OBSIDIAN EVIDENCE OF INTERACTION AND MIGRATION FROM THE MESA VERDE REGION, SOUTHWEST COLORADO

Fumiyasu Arakawa, Scott G. Ortman, M. Steven Shackley, and Andrew I. Duff

A growing body of evidence demonstrates that ancestral Pueblo people living in the central Mesa Verde region of the U.S. Southwest maintained long-distance contacts with other Pueblo peoples. Questions of Pueblo interactions through time and across space have traditionally been addressed using ceramic sourcing data. This research uses obsidian source data to argue that, from A.D. 600 to 920, residents of the central Mesa Verde region obtained obsidian from throughout the U.S. northern Southwest, but that from A.D. 1060 to 1280 they acquired obsidian almost exclusively from the Jemez Mountains area of north-central New Mexico. In addition, importation of obsidian from the Pajarito Plateau increased during the period of population decline in the Mesa Verde region, and population expansion on the Pajarito. Characteristics of the obsidian assemblage from central Mesa Verde region sites also suggest that Jemez obsidian entered the region primarily in the form of finished arrows, arrow points, and arrow-point preforms. We argue that these patterns reflect return migration by early immigrants from the Mesa Verde region to the northern Rio Grande, an early stage in the development of a migration stream between the two regions.

Un creciente acervo de evidencia demuestra que las comunidades ancestrales Pueblo que vivían en la región central del suroeste de los E.E.U.U. mantenían relaciones a larga distancia con otras comunidades Pueblo. Preguntas sobre las interacciones entre las comunidades Pueblo a través del tiempo y el espacio han sido tradicionalmente investigadas a través de estudios de cerámica. Esta investigación utiliza datos de fuentes de obsidiana para argumentar que a partir del 600 d.C. al 920 d.C. los habitantes de la región central de Mesa Verde adquirieron obsidiana a lo largo del suroeste de los E.E.U.U, pero a partir del 1060 d.C. al 1280 d.C. es solo adquirían obsidiana casi exclusivamente en la región de las Montañas Jemez, ubicadas en la zona norte-central de Nuevo México. Además, la importación de obsidiana de la Meseta Pajarito aumento durante el periodo de declive poblacional en la región de Mesa Verde, y de crecimiento poblacional en la Meseta Pajarito. Características de las colecciones de obsidiana provenientes de la región central de Mesa Verde sugieren que la obsidiana de Jemez fue introducida primordialmente en forma de flechas, puntas de flechas, y prototipos de puntas de flecha. Nosotros argumentamos que estos patrones reflejan migraciones de regreso de los primeros inmigrantes de la región de Mesa Verde hacia la zona norte del Rio Grande (Bravo), lo cual fue una etapa inicial en el desarrollo de una corriente de migraciones entre estas dos regiones.

This paper has two primary goals. The first is to take a critical look at the early stages of the migration process. In recent years, archaeologists (Anthony 1990; Arakawa 2006; Cameron 1995; Cameron and Duff 2008; Clark 2001; Duff 1998; Ortman 2009) have begun to consider prehistoric migration as a social process with several stages, rather than as an event. However, research along these lines has tended to focus on detection of immigrants in the destination area and the impact of migration on destination area societies (e.g., Clark 2001; Stone 2003). In other words, archaeologists have emphasized the late stages of the migration process. We believe it is also worthwhile to examine earlier stages of the migration process and tackle such questions as: how did migrants develop social contacts with people who lived in eventual destination areas;
how did people learn about eventual destination areas; and who visited destination areas before the migration stream developed?

The second goal is to use obsidian artifacts, an under-utilized line of evidence, to investigate a specific prehistoric migration that has often been proposed in the literature—the movement of ancestral Pueblo peoples from the Mesa Verde region of southwest Colorado and southeast Utah to the northern Rio Grande region of north-central New Mexico (Cordell 1995; Kidder 1924; Kohler 2004; McNutt 1969). In the classic migration studies in these two regions, archaeologists have mainly investigated carbon-painted ceramics, linguistic, and architectural styles (Ford et al. 1972; Hawley 1950; Mera 1935; Reed 1950; Trager 1967; Wendorf 1954). We illustrate that obsidian procurement patterns provide especially compelling evidence of the early stages of this particular migration, especially return migration of the initial scouts who acquired information about the northern Rio Grande as a potential destination and relayed it back to relatives in their Mesa Verde region homeland.

The Mesa Verde region provides an ideal setting for examining migration as a social process and for illustrating the role of long-distance, chipped-stone artifact exchange in this process. It is one of the most intensively studied areas in the world and the depopulation of this region in the late A.D. 1200s remains one of the classic problems in North American prehistory. We begin by briefly reviewing recent approaches to migration in archaeology. Then, we turn to archaeological data from the central Mesa Verde region to argue that the exchange of obsidian artifacts represents the clearest evidence adduced to date of increasing long-distance contact between the Mesa Verde and the northern Rio Grande regions during the period of population movement between the two areas.

Migration as a Social Process

Migration has once again become an important research topic in archaeology (Anthony 1990; Clark 2001; Duff 1998; Herr and Clark 1997). In his classic article that re-framed migration as a social process for archaeologists, Anthony (1990) distinguished between short- and long-distance movements. Short-distance movements can result from post-marital residence rules or the desire to take advantage of economic opportunities in the local area (Anthony 1990:901). This type of movement is relatively difficult to identify in the archaeological record (but see Varien [1999] for a case study of this process from the Mesa Verde region) because the source and destination areas are usually within the area encompassed by a single archaeological tradition and within a single resource area.

