BIFACIAL LITHIC TECHNOLOGY AT TUZIGOOT AND MONTEZUMA CASTLE NATIONAL MONUMENTS: A SOUTHERN SINAGUA CASE STUDY

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ABSTRACT

A diverse collection of projectile points and bifaces have been recovered from the Tuzigoot and Montezuma Castle National Monuments. This paper presents the preliminary findings of a recent analysis that focused on spatial and temporal patterns of stone tool manufacture and lithic material use. We briefly discuss biface manufacture and use followed by discussion of evidence for expert biface manufacture during the Formative era. The main focus of this paper centers on the projectile point collection. While arrow points vastly dominate, the Verde Valley inhabitants collected earlier dart points for use in functional and symbolic activities. Finally, use of the term "Sinagua" to designate the pre-Columbian inhabitants of the Verde Valley is considered through a comparison of Northern Sinagua projectile point data and the Verde Valley National Monuments data.

The first Verde Valley Conference convened in 2012 to discuss the cultural historical characteristics of the Southern Sinagua. Colton (1946) originally defined the Southern Sinagua on the basis of material culture, primarily pottery, and similarity to habitation structures of the Northern Sinagua who occupied the Flagstaff area. Here, we take into consideration the Southern Sinagua archaeological culture label through flaked stone tools. This paper presents bifacial implement data from the Verde Valley National Monuments of Tuzigoot, Montezuma Well, and Montezuma Castle. Comparisons with Northern Sinagua data follow. Recent analysis of the bifacial tool collections from the Verde Valley National Monuments resulted in the examination of 383 implements, comprising approximately 82 percent of the total bifacial flaked stone tool collection.

The paper begins with a brief overview of the collection followed by a discussion of the typology used in the analysis. The variability within the bifacial tool collection is then discussed with an emphasis on the projectile points. Finally, the primary projectile point types within the collection are compared with collections from sites in the Northern Sinagua territory.

SITE OVERVIEWS

The flaked stone collection was recovered from multiple sites within the Verde Valley of central Arizona (Table 1). While the various sites of the Verde Valley have been the focus of archaeological investigations for over 150 years (Fish and Fish 1977; Mearns 1890; Powers and Pearson 2008), the collection results from nearly a century of excavation, surface collection, and grab samples. Unfortunately, the data we had provided minimal contextual information beyond the site. The majority, 74 percent, of the collection originated from unknown contexts within the respective sites. Twenty-four percent of the collection is reported from rooms, one percent from middens, and one percent from surface contexts.

Absolute dating methods, including radiocarbon, dendrochronology, and archaeomagnetometry in combination with ceramic cross dating indicate that Tuzigoot Pueblo, Montezuma Well, Castle A, Swallet Cave, and Hatalacva Pueblo were occupied between the Honanki and Tuzigoot Phases, from AD 1125 to 1400 (AZSite database online; Powers and Pearson 2008; Shepard et al. 1998; Wells and Anderson 1988). Castle A lies immediately west of Montezuma Castle at the base of a southwest-facing limestone cliff and overlooks Wet Beaver Creek. Castle A includes an estimated 45 total rooms on six levels, with 26 excavated surface and cavate rooms (Wells and Anderson 1988, also Guebard, this issue). Cavate rooms refer to culturally manipulated or manufactured alcoves cut into vertical cliff faces that commonly include the addition of masonry walls. Montezuma Castle is a five story cliff dwelling consisting of approximately 20 rooms

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Table 1. The Verde Valley National Monuments Site Information.

Monument/ Area	Site Number	Site Name	Occupation Dates	Site Type	Tool Frequency
Tuzigoot	AZ N:4:01 (ASM)	Tuzigoot Pueblo	AD 900/1125-1400	~100-110 room, three story pueblo	285
	AZ N:4:20 (ASM)		AD 1000-1300	Artifact Scatter	2
	AZ N:4:3 (ASM)	Hatalacva Pueblo	AD 1125-1400	60-80 room, 2-3 story pueblo	5
Montezuma Castle	AZ O:5:15 (ASM)	Montezuma Castle	AD 1125-1400	~20 room, five story cliff dwelling	2
	AZ O:5:95 (ASM)	Castle A	AD 1125-1400	~45 room, 6 story cliff dwelling	26
	AZ O:5:78 (ASM)		AD 1125-1400	Artifact Scatter; 3 indeterminate features	2
	AZ O:5:41-42 (ASM)		AD 1125-1400	Rockshelter	1
	n/a		n/a	Isolated find	1
Montezuma Well	AZ O:5:92 (ASM)		AD 1125-1400	Pueblo	3
	AZ O:5:46 (ASM)		AD 600/900-1125	Pithouse habitation	6
	AZ O:5:93 (ASM)	Swallet Cave	AD 1125-1400	10 room cliff dwelling	6
	NA 4609A		Unknown	Rockshelter	5
	AZ O:5:92 (ASM)		AD 1125-1400	Burial ground with at least 30 burials looted in 1930s	27
Sycamore Canyon	n/a		n/a	Isolated find	1

