CHAPTER 10
FROM CLIFF TO CACHE: ANALYSIS OF A MIDDLE ARCHAIC OBSIDIAN CACHE FROM SOUTHWESTERN MONTANA

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ABSTRACT
The Yearling Spring site (24PA1377) consists of a cache of ochre-covered bifaces, flake tools, and core fragments all made of obsidian. This site was found eroding from a cutbank south of the Yellowstone River in southwestern Montana. Sixty-one of the 62 pieces were found on the ground surface or within the sod layer down slope from a recent bank washout. Archaeological excavations undertaken during the spring of 2011 revealed a portion of a subsurface ochre-stained pit with one obsidian biface in situ. No other artifacts or features were found in association with this subsurface pit. No flake debitage was found, indicating that the pieces were not manufactured on site. Two specimens with possible use wear were analyzed for protein residue, and were found to exhibit sera for Salmonidae and Cervidae. An ochre sample tested positive for Ursus sera. Obsidian specimens were submitted for x-ray fluorescence sourcing, and are attributed to Obsidian Cliff, Wyoming. Hydration rim measurements dating to approximately 3680 years B.P., indicate a probable single event of procurement and caching. Geoarchaeological studies have been undertaken, with optically stimulated luminescence dating supporting the obsidian hydration date.

INTRODUCTION
The Yearling Spring Cache site (24PA1377) is located in southwestern Montana near the present day town of Livingston (Figure 10.1). The site lies near a small spring a few miles uphill from the Yellowstone River. Research is ongoing at the site and, to date, 62 obsidian artifacts have been recovered. Obsidian is the only lithic raw material present at the site, and the lack of debitage indicates that the artifacts were produced elsewhere and cached at the site. Dating by obsidian hydration (OH) and optically stimulated luminescence (OSL) indicates that the Yearling Spring Cache was created during the Middle Archaic Period, approximately 3,700 years ago. A number of the artifacts were found covered in ochre, and a large ochre-stained pit was identified eroding out of a cut bank believed to be the cache area. At the bottom of this pit a single flake tool was recovered in situ during excavation. The other specimens were found down slope from this pit either on the ground surface or within the existing sod layer (Figure 10.2). We believe that all of these artifacts likely had been recently eroded out of the pit and some were subsequently covered by slopewash sediments.

Cache sites are relatively uncommon and can occur as isolated sites or as part of a larger site with one or more functions. Most lithic caches in western North America appear to be isolated from other sites and are often discovered only after some or all of the material has eroded or been accidentally excavated from their primary context (Rennie and Rittel 2007). Lithic caches have been discovered in North America throughout the Archaic period (Rennie and Rittel 2007), and the earliest known caches are associated with Clovis technology (Collins 1999; Gramly 1993; Kilby 2008; Kohntopp 2010; Lassen 2005; Wilke et al. 1991). In the region surrounding the Yearling Spring Cache site there are a number of known biface caches. These caches, located in southwestern Montana and Idaho, vary in the stage of reduction of the bifaces and in age of the site. The oldest and closest cache to Yearling Spring is the Anzick site (Lahren and Bonnichsen 1974; Owsley and Hunt 2001; Wilke et al. 1991) which is located about 38 km to the north of Yearling Spring. Others in the region include the Yellowstone Bank Cache, Montana (MacDonald et al. 2010), the Fenn Cache, from an undisclosed location in either Utah, Idaho, or Wyoming (Kornfeld et al. 2010; Frison and Bradley 1999) and in Idaho the Simon Clovis Cache (Kohntopp 2010), the China Creek Cache
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(Kohntopp 2001), the Cedar Draw Cache (Kohntopp 2006) and others (Pavesic 1966, Plew and Woods 1986).

Caching is a behavior in which an individual or group of individuals hides or conceals a resource for possible retrieval at a later date (Garfinkel et al. 2004; Lassen 2005). The definition of prehistoric caches often refers to lithic materials, but caches can also include other items. The cached material presumably held some value to the cacher (Rennie and Retter 2007) due to the fact that if the artifacts are in early stages of production and use and they have the potential to be used in a great deal of future activity (Odess and Rasic 2007). Tools in early stages of production and use are not at a point in their use-life that warrants abandonment and would not be expected to have been intentionally discarded (Odess and Rasic 2007). Caching is therefore an intentional act by those who cached the material.

A number of hypotheses have been proposed to explain caching behavior. However, caches vary greatly in assemblage content, time period, and context, thus they must be approached carefully when trying to determine why a cache was created (Kilby 2008; Lassen 2005). One explanation proposes that caches form a safety net of sorts where a collection of tools are stored that can be recovered for later use. Caches can therefore be viewed as utilitarian in nature and function as a place of storage for a variety of later uses (Garfinkel et al. 2004, Kilby 2008; Lassen 2005; Rennie and Rittel 2007). Another hypothesis is that caches are the result of ceremony or ritual. Ritual caches are often associated with human burials such as the Anzick site in Montana (Kilby 2008; Lassen 2005; Wilke et al. 1991). However, ritualistic caches need not be associated with human remains. Ritual caches can be dedications to ancestors or deities as well as towards future endeavors (Kilby 2008; Lassen 2005; Kohntopp 2001). Caches must be assessed individually when seeking to determine their possible

Figure 10.1. Map showing general location of Yearling Spring Cache Site in southwest Montana and location of Obsidian Cliff obsidian source in Yellowstone National Park, Wyoming.
function, such as utilitarian or ritualistic or a combination of both (Kilby 2008; Lassen 2005).