In contrast, long-distance movements can be highly visible in the archaeological record, especially when such movements cross material culture boundaries or resource areas (e.g., Haury 1958). Anthony (1990:902–905) identified several aspects of long-distance movement, including scouting, return migration, migration streams, and leapfrogging. Anthony (1990:902) defined scouts as the initial, disproportionately young and male migrants “who collect information on social conditions and resource potentials and relay it back to the potential migrants” (Anthony 1990; Lefferts 1977; Stone 1993). Return migration refers to the cycling of scouts or other early migrants back to the homeland to visit friends and relatives. The information conveyed through return migration facilitates the decision-making of others about whether migration to a certain destination is a logical and practical aim for their families, groups, and communities. The cyclical movement of people between homeland and destination also leads to well-developed routes of travel between the two areas (Anthony 1990:903), and to communication networks that encourage migrants to follow kin and co-residents to targeted locations where social support is already in place (Anthony 2007:112; Ho 1993; Lomnitz 1977). The resulting flow of people along well-defined routes is known as a migration stream. Finally, the information collected by scouts and other early migrants about potential destinations often results in subsequent migrants leapfrogging undesirable or already occupied destinations, as opposed to a gradual wave of advance across the landscape.

Several archaeologists (Burmeister 2000; Cameron 1995; Clark 2001; Cordell 1995; Stone 2003) have applied Anthony’s insights in case studies of prehistoric migration. For example,
Clark (2001) examined the late stages of the migration process in the Tonto Basin of central Arizona. His great insight was to suggest that high-visibility and low-visibility material culture attributes play different roles in archaeological migration studies. He suggested that high-visibility attributes of artifacts and architecture tend to send social messages, and thus reflect social relations in the post-migration destination area. In contrast, low-visibility attributes that are created early in artifact production (e.g., raw material selection and basic forming techniques) often do not send social messages, and thus tend to reflect the enculturative tradition of their makers (Clark 2001:13). This makes low-visibility attributes especially useful for identifying immigrants in the archaeological record.

Here, we focus on earlier stages of the migration process, including scouting, return migration, migration streams, and leapfrogging. Following Anthony (1990) and Duff (1998), we argue that large numbers of people rarely migrate to places they know nothing about. Thus, a necessary step in the development of a migration stream is interaction with people from the eventual destination area. Return migration by scouts is one of the primary ways people in the homeland would obtain information about potential destinations, and to the extent that this process leaves material residues, one would expect return migration to be reflected in long-distance exchange data. We apply this perspective in the case study that follows, arguing that the movement of objects from the northern Rio Grande back to the Mesa Verde region, prior to the depopulation of the latter, provides crucial information about the early stages of the proposed migration between the two regions. To accomplish this goal, we investigate obsidian toolstone procurement patterns (i.e., both projectile points and associated debris) in the central Mesa Verde region through time.

**Background on the Study Area**

This study uses samples collected from numerous individual sites to evaluate regional trends in obsidian procurement in the central Mesa Verde region (as defined by Varien et al. 1996) in Southwest Colorado (Figure 1). We summarize information from 26 ancestral Pueblo habitation sites excavated by the Crow Canyon Archaeological Center, the Dolores Archaeological Program, and the Wetherill Mesa Archaeological Project (Table 1 and Figure 2), all of which had at least one obsidian specimen analyzed by X-ray fluorescence (XRF).

**Chronology**

In our discussions of chipped-stone assemblages overall, we focus on four date ranges (A.D. 1060–1140, 1140–1225, 1225–1260, and 1260–1280), the last of which corresponds to the period of actual depopulation in the late thirteenth century (Varien et al. 2007). We do not consider the period between A.D. 920 and 1060 because population was low in the central Mesa Verde region during this period, and no obsidian samples dating to this period have been sourced. Table 2 lists the corresponding date ranges for each period and six cultural periods—Basketmaker III, Pueblo I, early Pueblo II, late Pueblo II, early Pueblo III, and late Pueblo III. For our discussions of the obsidian sourcing data, we group these six cultural periods into two broad time periods: Early (A.D. 600–920) and Late (A.D. 1060–1280). These two broad periods correspond to the two cycles of population increase and decrease that have been documented for the central Mesa Verde region (Varien 1999; Varien et al. 2007; Wilshusen 2002). Below we provide a brief overview of the study area and its culture history structured around these chronological and cultural subdivisions.

**Early (A.D. 600–920)**

From A.D. 600 to 725, residents of the central Mesa Verde region lived in pithouses, engaged in hunting and gathering, and cultivated maize, beans, and squash. People moved frequently in a settlement pattern that is best characterized as “dispersed.” In contrast, from A.D. 725 to 920, aggregated villages developed, especially in the Dolores River valley (Figure 2). Although residents of the central Mesa Verde region from A.D. 725 to 920 were village farmers, they continued to travel long distances to hunt (Driver 2002). During the late tenth century, much of the population left the central Mesa Verde region, migrating to the northern periphery of the central Mesa Verde region (Coffey 2006), and perhaps also to the San Juan Basin and...
the slopes of the Chuskas in northwestern New Mexico (Wilshusen and Ortm an 1999).

Late (A.D. 1060–1280)

During the eleventh century, Pueblo people established a regional cultural, political, and religious center in Chaco Canyon, south of the central Mesa Verde region (Figure 1). The so-called Chaco Phenomenon peaked between A.D. 1040 and 1135. There is debate on the degree to which Mesa Verde region communities participated in or were part of the Chacoan Regional System, but they were clearly affected by it in multiple ways (Cameron 2009; Cameron and Duff 2008; Cordell 1997:324; Lekson 2006, 2009; Lipe 2006; Ortm an 2008; Van Dyke 2007; Varien et al. 2008). From A.D. 1060 to 1140, the population of the central Mesa Verde region increased dramatically, as residents constructed great houses and great kivas that served as community gathering places, replicating the pattern seen in Chaco Canyon (Cameron and Duff 2008). They also engaged in frequent long-distance exchange (Arakawa and Duff 2002; Lipe 1995, 2006; Neily 1983).

