

# UC Berkeley

## Archaeological X-ray Fluorescence Reports

### Title

Source Provenance of Folsom Point Fragments and Debitage from the Boca Negra Wash Site (LA 124474), West Mesa, Albuquerque, New Mexico

### Permalink

<https://escholarship.org/uc/item/82r1n03c>

### Author

Shackley, M. Steven

### Publication Date

2010-01-08

### Supplemental Material

<https://escholarship.org/uc/item/82r1n03c#supplemental>

### Copyright Information

This work is made available under the terms of a Creative Commons Attribution-NonCommercial License, available at <https://creativecommons.org/licenses/by-nc/4.0/>

# BERKELEY ARCHAEOLOGICAL



## XRF LAB

Department of Anthropology  
232 Kroeber Hall  
University of California  
Berkeley, CA 94720-3710

### SOURCE PROVENANCE OF FOLSOM POINT FRAGMENTS AND DEBITAGE FROM THE BOCA NEGRA WASH SITE (LA 124474), WEST MESA, ALBUQUERQUE, NEW MEXICO



FS 2021



FS 1753



by

M. Steven Shackley  
Professor and Director  
Geoarchaeological XRF Laboratory  
University of California, Berkeley

Report Prepared for

Dr. Bruce Huckell  
Maxwell Museum of Anthropology  
University of New Mexico, Albuquerque

8 January 2010

## INTRODUCTION

The analysis here of two Folsom point fragments and two debitage pieces indicates that all the artifacts were produced from raw material procured from Cerro del Medio, part of Valles Rhyolite (Tewa Member) of the Valles Caldera, Jemez Mountain, northern New Mexico. While a very small amount of Valles Rhyolite obsidian is present in the Rio Grande Quaternary alluvium as far south as Tijeras Wash, the largest size recovered is only 16 mm in maximum dimension (Shackley, in preparation). The projectile points here were most likely produced from obsidian originally procured at the primary source in the caldera (see Shackley 2005a). Valles Rhyolite obsidian is dominant at Boca Negra Wash, possibly suggesting frequent visits to the caldera and the Jemez Mountains by this particular Folsom group (Shackley 2005b).

## 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).

The trace element analyses were performed in the NSF Geoarchaeological XRF Laboratory, Department of Anthropology, University of California, Berkeley, using a Thermo Scientific *Quant'X* energy dispersive x-ray fluorescence spectrometer. The spectrometer is equipped with a ultra-high flux peltier air cooled Rh x-ray target with a 125 micron beryllium (Be) window, an x-ray generator that operates from 4-50 kV/0.02-1.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTrace<sup>TM</sup> 4.1 reduction software. The x-ray beam is conducted through an 8.8 mm tube collimator for samples larger than 10 mm in

minimum diameter. For samples below that threshold, the beam is conducted through a 3.5 mm tube collimator. The spectrometer is equipped with a 2001 min<sup>-1</sup> Edwards vacuum pump for the analysis of elements below titanium (Ti). Data is acquired through a pulse processor and analog to digital converter. This is a significant improvement in analytical speed and efficiency beyond the former Spectrace 5000 and *QuanX* analog systems (see Davis et al. 1998; Shackley 2005a).

For Ti-Nb, Pb, Th elements the mid-Zb condition is used operating the x-ray tube 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  $K\alpha_1$ -line data for elements titanium (Ti), manganese (Mn), iron (as Fe<sup>T</sup>), 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 is 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 acquired, the Rh tube is operated at 50 kV and 0.5 mA in an air path at 200 seconds livetime to generate x-ray intensity  $K\alpha_1$ -line data, through a 0.630 mm Cu (thick) filter ratioed to the bremsstrahlung region (see Davis et al. 1998). Further details concerning the petrological choice of these elements in North American obsidians is available in Shackley (1988, 1990, 1995, 2005; also Mahood and Stimac 1991; and Hughes and Smith 1993). A suite of 17 specific standards used for the best fit regression calibration for elements Ti- Nb, Pb, and Th, 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), BCR-2 (basalt), TLM-1 (tonalite), SCO-1 (shale), all US Geological Survey standards, NBS-278 (obsidian) from the National Institute of Standards and Technology, BR-1 (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 and into SPSS for statistical manipulation (Table 1). In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run (Table 1). Source assignments made by reference to source data at Berkeley (see Shackley (2005a). For the small sample (FS 2000) measuring about 9.3 X 5.0 mm, the 3.5 mm tube collimator was used yielding data well within the Valles Rhyolite source standard data (Table 1). The RGM-1 standard data was acquired using the 3.5 mm collimator as well.

