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Publication Date
2011-08-13

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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM THE SPRINGS RESERVE, LAS VEGAS, NEVADA

by

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Report Prepared for

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Las Vegas, Nevada

13 August 2011

INTRODUCTION

The analysis here of 18 volcanic rocks, mostly obsidian, indicates a very diverse assemblage with sources from western Utah, southern Nevada, and eastern California. This could represent shifts in procurement through time.

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).

The trace element analyses were performed in the NSF Geoarchaeological XRF Laboratory, Department of Anthropology, University of California, Berkeley, using a Thermo Scientific *Quant'X* energy dispersive x-ray fluorescence spectrometer. The spectrometer is equipped with a ultra-high flux peltier air cooled Rh x-ray target with a 125 micron beryllium (Be) window, an x-ray generator that operates from 4-50 kV/0.02-1.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTrace™ 4.1 reduction software. The spectrometer is equipped with a 2001 min^{-1} Edwards vacuum pump for the analysis of elements below titanium (Ti). Data is acquired through a pulse processor and analog to digital converter. This is a significant improvement in analytical speed and efficiency beyond the former Spectrace 5000 and *QuanX* analog systems (see Davis et al. 2011; Shackley 2005).

For Ti-Nb, Pb, Th elements the mid-Zb condition is used operating the x-ray tube 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 $K\alpha_1$-line data for elements titanium (Ti), manganese (Mn), iron (as Fe^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 is 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 acquired, the Rh tube is operated at 50 kV and 0.5 mA in an air path at 200 seconds livetime to generate x-ray intensity $K\alpha_1$-line data, through a 0.630 mm Cu (thick) filter ratioed to the bremsstrahlung region (see Davis et al. 2011). Further details concerning the petrological choice of these elements in North American obsidians is available in Shackley (1988, 1990, 2005; also Mahood and Stimac 1991; and Hughes and Smith 1993). A suite of 17 specific standards used for the best fit regression calibration for elements Ti- Nb, Pb, and Th, 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), BCR-2 (basalt), TLM-1 (tonalite), SCO-1 (shale), all US Geological Survey standards, NBS-278 (obsidian) from the National Institute of Standards and Technology, BR-1 (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 and into SPSS for statistical manipulation (see Figures 1 and 2). In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run (Table 1). RGM-2 is analyzed during each sample run for obsidian artifacts to check machine calibration (Table 1). Obsidian source investigation made by reference to source data at Berkeley including Shackley (1994), Hughes (1988), Nelson (1984), and Haarklau et al. (2005).

DISCUSSION

While the obsidian sources present in the assemblage are generally from sources nearest to Las Vegas, there are some exceptions (Figure 3). The raw material used to produce these artifacts were from sources to the east, north and west (Figure 3). Interestingly, the nearest source, Devil Peak in the Spring Mountains just to the west, was present in only small numbers (Tables 1 and 2).

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Table 1. Minor and trace element analysis of archaeological samples. All measurements in parts per million (ppm).

Site/Sample	Mn	Fe	Zn	Rb	Sr	Y	Zr	Nb	Pb	Th	Source
29CK948											
4	525	11246	85	186	260	29	158	22	37	23	Devil Pk W, NV
6	490	9113	90	191	102	30	100	19	38	22	Devil Pk E, NV
16	1004	195132	159	4	21	12	23	1	339	0	not obsidian
165	362	8825	42	199	8	32	107	25	26	26	Mono Craters, CA
172A	286	11326	68	199	43	38	152	21	25	29	Kane Springs Wash Caldera 2, NV
190	366	9145	48	199	9	33	107	28	26	25	Mono Craters, CA
249	387	13664	170	231	85	27	210	28	31	31	Shoshone Mtn, NV
1990-1-7	153	6127	67	0	14	4	25	1	11	1	not obsidian
29CK949											
2	363	9017	54	196	7	31	109	27	26	30	Mono Craters, CA
13	441	9954	62	221	8	33	112	28	28	27	W Sugarloaf, Coso, CA
15	333	13257	114	226	48	42	153	30	29	29	Kane Springs Wash Caldera 2, NV
141	276	12086	113	198	17	46	187	37	28	27	Kane Springs Wash Caldera 1, NV
Nonsite											
4-17	270	11897	86	197	19	49	179	38	29	27	Kane Springs Wash Caldera 1, NV
18	263	11851	87	220	42	37	153	28	26	29	Kane Springs Wash Caldera 2, NV
19	324	10220	78	214	81	30	122	23	33	33	Panaca Summit, Modena Area, UT
20	271	11410	66	190	17	56	182	33	26	21	Kane Springs Wash Caldera 1, NV
21	284	8201	54	0	23	2	17	1	50	7	not obsidian
22	259	10014	52	160	37	33	138	24	24	22	Saline Range 2, CA
RGM-2	295	13753	46	150	107	24	216	8	24	23	standard

