Obsidian conveyance and late prehistoric hunter-gatherer mobility as seen from the high Wind River Range, Western Wyoming

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Sampling 16 of 52 house features at High Rise Village (HRV; 48FR5891), a large residential locus at 3,273 m (10,720 ft) elevation in Wyoming’s Wind River Range produced 25 AMS dates, 23 diagnostic projectile points, 148 obsidian artifacts (mostly retouch debris) as well as abundant chertdebitage, small quantities of faunal bone, and groundstone milling equipment. Based on AMS, projectile point, and obsidian hydration data, the site’s lodges appear to have been occupied on a sporadic basis mainly between 2,300 and 850 cal BP. Source provenance determination made via X-ray fluorescence spectrometry indicates that most of the obsidian at the site originated in Jackson Hole and secondarily is from Yellowstone Plateau sources, suggesting a Late Prehistoric residentially-mobile, seasonal, and elevationally transhumant settlement system focused on the Jackson Hole area. GIS-based assessments of the costs of procuring the obsidian found at HRV suggests, however, that though economic considerations certainly played a principal role in determining obsidian conveyance decisions, other factors such as social or cultural dynamics may have conditioned the preference for Yellowstone sources over eastern Idaho sources, ultimately suggesting that social boundaries played a role in generating the different toolstone conveyance zones seen in the region during the Late Prehistoric.

KEYWORDS obsidian conveyance, lithic technological organization, mobility, high altitude, Wyoming

This study presents evidence for a seasonally and elevationally-transhumant hunter-gatherer mobility pattern operating mainly within the confines of the Yellowstone
Plateau and focused on the Jackson Hole area in western Wyoming (Hansen et al. 2002) between about 2,300 and 850 cal BP. This evidence is based on obsidian source identification using X-ray fluorescence spectrometry (XRF), AMS radiocarbon dates, obsidian hydration (OH) data, and flaked stone artifact analyses from collections made at High Rise Village (HRV; site 48FR5891). HRV is a large, high-elevation residential locus in the northeastern Wind River Range (Adams 2010; Morgan et al. 2012a) (Figure 1). Using these data, prehistoric mobility patterns were reconstructed in a GIS that used least-cost paths as proxies for the routes most likely traversed by HRV inhabitants to the obsidian sources identified in the site’s lithic assemblage. Based on these reconstructions, it appears that HRV was a sporadically occupied, high-altitude node in a settlement and subsistence system that operated mainly between the Snake River Valley near modern-day Jackson, Wyoming, the Togwotee Pass area between the Wind River and Absaroka ranges, the upper Wind River Valley, and the higher elevations of the Wind River Range.
near Dubois, Wyoming. Occasional forays into, or interactions with other groups living in eastern Idaho are not precluded by this analysis, but appear to have played a minor role in this system.

These reconstructions are interesting for four main reasons. One, they provide evidence that there was a late Holocene obsidian conveyance zone centered more or less on the Yellowstone Plateau, in accord with the general idea that there were two main conveyance zones in western Wyoming in prehistoric times: one to the north that accessed mostly western Wyoming obsidian sources and another to the south characterized by a higher frequency of eastern Idaho sources (Harvey 2012; Scheiber and Finley 2011). Two, they provide evidence for a seasonal, residentially-mobile transhumance pattern where groups took advantage of the pronounced elevational gradient of the region, likely overwintering in lower elevations in the Snake and perhaps Wind River valleys and moving into the high country in the spring, summer and fall in pursuit of mobile game and plant resources like roots and perhaps pine nuts (Black 1991; Frison 1997; Losey 2013; Stirn 2014). Three, it appears this pattern was in place mainly during the Late Prehistoric Uinta Phase in the region’s culture chronologies (1800 to 900 cal BP), a span characterized by housepit construction, resource storage, widening diet breadth and repeated site re-use at persistent places, at least in the Wyoming Basin (Kornfeld et al. 2010; Metcalf 1987; Schlanger 1992; Smith and McNees 1999, 2000, 2005). Four, it appears these transhumant groups to some degree planned their high elevation moves by gearing-up with finished flaked stone tools prior to moving into the high country, but to an extent less than that predicted by Thomas (2012); this is likely due to the abundance of high-quality chert sources in the Wind River Range. The data and arguments supporting these assertions follow.

Obsidian conveyance, mobility patterns, and high altitude land use

Obsidian conveyance studies assist reconstruction of prehistoric mobility patterns (Bamforth 2009; Eerkens et al. 2008; Jones et al. 2012, 2003; Kelly 1992; Newlander 2012; Smith 2010) and consequently clarify the ways high altitude land use articulated with regional settlement and subsistence systems (Bettening 1991; Moore 1998; Morgan et al. 2012a, 2012b). Eastern Idaho, western Wyoming and the Yellowstone Plateau in particular contain numerous obsidian sources (Christiansen and Blank 1972; Davis et al. 1995; Holmer 1997; Iddings 1888; Schoen 1997; Wright and Chaya 1985; Wright et al. 1990), making the region a good place to address these interrelated topics (Cannon 1993; Cannon and Hughes 1997; Connor and Kunselman 1995; Frison 1974; Kunselman 1994).

