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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM FIVE SITES IN ORANGE COUNTY, CALIFORNIA

by

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Report Prepared for

Stantec Consulting Irvine, California

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INTRODUCTION

The analysis here includes 50 artifacts from various period sites in Orange County, California. The dominance of obsidian from the Coso Volcanic Field in Inyo County, California argues for a strong Archaic presence in the sites.

LABORATORY SAMPLING, ANALYSIS AND INSTRUMENTATION ANALYSIS AND INSTRUMENTATION

This assemblage was analyzed on a Spectrace/Thermo *QuanX* energy-dispersive x-ray spectrometer at the Archaeological XRF Laboratory, Department of Earth and Planetary Sciences at the University of California, Berkeley.

All samples were analyzed whole with little or no formal preparation. 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 spectrometer is equipped with an electronically cooled Cu x-ray target with a 125 micron Be window, an x-ray generator that operates from 4-50 kV/0.02-2.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTraceTM reduction software. The x-ray tube is operated at 30 kV, 0.14 mA, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity K α -line data for elements titanium (Ti), manganese (Mn), iron (as Fe^T), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), and thorium (Th). Weight percent iron (Fe₂O₃^T) can be derived by multiplying ppm estimates by 1.4297(10-4). Trace element intensities were converted to concentration

estimates by employing a least-squares calibration line 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). Further details concerning the petrological choice of these elements in Southwest obsidians is available in Shackley (1992, 1995, 2005; also Mahood and Stimac 1991; and Hughes and Smith 1993). Specific standards used for the best fit regression calibration for elements Ti through Nb include G-2 (basalt), AGV-1 (andesite), GSP-1, SY-2 (syenite), BHVO-1 (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), all US Geological Survey standards, JR-1 and JR-2 (rhyolite) from the Geological Survey of Japan, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). In addition to the reported values here, Ni, Cu, Zn, and Ga were measured, but these are rarely useful in discriminating glass sources and are not generally reported.

The data from both systems 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. Multiple analyses of RGM-1 are included in Table 1. Source references come from Ericson and Glascock (2004), Haarklau et al. (2005), Hughes (1988), Jack (1976), and source data at Berkeley. Further information on the laboratory instrumentation can be found at: http://www.swxrflab.net/ and Shackley (1998). Trace element data exhibited in Table 1 are reported in parts per million (ppm), a quantitative measure by weight (see also Figures 1 and 2).

SUMMARY AND CONCLUSIONS

Recently, a number of scholars have argued over the utility of separating the various obsidian producing domes in the Coso Volcanic Field (Ericson and Glascock 2004; Gilreath and Hildebrandt 1997; Hughes 1988). While there appears to be some differential procurement of some of the domes through time, the small samples sizes in this collection make discrimination at Coso difficult. It was not attempted for that reason.

Although the assemblage is dominated by eastern Sierra sources (Coso and Casa Diablo), three samples were from Obsidian Butte in Imperial County, California. Obsidian Butte is most common in late period sites in Orange and San Diego Counties (Ericson and Glascock 2004; Hughes and True 1985).

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Table 1. Elemental concentrations and source assignments for the archaeological specimens.

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762-5011 3825 14300 11598 7 195 21 299 15 not obsidian										
	102-5011	3825	14300	11598	(195	21	299	15	not odsiđian

762-5012	3759	10318	36335	14	192	10	206	0	not obsidian
762-5018	3184	10849	17014	15	157	12	133	9	not obsidian
RGM1S3	1628	302	13260	147	105	24	219	3	standard
Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
RGM-1S3	1563	335	13398	153	114	22	217	13	standard
RGM1-S3	1599	307	13289	154	112	22	221	0	standard

* and ?: These samples are slightly outside the range of elemental concentrations, mainly due to small sample sizes (see Davis et al. 1998).

Table 2. Crosstabulation of obsidian source provenance by site.

