Title
Source Provenance of Obsidian Artifacts from Shady Canyon Archaeological Project Sites, Orange County, California

Author
Shackley, M. Steven

Publication Date
2002-08-23

Phoebe Hearst Museum of Anthropology
103 Kroeber Hall
University of California
Berkeley, CA 94720-3712

SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM SHADY CANYON ARCHAEOLOGICAL PROJECT SITES, ORANGE COUNTY, CALIFORNIA

by

M. Steven Shackley, Ph.D.
Archaeological XRF Laboratory
Phoebe Hearst Museum of Anthropology
University of California, Berkeley

Report Prepared for

Christopher Drover, Ph.D.
The Keith Companies,
Costa Mesa, California

23 August 2002

INTRODUCTION

The analysis here of 32 obsidian artifacts from eight sites in Orange County exhibits a mix of source provenance typical for this part of southern California with Obsidian Butte and Coso nearly equally represented in the assemblage. Whether the difference in procurement is due to shifts in procurement from the Archaic to Late Prehistoric is not evident with the data available. Four of the samples were determined to be too small for analysis (see Davis et al. 1998).

LABORATORY SAMPLING, ANALYSIS AND INSTRUMENTATION

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 trace element analyses were performed in the Department of Geology and Geophysics, University of California, Berkeley, using a Philips PW 2400 wavelength x-ray fluorescence spectrometer using a LiF 200 crystal for all measurements. This crystal spectrometer uses specific software written by Philips (SuperQ/quantitative) and modifies the instrument settings between elements of interest. Practical detection limits have not been calculated for this new instrument, but should be available later this year. Sample selection is automated and controlled by the Philips software. X-ray intensity Kα-line data with the scintillation counter were measured for elements rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). X-ray intensities for barium (Ba) were measured with the flow counter from the Lα-line. 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). Specific standards used for the best fit regression calibration for elements Ti through Nb include G-2 (basalt), AGV-1 (andesite), GSP-1 and SY-2 (syenite), BHVO-1 (hawaiite), STM-1 (syenite), QLM-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, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994).

The data from the SuperQ software were translated directly into Excel™ for Windows software. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. An analysis of RGM-1 is included in Table 1. Source nomenclature and assignments follow Hughes (1986, 1988), and the source standards at Berkeley (http://obsidian.pahma.berkeley.edu/obsbutte.htm). Further information on the laboratory instrumentation can be found on the World Wide Web at: http://obsidian.pahma.berkeley.edu/ and Shackley (1998). Trace element data exhibited in Table 1 and Figure 1 are reported in parts per million (ppm), a quantitative measure by weight.

DISCUSSION

Taken overall with this relatively small sample, the distribution of the two source groups is nearly equal (Table 2). Obsidian Butte comprises 59.4% of the assemblage and the Coso sources 40.6%. The distribution seems close to typical for southern California, although there is some evidence that Coso was preferred during the Archaic, while Obsidian Butte was procured most commonly during the Late Prehistoric period (Hughes and True 1985). Again, while the sample size is small, differences in the distribution of the two sources in these sites may be due to temporal issues.

REFERENCES CITED

Davis, M.K., T.L. Jackson, M.S. Shackley, T. Teague, and J.H. Hampel
1998 Factors Affecting the Energy-Dispersive X-Ray Fluorescence (EDXRF) Analysis of Archaeological Obsidian. In *Archaeological Obsidian Studies: Method and Theory*, edited by M.S. Shackley, pp. 159-180. Kluwer-Plenum Press, New York.

Govindaraju, K.
1994 1994 Compilation of Working Values and Sample Description for 383 Geostandards. *Geostandards Newsletter* 18 (special issue).

Hampel, Joachim H.
1984 Technical Considerations in X-ray Fluorescence Analysis of Obsidian. In *Obsidian Studies in the Great Basin*, edited by R.E. Hughes, pp. 21-25. Contributions of the University of California Archaeological Research Facility 45. Berkeley.

Hildreth, W.
1981 Gradients in Silicic Magma Chambers: Implications for Lithospheric Magmatism. *Journal of Geophysical Research* 86:10153-10192.

