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Author
Shackley, M. Steven

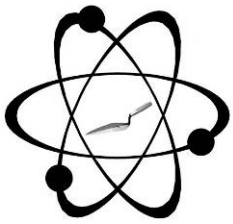
Publication Date
2012-07-25

Supplemental Material
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GEOARCHAEOLOGICAL XRF LAB

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

SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS 5SA57, SAN JUAN COUNTY, COLORADO

by

M. Steven Shackley Ph.D., Director
Geoarchaeological XRF Laboratory
Albuquerque, New Mexico

Report Prepared for

Jon Hedlund
ERO Resources Corporation
Durango, Colorado

25 July 2012

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INTRODUCTION

The analysis here of 15 obsidian artifacts from 5SA57 in San Juan County, Colorado indicates a dominance of Jemez Mountains sources in northern New Mexico, about evenly split between artifacts produced from Valles Rhyolite (Cerro del Medio, n=8), and El Rechulos (n=6). One sample could not be assigned to source, and does not match any source published in western North America, however it is a very small sample and the elemental concentrations may be somewhat skewed. The sample was run twice and barium acquired to aid in source determination (Table 1).

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 the mirror lab of the NSF sponsored Geoarchaeological XRF Laboratory at the 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

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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

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(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 attributions were made using laboratory source data (see also Shackley 2005; Table 1 and 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	Rb	Sr	Y	Zr	Nb	Ba	Source
27	1162	374	10006	149	8	38	141	47		Valles Rhyolite
41	900	386	7380	149	11	20	67	44		El Rechuelos
42	996	438	11079	171	13	46	156	52		Valles Rhyolite
43	896	405	7606	153	12	22	70	45		El Rechuelos
44	1087	447	11332	182	9	44	169	51		Valles Rhyolite
45	927	413	7667	154	10	21	68	45		El Rechuelos
46	1599	447	10489	217	48	18	105	24	5	unknown
47	1375	459	11395	167	13	46	155	50		Valles Rhyolite
48	1157	373	10072	158	9	40	148	50		Valles Rhyolite
49	1346	505	11985	165	13	37	146	46		Valles Rhyolite
50	1041	429	11101	178	10	43	159	51		Valles Rhyolite
51	1070	454	11579	177	11	40	169	52		Valles Rhyolite
52	999	408	7534	151	11	25	65	41		El Rechuelos
53	1454	427	7621	144	12	19	63	40		El Rechuelos
54	969	418	7630	158	13	24	65	46		El Rechuelos
RGM1-S4	1661	307	13301	145	105	24	220	7		standard
RGM1-S4	1539	293	13377	146	106	22	211	12	834	standard

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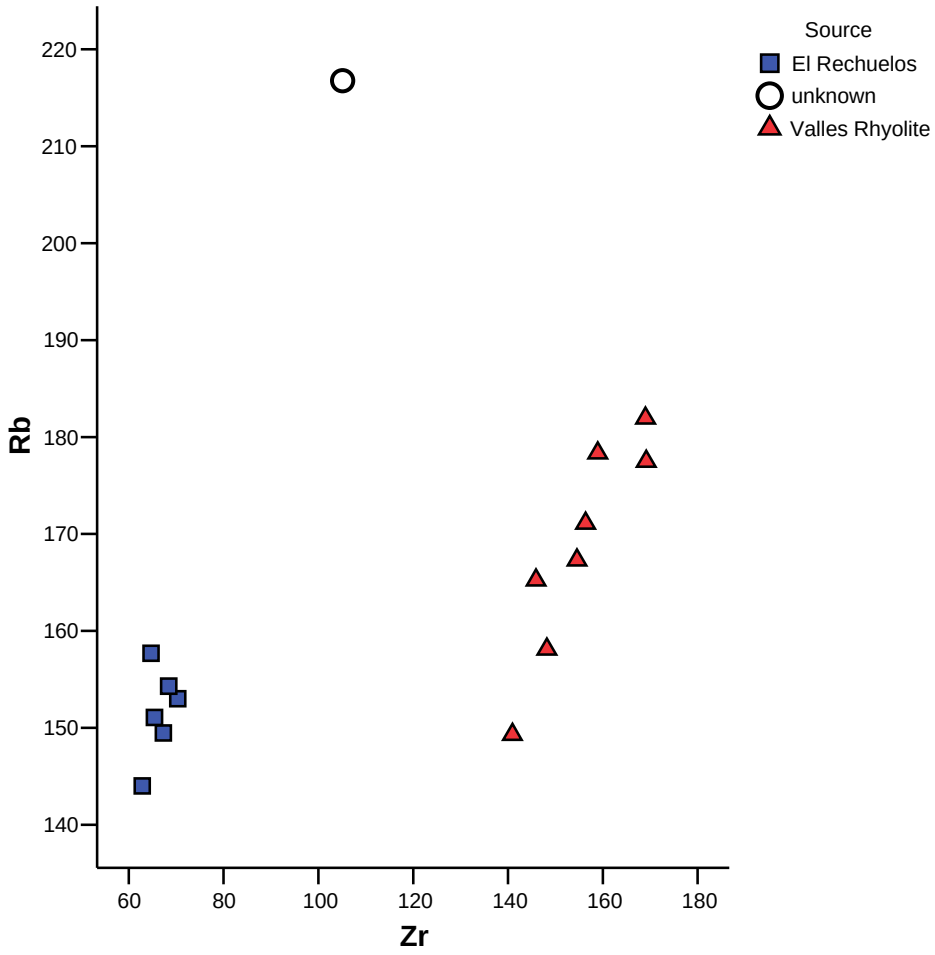


Figure 2. Zr versus Rb bivariate plot of the elemental concentrations for all the archaeological specimens.