and located within a naturally eroded overhang in the limestone cliff face (Wells and Anderson 1988). Located in the inner rim of Montezuma Well is a 10 room dwelling designated Swallet Cave (Wells and Anderson 1988). Tuzigoot Pueblo consists of 86 terraced ground-floor rooms with 100-110 rooms estimated on two to three levels (Powers and Pearson 2008). Tuzigoot pueblo was occupied intensively during the Honanki (AD 1150-1300) and Tuzigoot phases (AD 1300-1425) (Shepard et al. 1998), but was likely occupied as early as the Camp Verde phase from AD 900 to 1125 based on ceramics recovered from early refuse deposits on the hilltop (Powers and Pearson 2008). Another large habitation, Hatalacva pueblo, consisting of approximately 75-100 rooms (Powers and Pearson 2008; Tagg 1986), is located one and a half miles from Tuzigoot Pueblo. One pithouse at Montezuma Well dates to the Camp Verde Phase (AD 900 to 1125), while a nearby, smaller pithouse dates to the Squaw Peak phase (circa AD 1 to 600) (Powers and Pearson 2008; Tagg 1986).

TYPOLOGY

The typology employed in this analysis was based largely on morphological attributes of the artifacts, drawing from multiple previous typologies. An initial rough sort divided points into large (dart) and small (arrow) points. Large points are typically manufactured through percussion and pressure flaking, with larger overall dimensions, including mean thickness over 5.0 mm and mean weight over 3 grams. In contrast, small points are typically manufactured through pressure flaking flake blanks resulting in a mean thickness of 3.2 mm and mean weight of less than 3.0 grams. Large points were categorized following previously established types (Guernsey and Kidder 1921; Holmer 1986; Huckell 1995; Stevens and Sliva 2002; for projectile point type overviews see Justice 2002; Lorentzen 1998; Whittaker and Bryce, in press), while small points were classified following a descriptive typology created by Whittaker (1999) for Lizard Man Village, as well as the GRIN typology being developed for the Flagstaff region (Whittaker et al. 2012). "GRIN" is the moniker of the typology and refers to Grinnell College, the affiliate institution of the primary author, Whittaker. We also employ the work of Hoffman (1997) for Hohokam types. While more recent typologies address Hohokam projectile points (Justice 2002; Loendorf and Rice 2004), Hoffman's dissertation involves an exhaustive analysis without conflating type designations typical of more anthological approaches (see Justice 2002) and covers the greater Phoenix Basin region rather than specific to a smaller area (Loendorf and Rice 2004). The overall collection exhibits substantial diversity based on morphological attributes including outline form, notch shape, notch placement, haft form (e.g. notched, stemmed, etc.), and blade treatment.

VERDE VALLEY BIFACES AND THE FORMATIVE ERA

For the purposes of this paper, the Formative era is defined as the time after the introduction of ceramics and agriculture and before the arrival of the Spanish. Based on Pilles (1981; see also Reid and Whittlesey 1997 and Sorrell et al. 2007), we date this era to circa AD 700-1500. Accordingly, the bifacial collections used in this paper all originate from Form-

Figure 1. Examples of biface morphologies within the Verde Valley National Monument collection.

ative era contexts, with pre-Formative projectile point types presumably the result of the human predisposition toward collection.

Thirty-one bifaces were analyzed, being divided into small and large forms. The biface category includes implements without haft modification, subsuming preforms and knives (bifaces exhibiting use-wear confined to one edge). Large bifaces are defined as being at least 75 mm long or 30 mm wide. This measure is based on the size of Early Agricultural preforms used in dart point manufacture (for examples see Bryce 2010; Geib 2011; Lindsay et al. 1968), which microscopic analysis has shown functioned as hafted knives (Phil Geib, personal communication, August 2007). While bifaces do not equate to preforms, the measurements are based on the concept that any biface larger than a large dart preform is considered a large biface. Large bifaces outnumber smaller bifaces with manufacture varying from decent to expert. The manufacturing technique typically consists of percussion flaking. Pressure flaking was used to finish shaping or later rejuvenate the edges after use.

The morphology of the biface collection varies greatly from well made and symmetrical to asymmetrical (Figure 1). Many of the asymmetrical forms exhibit rejuvenated edges as well as the opposite edge being dulled, or backed, possibly so that the implement could be held in the hand. Based on backing and the presence of multiple asymmetrical bifaces, we believe that this was an intentional form used as a handheld implement rather than a hafted tool. In addition, three of the bifaces exhibit symmetry in form, finished edges, and thinness indicative of preforms for large points or perhaps knives.

