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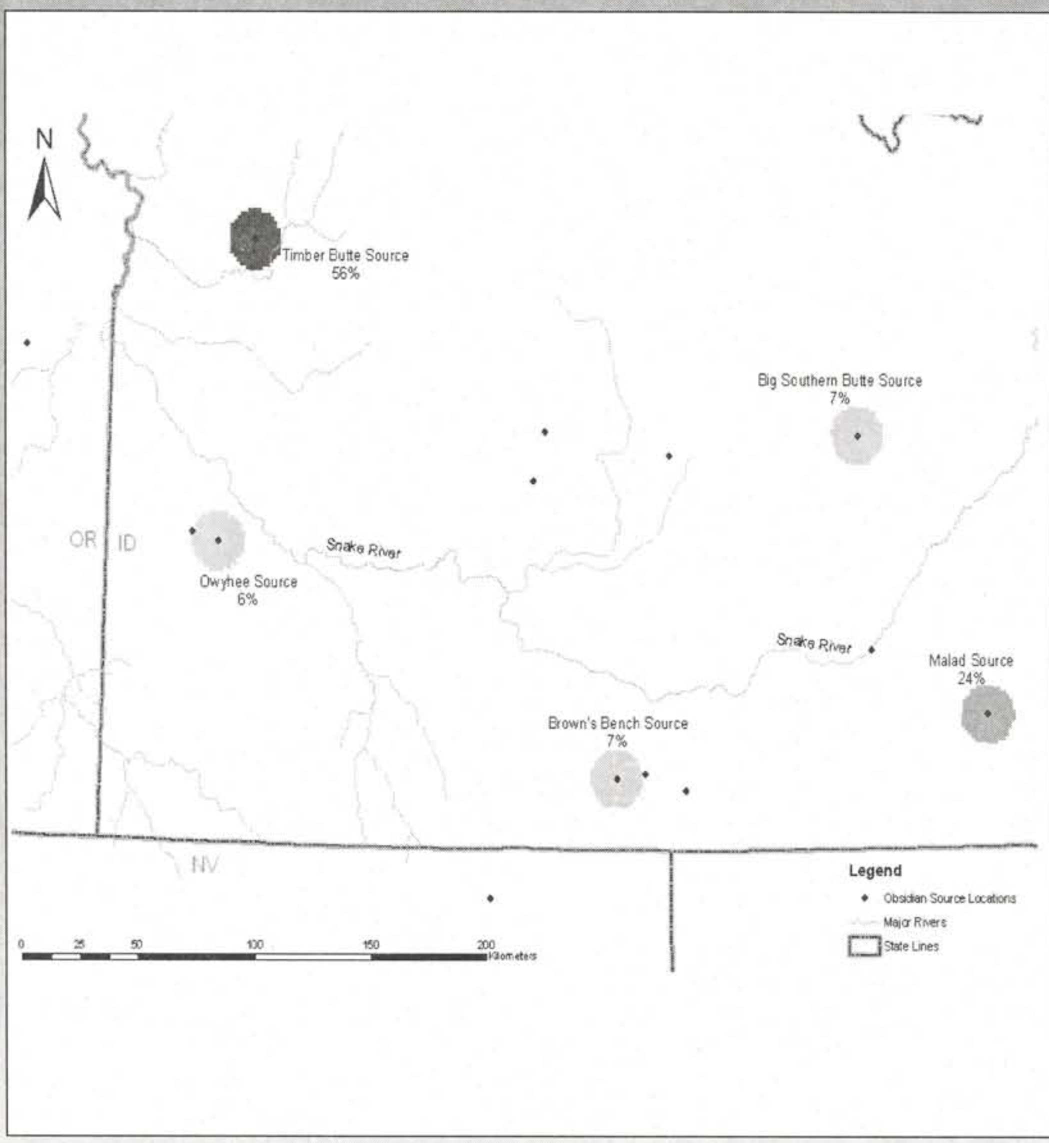

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Cover Photo: Location and percentages of primary sources.

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ARTICLES AND REPORTS

A RE-EVALUATION OF X-RAY FLUORESCENCE DATA FROM IDAHO AND SOUTHEASTERN OREGON

Christopher A. Willson

INTRODUCTION

This paper re-evaluates X-Ray Fluorescence (XRF) data from over two-thousand obsidian samples from ninety-six Archaic period (8000-250 BP) archaeological sites located in Idaho and southeastern Oregon. The purpose of this study is to re-assess the distribution frequencies of the XRF results. The study suggests that obsidian recovered from archaeological sites in the region is primarily associated with five primary and five secondary sources. These ten sources, with an additional 20 tertiary, or outlier sources, appear to have been utilized for toolstone in both the early and later Archaic periods. A discussion at the end of this paper examines the potential for further applying XRF to archaeological interpretations for the region and addresses potential problems associated with the XRF process.

PREVIOUS XRF ANALYSIS

Applying the XRF technique to identify prehistoric obsidian source locations and examining their connections to the archaeological context has a substantial history (see, e.g., Sappington 1981a, 1981b; Hanes 1988; Bailey 1992; Plager 2001; Eerkens and Rosenthal 2004; Jones et al. 2003; Willson 2005; Corn 2005; Skinner 2007). XRF analysis begins in earnest with Sappington's 1970s work and subsequent publications (1981a, 1981b, 1982, and 1984). Many obsidian items analyzed during the development of XRF reflected greater source diversity and eventually would be applied to archaeological studies in examining potential behaviors such as mobility and trade (Holmer 1997; Plager 2001; Jones et al. 2003; Eerkens and Rosenthal 2004).

The most comprehensive XRF study in this region is Plager's (2001) study of volcanic glass distributions in Idaho. This study follows from Holmer's (1997) use of distance decay modeling as originally defined by Renfrew (1969) which measures material frequencies as they move away from the parent sources and argues that the observed variability results from cultural mechanisms. Extending these models, Plager's (2001) XRF results graphically represent, in 30-minute isoline density grids, variation in landforms over Euclidian distance measurements as a method for more accurately defining potential distance decay patterns on the landscape. Plager concludes that although these studies define relative distributions of tool stone material (2001:106), they do establish proxies by which one can examine mobility and social interaction such as trade (Plager 2001:113).

In the Great Basin, but relative to the study area, Jones et al. (2003) have argued that obsidian distributions can be directly correlated to reflect mobility patterns and foraging territories. Jones et al. (ibid) attempt to develop a method to discuss broader archaeological arguments regarding forager behavior as defined by Binford (1980) and Kelly (1983a, 1992, 2001) and conclude that lithic source distributions offer discernible patterns that can be directly associated with prehistoric movement of resources as well as of people.

METHODS AND RESEARCH DESIGN

This study re-evaluates the XRF results from 2033 specimens recovered from 96 archaeological sites located in Idaho and southeastern Oregon (Figure 1). It focuses on the geographic configuration of the region, the ecological setting of the archaeological sites, the site functions, and the temporal period from which the XRF samples were analyzed. This method was designed as a means to address possible shifts in the distribution of obsidian materials within varied environmental settings, archaeological contexts, and more importantly, within earlier and later time frames.