The use of ochre is often associated with prehistoric caching in North America (Binford 1972; Kilby 2008; Kohntopp 2010; Lassen 2005; Wilke et al. 1991). Ochre has been used for pigment, medicines, and ceremonial purposes throughout the world for over 100,000 years (Henshilwood et al. 2011; Popelka-Filcoff 2006). Iron oxide ($\text{Fe}_2\text{O}_3$), commonly known as red ochre, is an impure variety of hematite (Erlandson et al. 1999; Mrzlack 2003; Tankersley et al. 1995). Hematite can be found occurring naturally in geological formations (Erlandson et al. 1999). Prehistoric use of ochre is not limited to caches and is often associated with utilitarian, medicinal, ritualistic, and ceremonial activities. A few important uses of ochre include the tanning of hides, as a

*Figure 10.2. Topographic map of Yearling Spring Cache site area showing locations of obsidian pieces and ochre stain that eroded out of collapsed cutbank during the spring of 2010.*
pigment in rock art, decorative application to peoples’ skin, for medicinal purposes, and use in ceremonal contexts associated with burials (Erlandson et al. 1999; Mrzlack 2003; Tankersley et al. 1995; Wilke et al. 1991).

Prior to archaeological excavation at the Yearling Spring Cache site, an ochre stain was observed in the exposed cut bank profile. Many of the obsidian artifacts that were recovered nearby on the surface and from the sod layer were also covered in ochre and/or a mud/ochre stain. The staining could be a result either of direct application of ochre to the artifacts before caching, of being placed in an ochre-filled pit, or as a result of secondary deposition in a mud/ochre mixture after slope failure exposed the cache. It appears that the ochre and the cache of obsidian artifacts are associated with one another, given that one flake tool was discovered in situ at the base of what appears to be the edge of the ochre-filled subsurface pit. Based on X-ray fluorescence spectrometry and obsidian hydration dating, it appears that the site is the result of a single caching event. The lack ofdebitage at the site suggests that the artifacts were produced off site. Currently the Yearling Spring Cache site does not appear to be part of a larger site.

The data presented here are preliminary, and further archaeological investigation is ongoing. It is possible that additional artifacts associated with the cache are buried downslope in the sod layer in a secondary context. As work continues it should be expected that the artifact count and other data presented in this chapter will change.

ECOLOGICAL SETTING

The Yearling Spring Cache site is located within the Middle Rocky Mountains. Average elevation is 1403 m (4600 ft.) above mean sea level (amsl). Major natural features in the region include the Absaroka Range to the south and the Yellowstone River and the Crazy Mountain Basin and Sheep Mountain to the north. The Yearling Spring site is situated within an intermittent drainage that flows north to approximately 2.75 km (0.71 mi.) to the Yellowstone River. The unnamed drainage and other adjacent streams originate to the south on Elephant Head Mountain at 2875 m (9431 ft.).

Rock lithologies in the headwaters are amphibolite and gneiss, transitioning downstream (northward) into the drainage midsection to steeply dipping Cambrian through Cretaceous sedimentary rocks including sandstone, limestone, dolomite, quartzite, and shale (Eckerle 2011; Berg et al. 2000). Glacial moraine deposits also occur in the headwaters and midsection of Mission Creek that is situated nearby. The drainages in the vicinity of the site flow across a piedmont slope which consists of a composite set of gravel-capped, pro-glacial, outwash fans which transition to terrace treads near the axis of the Yellowstone River. The upstream origin of the fans begins near the confluence of Beaver Creek at around 1463 m (4800 ft.) and the fans extend to the south margin of the Yellowstone Valley where their gradient flattens to a gravel terrace tread before they terminate at a scarp-edge at an elevation of ~1402 m (~4600 ft.). These terraces are mapped as “Alluvium of fourth youngest alluvial terrace” and “Alluvium of fifth youngest alluvial terrace, oldest” (Berg et al. 2000, map legend). The mouth of area drainages, where they grade to the Yellowstone River valley bottom are incised ~36.6 m (~120 ft.) below these terraces. The presence of this fan-terrace landscape is attributable to bedload deposition from Mission Creek and other adjacent drainages at a time when the channel of the Yellowstone River stood greater than 30 m higher than its present elevation of 1323 m (4330 ft.)(Eckerle 2011). The downstream portion of the fan overlies the Cretaceous Sedan Formation (possible equivalent of portions of the Livingston Formation) consisting of sandstone, mudstone, and ash-flow tuff (Berg et al. 2000).

