Title
Source Provenance of Obsidian Artifacts from Southern Mimbres Sites, Southwestern New Mexico

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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM SOUTHERN MIMBRES SITES, SOUTHWESTERN NEW MEXICO

Digital elevation model of Sierra Fresnal and surrounding region, Chihuahua (from Shackley 2005)

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INTRODUCTION

The analysis here of 16 artifacts from a number of Mimbres sites in southwestern New Mexico exhibits a very diverse obsidian source provenance including sources from northern Chihuahua, western New Mexico, and the Rio Grande Quaternary alluvium, similar to a previous analysis from the Florida Mountains area (Shackley 2004).

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/Thermo™ *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 (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). 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, BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France, and JR-1 and JR-2, obsidian standards from the Geological Survey of Japan (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 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, 1998, 2005). Further information on the laboratory instrumentation and source nomenclature can be found at: http://www.swxrflab.net/ and Shackley (2005). 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).

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 Antelope Wells), and secondarily western New Mexico (Mule Creek and the Blue/San Francisco River alluvium; Table 1 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 Cerro Toledo Rhyolite glass, could have been procured in the Rio Grande alluvium just to the east of Florida Mountains toward Las Cruces (see Church 2000; Shackley 2005). 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 (Antelope Wells).

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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
FS167	1249	248	8901	257	42	59	149	35	Sierra Fresnal, CHIH?
FS202	1144	345	8671	256	43	48	143	23	Sierra Fresnal, CHIH?
FS89	1330	388	10629	296	43	68	175	38	Sierra Fresnal, CHIH
FS61	1228	345	9142	288	41	71	152	31	Sierra Fresnal, CHIH
FS199	1013	488	6471	207	23	25	88	35	Blue/SF River, NM
FS146	946	413	7590	210	17	43	105	21	Mule Cr/AC-MM, NM
FS76	866	420	7708	213	22	40	108	25	Mule Cr/AC-MM, NM
FS66	1402	370	10336	281	43	61	168	31	Sierra Fresnal, CHIH
FS58	1276	316	8986	277	37	62	162	23	Sierra Fresnal, CHIH?
FS75	1324	978	18481	304	23	120	1074	98	Antelope Wells, NM/CHIH
FS147	1487	890	19093	291	24	123	1110	89	Antelope Wells, NM/CHIH
FS82	1537	942	17322	269	15	122	1048	91	Antelope Wells, NM/CHIH
FS174	844	583	8864	196	5	54	173	92	Cerro Toledo Rhy, NM
FS201	1464	793	17812	282	19	121	1083	97	Antelope Wells, NM/CHIH
FS110	1174	367	9821	292	48	69	154	34	Sierra Fresnal, CHIH
FS138	1202	346	9702	291	42	59	171	40	Sierra Fresnal, CHIH
RGM1-S3	1501	314	13352	156	109	17	221	15	standard

? These Sierra Fresnal sources are slightly outside the elemental concentrations reported for this source, but the source sample is small (Shackley 2005). These artifacts are likely produced from that source or one derived from the same magma source in Chihuahua.

