AREVA

10 CFR 70.5

July 26, 2011

AES-O-NRC-11-01546

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

AREVA Enrichment Services LLC
Eagle Rock Enrichment Facility
NRC Docket No: 70-7015

Subject: Geochemical and Hydration Analyses of Obsidian Artifacts Collected at the Eagle Rock Enrichment Facility Site

As noted in the AREVA Enrichment Services LLC (AES) letter transmitting the data recovery report for archaeological site 10BV246 (Reference 1), AES hereby submits the subject report documenting the geochemical and hydration analyses of five obsidian artifacts collected at the Eagle Rock Enrichment Facility (EREF) site in 2010. In consultation with the Idaho State Preservation Office (SHPO), the five artifacts were submitted for x-ray fluorescence (XRF) analysis to determine the geochemical source of the obsidian and for obsidian hydration dating. All five of the artifacts were determined to be manufactured from obsidian that originated at the Big Southern Butte situated approximately 50 kilometers southwest of the EREF site. Three of the five artifacts yielded a hydration date of 2,215 years before present (BP); one was determined to have a hydration date of 9,574 years BP and one had no measurable hydration band.

Please note that the subject report amends the geochemical analysis report (Reference 2) previously transmitted and completes the requested analyses of artifacts collected from the EREF site.

If you have any questions regarding this submittal, please contact me at (508) 573-6554.

Respectfully,

J.A. Kay

Jim A. Kay
Licensing Manager

NMSS01

AREVA ENRICHMENT SERVICES LLC

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Reference:

1) AES Document No. AES-O-NRC-11-01494, dated June 27, 2011, Report of Archaeological Data Recovery at Site 10BV246: The John Leopard Homestead, Bonneville County, Idaho

2) AES Document No. AES-O-NRC-11-01513, dated July 6, 2011, Geochemical Analysis of Obsidian Artifacts Collected at the Eagle Rock Enrichment Facility Site

Enclosure:

1) Geochemical and Hydration Analyses of Obsidian Artifacts Collected at the Eagle Rock Enrichment Facility Site

cc:
Breeda Reilly, U.S. NRC Senior Project Manager
Steve Lemont, U.S. NRC Senior Project Manager
Bruce Biwer, Argonne National Laboratory
Ken Reid, Idaho State Historic Preservation Officer (2 copies)

Geochemical and Hydration Analyses of Obsidian Artifacts Collected at the Eagle Rock Enrichment Facility Site

July 11, 2011

Kenneth Reid, Ph.D.
State Archaeologist
Deputy State Historic Preservation Officer
Idaho State Historical Society
210 Main Street
Boise, ID 83702

Dear Dr. Reid,

In 2009 at the request of the Idaho State Historic Preservation Office (SHPO) State Archaeologist Dr. Kenneth Reid, WCRM collected five of the obsidian projectile point fragments recorded during the Class III inventory of the proposed Eagle Rock Enrichment Facility located in Bonneville County, Idaho in order to geologically source them. The results of this analysis are detailed in a letter report dated December 18, 2009 (Stoner 2009). As part of the plan to mitigate adverse effects of the Eagle Rock project to the John Leopard Homestead site (MW04/10BV246) the collection of the remaining obsidian bifacial artifacts within the project area for x-ray fluorescence (XRF) was proposed (Ringhoff and Stoner 2010).

This letter reports on the geochemical and obsidian hydration analyses of five obsidian bifacial artifacts collected in 2010 as part of the data recovery effort noted above. Of these, four of the obsidian artifacts were recovered from two sites (MW04/10BV246 and MW12) along with one isolated find (IF-18) by archaeologists from WCRM, Inc. in October of 2010 (**Figure 1**). Collected specimens were sent to Dr. Richard Hughes of Geochemical Research Laboratory for x-ray fluorescence analysis to determine the geochemical source of the obsidian used in their manufacture and to the Obsidian Hydration Laboratory of Dr. Thomas Origer for obsidian hydration dating; copies of both reports are attached.

