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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM VARIOUS SITES IN IOWA

by

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Report Prepared for

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INTRODUCTION

The eight artifacts from Iowa analyzed here are all from one of the sources in Wyoming, dominated by those from the Yellowstone Volcanic Field. These are the nearest sources to the sites, and not unexpected.

LABORATORY SAMPLING, ANALYSIS AND INSTRUMENTATION

This assemblage was analyzed on a Spectrace/Thermo *QuanX* energy-dispersive x-ray spectrometer at the Archaeological XRF Laboratory, Department of Earth and Planetary Sciences at the University of California, Berkeley. All samples were analyzed whole with little or no formal preparation. 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 spectrometer is equipped with an electronically cooled Cu x-ray target with a 125 micron Be window, an x-ray generator that operates from 4-50 kV/0.02-2.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTrace™ reduction software. The x-ray tube is operated at 30 kV, 0.14 mA, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity Kα-line data for elements titanium (Ti), manganese (Mn), iron (as Fe^T), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). Weight percent iron ($Fe_2O_3^T$) can be derived by multiplying ppm estimates by 1.4297(10-4). Trace element intensities were converted to concentration estimates by employing a least-squares calibration line established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology

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(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). Further details concerning the petrological choice of these elements in Southwest obsidians is available in Shackley (1992, 1995, 2005; also Mahood and Stimac 1990; and Hughes and Smith 1993). Specific standards used for the best fit regression calibration for elements Ti through Nb include G-2 (basalt), AGV-1 (andesite), GSP-1, SY-2 (syenite), BHVO-1 (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), all US Geological Survey standards, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France, and JR-1 and JR-2 obsidian standards from the Japan Geological Survey (Govindaraju 1994). In addition to the reported values here, Ni, Cu, Zn, Th, and Ga were measured, but these are rarely useful in discriminating glass sources and are not generally reported.

The data from both systems 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. An analysis of RGM-1 analyzed during each run is included in Table 1. Further information on the laboratory instrumentation can be found at: http://www.swxrflab.net/. Trace element data exhibited in Table 1 are reported in parts per million (ppm), a quantitative measure by weight (see also Figure 1).

Many artifacts in this assemblage were near the smallest size that can be reliably analyzed with EDXRF (see Davis et. al. 1998; Table 1 here). Those sources marked by "?" are somewhat outside the range of elemental concentrations for these sources, but close enough to assign to source. Two of the samples were too small to confidently analyze and assign to

source. Source assignment was made by reference to standards at Berkeley, Haarklau et al. (2005), and Nelson (1984).

DISCUSSION

It is not surprising to see the dominance of Wyoming sources in the collection. The movement west from this source is well documented in the literature, and these sources are nearest to Iowa sites (Anderson et al. 1986; Griffin et al. 1969; Hughes and Nelson 1987; see Figure 2 here). While the results were predictable, it adds more information to the obsidian source provenance data from Iowa.

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Table 1. Elemental concentrations and source assignments for the archaeological specimens. All measurements in parts per million (ppm).

