Title
SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM ARCHAEOLOGICAL SITES IN THE EAST RANKIN VALLEY, BARRY M. GOLDWATER AIR FORCE RANGE, SOUTHWESTERN ARIZONA

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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM ARCHAEOLOGICAL SITES IN THE EAST RANKIN VALLEY, BARRY M. GOLDWATER AIR FORCE RANGE, SOUTHWESTERN ARIZONA

Location of Rankin Valley and the three sources present in the assemblage

by

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INTRODUCTION

The analysis here of 18 obsidian artifacts from various sites in the east Rankin Valley on the Barry Goldwater Air Force Range (BMGR) yields a source provenance typical of various periods on the range, dominated by one of the two chemical groups of Sauceda Mountains, with Los Vidrios, and Los Sitios del Agua present in the minority (Martynec et al. 2011; Shackley 2005, 2012, 2014; Shackley and Tucker 2001).

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 (Davis et al. 2011; Hampel 1984; Shackley 2011).

Minor and Trace Element Analyses

All analyses for this study were conducted on a ThermoScientific *Quant'X* EDXRF spectrometer, located in the Geoarchaeological XRF Laboratory, Albuquerque, New Mexico (Tables 1 and 2 and Figure 1). 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 100 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 quadratic 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. 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 (release 21) 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 rhyolite obsidian standard is analyzed during each sample run for obsidian artifacts to check machine calibration (Table 1). Source assignments were made by reference to Martynec et al. (2011), Shackley and Tucker (2001) and Shackley (1995, 2005; see Tables 1 and 2 and Figure 1 as well as source standard data at this lab (see http://swxrflab.net/sauceda.htm).

RESULTS AND SUMMARY

While the assemblage is dominated by one of the two chemical groups of Sauceda Mountains, two of the other regional sources in the Sonoran Desert are present as well (Tables 1 and 2, Figure 1). The Sauceda Mountains source is geochemically divided into two low/high strontium groups (see Table 1 and Figure 1). Generally the low strontium group seems to be dominant in the western portion of the Sauceda Mountains while the higher strontium group to the east and south (Shackley 2005). However, previous archaeological analyses against the two source standard groups indicated some mixing between the areas (Shackley 2012). This "mixing" is likely due to the deep Tertiary (Neogene) Period time depth and alluvial changes in the region over tens of millions of years. The difference in strontium concentrations is likely due to fractionation in the melt. Regardless, the difference is small in comparison to other sources in the region and does not cause problems in assignment, and the raw material quality, and variability in color and opacity appears to transcend the spatial differences.

Projectile Point Comments

The obsidian projectile point assemblage is an active assemblage through time, with what appears to be preforms, impact fractures, and possible rejuvenation, similar to the obsidian points reported in Shackley (2014; Figures 2 and 3 here). Middle Archaic (Chiricahua) through Historic Pima or Sobaipuri forms appear to be present, and all were produced from local Sauceda Mountains obsidian (Hoffman 1997; Loendorf 2012; Loendorf and Rice 2004; Shackley 1989, 1996). Based on these time sensitive artifacts the region now known as the BMGR was used for at least the last ≈5000 years, and the major source of Sauceda Mountains was used extensively throughout prehistory, although more common in the Late Classic in Phoenix Basin sites (Shackley 2005).

A final comment concerns the presence of the Elko-eared point and two projectile points types that are typical in the late prehistory in San Diego and Imperial Counties in southeastern California (McDonald 1992; Shackley 2004; Figure 2 here). At Indian Hill Rockshelter (CA-SDI-2537) in far eastern San Diego County in the Colorado Desert, both Late Archaic Elko-eared and Late Prehistoric point styles called Dos Cabezas Serrated were present in the rockshelter (McDonald 1992). These point styles were present in the 2014 study as well (Shackley 2014; Figure 3 here). With regard to the Elko-eared Late Archaic style, the morphology and metric measurements of the specimen here are well within those recovered at Indian Hill and throughout southeastern California (McDonald 1992:156-157).