Three specimens came from site MW12 (FS-4, FS-5, and FS-10). FS-4 is a small biface fragment made on a flake. FS-5 is a Stage II biface in two pieces, and FS-10 is the base of an Elko Series projectile point. One specimen came from site MW04/10BV246 and is a late stage biface or projectile point mid-section (FS-4). The remaining artifact is an isolated find (IF-18, an obsidian biface). All five of the obsidian artifacts were manufactured from obsidian that originated at the Big Southern Butte source which is located about 50 km from the project area (**Figure 2**).

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The Elko Series projectile point base (FS-10) dates to the Archaic Period (8000-1000 BP) in the Great Basin (Holmer 1986; Thomas 1981) and the Middle Prehistoric Period (7500-1300 BP) in the Snake River Plain (Plew 2000). Obsidian hydration dating of the of the artifacts indicate that three of them (Catalog numbers 530, 532 and 533, FS numbers 4 and 19 and IF-18) have hydration band widths of 3.8 microns and yielded a hydration date of 2215 BP which also falls within the Middle Prehistoric Period. This includes the Elko Series point base (Catalog number 532, FS-10). Catalog number 506 (FS-4) has a hydration band width of 7.0 microns and a hydration date of 9574 BP indicating a Late Paleoindian occupation of the area. Catalog number 531 (FS-5) had no measurable hydration band.

We hope you find this information useful. If you should have any questions or comments please do not hesitate to call me.

Sincerely,

Edward J. Stoner, RPA
Regional Manager, Northwest – Project Director
WCRM, Inc.

Encl: Geochemical Research Laboratory Letter Report 2011-51; and Origer's Obsidian Laboratory Report).

Cc: Tom Lennon (WCRM)
Stacy Thomson (Areva)

References Cited

Holmer, Richard N.
1986 Projectile points of the Intermountain Region. In *Anthropology of the Desert West: Essays in Honor of Jesse D. Jennings,* edited by Carol J. Condie and Don D. Fowler, pp. 89-115. University of Utah Press, Salt Lake City.