One biface in particular displays expert percussion flaking. The size of the fragment and skill of manufacture have lead to the presumption (as stated at the Tuzigoot National Monument Visitor's Center) that it is a Clovis biface. However, the biface does not exhibit indications of Clovis manufacturing techniques. The flaking consists of selective full facial or near full facial percussion flaking initiated from one margin. The initial flaking was followed by overlapping marginal horizontal percussion flaking from the opposite margin (Figure 2a). This manufacturing method was repeated on the opposite face. None of these flake scars exhibit attributes indicative of overshot flaking, which Bradley and others (2010:68) define as, "where flakes travel from one margin across a face of a biface… and remove part of the opposite margin." Bradley and Stanford (2004; see also Bradley et al. 2010) suggest that overshot flaking was a thinning method that was *intentionally* used by Clovis knappers. In addition, Bradley and others (2010) note that flakes are first removed from one edge, and subsequently the opposite edge, with spacing between the flake removals. This manufacturing method varies considerably from the method used to produce the Tuzigoot biface.

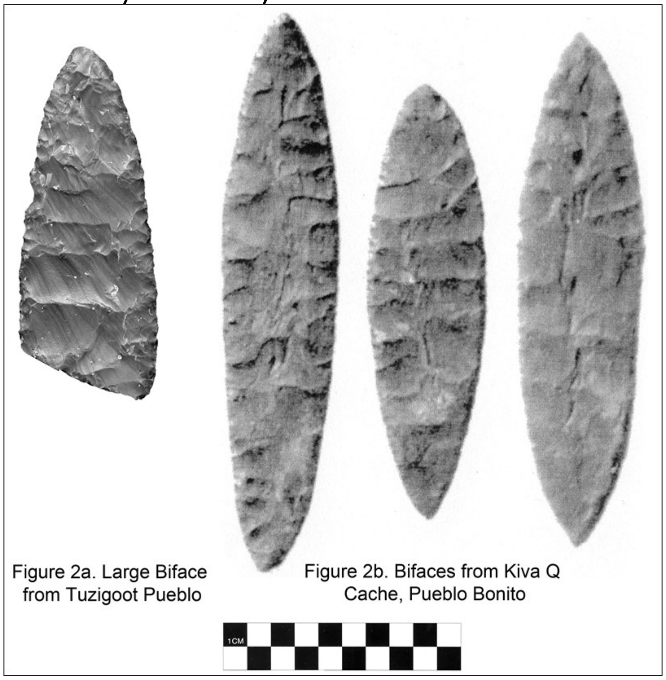


Figure 2. Images of the largest Tuzigoot biface and the Kiva Q bifaces; image of Kiva Q bifaces adapted from Judd (1954, Plate 28).

The Tuzigoot biface, however, is similar to other large, well made bifaces from Puebloan (Cameron 2001; Judd 1954; Lekson 1997), Mogollon (Whittaker 1984; Whittaker et al. 1988), Sinagua (McGregor 1943; Whittaker et al. 2013), and at least one unpublished Hohokam assemblage. This last, referred to as the "Queen Creek cache," consists of three large lanceolate bifaces recovered by Soil Systems, Inc. from a Classic Period Hohokam site. In comparison to the Tuzigoot biface, the cached bifaces from Kiva Q at Pueblo Bonito (Cameron 2001; Judd 1954; Lekson 1997) exhibit similar overall form. Furthermore, the metric measurements obtained by Bruce Bradley (Bruce Bradley, personal communication, January 2012) also display similarity to the Tuzigoot biface (Table 2). Unfortunately, the base of the Tuzigoot biface is missing, so we cannot know the overall form. However, as Bradley notes,

> While being more like the Kiva Q bifaces, it [the Tuzigoot Biface] displays a somewhat different finishing technology... The Kiva Q bifaces are all finished with highly controlled diving flaking... I think you are correct in pointing out that your piece is not Clovis-like, yet at the same time it isn't really all that similar to the Kiva Q (or the Wyoming [Whittaker et al. 1988]) bifaces... The Formative large biface technologies are very poorly published and I believe are significant in understanding regional and super-regional interactions (Bruce Bradley, personal communication, 26 March 2013).

We suggest two conclusions from these data. First, the Tuzigoot biface was manufactured during the occupation of the pueblo. It is not a collected Clovis biface. Second, based on the differences noted by Bradley (see above) with other well crafted and contemporary large bifaces, the Tuzigoot biface was arguably manufactured by an inhabitant of Tuzigoot Pueblo.