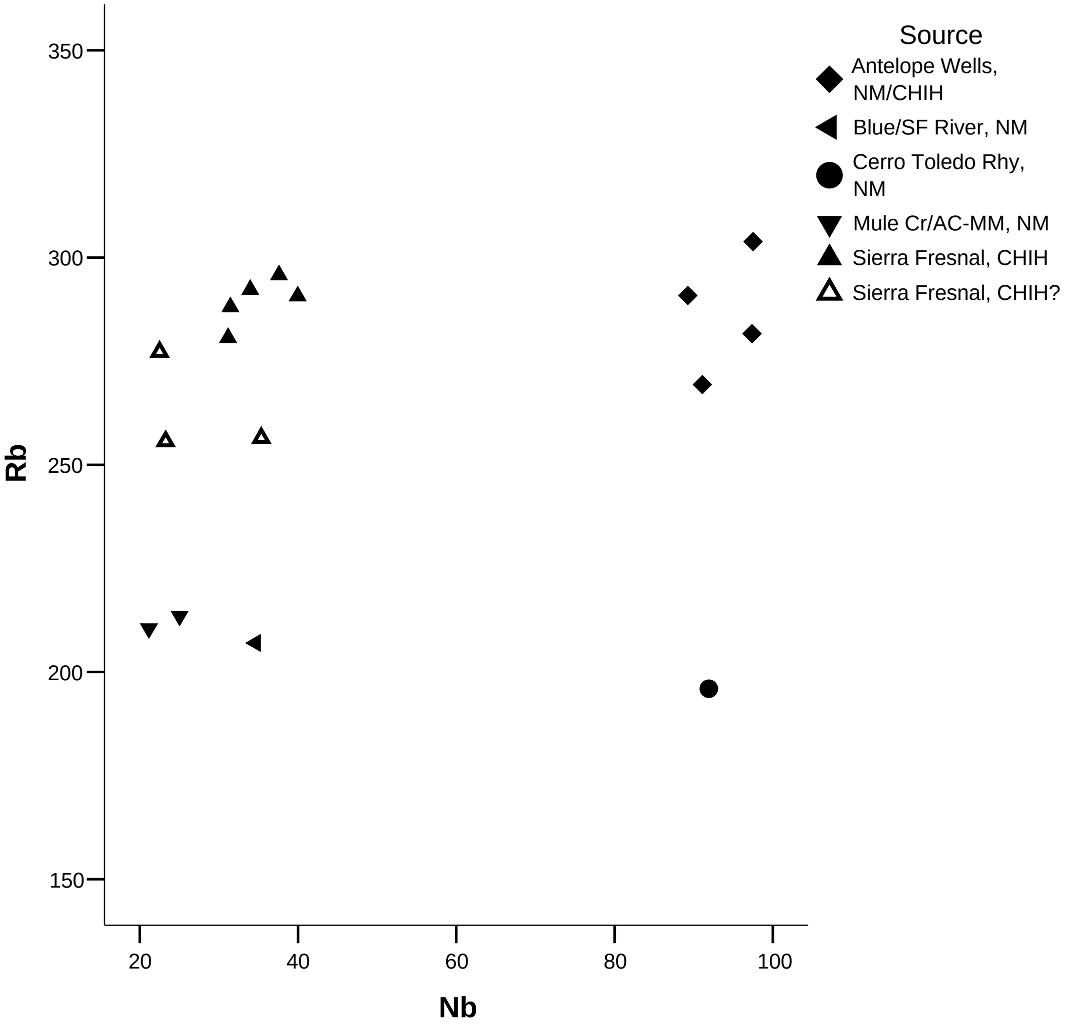

Figure 1. Rb versus Nb plot of the archaeological specimens.

