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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM SITES NEAR PUERTO PEÑASCO, SONORA, MEXICO

by

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INTRODUCTION

The analysis here of 19 artifacts produced from obsidian yielded a somewhat more diverse source provenance than the earlier smaller study including sources north of the international border (Shackley 2005a; Table 1 here). While there were a number of artifacts that could not be assigned to source, including vitrophyric glass, the analysis is intriguing.

LABORATORY SAMPLING, 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 WinTrace™ 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 Kα-line data for elements titanium (Ti), manganese (Mn), iron (as Fe^T), 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 (1992, 1995, 2005b; 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, and JR-1 and JR-2 obsidian standards from the Japan Geological Survey (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 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. An analysis of RGM-1 analyzed during each run is included in Table 1. Source nomenclature follows Shackley (1988, 1995, 2005b). Further information on the laboratory instrumentation can be found at: http://www.swxrflab.net/. 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).

DISCUSSION

There have been very few studies of archaeological obsidian in Sonora, so the results here are really not comparable to anything in the literature (Shackley 2005b). The "unknowns" with relatively high Sr and Zr (i.e. samples S1U1L3, 16, 20b, 23) also appeared in the earlier study, but appear to be rather vitrophyric and probably quite local (Shackley 2005a). The presence of Sauceda Mountains and AZ Unknown A, the latter probably located on the western Tohono O'odahm reservation certainly indicates some contact to the north (see Shackley 2005b). Of course, the Los Vidrios source is located just upstream near the border, and is available as marekanites in secondary contexts in the Rio Sonoita nearly as far south as Puerto Peñasco (Shackley 2005b). The relatively high proportion of unknown provenance is due to the general lack of obsidian research in the region.

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Table 1. Elemental concentrations and source assignments for the archaeological specimens. All measurements in parts per million (ppm).

| Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
S1U1L3	3185	571	32679	95	142	45	395	6	unknown
7	1244	240	11994	121	73	34	228	21	Sauceda Mts
8	841	204	11019	223	15	70	219	29	Los Vidrios
9	957	194	9863	216	18	65	218	27	Los Vidrios
11	990	260	11576	245	17	67	228	24	Los Vidrios
12	816	109	5256	148	18	42	169	14	unknown
13	878	252	11030	234	17	73	215	32	Los Vidrios
14	1235	256	12668	128	79	37	220	19	Sauceda Mts?
15	1465	532	24975	141	20	84	736	46	AZ Unknown A
16	3016	575	29676	89	128	38	385	2	unknown
17	1490	591	25222	134	23	81	712	55	AZ Unknown A
18	1022	233	11258	230	13	67	223	28	Los Vidrios
19	786	246	8299	184	13	59	207	37	Los Vidrios
20a	1033	263	10438	226	13	63	215	27	Los Vidrios
20b	3192	668	32565	93	134	51	408	2	unknown
20c	1042	240	10884	222	10	58	198	28	Los Vidrios
21	1387	549	23515	133	16	71	651	54	AZ Unknown A
22	2579	394	22654	140	89	43	386	6	unknown
23	2228	825	21458	56	185	32	308	5	unknown
rgm1-s3	1731	343	13467	151	114	19	221	8	standard
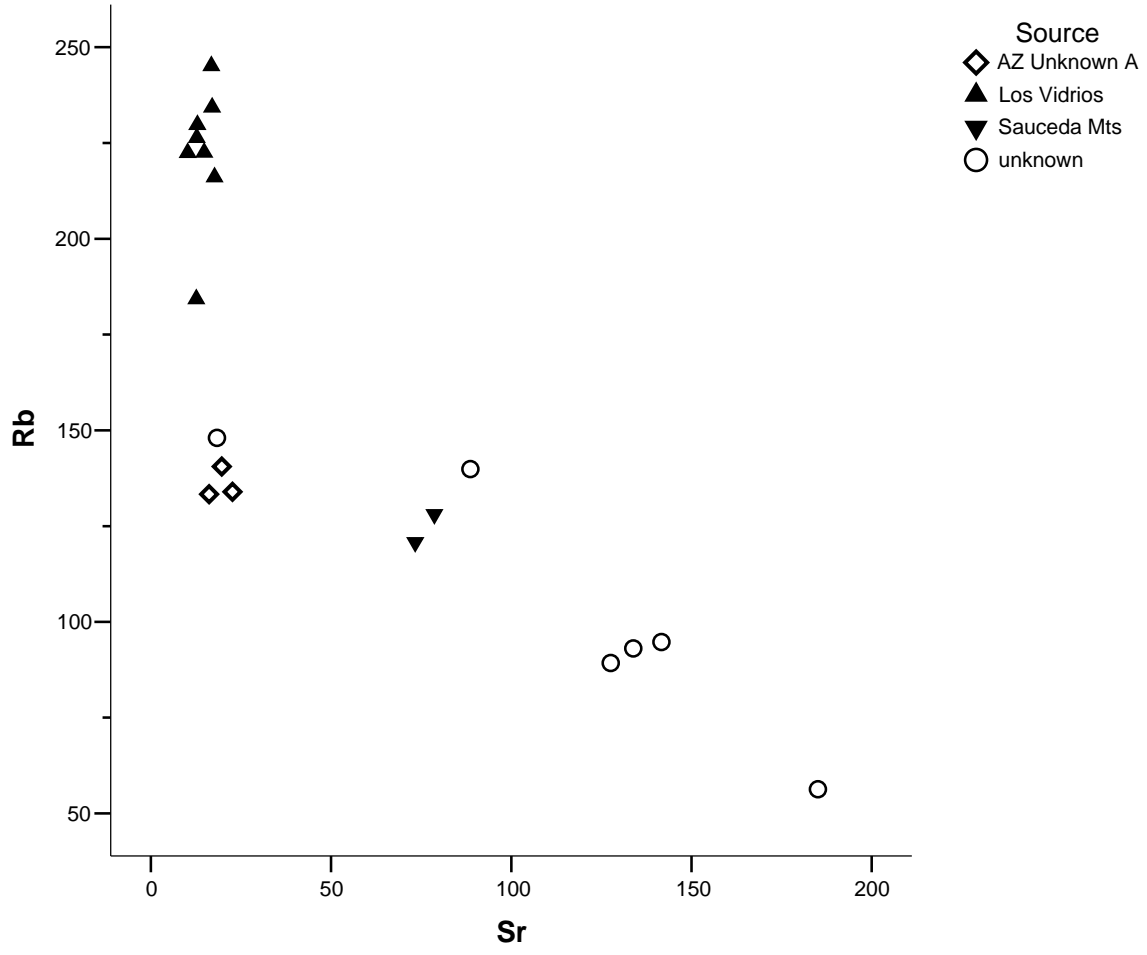
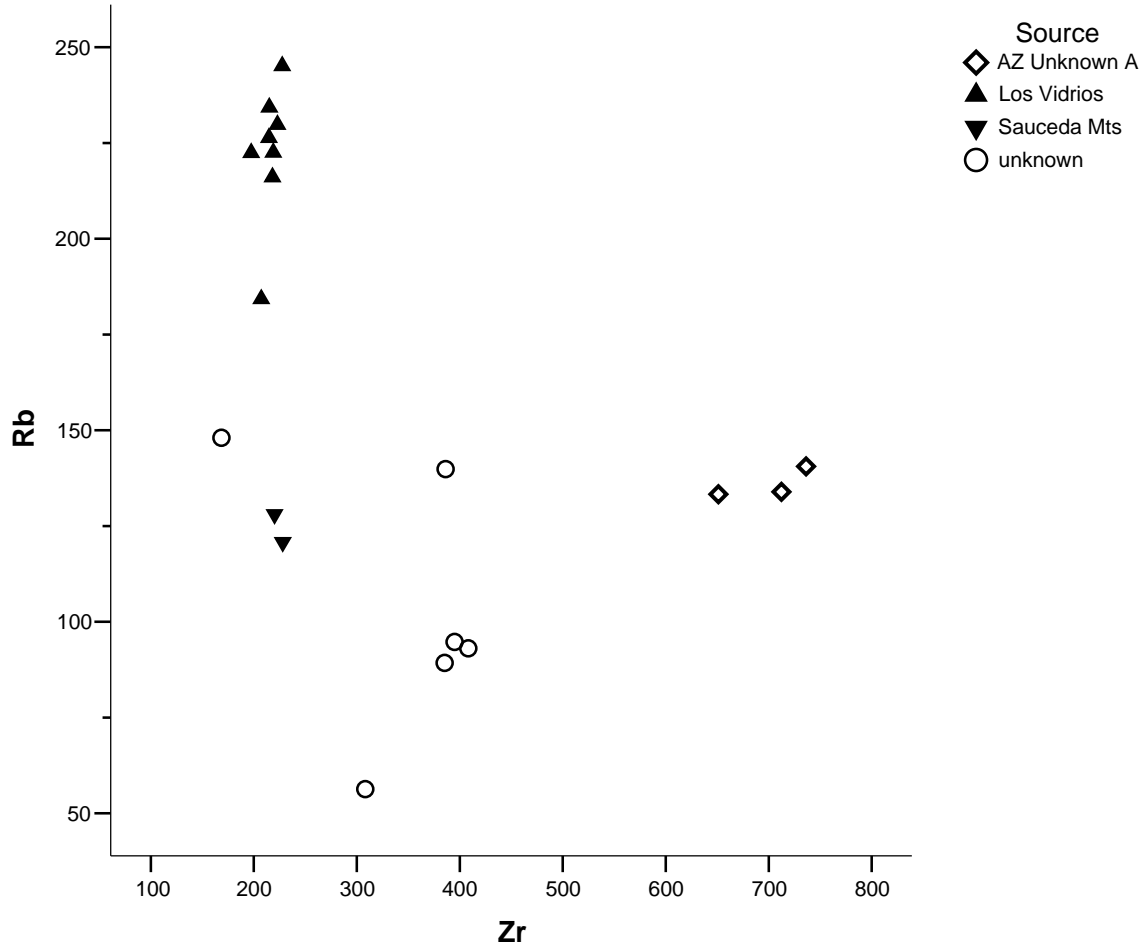Figure 1. Rb versus Sr, plot of the elemental concentrations for the archaeological specimens.

Figure 2. Rb versus Zr biplot of the elemental concentrations.