PROJECTILE POINTS FROM THE VERDE VALLEY NATIONAL MONUMENTS

Projectile points vastly dominate the bifacial collection. Both large points (darts) and small points (arrows) comprise the collection. Parsing the difference between dart and arrow points is an on-going effort (see Shott 1997; Sliva 1999; Thomas 1978; Van Pool 2006) currently relying on equivocal discriminate analyses (Shott 1997; Thomas 1978) to divide between what constitutes a dart point versus an arrow point. An in-depth discussion of the current views on the difference is beyond the scope of this paper. Suffice it to say that the discriminant analyses currently being used remain equivocal and were not used for our analysis. As Justice notes, "the fact remains that most stratified archaeological sites demonstrate a gradual decrease in the average size of projectile points through time" (2002:16). Along those lines, larger, heavier points, typically manufactured through both percussion and pressure, that conform to well established dart point types are considered dart points. Arrow points are considered as those specimens that are generally small, narrow, thin, and exhibit light weight. In regards to weight, dart points from the collection average 3.2 grams compared to arrow points that average 0.7 grams. This section briefly discusses the dart points within the collection followed by a more in-depth consideration of the arrow points.

In brief, dart points occur in a variety of contexts, but do not comprise a large portion of the collection (n=27, 8.0 percent of projectile points). Presumably, the large points were collected from earlier sites (for examples see Bryce 2011; Hesse 2009; ; Whittaker 2012). Use of earlier large points by later groups for both utilitarian and symbolic activities is well documented (Bryce 2012, 2013; Hesse 1995; Parry and Christenson 1987; Sedig 2014; Wendorf 1953; Whittaker 2012; Whittlesey and Benaron 1997).

The dart point forms are diverse, and include corner notched (n=9), side notched (n=6), stemmed (n=4), and forms without haft modification (n=1). Five of the dart points were missing the haft element and two were broken at the notches. One San Pedro

Table 2. Tuzigoot Biface and Kiva Q Biface Data Compared; Kiva Q Data Courtesy of Dr. Bruce Bradley.

Biface Provenience	Maximum Length (mm)	Maximum Width (mm)	Maximum Thickness (mm)	Notes
Tuzigoot Pueblo	150.8	59.8	10.3	maximum length is incomplete; selective percussion
Pueblo Bonito, Kiva Q	238.8	47.0	5.1	selective percussion, no sequence obvious; non-invasive pressure retouch
Pueblo Bonito, Kiva Q	219.0	57.0	5.6	selective percussion, no sequence obvious; non-invasive pressure retouch
Pueblo Bonito, Kiva Q	184.0	50.0	5.6	selective percussion, no sequence obvious; non-invasive pressure retouch

point (sub-cat. no. MOCA 1002/2) recovered from Castle A has the distal end reworked into a drill. A torque break fragmented the drill bit. The distal end of a second San Pedro point (sub-cat. no. TUZI 2295) was broken through impact. The end was later reworked into a scraper and presumably used as a hafted tool. A third collected dart point, an Agate Basin point (sub-cat. no. TUZI0870) from Tuzigoot Pueblo, exhibits potential indicators of symbolic use. The blade edges are ground down and the flake scar ridges are heavily worn down and rounded creating a polished appearance. This wear may be attributed to being carried around in a pouch or bag (see Whittaker 1999) and suggests the point may have served a symbolic use.

ARROW POINT TYPOLOGIES

With the exception of the Squaw Peak phase pithouse, all of the sites discussed herein date to centuries after the adoption of the bow and arrow around AD 500 (Blitz 1988; Roth et al. 2011; Whittaker 2012; but see Geib and Spurr 2000; Sliva 1999; Van Pool 2006). A diverse range of small points are present including all twelve types established by Whittaker (1999) for Lizard Man Village, a Northern Sinagua habitation site (Kamp and Whittaker 1999). The typology more recently developed by Whittaker and others (2012), based on synthesis with previously established typologies and the attributes of outline, haft form, notch placement, base treatment, and blade form includes twenty-five types present within the Verde Valley Monuments (Table 3).

In general, it appears that the Verde Valley collection is most similar to Northern Sinagua assemblages, with high side notched, low side notched, and unnotched triangular forms common in both areas. However, we would be remise if we did not note that these three types become common place across the southwest post AD 1150. For this paper and based on these similarities, we compared the Verde Valley collection to points from two sites of similar age from the Flagstaff Area.