Scheiber and Finley (2011) provide a comprehensive recent look at these interrelated phenomena, using time-controlled source identifications on over 2,300 obsidian artifacts in the central Rocky Mountain region to argue that access to eastern Idaho (mainly Malad) and western Wyoming (Jackson Hole area) obsidian sources became constrained into five main conveyance zones in postcontact times. Importantly, they also use these data to argue for temporal and geographic variability in
Archaic and Late Prehistoric obsidian use, with regions like southwestern Montana showing the least source diversity through time and, in most regions, reduced source diversity in Paleoindian and Middle Archaic times. Harvey (2012) makes somewhat similar assertions: that access to distant obsidian sources was mostly direct through the Holocene and that social or cultural barriers may have resulted in a northern versus southern set of conveyance zones in western Wyoming. Finley et al. (2015) expand on these conclusions with additional temporal data to assert that the development and maintenance of these zones were affiliated with the emplacement of regionally-distinct Numic-speaking populations in the region between 5,000 and 3,500 years ago, certainly an interesting yet contentious assertion given the diverse views on when the Numa settled or became a distinct population in the region (Aikens and Witherspoon 1986; Bettinger 1994; Husted and Edgar 2002; Larson and Kornfeld 1994; Loendorf and Stone 2006; Loosle and Knoll 2003; Simms 1994; Sutton 1987). Park (2010) uses similar types of data to argue for an annual round in Yellowstone National Park, where Obsidian Cliff obsidian was the main source used due to it being the least costly to access from the foraging territories exploited by Yellowstone Plateau populations (see Connor 1993 for a similar argument for the Jackson Hole area). The implication is that obsidian acquisition was embedded with other pursuits on a yearly round (see Binford 1979 and Surovell 2009:113–119 on embedded procurement).

Bohn (2007) notes similar patterns: Obsidian Cliff obsidian predominates in the Greybull River area of northwestern Wyoming and obsidian artifacts found there show evidence for high levels of curation, indicating raw material conservation and perhaps infrequent access to quarries during the annual round. In contrast, Thompson et al. (1997), working in the Wyoming Basin, argue that obsidian there was obtained via exchange, rather than through long-range seasonal transhumance. A nuanced view on the subject is that of Smith (1999), who found that though Obsidian Cliff obsidian (along with Malad and Bear Gulch sources) predominates across Wyoming and northern Colorado, at least some obsidian from these sources ended up in sites closer to quarries in the form of unfinished blanks. More distal sites show greater evidence for curation, similar to the pattern Bohn (2007) recognized in the Greybull River area. Importantly (cf. Thompson et al. 1997), Smith argues that direct procurement as opposed to trade brought obsidian into central Wyoming. In summary, Wyoming obsidian conveyance research points to regional and temporal variability in obsidian conveyance and lithic technological organization, the possibility of regional conveyance zones whose boundaries may have been delineated by the economics of toolstone acquisition, social barriers, or both, and differing perspectives about whether trade or direct procurement characterized raw material acquisition (see Hughes 2011 for a concise summary of the theoretical and methodological problems associated with this last conundrum).

These issues are inextricably associated with larger perspectives on the nature, causes, and means by which indigenous mountain populations exploited the high country. These perspectives consist of several similar and interrelated ideas about settlement, subsistence, and land use that focus on modeling residually versus logistically mobile strategies and how intensively people exploited resources, especially lower-return plant resources. Chief among these is the Mountain
Tradition model, where Black (1991) proposes that mountains and higher elevations were used on a seasonal basis by residentially-mobile groups who overwintered in foothills or lower-elevation valleys, but still within what must be considered montane environments (see also Frison 1997; Frison et al. 1986; Kornfeld et al. 2010; Metcalf and Black 1991). Importantly, Black argues that rather than being peripheral to adjoining Great Basin and Plains adaptations, the Mountain Tradition itself was a unique form of human adaption to mountain ecologies where high elevation plant and animal resources were mapped onto (Binford 1980) as they became productive in the spring and on into summer (see also Frison 1992, 1997; Larson 1990, 1997a for similar arguments regarding the region’s Paleoindian and Archaic Foothill/Mountain adaptations). Benedict (1992) made a somewhat similar case for a “circuit” of seasonal residential movements through the high mountain valleys, parks, and Front Range region of central Colorado and southeast Wyoming. Importantly, these models do not exclude the possibility of residential base camps being established in the mountains from which logistically-mobile task groups operated to more intensively exploit the region’s plant and animal resources. This type of up-down, seasonally transhumant, but also logistically-organized pattern is similar to the one Bender and Wright (1988; see also Wright et al. 1980) identify in the Jackson Hole area from about 3,500 cal BP through the Late Prehistoric (see Stiger 2001 for a similar perspective from Colorado’s Gunnison Basin).

Important to these interrelated models is the fact that mobility and seasonal transhumance patterns relate to lithic technological organization. The literature on this subject is vast, but boils down to the rather intuitive idea that people make rational microeconomic decisions to obtain, reduce, transport, conserve, and use lithic raw materials (Andrefsky 2000; Hall 2004; Michaelson 1980; Odell 1996; Prentiss 1988; Surovell 2009; Torrance 1989), that the abundance, quality and distribution of raw material sources play fundamental roles in this decision making (Andrefsky 1994; Bamforth 1986, 1990, 1992, 2006), and that toolstone procurement is often embedded with other pursuits, which can increase the overall efficiency of raw material acquisition, lithic or otherwise (Brown 1991; Newlander 2012; Surovell 2009). For high altitude land use, a critical hypothesis along these lines recognizes that occupying the high country may be costly and consequently that prehistoric, elevationally-transhumant hunter-gatherers would have had to gear-up with high-quality, multifunctional bifacial tools (Kelly 1988) prior to moving to higher elevations (Thomas 2012). Within these contexts, the socioeconomics of high altitude toolstone acquisition and use in western Wyoming are reconstructed using data generated from HRV, described below.