Hughes, Richard E.
1986 Trace Element Composition of Obsidian Butte, Imperial County, California. *Bulletin of the Southern California Academy of Science* 85:35-45.

1988 The Coso Volcanic Field Reexamined: Implications for Obsidian Sourcing and Hydration Dating Research. *Geoarchaeology* 3:253-265.

Hughes, Richard E., and Robert L. Smith
1993 Archaeology, Geology, and Geochemistry in Obsidian Provenance Studies. *In Scale on Archaeological and Geoscientific Perspectives*, edited by J.K. Stein and A.R. Linse, pp. 79-91. Geological Society of America Special Paper 283.

Hughes, Richard E., and Delbert L. True
1985 Perspectives on the Distribution of Obsidians in San Diego County, California. *North American Archaeologist* 6(4):325-339.

Mahood, Gail A., and James A. Stimac
1992 Trace-Element Partitioning in Pantellerites and Trachytes. *Geochemica et Cosmochimica Acta* 54:2257-2276.

McCarthy, J.J., and F.H. Schamber
1981 Least-Squares Fit with Digital Filter: A Status Report. In *Energy Dispersive X-ray Spectrometry*, edited by K.F.J. Heinrich, D.E. Newbury, R.L. Myklebust, and C.E. Fiori, pp. 273-296. National Bureau of Standards Special Publication 604, Washington, D.C.

Schamber, F.H.
1977 A Modification of the Linear Least-Squares Fitting Method which Provides Continuum Suppression. In *X-ray Fluorescence Analysis of Environmental Samples*, edited by T.G. Dzubay, pp. 241-257. Ann Arbor Science Publishers.

Shackley, M. Steven
1998 Geochemical Differentiation and Prehistoric Procurement of Obsidian in the Mount Taylor Volcanic Field, Northwest New Mexico. *Journal of Archaeological Science* 25:1073-1082.

Table 1. Elemental concentrations for the archaeological specimens. All measurements in parts per million (ppm). The standard analysis (RGM-1) is a USGS obsidian standard (see Govindaraju 1994).

Site/Sample	Rb	Sr	Y	Zr	Nb	Ba	Source
CA-ORA-1422A-20089	136	33	113	346	30	468	Obsidian Butte
CA-ORA-1422A-20144	134	26	114	307	31	425	Obsidian Butte
CA-ORA-1422A-20168	139	31	117	327	32	444	Obsidian Butte
CA-ORA-1422A-20203	135	40	111	365	29	523	Obsidian Butte
CA-ORA-1422A-20279	133	41	107	384	29	518	Obsidian Butte
CA-ORA-1422A-20378	129	26	105	291	28	394	Obsidian Butte
CA-ORA-1422A-20444	131	29	114	298	31	399	Obsidian Butte
CA-ORA-1422B-30109	131	39	104	344	28	539	Obsidian Butte
CA-ORA-1582-10369	263	12	53	140	48	25	Coso
CA-ORA-1582-11291	242	12	46	131	43	43	Coso
CA-ORA-1586-10368	274	12	55	138	48	0	Coso
CA-ORA-1587-11260	146	24	125	315	36	394	Obsidian Butte
CA-ORA-1587-11286	138	34	113	327	30	464	Obsidian Butte
CA-ORA-1587-12347	271	12	49	130	44	68	Coso
CA-ORA-1587-12752	117	35	95	330	25	479	Obsidian Butte
CA-ORA-383-30249	277	11	55	141	49	21	Coso
CA-ORA-383-31033	254	15	49	141	43	0	Coso
CA-ORA-383-31034	247	14	50	149	46	76	Coso
CA-ORA-383-31160	130	42	106	368	28	516	Obsidian Butte
CA-ORA-730-30096	261	12	54	139	49	39	Coso
CA-ORA-730-30178	183	11	38	101	37	40	Coso
CA-ORA-730-31042	136	39	110	371	29	531	Obsidian Butte
CA-ORA-730-31063	272	12	55	145	50	17	Coso
CA-ORA-730-31516	247	14	52	142	47	36	Coso
CA-ORA-730-32537	139	29	117	328	33	400	Obsidian Butte
CA-ORA-730-33435	174	21	47	170	33	69	Coso
CA-ORA-806-30209	138	30	115	332	31	426	Obsidian Butte
CA-ORA-806-30945	136	29	115	323	33	449	Obsidian Butte
CA-ORA-806-31690	304	13	59	151	52	31	Coso
CA-ORA-806-31856	156	30	128	353	35	500	Obsidian Butte
CA-ORA-806-32335	138	37	108	323	28	509	Obsidian Butte
CA-ORA-806-32427	138	34	114	347	31	476	Obsidian Butte
RGM1	145	102	24	215	8	769	standard

Table 2. Distribution of obsidian source provenance by site.