Of the sites included in this study, 36 were temporally identified as having components of the Late Archaic (2500-250 BP), Middle and Late Archaic (5000-250 BP), or Early-Middle-Late Archaic (8000-250 BP) (Figure 2). An additional 51 sites were subsumed into Boise and Valley counties and the temporal components generally fell within the Middle-Late Archaic Period. These categories do not suggest that the sites were utilized continually during these periods but rather many times within the temporal range. Dates have either been established by radiocarbon dates or relative dating techniques such as typological studies conducted on the various assemblages.

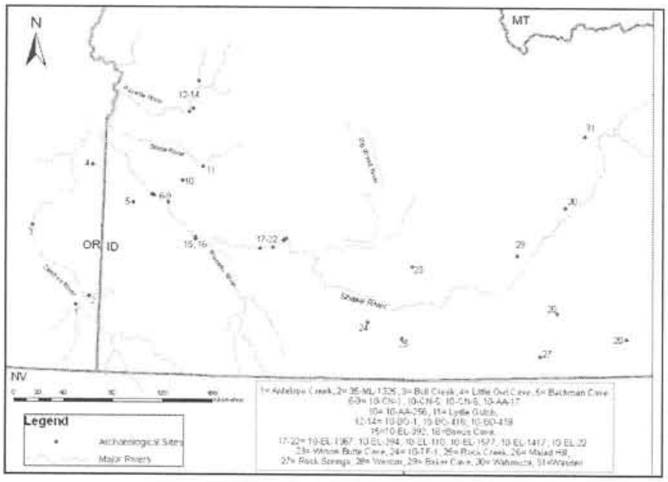


Figure 1. General location of archaeological sites included in this study.

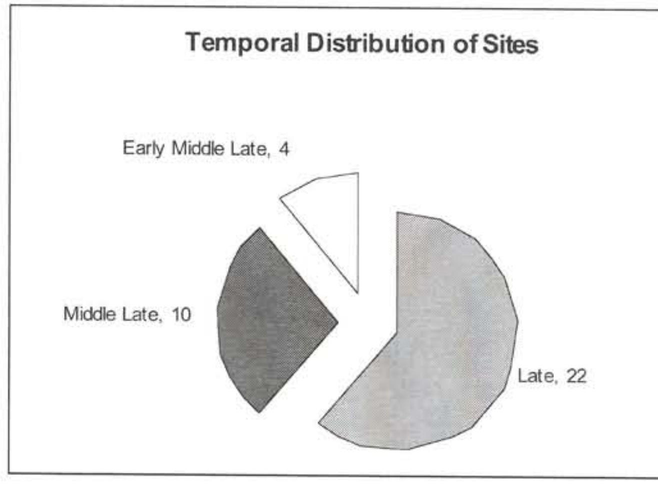


Figure 2. Temporal distribution frequencies.

The archaeological sites included in this study are located in various environmental contexts and have been interpreted as having many functions. Typically, site functions include short-term or long-term habitation sites, hunting/butchering sites, processing sites and caches. Additionally, sites are located within various ecological zones. These include riverine, upland, transitional, and mountain (Figure 3). Every attempt is made to avoid over-simplifying this description through terms designed primarily as an analogical framework for establishing context rather than as a method for determining source use variations within zones.

The samples that are re-evaluated in this study represent an accumulation of many years of archaeological research, and the XRF data were generated from analysis conducted over nearly 30 years. Given the varied contexts from which these samples were recovered, the type of analysis initially conducted, and the sample variation, these geochemical data were combined into a single, comprehensive database. Within this database, the analysis included the regional distributions of the obsidian materials, as well as the archaeological and the geologic context of the parent sources and the setting and function of the archaeological sites from which analyzed samples were obtained. These data were further analyzed for statistical significance using a Pearson's correlation and Wilcox, Anova, and Chi-Squared tests to determine whether all of the data collected should be considered meaningful to the discussion of variability in the distributions.

Since a large population of XRF data exists for single artifacts, a minimum of five samples from each archaeological assemblage or at least one hundred samples per regional assemblage were included in this re-evaluation. Debitage as well as formal tools were included from many sites since addressing whether formal tools collected for analysis match the geochemical signature for the debris is important in establishing site function.

Samples included in this analysis have been organized by statistical results. Three organizational categories have been defined: a) primary sources individually occurring at an overall frequency greater than or equal to 16.1% of the total analyzed collections, b) secondary sources equal to or greater than 4.99% but less than 16.1%, and c) tertiary sources which comprise less than 4.99% of the total analyzed specimens and are considered outlier sources.

In some cases the results are grouped together so as to examine a broader regional context. For example, in Valley County there are 51 archaeological sites and 275 samples with XRF data. Due to the overwhelming presence of the Timber Butte source (>89%), materials identified in sites located in this area have been subsumed to reflect a general pattern for the region.

The overall study area has been subdivided into five regions. Eastern Idaho generally includes sites and sources located in the far eastern part of the state. Southcentral Idaho includes the Twin Falls and Middle Snake River area. Southwestern Idaho is primarily Owyhee, Ada, and Canyon counties, western Idaho consists of the Payette and Boise River drainages, and lastly, southeastern Oregon (See Figure 4).

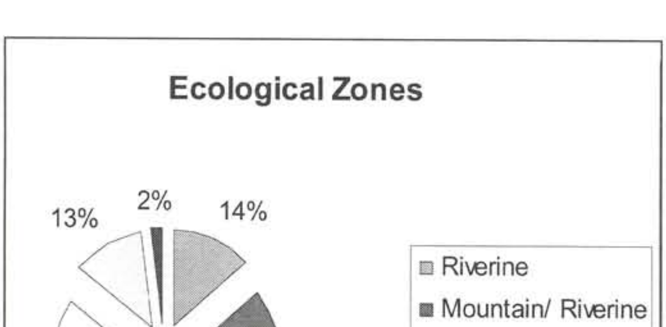


Figure 3. Ecological Zone Distributions.

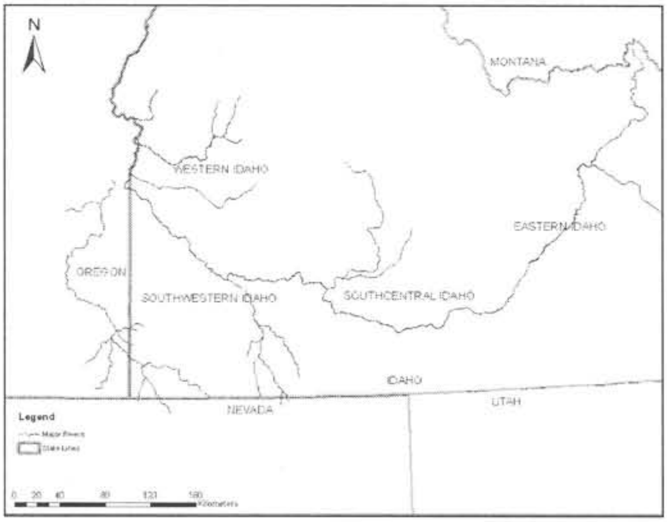


Figure 4. Location of sub-areas within the area of study.