The vegetation at the site and surrounding immediate vicinity is limited to sparse grasses and forbs, with indications of recent and historic cattle grazing. The adjacent Yellowstone River drainage to the north exhibits mixed riparian vegetation with cottonwood, willow, and other species. Adjacent terraces have very sparse tree cover with cottonwood and cultivated species, grasses, and forbs.
SITE DESCRIPTION

The site consists of a small, subsurface cache pit and 62 obsidian bifaces, preforms, cores, core fragments, and flake tools, some of which are ochre-covered (Figures 10.3 and 10.4). The top of the ochre-filled cache pit is located at a level approximately 70 cm below existing ground surface. One obsidian biface reduction flake was found in situ during excavation within the remaining edge of the sub-surface, ochre-filled cache pit. Twenty obsidian pieces were found on the ground surface after a bank/slope failure in spring 2010. The recent surface distribution of artifacts was located immediately east and downslope of the ochre-filled cache pit location. The remaining 41 specimens were found in the same downslope area within the recent sod layer, indicating an earlier but recent slope failure that first exposed the cache pit.

RESEARCH METHODOLOGY

Artifact discovery and collection first occurred in the spring of 2010 when 20 obsidian artifacts were discovered lying on the surface near Yearling Spring by non-archaeologists who reported their discovery to professional archaeologists. It appears the artifacts were deposited on the surface that spring after a slope failure caused the artifacts to erode out of primary context and slide downhill on wet grass. This was apparent from the fact the 20 artifacts were resting either atop freshly eroded soil or on a bed of new season’s growth of grass. At first it was believed that these artifacts might represent the entirety of the cache located adjacent to a heavy ochre stain in the mud wall of the cut bank. However, subsequent excavations

Figure 10.3. Photograph view to west of placement of EU-1 and EU-2 at site. Note recent bank running left to right, resulting from recent slope failure.

Figure 10.4. Photograph view to west showing EU-2 with details of ochre-filled cache pit (outlined with dotted line) and location of in situ obsidian flake (Artifact 49) at bottom of cache pit. OSL-002, -003, -004 mark locations of sediment cores taken for OSL analysis.
undertaken by the authors have revealed a larger number of obsidian artifacts that almost certainly are associated with the cache.

The remaining 42 obsidian artifacts were recovered through excavation of the cut bank and the sod layer below the slope failure. The orientation of the excavation units (EU-1 and EU-2) is shown in Figure 10.5.

Sub-centimeter topographic mapping of the site and surrounding land surfaces was carried out with the use of Real Time Kinematic (RTK)/dual station Global Positioning System (GPS). A large area around the site was mapped at 15- and 30-cm contours to indicate topography, artifact locations, excavation units, and other elements.

A single excavation unit (EU-1) was placed up slope above the cut bank to determine the possible lateral extent of the cache area. During excavation, 1/8th inch screens were employed to ensure recovery of very small items. Excavation of EU-1 failed to recover any artifacts or concentrations of ochre. A second excavation unit (EU-2) was placed directly to the east and down slope, and exposed the extent of the ochre stain noted in the cut bank. Only the eastern half of the unit was excavated, leaving a 50cm thick balk-wall between EU-1 and EU-2.
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Table 10.1. Biface reduction stages and tool types exhibited by the Yearling Spring Cache (24PA1377).

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>Count (n)</th>
<th>Maximum Length (range, cm)</th>
<th>Weight (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bifaces</td>
<td>31</td>
<td>6.88-20.12</td>
<td>41.94-601 g</td>
</tr>
<tr>
<td>Flake tools</td>
<td>27</td>
<td>5.62-9.62</td>
<td>19.55-125.35 g</td>
</tr>
<tr>
<td>Biface core</td>
<td>1</td>
<td>26.02</td>
<td>2.498 kg</td>
</tr>
<tr>
<td>Biface thinning flakes</td>
<td>2</td>
<td>10.98-15.64</td>
<td>128-272 g</td>
</tr>
<tr>
<td>Core fragments</td>
<td>1</td>
<td>15.64</td>
<td>793 g</td>
</tr>
</tbody>
</table>

(see Figure 10.5). At the bottom of the ochre stain in EU-2 a single in situ artifact was recovered.

Recovery of the other 41 artifacts all occurred within the sod layer down slope from the cutbank and cache pit. Horizontal provenience was recorded and depths measured relative to both the site datum and below ground surface. The depths below surface at which artifacts were recovered ranged from one centimeter to just over 15cm. The sod layer itself was less than 20cm thick and contained all of the excavated artifacts. It is likely that this indicates at least one previous slope failure at some undetermined number of years ago and re-deposition of artifacts before those on the surface were discovered in 2010. All artifacts are in secondary context except for the single flake tool located at within the ochre-filled pit observed in EU-2.

