SOURCE PROVENANCE OF PALEOINDIAN OBSIDIAN ARTIFACTS FROM THE SALLY RICHARDS COLLECTION, QUAY COUNTY, NEW MEXICO, AND THE ESCAPULE SITE, ARIZONA

Folsom and Late Paleoindian Projectile Points from the Sally Richards Collection, Quay County, New Mexico

by

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INTRODUCTION

The analysis here of four obsidian artifacts from Quay County, New Mexico, and the Escapule Site, Cochise County, Arizona indicates the high residential mobility posited for Paleoindian hunter-gatherers with sources for the artifacts in these contexts from hundreds of kilometers distant. A short discussion follows on this social pattern during the earliest occupation of the North American Southwest.

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 Nelson and Tingey (n.d.) and Shackley (1995, 2005) and source standard data at this lab (Table 1, and Figures 1 and 2).

**DISCUSSION**

Recent and continuing research on obsidian provenance in Paleoindian contexts in the U.S. Southwest indicate great distances to source, probable expanded procurement ranges, and likely territorial signatures (Hamilton et al. 2013; Shackley 1990, 2005). The two sources used to produce the artifacts in these two collections are two that were used commonly in Clovis, Folsom, and later Paleoindian contexts throughout the region (Hamilton et al. 2009, 2013; Huckell et al. 2008, 2012; Johnson et al. 2010; Shackley 2007; Vierra et al. 2012).

Cow Canyon obsidian from eastern Arizona was a source relatively commonly used in Clovis contexts in southern Arizona and New Mexico (Hamilton et al. 2008; 2013; Shackley 2007). I have not seen it in Folsom and later Paleoindian context before the Sally Richards artifacts from Quay County, New Mexico (Table 1 here). The length of these projectile points is near the maximum available at the primary source at Cow Canyon, and the secondary contexts in the 111 Ranch Formation in the San Simon Valley of southern Arizona, probably indicating early access to the largest marekanites (see Shackley 2005). Cow Canyon was used exclusively by Clovis knappers at Murray Springs in southern New Mexico, and occurs in contemporaneous
contexts in Socorro County, New Mexico (Hamilton et al. 2009, 2013; Shackley 1990, 2007). The direct distance from Cow Canyon to the western edge of Quay County is over 500 km.

A word about the Malad, Idaho versus Cow Canyon, Arizona source provenance is in order. Both these sources occur in Paleoindian contexts in western North America, and exhibit very similar elemental chemistry except in barium, and to a certain extent zirconium and thorium. Plots of these elements as shown in Figures 1 and 2 separate these well.

The one angular flake from the Escapule Site is certainly from the Valles Rhyolite (Cerro del Medio) source in the Jemez Mountains of northern New Mexico. The eruptive event that produced this source is quite recent (ca.1 mya), and is not available in secondary deposits in any size or quantity, and must have been originally procured from Cerrro del Medio (see Shackley 2012). Similar to the distance for the Quay County artifacts, Valles Caldera is over 500 direct km to the Escapule Site.

The obsidian source provenance of these Paleoindian artifacts indicate the large procurement distances and procurement ranges or exchange that appears to be common during this early period.

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Shackley, M. Steven


Vierra, B.J., M.A. Jodry, M. Steven Shackley, and M. J. Dilley,

Table 1. Elemental concentrations and source assignments for the archaeological specimens, and analysis of USGS RGM-1 obsidian standard. All measurements in parts per million (ppm).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Ti</th>
<th>Mn</th>
<th>Fe</th>
<th>Zn</th>
<th>Rb</th>
<th>Sr</th>
<th>Y</th>
<th>Zr</th>
<th>Nb</th>
<th>Ba</th>
<th>Pb</th>
<th>Th</th>
<th>Source</th>
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<tbody>
<tr>
<td>SR-1</td>
<td>1369</td>
<td>316</td>
<td>1053</td>
<td>28</td>
<td>129</td>
<td>83</td>
<td>18</td>
<td>143</td>
<td>10</td>
<td>1039</td>
<td>19</td>
<td>25</td>
<td>Cow Canyon/111 Ranch, AZ</td>
</tr>
<tr>
<td>SR-2</td>
<td>1120</td>
<td>358</td>
<td>8739</td>
<td>38</td>
<td>112</td>
<td>75</td>
<td>19</td>
<td>100</td>
<td>12</td>
<td>945</td>
<td>19</td>
<td>17</td>
<td>Cow Canyon/111 Ranch, AZ</td>
</tr>
<tr>
<td>SR-3</td>
<td>1170</td>
<td>394</td>
<td>9248</td>
<td>39</td>
<td>114</td>
<td>76</td>
<td>20</td>
<td>100</td>
<td>13</td>
<td>943</td>
<td>20</td>
<td>15</td>
<td>Cow Canyon/111 Ranch, AZ</td>
</tr>
<tr>
<td>ESC-1</td>
<td>987</td>
<td>362</td>
<td>9997</td>
<td>61</td>
<td>157</td>
<td>48</td>
<td>161</td>
<td>56</td>
<td>55</td>
<td>25</td>
<td>21</td>
<td>Valles Rhy. (Cerro del Medio), NM</td>
<td></td>
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<tr>
<td>RGM1-S4</td>
<td>1686</td>
<td>288</td>
<td>1343</td>
<td>35</td>
<td>150</td>
<td>110</td>
<td>23</td>
<td>222</td>
<td>8</td>
<td>823</td>
<td>22</td>
<td>14</td>
<td>standard</td>
</tr>
</tbody>
</table>
Figure 1. Ba versus Th bivariate plot of the archaeological specimens from the Sally Richards collection and source standard data from the Cow Canyon, Arizona source and the Malad, Idaho source that are similar elementally.
Figure 2. Ba versus Zr bivariate plot of the archaeological specimens from the Sally Richards collection and source standard data from the Cow Canyon, Arizona source and the Malad, Idaho source that are similar elementally.