Title
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AN ENERGY DISPERSIVE X-RAY FLUORESCENCE (EDXRF) ANALYSIS OF 10 OBSIDIAN ARTIFACTS FROM AZ AA:2:62(ASM), SOUTHERN ARIZONA

by

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University of California, Berkeley

Report Prepared for
Archeological Consulting Services
Tempe, Arizona

8 December 1992
INTRODUCTION

The following report documents the EDXRF analysis of 10 obsidian artifacts recovered from AZ AA:2:62(ASM) in southern Arizona. Five of the samples were derived from Saucedo Mountain glass and five of the samples were derived from Superior (Picketpost Mountain) glass. The mix of obsidian sources apparent in this small sample is consistent with other Sedentary and Classic period Hohokam contexts in central and southern Arizona.

ANALYSIS AND INSTRUMENTATION

All samples were analyzed whole, and were washed in distilled water before analysis. 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 trace element analyses were performed in the Department of Geology and Geophysics, University of California, Berkeley, using a Spectrace 440 (United Scientific Corporation) energy dispersive x-ray fluorescence spectrometer. The spectrometer is equipped with a Rh x-ray tube, a 50 kV x-ray generator, with a Tracor X-ray (Spectrace) TX 6100 x-ray analyzer using an IBM PC based microprocessor and Tracor reduction software. The x-ray tube was operated at 30 kV, .20 mA, using a .127 mm Rh primary beam filter in a vacuum path at 250 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). Weight percent iron (Fe=Fe$_2$O$_3$$^T$) can be derived by multiplying ppm estimates by 1.431 (Glascock 1991). Trace element
intensities were converted to concentration estimates by employing a least-squares calibration line established for each element from the analysis of up to 26 international rock standards certified by the U.S. Bureau of Standards, the U.S. Geological Survey, Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1989). Further details concerning the petrological choice of these elements in Southwest obsidians is available in Shackley (1988, 1990, 1992a; also Mahood and Stimac 1991).

The data from the Tracor software were translated directly into Quattro Pro 4.0 software for manipulation and on into SPSSPC+ 3.0 for statistical analyses. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards. Table 1 shows a comparison between values recommended for two international rock standards, one rhyolite (RGM-1) and one obsidian (NBS-278). One of these standards is analyzed during each sample run to insure machine calibration. The results shown in Table 1 indicate that the machine accuracy is quite high, and other instruments with comparable precision should yield comparable results.

Trace element data exhibited in Tables 1 and 2 are reported in parts per million (ppm), a quantitative measure by weight. Table 2 exhibits the trace element concentrations for the 10 samples. Figures 1 through 3 exhibit bivariate plots of five elements for the site data.

DISCUSSION

If indeed these artifacts were recovered from Sedentary period contexts, this sample constitutes a major study of archaeological obsidian from that period. The vast majority of studies of this kind have been directed toward Classic period sites where the quantity of obsidian appears to be greatest of all Hohokam periods (Peterson et al. 1992; Shackley 1992b, 1992c). Sauceda Mountains material from about 30 km south of Gila Bend is typically the most common obsidian found in Hohokam contexts (Shackley 1988, 1990).
During the Sedentary period, this raw material may have been distributed by groups in the Gila Bend area such as the Gatlin Site where Sauceda Mountains obsidian is very common for a site dating to this period. Proximity to the source is the obvious explanation (Shackley 1992d).

Superior occurs much less commonly in Hohokam sites, even in sites at the Escalante Ruin group where the source is relatively nearby (Shackley 1992c). If the small sample is representative, then the relatively high proportion (50%) of obsidian from Superior is somewhat unusual.

REFERENCES CITED

Glascock, Michael D.

Govindaraju, K.

Hampel, Joachim H.

Mahood, Gail A., and James A. Stimac

McCarthy, J.J., and F.H. Schamber

Peterson, Jane, Douglas Mitchell, and M. Steven Shackley
Schamber, F.H.