The absence of lithic debitage at the site suggests that the artifacts at Yearling Spring were produced elsewhere and later cached at the site. When obsidian artifacts were uncovered during excavation a number of procedures were employed to ensure the integrity of the artifacts for subsequent technical analyses. Artifacts were handled with plastic protective gloves to prevent human contamination during protein residue analysis. Artifacts were wrapped in aluminum foil and then placed into paper bags, rather than plastic, in case chemicals from plastic bags could off-gas and contaminate the specimens or related residues.

ASSEMBLAGE ANALYSIS

The Yearling Spring Cache assemblage consists of 62 obsidian artifacts. It should be noted that excavation of the site is not complete and with continued excavation this number might increase, thus changing the totals presented below. The lithic specimens have been classified into five broad categories. These artifact categories include bifaces, flake tools, biface cores, large biface thinning flakes, and core fragments. The assemblage of obsidian artifacts from the Yearling Spring Cache weighs a total of 8.375kg. Measurements taken on individual specimens include maximum length, maximum width, and maximum thickness in centimeters, as well as the weight in grams of each artifact. If platforms are present on flake tools additional measurements of platform width and thickness in centimeters have been recorded as defined by Andrefsky (2005). Other attributes such as transport wear, possible use wear, and the presence or absence of ochre stains have been noted during lab analysis. Basic measurements were taken before potentially destructive analyses were performed. Table 10.1 presents the distribution of artifact types present in the Yearling Spring Cache.

A total of 31 artifacts from the cache are classified as bifaces. Bifaces are defined as those exhibiting flake scars that are present on both sides of the artifact and extend to at least its center line (Andrefsky 2005). All of these artifacts are at least bi-marginally worked on both sides but the flake scars do not extend to at least the center line. Rather, the original flake scar from detachment remains in the center of the artifact.

In these instances the artifact was classified as a biface even though it is not what is classically considered a biface (Figure 10.6). Such classification was undertaken because the artifact appeared to have been reduced to the point, as a rough preform or blank, where further
work was not needed to reduce, thin, or shape the artifact. The maximum length of bifaces ranges from 6.86cm to 20.12cm and weight ranges from 41.94g to 601g. Figure 10.7 shows an overlay of all 31 bifaces and the large biface core. The bifaces are all in early stages of reduction. These bifaces are all roughed-out preforms with no diagnostic form or features to enable classification to a specific cultural complex or time period.

Flake tools are defined as artifacts with uni-marginal or bi-marginal flaking on either the dorsal, ventral, or both sides. Flake tools still have flake characteristics present, such as a bulb of percussion and/or conchoidal fracture lines (ripple marks) on the ventral side, and in some cases the presence of a platform (Figure 10.8). A total of 27 flake tools have been classified within the Yearling Spring collection.
In our classification of Yearling Spring Cache artifacts, flake tools differ from the second type of biface discussed above in that these flake scars on a unimarginal or bi-marginal edge are more limited in their internal penetration from the edge of the artifact to its center, as well as in the extent of the flaking around the perimeter of the artifact. Reduction has not completely erased flake characteristics such platforms, bulb of percussion, ripple marks, and eraillure scars - unlike the previously discussed bifaces. Flake tools range in maximum length from 5.62cm to 9.62cm. Weight of these artifacts ranges from 19.55g to 125.35g.

A single artifact is classified as a biface core. This specimen happens to be the largest artifact in the assemblage (see Figure 10.9). A biface core is a biface on which the edges are used as platforms for the removal of flakes (Andrefsky 2005). Some of the flake scars on this biface core are large enough to have produced a majority of the tools in this cache. None of the artifacts, however, have been refitted to the biface core. The biface core has a maximum length of 26.02cm and weighs 2.498kg. The outline of the single biface core can be seen in Figure 10.9. The biface core is the largest artifact in the overlay and in the cache itself.
Two of the artifacts from the cache are classified as biface thinning flakes. Large biface thinning flakes are characteristic flakes with a platform and a bulb of percussion on the ventral side. The dorsal side shows remnants of flake scars from earlier biface reduction (see Figure 10.10). The edges of these artifacts have little to no use wear or visible retouch. Biface thinning flakes range in maximum length from 10.98cm to 15.64cm and range in weight from 128g to 272g.

The final tool type category is the core fragment. A core fragment is defined here as a non-diagnostic multidirectional obsidian core that exhibits a number of flake scars from previous flake removals. There is a single core fragment from the cache; it weighs 793 g, and has maximum dimensions of 15.64cm by 10.98cm.
While nodebitage was recovered from the site, 11

Figure 10.9. Photograph of large biface core from Yearling Spring cache (2010-F-003).
small flakes were recovered from the screen during excavation. All of these flakes weigh less than one gram and average around 0.25 g. These flakes all appear to have been recently produced and seem not to be the result of artifact production in the past. We believe these small flakes are likely the result of trampling by large animals when the artifacts were exposed on the surface after the slope failure. As the site is located near a spring it is subject to heavy traffic by large mammals including cattle. While none of these small flakes have been refitted to larger artifacts there is no reason to believe they won’t fit artifacts in the assemblage or others yet to be excavated. Other artifacts also show signs of recent trampling damage. Examples of this include artifacts with heavy mud and ochre staining on the exterior that have been broken into at least two pieces. On the broken and most recently exposed surface of the artifact the mud and ochre staining is light to nonexistent indicating that it is a recent phenomenon and not a result of production or initial cache deposition.

