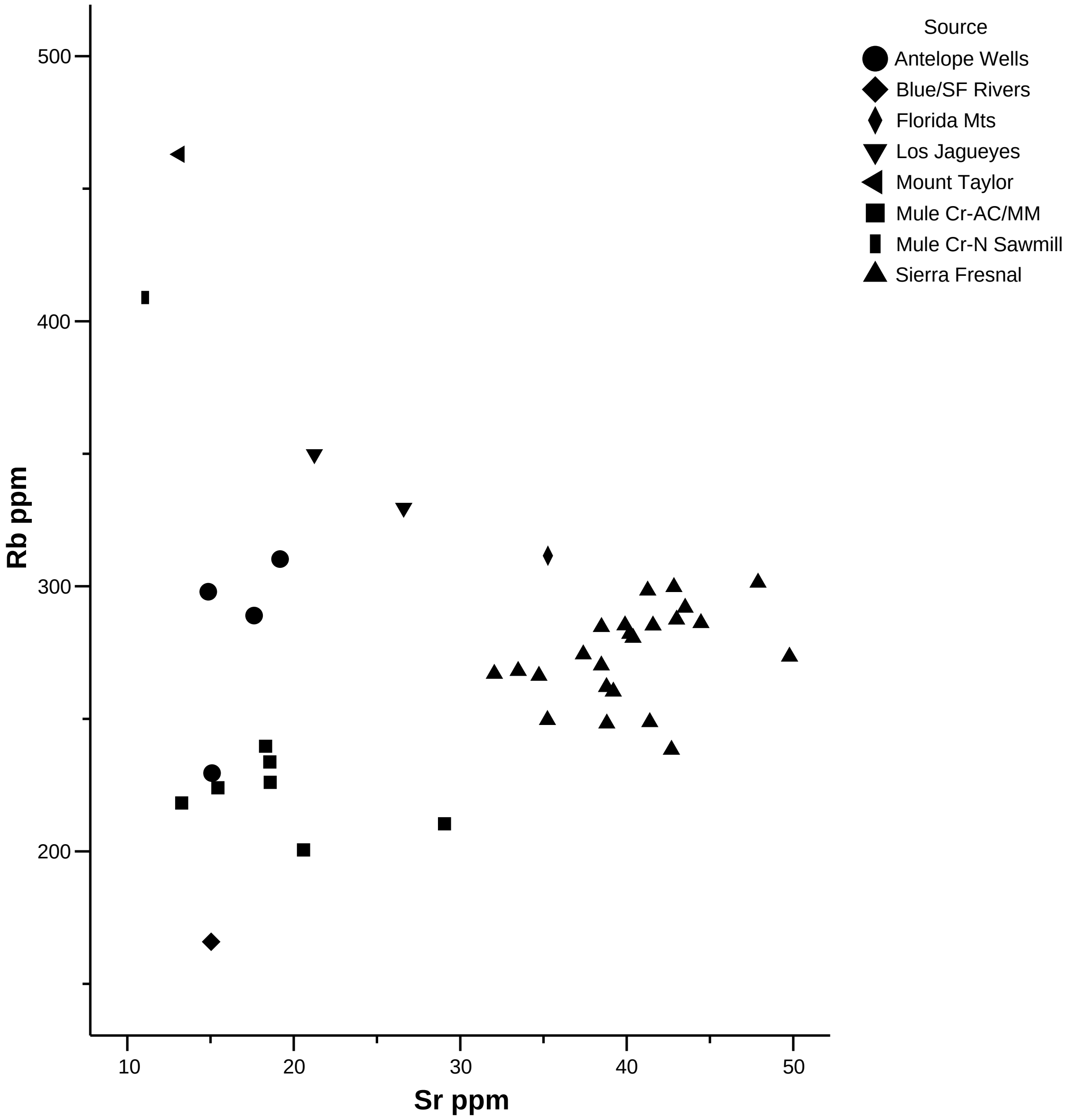

Figure 1. Rb versus Sr biplot of archaeological data.