From A.D. 1140 to 1225, coincident with the disappearance of the Chaco regional system, rising population levels, and an extended period of drought (Benson and Berry 2009), large aggregated communities such as Yellow Jacket, Albert Porter, and Shields pueblos developed in the cen-
central Mesa Verde region (Figure 2; see also Arakawa 2006; Glowacki 2006; Varien et al. 2007). Population continued to increase and peaked at about 19,400 people in the Village Dynamics Project study area sometime between A.D. 1225 and 1260 (Varien et al. 2007:283). The cliff dwellings of Mesa Verde National Park and canyon-rim villages such as Sand Canyon, Woods Canyon, and Castle Rock pueblos began taking shape late in this period (Kuckelman 2010; Lipe and Ortman 2000; Ortman and Bradley 2002; Ortman et al. 2000). The migration streams that eventually emptied the central Mesa Verde region also formed at this time and as a result overall population declined to 10,000 by the A.D. 1260s, and to zero by shortly after A.D. 1280 (Varien 2010; Varien et al. 2007).

Duff (1998) reconstructed population densities for the entire Pueblo area from A.D. 1050 to 1400, and Figure 3 illustrates these population trends (also see Hill et al. 2004). It is clear from this figure that the population density of the central Mesa Verde region was high from A.D. 1050 to 1250, but that it declined rapidly after 1250. In addition, by A.D. 1300, population densities had increased markedly in the northern Rio Grande region, as well as in portions of eastern Arizona and western New Mexico. On the basis of these data, Duff and Wilshusen (2000:185) argued that the Pueblo inhabitants of the central Mesa Verde region migrated to destinations in the northern Rio Grande and that this movement began before A.D. 1200. Varien (2010), using the Village Ecodynamics Project2 data set, also believes the final migrations could have begun by A.D. 1225. This model implies that people in the central Mesa Verde region interacted with and/or traveled to the northern Rio Grande region over time and therefore would have had prior knowledge of this area. More recent research (Varien et al. 2007) suggests

<table>
<thead>
<tr>
<th>Sites Included in Study</th>
<th>Site Numbers</th>
<th>Cultural Period(s)*</th>
<th>Reference</th>
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<tr>
<td>Crow Canyon Archaeological Center</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Duckfoot</td>
<td>5MT3868</td>
<td>Pueblo I</td>
<td>Lightfoot and Etzkorn (1993)</td>
</tr>
<tr>
<td>Albert Porter Pueblo</td>
<td>5MT123</td>
<td>Late Pueblo II-Late Pueblo III</td>
<td>Ryan (2004)</td>
</tr>
<tr>
<td>Castle Rock Pueblo</td>
<td>5MT1825</td>
<td>Late Pueblo III</td>
<td>Kuckelman (2000 ed.)</td>
</tr>
<tr>
<td>Lester’s Site</td>
<td>5MT10246</td>
<td>Late Pueblo III</td>
<td>Varien (1999 ed.)</td>
</tr>
<tr>
<td>Lookout House</td>
<td>5MT10459</td>
<td>Late Pueblo III</td>
<td>Varien (1999 ed.)</td>
</tr>
<tr>
<td>Stanton’s Site</td>
<td>5MT10508</td>
<td>Late Pueblo III</td>
<td>Varien (1999 ed.)</td>
</tr>
<tr>
<td>G &amp; G Hamlet</td>
<td>5MT11338</td>
<td>Early Pueblo III</td>
<td>Varien (1999 ed.)</td>
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<td>Early Pueblo III-Late Pueblo III</td>
<td>Churchill (2002)</td>
</tr>
<tr>
<td>Shields Pueblo</td>
<td>5MT3807</td>
<td>Late Pueblo II-Late Pueblo III</td>
<td>Duff and Ryan (2000)</td>
</tr>
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<td>Green Lizard Pueblo</td>
<td>5MT3901</td>
<td>Late Pueblo III</td>
<td>Huber (1993)</td>
</tr>
<tr>
<td>Shorelene’s Site</td>
<td>5MT3918</td>
<td>Early Pueblo III</td>
<td>Varien (1999 ed.)</td>
</tr>
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<td>Troy’s Tower</td>
<td>5MT3951</td>
<td>Late Pueblo III</td>
<td>Varien (1999 ed.)</td>
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<tr>
<td>Yellow Jacket Pueblo</td>
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<td>Late Pueblo II-Late Pueblo III</td>
<td>Kuckelman (2003)</td>
</tr>
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<td>Sand Canyon Pueblo</td>
<td>5MT765</td>
<td>Late Pueblo III</td>
<td>Kuckelman (2007)</td>
</tr>
<tr>
<td>Dolores Archaeological Program</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Grass Mesa</td>
<td>5MT23</td>
<td>Pueblo I</td>
<td>Lipe et al. (1983)</td>
</tr>
<tr>
<td>Tres Chapulines Pueblo</td>
<td>5MT4725</td>
<td>Pueblo I</td>
<td>Chenault (1983)</td>
</tr>
<tr>
<td>Rio Vista Village</td>
<td>5MT2182</td>
<td>Pueblo I</td>
<td>Wilshusen (1985)</td>
</tr>
<tr>
<td>McPhee Pueblo</td>
<td>5MT4475</td>
<td>Pueblo I</td>
<td>Brisbin et al. (1985)</td>
</tr>
<tr>
<td>Masa Negro</td>
<td>5MT4477</td>
<td>Pueblo I</td>
<td>Kuckelman (1984)</td>
</tr>
<tr>
<td>Escalante Pueblo</td>
<td>5MT2149</td>
<td>Late Pueblo II</td>
<td>White and Breternitz (1979)</td>
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<tr>
<td>Wetherill Mesa Archeological Project</td>
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<td></td>
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<tr>
<td>Dog House</td>
<td>5MV1676</td>
<td>Pueblo I</td>
<td>Osborn (1965)</td>
</tr>
<tr>
<td>Two Raven House</td>
<td>5MV1645</td>
<td>Late Pueblo II</td>
<td>Hayes (1984)</td>
</tr>
<tr>
<td>Badger House</td>
<td>5MV1452</td>
<td>Late Pueblo II-Late Pueblo III</td>
<td>Hayes and Lancaster (1975)</td>
</tr>
<tr>
<td>Big Juniper House</td>
<td>5MV1595</td>
<td>Late Pueblo II-Late Pueblo III</td>
<td>Swannack (1969)</td>
</tr>
</tbody>
</table>
that the final stages of movement from the Mesa Verde region were more rapid than Duff and Wilshusen envisaged. Nonetheless, it appears likely that small groups began to leave the region in the early A.D. 1200s, if not earlier, and that some of these would have settled into districts in the northern Rio Grande and created the information and migration streams that facilitated later, large-scale movements (Duff 1998:13; Duff and Wilshusen 2000).

