GEOARCHAEOLOGICAL XRF LAB

ARCHAEOLOGICAL X-RAY FLUORESCENCE SPECTROMETRY LABORATORY
8100 WYOMING BLVD., SUITE M4-158 ALBUQUERQUE, NM 87113 USA

SOURCE PROVENANCE OF OBSIDIAN PROJECTILE POINTS FROM MULTIPLE SITES IN THE PORTAL-RODEO AREA OF CENTRAL ARIZONA

by

M. Steven Shackley Ph.D., Director
Geoarchaeological XRF Laboratory

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Dr. Jesse Ballenger
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INTRODUCTION

The analysis here of 20 obsidian artifacts from Archaic and late period projectile points indicates a very diverse procurement assemblage. Sources from Arizona, New Mexico, and northern Mexico are present in the collection.

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; Shackley 2011).

All analyses for this study were conducted on a ThermoScientific *Quant'X* EDXRF spectrometer, located in the Archaeological XRF Laboratory, Albuquerque, New Mexico. 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 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 $Fe_2O_3^T$), 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 quadratic 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 up to 1.0 mA, ratioed to the bremsstrahlung region (see Davis 2011; Shackley 2011). 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). Nineteen specific pressed powder standards are used for the best fit regression calibration for elements Ti-Nb, Pb, Th, and Ba, include G-2 (basalt), AGV-2 (andesite), GSP-2 (granodiorite), SY-2 (syenite), BHVO-2 (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), NOD-A-1 and NOD-P-1 (manganese) all US Geological Survey standards, NIST-278 (obsidian), U.S. National Institute of Standards and Technology, BE-N (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. 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, 2005) and source standard data at this lab (Table 1, and Figure 1).

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Table 1. Elemental concentrations and source assignments for the archaeological specimens, and analysis of USGS RGM-1 obsidian standard. All measurements in parts per million (ppm).

SAMPLE	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Pb	Th	Source
3-1	1562	928	25039	370	2	136	1261	92	39	36	Antelope Wells
5-1	1359	836	22438	357	9	127	1219	89	39	31	Antelope Wells
5-2	546	631	7330	439	4	74	109	116	35	40	N Sawmill Cr (Mule Cr)
5-3	1028	328	10264	310	39	61	171	31	27	37	Sierra Fresnal, CHIH
5-4	772	755	9833	346	1	67	222	43	27	26	SON Unknown A
5-5	1251	840	22634	348	1	127	1205	91	36	35	Antelope Wells
5-6	914	331	9981	295	35	61	167	31	24	38	Sierra Fresnal, CHIH
5-7	1423	868	23321	347	2	122	1186	88	38	35	Antelope Wells
5-8	1281	553	30670	277	5	191	1677	142	46	30	Los Jagueyes, CHIH
5-9	1402	935	24607	355	4	130	1206	87	39	40	Antelope Wells
5-10	1198	913	23605	341	2	124	1173	89	37	45	Antelope Wells
5-11	631	377	8731	243	17	43	117	24	29	31	Antelope Cr (Mule Cr)
5-12	543	381	8467	241	15	37	110	26	28	31	Antelope Cr (Mule Cr)
5-13	595	425	9280	253	16	40	114	26	31	33	Antelope Cr (Mule Cr)
5-14	809	411	8885	252	12	40	109	22	31	33	Antelope Cr (Mule Cr)
5-15	562	391	8102	221	14	39	102	25	30	44	Antelope Cr (Mule Cr)
5-16	1082	459	7483	135	127	17	119	13	23	12	Cow Canyon
5-17	820	773	10164	347	3	73	199	44	29	28	SON Unknown A
5-18	547	384	8333	237	10	38	108	22	31	30	Antelope Cr (Mule Cr)
5-19	1655	926	25033	349	2	121	1102	78	38	33	Antelope Wells
RGM1-S4	1574	303	12993	148	101	28	220	10	24	16	standard

