Title
Source Provenance of Obsidian Artifacts from Various Contexts on the Gila River Indian Community Land, Central Arizona

Author
Shackley, M. Steven

Publication Date
2006-04-13

BERKELEY ARCHAEOLOGICAL XRF LAB

232 Kroeber Hall
University of California
Berkeley, CA 94720-3710

SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM VARIOUS CONTEXTS ON THE GILA RIVER INDIAN COMMUNITY LAND, CENTRAL ARIZONA

by

M. Steven Shackley, Ph.D.
Director

Report Prepared for
Gila River Indian Community
Sacaton, Arizona

13 April 2006

INTRODUCTION

The analysis here of 79 artifacts produced from obsidian indicates a very diverse provenance assemblage a result of the diverse temporal contexts from which the artifacts were derived, similar to the previous study. Ten separate sources are present in the assemblage.

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 Archaeological XRF Laboratory, Department of Earth and Planetary Sciences, University of California, Berkeley, using a Spectrace/ThermoNoran™ QuanX energy dispersive x-ray fluorescence spectrometer. The spectrometer is equipped with an air 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 WinTrace™ reduction software. The x-ray tube is operated at 30 kV, 0.16 mA, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity Kα-line data for elements titanium (Ti), manganese (Mn), iron (as Fe^T), thorium (Th), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). 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 (1995, 2005; also Mahood and Stimac 1990; 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, 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, Th, and Ga were measured, but these are rarely useful in discriminating glass sources and are not generally reported.

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 is analyzed during each sample run to check machine calibration (Table 1).

Trace element data exhibited in Table 1, and Figures 1 and 2 are reported in parts per million (ppm), a quantitative measure by weight. Source nomenclature is from Shackley (1988, 1995, 2005; see also http://www.swxrflab.net/swobsrcs.htm).

RESULTS AND SUMMARY

Combined with the previous study (Shackley and Daehnke 2004), this is one of the largest obsidian studies of its type in central Arizona. The chronological contexts are evidently better for this assemblage. I would say, just looking at the source provenance itself, that the assemblage represents and larger proportion of Classic period contexts then the earlier study (Tables 1 and 2, Figure 3). This is mainly due to the dominance of western Sonoran Desert sources and the general lack of Superior (Picketpost Mountain) obsidian (Shackley 2005).

Also as in the previous analysis, the most common single source in the assemblage overall is Sauceda Mountains (63.6%), a source generally more common in the Classic than Preclassic in the Middle Gila region from well dated contexts (Bayman and Shackley 1999; Peterson et al. 1997; Shackley 2005; Shackley and Bayman 2004; Table 2 here). While Sauceda Mountains obsidian does occur in Sacaton Phase contexts and earlier, it is usually in the form of projectile point forms more common in the Lower Gila sites such as the Gatlin Site according to the Hoffman (1997) typology (Shackley 2005). When looking at the western Sonoran Desert sources overall, the sources more common during the Classic and including AZ Unknown A, over 84% of the artifacts were produced from these sources (Table 2). Superior, the second most common source overall (7.8%) is typical of the Sacaton Phase sites in the Middle Gila, but very rare in Classic sites, however it was much less common in this study than the previous work (Shackley and Daehnke 2004; Shackley 2005). Territoriality, probably enforced by the Salado, and easy access to other sources such as Sauceda Mountains during the Classic is the most likely reason for this procurement pattern.

REFERENCES CITED

Bayman, James M., and M. Steven Shackley
1999 Dynamics of Hohokam Obsidian Circulation in the North American Southwest. *Antiquity* **73**:836-845.

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. Springer/Plenum Press, New York.

Glascock, M.D., G.E. Braswell, and R.H. Cobean
1998 A Systematic Approach to Obsidian Source Characterization. In *Archaeological Obsidian Studies: Method and Theory*, edited by M.S. Shackley, pp. 15-66. Advances in Archaeological and Museum Science 3. 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.

