Title
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Author
Shackley, M. Steven

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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM AZ AA:14:39 (ASM), TOHONO O’ODAHM NATION, PIMA COUNTY, ARIZONA

by

M. Steven Shackley Ph.D., Director
Geoarchaeological XRF Laboratory

Report Prepared for

Stacy Ryan
Desert Archaeology, Inc.
Tucson, Arizona

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INTRODUCTION

The analysis here of 8 artifacts from AZ AA:14:39 (ASM) indicates a very diverse obsidian provenance assemblage for such a small sample, with most of the sources from near or below the international border.

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 in the Archaeological 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 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 200 seconds livetime
to generate x-ray intensity Ka-line data for elements titanium (Ti), manganese (Mn), iron (as Fe$_2$O$_3$), 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 least-squares 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 but Fe where a derivative fitting is used to improve the fit for iron and thus for all the other 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 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 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 obsidian standard is analyzed during each sample run for obsidian artifacts to check machine calibration (Table 1). Source assignments were made by reference to Shackley (1995, 1998, 2005; see Table 1 and Figures 1 and 2, as well as source standard data at this lab.

DISCUSSION

As mentioned above, the obsidian source provenance assemblage is very diverse with most of the artifacts produced from obsidian from south of the U.S.-Mexican border (Table 1, Figures 1 and 2). Two of those sources, Los Sitios del Agua, and Selene, have recently been located and only the former published (Martynec et al. 2011; Shackley 2012). Both sources have been seen in sites north of the border, and given the location of this source very near the border, it is not surprising that these sources are present. Sauceda Mountains and Superior are rather typical in all periods in southern Arizona, and Antelope Wells/El Berrendo at the international “four corners” region is also present in most time periods, especially the Archaic and Early Agricultural (Shackley 2005).

The Selene source was recently located by Karl Kibler and Hector Hinojosa in the Rio Bavispe over 100 km south of the border. The source has been detected in sites in Sonora and along the border (Shackley 2012). Publication of the source is in preparation.
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McCarthy, J.J., and F.H. Schamber

Schamber, F.H.

Shackley, M. Steven


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

<table>
<thead>
<tr>
<th>Sample</th>
<th>Ti</th>
<th>Mn</th>
<th>Fe</th>
<th>Rb</th>
<th>Sr</th>
<th>Y</th>
<th>Zr</th>
<th>Nb</th>
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<td>335</td>
<td>1093</td>
<td>565</td>
<td>8628</td>
<td>137</td>
<td>22</td>
<td>24</td>
<td>99</td>
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<td>436</td>
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<td>251</td>
<td>1274</td>
<td>247</td>
<td>16</td>
<td>66</td>
<td>215</td>
<td>33</td>
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<tr>
<td>464</td>
<td>1670</td>
<td>277</td>
<td>1239</td>
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<td>144</td>
<td>20</td>
<td>160</td>
<td>10</td>
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<td>325</td>
<td>1173</td>
<td>168</td>
<td>113</td>
<td>30</td>
<td>185</td>
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<td>478</td>
<td>1576</td>
<td>541</td>
<td>2724</td>
<td>154</td>
<td>16</td>
<td>81</td>
<td>683</td>
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<tr>
<td>625</td>
<td>1396</td>
<td>499</td>
<td>2494</td>
<td>151</td>
<td>16</td>
<td>84</td>
<td>731</td>
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<td>637</td>
<td>1731</td>
<td>876</td>
<td>3602</td>
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<td>12</td>
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<td>1442</td>
<td>120</td>
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<td>877</td>
<td>220</td>
<td>1131</td>
<td>223</td>
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<td>RGM1-S4</td>
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<td>1326</td>
<td>151</td>
<td>106</td>
<td>25</td>
<td>219</td>
<td>13</td>
<td>standard</td>
</tr>
</tbody>
</table>

1 Some of the elemental concentrations are slightly beyond the source standard data, but the sample is likely produced from this source.
Figure 1. Sr versus Rb bivariate plot of the elemental concentrations for all the archaeological specimens.
Figure 2. Zr versus Rb bivariate plot of the archaeological specimens providing discrimination beyond that shown in Figure 1.