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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM ARCHAEOLOGICAL CONTEXTS IN CENTRAL AND NORTHERN WYOMING

by

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INTRODUCTION

The analysis here of 8 obsidian artifacts from three sites in Wyoming exhibits a diverse provenance assemblage with artifacts produced from sources in Idaho and Wyoming. One sample does not match any known source in the laboratory database that includes sources from all the mountain states, the greater North American Southwest, and Alta and Baja California, approximately 200 known sources.

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 Geoarchaeological 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 $\mathrm{l\ min^{-1}}$ 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 100 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 JMP 12.0.1 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 updated at http://swxrflab.net/swobsrcs.htm, and the Skinner/Shackley North American database; see Table 1 and Figure 1.

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

SAMPLE	SITE	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Ba	Pb	Th	SOURCE
P7	GC 2019-S3	827	242	10746	250	12	74	177	49	5	33	32	Obsidian Cliff, WY
P8	GC 2019-S3	867	270	11151	257	11	77	183	46	0	37	44	Obsidian Cliff, WY
P9	GC 2019-S6	1157	254	9485	121	74	36	90	19	1965	29	25	Malad, Oneida Co., ID
P10	GC 2019-S6	1269	264	9784	124	73	34	96	22	1917	25	23	Malad, Oneida Co., ID
P11	GC 2019-S6	1056	252	9369	120	79	34	95	13	1999	25	14	Malad, Oneida Co., ID
P103	LRC 32	764	641	6999	257	9	53	83	91	0	34	29	Toy Pass A, Owyhee Co., ID
P108	LRC 32	1084	246	10906	233	9	72	166	41	69	30	24	Obsidian Cliff, WY
P109	LRC 32	1237	380	9497	205	46	24	134	24	202	33	18	unknown
RGM1-S4		1543	300	13113	147	104	26	215	11	834	21	18	standard

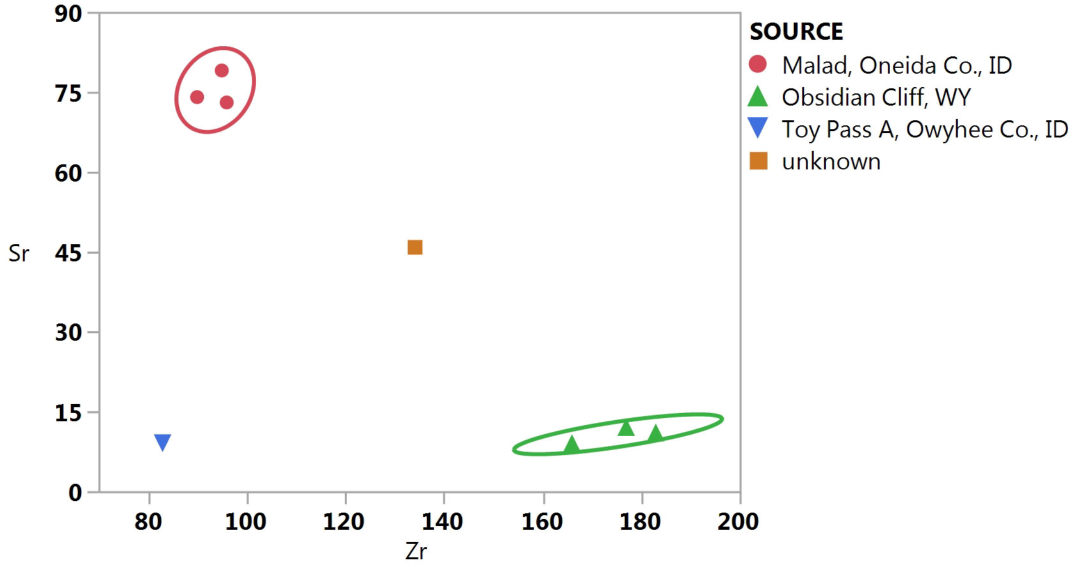

Figure 1. Zr/Sr bivariate plot of the archaeological specimens. Confidence ellipses at 95%.