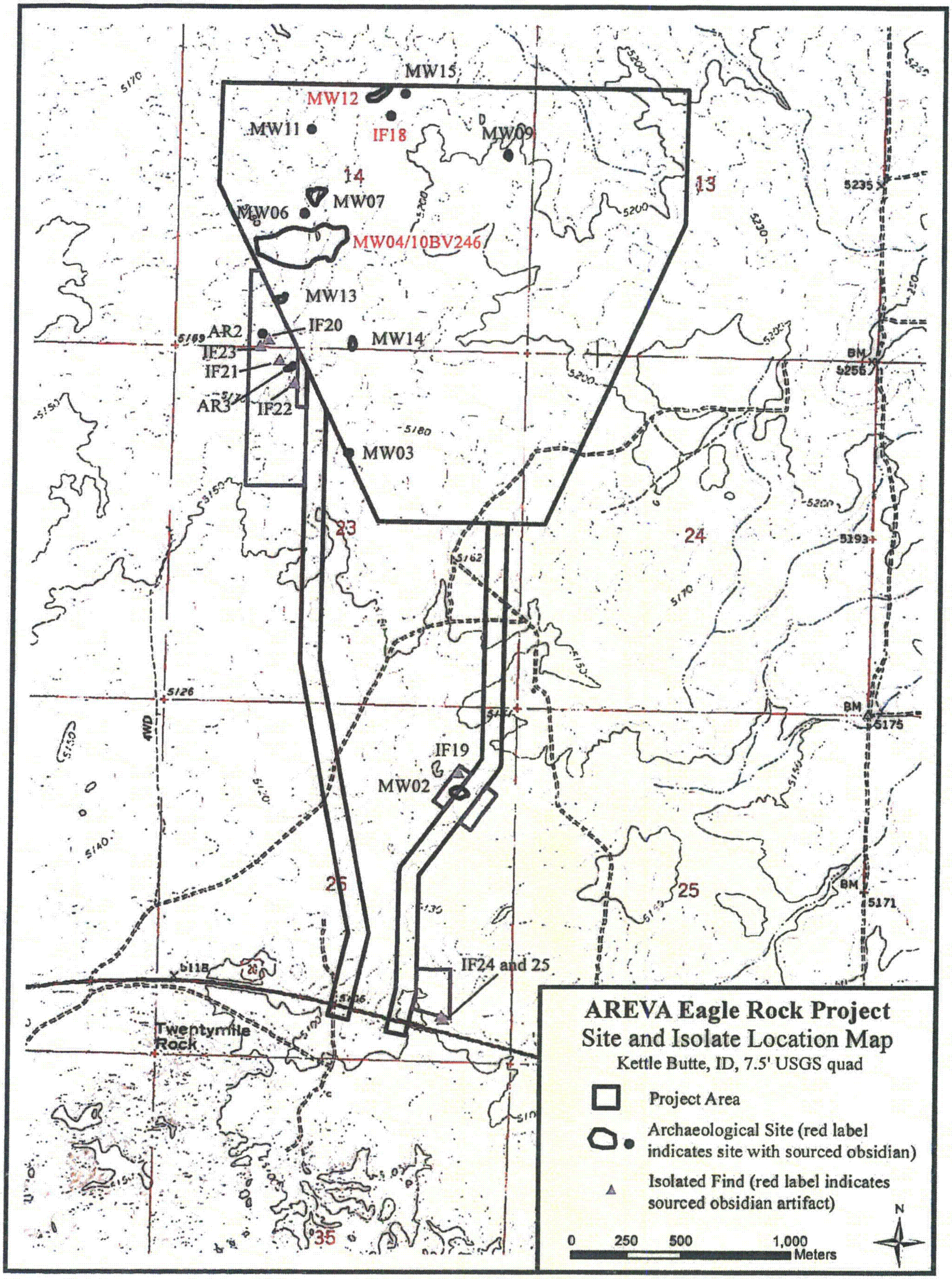
Plew, Mark G.
2000 *The Archaeology of the Snake River Plain.* Boise State University, Boise.

WCRM
Western Cultural Resource Management, Inc.

Ringhoff, Mary C. and Edward J. Stoner
2010 *A Treatment Plan for Historic Site MW004 in the Area of the Proposed Eagle Rock Enrichment Facility, Bonneville County, Idaho.* WCRM Report No. 09R130. Ms. on file Idaho State Historic Preservation Office, Boise.

Stoner, Edward J.
2010 Letter report to Dr. Ken Reid of the Idaho SHPO on the results of geochemical analysis of five obsidian artifacts collected from the proposed Eagle Rock Enrichment Facility in Bonneville County, Idaho dated December 18, 2009.

Thomas, David. H.
1981 How to Classify the Projectile Points from Monitor Valley, Nevada. *Journal of California and Great Basin Anthropology* 3(1):7-47.



MW15
MW12
MW11
IF18
MW09
14
13
MW07
MW06
MW04/10BV246
MW13
AR2
IF20
IF23
MW14
IF21
AR3
IF22
MW03
23
24
IF19
MW02
26
25
IF24 and 25
Twentymile Rock
35
4WD
5235
5256
5193
5175
5171
BM
AREVA Eagle Rock Project
Site and Isolate Location Map
Kettle Butte, ID, 7.5' USGS quad
Project Area
Archaeological Site (red label indicates site with sourced obsidian)
Isolated Find (red label indicates sourced obsidian artifact)
0
250
500
1,000
Meters
N

