Title
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AN ENERGY DISPERSIVE X-RAY FLUORESCENCE (EDXRF) ANALYSIS OF ONE FOLSOM AND TWO ARCHAIC PROJECTILE POINTS FROM BIG CHINO WASH, PRESCOTT NATIONAL FOREST, NORTHERN ARIZONA

by

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for

Chino Valley Ranger District
Prescott National Forest
Chino Valley, Arizona

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INTRODUCTION

The analysis of archaeological obsidian in northern Arizona lags somewhat behind other areas of the Southwest although recent work suggests some important procurement patterns of the important sources in northern Arizona (Lesko 1989; Shackley 1988; 1990, 1991).

The two important archaeological obsidian sources in northern Arizona are represented in the assemblage. The possible Folsom point fragment and the Archaic point from AR-03-09-01-520 are produced from Government Mountain glass in the San Francisco Volcanic Field, and the Archaic point from AR-03-09-01-581 was produced from Partridge Creek glass in the Mount Floyd Volcanic Field. All the sources mentioned here are discussed by Lesko (1989) and Shackley (1988, 1990).

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\textsuperscript{T}), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). Weight percent iron (Fe=Fe\textsubscript{2}O\textsubscript{3} \textsuperscript{T}) can be derived by multiplying ppm estimates by 1.4297. 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, 1992; also Mahood and Stimac 1991).

The data from the Tracor software were translated directly into Quattro Pro for Windows 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 17 samples by site. Figures 1 through 4 exhibit bivariate plots of five of the measured elements for the site data.

**DISCUSSION**

Little can be said about the source provenience of the artifacts. These bifaces were produced from the best of the nearest sources of obsidian in northern Arizona. This is,
however, the first known case of a fluted point produced from Government Mountain obsidian. This procurement pattern was also common in a larger study that included Archaic projectile points in northern Arizona (Shackley 1991).

REFERENCES CITED

Govindaraju, K.

Hampel, Joachim H.

Lesko, Lawrence M.

Mahood, Gail A., and James A. Stimac

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

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 can be found in 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>1513.24±46</td>
<td>232.86±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 three obsidian projectile points from northern Arizona sites. All values are 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>1044</td>
<td>807.2</td>
<td>1120.7</td>
<td>10755.1</td>
<td>97.1</td>
<td>77.5</td>
<td>19.7</td>
<td>79.8</td>
<td>49.0</td>
<td>Government Mtn</td>
</tr>
<tr>
<td>520</td>
<td>303.5</td>
<td>527.8</td>
<td>9003.6</td>
<td>104.6</td>
<td>76.9</td>
<td>19.1</td>
<td>79.8</td>
<td>49.4</td>
<td>Government Mtn</td>
</tr>
<tr>
<td>581</td>
<td>384.2</td>
<td>475.3</td>
<td>8710.3</td>
<td>244.8</td>
<td>7.1</td>
<td>35.9</td>
<td>93.4</td>
<td>50.9</td>
<td>Partridge Cr</td>
</tr>
</tbody>
</table>
Figure 1. Y versus Zr concentration plot of archaeological obsidian (G=Government Mountain; P=Partridge Creek) Ellipses represent plot of analyzed standards for Government Mountain and Partridge Creek sources. Single plot entries for artifacts indicate overlap.

Figure 2. Sr versus Zr concentration plot of archaeological obsidian (G=Government Mountain; P=Partridge Creek) Ellipses represent plot of analyzed standards for Government Mountain and Partridge Creek sources. Single plot entries for artifacts indicate overlap.
Figure 3. Rb versus Zr concentration plot of archaeological obsidian (G=Government Mountain; P=Partridge Creek) Ellipses represent plot of analyzed standards for Government Mountain and Partridge Creek sources. Single plot entries for artifacts indicate overlap.

Figure 4. Y versus Nb concentration plot of archaeological obsidian (G=Government Mountain; P=Partridge Creek) Ellipses represent plot of analyzed standards for Government Mountain and Partridge Creek sources. Single plot entries for artifacts indicate overlap.