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An Energy Dispersive X-ray Fluorescence (EDXRF) Analysis of an Obsidian Artifact from Pueblo Viejo (AZ T:12:73 ASM), Central Arizona

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AN ENERGY DISPERSIVE X-RAY FLUORESCENCE (EDXRF) ANALYSIS OF AN OBSIDIAN ARTIFACT FROM PUEBLO VIEJO (AZ T:12:73 ASM), CENTRAL ARIZONA

by

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INTRODUCTION

This report documents the EDXRF analysis of one piece of obsidian debitage recovered from a trash context of probable Classic period origin. The source provenience of Sauceda Mountains is consistent with a Classic period assignment, but this source was used throughout the prehistoric record in Arizona in the production of flaked stone tools (Shackley 1988, 1990, 1991a).

ANALYSIS AND INSTRUMENTATION

Unlike the earlier study of Southwestern obsidians (Shackley 1988, 1990), these data are generated under different analytical conditions (see Shackley 1991b, 1992). These results 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 data for elements titanium (Ti), manganese (Mn), 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 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 Southwestern obsidians is available in Shackley (1988, 1990).

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. Source probability is based on a comparison with 1-sigma levels of variability. Table 2 exhibits the trace element concentrations for the piece of obsidian debitage.

DISCUSSION OF RESULTS

Figures 1 and 2 display concentration plots of the major known western Sonoran Desert obsidian sources and the analyzed artifact. Sauceda Mountains obsidian is rather unique in its concentration of strontium in this group, and the assignment of the artifact to this source is confident. This source comprised the largest proportion of the analyzed obsidian (n=220) from mainly Classic period contexts at Pueblo Grande, and appears to be favored during this period (Peterson et al. 1992). It is a very fine medium for tool production and can be found in nodules up to 10 cm in diameter, a size rather large for most of the Tertiary glasses in the Southwest (Shackley 1990).

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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.

SAMPLE	Ti	Mn	Rb	Sr	Y	Zr	Nb	Ba
RGM-1 (Govindaraju 1989)	2670	360	149	108	25	219	8.9	807
RGM-1 (this study)	2433.07±147.1	321.12±16.75	150±3.4	105±1.7	26±0.9	218±5	9.5±1.1	844±48.86
NBS-278 (Govindaraju 1989)	2450	520	127.5	63.5	41	295	n.r.[1]	1140
NBS-278 (this study)	n.m.	n.m.	126±1.9	62±2.3	40±2.2	280±3.6	14±1.4	n.m.

[1] n.r = no report; n.m. = not measured

Table 2. X-ray fluorescence concentrations for obsidian artifact from Pueblo Viejo (AZ T:12:73 ASM), central Arizona. All values are in parts per million (ppm).

SAMPLE	Ti	Mn	Rb	Sr	Y	Zr	Nb	Source
228	1487.58	260.013	140.204	71.219	31.475	180.432	18.091	Sauceda Mts

Figure 1. Sr versus Zr concentration plot for western Sonoran Desert obsidians and obsidian artifact from Pueblo Viejo (X= analyzed artifact).

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             +
             |           T
     142.5+      TTT T    Tank Mts
             |     T T
             |
             |                                S
             |                            SSS S
Sr      95+            Sauceda Mts    S
(ppm)        |                                            S
             |                                S S
             |                            X
      47.5+             V     Vulture
             |           VVVV
             |
             |SS SSS
             | S      Superior
             +-+----+----+----+----+----+----+----+-+
                  100       140       180       220
               80      120       160       200

                        Zr (ppm)
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Figure 2. Y versus Zr concentration plot for western Sonoran Desert obsidians and obsidian artifact from Pueblo Viejo (X= analyzed artifact).