Hoffman, C. Marshall
1997 *Alliance Formation and Social Interaction During the Sedentary Period: A Stylistic Analysis of Hohokam Arrowpoints*. Ph.D. dissertation, Arizona State University. University Microfilms, Ann Arbor.

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

Mahood, G., and Stimac, J.A.
1990 Trace-Element Partitioning in Pantellerites and Trachytes. *Geochimica 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.

Peterson, Jane, D.R. Mitchell, and M.S. Shackley
1997 The Social and Economic Contexts of Lithic Procurement: Obsidian from Classic Period Hohokam Sites. *American Antiquity* 62(2):231-259.

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
1988 Sources of Archaeological Obsidian in the Southwest: An Archaeological, Petrological, and Geochemical Study. *American Antiquity* 53(4):752-772.

1995 Sources of Archaeological Obsidian in the Greater American Southwest: An Update and Quantitative Analysis. *American Antiquity* 60(3):531-551.

2005 *Obsidian: Geology and Archaeology in the North American Southwest*. University of Arizona Press, Tucson.

Shackley, M. Steven, and James Bayman
2004 Obsidian Source Provenance, Projectile Point Morphology and Sacaton Phase Hohokam Cultural Identity. In *A Snaketown Retrospective*, edited by P. Fish and S. Fish. University of Arizona Press, in preparation.

Shackley, M.S., and J. Daehnke
2004 Source Provenance of Obsidian Artifacts From Various Contexts on the Gila River Indian Community Land, Central Arizona. Report prepared for the Gila River Indian Community, Sacaton, Arizona.

Table 1. Elemental concentrations for the archaeological samples. All measurements in parts per million (ppm).

Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
GR-1431-1	1102	414	6870	138	38	12	123	22	Vulture
GR-1432-1	957	551	8105	317	7	72	90	53	Burro Creek
GR-1432-2	1356	389	9208	165	82	31	202	23	Sauceda Mts
GR-1433	1025	240	10928	235	12	73	228	35	Los Vidrios
GR-1438	1310	666	8534	109	86	15	78	55	Government Mtn
GR892-1	1393	425	9361	156	84	31	201	20	Sauceda Mts
GR892-2	1438	308	9084	139	93	23	172	13	Sauceda Mts
GR892-3	1324	403	9193	148	78	31	189	21	Sauceda Mts
GR892-4	1302	643	10055	161	10	32	251	40	Sand Tanks
GR892-5	1606	361	10285	161	113	21	200	11	Sauceda Mts
GR892-6	1647	321	9993	152	109	23	190	13	Sauceda Mts
GR892-7	1557	349	9557	162	102	28	182	16	Sauceda Mts
GR893-1	1534	220	8332	139	99	14	165	14	Sauceda Mts
GR893-10	1425	364	9378	155	77	36	211	26	Sauceda Mts
GR893-11	1677	356	10486	156	105	30	169	11	Sauceda Mts
GR893-12	1317	556	8696	152	15	23	209	24	Sand Tanks
GR893-13	1014	522	5603	110	15	19	89	26	Superior
GR893-14	1808	470	8937	132	66	37	165	36	Sauceda Mts?[1]
GR893-15	1451	317	9118	154	102	24	172	17	Sauceda Mts
GR893-16	1896	418	8487	136	74	26	182	21	Sauceda Mts
GR893-17	1435	377	9081	147	69	28	184	17	Sauceda Mts
GR893-18	1019	532	5742	109	12	15	79	45	Superior?
GR893-19	1519	271	7651	118	68	19	146	35	too small
GR893-2	1437	410	9351	161	77	27	195	26	Sauceda Mts
GR893-20	1124	198	9302	191	11	59	178	22	Los Vidrios?
GR893-21	2036	485	10121	159	71	18	154	6	Sauceda Mts
GR893-22	1663	404	9303	165	77	26	191	30	Sauceda Mts
GR893-23	1156	626	9348	151	16	36	236	32	Sand Tanks
GR893-24	1225	310	8333	140	85	13	156	16	Sauceda Mts?
GR893-25	1538	396	9312	148	73	33	196	24	Sauceda Mts
GR893-26	1096	603	9619	156	150	17	110	25	unknown
GR893-27	1037	371	6904	126	34	11	119	15	Vulture
GR893-28	1432	460	8393	137	74	21	182	15	Sauceda Mts?
GR893-29	1582	407	9647	141	69	34	173	18	Sauceda Mts?
GR893-3	1453	332	8925	148	99	18	168	7	Sauceda Mts
GR893-30	1302	342	8377	139	69	28	191	24	Sauceda Mts?
GR893-31	1500	324	10094	159	107	27	187	25	Sauceda Mts
GR893-32	1914	420	9117	149	65	17	172	18	Sauceda Mts
GR893-33	1522	487	21914	129	13	77	689	43	AZ Unknown A
GR893-34	1981	324	10037	151	100	26	175	5	Sauceda Mts
GR893-35	816	483	8888	369	10	87	161	253	RS Hill/Sitgreaves
GR893-36	837	501	8929	373	10	88	162	265	RS Hill/Sitgreaves
GR893-37	895	470	7907	321	11	77	129	221	RS Hill/Sitgreaves
GR893-38	1752	363	8598	151	59	24	186	29	Sauceda Mts
GR893-4	1527	407	9520	156	73	35	190	27	Sauceda Mts
GR893-5	1134	665	9576	160	13	38	241	35	Sand Tanks
GR893-6	1815	371	8811	146	66	18	183	18	Sauceda Mts
GR893-7	1000	198	10402	217	7	66	207	27	Los Vidrios
GR893-8	1350	263	8586	170	20	57	161	20	too small

Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
GR893-9	1568	442	9591	157	74	28	192	25	Sauceda Mts
GR894-1	1414	434	9477	163	75	31	203	30	Sauceda Mts
GR894-10	856	583	7830	105	74	15	76	61	Government Mtn
GR894-11	1779	502	10173	157	79	21	194	27	Sauceda Mts
GR894-12	1509	310	9195	154	97	26	175	6	Sauceda Mts
GR894-2	1527	426	9461	160	78	26	202	27	Sauceda Mts
GR894-3	1278	612	6310	117	13	15	92	28	Superior
GR894-4	1762	422	8884	144	63	25	174	33	Sauceda Mts
GR894-5	839	593	5921	110	13	26	84	29	Superior
GR894-6	1327	458	8286	143	65	29	178	24	Sauceda Mts
GR894-7	1314	390	8776	154	72	28	186	22	Sauceda Mts
GR894-8	1001	276	12603	266	12	72	235	42	Los Vidrios
GR894-9	1454	423	9413	158	74	28	194	19	Sauceda Mts
GR895-1	865	211	9233	202	13	62	190	31	small
GR895-10	1776	474	9651	154	68	38	195	27	Sauceda Mts
GR895-11	1059	238	11770	244	9	69	210	27	Los Vidrios
GR895-12	1547	426	9649	159	74	31	202	24	Sauceda Mts
GR895-13	1304	439	9406	152	78	33	195	16	Sauceda Mts
GR895-14	2130	593	5569	82	15	28	77	24	Superior
GR-895-15	1358	410	9412	152	78	29	202	20	Sauceda Mts
GR-895-16	1168	470	7161	137	39	13	130	20	Vulture
GR-895-17	1589	455	9897	164	83	28	197	13	Sauceda Mts
GR895-2	1566	318	9506	151	109	22	174	6	Sauceda Mts
GR895-3	1709	418	9111	149	70	30	179	12	Sauceda Mts
GR895-4	1472	503	9273	138	44	21	135	28	Vulture
GR895-5	1020	561	6483	113	24	21	96	38	Superior
GR895-6	1457	449	9529	165	79	32	206	24	Sauceda Mts
GR895-7	1180	371	7684	136	63	19	174	33	Sauceda Mts?
GR895-8	1309	524	24110	138	16	82	708	58	AZ Unknown A
GR895-9	1619	443	9359	146	69	30	185	24	Sauceda Mts
RGM1-S3	1544	336	13158	149	112	20	216	4	standard
RGM-1-S3	1498	331	13027	148	107	24	218	2	standard
RGM-1-S3	1549	341	12940	151	113	22	223	12	standard
RGM-1-S3	1583	292	13047	155	111	18	224	17	standard
RGM--S3	1488	323	12886	152	109	20	218	11	standard