HRV description and dating

HRV (48FR5891) is a high-altitude hunter-gather site containing at least 52 3 to 4 m diameter house features (lodges or lodge pads) that straddles the modern treeline ecotone of the northeastern Wind River Mountains (Figure 1). The site is on a steep, 23° slope between 3,320 and 3,225 m elevation and covers an area of over 7.6 ha. HRV contains a shallow and surficial deposit of flaked stone tools and
debitage, groundstone implements, and small quantities of ceramics and animal bone deposited mainly in and around the lodge pads (Adams 2010; Koenig 2010; Morgan et al. 2012a). Roughly two-thirds of the site is below modern treeline, in a whitebark pine (Pinus albicaulis) forest. The rest of the site is in alpine tundra above timberline, though it is likely that treeline covered today’s alpine portion of the site during the site’s principal occupations (Morgan et al. 2012a, 2014b).

Though excavations at HRV occurred prior to 2010 (Adams 2010; Adams et al. 2006; Koenig 2010), this study relies on a sample of 16 of the 52 lodges at the site excavated between 2010 and 2012. These excavations produced 11,926 artifacts, the majority of which (92 percent) are chipped stone (mostly debitage but also expedient flake tools and a small number of bifacial tools and projectile points) (Trout 2015). Of the 11,926 pieces, 148 or 1.3 percent of the chipped stone assemblage are made on obsidian. Excavations also produced groundstone artifacts (manos and milling slabs), a small quantity of bone (artiodactyl and marmot), and recovered charcoal and soil samples (Morgan et al. 2012a). The vast majority (79 percent) of the artifactual remains at the site consists of late stage tool manufacture and especially retouch debris of cherts available throughout the Wind River Range (Losey 2013; Morgan et al. 2012a; Trout 2015).

Twenty-three-time-sensitive diagnostic projectile points, 137 OH rind measurements, and 25 AMS dates provide chronological controls for the site. Nearly all of the temporally-diagnostic projectile points (Table 1; Figure 2) are of the small corner-notched variety and compare favorably to Rosegate or Rose Springs designations. Rose Spring and corner-notched points date from approximately 1500 to 900 cal BP on the Plains (Kornfeld et al. 2010), 1500 to 600 cal BP in the mountains (Larson and Kornfeld 1994), and 1800 to 900 cal BP in the basins of southwestern Wyoming (McNees 1992; Thompson and Pastor 1995). Some of the larger corner-notched varieties arguably resemble Elko or even Pelican Lake types (Frison and Walker 2007; Heizer and Baumhoff 1961; Mulloy 1958; Thomas 1981; Wettlaufer 1955), the dating for which are consistent with the pre-1,800 cal BP, Archaic AMS dates for the site (Frison 1991; Kornfeld et al. 2010; Metcalf 1987).

OH measurements range from 0.96 to 3.7 microns ($\mu$), with a mean and standard deviation of $1.55 \pm 0.66 \mu$ (descriptive statistics for OH measurements by source are in Table 2). Very little variability is exhibited in hydration rind thickness by source (marked by very small standard deviations), suggesting, along with the debitage analysis results presented later in this article, that much of the obsidian debitage at the site was derived from only a few tools. Also evident in these data is that more distal sources (e.g., Packsaddle Creek and Bear Gulch) generally have thicker hydration rinds than more proximal sources (e.g., Teton Pass). This relationship might lead to the potentially erroneous conclusion that obsidian conveyance zones became smaller over the period of time that HRV was occupied, with the larger rims at more distal sources representing an earlier and more wide-ranging mobility pattern and the thinner rims at more proximal sources indicating a more constricted pattern (sensu Scheiber and Finley 2011). Of course, different obsidians hyrate at different rates, meaning teasing out variability in obsidian conveyance by source at fine temporal resolutions necessitates converting OH measurements into absolute dates, or at least approximations thereof.
TABLE 1
PROJECTILE POINTS FROM HRV LODGES