A recent study of climate change by Cordell et al. (2007) also supports the idea that the inhabitants of the central Mesa Verde region had strong affiliations with the northern Rio Grande region through time. There are two different precipitation patterns in the Southwest: unimodal and bimodal. The former, which prevails in the Rio Grande region, is characterized by summer-dominant precipitation; the latter, which prevails in the central Mesa Verde region, is characterized by both summer and winter precipitation (Cordell et al. 2007; Dean 1996; Dean and Van West 2002). However, at times, the summer rains are relatively more predictable and plentiful in the Rio Grande valley than in the central Mesa Verde region. In years of low summer precipitation in the central Mesa Verde re-

Table 2. Time Periods Used in This Study (after Lipe et al. 1999; Ortman et al. 2007).

<table>
<thead>
<tr>
<th>Date Range</th>
<th>Cultural Period</th>
<th>Obsidian Sourcing Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.D. 600–725</td>
<td>Basketmaker III</td>
<td>Early</td>
</tr>
<tr>
<td>A.D. 725–920</td>
<td>Pueblo I</td>
<td>Early</td>
</tr>
<tr>
<td>A.D. 920–1060</td>
<td>Early Pueblo II</td>
<td>No samples</td>
</tr>
<tr>
<td>A.D. 1060–1140</td>
<td>Late Pueblo II</td>
<td>Late</td>
</tr>
<tr>
<td>A.D. 1140–1225</td>
<td>Early Pueblo III</td>
<td>Late</td>
</tr>
<tr>
<td>A.D. 1225–1260</td>
<td>Late Pueblo III</td>
<td>Late</td>
</tr>
<tr>
<td>A.D. 1260–1280</td>
<td>Late Pueblo III</td>
<td>Late</td>
</tr>
</tbody>
</table>
Figure 3. Population densities by regions, A.D. 1000–1350 (adapted from Duff 1998: Figure 2.4, 2.6, and 2.7).
ging, residents of that region may have looked to the Rio Grande for food and other resources (Rautman 1993). Some individuals may have also scouted out the Rio Grande as an alternative place to live and farm. Cordell et al. (2007) thus suggest that long-term affiliations and interactions between people in these two regions would have contributed to maintaining and sustaining both societies for hundreds of years prior to the thirteenth-century migrations. We believe obsidian sourcing provides a tangible means of documenting that Mesa Verde region populations had strong connections with the northern Rio Grande prior to the final depopulation of the former region.

Finally, Ortman (2009, 2010) has recently buttressed the view that a significant portion of the central Mesa Verde region population migrated to the northern Rio Grande by compiling multiple lines of evidence—archaeological, bioarchaeological, linguistic, and ethnohistoric—which argue that ancestral Tewa villages in the northern Rio Grande formed primarily as a result of population movement from the Mesa Verde region (see Boyer et al. [2010] for an opposing view). Specifically, Ortman shows that inhabitants of ancestral Tewa sites were more biologically similar to earlier Mesa Verde region populations than they were to other Southwestern populations, including earlier inhabitants of the Rio Grande. He also shows that a number of words in the Tewa language reflect symbolic elements of the Mesa Verde archaeological complex that are absent from northern Rio Grande material culture. Thus, although the large ancestral Pueblo population of the central Mesa Verde region likely migrated to many areas, including all of the areas where Pueblo people live today, multiple lines of evidence suggest that a primary destination was the northern Rio Grande region (also see Cameron 1995; Cameron and Duff 2008; Cordell 1995; Cordell et al. 2007; Duff 1998; Duff and Wilshusen 2000; Ford et al. 1972; Kidder 1924: 341–342; Lipe 1995, 2010).

**Obsidian and Migration**

On the basis of migration theory, we expect one should be able to identify intensified interaction between the destination and source areas of a long-distance migration during, and perhaps even prior to, the period of population decline in the source area. Social interaction between the source and destination areas should increase primarily due to the development of a migration stream along defined routes of travel, along which scouts can return to the source area to visit relatives, relay information about their new homes, and perhaps encourage others to follow. Return migrants may in some cases bring objects made of materials available in the destination area as tokens of its attractiveness as a destination. One would expect some of these objects to find their way into the archaeological record. Thus, archaeological traces of return migration in the source area should consist of evidence for an increased flow of objects made of materials available in the destination area, but not in the source area. In addition, because the sex ratio of scouts and return migrants tends to be male-biased (Anthony 1990; Lefferts 1977; Stone 1993), one might expect the objects brought back to the source area to be objects typically made and used by males.

The objects that best meet these requirements in this specific setting, and thus have the greatest potential for illuminating early stages of the migration process, are artifacts made of obsidian. There are no sources of obsidian in the Mesa Verde region, but several major obsidian sources occur at Mount Taylor in central New Mexico, Government Mountain in northeastern Arizona, and most importantly, the Jemez Mountains on the western edge of the northern Rio Grande region. Artifacts from these quarries can be identified reliably using XRF (Shackley 1988, 1995, 2005a). In addition, although obsidian was never common in central Mesa Verde region sites, the large amount of excavation at numerous central Mesa Verde region sites has resulted in a robust chipped-stone artifact database suitable for analyses of obsidian procurement through time.