Specimens from the cache assemblage have been subjected to a number of technical analyses. A large portion of the assemblage has been subjected to analyses that include x-ray fluorescence (XRF) spectrometry source characterization, obsidian hydration dating, protein residue analysis, and FTIR starch residue analysis. In addition to these special studies, we have estimated minimum cache volume, and specialists have undertaken geomorphological and chronometric studies of the soil matrix, including the use of optically stimulated luminescence (OSL) dating. These studies are discussed further below.

SPECIAL STUDIES

ED-XRF Source Characterization

Sixty of the obsidian specimens from the Yearling Spring cache were submitted to Geochemical Research Laboratory for Energy Dispersive X-ray Fluorescence Spectrometry (ED-XRF) obsidian source characterization (Hughes 2011, 2012). ED-XRF is a special analytical tool used to determine the selected major, minor, trace, and rare earth element composition of volcanic rocks. The distinctive combinations of various chemical elements can aid in the determination of likely geologic source of origin for archaeological artifacts.

The 60 specimens from this project were all found to be from the Obsidian Cliff source in Yellowstone National Park, approximately 155 km south of the Yearling Spring Cache site (Figure 10.11).
Figure 10.11. Map showing possible transport route between Obsidian Cliff source and Yearling Spring Cache site, based on least-cost geospatial model application.
Obsidian Hydration Dating Measurements

Twenty-four of the Yearling Spring obsidian specimens were submitted for obsidian hydration (OH) measurement to Tom Origer & Associates (Origer 2011). Obsidian, a volcanic glass, obeys the property of mineral hydration and absorbs molecular water when exposed to air. Over time, water slowly diffuses into the artifact forming a narrow band or rim that can be observed and measured. Under most environmental and archaeological conditions hydration bands will accumulate at a relatively constant rate. The resulting measurement of the thickness of the hydration layer allows for the determination of relative and sometimes absolute dating of the time that has passed since the artifact was manufactured.

OH measurements for the Yearling Spring sample clustered in a very tight range from 3.9 - 4.1 microns (±0.1 micron), indicating a high potential that all measured pieces were obtained during the same procurement event. Origer (2011) calculated absolute dates for the derived hydration rates by determining the rate of hydration through comparison to an obsidian with well-established rates, and then calculating the "effective hydration temperature" (EHT) for the specimens' known location. Adjusted calculated hydration dates for the Yearling Spring collection is estimated to be approximately 3,683 years ago. This OH date has not been corroborated by other absolute dating methods such as radiocarbon dating, but has been substantiated by bracketed soil dates obtained through optically stimulated luminescence (OSL) dating, described below.

Protein Residue and Fourier Transform Infrared Spectroscopy Analysis

Protein residue analysis is used to identify the presence of prehistoric, historic, or even modern proteins, both animal and plant that are present on a specimen. Proteins are present in plant tissues and in all body fluids and tissues, including blood, urine, saliva, fecal material, etc. This analytical tool can be used to determine what animals were processed using prehistoric tools. Additionally, animal and/or plant proteins may indicate the use of such products in the manufacture and use of ochre pigments.

Fourier Transform Infrared Spectroscopy (FTIR) analysis is used to detect specific signatures resulting from organic compounds, including those that originate from food residues on artifacts.

Three obsidian artifacts and one ochre sample from the Yearling Spring cache were submitted to PaleoResearch Institute for Protein Residue and FTIR analysis (Yost et al. 2012). Organic residue analysis by means of FTIR proved inconclusive for specific organic starches other than ubiquitous/local environmental components. One of the two obsidian specimens with identifiable protein residue tested positive for Cervidae (deer, elk, etc.) and the other tested positive for Salmonidae (trout, salmon). A sample of ochre from the intact portion of the ochre-filled cache pit tested positive for Ursus (bear). Lithic analysis of the two obsidian pieces indicates minimal, if any use-wear. Hence, the existence of animal proteins most likely is the result of formulation of the ochre mixture with various animal fats, blood, oils, or other by-products.

Geoarchaeological Analysis

Limited geoarchaeological studies have been conducted at the site (Eckerle 2011). Geoarchaeological investigations focused on sediments exposed in excavation units EU-1 and EU-2. The site occurs in a north-flowing first order stream drainage with a spring located immediately downslope from the cache site, within the drainage bottom. The defined soil constituents of EU-1 and EU-2 are characterized by a single stratum (I) of dark grayish brown, massive (unbedded), slightly pebbly, muddy, very fine sand (sedimentary texture) unit. The upper portion of Stratum I is characterized by three soil layers of similar appearance and constituents. A1 is the present-day organic sod layer, and A2 is an earlier organic/depositional layer. The top of Layer C is situated at the top of the sub-surface ochre pit, and possibly relates to an early ground surface.