<table>
<thead>
<tr>
<th>Figure 2 callout</th>
<th>Lodge</th>
<th>Material</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>16</td>
<td>Chert</td>
<td>Small, concave-based triangular</td>
</tr>
<tr>
<td>b</td>
<td>16</td>
<td>Chert</td>
<td>Small side-notched</td>
</tr>
<tr>
<td>c</td>
<td>22</td>
<td>Chert</td>
<td>Poss. Rosegate series</td>
</tr>
<tr>
<td>d</td>
<td>26</td>
<td>Chert</td>
<td>Rosegate series</td>
</tr>
<tr>
<td>e</td>
<td>26</td>
<td>Chert</td>
<td>Poss. Rosegate series</td>
</tr>
<tr>
<td>f</td>
<td>10</td>
<td>Chert</td>
<td>Rosegate series</td>
</tr>
<tr>
<td>g</td>
<td>SS</td>
<td>Chert</td>
<td>Rosegate series</td>
</tr>
<tr>
<td>h</td>
<td>8</td>
<td>Chert</td>
<td>Rosegate series</td>
</tr>
<tr>
<td>i</td>
<td>26</td>
<td>Chert</td>
<td>Rosegate series</td>
</tr>
<tr>
<td>j</td>
<td>26</td>
<td>Chert</td>
<td>Rosegate series</td>
</tr>
<tr>
<td>k</td>
<td>26</td>
<td>Chert</td>
<td>Rosegate series</td>
</tr>
<tr>
<td>l</td>
<td>26</td>
<td>Chert</td>
<td>Rosegate series</td>
</tr>
<tr>
<td>m</td>
<td>49</td>
<td>Chert</td>
<td>Rosegate series (fragment)</td>
</tr>
<tr>
<td>n</td>
<td>16</td>
<td>Quartzite</td>
<td>Corner-notched</td>
</tr>
<tr>
<td>o</td>
<td>26</td>
<td>Chert</td>
<td>Crude corner-notched</td>
</tr>
<tr>
<td>p</td>
<td>21</td>
<td>Chert</td>
<td>Corner-notched</td>
</tr>
<tr>
<td>q</td>
<td>SS</td>
<td>Chert</td>
<td>Corner-notched (base)</td>
</tr>
<tr>
<td>r</td>
<td>49</td>
<td>Chert</td>
<td>Small, crude corner-notched</td>
</tr>
<tr>
<td>s</td>
<td>SS</td>
<td>Chert</td>
<td>Crude corner-notched (1 side)</td>
</tr>
<tr>
<td>t</td>
<td>26</td>
<td>Chert</td>
<td>Small, crude corner-notched (1 side)</td>
</tr>
<tr>
<td>u</td>
<td>19</td>
<td>Chert</td>
<td>Small, crude corner-notched</td>
</tr>
<tr>
<td>v</td>
<td>16</td>
<td>Chert</td>
<td>Corner-notched (base)</td>
</tr>
</tbody>
</table>

TABLE 2
OH MEASUREMENT (IN MICRONS) SUMMARY STATISTICS, BY SOURCE

<table>
<thead>
<tr>
<th>Source</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teton Pass</td>
<td>46</td>
<td>1.11</td>
<td>.06</td>
<td>0.98</td>
<td>1.21</td>
</tr>
<tr>
<td>Crescent H</td>
<td>23</td>
<td>1.07</td>
<td>.09</td>
<td>0.96</td>
<td>1.40</td>
</tr>
<tr>
<td>Obs. Cliff</td>
<td>29</td>
<td>2.26</td>
<td>.31</td>
<td>1.75</td>
<td>3.07</td>
</tr>
<tr>
<td>Huckleberry Tuff</td>
<td>1</td>
<td>1.40</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Packsaddle Cr.</td>
<td>2</td>
<td>3.64</td>
<td>.02</td>
<td>3.63</td>
<td>365</td>
</tr>
<tr>
<td>Bear Gulch</td>
<td>4</td>
<td>2.55</td>
<td>.51</td>
<td>1.92</td>
<td>2.97</td>
</tr>
<tr>
<td>Malad</td>
<td>5</td>
<td>1.71</td>
<td>.24</td>
<td>1.36</td>
<td>2.00</td>
</tr>
</tbody>
</table>
Unfortunately, OH chronologies are not well developed for the region (Connor and Kunselman 1995; Smith 1999), a phenomenon no doubt affiliated with the
problems associated with hydration dating in general (Anovitz et al. 1999; Liritzis and Laskaris 2011; Rogers 2008; Stevenson et al. 2000). The only attempts at developing absolute chronologies for some of the sources at HRV that we are aware of are those of Michels (1981a, 1981b, 1982) for Obsidian Cliff, Teton Pass and Malad obsidians, which were based on error-prone, lab-based forced hydration experiments that have been shown to often overestimate age (Rogers and Duke 2011, 2014). Given this, we simply argue that the OH measurements (Table 2) are consistent with a Late Prehistoric temporal assignment, in accord with regional OH research (Connor and Kunselman 1995; Morgan et al. 2012a; Smith 1999).

The 25 AMS dates from HRV come from various contexts (Table 3). The first set of eight (dated by Beta Analytic) was reported in Adams (2010) and an additional seven (dated at the Center for Applied Isotope Studies at the University of Georgia; UGAMS) were previously reported by Morgan et al. (2012a). Ten new dates (also run by UGAMS) are reported here. Overall, the HRV dates range from 4,010 ± 25 to 130 ± 40 rcyBP, a 3,880-year span, but are skewed toward the younger end of the range, between about 2,200 and 1,070 rcyBP.