**Obsidian Sourcing Results**

On the basis of XRF analysis, Shackley (1988, 1995, 1998, 2005a) has identified more than 40 obsidian sources or source groups in the Southwest. Figure 4 illustrates 20 of these source groups. For this project, Shackley (1999, 2002, 2005b, 2008) conducted wavelength- and energy-dispersive XRF analysis of 274 pieces of obsidian from...
the central Mesa Verde region as part of Arakawa’s (2006) and Ortmann’s (2009) dissertation projects. All sourcing analyses were performed by the Archaeological X-Ray Fluorescence Spectrometry Laboratory at the University of California, Berkeley. Details of the instrumental analysis are available in Shackley (2005a:193–196) and online at http://www.swxrflab.net/analysis.htm. Table 3 tabulates the obsidian artifacts that were analyzed by site, time period, and source. Eighty-eight items are tools, such as modified flakes, projectile points, and bifaces; the remainder consists of small pieces of debitage.3

The XRF analyses indicate that 245 of the 274 (89.4 percent) obsidian items in our dataset derive from Jemez Mountain sources. Previous work by Ferguson and Skinner (2003), Phagan (1985), and Ward (2004) yielded similar results, suggesting that almost all of the obsidian found in central Mesa Verde region sites derives from the Jemez Mountains (Shackley 1998, 2002, 2005a, 2005b, 2008). The dominance of Jemez obsidian in central Mesa Verde region sites suggests that residents of the central Mesa Verde region had direct contact with peoples of the Jemez Mountains area, made special trips to these sources, and/or obtained these items through down-the-line exchange.

All other obsidian sources are relatively rare in this dataset. Twenty-two items derive from Mount Taylor (Grants Ridge and Horace Mesa chemical groups), located near Grants, New Mexico. Twelve of these are from Early (A.D. 600-920) sites, and ten are from Late (A.D. 1060-1280) sites. Only six Early specimens derive from Government Mountain, despite the fact that obsidian from this source was of higher quality than Jemez obsidian and was the most widely traded variety in the Southwest (Shackley 2008). Finally, one obsidian sample from a Late site was procured from Cow Canyon in eastern Arizona. According to Shackley (2008), this source was probably “controlled” by Mogollon groups. The occurrence of obsidian from this source in a central Mesa Verde region site is tangible evidence that the Pueblo residents of the region had some kind of contact with people in the Mogollon area during the thirteenth century, though connections do not appear to have been strong.

Figure 4. Sources of obsidian in the American Southwest (adapted from Shackley 2005a).
Table 3. Obsidian Samples Analyzed by X-Ray Fluorescence.

<table>
<thead>
<tr>
<th>Period</th>
<th>Site Number</th>
<th>Site Name</th>
<th>Date Range</th>
<th>Cow Canyon</th>
<th>Government Mt. Mt. Taylor</th>
<th>El Rechuelos</th>
<th>Valles Rhyolite</th>
<th>Cerro Toledo Rhyolite</th>
<th>Total</th>
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</thead>
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<td>EARLY</td>
<td>5MT4545</td>
<td>Tres Bobos Hamlet</td>
<td>600–725</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5MV1676</td>
<td>Dog House</td>
<td>600–920</td>
<td>1</td>
<td></td>
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<td></td>
<td>1</td>
<td></td>
</tr>
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<td></td>
<td>5MT2182</td>
<td>Rio Vista Village</td>
<td>725–920</td>
<td>2</td>
<td>16</td>
<td>7</td>
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<tr>
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<td>20</td>
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<td>Grass Mesa Pueblo</td>
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<td>6</td>
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<td>96</td>
<td>47</td>
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</table>
Figure 5 summarizes these obsidian source data by time period to illustrate changes in obsidian procurement patterns through time. These results suggest that, during the Early period, around 80 percent of the obsidian deposited in central Mesa Verde region sites came from Jemez Mountains sources in New Mexico, with lesser amounts from Mt. Taylor and Government Mountain. These data thus suggest that the residents of the central Mesa Verde region had social or economic connections that linked them to all these areas during this period. During the Late period, in contrast, more than 90 percent of the obsidian deposited in central Mesa Verde region sites derived from Jemez sources, with the remainder deriving from Mt. Taylor and Cow Canyon. None of the obsidian in our Late sample derived from Government Mountain. Thus, the social and economic connections of Mesa Verde people became increasingly focused on the Jemez Mountains area over time.
Jemez Mountains Obsidian Sources

Closer examination of the specific sources of Jemez obsidian artifacts suggests increasing material flows from areas of the northern Rio Grande where population grew most substantially as the Mesa Verde region population declined. There are three distinct obsidian sources in the Jemez Mountains (Figure 6). The first source, El Rechuelos, is located northeast of the Valles Caldera, and erodes into the Rio Chama and ultimately the Rio Grande. The second source, Valles Rhyolite, occurs only within the Jemez Caldera and thus must have been procured from there. Finally, the third source, Cerro Toledo Rhyolite,
erodes from the eastern and southeastern flanks of the Jemez Mountains through the canyons of the Pajarito Plateau and into the Rio Grande. This last material is common at sites on the Pajarito Plateau and is available in secondary deposits along the Rio Grande all the way to Chihuahua, Mexico (Church 2000; Shackley 2005a, 2008). Obsidian from all three sources makes excellent chipped-stone tools, so changes in the representation of these sources over time is more likely to reflect changes in acquisition and interaction networks than changes in raw material preference.

Figure 7 shows the percentages of obsidian from the three Jemez Mountains sources for Early (A.D. 600–920) and Late (A.D. 1060–1280) sites in the central Mesa Verde region. The percentages of obsidian from these sources exhibit a distance-decay relationship. More than 60 percent of the obsidian specimens in the Early sample derive from El Rechuelos, the closest source, and more than 30 percent derive from the Valles Rhyolite source, the next closest source. However, less than three percent of the obsidian artifacts from these early sites derive from the Cerro Toledo Rhyolite.

