Title
Source Provenance of Obsidian Artifacts from Sites Near Puerto Peñasco, Sonora, Mexico

Permalink
https://escholarship.org/uc/item/79c5353j

Authors
Shackley, M. Steven
Bardolph, Dana
Luu, Cuong

Publication Date
2006-07-25

Supplemental Material
https://escholarship.org/uc/item/79c5353j#supplemental

Data Availability
The data associated with this publication are in the supplemental files.

License
CC BY-NC 4.0
SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM SITES NEAR PUERTO PEÑASCO, SONORA, MEXICO

by

M. Steven Shackley, Ph.D.
Director
Archaeological XRF Laboratory
University of California, Berkeley

Undergraduate Lab Assistants

Dana Bardolph
Cuong Luu

Report Prepared for

Center for Desert Archaeology
Tucson, Arizona

25 July 2006
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.

REFERENCES CITED

Govindaraju, K.

Hampel, Joachim H.

Hildreth, W.

Hughes, Richard E., and Robert L. Smith

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