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Publication Date

2010-12-15

Supplemental Material

<https://escholarship.org/uc/item/2hp703vc#supplemental>

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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM YAV-3, YAVAPAI- PRESCOTT INDIAN TRIBAL LAND, PRESCOTT, ARIZONA

by

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Report Prepared for

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15 December 2010

INTRODUCTION

The analysis here of 21 obsidian artifacts from YAV-3 indicates a very diverse obsidian provenance assemblage dominated by artifacts produced from obsidian sources in the regional Mount Floyd and San Francisco Volcanic Fields. Additionally, one sample was from the Vulture source to the south in the Sonoran Desert.

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).

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All analyses for this study were conducted on a ThermoScientific *Quant'X* EDXRF spectrometer, located in the Archaeological XRF Laboratory, El Cerrito, California. 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 2010; Shackley 2010a). 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, 1998, 2005; see Tables 1 and 2 and Figure 1 here), as well as source standard data at this lab.

DISCUSSION

The procurement of obsidian for the production of these artifacts from regional sources seems reasonable. The diversity of sources from Presley Wash in the Mount Floyd Volcanic Field relatively nearby, and Government Mountain and RS Hill/Sitgreaves in the San Francisco Volcanic Field to the northeast, and the one artifact produced from Vulture to the south is unusual compared to the previous study at YAV-77 which was dominated by RS Hill/Sitgreaves obsidian (Shackley 2010b; Tables 1 and 2 here). The one piece of debitage produced from Vulture obsidian, while uncommon, was also found in the YAV-77 collection. The source is only about 100 km southeast of YAV-3 (see recent discussion of Vulture at <http://swxrflab.net/vulture.htm>).

The Presley Wash glassy rhyolite has been called by a number of names including obsidian, rhyodacite, dacite, glassy basalt, as well as others (see Lesko 1986, 1989; Shackley 2005). A recent major oxide analysis and alkali/silica plot indicates that while the trace element composition is somewhat unusual with low Rb and high Sr values, it is certainly a high-silica rhyolite not unlike the Partridge Creek obsidian from Round Mountain with very different trace element composition (see Table 3 and Figure 2 here). There is no compositional difference between the gray and green varieties at the Presley Wash source, as seen in this collection (Figure 1).

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

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
1	829	512	9765	106	82	20	80	53	Government Mtn
2	3249	415	22744	71	238	13	138	21	Presley Wash
3	836	505	9667	103	79	21	74	54	Government Mtn
27	724	406	10207	384	8	84	159	248	RS Hill/Sitgreaves Pk
48	857	530	9640	109	79	19	78	55	Government Mtn
80	1804	298	14022	86	183	13	135	17	Presley Wash
145	838	414	10330	396	10	90	162	255	RS Hill/Sitgreaves Pk
171	1050	517	10713	106	80	17	79	56	Government Mtn
176	2320	387	18253	86	211	14	132	19	Presley Wash
230	880	479	9542	104	79	18	74	51	Government Mtn
390	930	487	10394	107	81	20	80	54	Government Mtn
428	873	454	9689	107	81	18	77	53	Government Mtn
524	820	471	9057	105	80	19	78	52	Government Mtn
535	732	417	10404	398	8	89	162	255	RS Hill/Sitgreaves Pk
584	842	493	9342	101	75	21	75	48	Government Mtn
604	906	430	10974	389	9	85	162	251	RS Hill/Sitgreaves Pk
709	791	554	9977	111	82	21	79	54	Government Mtn
749	859	505	9435	106	74	18	73	48	Government Mtn
750	770	506	9609	106	80	19	76	53	Government Mtn
544A	3293	371	23279	80	244	14	136	22	Presley Wash
544B	1257	418	9121	147	41	21	133	25	Vulture
RGM1-S4	1625	278	13158	149	107	24	220	8	standard
RGM1-S4	1625	301	13140	148	108	24	218	11	standard

Table 2. Frequency distribution of obsidian source provenance at YAV-3.

		Frequency	Percent
Source	Government Mtn	12	57.1
	RS Hill/Sitgreaves Pk	4	19.0
	Presley Wash	4	19.0
	Vulture	1	4.8
	Total	21	100.0

Table 3. Major oxide analysis of one sample of the gray Presley Wash glass and the RGM-1 USGS obsidian standard.

Sample	SiO ₂	Al ₂ O ₃	CaO	Fe ₂ O ₃	K ₂ O	MgO	MnO	Na ₂ O	TiO ₂
<u>Presley Wash</u>									
PW-2-1	75.100	12.485	1.6251	1.7508	4.606	0.391	0.0402	3.62	0.228
RGM1-S4	75.680	12.477	1.3024	1.806	4.550	<.001	0.0379	3.77	0.196

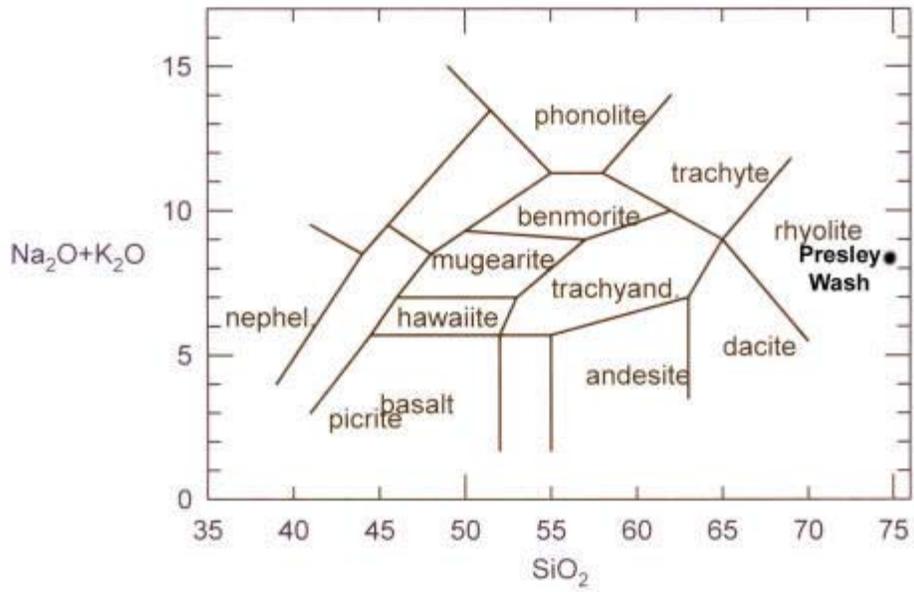


Figure 2. Alkali/silica plot of the Presley Wash sample from Table 2.