Figure 1

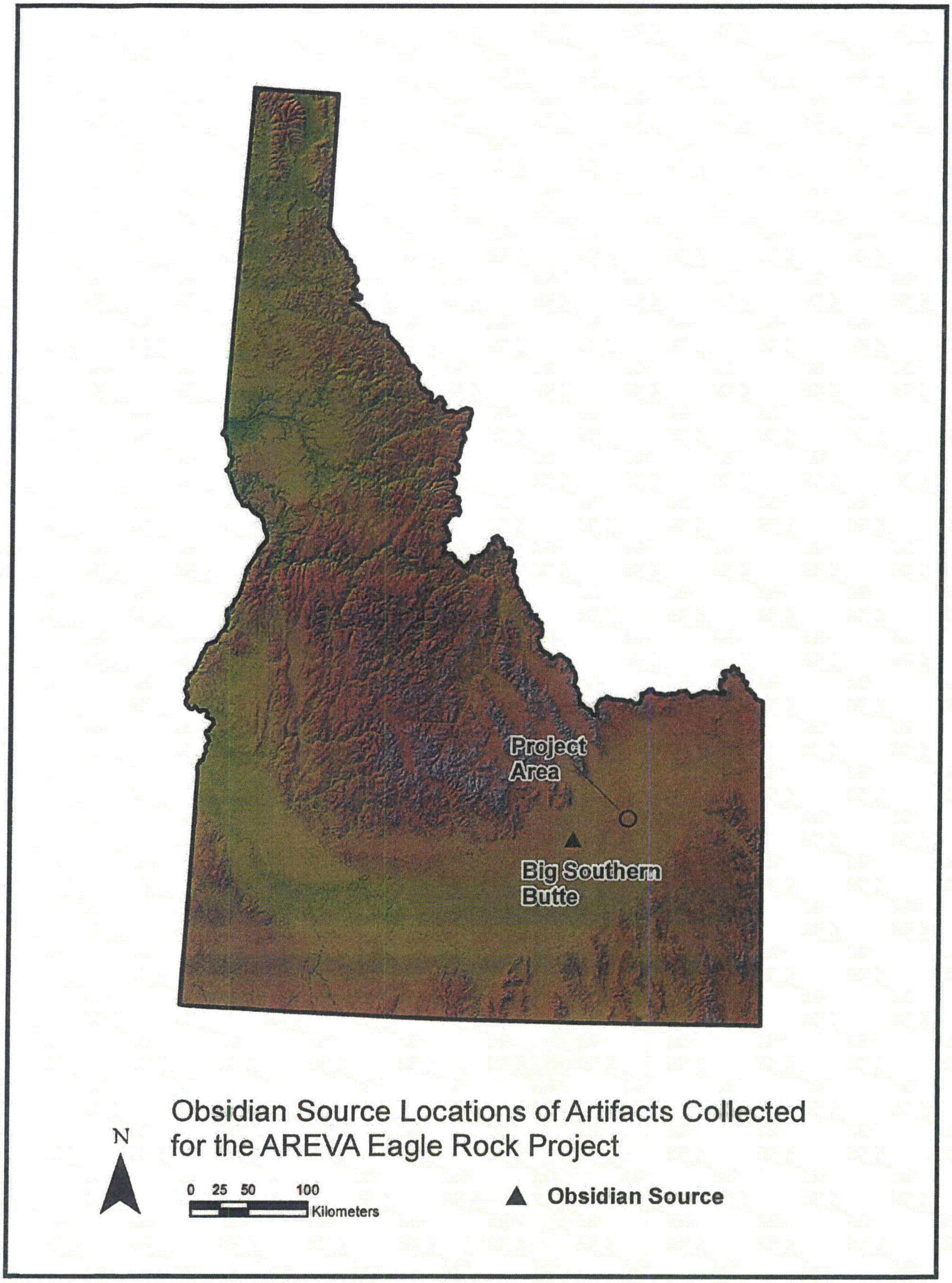

Project Area
Big Southern Butte
Obsidian Source Locations of Artifacts Collected for the AREVA Eagle Rock Project
N
0 25 50 100
Kilometers
Obsidian Source

Figure 2

Geochemical Research Laboratory Letter Report 2011-51

June 23, 2011

Mr. Edward J. Stoner
Western Cultural Resource Management, Inc.
50 Freeport Boulevard, Suite 15
Sparks, NV 89431

Dear Ed:

Enclosed with this letter you will find a table and figure presenting x-ray fluorescence (xrf) data generated from the analysis of five obsidian artifacts from archaeological sites and localities from the Eagle Rock project, west of Idaho Falls, Idaho. This research was conducted pursuant to your letter request of June 20, 2011.