The oldest dates at the site are from Lodges 16 and 49, while the youngest are from Lodge CC. The latter, however, are rejected due to context problems. The oldest dates are rejected as well because of possibility of an old wood problem (Morgan et al. 2012a; Schiffer 1986; Thomas 1982). Old wood is abundant across the site and whitebark pine can live for seven or more centuries, meaning wood burned in ancient campfires could be as many as seven centuries older than the campfires that generated the charcoal used in the radiometric analyses (Perkins and Swetnam 1996; Tomba et al. 2001). Radiocarbon dating and dendrochronological assay of above treeline remnants at the site and in the region indicates that downed wood can persist for at least that long (Losey 2013; Morgan et al. 2012a, 2014b). Further, no temporally diagnostic artifacts were recovered from subsurface contexts that clearly correspond to the older, mid-Archaic AMS dates from the site and no OH measurements suggest Archaic timeframes. Based on the paucity of corresponding projectile points, the excellent preservation of old wood at the site, and the Late Prehistoric OH data, we do not consider these dates representative of human use of the site; they may represent burning of old wood in prehistoric campfires. The dates could also represent a Middle Archaic site occupation, but at this point such an assertion would have to be considered unlikely, especially given the fact that no definite Middle Archaic points were recovered in our excavations. The most recent dates (from 420 to 130 BP) are also rejected because of the materials sampled for dating. One date was obtained from organic residue on an Intermountain Grayware sherd recovered during excavation. Dating residues on sherds is highly problematic (Roper 2013) and it is unknown whether the dated residue is from food prepared in the vessel or from organic material introduced since deposition (though it is not entirely inconceivable that the pot was indeed used around AD 1820; 130 cal BP). The other date is from part of a log found during excavation of the lodge. It is unknown whether the dated sample represents a structural timber as suggested by Adams (2010) or naturally downed wood buried over the last four centuries.

To develop a more robust picture of the occupational history of the site, 1-sigma calibrated summed probability distributions were generated for the AMS dates from
the site (i.e., the data in Table 2) with CalPal 2007 (Weninger et al. 2015) using the Hulu calibration curve (Weninger and Jöris 2008). Though inferring occupational and population histories with these methods is somewhat contentious (Williams 2012), these methods have provided nuance when attempting to reconstruct such histories (Anderson et al. 2011; Morgan et al. 2014a; Steele 2010). Discounting the dates before 4,000 cal BP and the problematic most recent dates, the HRV curve suggests a series of punctuated occupations between roughly 2,800 and 850 cal BP, with the most robust occupational signal between roughly 2,300 and 850 cal BP. This likely represents the period of time when people made, occupied, and used

<table>
<thead>
<tr>
<th>Lab</th>
<th>Lab No.</th>
<th>Lodge</th>
<th>Context</th>
<th>Material</th>
<th>(^{13}C) Age</th>
<th>cal BP ((\sigma))</th>
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<tbody>
<tr>
<td>Beta²</td>
<td>269156</td>
<td>CC</td>
<td>Sherd Residue</td>
<td>Residue</td>
<td>130±40</td>
<td>360 to 40</td>
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<tr>
<td>Beta²</td>
<td>248565</td>
<td>CC</td>
<td>Structural Timber</td>
<td>Wood</td>
<td>420±50</td>
<td>610 to 290</td>
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<td>Beta²</td>
<td>245931</td>
<td>S</td>
<td>Hearth</td>
<td>Charcoal</td>
<td>840±40</td>
<td>870 to 670</td>
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<td>Beta²</td>
<td>290219</td>
<td>D</td>
<td>Lodge Fill</td>
<td>Charcoal</td>
<td>1,070±30</td>
<td>1080 to 920</td>
</tr>
<tr>
<td>Beta²</td>
<td>263853</td>
<td>SS</td>
<td>Hearth</td>
<td>Charcoal</td>
<td>1,570±30</td>
<td>1560 to 1400</td>
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<td>Beta²</td>
<td>262495</td>
<td>SS</td>
<td>Lodge Fill</td>
<td>Charcoal</td>
<td>2,700±40</td>
<td>2890 to 2730</td>
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<td>Beta²</td>
<td>290220</td>
<td>49</td>
<td>Hearth</td>
<td>Charcoal</td>
<td>3,880±40</td>
<td>4460 to 4210</td>
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<td>Beta²</td>
<td>262460</td>
<td>49</td>
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<td>Charcoal</td>
<td>4,000±40</td>
<td>4560 to 4400</td>
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<td>UGAMS³</td>
<td>8382</td>
<td>26</td>
<td>Hearth</td>
<td>Charcoal</td>
<td>1,210±25</td>
<td>1250 to 1050</td>
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<td>UGAMS³</td>
<td>8380</td>
<td>26</td>
<td>Hearth</td>
<td>Charcoal</td>
<td>1,480±25</td>
<td>1440 to 1220</td>
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<td>UGAMS³</td>
<td>8383</td>
<td>W</td>
<td>Charcoal lens</td>
<td>Charcoal</td>
<td>1,560±25</td>
<td>1550 to 1990</td>
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<td>UGAMS³</td>
<td>8378</td>
<td>SS</td>
<td>Charcoal Smear</td>
<td>Charcoal</td>
<td>1,990±25</td>
<td>2030 to 1870</td>
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<td>UGAMS³</td>
<td>8379</td>
<td>22</td>
<td>Burned Floor</td>
<td>Charcoal</td>
<td>2,220±25</td>
<td>2360 to 2120</td>
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<td>UGAMS³</td>
<td>8381</td>
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<td>Hearth</td>
<td>Charcoal</td>
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<td>4530 to 4370</td>
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<td>9756</td>
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<td>Charcoal</td>
<td>4,010±25</td>
<td>4560 to 4400</td>
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<td>13681</td>
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<td>Hearth</td>
<td>Charcoal</td>
<td>1,380±25</td>
<td>1350 to 1270</td>
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<td>UGAMS</td>
<td>13682</td>
<td>21</td>
<td>Charcoal lens</td>
<td>Charcoal</td>
<td>2,050±20</td>
<td>2080 to 1960</td>
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<td>UGAMS</td>
<td>13683</td>
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<td>Charcoal Smear</td>
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<td>1,150±20</td>
<td>1170 to 970</td>
</tr>
<tr>
<td>UGAMS</td>
<td>13684</td>
<td>40</td>
<td>Charcoal Smear</td>
<td>Charcoal</td>
<td>2,060±25</td>
<td>2120 to 1960</td>
</tr>
<tr>
<td>UGAMS</td>
<td>13685</td>
<td>10</td>
<td>Hearth</td>
<td>Charcoal</td>
<td>1,690±25</td>
<td>1720 to 1520</td>
</tr>
<tr>
<td>UGAMS</td>
<td>13686</td>
<td>21</td>
<td>Charcoal lens</td>
<td>Charcoal</td>
<td>1,160±20</td>
<td>1190 to 990</td>
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<tr>
<td>UGAMS</td>
<td>13687</td>
<td>28</td>
<td>Charcoal lens</td>
<td>Charcoal</td>
<td>1,130±20</td>
<td>1100 to 980</td>
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<tr>
<td>UGAMS</td>
<td>13688</td>
<td>19</td>
<td>Charcoal Smear</td>
<td>Charcoal</td>
<td>1,590±20</td>
<td>1560 to 1400</td>
</tr>
<tr>
<td>UGAMS</td>
<td>13689</td>
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<td>Hearth</td>
<td>Charcoal</td>
<td>3,990±25</td>
<td>4550 to 4390</td>
</tr>
<tr>
<td>UGAMS</td>
<td>13690</td>
<td>8</td>
<td>Charcoal lens</td>
<td>Charcoal</td>
<td>1,460±20</td>
<td>1420 to 1300</td>
</tr>
</tbody>
</table>