With the aid of GIS software, this project geographically represents the relationships between obsidian sources and archaeological sites located within the five regions Idaho and southeastern Oregon. Studying obsidian site/source correlations through XRF analysis can result in a discussion regarding site locations, site type, mean and actual distances to obsidian source coordinates, source locations and range, and regional landscape variations as related to the XRF results.

XRF RESULTS

Thirty known sources of volcanic glass were confirmed during this re-evaluation. Generally, the obsidian materials found in archaeological sites located in Idaho come from five primary sources—Timber Butte, Malad, Brown's Bench, Big Southern Butte, and Owyhee (Figure 5). However, in southeastern Oregon, Paradise Valley and White Horse dominate the analyzed specimens. The use of the Owyhee source area is observed in Oregon sites but the frequencies in which these materials occur are far fewer than might be expected given the proximity of sites to parent sources.

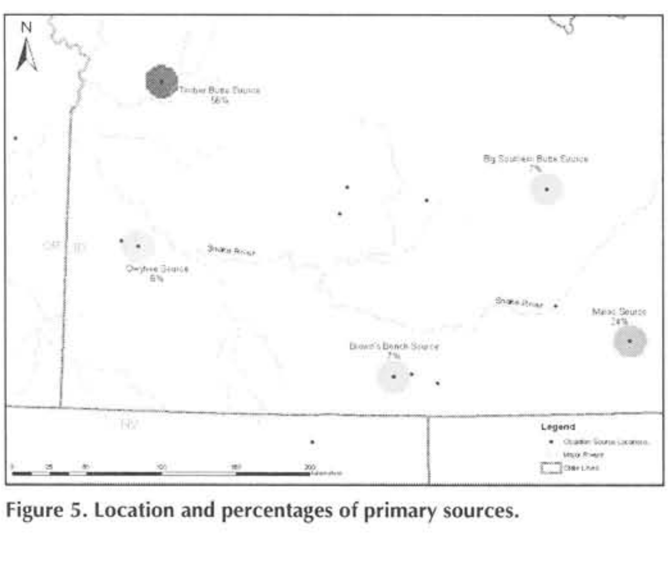


Figure 5. Location and percentages of primary sources.

These five primary sources occurred collectively 1707 times, comprise 85.1% of the entire collection (1707/2033), and are found to be statistically significant within a .01% confidence interval. A Pearson's correlation and R-squared bivirate analysis were conducted in establishing this correlation (See Table 1 and Figure 6). This analysis confirms the likelihood that these five primary sources will occur with regularity in XRF data sets from the region.

TABLE 1. PEARSON'S CORRELATION FOR .01% CONFIDENCE INTERVAL.

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{(n-1)s_x s_y},$$

Correlations			
		VAR00008	VAR00009
Number of samples	Pearson Correlation	1	.488
	Sig. (2-tailed)		.003
	N	36	36
Frequency of sources	Pearson Correlation	.488	1
	Sig. (2-tailed)	.003	.
	N	36	36

** Correlation is significant at the 0.01 level (2-tailed).

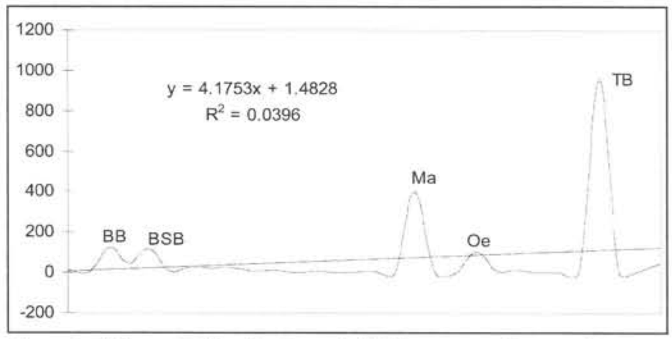


Figure 6. Bivirate R2 distributions of obsidian source frequencies.

Secondary sources have been defined in this study by the frequency with which they occur and are not considered to be geographically smaller or lesser quality "subsources" as defined by Eerkens and Rosenthal (2004) in the Coso lava fields of California. These five secondary sources represent 71.3% of the overall secondary and tertiary category, while 20 tertiary sources, including the unknown and "other" category, individually occur less than .049% of the time. The category "other" was established for extreme outliers. These frequencies often represented by a single artifact geochemically linked to a source well outside normal distributions individually represent < .002% of the collection. Combined, these 25 secondary and tertiary sources occur in the archaeological record 14.9% of the time and include a range of sources in Oregon, Nevada, Idaho, and Wyoming (Table 2).

TABLE 2. FREQUENCY DISTRIBUTION OF ALL SECONDARY AND TERTIARY SOURCES.

	Source	Number	%	Source	>.049%	<.049%
1	AF	16	0.053512	AF	0.0530	
2	BaV	1	0.003344			0.003
3	Bgul	46	0.153846	Bgul	0.1530	
4	BU	9	0.0301			0.03
5	CB Spr	24	0.080268	CB Spr	0.0800	
6	CBM	45	0.150502	CBM	0.1500	
7	CBS	1	0.003344			0.003
8	CP	7	0.023411			0.02
9	CW	14	0.046823			0.046
10	DHM	3	0.010033			0.01
11	DM	6	0.020067			0.02
12	GMB	1	0.003344			0.003
13	HR	4	0.013378			0.01
14	IndCB	5	0.016722			0.016
15	KC	2	0.006689			0.006
16	OC	3	0.010033			0.01
17	OT	21	0.070234	OT	0.0700	
18	PaV	8	0.026756			0.03
19	PiH	16	0.053512	PiH	0.0530	
20	SC	2	0.006689			0.006
21	SDM	4	0.013378			0.01
22	SkSpr	1	0.003344			0.003
23	Unk	49	0.16388	unk	0.1640	
24	WH	10	0.033445			0.033
25	VR	1	0.003344			0.003
		299	100.00%		0.723	0.262

AF=American Falls, BaV=Barren Valley, Bgul=Bear Gulch, BU= Burns, CBS=Coal Bank Springs, CBM=Cannonball Mtn., CP=Camas Prairie, CW=Coyote Wells, DHM=, DM=Dooley Mtn., GMB=Grassy Mountain Butte, HR=Hudson Ridge, IndCB=Indian Creek Butte, KC=Kelly Canyon, OC=Obsidian Cliff, OT=Other, PaV=Paradise Valley, PiH=Picabo Hills, SC=Sinker Canyon, SDM=Sourdough Mtn., SkSpr=Skull Springs, Unk=Unknown, WH=White Horse, VR=Venator.

In southeastern Idaho, more than half of the 790 artifacts analyzed were geochemically traced to the Malad source materials (51%), with a significant number of Big Southern Butte (14.8%) materials located to the northeast and of Brown's Bench source (12%) located in southcentral Idaho and northern Nevada (Figure 7). In addition to these primary sources, several secondary-tertiary sources collectively represent less than .05%.

Analyzed samples from sites in this region are typically associated with varied environmental and ecological settings including upland and riverine contexts. Sites located along the Snake River region are principally associated with a Late Archaic (2500-250 BP) period whereas rockshelters such as Wilson Butte (Gruhn 1961a, 2006) and Baker Cave (Plew et al. 1987) demonstrate multiple occupations during the entire Archaic period. These sites are defined as having varied functional distributions including activities associated with the hunting and butchering of bison.