Optically Stimulated Luminescence Dating

Optically stimulated luminescence (OSL) dating is a method of determining how long ago minerals in soil
layers were last exposed to daylight. When an archaeological site exhibits buried deposits indicating possible earlier soil surface layers, OSL can be used to differentiate the ages between these specific layers.

Two sediment samples were submitted to the Utah State University Luminescence Laboratory for controlled analysis with Optically Stimulated Luminescence (OSL) dating techniques (Rittenour 2012). Both samples were taken in EU-2, one above the top of the remaining portion of the ochre-filled pit and one below the pit. The upper sample was assigned an OSL age of 2,590 ± 410 years. The lower sample was found to date to 6,800 ± 1,220 years. Both of these dates bracket the estimated OH date calculation of 3,683 years ago for the obsidian cache.

**Minimum Cache-Pit Volume Calculation**

A minimum cache-pit volume calculation was made to determine the minimum volume required to contain all of the known 62 obsidian specimens. This calculation assumes that all of the documented specimens were originally deposited within a cache-pit of some unknown size. To make the calculation, all specimens were wrapped in protective plastic bags and placed within a plastic cylinder of known dimensions. The obsidian pieces were placed into the cylinder three different times with the volume averaged to allow for potential different arrangements within a space. It should be noted that this calculation is only a minimum volume to determine the smallest size pit to hold all specimens. Obviously, a pit of larger volume could be utilized to cache all artifacts with more space between each artifact.

The minimum cache-pit volume calculation suggests that, if all specimens had been placed within the pit, the minimum volume would be approximately 7700 cm³. The volume of the remaining west edge of the ochre-filled cache pit defined as Feature 1 in EU-2, is calculated to be approximately 12,500 cm³. The recent slope/bank failure, transport of obsidian pieces down slope, and existence of ochre-stained soil suggests that some portion of the originally larger ochre-filled cache pit was destroyed during the recent slope/bank failure.

**Functional Interpretation of the Yearling Spring Cache**

A number of ideas have been proposed to determine the function of prehistoric caches. Because caches vary greatly in assemblage content, time period, and context, they must be approached carefully at an individual level when trying to determine function (Kilby 2008; Lassen 2005). We explore three hypotheses and related expectations for the caching of lithic material to evaluate the Yearling Spring Cache.

The first hypothesis proposes that lithic caches are the result of ritual or ceremony. Putative ritual or ceremonial caches are often associated with ochre use and human burials - such as the Anzick site in Montana (Kilby 2008; Lassen 2005; Tankersley 2001; Wilke et al. 1991). However, ritualistic caches need not be associated with human remains. Ritual caches can be dedications to ancestors or deities as well as towards future activities (Kilby 2008; Lassen 2005; Kohntopp 2001). Schiffer (1987) defines ritual caches as having a discrete concentration of complete artifacts that are largely unused and that are located in primary context. Additional expectations for ritual caches are the presence of ochre and the presence of complete tool kits, not just complete specimens. Also helpful in associating the function of a cache as ritualistic is proximity to a burial (Tankersley 2001).

Falling under ritualistic caching but deserving of a separate hypothesis is the idea of ideological caching. Gillespie’s analysis of Clovis caches (2007) argues that some Clovis caches are an ideological adaption, which, allows hunter-gatherers to transfer a mobile sense of the landscape to a fixed one. The expectations for ideological caches are, thus, somewhat similar in nature to expectations for ritual caches, but differ in key ways. Gillespie’s (2007) expectations under which the function of a cache can be described as ideological are as follows: 1) the finished tools (in his study these are Clovis points) are exceptionally well crafted and aesthetically pleasing, are unused, and are larger than utilitarian specimens of the same tool type; 2) the raw material is of high quality, sometimes having potentially traveled a great distance from the source; and 3) ochre is present within the cache.
or on the cached artifacts. Additionally, Wilke et al. (1991) propose a possible ideological explanation for the Anzick Clovis cache and burial based on ideas about the afterlife. The lithic assemblage from the Anzick Cache contains multiple specimens from varying stages of production. The authors therefore propose that the Yearling Spring Cache could be a “teaching kit” to aid individuals in the afterlife based on the technological information evident in the physical assemblage.