FROM SOUTH TO NORTH: A COMPARISON

Assemblages from Elden and Wupatki Pueblos are used for the comparison. Elden Pueblo is an approximately 70 room pueblo located at the base of Mount Elden near the northeastern edge of Flagstaff. Wupatki Pueblo consists of a four story, approximately 100 room pueblo in the Wupatki Basin northeast of Flagstaff. While the Verde Valley site occupations extend well into the AD 1300s, a time when most of the Northern Sinagua sites were largely uninhabited, Elden and Wupatki Pueblos were two exceptions, with occupations extending past AD 1250. Therefore, the Elden Pueblo and Wupatki Pueblo assemblages are chronologically comparable to the Verde Valley sites. Both assemblages underwent the same analytical procedures using the same typology as the Verde Valley collection. In addition, a large sample (N=765) of projectile points provides a robust database from these sites. Nine attributes including maximum length, maximum width, maximum thickness, notch height, shoulder width, neck width, weight, material type, and material source were compared for notched points. Unnotched points were compared for all applicable attributes, which does not include notch height, shoulder width, or neck width (Figure 3). Notch height refers to the length of the hafting element, measured from base to the center of the notches.

Large points occur in relatively low frequencies within the collections from the two regions. Corner notched and stemmed types are more frequent in the Northern Sinagua site collections, while side notched dart points occur more frequently at the Verde Valley sites. The small sample size and lack of a

Table 3. Verde Valley National Monument Projectile Point Types and Frequencies.

GRIN Typology	Lizard Man Village Type	Flagstaff Area Count	Flagstaff Area Percent	Verde Valley Count	Verde Valley Percent
Red Lake	Unnotched	18	2.59	4	1.32
Anasazi Side notched	Low notched	11	1.58	7	2.32
Eastern Anasazi Side notched	Low notched	4	0.58	0	0.00
Concave Based Long Low Side notched	Low notched	7	1.01	0	0.00
Fish-tailed Side notched	Low notched	0	0.00	2	0.66
Other Side notched	Low notched	12	1.73	2	0.66
Early Pueblo	Corner notched	3	0.43	10	3.31
Sinagua Corner notched	Corner notched	9	1.29	2	0.66
Yavapai	Low notched	0	0.00	7	2.32
Red Lake notched	Low notched	2	0.29	0	0.00
Red Lake Serrated	Serrated	30	4.32	3	0.99
Red Lake Serrated notched	Serrated	1	0.14	3	0.99
Sinagua Triangular	Unnotched	227	32.66	90	29.80
Sinagua Ovate	Unnotched	1	0.14	0	0.00
Snaketown Serrated	Serrated	0	0.00	2	0.66
Short Serrated	Serrated	53	7.63	9	2.98
Short Serrated notched	Serrated	6	0.86	0	0.00
Hohokam Serrated	Serrated	3	0.43	10	3.31
Citrus Side notched	Low notched	0	0.00	2	0.66
Long Triangle	Unnotched	98	14.10	5	1.66
Long Triangle Serrated	Serrated	13	1.87	4	1.32
Mogollon Triangular	Unnotched	4	0.58	0	0.00
Elden Side notched	High notched	115	16.55	49	16.23
Ridge Ruin Side notched	High notched	7	1.01	0	0.00
Sinagua Side notched	Low notched	47	6.76	62	20.53
Indeterminate	Indeterminate	24	3.45	29	9.60
Total		**695**	**100**	**302**	**100**

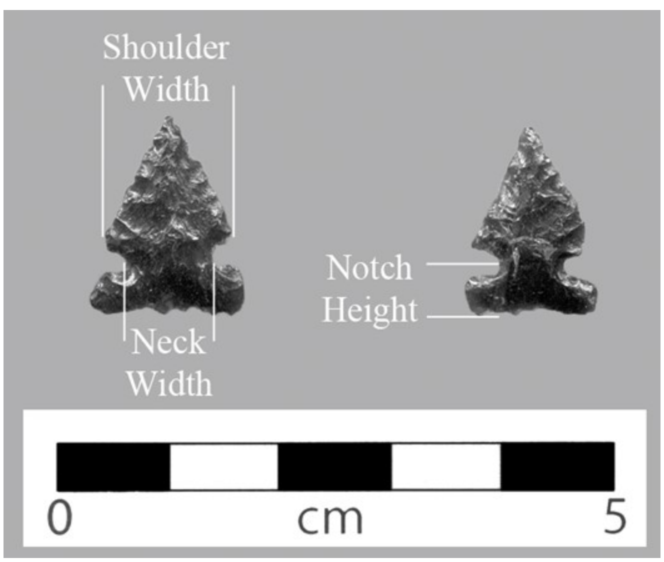


Figure 3. Diagram of three measurements taken in addition to maximum extents and weight.

regional consideration of pre-Formative sites in the respective areas negates any inferences as to the whether or not the frequencies reflect type preferences, either functional or symbolic; local availability; or the potential for dart points as trade items. However, the presence of dart points, reworking/rejuvenation, and usewear show that earlier bifacial tools were procured and used for multiple purposes.