While it is notable that the Malad source occurs most frequently, it is the sharp decline of the Timber Butte source materials (.048%) which dominate assemblages in the westernmost region of Idaho that is most interesting. This decline is proportionate to the increase of relatively localized primary sources which collectively comprise 82.9% of the collection analyzed and further supports intensification of localized resources.

From within southwestern Idaho, 140 samples were analyzed through the XRF process. The Owyhee (33%), Brown's Bench (19%), Cannonball Mountain (15%), and Timber Butte (11%) sources occur most frequently, with Bear Gulch, Coyote Wells, and Hudson Ridge collectively comprising 12% of the analyzed specimens and 10% representing extreme outliers (Figure 8).

The Late Archaic (2500-250 BP) sites located on the Middle Snake River near Glenn's Ferry in southwestern Idaho exhibit a marked increase in Brown's Bench and Cannonball Mountain obsidian sources. XRF analysis of these sites also demonstrates an increase in the frequencies of American Falls, Bear Gulch, Malad, and Big Southern Butte resources, but the overall frequency is less than 1% of the total distribution. XRF data suggest that 78% of the analyzed specimens occur from localized primary sources with the remaining 22% distributed among ten secondary and tertiary sources occurring less than .002% of the time (Figures 8 and 9).

The archaeological sites included from this region are typically open-air sites associated with a riverine or upland context and reflect varied functional distributions. Temporally, the sites reflect a Late Archaic (2500-250 BP) occupation and appear to have been used often by many groups. (Gould and Plew 2000; Plew and Willson 2005a, 2006; Willson and Plew 2007). The primary use (78%) of obsidian analyzed from southwestern Idaho collections may in fact have resulted from many groups occupying the area over thousands of years. The obsidian appears to originate from fairly local sources and

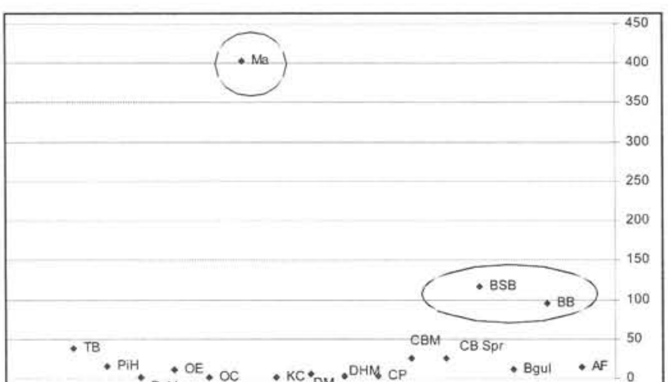


Figure 7. Distribution frequencies in southeastern Idaho.

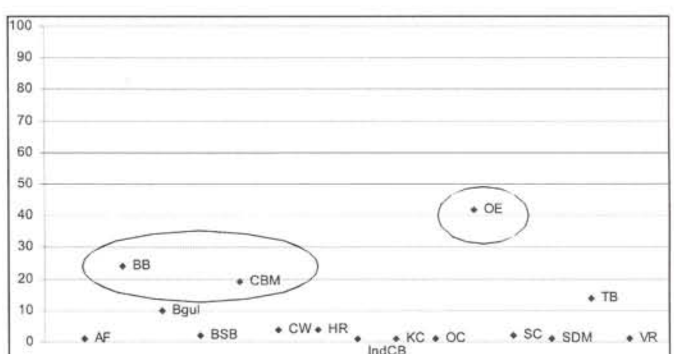


Figure 8. Distribution of sources materials in southwestern Idaho.

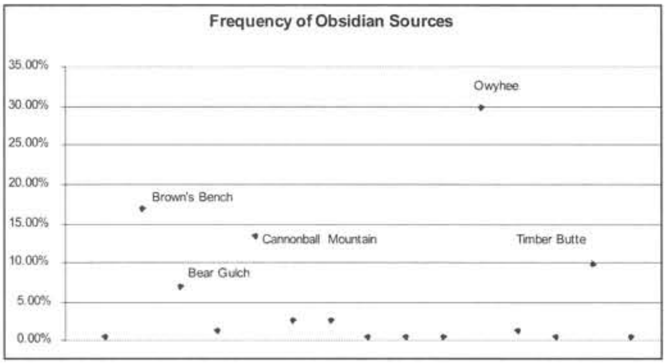


Figure 9. Percentage frequencies of source materials represented in the archaeological record on the Middle Snake River in southwestern Idaho.

supports Willson's (2005) discussion of obsidian distributions in the region.

In the western Idaho region, north of the Snake River, a substantial number (>85% of all samples analyzed) are Timber Butte source materials, especially as reflected in the mountainous riverine sites of Boise and Valley counties (Figure 10). In this region, 1050 samples were analyzed from 51 archaeological sites located near the Payette and Boise River drainages. The samples represent an average of three per site (Plager 2001), and although this does not reflect individual site distributions of obsidian, it does represent an overall distribution for the region.

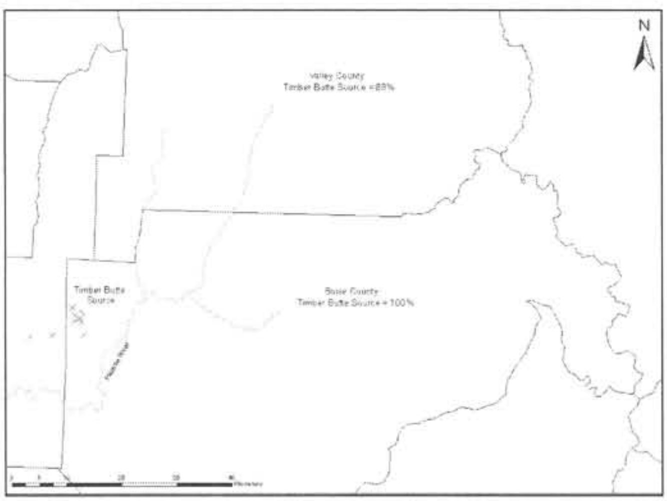


Figure 10. Boise and Valley county source distributions.

The archaeological context in this region is configured within a mountainous/riverine biome. Principally, the sites are located along the Payette River drainages. The primary obsidian source in the archaeological record is Timber Butte, occurring 85.9% of the time. Although Bear Gulch occurs more frequently in this region than in other areas of the study, it only equates to .023% of western Idaho source distributions.

Analysis of Lydle Gulch (Sappington 1981c), located just to the south of Boise County near the Boise River in Ada County, provided overwhelming XRF sourcing data for Timber Butte as well. Since this site is situated north of the Snake River in proximity to the mountainous zone, it is considered a foothills/transitional environment and is included in the analysis of the western region of Idaho. The XRF results of 506 samples suggest a primary use of Timber Butte (76.8%) and the Owyhee source (9.6%). Secondary and tertiary sources include Burns, Coyote Wells, White Horse, Camas Prairie, and unknown source locations which make up the remaining 13.6%.

XRF results from Oregon sites are mixed. In all, 33% of the total is from the Paradise Valley source, 30% from White Horse, with the remaining sources evenly dispersed among the Indian Creek Butte (8%), Sourdough Mountain (12%), and Coyote Wells (12%) sources all located within the Owyhee uplands (Figure 11).