\(^1\text{Radiocarbon dates calibrated at 2-sigma with CalPal 2007 (Weninger et al. 2015) using the Hulu calibration curve (Weninger and Jöris 2008).}\)

\(^2\text{Originally reported by Adams (2010).}\)

\(^3\text{Originally reported in Morgan et al. (2012a).}\)
the HRV lodges. To be absolutely clear on the dating of the site: this is not to say that people did not use the site area earlier or later than this time – the Intermountain Grayware sherds clearly attest to a later period of site use and Archaic and even Paleoindian projectile points have been found in the site vicinity – but that the building, use and occupation of the site’s lodges falls mainly within a 2300 to 850 cal BP span. These conclusions refine Morgan et al.’s (2012a) preliminary dating of the site, which indicated most of the site’s lodge occupations dated to between 1,500 and 500 cal BP and refutes Adams’ (2010) earlier assertion that the site may represent a Mountain or Sheepeater Shoshone occupation.

**Obsidian analyses**

A total of 137 of the 148 obsidian artifacts recovered from the site were analyzed for source provenance via energy-dispersive XRF by Geochemical Research Laboratory. Though sample size is small relative to the overall flaked stone assemblage (just over 1 percent), obsidian is the only material from the site that we can confidently ascribe to source. We also assert that the small amount (and small size) of the obsidian artifacts from HRV likely indicates that this material came from quarries near the maximum extent of the territory exploited by HRV’s inhabitants (sensu Eerkens et al. 2008) and is thus a good way of approximating the entirety of these people’s movement across the landscape. Not surprisingly, Jackson Hole area obsidians (i.e., Teton Pass and Crescent H) predominate, comprising over 62 percent of the assemblage (Figure 4). Equally unsurprising is that other high quality sources on
null
occupying HRV (the greatest source diversity is in Lodge 10, with four geochemically distinct sources) or that lodges were repeatedly occupied by different groups bringing different source materials to the site at different times. The highest frequency of obsidian, however, is found in only two lodges (19 and 21) where either Teton Pass or Obsidian Cliff raw materials predominate. The predominance of these sources in these lodges likely entails single reduction episodes as they consist almost exclusively of small, retouch debris with highly consistent OH rims.

Only one obsidian biface was recovered (the tip of what appears to be a projectile point) and 13 edge modified flakes are in the obsidian debitage assemblage. The remaining obsidian debitage (n = 134) consists almost exclusively of debris associated with tool maintenance, with over 87 percent consisting of small biface thinning flakes, pressure flakes, or retouch chips (Table 5; Figure 5). Only 10 flakes (6.8 percent of the obsidian debitage assemblage) could confidently be associated with core reduction and only one flake exhibited cortex. Based on the predominance of pressure flakes and especially retouch chips, it appears that most of the obsidian at the site arrived as finished or nearly finished tools and that these tools were

<table>
<thead>
<tr>
<th>Flake type</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Late stage core reduction</td>
<td>13</td>
<td>93</td>
</tr>
<tr>
<td>Biface thinning</td>
<td>42</td>
<td>29</td>
</tr>
<tr>
<td>Pressure</td>
<td>22</td>
<td>15</td>
</tr>
<tr>
<td>Retouch chip</td>
<td>66</td>
<td>46</td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>100</td>
</tr>
</tbody>
</table>

**TABLE 5**
OBSIDIAN DEBITAGE BY FLAKE TYPE

Figure 5  Obsidian debitage proportions by flake type.
maintained and resharpened at the site. The dearth of formed obsidian tools at the site may also suggest high degrees of curation, with tools carried off-site whenever the site was abandoned, seasonally or otherwise.