COMMON PROJECTILE POINT TYPE COMPARISONS

This section focuses on the three arrow point types that occur most frequently in both regional assemblages: unnotched, low notched, and high notched small triangular forms (Figure 4). In both regions, the unnotched, small triangular points are typically nearly equilateral in outline, relatively broad and short; usually less than 30 mm long, and have concave or straight bases. Blade edge serration occurs equally, 23.0 percent in the northern assemblages and 22.8 percent in the southern collections. Low notched, small triangular points have side notches along the lateral edges less than one-third the length of the point from the base, differentiating the blade margins from the haft. When the side notch placement occurs at or higher than one-third of the length from the base then the point is considered high notched.

The four maximum metric attributes compared for small triangular unnotched points were not statistically significantly different between the northern

Table 4. Statistical Outcomes of Quantitative Comparisons between the Verde Valley (V.V.) and Flagstaff Area (F.A.) Data.

High Notched Form							
Variable	Length	Width	Thickness	Notch Height	Shoulder Width	Neck Width	Weight
N (Sample Size)	F.A.=89 V.V.=44	F.A.=120 V.V.=39	F.A.=121 V.V.=50	F.A.=119 V.V.=50	F.A.=117 V.V.=47	F.A.=120 V.V.=50	F.A.=121 V.V.=50
Mann-Whitney U	1856.00	1638.00	2036.50	1128.50	1383.00	2590.00	2766.50
Wilcoxon W	5861.00	8898.00	9417.50	2403.50	8286.00	3865.00	10147.50
Z Value	-0.49	-2.81	-3.36	-6.36	-4.97	-1.48	-0.89
Asymp. Sig. (2-tailed)	0.63	0.00	0.00	0.00	0.00	0.14	0.37
Low Notched Form							
Variable	Length	Width	Thickness	Notch Height	Shoulder Width	Neck Width	Weight
N (Sample Size)	F.A.=63 V.V.=74	F.A.=76 V.V.=65	F.A.=80 V.V.=83	F.A.=75 V.V.=77	F.A.=72 V.V.=78	F.A.=78 V.V.=79	F.A.=80 V.V.=83
Mann-Whitney U	1780.50	1900.00	2583.50	2155.50	1865.50	1051.00	1772.00
Wilcoxon W	4555.50	4045.00	6069.50	5158.50	4946.50	4211.00	5258.00
Z Value	-2.38	-2.36	-2.45	-2.70	-3.55	-7.13	-5.17
Asymp. Sig. (2-tailed)	0.02	0.02	0.01	0.01	0.00	0.00	0.00
Unnotched Form							
Variable	Length	Width	Thickness	Notch Height	Shoulder Width	Neck Width	Weight
N (Sample Size)	F.A.=280 V.V.=78	F.A.=350 V.V.=85	F.A.=358 V.V.=100	n/a	n/a	n/a	F.A.=357 V.V.=100
Mann-Whitney U	9964.00	14349.50	17587.50	n/a	n/a	n/a	15999.50
Wilcoxon W	13045.00	75774.50	81848.50	n/a	n/a	n/a	21049.50
Z Value	-1.18	-0.51	-0.27	n/a	n/a	n/a	-1.59
Asymp. Sig. (2-tailed)	0.24	0.61	0.79	n/a	n/a	n/a	0.11

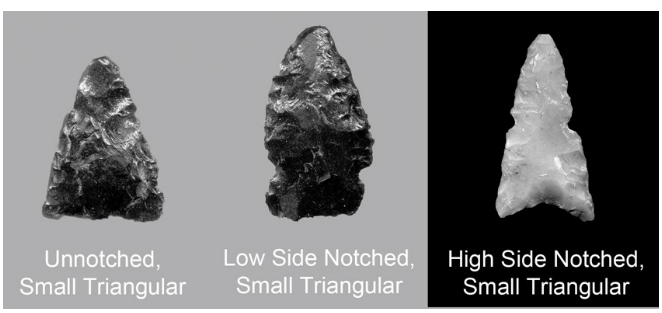


Figure 4. Examples of the three most common arrow point types from the Verde Valley National Monuments collection and the Flagstaff area sites.

and southern collections (Table 4). High side notched points exhibit similar lengths, neck widths, and weights, but width, thickness, notch height, and shoulder width are statistically different between the northern and southern regions (Table 4). High notched points from the Verde Valley are generally wider and thicker, and the notches are placed on average 2.3 mm lower than the similar type from the Flagstaff area. Low side notched forms differ statistically in all of the measurements. Low side notched points from the Verde Valley are smaller and have notches placed lower than points from the Flagstaff sites.