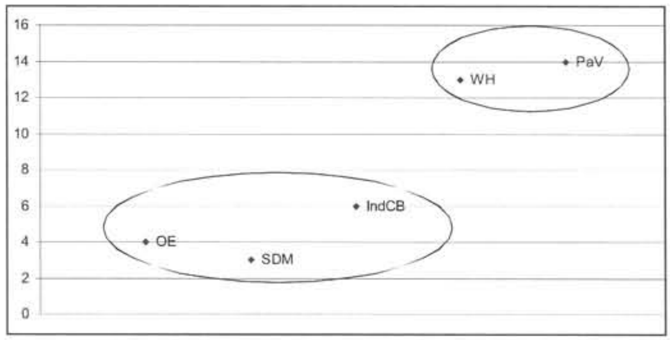


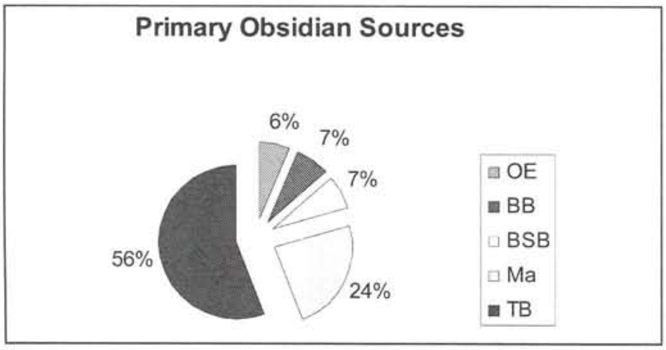
Figure 11. Frequencies of obsidian sources from Oregon sites.

The recorded sources of obsidian are from sites associated with rockshelters situated in the canyonlands of southeastern Oregon (Plager 2001; Plew and Willson 2005b; Hanes 1988). These sites include habitation sites with multiple activities and occupations during the entire archaic period (Plew et al. 2003, 2004, 2005b; Hanes 1988). Analysis suggests primary use of Paradise Valley in Nevada, White Horse in southeastern Oregon, and various sources located within the Owyhee Mountain chain.

Notable is that the best known obsidian sources in southeastern Oregon are part of a line of sources associated with the Owyhee uplands extending 144 km northwest and southeast. There are clusters of source coordinates intermixed with differing geochemical signatures. The Coyote Wells, Skull Springs, and northwestern Owyhee sources are geographically dispersed over an area of 400 km^2 but are fairly isolated from the main Owyhee source, which lies more than 100 km to the south. Within the main Owyhee source as described by Skinner (2007) and Sappington (1981a), the Sinker Canyon and Reynolds sources are at the northern edge of the expansive lava flow. It is possible that the materials acquired from within this region have intermixed over time by natural agency.

DISCUSSION

This analysis has demonstrated that among the samples analyzed, there are at least 30 known and several unknown Idaho, Nevada, Oregon, and Wyoming obsidian sources present in the archaeological record. These sources are geochemically linked to the archaeological sites located in Idaho and in southeastern Oregon. Analysis conducted during this study suggests that five primary obsidian sources utilized in the Idaho region comprise 1707 of the total analyzed sample population (Figure 12).



#	Source	Number	%
1	OE	107	0.062683
2	BB	123	0.072056
3	BSB	120	0.070299
4	Ma	403	0.236087
5	TB	954	0.558875
	Totals	**1707**	**100%**

Figure 12. Percentages of primary obsidian sources in the region.

There are also five secondary sources identified and nineteen tertiary sources which represent less than 15% of the entire analyzed collection (Figure 13). Although these sources were likely frequented by prehistoric people living in the region, it is unclear whether they were visited directly or indirectly, traded, or possibly acquired through an archaeologically indeterminate mechanism.

This study has reaffirmed that volcanic glass is widely distributed throughout the region. The results suggest that in general obsidian recovered from archaeological sites in Idaho and Oregon is geochemically associated with local availability of sources in both the early and later prehistoric period.

Of the 96 sites included in this study, 22% were Late Archaic (2500-250 BP), and 14% provided evidence for Early, Middle, and Late period (8000-250 BP) occupations in the region. There does not appear to be much variation in the distributions over these period intervals. Rather, the distributions seem to reflect local use of the regions within the various archaeological contexts. It is however notable that most of the archaeological sites that are described as Late Archaic are often located on the Snake River.

On a regional scale, it appears that the localized obsidian resources dominate the archaeological assemblages. In southeastern Idaho, Malad and Big Southern Butte sources increase in all contexts and in both the early and later time frames. In Southwestern Idaho, there is an increase in the Owyhee and Brown's Bench sources, and in the western part of the state Timber Butte seems to be the primary source.

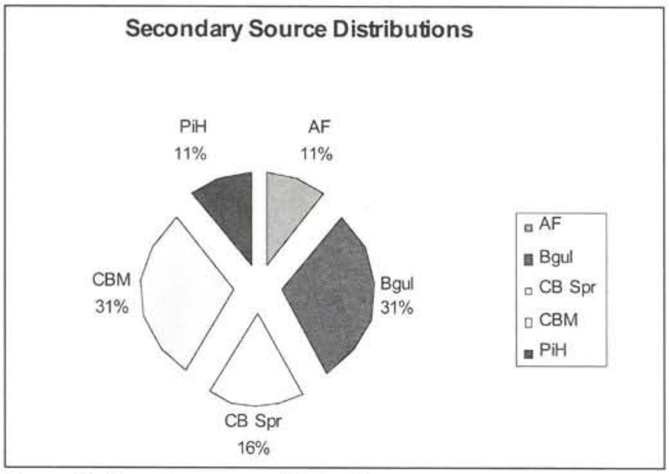


Figure 13. Secondary source distributions.

Given the number of obsidian sources located in Idaho and southeastern Oregon, it is expected that the XRF results demonstrate a degree of variability that may be interpreted as reflecting certain behaviors (Jones et al. 2003; Plager 2001). While examining the regional distributions of a resource, one can expect the range of variability to increase with the number of samples analyzed (Skinner 2007). However, sample size, sample type, and the context from which samples are collected are problematic in terms of applying XRF to broader questions. Too often the samples are selected from previously excavated sites. Samples chosen for interpretation are therefore varied, often derived from unknown contexts, and the overall sample populations are too small to be included in the analysis.

Many limiting factors that have thus emerged during this study should be addressed. Most problematic are the sample populations. Since samples from this region are the result of comprehensive studies, rarely are there mechanisms in place for fully addressing time and space in the archaeological contexts from which items have been selected for XRF analysis. Many samples were not initially collected for XRF analysis but as part of the common protocol of archaeological inquiry and were only later re-examined for geochemical variability. This makes it nearly impossible to control for time in most of the existing XRF collections.

For example, in Plager's (2001) study, 2607 artifacts were analyzed from 284 archaeological sites. In this study nearly 400 selected samples were small collections (<3 per assemblage) and represented >15% of the total analyzed specimens. This sample population is too small to be included in the interpretation. Isolates and small samples represent greater source diversity on a regional scale but do not address variability within individual assemblages. Extreme outliers comprise < .002% of the analyzed collections. These appear to be statistically insignificant since they pertain to the broader discussion of prehistoric use of the region.