| SITE/SAMPLE	Ti	Mn	Fe	Zn	Rb	Sr	Y	Zr	Nb	Source
CK71-48	968	246	10247	80	239	5	65	159	48	Obsidian Cliff, WY
CK71-479	812	238	9347	79	229	6	75	164	53	Obsidian Cliff, WY
LE357-135	1074	203	9419	79	226	9	81	163	42	Obsidian Cliff, WY
LA98-8	1074	442	11219	64	149	16	51	251	46	Grand Junction, WY?
AM100-903	1189	435	9947	50	123	136	18	141	12	Fish Creek, WY?
FSBN2	1326	400	12845	57	84	216	16	171	14	Green River, WY
LA84-958	978	247	11356	87	259	8	86	178	48	Obsidian Cliff, WY
SA93-2.2	910	264	10123	81	239	7	74	170	47	Obsidian Cliff, WY
RGM1-S3	1663	326	13225	34	151	112	25	216	11	standard
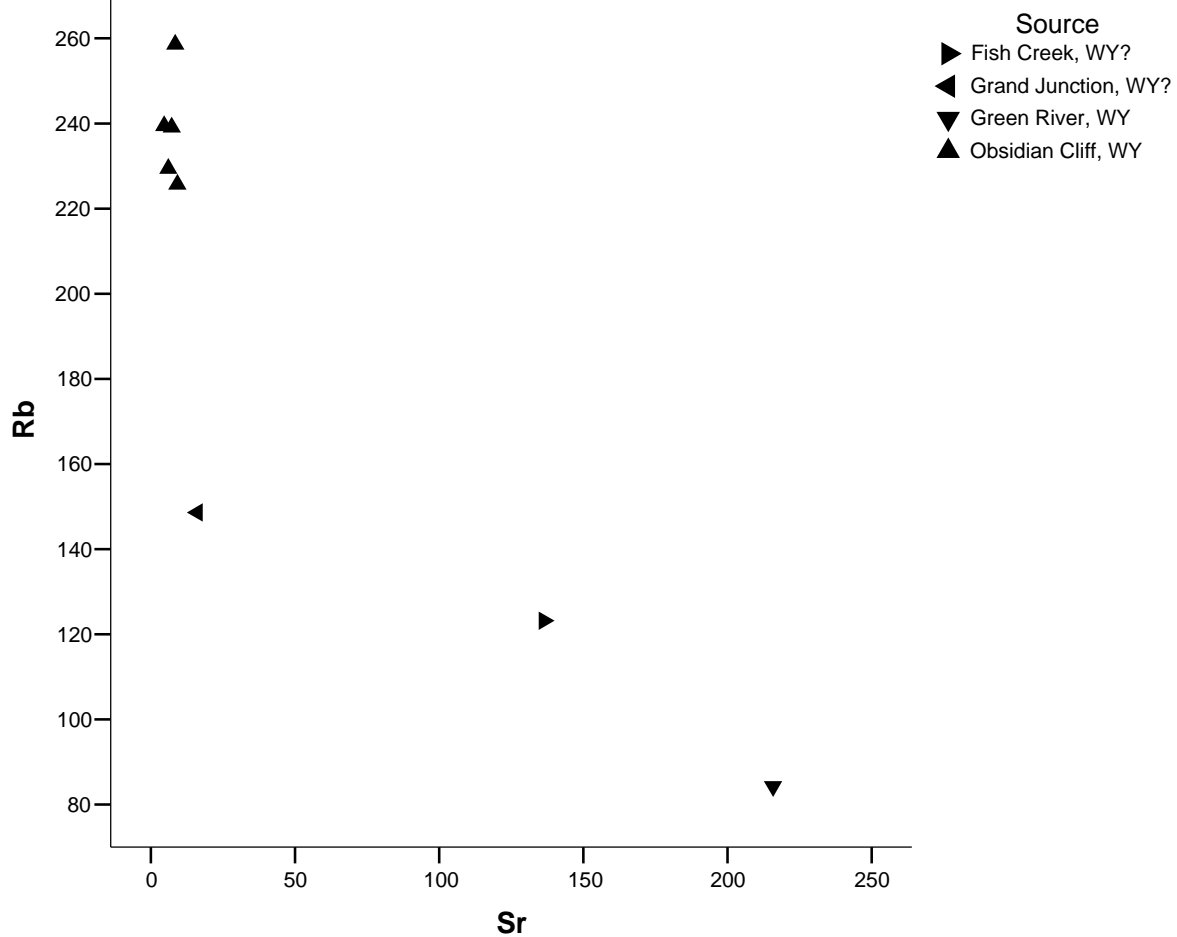
Figure 1. Rb versus Sr plot of the elemental concentrations for the archaeological specimens.
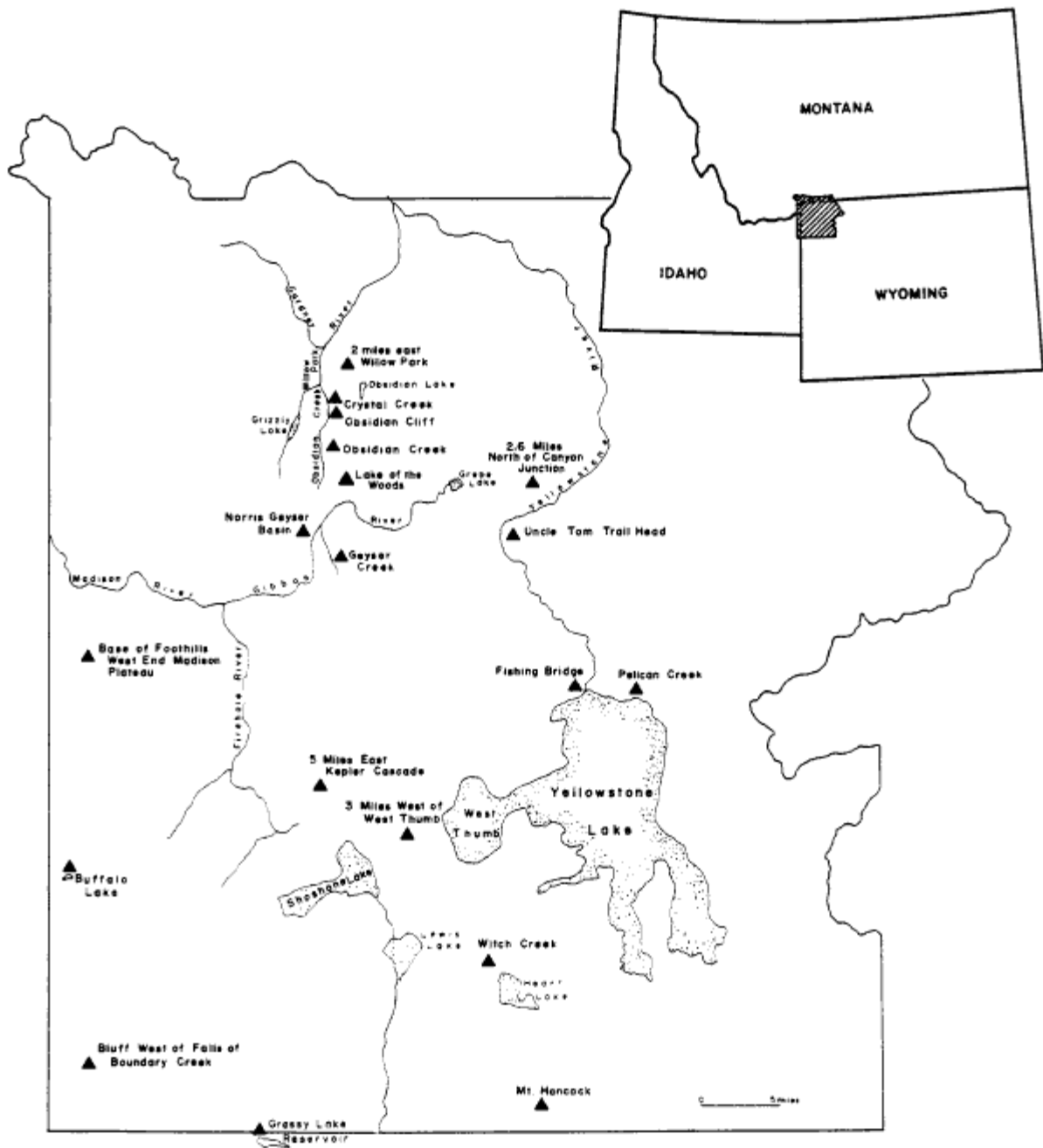
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Figure 2. Location of major sources of artifact quality obsidian in Wyoming (from Anderson et al. 1986).