Table 2. Crosstabulation of site by source.

			Site			
			29CK948	29CK949	Nonsite	Total
Source		Count	1	1	1	3
		% within Source	33.3%	33.3%	33.3%	100.0%
		% within Site/Sample	14.3%	20.0%	16.7%	16.7%
		% of Total	5.6%	5.6%	5.6%	16.7%
	Devil Pk E, NV	Count	1	0	0	1
		% within Source	100.0%	.0%	.0%	100.0%
		% within Site/Sample	14.3%	.0%	.0%	5.6%
		% of Total	5.6%	.0%	.0%	5.6%
	Devil Pk W, NV	Count	1	0	0	1
		% within Source	100.0%	.0%	.0%	100.0%
		% within Site/Sample	14.3%	.0%	.0%	5.6%
		% of Total	5.6%	.0%	.0%	5.6%
	Kane Springs Wash Caldera 1, NV	Count	0	1	2	3
		% within Source	.0%	33.3%	66.7%	100.0%
		% within Site/Sample	.0%	20.0%	33.3%	16.7%
		% of Total	.0%	5.6%	11.1%	16.7%
	Kane Springs Wash Caldera 2, NV	Count	1	1	1	3
		% within Source	33.3%	33.3%	33.3%	100.0%
		% within Site/Sample	14.3%	20.0%	16.7%	16.7%
		% of Total	5.6%	5.6%	5.6%	16.7%
	Mono Craters, CA	Count	2	1	0	3
		% within Source	66.7%	33.3%	.0%	100.0%
		% within Site/Sample	28.6%	20.0%	.0%	16.7%
		% of Total	11.1%	5.6%	.0%	16.7%
	Panaca Summit, Modena Area, UT	Count	0	0	1	1
		% within Source	.0%	.0%	100.0%	100.0%
		% within Site/Sample	.0%	.0%	16.7%	5.6%
		% of Total	.0%	.0%	5.6%	5.6%
	Saline Range 2, CA	Count	0	0	1	1
		% within Source	.0%	.0%	100.0%	100.0%
		% within Site/Sample	.0%	.0%	16.7%	5.6%
		% of Total	.0%	.0%	5.6%	5.6%
	Shoshone Mtn, NV	Count	1	0	0	1
		% within Source	100.0%	.0%	.0%	100.0%
		% within Site/Sample	14.3%	.0%	.0%	5.6%
		% of Total	5.6%	.0%	.0%	5.6%
	W Sugarloaf, Coso, CA	Count	0	1	0	1
		% within Source	.0%	100.0%	.0%	100.0%
		% within Site/Sample	.0%	20.0%	.0%	5.6%
		% of Total	.0%	5.6%	.0%	5.6%
Total		Count	7	5	6	18
		% within Source	38.9%	27.8%	33.3%	100.0%
		% within Site/Sample	100.0%	100.0%	100.0%	100.0%
		% of Total	38.9%	27.8%	33.3%	100.0%