A simple t test for variability of the means suggests that where *df* equals 35, the 2-tailed *sig* = .003, t = 3.16. This analysis suggests that all tertiary sources and many secondary sources as defined in this paper are insignificant in discussing behavioral mechanisms because the witnessed frequencies do not reflect the behavioral realities associated with their occurrences. Further, when exploring the relationships between the total number of samples analyzed and the overall frequencies in which sources occur, a mean distribution of analyzed specimens is equal to *sig* = 3.88 confirming the likelihood of any analyzed assemblages reflecting one of the five primary sources.

TABLE 3. T-TEST FOR SAMPLE DISTRIBUTION, SIGNIFICANCE, AND CORRELATIONS

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s_{\overline{X}_1 - \overline{X}_2}} \text{ where } s_{\overline{X}_1 - \overline{X}_2} = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

BY SAMPLE SIZE.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	VAR00008	56.4722	36	101.02658	16.83776
	VAR00009	3.8889	36	2.73368	.45561

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	VAR00008 &VAR00009	36	.488	.003

The statistical analysis suggests that the interpretative value of the analyzed collections on a regional scale may be problematic due to varied sample sizes. It is suggested that in order to achieve statistical validity, a minimum of six samples be analyzed per archaeological assemblage. This mean sample size of six, when included in the calculation, provides a result of .488 and is expressed as a strong correlation at the .01 confidence interval.

Since XRF analysis appears to have value in the discussion of more complex behaviors, the method has intensified and its application to archaeological inquiry has grown exponentially (Sappington 1984; Hughes 1986, 1992, 2007; Holmer 1997; Plager 2001; Corn 2005; Willson 2004, 2005). However, to date in this region fewer than 3000 samples representing fewer than 300 archaeological sites for all of Idaho and southwestern Oregon have been examined by the XRF process. Many of these XRF samples were analyzed many years ago, (Sappington 1981a, 1981b, 1982, and 1984; Green 1982; Glascock and Ambroz 1996) reducing the number of recently examined samples to fewer than 1000. Since the regional sample population is relatively small, no consistent methods are employed for sample recovery, and the increase in XRF reliability is fairly recent, it is expected that much of the variability commonly observed in these comprehensive studies is due to inconsistencies in the analytical method and may not have interpretive value in discussing prehistoric behavior.

There appear to be inherent problems associated with examining obsidian distribution on a regional scale. XRF results can still serve in confirming existing archaeological discussions regarding the relationships between regional and local use of the landscape over time, but must be used with caution. For example, in sites located along the Snake River, not only is there an increase in what appears to be Late Archaic occupations, but more importantly an increase in the localized use of the area. XRF could be used to examine if toolstone resource acquisition is reflected in this behavior as well. Examinations thus far suggest that the riverine contexts of the Middle Snake River reflect a use of local resources by highly mobile groups and that the variability witnessed in the outlier sources is expected. Kelly's (1992, 2001) forager model suggests that in addition to reviewing obsidian resources, one must carefully examine the use of other toolstone source materials, such as local basalts and cryptocrystalline, and the resulting debris and formal tools in order to understand potential patterns regarding residence patterns as well as mobility.

By way of example, McAlister's (see Skinner 2007) preliminary study on the Craters of the Moon area in Idaho primarily focuses on isolated finds. This examination confirmed a greater use of fairly local sources situated 50-100 km away and suggested a greater use of "distant sources" in the Late Archaic period. However, the samples have no defined archaeological context except for relative time established through typological comparisons. Although temporal patterns do appear to be associated within the region, the finding can be substantiated or developed as an archaeological description for the cultural use of the region simply through XRF analysis. As XRF studies have become more common, the process for selecting items for analysis has become more uniform and should result in an increased understanding of the proveniences from which the samples were selected.

Because of the general incompleteness of the archaeological record it is difficult to discern patterns from these contexts. In addition, the statistical variance of the results, problems in sample size, and the methods by which these samples are collected all influence potential interpretations of the XRF results. The inability to adequately control for these variables impacts the hypothetical analogies that attempt to juxtapose ranges of variability in the XRF results to behavioral realities.

The existing literature does not adequately discuss the theoretical implications of XRF studies as they apply to archaeological investigations. The method of XRF has demonstrated great reliability in the natural sciences (Skinner 2007; Eerkens and Rosenthal 2004), but it has not yet been proven reliable in discussing the complexity involved in behavioral mechanisms such as mobility, trade, and resource acquisition.

Contrary to conclusions made about the region based on the XRF results, this re-evaluation suggests a variety of obsidian sources were used with only a few of these sources being utilized with any frequency. Without additional archaeological data, no interpretations can be made regarding behavioral patterns. Evidence witnessed in the archaeological record suggests that in addition to mobility, many behavioral adaptations such as settlement patterns and resource acquisition began to change markedly during the Archaic period (Aikens 1984; Mehringer 1985:167-189).

Kelly (1983b, 2001:37-38) suggests that highly mobile groups likely moved across a given landscape in relationship to resource availability and adapt to their environment by exploiting resources as they become available. Given this, environmental changes over time may have altered these behavioral patterns and can be observed in variations within the archaeological record relating to the acquisition of stone resources. Unfortunately, the mechanisms underlying behaviors of mobility are not clearly defined and the relationships between how materials are initially acquired and then transported or traded between groups are not yet demonstrated. To suggest that there is uniformity for mobility or trade over-simplifies the behavior.

The argument is not whether prehistoric peoples moved great distances to obtain various resources. In fact, high mobility was likely related to the success of groups occupying the region (see also Sellet 2006; Thacker 2006). The problem is simply whether or not toolstone acquisition reflects this behavior, and more importantly whether XRF analysis can be used for examining the mechanisms of this behavior. XRF results illustrate that distributions of obsidian exist in the region but do not demonstrate the complexity surrounding the movement of these materials. By simply addressing the distances that toolstone travels on the landscape only exemplifies the problem. XRF analysis in itself does not reflect the mechanisms under which people were acquiring or moving these materials within the systemic context.

XRF studies may prove most valuable in identifying changes in toolstone resource acquisition over time. It is expected that changing prehistoric patterns during the Archaic period would have led to increased knowledge of source locations, augmenting the use of one particular source or another.

CONCLUSION

In conclusion, it is clear that XRF studies are inherently limited in their ability to address specific behaviors involved in toolstone resource acquisition. The inconsistency in the specimens selected for study (i.e. debitage vs. formal tools), variation in the sample populations, and the condition of the archaeological context from which the samples were selected all must be considered when examining and interpreting XRF results. Furthermore, considering the ecological setting, the archaeological site function, and the range of temporal periods may assist in establishing a context from which deductive questions can be framed. Due to the countless variables and an inability to directly address behavioral realities and by accepting that behavioral mechanisms are not uniform in their configuration, interpretations of the distributions of obsidian resources are purely hypothetical.

