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### Title

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SOUTHERN ARIZONA

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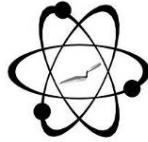
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**SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM FROM AZ AA:12:312  
(ASM) SOUTHERN ARIZONA**

by

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## INTRODUCTION

The analysis here of four obsidian artifacts from AZ AA:12:312 (ASM) indicates procurement of both regional sources (Sauceda Mountains, western Arizona) and extra-regional sources (Antelope Creek/Mule Creek western New Mexico; Table 1 and Figure 1). These two sources are relatively common in Late Classic contexts in southern Arizona (i.e. Casa Grande, Marana), and Antelope Creek is a common source in this time period throughout the Southwest (Bayman and Shackley 1999; Mills et al. 2013; Shackley 2005; Shackley et al. 2018).

## LABORATORY SAMPLING, 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; Shackley 2011).

All analyses for this study were conducted on a ThermoScientific *Quant'X* EDXRF spectrometer, located at the Geoarchaeological XRF Laboratory, Albuquerque, New Mexico. 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  $\mu\text{m}$  (3 mil) beryllium (Be) window (air cooled), that runs on a power supply operating from 4-50 kV/0.02-1.0 mA at 0.02 increments. The spectrometer is equipped with a 200  $\text{l min}^{-1}$  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.

### **Trace Element Analysis**

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  $K\alpha_1$ -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 linear 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 Géo-chimiques in France (Govindaraju 1994). Line fitting is linear (XML) for all elements. When barium (Ba) is analyzed in the High Zb condition, the Rh tube is operated at 50 kV and up to 1.0 mA, ratioed to the bremsstrahlung region (see Davis 2011; Shackley 2011). Further details concerning the petrological choice of these elements in North American obsidians is available in Shackley (1988, 1995, 2005, 2019b; 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, and 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).

### **Statistical and Graphical Source Assignment.**

The data from the WinTrace™ software were translated directly into Excel for Windows software for manipulation and on into SPSS ver. 21 and/or JMP 12.0.1 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 obsidian standard is analyzed during each sample run of  $\leq 19$  for obsidian artifacts to check machine calibration (Table 1).

Source assignments were made by reference to the laboratory database (see Shackley 2005; Shackley et al. 2018). Further information on the laboratory instrumentation and source data can be found at: <http://www.swxrflab.net>. Trace element data exhibited in Table 1 and Figure 1 are reported in parts per million (ppm), a quantitative measure by weight.

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

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Ba	Ce	Source
98-1	1593	388	11489	172	81	35	211	23	1091	61	Sauceda Mtns AZ
98-2	1508	419	11467	176	80	34	204	21	1034	49	Sauceda Mtns AZ
118	1498	384	10725	165	78	32	208	23	1067	101	Sauceda Mtns AZ
134	785	380	9947	246	24	44	119	25	99	49	Antelope Cr/Mule Cr NM
RGM1-S4	1544	286	13383	157	110	24	225	11	829	46	standard

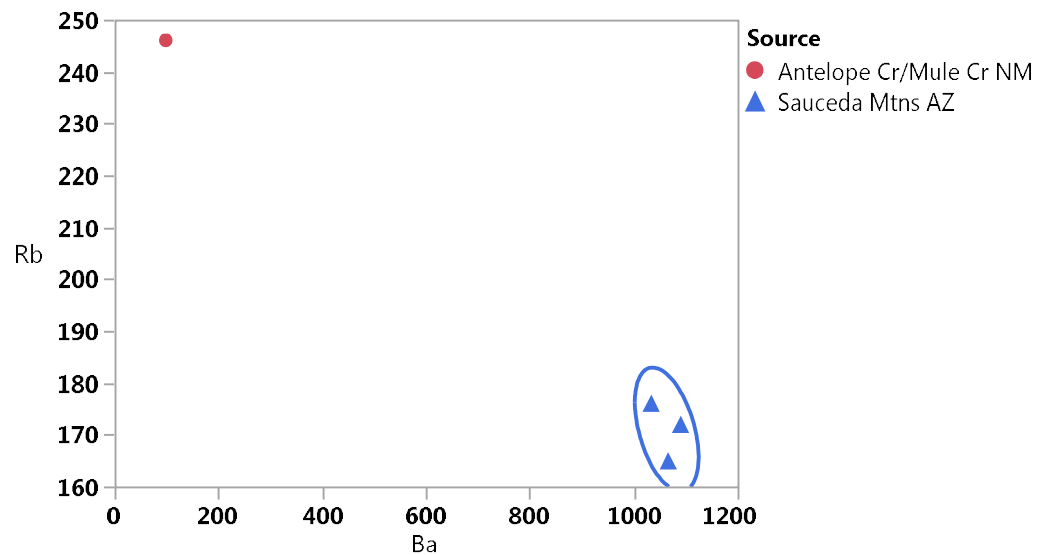


Figure 1. Ba/Rb bivariate plot of the archaeological samples. Confidence ellipse at 90%.