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**SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM 5LP7419, 5LP7420 AND
5LP9541, LA PLATA COUNTY, COLORADO**

by

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Report Prepared for

Woods Canyon Archaeological Consultants
Cortez, Colorado

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INTRODUCTION

The analysis here of 10 obsidian artifacts from three sites in La Plata County, Colorado indicates source provenance of two of the sources in the Jemez Mountains, northern New Mexico. The dominant source is Valles Rhyolite (Cerro del Medio), that was available only in the Valles Caldera proper, and El Rechuelos, a pre-caldera source north of the caldera, and eroding into the Rio Chama and Rio Grande, present only in 5LP7420 (see Shackley 2005: 64-74; Table 1 and Figure 1 here).

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 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 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).

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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).

Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Ba	Pb	Th	Source
5LP7419												
275	116 9	41 3	1130 3	172	15	47	163	55	19	29	20	Valles Rhyolite
187	106 9	35 1	1014 1	152	12	41	157	46	14	21	17	Valles Rhyolite
160	119 0	40 1	1063 3	143	13	36	159	51	49	23	19	Valles Rhyolite
68	982	37 5	1063 5	170	13	42	172	59	<1	26	20	Valles Rhyolite
5LP7420												
60	946	40 5	7758	154	10	21	70	46	24	23	17	El Rechuelos
64	986	42 6	8126	165	14	23	75	49	73	28	19	El Rechuelos
55	108 0	45 5	8158	161	13	25	69	44	72	26	20	El Rechuelos
5LP9541												

31	104 6	38 8	1064 9	159	13	44	158	51	17	25	15	Valles Rhyolite
36	958	35 0	9943	151	11	43	156	54	87	23	23	Valles Rhyolite
45	909	39 1	1048 5	169	12	48	169	56	25	23	15	Valles Rhyolite
RGM1-S4	160 0	26 5	1339 8	150	110	26	220	6	908	22	11	standard

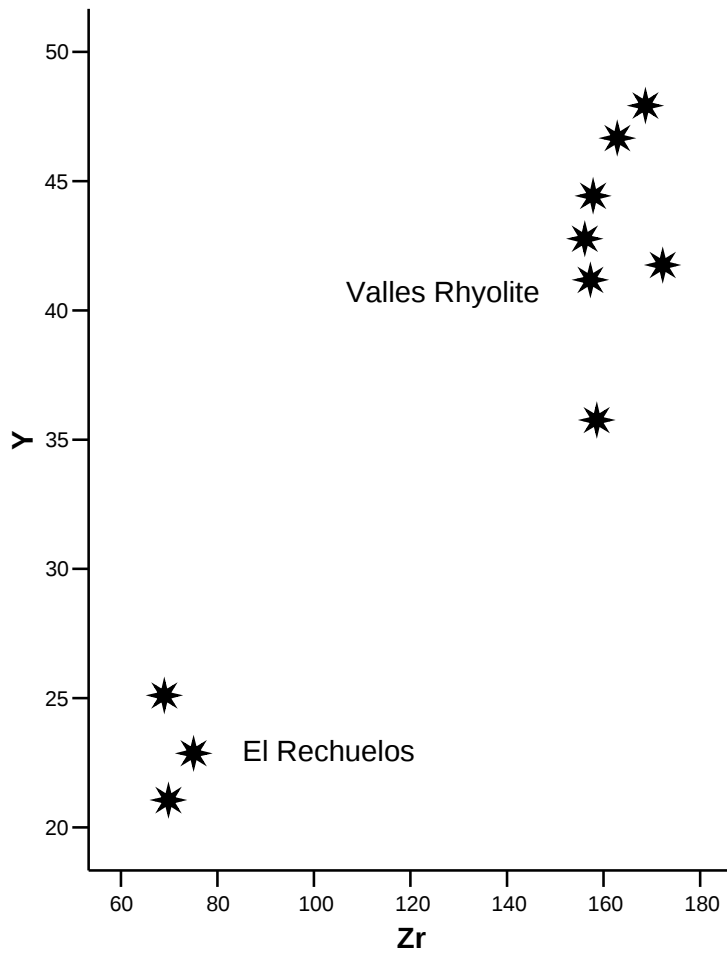


Figure 1. Zr versus Y bivariate plot of the archaeological specimens.