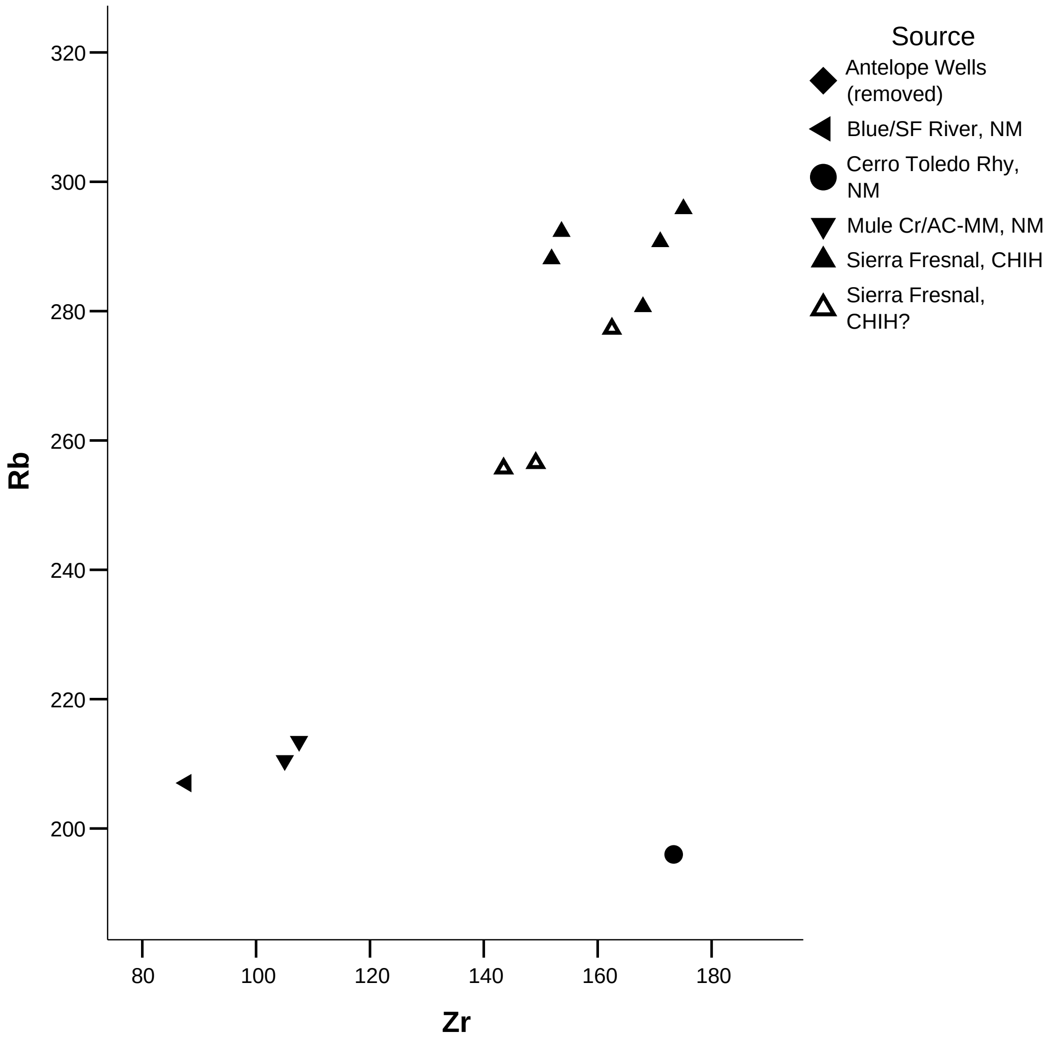

Figure 2. Rb versus Zr biplot of the archaeological specimens with the high Zr Antelope Wells removed for clarity.

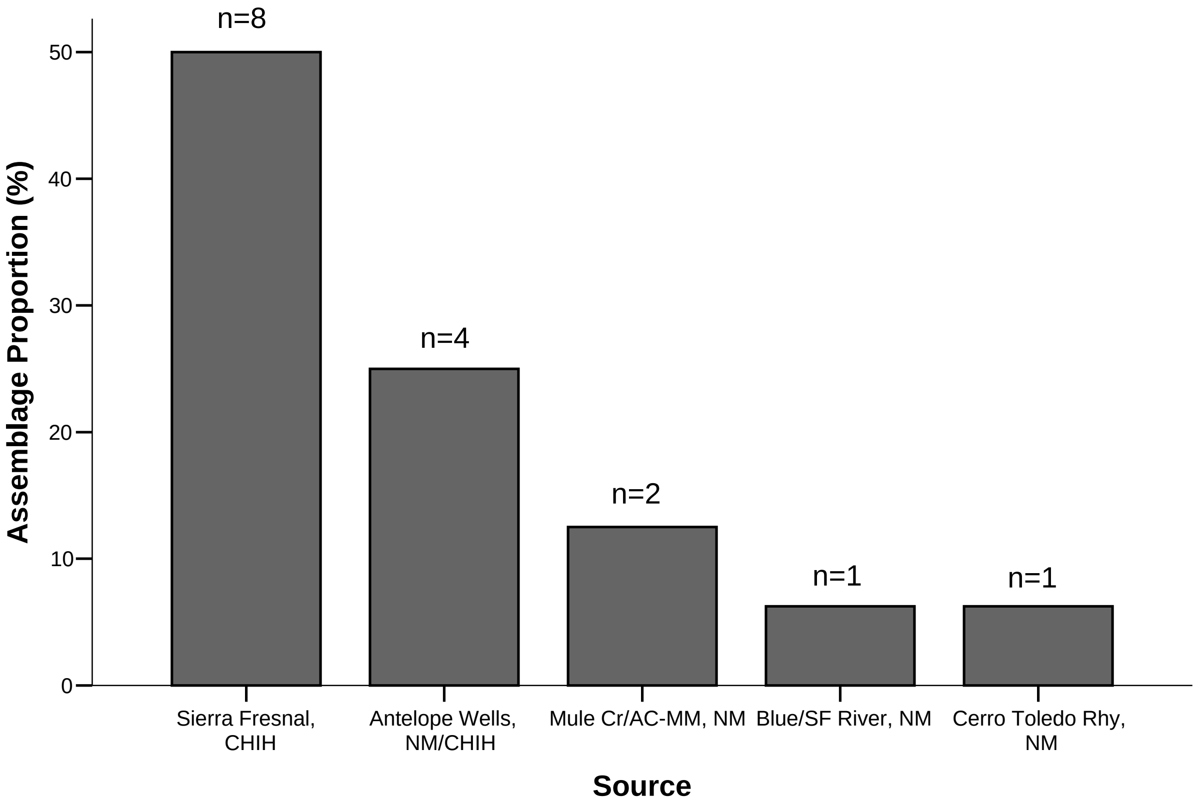

Figure 3. Frequency distribution of obsidian source provenance in the assemblage.