Assessing the economics of HRV obsidian acquisition

To determine the costs of accessing obsidian source locations from HRV, least cost paths (LCPs) (sensu Kantner 1997; Morgan 2008; Surface-Evans and White 2012) were generated between HRV and the sources identified at the site, as were caloric costs required to traverse these paths. Caloric costs were calculated following Harvey (2012) using what he calls the Spatial Caloric Model (SCM). The SCM builds on previous research (e.g., Brannan 1992; Jones and Madsen 1989; Machovina 1996; Mickelson 2003) and produces round trip costs following LCPs across the landscape. These predict the most economical way to directly procure resources (in this case obsidian) from a central place (i.e., HRV) in a single round trip, with no other activities save travel occurring during the trip. This model operates on the assumption that an agent traverses the same path on the out and inbound foray with a 10 kg load increase on the return trip. To simplify the analysis, Teton Pass and Crescent H were grouped together due to their proximity.

The most common obsidian at HRV (Figure 4) comes from sources that are least costly to access (Teton Pass, Crescent H, and Obsidian Cliff), in much the same economizing pattern Park (2010) identifies in Yellowstone (Table 6; Figure 6). The main exception to this pattern consists of the data from Packsaddle Creek. The source is extremely uncommon at HRV, yet the only source access costs that are lower than Packsaddle Creek’s are those of Teton Pass/Crescent H. Also surprising is the dearth of Huckleberry Tuff and Lava Creek Tuff obsidian at the site. Fewer artifacts from these sources are at HRV than from Bear Gulch or Malad, but the latter sources are far more costly to access. A final methodological point is that although LCP generation results in distances that likely approximate the actual distances traversed by prehistoric obsidian conveyors (sensu Morgan 2009), it is also clear that much easier to generate Euclidian distances serve as

<table>
<thead>
<tr>
<th>Source</th>
<th>Cost (kcal)</th>
<th>LCP Distance (km)</th>
<th>Euclidian distance (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teton Pass/Crescent H</td>
<td>1295.79</td>
<td>25390</td>
<td>21384</td>
</tr>
<tr>
<td>Obsidian Cliff</td>
<td>28,045.25</td>
<td>41060</td>
<td>358.84</td>
</tr>
<tr>
<td>Lava Creek Tuff</td>
<td>27,891.67</td>
<td>3926</td>
<td>344.98</td>
</tr>
<tr>
<td>Huckleberry Tuff</td>
<td>30,419.37</td>
<td>440.88</td>
<td>377.94</td>
</tr>
<tr>
<td>Packsaddle Creek</td>
<td>22,291.10</td>
<td>314.44</td>
<td>276.24</td>
</tr>
<tr>
<td>Bear Gulch</td>
<td>32,247.12</td>
<td>495.64</td>
<td>358.82</td>
</tr>
<tr>
<td>Malad</td>
<td>42,115.96</td>
<td>599.70</td>
<td>499.50</td>
</tr>
</tbody>
</table>
FIGURE 6 Comparison of LCP caloric costs, round trip LCP distances, round trip Euclidian distances, and proportion of obsidian sources in the obsidian assemblage. The scale for caloric costs (in kcals) is in bold on the left Y-axis; the scale for distance (in km) is on the right Y-axis. Obsidian source percentages appear as gray bars, rounded the nearest whole number.

reasonable proxies for conveyance costs if the goal is comparison of these costs in a relative as opposed to an absolute sense.

Discussion

The results of this study have important implications for chronology building and especially to conveyance studies and mobility pattern reconstruction. In terms of chronology, AMS dating, diagnostic artifacts, and to a lesser extent OH dating from HRV indicate that the site is mainly a Late Prehistoric, Uinta Phase phenomenon (Metcalf 1987). This is important because it was at this time that diet appears to have broadened and the region’s hunter-gatherers invested more energy in domicile construction and place than in most other periods (save the middle Holocene). If so, HRV may be a high-altitude version of this pattern, where its occupants invested in residential facilities in a persistently-occupied place (sensu Larson 1997b; Schlanger 1992; Smith and McNees 2011). The dearth of faunal remains at the site and preponderance of groundstone arguably suggests a focus on plant resources, a pattern also seen in the Wyoming Basin at about the same period (Losey 2013; Smith and McNees 2011; Trout 2015).