The final hypothesis is utilitarian in nature and proposes that lithic caches form a safety net of sorts where a collection of artifacts is stored that can be recovered for later use. The function of utilitarian caches can therefore be viewed as a place of storage for a variety of later uses (Collins 1999; Garfinkel et al. 2004; Kilby 2008; Lassen 2005; Meltzer 2002; Rennie and Rittel 2007). This third hypothesis looks into the economic or utilitarian aspect of caching. If the function of a cache is to safely store material for later retrieval and use (Collins 1999; Garfinkel et al. 2004; Kilby 2008; Lassen 2005; Meltzer 2002; Rennie and Rittel 2007) then the artifacts can be expected to be in various stages of reduction and production. Expectations for a utilitarian cache could consist of completed tools, unfinished tools, or a combination of both. As later retrieval and use is expected from a utilitarian cache, the tools could have been used prior to caching. The most important difference to note between utilitarian versus ritual and ideological is that tools need not be completed and they need not be unused. Another expectation helpful in determining the function of a cache as utilitarian is its geographic location – wherein a plausible argument for one or another economic process or possible course of action can be made.

Relationships to the raw material source such as distance and travel time should be examined. The surrounding topography is also important. Surrounding topography refers to relationships to physical features on the landscape such as mountains, rivers, canyon mouths, or passes. Location as a criterion is not as clear-cut as other expectations and should be examined on a cache by cache basis. Nonetheless, the location of a given cache was specifically chosen by those who cached the material; therefore, it deserves examination.

We do not expect the Yearling Spring Cache will necessarily fit cleanly into the expectations of a single functional hypothesis. It is hard to define categories of caching that will neatly subsume all caches. Indeed, the same expectations can be found under more than one hypothesis. Moreover, it is probably unrealistic to expect that a cache will meet all the expectations for a given hypothesis. However, we proceed on the premise that the hypothesis that best fits the Yearling Spring evidence is the best explanation for the function of the Yearling Spring Cache.

After evaluating the various hypotheses, we infer the Yearling Spring Cache to be utilitarian. According to the expectations for either a ritual or ideological cache the artifacts should be complete, finished tools that probably should not show signs of use. We do not believe that the function of the Yearling Spring Cache was ritual or ideological due to fact that all of the artifacts are in early stages of reduction or production. All of the bifaces appear to be preform blanks and there is no definable tool kit with typologically diagnostic artifacts present. Some of the artifacts in the assemblage show signs of use-wear and possible retouch. Protein residue analysis found remains of fish and ungulate on two of the tested artifacts. While this does not definitively demonstrate that the artifacts were used to process meat (fat from these animals could have been used as a binder with the ochre), the presence of protein residues is consistent with the inference that these artifacts had been used. Finally, unlike the Anzick site, the Yearling Spring Cache is not associated with a burial. As all of the artifacts are in early stages of reduction or production and there are no complete or finished diagnostic tools, the Yearling Spring Cache assemblage best fits the expectations for a utilitarian lithic cache.

Finally, the location of the Yearling Spring Cache in relation to the surrounding area is extremely important. The cache is only a few miles south of the Yellowstone River and at the interface between the Rocky Mountains and the Great Plains. The Yellowstone River was likely the easiest and fastest way to travel to the Yearling
Spring Cache from the raw material source at Obsidian Cliff (Figure 10.11). From the Yearling Spring Cache site the artifacts could have been transported either into the Rocky Mountains or onto the Great Plains. In fact, Obsidian Cliff obsidian has been found as far east as Hopewell sites in Ohio (Hatch et al. 1990).

The presence of ochre is the only exception to the expectations that support Yearling Spring as a utilitarian cache. Many of the artifacts were coated in ochre, and the partially eroded ochre-lined pit is probably where the artifacts had been cached. Prehistoric use of ochre is often associated with ceremonial and ritual activities, but it could also be used for symbolic transformation or transformation of power (Gillespie 2007). To this end, it is possible that the Yearling Spring Cache is result of a combined utilitarian and ritualistic function. It is conceivable to us that ochre was used at a utilitarian cache, as we infer the Yearling Spring Cache to be, to ritually protect the cache from being discovered and to keep it safe until the cached artifacts could be retrieved. In sum, the Yearling Spring Cache is best explained, at this point, as a utilitarian cache.

LITHIC MATERIAL PROCUREMENT MODEL

The Yearling Spring Cache presents a unique glimpse into single-source procurement and caching activities. As discussed earlier, the cache indicates a single procurement event from a single source with no apparent lithic reduction or utilization at the terminal cache location.

Ongoing research includes the examination of tool-quality lithic sources in southwestern Montana, northwestern Wyoming, and southeastern Idaho. Existing prehistoric site data related to known lithic quarry and procurement sites in Madison, Gallatin, Park, and Sweet Grass Counties has been synthesized from the Montana State Historic Preservation Office. Additionally, available information from area site records and studies in southwestern Montana, Yellowstone National Park, and known obsidian sources in Idaho and Wyoming have been utilized.

A total of 92 tool-quality lithic sources, including the Obsidian Cliff source, have been documented within an approximate 200 km radius of the Yearling Spring Cache site. It should be noted that this distribution of lithic sources may exhibit apparent patterns that may be attributable to a greater or lesser degree to area geology and where archaeological studies have been performed. The procurement pattern presented here may in fact change as more lithic sources are documented.