Shackley, M. Steven


Table 1. X-ray fluorescence concentrations for selected trace elements of two international rock standards. ± values represent first standard deviation computations for the group of measurements. All values are in parts per million (ppm) as reported in Govindaraju (1989) and this study. RGM-1 is a U.S. Geological Survey rhyolite (obsidian) rock standard, and NBS-278 is a National Bureau of Standards obsidian standard. Element-to-Oxide conversions from Glascock (1991).

<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>
</tr>
</thead>
<tbody>
<tr>
<td>RGM-1 (Govindaraju 1989)</td>
<td>1600</td>
<td>279</td>
<td>12998</td>
<td>149</td>
<td>108</td>
<td>25</td>
<td>219</td>
<td>8.9</td>
</tr>
<tr>
<td>RGM-1 (this study)</td>
<td>1513.2±46</td>
<td>232.8±15</td>
<td>13813±59</td>
<td>149.58±4.05</td>
<td>108.03±3</td>
<td>22.7±.86</td>
<td>226.8±2</td>
<td>10±28</td>
</tr>
<tr>
<td>NBS-278 (Govindaraju 1989)</td>
<td>1468</td>
<td>402</td>
<td>14256</td>
<td>127.5</td>
<td>63.5</td>
<td>41</td>
<td>295</td>
<td>n.r.¹</td>
</tr>
<tr>
<td>NBS-278 (this study)</td>
<td>1405±93</td>
<td>365±8</td>
<td>15399±394</td>
<td>130±2</td>
<td>68±2</td>
<td>43±1.7</td>
<td>290±4</td>
<td>18±2</td>
</tr>
</tbody>
</table>

¹ n.r = no report

Table 2. X-ray fluorescence concentrations for archaeological samples. 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>61</td>
<td>1628.3</td>
<td>287.604</td>
<td>11598.427</td>
<td>160.412</td>
<td>105.1</td>
<td>20.924</td>
<td>171.8</td>
<td>12.909</td>
<td>Sauceda Mts</td>
</tr>
<tr>
<td>225</td>
<td>660.0</td>
<td>575.537</td>
<td>7398.397</td>
<td>122.734</td>
<td>18.0</td>
<td>22.21</td>
<td>102.7</td>
<td>21.537</td>
<td>Superior</td>
</tr>
<tr>
<td>329</td>
<td>1722.1</td>
<td>283.255</td>
<td>11392.288</td>
<td>169.048</td>
<td>106.3</td>
<td>24.834</td>
<td>185.5</td>
<td>17.161</td>
<td>Sauceda Mts</td>
</tr>
<tr>
<td>400</td>
<td>706.7</td>
<td>465.436</td>
<td>6620.312</td>
<td>113.772</td>
<td>17.8</td>
<td>25.098</td>
<td>93.4</td>
<td>27.041</td>
<td>Superior</td>
</tr>
<tr>
<td>734</td>
<td>1551.5</td>
<td>289.577</td>
<td>11136.53</td>
<td>169.654</td>
<td>111.4</td>
<td>23.712</td>
<td>187.9</td>
<td>20.916</td>
<td>Sauceda Mts</td>
</tr>
<tr>
<td>904</td>
<td>1462.1</td>
<td>250.616</td>
<td>10942.099</td>
<td>154.639</td>
<td>98.5</td>
<td>22.494</td>
<td>175.0</td>
<td>20.665</td>
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</tr>
<tr>
<td>964</td>
<td>1563.1</td>
<td>310.73</td>
<td>11268.422</td>
<td>158.535</td>
<td>78.0</td>
<td>31.803</td>
<td>192.4</td>
<td>21.003</td>
<td>Sauceda Mts</td>
</tr>
<tr>
<td>996</td>
<td>1070.4</td>
<td>414.671</td>
<td>7435.548</td>
<td>104.582</td>
<td>19.0</td>
<td>17.261</td>
<td>82.4</td>
<td>33.196</td>
<td>Superior</td>
</tr>
<tr>
<td>1269</td>
<td>919.9</td>
<td>470.732</td>
<td>6886.073</td>
<td>120.971</td>
<td>16.3</td>
<td>21.669</td>
<td>90.5</td>
<td>23.838</td>
<td>Superior</td>
</tr>
<tr>
<td>1272</td>
<td>686.9</td>
<td>439.336</td>
<td>6259.435</td>
<td>108.485</td>
<td>18.7</td>
<td>21.351</td>
<td>86.1</td>
<td>27.425</td>
<td>Superior</td>
</tr>
</tbody>
</table>