Perhaps more intriguing are the serrated points called Dos Cabezas Serrated at Indian Hill. Shackley in interviews with a 100+ year old Kumeyaay, said that this style was used in desert mountains particularly for bighorn sheep hunting to create greater damage and better to leave a blood trail in these very rough boulder habitats (Shackley 1981, 1984, 2004). Additionally, he said that they are mainly produced from obsidian "so they would break easily on impact and create great damage" (Shackley 1984, 2004). Over 48% of the Dos Cabezas Serrated points at Indian Hill were produced from obsidian (all Obsidian Butte in Imperial Valley), and in a greater frequency than in the Cottonwood Triangular and Desert-side notched point assemblages at the rockshelter (McDonald 1992).

While I am not suggesting necessarily that the presence of Elko-eared at BMGR and Indian Hill rockshelter well to the west in the Colorado Desert indicate cultural affiliation, but there was contact between the Hohokam in the Papaguería and Patayan (proto-Yuman) groups along and west of the Colorado River, and indeed this could have been a long term pattern well into the Archaic (see Beck 2006, 2008; McGuire 1982; Shackley 1981, 2004). However, it is perfectly possible with regard to the Kumeyaay strategy for the production and use of Dos Cabezas Serrated points that this production and strategy was also employed independently in the Papaguería.

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Table 1. Elemental concentrations for the archaeological samples and RGM-1, USGS obsidian standard. All measurements in parts per million (ppm).

Sample	Site	Ti	Mn	Fe	Zn	Rb	Sr	Y	Zr	Nb	Ba	Source
4216	12-A-12	1431	366	10667	90	157	75	31	194	24	1127	Sauceda Mtns
4225	12-A-12	1844	340	11852	64	158	107	30	185	19	1080	Sauceda Mtns
28002	12-A-12	1513	302	10786	44	156	104	27	185	19	1120	Sauceda Mtns
28003	12-A-12	1869	373	12732	48	183	119	28	202	18	1117	Sauceda Mtns
28005	12-A-12	1304	333	10004	46	153	73	37	214	24	1437	Sauceda Mtns
88	15-A-06	981	249	12068	84	240	16	74	224	30	20	Los Vidrios
28001	15-A-13	1598	379	11332	54	163	84	36	202	20	1189	Sauceda Mtns
28007	15-A-13	1629	386	11674	47	170	79	34	210	30	1104	Sauceda Mtns
28011	15-A-13	1539	377	10949	41	165	74	34	205	25	1205	Sauceda Mtns
28014	15-A-13	1547	401	11276	48	169	80	33	200	25	1135	Sauceda Mtns
4279	15-A-15	1169	421	21649	133	147	14	75	707	51	103	Los Sitios del Agua
27	17-C-02	1466	318	11043	61	167	108	21	190	20	1052	Sauceda Mtns
39-1	17-C-02	1465	312	11318	66	173	106	28	184	14	1076	Sauceda Mtns
39-2	17-C-02	1522	305	11368	64	161	109	27	180	17	1081	Sauceda Mtns
1160	17-C-27	1583	393	11070	62	162	81	36	208	27	1101	Sauceda Mtns
1176	17-C-30	1552	401	11344	93	169	78	29	196	24	1150	Sauceda Mtns
68	18-A-04	1513	352	10382	47	161	76	30	208	29	1264	Sauceda Mtns
1155	ISOLATE	1480	317	10636	45	156	103	32	178	17	1181	Sauceda Mtns
RGM1-S4		1593	285	13228	35	152	104	29	217	7	816	standard

Table 2. Crosstabulation of site by source.