Laboratory equipment, instrumentation, and literature references follow Hughes (2009). Otherwise, artifact-to-source (geochemical type) attribution procedures (except as indicated), element-specific measurement resolution specifications, and additional literature references applicable to these samples follow those I reported for obsidian from sites in the Ely area (Hughes 1998).

Table 1

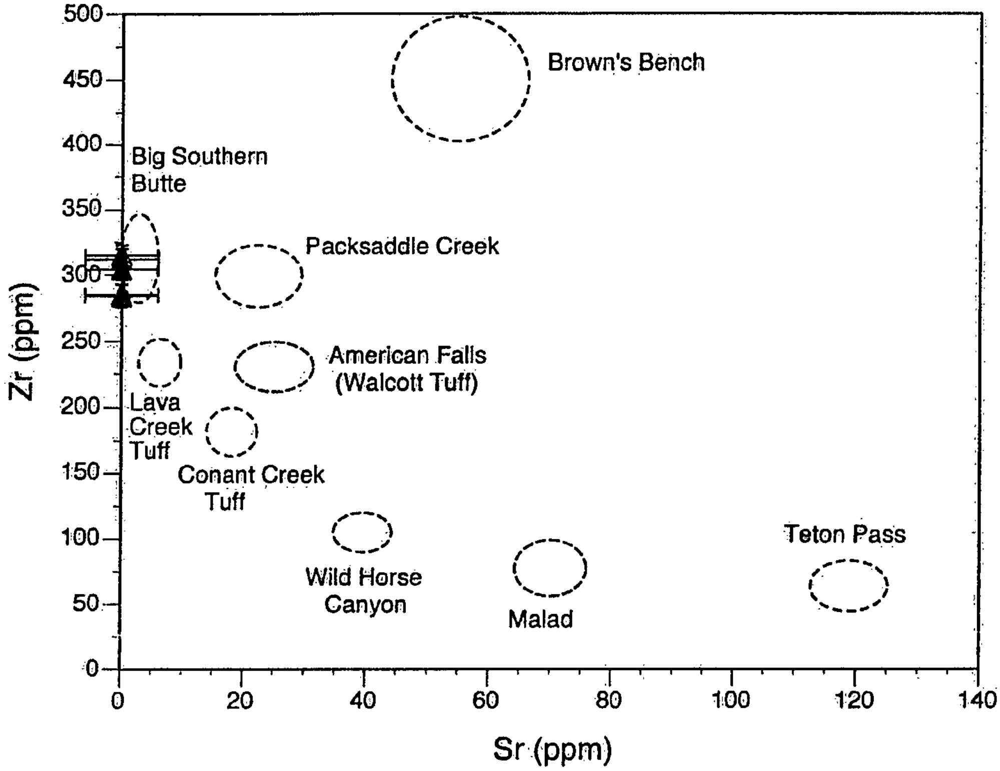
Quantitative Composition Estimates for Artifacts from the Eagle Rock Project, Idaho

