Title
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Author
Shackley, M. Steven

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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM FOUR SITES ALONG NEW MEXICO STATE HIGHWAY 6, CENTRAL, NEW MEXICO

Site locations and known sources present in the project site.

by

M. Steven Shackley Ph.D., Director
Geoarchaeological XRF Laboratory
Albuquerque, New Mexico

Report Prepared for

Dr. Kenneth Brown
TRC Environmental Corporation
Albuquerque, New Mexico

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INTRODUCTION

The analysis here of 18 obsidian artifacts from four sites along New Mexico State Highway 6 is dominated by one of the two sources from the Mount Taylor Volcanic Field, the primary source of which are approximately 90 km north, but these source are available as secondary deposits in Rio Puerco Quaternary alluvium very near these sites (Shackley 1998, 2005; see cover image here). One artifact was produced from the Valles Rhyolite (Cerro del Medio) source in northern New Mexico, none of which is available as secondary deposits this far south in Rio Grande alluvium (Shackley 2012).

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 Geoarchaeological 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 $\text{Fe}_2\text{O}_3$), 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 (ver. 21) 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, 2005 and updated at http://swxrf.lab.net/swobsrs.htm; see Table 1 and Figure 1.

DISCUSSION

The vast majority of the artifacts were produced from the Grants Ridge source in the Mount Taylor Volcanic Field, with one produced from the Horace/La Jara Mesa source (Table 1). Both these Mount Taylor sources are available as secondary deposits in the Rio Puerco. The cortex on some of the artifacts, particularly visible on a core fragment (Sample 7, LA 128085) is not what is common at the primary source (see Shackley 1998, 2005). It appears that much of the Mount Taylor raw material was likely procured in Rio Puerco alluvium.

The small piece of debitage produced from Valles Rhyolite obsidian is more difficult to determine provenance (Sample 7, LA 6554). A few very small nodules of Valles Rhyolite were recovered from Rio Grande Quaternary alluvium at Tijeras Wash above the Rio Grande, but these were less than 12 mm in diameter as compared to 10 cm size nodules from Cerro Toledo Rhyolite at this locality (Shackley 2012). It is likely that the original stone was procured from Valles Caldera proper.
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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, and USGS RGM-1 obsidian standard. All measurements in parts per million (ppm).

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Figure 1. Nb versus Y bivariate plot of the elemental concentrations for all the archaeological specimens.