Table 10.2 presents summary statistics of known lithic procurement sites by primary stone type within 200 km radius of the Yearling Spring Cache site, grouped by 20 km radius zones.

The Obsidian Cliff source in Yellowstone National Park is located approximately 100km, straight line, south-southwest of the Yearling Spring Cache site. Obsidian Cliff is a major high-quality lithic source utilized throughout prehistory over the greater Yellowstone area. Obsidian Cliff obsidian is characterized as a very homogeneous and mostly flawless obsidian prized for effective stone tool production. The source is located at approximately 2,256 meters (7,400 feet) above mean sea level, an elevation of about 854 km (2,802 feet) above Yearling Spring. Because of the substantial elevation difference, access to Obsidian Cliff was most likely limited to non-winter months (Adams, et al 2011).

Figure 10.12 presents a simple bar graph indicating the number all types of known lithic material sources within the 20 km zones radiating from the location of the Yearling Spring site, up to a distance of 200 km. The graph also shows the number of known obsidian sources within the same area. This graphic representation clearly shows the number of lithic material sources that are closer to and farther from Yearling Spring than the Obsidian Cliff source.

The Yearling Spring Lithic Material Procurement Model indicates that 66 lithic material sources (72.5%) are known to be located at distances closer to Yearling Spring than the Obsidian Cliff source. Twenty-five known lithic material sources (27.5%) are located at distances greater than Yearling Spring is to Obsidian Cliff within the 200 km radius around the site.
From this simple model showing the spatial distribution of known lithic procurement sites we can see that over 70% of the known sources are located closer to Yearling Spring than the utilized Obsidian Cliff source. Least-cost models for possible transport routes have not been derived for these sources, but it is presumed that most, if not all of the closer sources would be accessed with less actual energy cost than travel to and from Obsidian Cliff. The data are also clear that the Obsidian Cliff source is the closest known obsidian source to Yearling Spring.

It can be posited that the Obsidian Cliff lithic material was perhaps considered by prehistoric peoples to be of a higher quality for tool manufacture than other closer sources, but correlation between attributes of quality and past behavior is difficult to match.

In summary, the Obsidian Cliff lithic material was obtained during a single event, subjected to initial stages of biface reduction then transported over 100 km linear distance to cache at Yearling Spring. Such activity transforms the raw obsidian at its geologic source into a value-added commodity for future use.

CONCLUSIONS

To date, archaeological investigation of the Yearling Spring Cache (24PA1377) has yielded an artifact assemblage that is composed of 62 obsidian specimens. This assemblage constitutes one of the largest lithic caches in southwestern Montana. The artifacts, ochre, and surrounding sediment matrix from the cache were subjected to a number of technical analyses that help determine the age and raw material source of the obsidian artifacts, as well as the possible organic binder of the ochre. Based on the tight cluster of obsidian hydration rim measurements and the single raw material source (Obsidian Cliff, WY), it is likely the site represents a single caching event at an estimated age of 3,683 years ago.

The behavioral reason underlying prehistoric caching has been evaluated and the caching event at the Yearling Spring Cache site appears to be utilitarian in function, based on the artifacts in the assemblage and its location near the Yellowstone River in southwestern Montana. The site location is at a transitional zone between the Rocky Mountains to the south and west and the Great Plains to the north and east. Obsidian Cliff, the geological source of these specimens, lies 155 km, by likely travel route, to the south-southwest. We conclude that the
obsidian pieces were cached as a utilitarian source for future use. Such use might have been determined as either an intermediate location for future use or as a raw material cache for trading with groups in other locales. Such locations may have included eastward down the Yellowstone River, northward into the High Plains, or westward into and across the Rockies. The lack of late-stage reduction and tool production, as well as finished bifaces in the cache possibly points to a utilitarian cache event for later use rather than a ritualistic or ideological cache.

The use of prepared ochre to mark or store the artifacts presents an interesting element of potential site function and intended use. Ochre has often been documented for use related to spiritual or ceremonial activities and rituals. It is possible that a cache of artifacts placed for future utilitarian purposes could have been deposited with some level of ritual behavior. Unfortunately, the limited archaeological information about the Yearling Spring Cache that is available to us at this time does not enable answering such questions with confidence.

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Stone tools and the by-products of their manufacture are the dominant type of artifact found at prehistoric archaeological sites in North America and much of the world. For that reason, the study of lithic artifacts facilitates our understanding of human use of landscapes, resources, and technology in the past. On an international scale, stone tool and debitage analysis has matured intellectually from its culture-historical origins, incorporating elements of human behavioral ecology, technological organization, land-use strategies, functional interpretations, and a variety of methodological advancements. A multitude of middle-range approaches are now utilized to understand human behavior in the past via the study of stone tools.

*Lithics in the West* seeks to link the rich archaeological lithic data base from the western United States with some of the contemporary theoretical and analytical approaches used in global settings in stone tool and debitage analysis today. The book highlights the role that lithic analysis (in all its forms) plays in solving research problems in the prehistory of western North America.

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