			SOURCE		
			Coso	Obsidian Butte	Total
SITE (CA-ORA-)	1422A	Count		7	7
		% within Site		100.0%	100.0%
		% within SOURCE		36.8%	21.9%
		% of Total		21.9%	21.9%
	1422B	Count		1	1
		% within Site		100.0%	100.0%
		% within SOURCE		5.3%	3.1%
		% of Total		3.1%	3.1%
	1582	Count	2		2
		% within Site	100.0%		100.0%
		% within SOURCE	15.4%		6.3%
		% of Total	6.3%		6.3%
	1586	Count	1		1
		% within Site	100.0%		100.0%
		% within SOURCE	7.7%		3.1%
		% of Total	3.1%		3.1%
	1587	Count	1	3	4
		% within Site	25.0%	75.0%	100.0%
		% within SOURCE	7.7%	15.8%	12.5%
		% of Total	3.1%	9.4%	12.5%
	383	Count	3	1	4
		% within Site	75.0%	25.0%	100.0%
		% within SOURCE	23.1%	5.3%	12.5%
		% of Total	9.4%	3.1%	12.5%
	730	Count	5	2	7
		% within Site	71.4%	28.6%	100.0%
		% within SOURCE	38.5%	10.5%	21.9%
		% of Total	15.6%	6.3%	21.9%
	806	Count	1	5	6
		% within Site	16.7%	83.3%	100.0%
		% within SOURCE	7.7%	26.3%	18.8%
		% of Total	3.1%	15.6%	18.8%
Total		Count	13	19	32
		% within Site	40.6%	59.4%	100.0%
		% within SOURCE	100.0%	100.0%	100.0%
		% of Total	40.6%	59.4%	100.0%

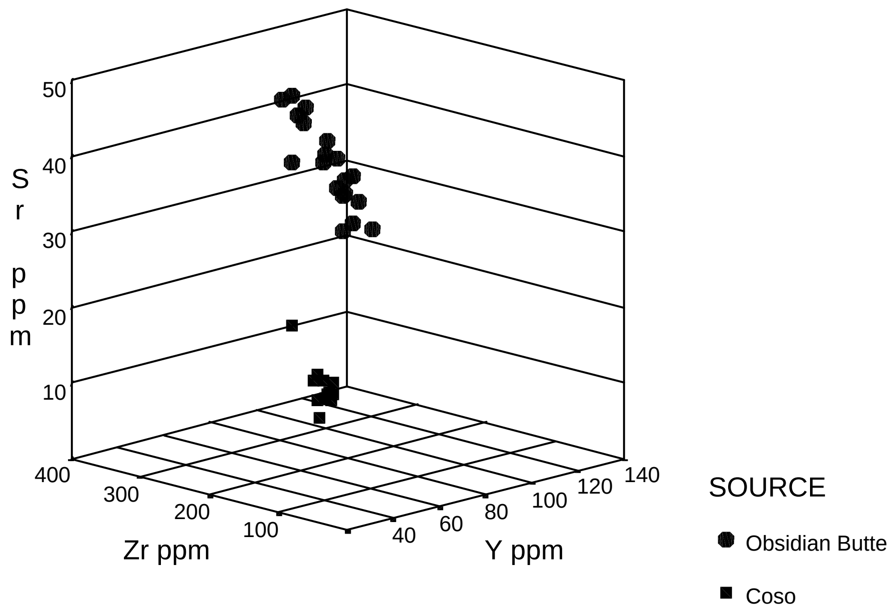

Figure 1. Sr, Zr, Y three-dimensional plot of the elemental concentrations for the obsidian artifacts.