Since XRF has become increasingly used to argue resource acquisition behaviors such as mobility and trade, it is strongly suggested that XRF studies be framed first within problem-oriented archaeological investigations. At this time there are insufficient data for discussing any direct correlations between observed frequencies and apparent distributions of obsidian in the regional context as having interpretive value for discussing behavior. Continued focus on broader archaeological discussions beyond XRF analysis will ultimately prove most beneficial; it is suggested that the XRF process supplement these broader archaeological investigations, and that as a method for discussing specific behaviors, XRF analysis should be used with caution.

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SHORT CONTRIBUTIONS

BOOK REVIEW

ARCHAEOLOGY AND ETHNOARCHAEOLOGY OF MOBILITY

Edited by Frédéric Sellet, Russell Greaves and Pei-Lin Yu. University Press of Florida, 2006. 290 pp., hardcover, US$65.00, illustrations, index.

Reviewed by Mark G. Plew

This book provides a broad examination of issues relating to mobility and is unique in its emphasis upon the ethnoarchaeology of mobility. The work contains 12 chapters divided into two parts. Part I addresses issues relating to the ethnoarchaeology of mobility while Part II presents perspectives on archaeological studies of mobility. The first chapter by Lewis Binford questions the analytical validity of the "band" so commonly used as an organizational framework for examining hunter-gatherer mobility. In a similar vein, Politis, in Chapter 2 discusses issues of territoriality and defense among Nukak foragers of Columbia. He observes that territorial behaviors and mobility are conditioned by many factors and challenges the concept of territorial defense noting that many Nukak bands freely use the same territories.

The remaining chapters in Part I of the book provide insights into ways ethnographic data may expand interpretation of archaeological deposits. In Chapter 3, Craig and Chagnon use a GIS analysis of Yanamamö horticultural plots to assess transportation costs between villages. In testing von Thünen's marginality theory, they demonstrate a critical drop-off of garden areas beyond 3 km from villages. They argue that this reflects transportation and travel costs that should be consistent across populations. In contrast to the settlement analysis of Craig and Chagnon, Kelly, Poyer and Tucker provide an ethnoarchaeological overview of the Mikea of Madagascar. With an eye to the work of Susan Kent, their focus is upon assessing whether length of stay is reflected in settlement. Examining house size, post diameter variation, feature diversity and distance to trash from outside hearths, they conclude that settlement types can be differentiated. They conclude that influences of social organization and food sharing affect the length of occupation. In Chapter 4, Michael Alvord addresses issues of sustainability among the Wana of Sulawesi, Indonesia, in the context of their transition from hunting to horticulture. Finally, Greaves, in Chapter 6 examines landscape use and residential organization among the Pumé of Venezuela. He provides a very interesting overview of the ways in which Pumé settlement mobility is directly responsive to seasonality. He notes distinct patterns of dry and wet season settlements that include a range of features that are not archaeologically obscure.

Part II of the book consists of seven papers examining what Sellet describes as archaeological signatures of mobility. In this context, writers offer observations on the organization of raw material procurement, technological strategies and assemblage variability, settlement patterns and faunal data for hunter-gatherers, horticulturalists, and those in transition. Ogilvie in Chapter 7 presents interesting biological data suggesting that populations in the American Southwest exhibit a trend toward decreasing femoral size with increased reliance on maize. She notes that Trans-Pecos and Lower Pecos foragers exhibit greater femoral development than committed late agriculturalists of Pottery Mound. She further notes that occupants of the Tucson Basin exhibit characteristics of locomotor behavior that appear intermediate between mobile foragers and late period sedentary agriculturalists. In a rather different vein, Chang in Chapter 8, assesses the pastoral archaeology of southeastern Kazakstan. Her focus is the potential impact of equestrian mobility upon agricultural sedentism. In Chapter 9, Pei-Lin Yu examines the transition from atlatl to bow and arrow technology in Coastal Spain, Japan, and the North American Great Basin. She suggests that the shift reflects decreased mobility associated with population packing in highly productive environments. She correctly notes that such shifts reflect adjustments to changing conditions not evolutionary thresholds. Shifting the discussion to ways in which archaeologists have examined Paleoindian mobility, Sellet in Chapter 10, very correctly notes that raw material economy and assemblage composition do not directly reflect mobility. Rather, he observes that the issues raised by equifinality demonstrates that the relationship between mobility strategies and technology does not lend itself to simplistic correlations. In a similar vein, Thacker in Chapter 11, examines the importance of local raw materials in assessing hunter-gatherer mobility. He argues that attempts to link artifact assemblages to settlement structures must emphasize the context of raw material exploitation within a technology. Finally, Veth evaluates eight sources of archaeological evidence of mobility relating to Late Pleistocene foragers in Australia. He importantly argues that identifiable changes in archaeological mobility will be reflected in broad configurations of data.

This book is a significant contribution to the study of the archaeology of mobility. Its unique perspectives demonstrates the utility of combining traditional archaeological analysis of mobility with the insights of ethnographers and ethnoarchaeologists. The volume provides original contributions to a number of issues relating to hunter-gatherer mobility and critical commentary on archaeological approaches.

ABSTRACTS FROM THE 34TH ANNUAL IDAHO ARCHAEOLOGICAL SOCIETY CONFERENCE

Boise, Idaho
October 27, 2007

PAPER ABSTRACTS

Archival Photos as Visual Text: Historic Images of Idaho's Rural and Urban Landscape

Pam Demo, Archaeologist and ISHS Volunteer

Historic photos provide visual links to the past, documenting the cultural and natural landscape in informational terms and context that written documentation does not — photo documentation meaningfully serves as more than an adjunct or after-thought to our pre- and post-field research. This presentation offers a cross-section of historic Idaho urban and rural images featured in a half-dozen of the many archival photo collections containing dozens to thousands of negatives and photos housed at the Idaho State Historical Society Library & Archives. For academic and avocational researchers from a broad array of disciplines, this discussion includes: (1) what's in them; (2) why use them; and (3) how to access them.

Examining the Un-Collection: No-Collection Excavation in Elk River, Idaho

Leah Evans-Janke, University of Idaho

This paper offers an alternative to traditional archaeological collections used for comparative research. The recent excavation of an early 20th century dumpsite is used as a basis for developing large scale "no-collection" projects. This alternative technique effectively balances the needs of meeting professional standards in field methods, research, and analysis, with the current crisis in archaeological collections management.

Geoarchaeology and Landscape Evolution in Arid Environments

Christopher L. Hill, Boise State University

Arid zones presently constitute about 25-35% of global terrestrial environments. The extent and distribution of hyper-arid, arid, and semi-arid environments have fluctuated during the late Cenozoic (Pliocene, Pleistocene, Holocene). Hydrologic patterns and geomorphic processes within these regions provide a record of climate change and landscape evolution that can be linked to hominid biological and behavioral adaptations. Physical landscapes (habitats) and biomes in arid environments constitute geoecological systems that can be used to examine contextual and site formational components of the prehistoric record, providing an opportunity to evaluate the ways environmental changes have influenced human populations and the ways humans have influenced the environment.