[1] A number of the samples were quite small. Consequently either the source assignment is less probable, noted by a "?", or just too small to assign to source (see Davis et al. 1998).

Table 2. Frequency distribution of obsidian source provenance.

		Frequency	Percent
Source	Sauceda Mts	49	63.6
	Los Vidrios	5	6.5
	Sand Tanks	4	5.2
	Vulture	4	5.2
	Burro Creek	1	1.3
	AZ Unknown A	2	2.6
	Superior	6	7.8
	Government Mtn	2	2.6
	RS Hill/Sitgreaves	3	3.9
	unknown	1	1.3
	Total	77	100.0

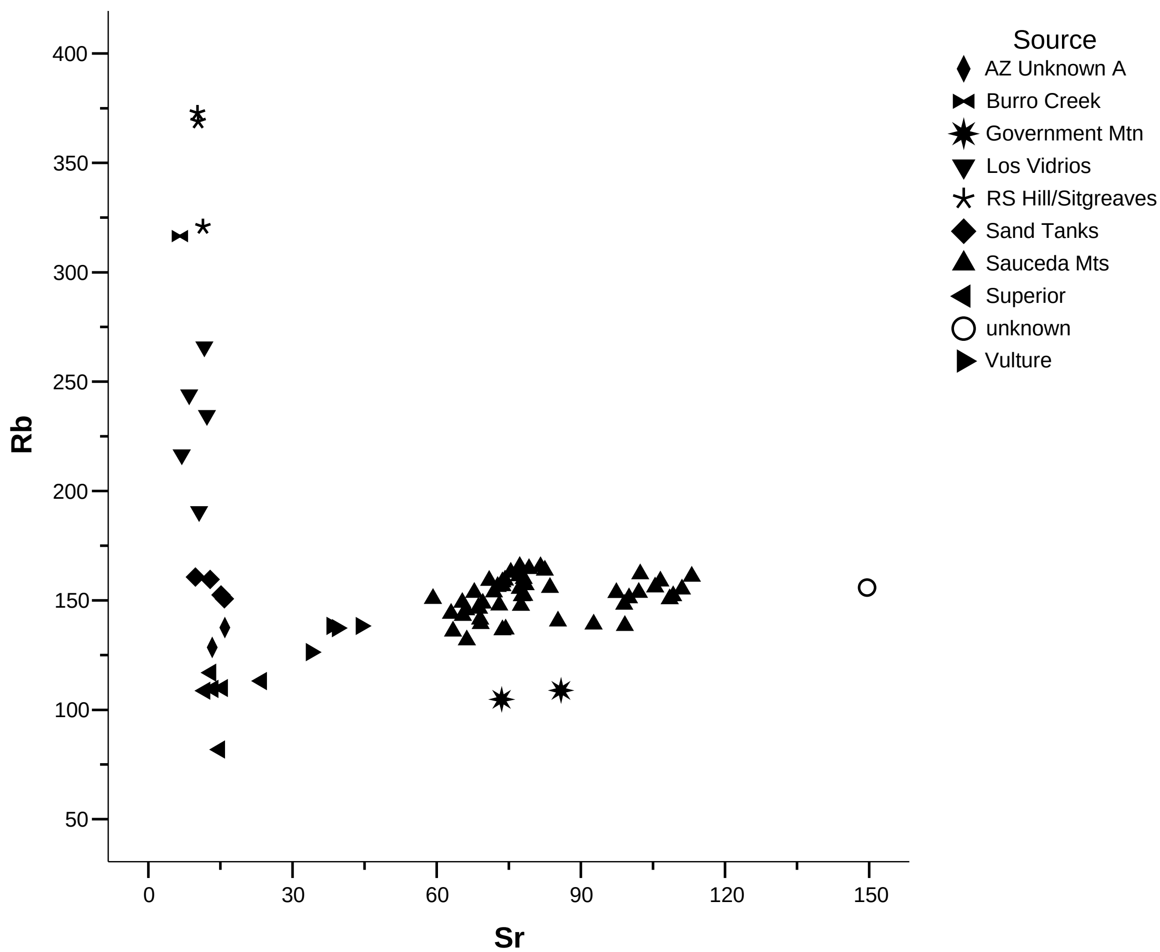

Figure 1. Rb versus Sr biplot of archaeological data.