During the Late period, in contrast, it appears that residents of the central Mesa Verde region procured obsidian in more balanced quantities from the three sources in the Jemez Mountains (Figure 7). This implies a dramatic increase in the importation of obsidian from Cerro Toledo, the furthest source. In other words, during the Early period, most of the obsidian that ended up in central Mesa Verde region sites came from the closest Jemez source, El Rechuelos. During later centuries, however, a much higher percentage of obsidian came from the more distant Cerro Toledo source. Although the secondary deposits of Cerro Toledo Rhyolite can be found all the way to Mexico, the primary source is on the Pajarito Plateau. As a result, these data suggest increasing flows of obsidian from the Pajarito Plateau to the central Mesa Verde region over time. This finding is important because the Pajarito Plateau was the portion of the northern Rio Grande where population grew most dramatically during the thirteenth century, coincident with population decline in the Mesa Verde region (Kohler and Root 2004; Orcutt 1999; Snead et al. 2004).

These changes argue against unstructured, down-the-line exchange as the primary mechanism by which Jemez obsidian reached Late Mesa Verde region sites. If this were the case, one would expect the pattern seen in early sites, where the closest sources were most common and the furthest sources least common, to have continued in later sites. The fact that obsidian from the furthest Jemez source, Cerro Toledo, increased in relative frequency over time suggests a corresponding increase in direct importation of obsidian from this source. This pattern is consistent with a model in which at least some early settlers of the Pajarito Plateau moved there from the Mesa Verde region and periodically returned to their homeland, bringing obsidian artifacts with them, as a migration stream between the two areas formed over the course of the thirteenth century.

**Obsidian Importation Patterns Through Time**

We further subdivided the Late period in our study to investigate changes in obsidian importation in the decades immediately preceding the final depopulation of the Mesa Verde region. Figure 8 summarizes the frequency of obsidian in chipped-stone artifact assemblages for all contexts.
in the Crow Canyon Archaeological Center Research Database dating to: A.D. 1060–1140; A.D. 1140–1225; and A.D. 1225–1280. Because nearly all obsidian in Late Mesa Verde region sites came from the Jemez Mountains, changes in the relative frequency of obsidian artifacts overall should approximate changes in the frequency of contact with the Jemez Mountains region. These data show that the flow of obsidian to the central Mesa Verde region was strongest during the heyday of the Chacoan regional system, A.D. 1060–1140. Long-distance exchange of a variety of items was also relatively frequent during this period (Lipe 1995:158), and may have been centralized through Chaco (Toll 2006). The flow of obsidian into the region declined during the Post-Chacoan period, but increased again during the A.D. 1200s. Several previous studies (Arakawa and Duff 2002; Lipe 1995; Neily 1983) have suggested that residents of the central Mesa Verde region became increasingly isolated from other regions during the A.D. 1200s. Figure 8, however, suggests that the flow of obsidian from the Jemez Mountains actually increased during the period of population decline. The correspondence of this increase in obsidian importation with regional population decline is once again consistent with a model of return migration associated with a migration stream as the underlying mechanism.

Given that obsidian was always quite rare in Mesa Verde region sites, however, an important question to ask is whether the absolute quantity of obsidian recovered from these sites reflects the level of interaction one might expect between two areas linked by a migration stream. Several lines of evidence suggest that even small quantities of obsidian likely reflect significant interaction between the central Mesa Verde and northern Rio Grande regions. First, obsidian artifacts found in Late Mesa Verde sites (Table 4) are most often small projectile points, small bifaces or modified flakes representing projectile point blanks, or tools made from reworked projectile points. No cores suggesting primary reduction of raw material have been found. This pattern contrasts with that of Dakota/Burro Canyon silicified sandstone (Kdb), a local, high-quality material that was clearly procured as raw material and worked into a variety of tool types. In addition, most of the obsidian debitage recovered from Late Mesa Verde region sites consists of small pieces with no evidence of cortex, whereas larger pieces and pieces with cortex are fairly common in Kdb silicified sandstone debitage from these same sites (Figure 9). This ev-

![Figure 8. Frequency of obsidian artifacts in total chipped-stone assemblages, by time period.](image-url)
Evidence suggests that many obsidian pieces that ended up in Late Mesa Verde region sites entered these sites as complete arrows, arrow points, or arrow point blanks as opposed to chunks of raw material. This in turn suggests that nearly every piece of obsidian discovered from late Mesa Verde region sites represents a separate exchange event, whereas one would expect thousands of pieces of chipped-stone to be deposited following a local raw material procurement event. Therefore, even though obsidian artifacts are small and rare, each piece is quite significant in terms of the human behavior it represents.

In addition, it appears that the importation of obsidian arrow points outpaced the importation of decorated pottery vessels during the final decades of ancestral Pueblo occupation. Figure 10 compares the proportion of obsidian projectile points to the proportion of imported bowl sherds for three villages with peak occupations during the

<table>
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<th>Artifact Category</th>
<th>Obsidian N</th>
<th>%</th>
<th>Kdb Silicified Sandstone N</th>
<th>%</th>
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<td>Core</td>
<td>54</td>
<td>11.3</td>
<td>254</td>
<td>11.3</td>
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<td>6</td>
<td>.3</td>
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<tr>
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<td>3.3</td>
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<td>Biface</td>
<td>3</td>
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<td>406</td>
<td>18.0</td>
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<tr>
<td>Drill</td>
<td>2</td>
<td>5.0</td>
<td>75</td>
<td>3.3</td>
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<tr>
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<td>40</td>
<td>100.0</td>
<td>2,250</td>
<td>100.0</td>
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</tbody>
</table>