Raw Material Sourcing

Tool stone identification plays an important role in considerations of mobility patterns (Andrefsky 1998; Binford 1979; Jones et al. 2003; Kooyman 2000; Parry and Kelly 1986; Roberts et al. 2015; Shackley 2005; Smith 2010), technological organization (Andrefsky 1994; Nelson 1991; Huckell et al. 2010), and socioeconomic interactions (Cameron 2001; Geib 2011; Loendorf 2012; Loendorf et al. 2013; Whittaker 1987; Whittaker et al. 1988). While geochemical sourcing methods, such as x-ray fluorescence spectrometry (XRF), provide an ideal method for extrusive igneous material sourcing (Shackley 1988, 1995, 2005; Roberts et al. 2015), constraints on the current project did not allow for XRF analysis. Although macroscopic identification of raw material is difficult, the senior author analyzed all of the materials using low power microscopy (20X), and reference to an extensive comparative collection, resulting in tentative source determinations. In instances where materials could not be assigned to a specific source (i.e. Government Mountain obsidian) due to similarities with other nearby sources a more general source area was assigned (i.e. Spring Valley Group). Materials that lacked confident source assignment were categorized as unidentified. In general, raw material usage is inter-regionally similar.

In both areas extrusive igneous materials (obsidians, rhyolite, dacite, etc.) primarily originate from the Spring Valley Group (obsidians) and Mount Floyd Volcanic Field (other extrusive igneous materials) sources located west of Flagstaff. Although the sources are closer to Flagstaff, the Spring Valley materials occur more often at the Verde Valley sites. Relevant to noting extrusive igneous source proximity to these two areas is the presence of Sycamore Canyon. Approximately 15 miles south of Spring Valley (the location of Government Mountain, Sitgreaves Mountain, and RS Hill), Sycamore Canyon meanders south, connecting with the Verde River approximately 8 miles north of Tuzigoot Pueblo. Accordingly, Sycamore Canyon provides a natural corridor for both direct procurement and interaction between the two areas. Spring Valley Group obsidians dominate both collections comprising 61.0 percent overall of the Flagstaff collection and 79.0 percent overall of the Verde Valley collection. Extrusive igneous materials from the Mount Floyd Volcanic field constitute 11.0 percent of the northern sites and 5.0 percent of the southern site collections. In addition, a small amount of Topaz Basin obsidian from the Verde Valley (Shackley 2009) occurs in both collections; 1.0 percent from the Flagstaff sites and 3.0 percent from the Verde Valley sites. Additional extrusive igneous materials include less than one percent of Kendrick Peak obsidian, a lower quality material (see Roberts et al. 2015; Shackley 1988) at the Flagstaff sites and Strawberry Dacite from the Payson area within the Verde Valley collection.

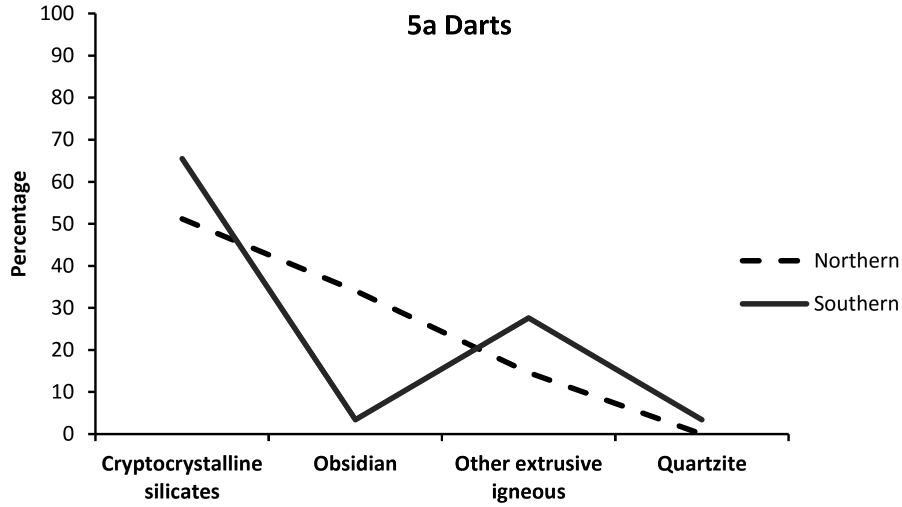
In contrast to extrusive igneous materials, it is difficult to chemically assess the source locations of cryptocrystalline silicates (chert, chalcedony, petrified wood, and jasper) because of the commonly high variability in chemical composition of even a single procurement area, which may occur as extensive geological deposits. With that in mind, similar cryptocrystalline materials occur in both locations. In many cases, these materials originate from the same primary geological sources, but occur in secondary depositional contexts affording procurement from a variety of locations. In which case, the materials could have been locally procured or obtained through interaction between the regions.