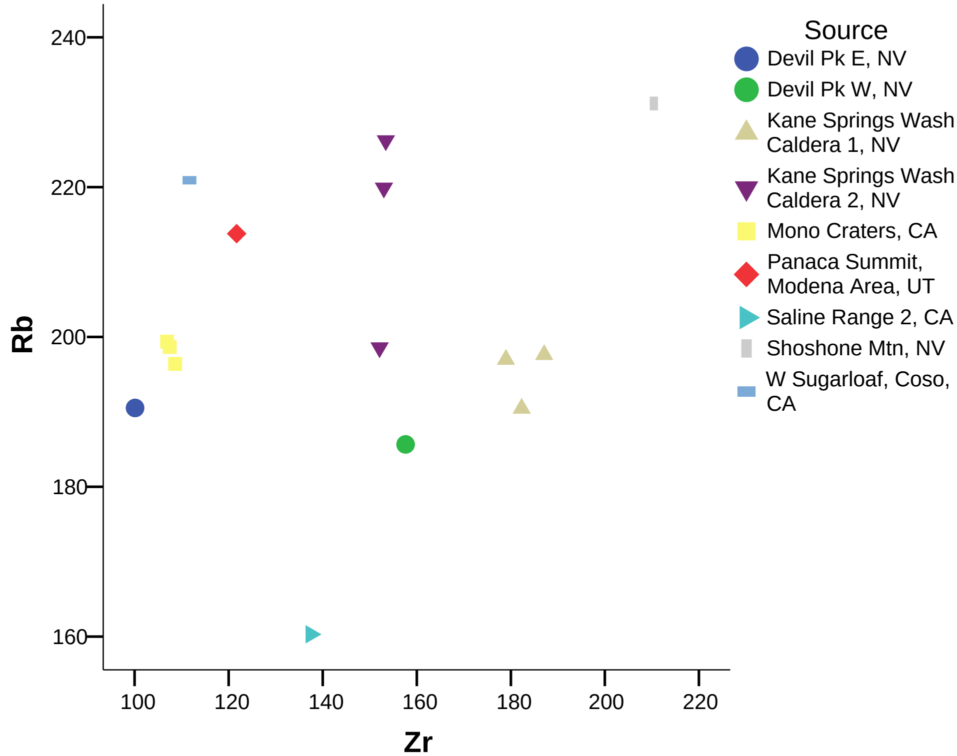

Figure 1. Zr versus Rb bivariate plot of archaeological specimens.

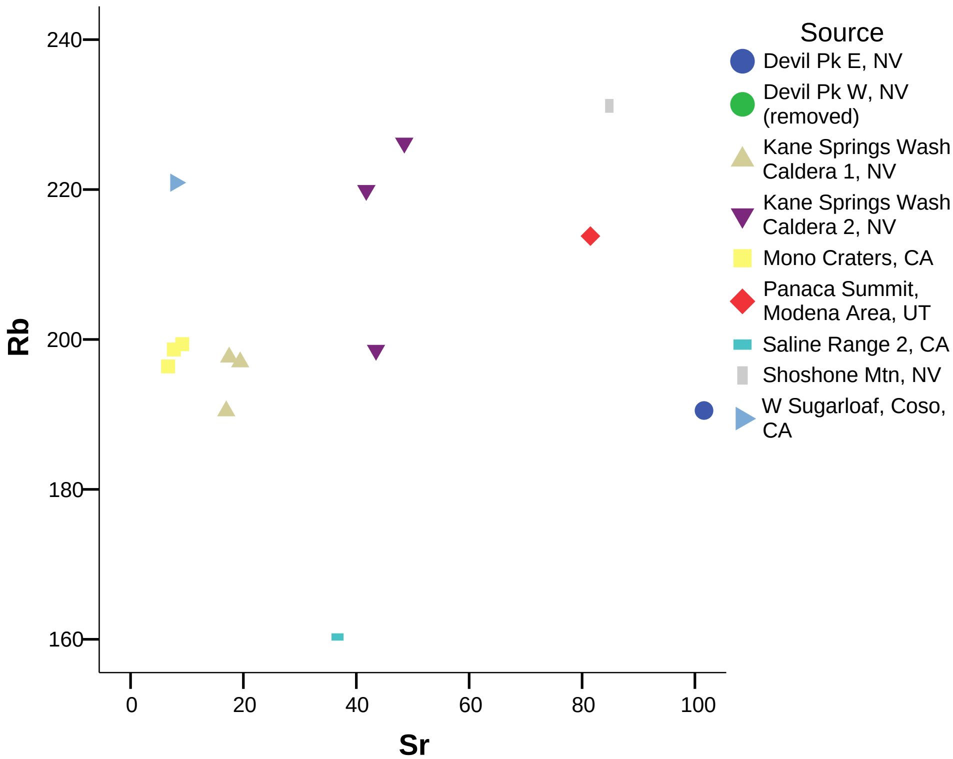

Figure 2. Sr versus Rb bivariate plot of archaeological specimens.