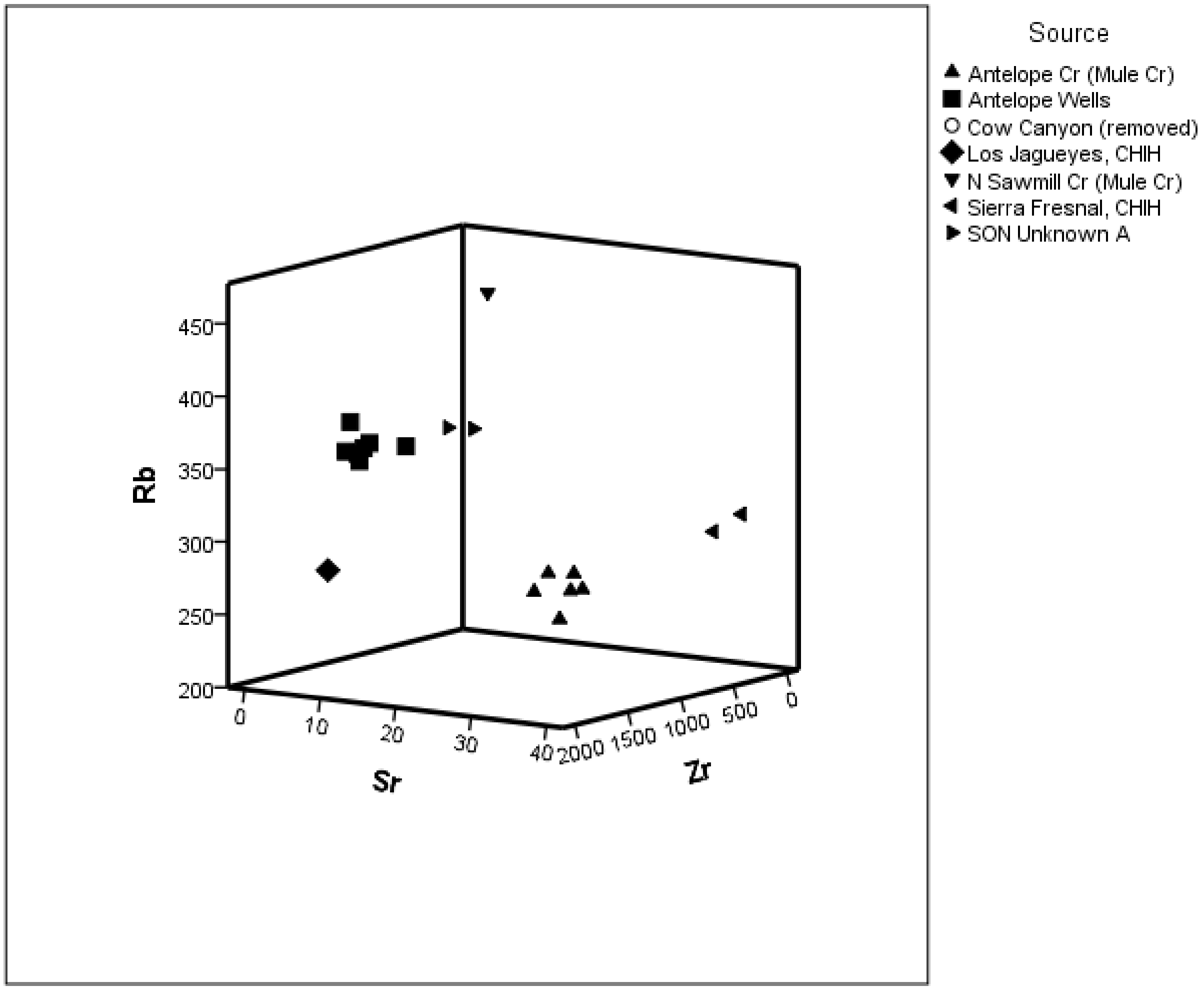

Figure 1. Sr, Rb, Zr three-dimensional plot of the archaeological specimens from the Sally Richards collection. High Sr Cow Canyon removed from the plot to better discriminate. While Antelope Wells and SON Unknown A are nearby in this plot, the 1000 ppm+ Antelope Wells is easily discriminated from this source (see Shackley 2005).