	Trace Element Concentrations											**Ratio**	
Cat. Number	Zn	Ga	Rb	Sr	Y	Zr	Nb	Ba	Ti	Mn	$Fe_2O_3^T$	Fe/Mn	Obsidian Source (Chemical Type)
MW4, # 86	nm	nm	277 ±4	0 ±3	223 ±3	312 ±4	345 ±3	nm	nm	nm	nm	58	Big Southern Butte
MW12, # 87	nm	nm	298 ±4	0 ±3	221 ±3	304 ±4	342 ±3	nm	nm	nm	nm	56	Big Southern Butte
MW12, # 88	nm	nm	274 ±4	0 ±3	207 ±3	285 ±4	324 ±3	nm	nm	nm	nm	55	Big Southern Butte
MW12, # 89	nm	nm	286 ±4	0 ±3	225 ±3	315 ±4	343 ±3	nm	nm	nm	nm	56	Big Southern Butte
IF18, # 90	nm	nm	269 ±4	0 ±3	204 ±3	284 ±4	320 ±3	nm	nm	nm	nm	59	Big Southern Butte
U.S. Geological Survey Reference Standard													
RGM-1 (measured)	nm	nm	148 ±4	109 ±3	25 ±3	216 ±4	9 ±3	nm	nm	nm	1.87 ±.02	63	Glass Mtn., CA
RGM-1 (recommended)	32	15	149	108	25	219	9	807	1600	279	1.86	nr	Glass Mtn., CA

Values in parts per million (ppm) except total iron [in weight %] and Fe/Mn intensity ratios; ± = two σ estimate of x-ray counting uncertainty and regression fitting error at 120-240 seconds livetime. nm= not measured. nr= not reported.

Figure 1

Zr vs. Sr Composition for Artifacts from the Eagle Rock Project, Idaho



Dashed lines represent range of variation measured in archaeologically significant geologic obsidian source samples. Filled triangles plot artifacts listed in Table 1. Error bars are two-sigma (95% confidence interval) composition estimates for each specimen (from Table 1).

Edxrf data (in Table 1 and Figure 1) indicate that all five specimens were manufactured from obsidian of the Big Southern Butte chemical type. I hope this information will help in your overall analysis of material from these sites. Please contact me at my laboratory ([650] 851-1410; e-mail: rehughes@silcon.com) if I can be of further assistance.

Sincerely,

Richard L Hughes

Richard E. Hughes, Ph.D., RPA
Director, Geochemical Research Laboratory

REFERENCES

Hughes, Richard E.

1998 X-ray Fluorescence Analysis of Obsidian Artifacts from Three Archaeological Sites in White Pine County, Nevada. Geochemical Research Laboratory Letter Report 98-80 submitted to Edward J. Stoner, Western Cultural Resource Management, September 4, 1998.

2009 X-ray Fluorescence Analysis of Obsidian Artifacts from Two Archaeological Sites (26WP2353 and 26WP7420) Located Near Ely in White Pine County, Nevada. Geochemical Research Laboratory Letter Report 2009-3 submitted to Edward J. Stoner, Western Cultural Resource Management, February 9, 2009.

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July 8, 2011

Edward Stoner
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Sparks, NV 89431

Dear Edward:

I write to report the results of obsidian hydration band analysis of five specimens from sites and localities associated with the Eagle Rock project on the Snake River Plain west of Idaho falls in southeast Idaho. This work was expedited pursuant to your letter of transmittal dated July 7, 2011.

Procedures typically used by our lab for preparation of thin sections and measurement of hydration bands are described here. Specimens are examined to find two or more surfaces that will yield edges that will be perpendicular to the microslides when preparation of each thin section is done. Generally, two parallel cuts are made at an appropriate location along the edge of each specimen with a four-inch diameter circular saw blade mounted on a lapidary trimsaw. The cuts result in the isolation of small samples with a thickness of about one millimeter. The samples are removed from the specimens and mounted with Lakeside Cement onto etched glass micro-slides.

The thickness of each sample was reduced by manual grinding with a slurry of #600 silicon carbide abrasive on plate glass. Grinding was completed in two steps. The first grinding is stopped when each sample's thickness is reduced by approximately one-half. This eliminates micro-flake scars created by the saw blade during the cutting process. Each slide is then reheated, which liquefies the Lakeside Cement, and the samples are inverted. The newly exposed surfaces are then ground until proper thickness is attained.