6
Figure 1. Fe versus Ti concentration plot for the archaeological samples.

Figure 2. Rb versus Sr concentration plot for the archaeological samples.
Figure 3. Sr versus Zr concentration plot for the archaeological samples.
INVOICE

UNIVERSITY OF CALIFORNIA, BERKELEY

M. STEVEN SHACKLEY, Ph.D.
X-RAY FLUORESCENCE SPECTROMETRY
PHOEBE HEARST MUSEUM OF ANTHROPOLOGY
103 KROEBER HALL

BERKELEY, CALIFORNIA 94720
USA

Margerie Green, Ph.D.
Archaeological Consulting Services
P.O. Box 27294
Tempe, AZ 85285

re: Rillito/Toltec Pipeline Project

8 December 1992

X-ray fluorescence analysis of 6 obsidian specimens from AZ AA:2:62(ASM). 6 specimens @ $20.00/specimen = $120.00

This invoice is due and payable within 30 days to:

M. Steven Shackley at the above address.

M. Steven Shackley
Assistant Research Professor

enclosure

TELEPHONE: 510/642-3681
FAX: 510/643-8557
BITNET: SHACKLEY @ UCBCMSA
INTERNET: SHACKLEY @ cmsa.berkeley.edu
Dear Dr. Shackley,

Dave Gregory would like to have several more obsidian samples tested and sourced. These all come from the same project and site as the ones previously completed, the Rillito/Toltec Pipeline Project, Site AZ AA:2:62(ASM).

Thank You,

Karolyn Jackman Jensen
Lab Director
Archaeological Consulting Services, Ltd.

[Signature]

Dave Gregory
(602) 367-2221
ARIZONA STATE MUSEUM
COLLECTIONS RELEASED FORM

Institution: Archaeological Consulting Svcs
Project Name: Rillito/Toltec Pipeline Loops
Project Sponsor: Santa Fe Pacific

Release to: Dr. Steve Shackley
Phoebe Hurst Museum of Anthropology
103 Kroebier Hall UC Berkeley Berkeley, CA 94720

For the purpose of: Obsidian X Ray Fluorescence
Date to be Returned: ASAP

Authorized by: Karolyn Jackman Jensen

Describe the material released, including specific field or specimen numbers, provenience of the material, the type of analysis to be conducted, whether or not the analysis is destructive, and whether or not the material is to be returned.

Process is non-destructive— all specimens will be returned

Site AZ AA:2:62(ASM)

Bag # 225 Feature 12 Prov 85-86N 51.63-53E Stratum 1 Level 1 1.85-2.07 MBD
Bag # 329 Feature 12 Prov 83-84N 50-51 E Stratum 3 Level 2 2.20-2.31 MBD
Bag # 400 Feature 3 Prov 52-54 N 51.63-53 E Stratum 1 Level 1 1.48-1.57 MBD
Bag # 734 Feature 10 Prov 108-110 N 59.63-53 E Stratum 1 Level 1 1.85-2.08 MBD
Bag # 1269 Feature 3 Prov 52-54N 51.63-53 E Stratum 2 Level 1 1.57-1.70 MBD
Bag 1272 Feature 21 Prov 106-108 N 51.63-53 E Stratum 1 Level 2 1.59-1.83 MBD

Receipt of material from Project is hereby acknowledged:

Signature __________________ Date __________________

Return of material to Project is hereby acknowledged:

Signature __________________ Date __________________

11/20/1984