Resource Reconstruction and Site Density on the Orchard Training Area, Idaho

Tedd D. Jacobs, Boise State University
Jacob Fruhlinger, Idaho Army National Guard

Three years of survey combined with 13 years of baseline data have provided information vital to the reassessment of archaeological sites within the Northern Great Basin. By combining this information with a preliminary resource reconstruction model, we can begin to form questions of how the use of resources in an arid environment are conditioned by the social organization, group size, and mobility of past populations and how archaeological sites are affected by not only past changes in the environment over time but by modern agents as well. A unique predictive model based on this information could assist archaeologists in evaluating sites based upon not only past conditions, but modern impacts as well.

Adventures in Underwater Archaeology in the Gulf of Mexico

Maija Glasier Lawson, Salmon Challis National Forest and University of West Florida

The Gulf of Mexico is littered with the remains of hundreds of prehistoric and historic vessels and their contents. Some of the earliest historic ships belonged to Tristan De Luna, the first man to attempt to settle in modern day Florida. In 1559 Tristan De Luna lost seven ships from his fleet to a raging hurricane, thus ending the first attempt at a new Florida colony. Two of these ships, the Emanuel Point Shipwrecks I and II, have been discovered by the University of West Florida's Maritime Archaeology Department. This paper will provide a detailed description of these ships and associated assemblages.

Archaeology and Biocomplexity in the Western Gulf of Alaska (with Implications for the Long-Term History of the Snake River Plain)

Herbert D. G. Maschner, Idaho State University

The Sanak Biocomplexity Project is a multidisciplinary research effort funded by the National Science Foundation to investigate the long-term history of the North Pacific. The underlying thesis of the project is that the Aleut have been harvesting the region for over 10,000 years and thus, have engineered many of the complex dynamics between people and other marine and terrestrial species in the region. Building on data from over 100 village sites, extensive paleoecological reconstructions, and hundreds of hours of ethnographic interviews, a long-term historical ecology is presented. This project also has an extensive applied component. For example, modern marine management is hampered by less than 50 years of time series data in most oceanic regions resulting in uninformed management decisions. New archaeological, ethnohistoric, ecological, and paleoecological data from the western Gulf of Alaska demonstrate that many species have centennial or millennial scale cycles often influenced by changing climatic and oceanic regimes, as well as human harvesting. Using a 5000 year time series, I will show that parts of the 'natural' north Pacific ecosystem has been engineered by human harvesters over many millennia in concert with changing climatic conditions and that the system cannot be understood without reference to humans as a critical aspect of that ecosystem. These results have powerful implications for our understanding of the Snake River Plain and address fundamental issues of ecosystem restoration, sustainability, and environmental resilience.

Revisiting the Idaho Fremont Question
Mark G. Plew, Boise State University

The original argument for Fremont influences upon groups inhabiting the Snake River Plain was proposed in 1979 (Plew 1979). Subsequently, Butler (1979, 1983) proposed a Fremont occupation of the Plain. Though this argument was challenged at the time (Plew 1980, 1983), Cockle (1993) and Gruhn (1999) have perpetuated the idea of a Fremont presence on the Plain. In fact, recently they state that data from Wilson Butte Cave clearly demonstrates a Fremont occupation of the area. They further suggest that there are two models of late Idaho prehistory. The first involves a rapid replacement of distinct Fremont populations or a gradual transition from Fremont to Northern Shoshoni. A second model, like the first, has two options. The first has intrusive Numic speakers co-existing, and then assimilating resident Fremont peoples or northern Fremont people who were the ancestral Shoshone. This paper briefly assesses the archaeological validity of an Idaho Fremont. Using data from a number of sites across the plain, it demonstrates that little evidence exists in support of the thesis.

Archaeological Investigations at Cow Creek (10-CA-1075), near Albion, Idaho (Poster)
Mark G. Plew, Chris A. Willson, and Jessica Dougherty, Boise State University

Cow Creek Rockshelter (10-CA-1075) is located approximately 2 miles south of Albion, Idaho on the east side of Cow Creek along a rhyolite cliff-face approximately 2 meters above the stream course and a mile above a relatively open valley floor. The investigation of Cow Creek Rockshelter suggests that the site has been extensively vandalized on a number of occasions over a period of time. The recovery of so little cultural material may also be indicative of long-term vandalism of the site area. The material recovered does allow us to suggest that the site was used primarily during the Late and possible Middle Archaic periods.

Archaeological Investigations at Cow Hollow Park: A 1930's CCC Camp, and a 1940's Japanese Internment Camp
Mark G. Plew and Chris A. Willson, Boise State University
Presented by Brian Wallace, Boise State University

Known regionally as a location of one of the Owyhee Dam construction camps, one of Oregon's first CCC camps and a later Japanese-American internment camp, Cow Hollow is located roughly 3 miles east of Nyssa, Oregon. In June 2007 Boise State University undertook archaeological evaluation of the Cow Hollow Park. This paper documents the results of historical records for the site, survey and archaeological testing of the location.

Historic Petroglyphs at Brand Rock
Julie Anna Rodman, Salmon Challis National Forest

Brand Rock is located in a canyon that provides a low elevation passage over the Bennett Hills from the Snake River Plain to the Camas Prairie. The large basalt boulder has an animal head and 127 cattle brands carved into the surface. A number of the brands have been identified and are associated with cattle operations throughout southern Idaho. The brand registrations date from the 1920's and include several still in use today. The petroglyphs site represents a time capsule of ranching history and is a unique example of historic rock art.

The Dark Side of Archaeology – Tackling a Common Curation Crisis
By RuthAnn Smith, Idaho Transportation Department

Section 106 of the NHPA requires the head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking to take into consideration project impacts on historic properties and to mitigate for any adverse impacts to historic properties that may occur. As a result, archaeological excavations are often chosen as a way to mitigate for adverse effects to National Register eligible archaeological sites. One activity that a number of cultural resource management programs do not follow through on is curating collections recovered during these field projects. The Idaho Transportation Department (ITD) realized it had a crisis in the form of unidentified and improperly stored artifacts and decided this issue had to be addressed. In this presentation, terms dealing with collections and curation are defined, the ethics and regulations requiring curated collections are outlined, and the steps ITD has taken to tackle its curation needs are detailed.

Diagenesis Scale for Bone Microstructure

Margaret Streeter, Boise State University

Histomorphological age at death estimation is increasingly applied to archaeological, paleontological and forensic skeletal material. The various methods are based on the quantification of the age associated accumulation of micromorphological structures (osteons) created through remodeling. Just as the postmortem environment can influence the preservation of gross morphological features, postmortem modification can produce diagenetic alteration that ranges from mild to severe, obstructing the view of bone microstructure to varying degrees. Processes such as fungal encroachment, microcracking and cortical erosion can conceal or obliterate morphological detail compromising the accuracy of osteon counts. This study presents a five stage method of evaluating the influence of taphonomy on bone microstructure. It also provides standardized terminology for describing diagenic changes and assessing the impact of diagenesis on the reliability and accuracy of histological analysis.

A Re-evaluation of X-Ray Florescence Analysis for Idaho and Southeastern Oregon

Chris A. Willson, Boise State University

A critical re-evaluation of X-Ray Fluorescence (XRF) data for over two-thousand obsidian samples from ninety-six archaeological sites located in Idaho and southeastern Oregon demonstrates that obsidian materials recovered in both the early and late Archaic periods predominately originate from five major sources. The results are further addressed regarding how XRF is commonly misused to argue behavioral adaptations including mobility.

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