			Source			
			Los Sitios del Agua	Los Vidrios	Sauceda Mtns	Total
Site	12-A-12	Count	0	0	5	5
		% within Site	0.0%	0.0%	100.0%	100.0%
		% within Source	0.0%	0.0%	31.3%	27.8%
		% of Total	0.0%	0.0%	27.8%	27.8%
	15-A-06	Count	0	1	0	1
		% within Site	0.0%	100.0%	0.0%	100.0%
		% within Source	0.0%	100.0%	0.0%	5.6%
		% of Total	0.0%	5.6%	0.0%	5.6%
	15-A-13	Count	0	0	4	4
		% within Site	0.0%	0.0%	100.0%	100.0%
		% within Source	0.0%	0.0%	25.0%	22.2%
		% of Total	0.0%	0.0%	22.2%	22.2%
	15-A-15	Count	1	0	0	1
		% within Site	100.0%	0.0%	0.0%	100.0%
		% within Source	100.0%	0.0%	0.0%	5.6%
		% of Total	5.6%	0.0%	0.0%	5.6%
	17-C-02	Count	0	0	3	3
		% within Site	0.0%	0.0%	100.0%	100.0%
		% within Source	0.0%	0.0%	18.8%	16.7%
		% of Total	0.0%	0.0%	16.7%	16.7%
	17-C-27	Count	0	0	1	1
		% within Site	0.0%	0.0%	100.0%	100.0%
		% within Source	0.0%	0.0%	6.3%	5.6%
		% of Total	0.0%	0.0%	5.6%	5.6%
	17-C-30	Count	0	0	1	1
		% within Site	0.0%	0.0%	100.0%	100.0%
		% within Source	0.0%	0.0%	6.3%	5.6%
		% of Total	0.0%	0.0%	5.6%	5.6%
	18-A-04	Count	0	0	1	1
		% within Site	0.0%	0.0%	100.0%	100.0%
		% within Source	0.0%	0.0%	6.3%	5.6%
		% of Total	0.0%	0.0%	5.6%	5.6%
	ISOLATE	Count	0	0	1	1
		% within Site	0.0%	0.0%	100.0%	100.0%
		% within Source	0.0%	0.0%	6.3%	5.6%
		% of Total	0.0%	0.0%	5.6%	5.6%
Total		Count	1	1	16	18
		% within Site	5.6%	5.6%	88.9%	100.0%
		% within Source	100.0%	100.0%	100.0%	100.0%
		% of Total	5.6%	5.6%	88.9%	100.0%