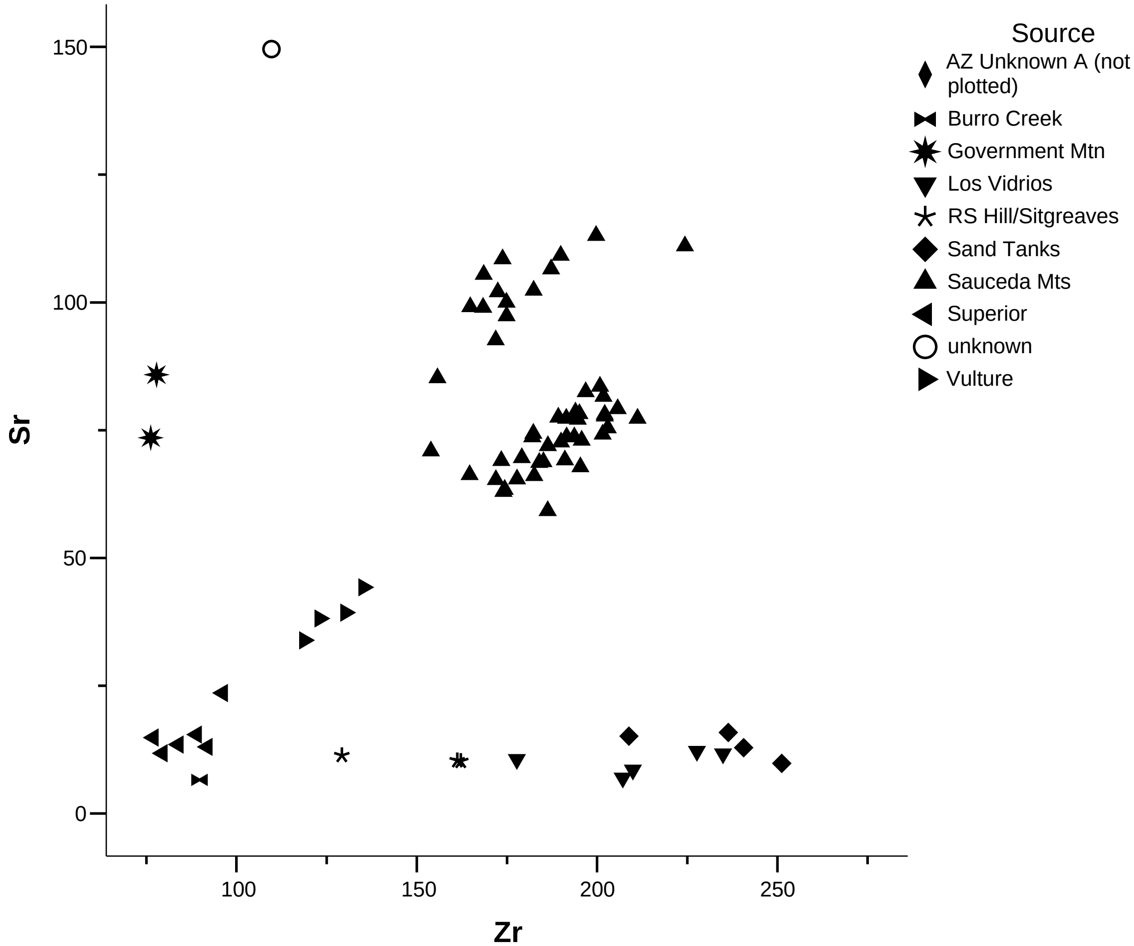

Figure 2. Rb versus Zr biplot of archaeological data.