The obsidian data from HRV, however, speak mainly to issues relating to conveyance and mobility patterns. The site’s relationship to regional spatial and temporal variation in obsidian conveyance is exhibited in comparison to the data presented in Scheiber and Finley (2011), who use Beals et al. (2000) to generate obsidian source diversity (H) and source evenness (E_41) indices across time and space in the central
Rocky Mountain region. Using these formulae, obsidian source diversity at HRV is 1.51 and evenness is 0.69. When these data are plotted on graphs containing Scheiber and Finley’s (2011) data, two main trends stand out (Figures 7 and 8). First, diversity and evenness at HRV (located in northwestern Wyoming) are consistent with regional trends, with diversity falling more or less between the values for northwestern and southwestern Wyoming and evenness essentially the same as that of northwestern Wyoming. Second, these same indices, especially low diversity, are more consistent with Paleoindian values than with the Late Prehistoric ones that correspond to the dates for the site’s principal occupations. Paleoindian times were arguably characterized by relatively greater residential mobility than the Late...
Prehistoric (Kornfeld et al. 2010, 2001; Metcalf 1987). It seems plausible that a similar degree of high residential mobility may also have pertained at HRV, despite evidence for increased investment in place and logistical mobility in the nearby, lower-elevation Wyoming Basin during the period of HRV’s main occupations (Kornfeld et al. 2010; Metcalf 1987; Smith and McNees 1999, 2000, 2011). We think, however, that the low source diversity at HRV may instead result from small sample size and the remoteness of the site’s setting relative to the region’s obsidian sources.

In terms of type of mobility, the high frequency of domiciles at the site and necessity of seasonal occupation (extreme cold and deep snow preclude all but summer occupations at HRV) suggests multi-family residential moves to the site on a seasonal basis. If true, this mobility pattern reconstruction is consistent with Black’s (1991) idea that a yearly round marked by residential mobility and considerable elevational transhumance characterized regional Archaic mobility patterns and that this pattern may characterize the Late Prehistoric patterns on the Yellowstone Plateau as well. It appears also that obsidian acquisition was embedded, albeit to a minor extent, in this round. Unfortunately, due to our poor understanding of Wind River Range settlement patterns (but see Stirn 2014), it is as-yet unclear if HRV was simply a large node in an exclusively residentially-mobile system or if it served more as a residential base from which logistically organized groups exploited different facets of the Wind River Range high country (but see Trout 2015).

This study also tentatively supports assertions for economizing behaviors with regard to toolstone acquisition and for regional variation in conveyance patterns. Obsidian arrived at the site in the form of curated, finished or nearly finished tools, the evidence for their presence at the site being for the most part a small amount of tool maintenance debris. This might on the surface seem to support the idea of gearing-up before heading into the high country (Thomas 2012), with only finished tools from distant quarries being brought to high elevation. But if this was the case, HRV inhabitants were not gearing up to any great extent: almost no obsidian was recovered from the site and most (95 percent) of the flaked stone assemblage is made up of high-quality cherts available within a day or two’s walk from the site (Trout 2015). It consequently appears that the local distribution of quarries superseded the necessity of bringing exotic obsidians to the site (see Bamforth 1992 for an example of the effect of quarry proximity on technological organization).

The study also does not refute the idea of separate regional conveyance zones. Nearly all the obsidian at the site is from the Yellowstone plateau, in accordance with what Scheiber and Finley (2011) and Harvey (2012) posit as a northwestern Wyoming conveyance zone. Supporting Harvey’s (2012) idea that something other than economic considerations (he argues for social or cultural boundaries) conditioned the geographic structure of these zones is the fact that non-Yellowstone Plateau obsidians (especially Packsaddle Creek in eastern Idaho) that were less costly to procure than even Obsidian Cliff material (which is abundant at the site), is nearly absent in the HRV obsidian assemblage. Perhaps social boundaries indeed played a role in delineating this pattern. More research is needed, however, to both model
these boundaries and to assess the alternative hypothesis that toolstone quality may have conditioned these patterns instead.

Conclusion
Our analyses indicate that HRV was sporadically occupied between 2,300 and 850 cal BP during a period of widening diet breadth and persistent settlement in the lowlands. We think that HRV articulated with these trends as a high altitude node in a residentially-mobile seasonally transhumance pattern operating within the Yellowstone Plateau area and centered primarily on Jackson Hole. It also appears that there were few forays into or interactions with groups in eastern Idaho and the Snake River Plain, supporting the idea of discrete Late Prehistoric conveyance zones in the greater central Rocky Mountain region. We still do not know if economic, social, cultural or other factors conditioned the development and maintenance of these zones. Preliminary results, however, suggest Harvey (2012) was on the right track: something other than just economic considerations played a role in determining the size, scale, and distribution of these Late Prehistoric conveyance zones. The obvious candidate for explaining the development and maintenance of these zones could be the emplacement and development of ethnographic, Numic-speaking populations and their ethno-linguistic subdivisions. But this potential explanation hinges on determining exactly when this occurred: a remarkably contentious subject that is well beyond the scope of this paper. But it is intriguing to hypothesize that if Late Prehistoric conveyance zones became set by about 2,000 cal BP (or perhaps earlier), this might argue for sociolinguistic boundaries developing at about the same time (sensu Finley et al. 2015). Resolving this issue clearly necessitates greater chronological control to elucidate fine-grained patterns in material conveyance during the Late Prehistoric and better models geared towards making predictions as to what territoriality and social boundaries might look like in the region’s archaeological conveyance signatures.

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References Cited


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David Harvey, PhD student, Department of Anthropology, University of Nevada, Reno. His MA thesis (2012, University of Memphis) reconstructed obsidian conveyance patterns in western Wyoming. His PhD research focuses on settlement pattern
reconstruction and the human paleoecology of the Tübatulabal, a hunter-gatherer group in California’s southern Sierra Nevada.

Lukas Trout recently completed his MA thesis at the University of Nevada, Reno. This thesis analyzed prehistoric lithic technological organization at the HRV site in Wyoming’s Wind River Range.

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