#### REFERENCES CITED

- Davis, M.K., T.L. Jackson, M.S. Shackley, T. Teague, and J. Hampel  
1998 Factors Affecting the Energy-Dispersive X-Ray Fluorescence (EDXRF) Analysis of Archaeological Obsidian. In *Archaeological Obsidian Studies: Method and Theory*, edited by M.S. Shackley, pp. 159-180. Springer/Plenum Press, New York.
- Govindaraju, K.  
1994 1994 Compilation of Working Values and Sample Description for 383 Geostandards. *Geostandards Newsletter* 18 (special issue).
- Hampel, Joachim H.  
1984 Technical Considerations in X-ray Fluorescence Analysis of Obsidian. In *Obsidian Studies in the Great Basin*, edited by R.E. Hughes, pp. 21-25. Contributions of the University of California Archaeological Research Facility 45. Berkeley.

Hildreth, W.

1981 Gradients in Silicic Magma Chambers: Implications for Lithospheric Magmatism. *Journal of Geophysical Research* 86:10153-10192.

Hughes, Richard E., and Robert L. Smith

1993 Archaeology, Geology, and Geochemistry in Obsidian Provenance Studies. In *Scale on Archaeological and Geoscientific Perspectives*, edited by J.K. Stein and A.R. Linse, pp. 79-91. Geological Society of America Special Paper 283.

Mahood, Gail A., and James A. Stinac

1990 Trace-Element Partitioning in Pantellerites and Trachytes. *Geochemica et Cosmochimica Acta* 54:2257-2276.

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

1981 Least-Squares Fit with Digital Filter: A Status Report. In *Energy Dispersive X-ray Spectrometry*, edited by K.F.J. Heinrich, D.E. Newbury, R.L. Myklebust, and C.E. Fiori, pp. 273-296. National Bureau of Standards Special Publication 604, Washington, D.C.

Schamber, F.H.

1977 A Modification of the Linear Least-Squares Fitting Method which Provides Continuum Suppression. In *X-ray Fluorescence Analysis of Environmental Samples*, edited by T.G. Dzubay, pp. 241-257. Ann Arbor Science Publishers.

Shackley, M. Steven

1988 Sources of Archaeological Obsidian in the Southwest: An Archaeological, Petrological, and Geochemical Study. *American Antiquity* 53(4):752-772.

1990 *Early Hunter-Gatherer Procurement Ranges in the Southwest: Evidence from Obsidian Geochemistry and Lithic Technology*. Ph.D. dissertation, Arizona State University, Tempe.

1995 Sources of Archaeological Obsidian in the Greater American Southwest: An Update and Quantitative Analysis. *American Antiquity* 60(3):531-551.

2005a *Obsidian: Geology and Archaeology in the North American Southwest*. University of Arizona Press, Tucson.

2005b Paleoindian Basalt and Obsidian Sources in the North American Southwest: A Preliminary Model of Late Paleoindian Territoriality. Paper presented in the Symposium on Archaeological Geology, Geological Society of America, Annual Meeting, Salt Lake City, Utah.

y7Table 1. Elemental concentrations for the archaeological specimens and the USGS RGM-1 standard. All measurements in parts per million (ppm).

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
FS1753	984	416	10811	164	8	45	155	53	Valles Rhyolite
FS2000 <sup>1</sup>	1185	451	12054	176	7	43	164	52	Valles Rhyolite
FS2021	735	423	10023	173	7	46	162	56	Valles Rhyolite
FS2059	1114	436	10548	166	6	41	154	56	Valles Rhyolite
RGM1-S4	1509	280	12577	150	108	28	218	9	standard

<sup>1</sup> These data acquired using the 3.5 mm tube collimator (see text above.)