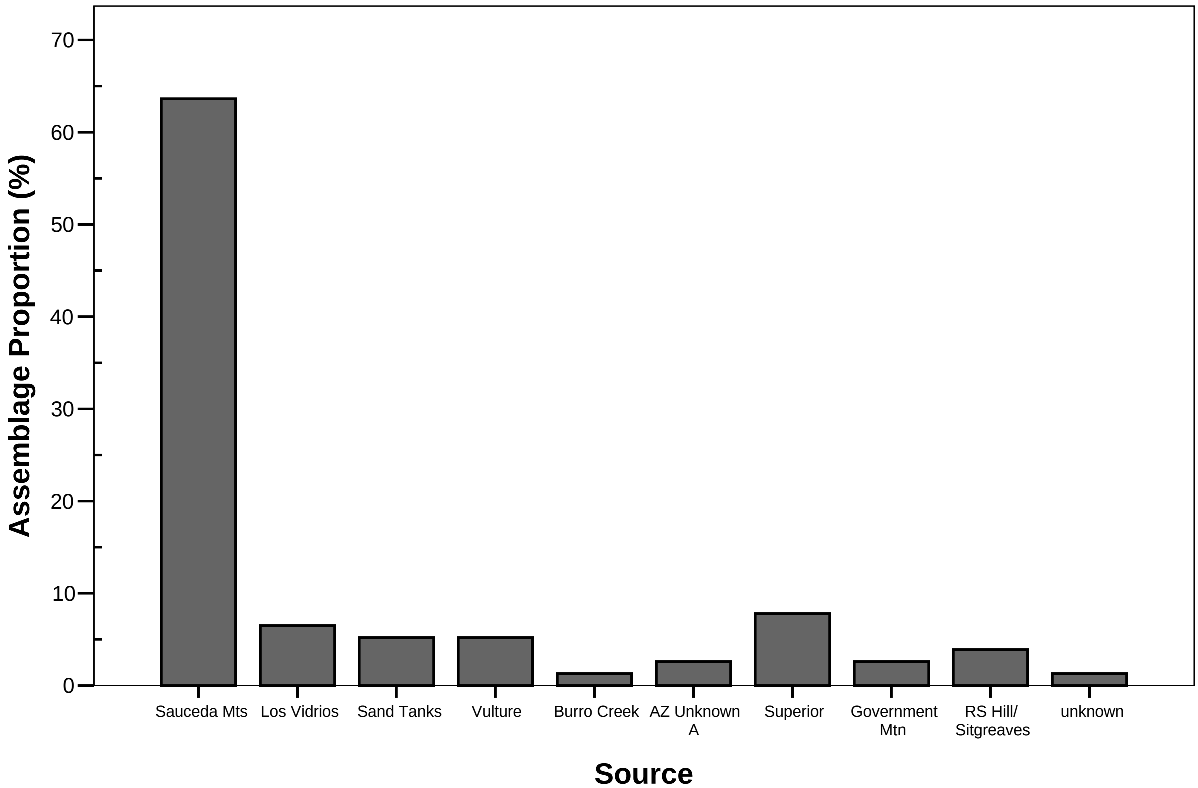

Figure 3. Distribution of obsidian source provenance.