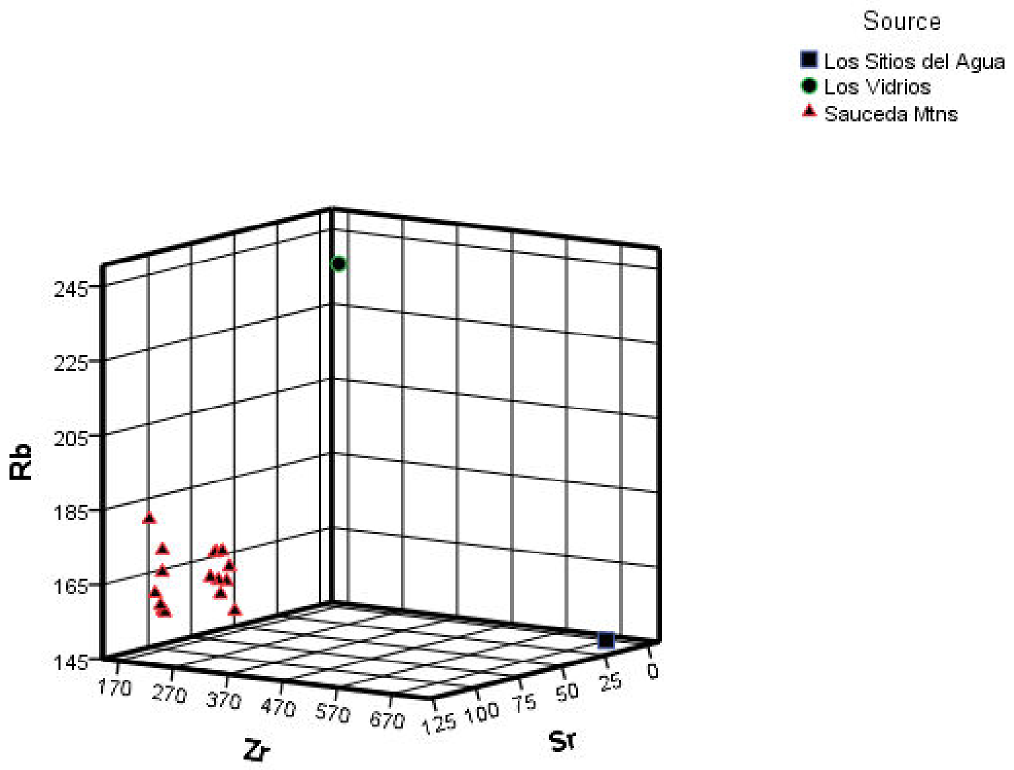

Figure 1. Zr, Rb, Sr three-dimensional plot of archaeological data. Note the bimodal distribution of Sauceda Mountain obsidian (see discussion and Shackley 1995, 2005).

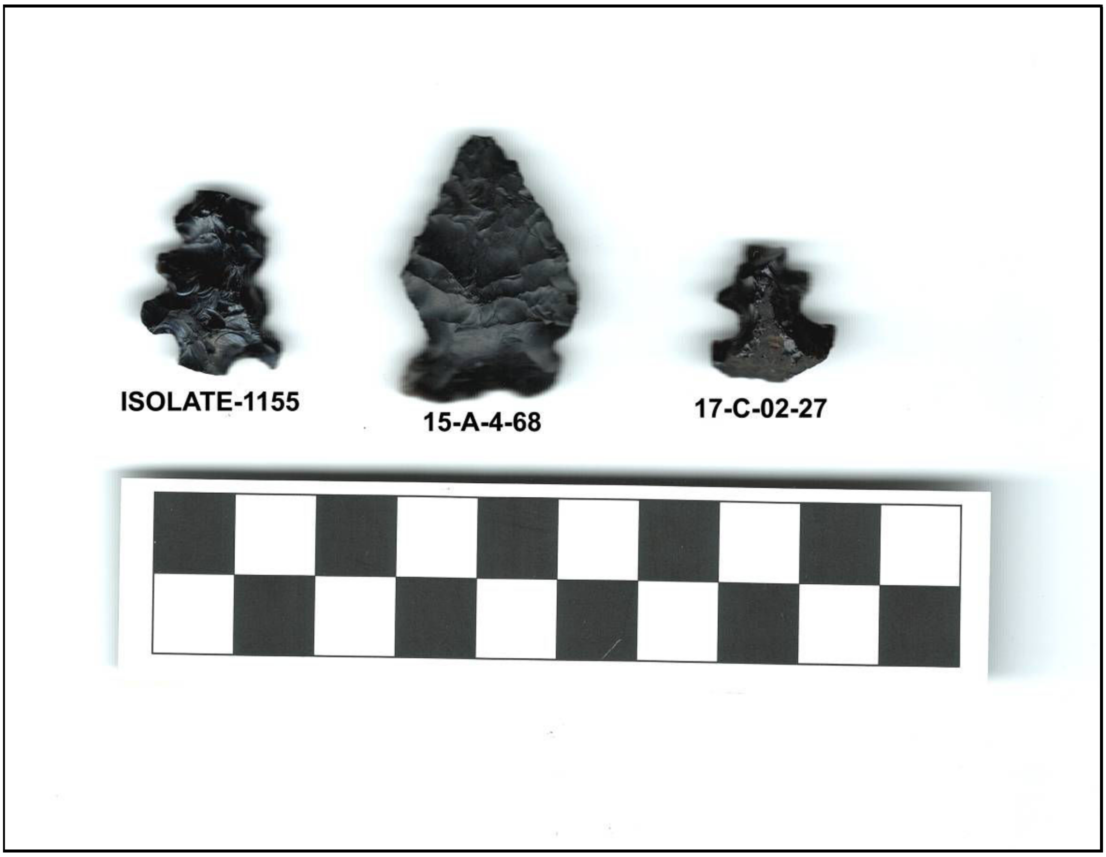

Figure 2. Selected projectile points from the assemblage, Elko-eared center, and possible Dos Cabezas Serrated left and right (see text). All are produced from Sauceda Mountains obsidian.