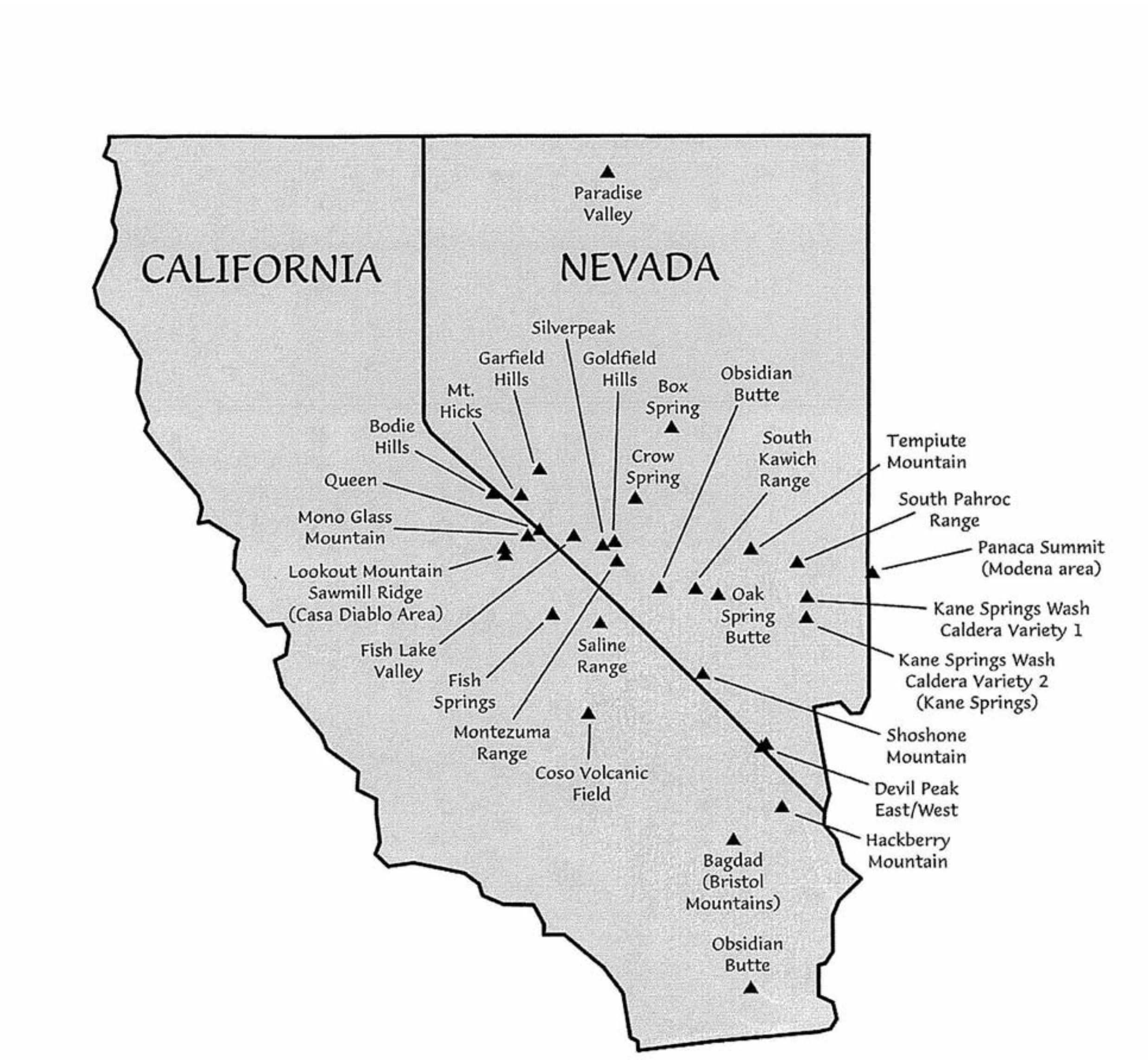

Figure 3. Selected obsidian sources in California and Nevada (from Haarklau et al. 2005:D-4).