Note: Data represent the total number of chipped-stone artifacts from Late (A.D. 1060–1280) Mesa Verde region sites assigned to the given raw material category in the Crow Canyon Archaeological Center Research Database (January, 2009).
A.D. 1225–1260 period (Shields Pueblo, Yellow Jacket Pueblo, and Albert Porter Pueblo), and three villages with peak occupations during the A.D. 1260–1280 period (Sand Canyon Pueblo, Castle Rock Pueblo, and Woods Canyon Pueblo). The A.D. 1225–1260 period was when the Mesa Verde region population reached its peak and began to decline, and the A.D. 1260–1280 period was characterized by population decline associated with final emigrations (Varien et al. 2007). These data show that the proportion of obsidian projectile points in assemblages dating from the period of population decline was almost twice as high as it was in earlier times. Due to low proportions and small sample sizes, the standard errors of these proportions overlap somewhat, so it is possible that the increase suggested by these data was not as large as it appears here. However, obsidian points do comprise larger proportions of projectile point assemblages than non-local bowl sherd do for pottery assemblages during both periods. Indeed, it appears long-distance pottery exchange declined during the final decades of occupation in the Mesa Verde region, whereas importation of obsidian projectile points, which came almost exclusively from the Jemez Mountains region, increased.

**Discussion**

A comparison of the shifts in population with changes in obsidian importation strongly suggests that obsidian procurement patterns reflect affiliations and interactions between residents of the central Mesa Verde and northern Rio Grande regions. We believe these relationships facilitated the migration of large numbers of people from the former to the latter region in the A.D. 1200s. This particular migration has been a topic of research and discussion for several decades, and now ob-
sidian importation patterns provide additional information about the social networks and patterns of alliance that likely preceded and accompanied this movement.

We further argue that the obsidian data summarized here illustrate several characteristics of early stages in the migration process. First, we propose that the increase in obsidian importation from the Jemez Mountains region reflects the activities of young male scouts and other early migrants to the Pajarito Plateau. According to Anthony (1990:905) and other studies of migration in agricultural societies (Lefferts 1977; Simkins and Wernstedt 1971), the scouts who gather information on potential destination areas and relay this information back to the homeland are disproportionately young and male. According to ethnographic and cross-cultural studies, projectile point manufacture and use are also strongly associated with males. For example, Burton and others (1977:231, Table 1) used Human Relations Area Files and coded 50 different technological activities from a total of 185 agricultural societies to identify cross-cultural patterns in the gendered division of labor. They recorded 73 societies (40 percent of the total) that engaged in stone-working activities. Males were the primary producers of stone tools in 91 percent of these societies, and in the remaining societies men and women participated equally. Although ethnographic and ethnoarchaeological studies do note that women are occasionally involved in stone tool production (Brandt and Weedman 2002; Burton et al. 1977; Hough 1897:191), projectile point manufacture and use by women appears quite rare in these studies. Also, according to Szuter (2000:208), projectile point possession, use, and manufacture are exclusively associated with males in American Indian societies of the American Southwest. Finally, ethnographic studies of the Hopi and Zuni indicate that men were responsible for hunting and maintaining their hunting tools, including projectile points (Lowell 1990). Because obsidian in central Mesa Verde region sites occurs almost exclusively as arrow points, arrow point blanks, arrow point fragments, and flakes from reworked arrow points, obsidian importation can be tied to men’s activities. Thus, we argue that the increased importation of Jemez obsidian artifacts during the final century of occupation in the Mesa Verde region reflects return visits by people who had recently migrated from the Mesa Verde region to the Pajarito Plateau.

A final reason obsidian arrow points may have been emphasized as tokens of return migration relates to the symbolic importance of obsidian in Pueblo culture. According to Ford, modern Pueblo people:

...believe that the mountains are closer to the deities who control important meteorological events, such as thunder, lightning, and rainfall. Their empirical evidence is the presence of lakes, cloud-shrouded mountains, trees fire-darkened from lightning, and obsidian, which they believe is formed by lightning striking the ground [Ford 1992:122, emphasis in original].

In a study of the conceptual underpinnings of Pueblo worldview, Saile (1977:76) also suggested that the Pueblo people believe that mountains and hills represent physical intersections between the earth and the sky that facilitate communication with the spirit world. Thus, mountains and hills are sacred places. In his ethnographic study, Trimble also noted: “On the horizons stand the sacred mountains in all their strength. They bound the Pueblo world. They are snowy and therefore holy” (1993:54, emphasis in original). These ethnographic descriptions suggest scouts who encountered obsidian in the Jemez Mountains and may have drawn a connection between the presence of obsidian and abundant lightning and rains, which further implies the growth of maize and other crops important to Pueblo agriculturalists. Thus, carrying obsidian arrow points back to the Mesa Verde region might have served as a symbolic demonstration of the beneficial environment of this area.

Conclusion

In this study, we have argued that obsidian artifact procurement patterns reflect the development of social networks between the central Mesa Verde and the northern Rio Grande regions, and that these networks facilitated the eventual migration of residents from the former to the latter. We reviewed sources of obsidian in the greater Southwest and presented sourcing results for 274 obsidian samples analyzed by XRF. We also
summarized data on obsidian artifacts in the context of overall chipped-stone artifact assemblages from central Mesa Verde region sites. These data suggest the following points.

First, the results suggest a change in obsidian importation patterns over time. During the Early period (A.D. 600–920), obsidian importation reflected connections with several areas of the greater Southwest. During the Late period (A.D. 1060–1280), in contrast, the data suggest a strengthening of affiliation and interaction with people in the northern Rio Grande region. Second, the representation of the three Jemez Mountain obsidian sources appears to have changed through time. Prior to A.D. 920, residents of the central Mesa Verde region procured the majority of their obsidian from the closest source (El Rechuelos), whereas later residents obtained a much higher percentage from the furthest source (Cerro Toledo) adjacent to areas of the northern Rio Grande that were colonized during the early A.D. 1200s.