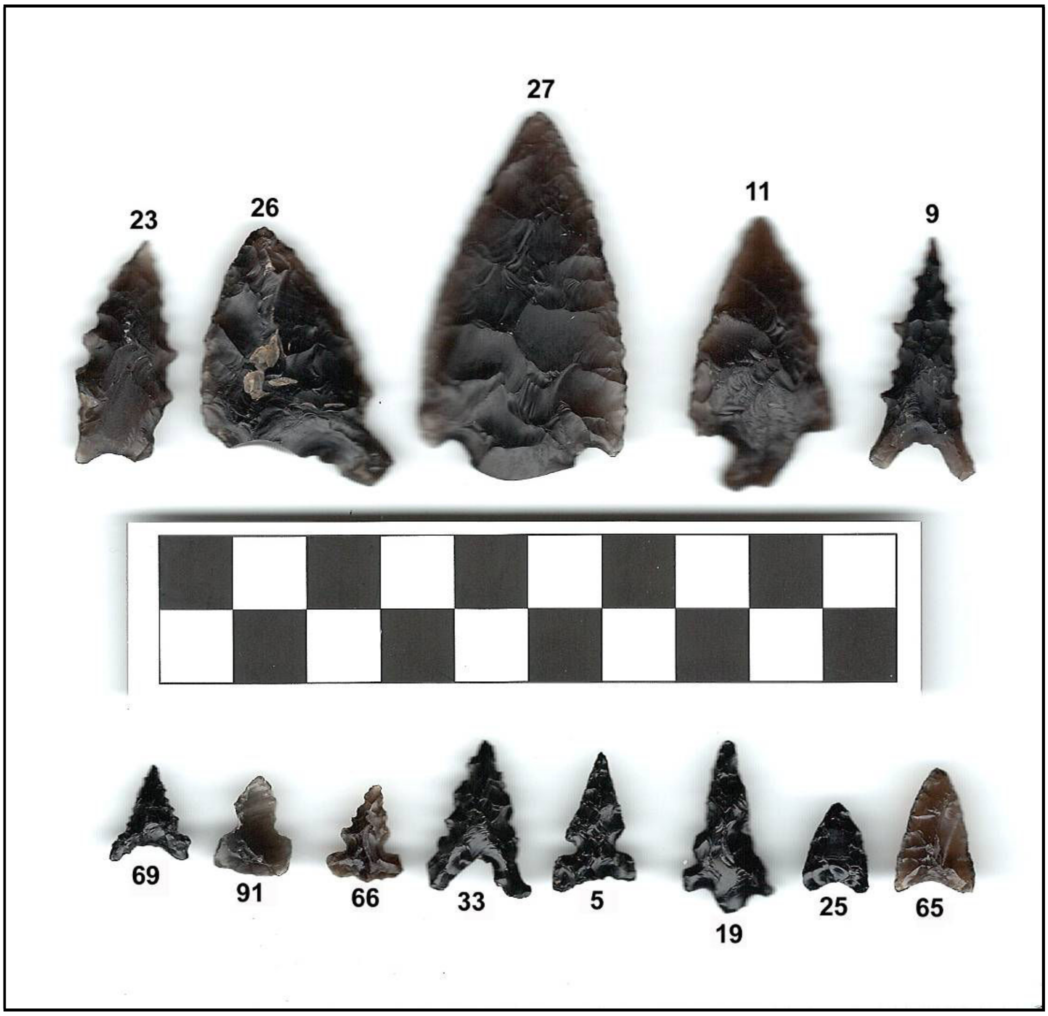

Figure 3. Selected Sauceda Mountain obsidian projectile points from the BMGR assemblage from the 2014 study (see Shackley 2014). Numbers are XRF sample numbers. Number 26 is a possible Elko-eared, and number 66 a possible Dos Cabezas Serrated.