Correct thin section thickness is determined by the "touch" technique. A finger is rubbed across the slide, onto the sample, and the difference (sample thickness) is "felt." The second technique used to arrive at proper thin section thickness is the "transparency" test where the micro-slide is held up to a strong source of light and the translucency of each sample is observed. The samples are reduced enough when it readily allows the passage of light. A cover glass is affixed over each sample when grinding is completed. The slides and paperwork are on file under File Number OOL-594.

The hydration bands are measured with a strainfree 60-power objective and a Bausch and Lomb 12.5-power filar micrometer eyepiece mounted on a Nikon Labophot-Pol polarizing microscope. Hydration band measurements have a range of +/- 0.2 microns due to normal equipment limitations. Six measurements are taken at several locations along the edge of the thin section, and the mean of the measurements is shown on the accompanying data page. One specimen lacked measurable hydration; however, the remaining four specimens were marked by measurable bands.

We used the hydration band measurements to calculate dates as described here. Two adjustments are needed: one for differences in temperature and one for source-specific geochemical differences in hydration rates. Induced hydration research has shown that Big Southern Butte obsidian hydrates faster/slower than does the control source of obsidian (Napa Glass Mountain, Napa County, California). The hydration ratio for Napa Valley to Big Southern Butte obsidian is 1:1.06, and this information can be used to adjust the actual hydration band measurements to their Napa Valley functional equivalent (see Table 1)

The effective hydration temperature (EHT) differences are taken into account between the control source's EHT and the subject specimens' EHT. EHT values are calculated using temperature data from the website, www.wrcc.dri.edu/summary/climsmut.html and following steps outlined by Rogers (2007). We are able to adjust the subject specimens' hydration band measurements and use them in the standard diffuse formula (Time = kx^2) to arrive at dates. "K" is the hydration rate constant and "x" is the hydration band measurement.

The EHT for the control obsidian source (Napa Glass Mountain) is 16.8, and we calculated an EHT of 13.6 for Idaho Falls, or roughly three degrees cooler than the control source EHT. This means that obsidian in the Eagle Rock project area hydrates more slowly than the same source of obsidian would have hydrated at the control locality (Santa Rosa, Sonoma County). Because the EHT for the project area is cooler we adjust the hydration band measurements upward by 6% per degree difference. Six percent has been found to be an appropriate adjustment based on several studies (Basgall 1990; Origer 1989). After adjusting the measurements for EHT differences, dates shown below were calculated.

Table 1. Dates from hydration bands based on adjustments for geochemical and EHT differences

Catalog Number	Hydration Band (in microns)	Source Adjustment	EHT Adjusted Hydration Band	Date (in years before present)
506	7.0	6.6	7.9	9,574
530	3.4	3.2	3.8	2,215
531	NVB	---	---	---
532	3.4	3.2	3.8	2,215
533	3.4	3.2	3.8	2,215

Don't hesitate to contact me if you have questions regarding this hydration work.

Sincerely,

Thomas M. Origer
Director

Submitter: E. Stoner - Western Cultural Resource Management, Inc.									July 2011
	Lab#	Sample#	Description	Unit	Depth	Remarks	Measurements	Mean	Source*
MW04									
	1	506	Biface Frag		Surface	none	6.8 6.8 7.0 7.1 7.1 7.1	7.0	BSB(x)
MW12									
	2	530	Biface Frag		Surface	none	3.3 3.4 3.4 3.4 3.4 3.4	3.4	BSB(x)
MW12									
	3	531	Biface Frag		Surface	none		NVB	BSB(x)
MW12									
	4	532	Projectile Point			none	3.3 3.3 3.3 3.4 3.4 3.4	3.4	BSB(x)
IF18									
	5	533	Biface			none	3.2 3.3 3.4 3.4 3.4 3.5	3.4	BSB(x)
Lab Accession No: OOL-594									Technician: Thomas M. Origer

*(x) = specimens were chemically sourced
BSB = Big Southern Butte