Third, the proportion of chipped-stone artifacts that were made of obsidian increased throughout the A.D. 1200s. This indicates that interaction between the Mesa Verde region and the Jemez Mountains area increased as populations were declining in the former and increasing in the latter areas. Fourth, Jemez obsidian entered the Mesa Verde region almost exclusively as complete arrows, arrow points, or arrow point blanks as opposed to raw material. Arrows were made and used by men for hunting and protection, and thus would have been carried by scouts and other early migrants returning from the destination area. In addition, small obsidian points or blanks would have been appropriate objects for return migrants to bring as gifts due to their small size, light weight, and association with the landscape of the destination area. Finally, the proportion of projectile points made of obsidian was greater than the proportion of non-local bowl sherds throughout the A.D. 1200s, and appears to have increased over time, opposite the trend in imported pottery. All of this is consistent with a model in which return migration was a primary mechanism behind the increased flow of Jemez obsidian into the Mesa Verde region during the thirteenth century.7

The behaviors revealed by the obsidian artifact data examined in this study parallel those observed in studies of prehistoric migrations throughout the greater U.S. Southwest (Anschuetz and Scheick 2006; Crown et al. 1996; Duff 1998; Hill et al. 2004; Shackley 2005a:134–146; Snead et al. 2004). The people of the central Mesa Verde region were already familiar with the places they migrated to—and with the people who had previously settled in those places. This facilitated the development of a migration stream that resulted in a population-level movement that leapfrogged over intervening regions. We believe obsidian source studies, particularly those focused on migration, hold great promise for furthering archaeological understandings of migration as a social process.

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Stone, Tammy

Swannack, Jervis D. Jr.

Sztur, Christine R.

Till, Jonathan, Jamie Merewether, Robin Lyle, and Scott G. Ortman

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Toll, H. W.

Trager, George L.

Trimble, Stephen

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Varien, Mark D.


Varien, Mark D. (editor)


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Varien, Mark D., Scott G. Ortman, Susan C. Ryan, and Kristin A. Kuckelman

Ward, Christine G.

Wendorf, Fred

White, Adrian S., and David A. Breternitz
test on the proportions of the Early and Late obsidian samples in our dataset to represent an individual trade event. An alternative to control for lithic reduction activities as effectively. Due to the partial excavation of most sites we believe this included 12 in our summary dataset because many pieces were followed this rule because we wanted each piece of obsidian in our dataset to represent an individual trade event. An alternative approach would have been to conduct refitting studies, but due to the partial excavation of most sites we believe this would not control for lithic reduction activities as effectively.

4. To better understand the relationship between Early and Late obsidian importation patterns, we conducted a significance test on the proportions of the Early and Late obsidian samples to see whether counts of obsidian from these three quarries are similar. The null hypothesis for this test is that there is no difference between the Early and Late assemblages. Using a Kolmogorov-Smirnov test (Shennan 1997:55–61), we compared the Early obsidian materials in each category to determine whether they are different from the Late obsidian samples. Based on this result, the observed maximum difference of .178 is close to the minimum required to reject the null hypothesis at the .05 level (.181). This test indicates that the observed difference in obsidian procurement from the three quarries between the Early and Late periods is statistically significant.

5. It has been well-documented that Chaco had a major influence on the interregional movement of goods into the central Mesa Verde region during the late Pueblo II period. An additional line of evidence that argues against down-the-line exchange comes from studies of obsidian from one of the Chaco outliers—the Aztec Ruin complex, which was built and inhabited during our Late period (A.D. 1060–1280). Aztec is closer to the Jemez Mountains than the central Mesa Verde region, and most of the Jemez obsidian from Aztec derives from Valles Rhyolite, the closest source (Shackley 2009, 2010). The fact that the Mesa Verde region is further from the Jemez Mountains than Aztec, and yet contains a higher proportion of obsidian from the furthest source, suggests that inhabitants of Aztec and the Mesa Verde region obtained obsidian through distinct long-distance interaction networks during the Late period.

6. The two latest periods—A.D. 1225–1260 and A.D. 1260–1280—were combined for this analysis in order to increase sample sizes.

7. It is important to add that, although there are alternatives to our return migration model, the available evidence does not support these alternatives. For example, one could propose that obsidian projectile points were procured and used for ceremonial activities, or that aggrandizing individuals procured and used non-local obsidian in attempts to elevate their status. However, obsidian projectile points are not strongly associated with ceremonial structures or high-status residences in the Crow Canyon Archaeological Center Research Database, so it would appear unlikely that ceremonialism and/or status competition were the dominant factors behind the flow of obsidian into the region.

A second alternative scenario is warfare between the two regions. In other words, residents of the central Mesa Verde region obtained large numbers of obsidian points just prior to regional depopulation because conflict between the Mesa Verde region and the northern Rio Grande resulted in the acquisition of Jemez obsidian by Mesa Verde populations. Although there is abundant evidence for warfare during the period of population decline in the Mesa Verde region (Kuckelman 2002; Kuckelman and Lightfoot 2000; Kuckelman et al. 2002), comparable evidence has not been reported from the northern Rio Grande for this period. Thus, conflict in the Mesa Verde region was probably internal, and was not a major factor in obsidian acquisition.

Notes

1. Although this study area covers only a portion of the central Mesa Verde region as defined by Varien and others (1996), we will use the term, “central Mesa Verde region,” to reference our study area here. Our study area covers 1,816-km² within the central Mesa Verde region as defined by Varien and others (1996).

2. The aim of the Village Ecodynamics Project is to understand long-term interactions between ancestral Pueblo people and their environments (Kohler et al. 2008; Kohler et al. 2010). The Village Ecodynamics Project study area encompasses about one-quarter of our study area.

3. In this study, we excluded 31 pieces of obsidian from unknown sources and attempted to control for lithic reduction activities by counting all pieces of debitage from the same intra-site provenience and source as one. For example, 96 pieces of obsidian were discovered from Escalante Ruin, but we only included 12 in our summary dataset because many pieces were possibly manufactured and recycled from the same item. We followed this rule because we wanted each piece of obsidian in our dataset to represent an individual trade event. An alternative approach would have been to conduct refitting studies, but due to the partial excavation of most sites we believe this would not control for lithic reduction activities as effectively.

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