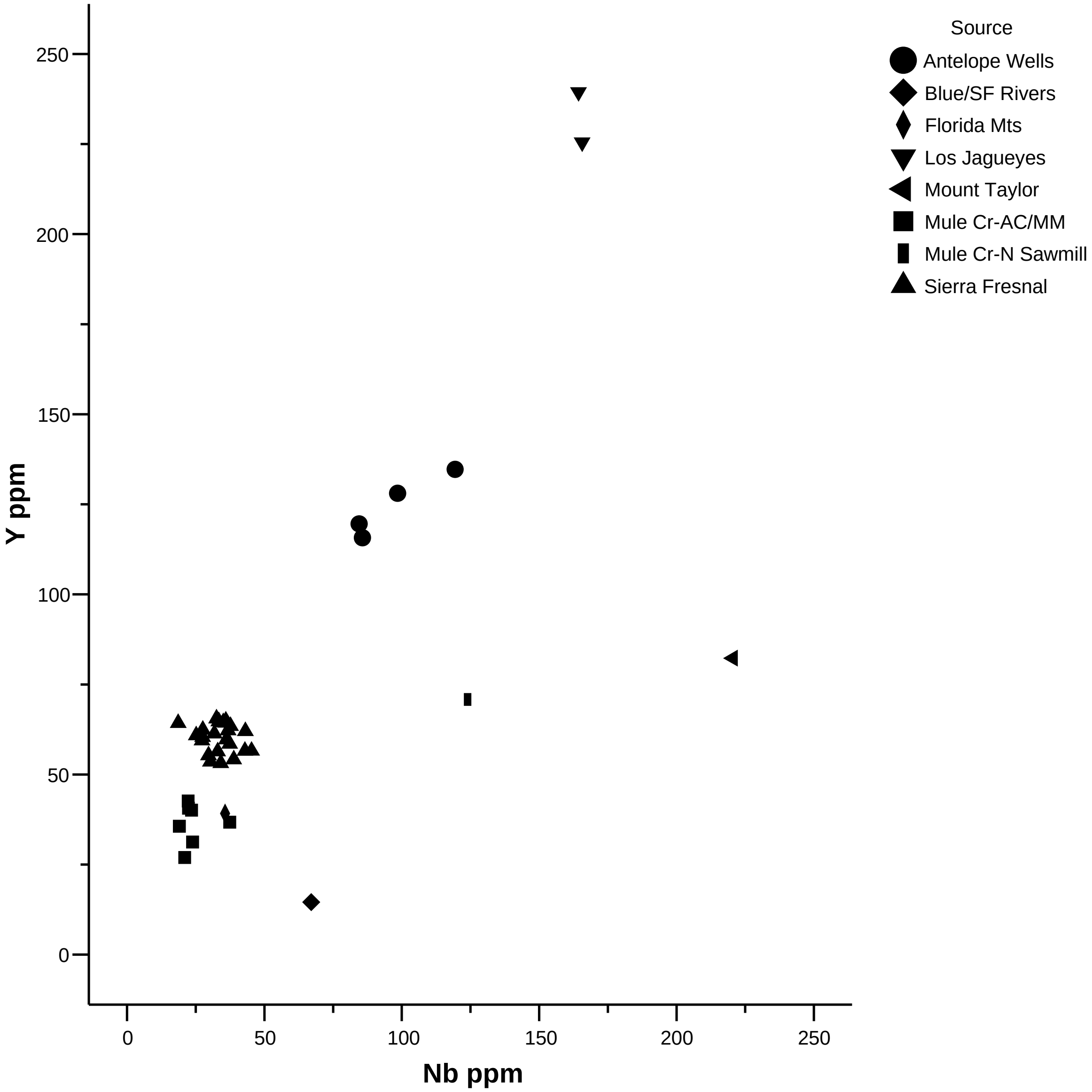

Figure 2. Y versus Nb biplot of archaeological data.