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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM A NUMBER OF SITES IN THE BIG BEND REGION, SOUTHWEST TEXAS

by

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Report Prepared for

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INTRODUCTION

The analysis here of 13 obsidian artifacts from a number of sites in the Big Bend region presents a very diverse source provenance assemblage from northern New Mexico to central Chihuahuan sources, plus a few as yet unlocated sources likely in Chihuahua.

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).

All analyses for this study were conducted on a Thermo Scientific *Quant'X* EDXRF spectrometer, located in the Department of Anthropology, University of California, Berkeley. It is equipped with a thermoelectrically Peltier cooled solid-state Si(Li) X-ray detector, with a 50 kV, 50 W, ultra-high-flux end window bremsstrahlung, Rh target X-ray tube and a 76 μm (3 mil) beryllium (Be) window (air cooled), that runs on a power supply operating 4-50 kV/0.02-1.0 mA at 0.02 increments. The spectrometer is equipped with a 200 l min^{-1} Edwards vacuum pump, allowing for the analysis of lower-atomic-weight elements between sodium (Na) and titanium (Ti). Data acquisition is accomplished with a pulse processor and an analogue-to-digital converter. Elemental composition is identified with digital filter background removal, least squares empirical peak deconvolution, gross peak intensities and net peak intensities above background.

The trace element analyses were performed in the Geoarchaeological XRF Laboratory, Department of Anthropology, University of California, Berkeley, using a Thermo/ARL *Quant'X*

energy dispersive x-ray fluorescence spectrometer. The analysis for mid Zb condition elements Ti-Nb, Pb, Th, the x-ray tube is operated 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 Ka-line data for elements titanium (Ti), manganese (Mn), iron (as Fe_2O_3^T reported elementally), 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 are 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 analyzed in the High Zb condition, the Rh tube is operated at 50 kV and 0.5 mA, 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, 1995, 2005; also Mahood and Stimac 1991; and Hughes and Smith 1993). Specific standards used for the best fit regression calibration for elements Ti- Nb, Pb, Th, and Ba, include G-2 (basalt), AGV-2 (andesite), GSP-1 (granodiorite), SY-2 (syenite), BHVO-2 (hawaiiite), 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-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. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. RGM-1 a USGS obsidian standard is analyzed during each sample run for obsidian artifacts to check machine calibration (Table 1). Source assignments were made by reference to Shackley (1995, 1998, 2005; see Table 1 Figure 1 here), as well as source standard data at Berkeley.

DISCUSSION

While the Lago Barreal source has been known for some time, I have yet to see it in archaeological context. Its presence here is reasonable given that it is the nearest known source other than Rio Grande secondary deposits (Church 2000; Shackley 2005; 2010). Cerro Toledo Rhyolite, the primary source of which is in the Jemez Mountains in northern New Mexico is relatively common in secondary deposits at least as far south as the Las Cruces area (Church 2000; Shackley 2005, 2010). More vexing is the presence of Valles Rhyolite (Cerro del Medio) also from the Jemez Mountains but does not enter the Rio Grande system in any appreciable amount and none have been found over 20 mm in diameter and only as far south as Albuquerque (Shackley 2010). The one sample (CBBS-9) produced from Valles Rhyolite obsidian is about 34.9 mm in length, much greater than the largest yet discovered in the sediments at Tijeras Wash south of Albuquerque (Shackley 2010). Shackley did not recover Valles Rhyolite in the sediments near San Antonito south of Socorro, and Church did not recover any Valles Rhyolite in any of the localities north or south of Las Cruces (Church 2000; Shackley 2010). As seems common in Clovis and Folsom contexts in the Middle Rio Grande Valley however, Valles Rhyolite was a favored raw material imported or directly procured from Valles Caldera. These samples could be a result of the same procurement strategy.

The presence of sources from central and northern Chihuahua in the assemblage (Antelope Wells, Lago Barreal, and the secondary sources at Los Jagüeyes) seems reasonable given the proximity (see Shackley 2005). The two chemical groups that do not match any known sources north or south of the border are likely from somewhere in Chihuahua since so little is known of this area, and “unknown a is compositionally similar to Chihuahuan peralkaline obsidian (Fralick et al. 1998; Shackley 2005; see Figure 1 here).