			1297	1311	244	650	762	Total
Source	Casa Diablo	Count	0	0	1	0	0	1
		% within Source	.0%	.0%	100.0%	.0%	.0%	100.0%
		% within Site/Sample	.0%	.0%	3.0%	.0%	.0%	2.2%
		% of Total	.0%	.0%	2.2%	.0%	.0%	2.2%
	Coso	Count	1	1	28	7	3	40
		% within Source	2.5%	2.5%	70.0%	17.5%	7.5%	100.0%
		% within Site/Sample	100.0%	100.0%	84.8%	100.0%	100.0%	88.9%
		% of Total	2.2%	2.2%	62.2%	15.6%	6.7%	88.9%
	Obsidian Butte, CA	Count	0	0	3	0	0	3
		% within Source	.0%	.0%	100.0%	.0%	.0%	100.0%
		% within Site/Sample	.0%	.0%	9.1%	.0%	.0%	6.7%
		% of Total	.0%	.0%	6.7%	.0%	.0%	6.7%
	unknown	Count	0	0	1	0	0	1
		% within Source	.0%	.0%	100.0%	.0%	.0%	100.0%
		% within Site/Sample	.0%	.0%	3.0%	.0%	.0%	2.2%
		% of Total	.0%	.0%	2.2%	.0%	.0%	2.2%
Total		Count	1	1	33	7	3	45
		% within Source	2.2%	2.2%	73.3%	15.6%	6.7%	100.0%
		% within Site/Sample	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	2.2%	2.2%	73.3%	15.6%	6.7%	100.0%

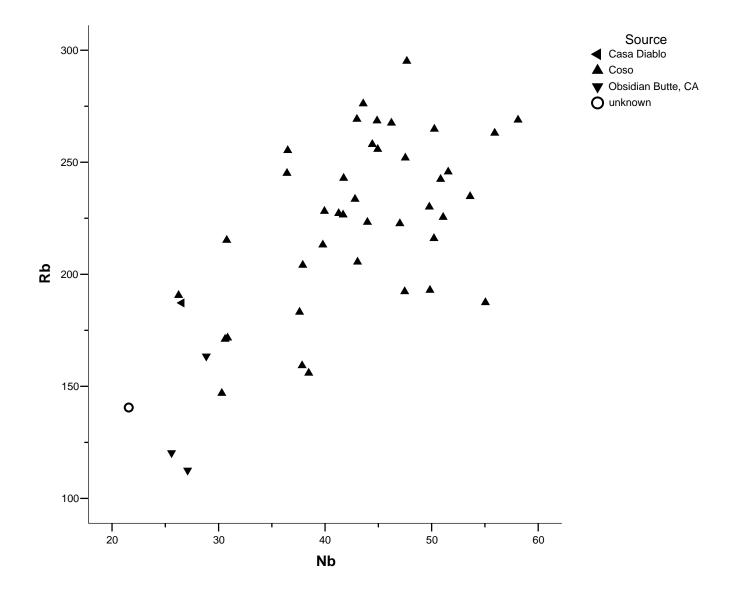


Figure 1. Rb versus Nb plot of the elemental concentrations for the archaeological specimens.

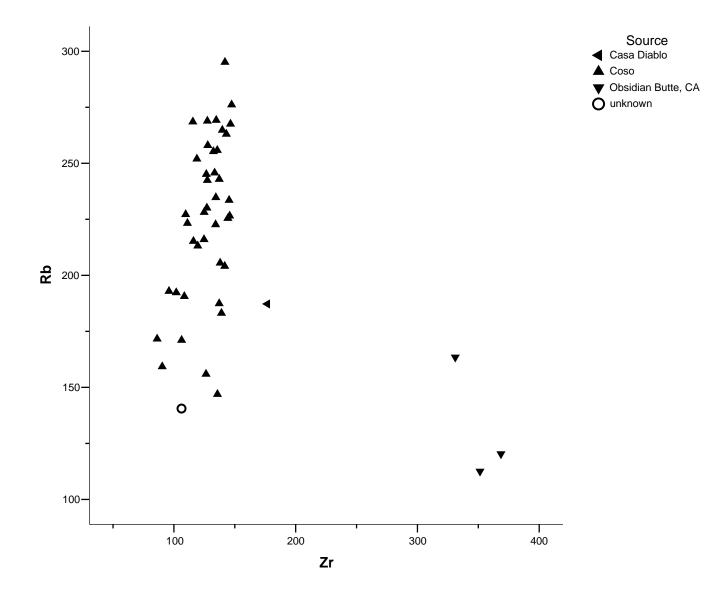


Figure 2. Rb versus Zr plot of archaeological specimens, more effectively separating Casa Diablo.