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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	Zn	Rb	Sr	Y	Zr	Nb	Pb	Th	Source
1	131	982	2690	313	289	8	156	136	120	68	27	Antelope Wells (El Berrendo)
2	150	977	2718	392	283	6	149	130	110	68	27	Antelope Wells (El Berrendo)
3	636	355	8378	66	150	7	44	153	49	26	17	Valles Rhy (Cerro del Medio)
4	162	905	2038	174	268	3	76	652	38	41	34	Lago Barreal
5	839	758	1676	223	288	5	96	719	113	45	29	unknown a
6	666	395	9487	86	160	9	45	173	56	29	23	Valles Rhy (Cerro del Medio)
7	208	861	1899	229	249	4	70	576	37	41	36	Lago Barreal
8	121	590	9639	58	116	30	31	185	13	24	18	unknown b
9	639	409	9245	74	156	8	44	161	53	29	15	Valles Rhy (Cerro del Medio)
10	152	844	1831	175	254	7	74	612	35	38	37	Lago Barreal
11	665	540	1028	166	228	6	64	172	98	43	25	Cerro Toledo Rhy
12	208	140	3775	374	384	6	219	207	163	71	44	Los JagueyesB
13	979	834	1810	209	300	6	98	809	114	48	41	unknown a
RGM1-S4	167	271	1300	34	153	105	27	215	10	28	15	standard

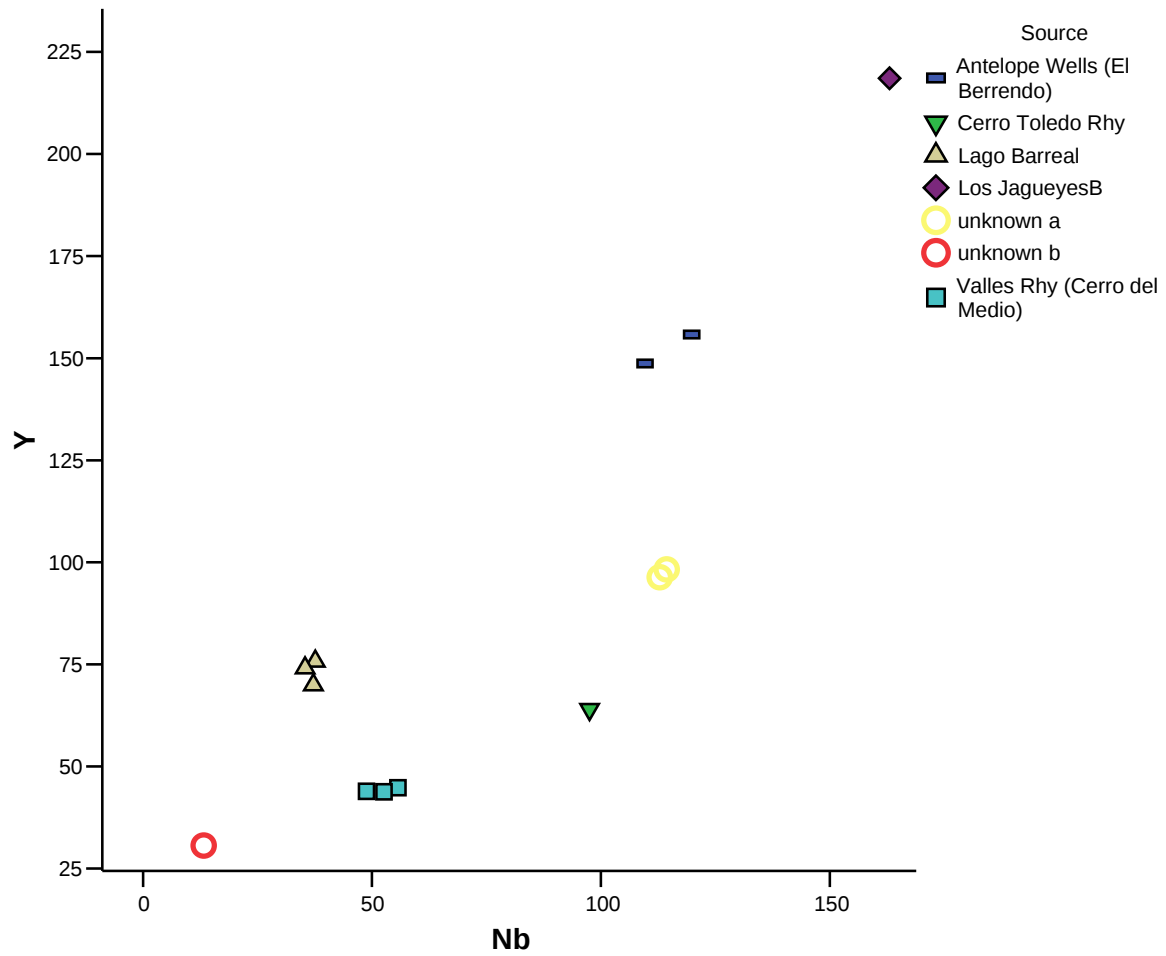


Figure 1. Y versus Nb bivariate plot of the elemental concentrations for the archaeological specimens.