Cryptocrystalline silicates constitute a low frequency of the collections: chert (15.9 percent), jasper (1.9 percent), chalcedony (1.8 percent), and petrified wood (0.8 percent). Low power microscopy in combination with a comparative collection suggests that these materials are local to middle and northern Arizona, and derive from the Kaibab (Kaibab chert), Martin (Perkinsville jasper), and Chinle (petrified wood) geological formations. These materials, along with additional unsorted cryptocrystalline silicates, are also available in secondary quaternary deposits, such as the Little Colorado River Valley in the Northern Sinagua area and the Verde River in the Southern Sinagua area.

Dart points from both areas were made from a variety of material types (Figure 5a). Cryptocrystalline silicates, in particular chert, were preferred for large point manufacture in both regions, employed to manufacture 51.2 percent of the Flagstaff area dart points and 65.5 percent of the Verde Valley points. Comparison of all material types by region resulted in no statistical difference (Table 5). However, the cryptocrystalline raw materials show differential source material use (Figure 6a) and suggest that locally available raw materials were preferential in both regions. Extrusive igneous materials from both areas primarily originated from the northern sources of the Spring Valley group (Government Mountain, Sitgreaves Mountain, and RS Hill) (Roberts et al. 2015) and Mount Floyd Volcanic Field (Partridge Creek and Presley Wash) (Roberts et al. 2015; Shackley 1988, 1995).

Arrow points display an opposing trend. Extrusive igneous materials, particularly obsidians, were preferred for small point manufacture employed to manufacture 75.0 percent of the Flagstaff area points and 94.0 percent of the Verde Valley points. While comparison of all material types by region resulted in statistical difference (Table 5), percentages show a strikingly similar trend (Figure 5b). Similar to dart points, the cryptocrystalline silicate raw materials display differential source use (Figure 6b). Extrusive igneous materials from both areas primarily originated from the northern sources of the Spring Valley group (Government Mountain, Sitgreaves Mountain, and RS Hill) (Roberts et al. 2015) and Mount Floyd Volcanic Field (Partridge Creek, Presley Wash, and Black Tank) (Roberts et al. 2015; Shackley 1988, 1995). Minor frequencies of Kendrick Peak and Topaz Basin obsidians as well as unidentified other extrusive igneous materials are also present.

While cryptocrystalline silicates constitute a small amount, approximately one-fifth, of the sample, the materials may be obtained from multiple extensive local primary and secondary procurement locations, as well as traded, and collected from nearby sites. In contrast, extrusive igneous materials occurring in much more confined locations are far more frequent, indicating that extrusive igneous materials were preferred over cryptocrystalline silicates. This



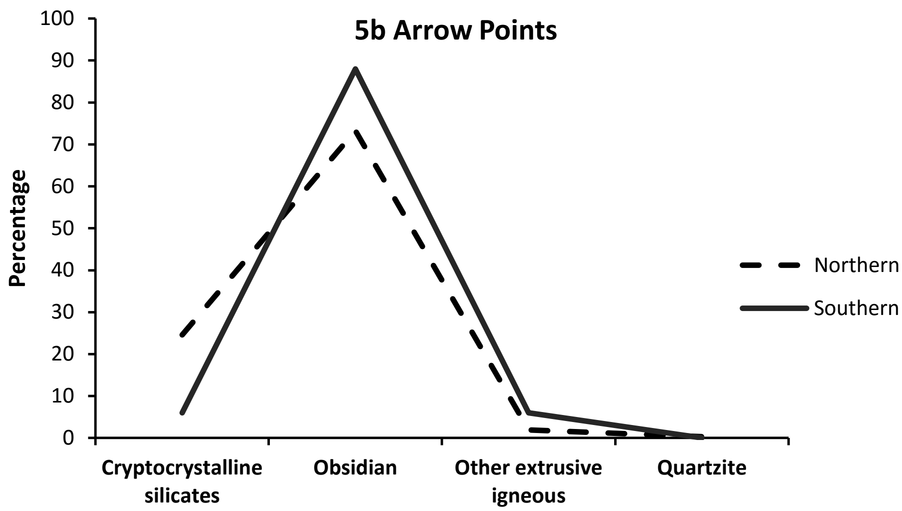


Figure 5. Percentages of material types used in the manufacture of dart (5a) and arrow (5b) points by region.

preference resulted in a general dismissal of cryptocrystallines (at least for bifacial tools) leading to concerted primary acquisition trips, inter-regional trade, or a combination of both to obtain extrusive igneous materials.

SUMMARY AND CONCLUSIONS

The bifaces and projectile points from sites within the Verde Valley National Monuments display substantial variability in form. The collection includes both large and small bifaces of varying forms used in utilitarian and likely symbolic contexts. Biface attributes also suggest use through both hafted and unhafted methods. Furthermore, the workmanship of some bifaces demonstrates that competent as well as masterful biface manufacture continued well into late pre-Columbian times. The projectile point collection also provides circumstantial evidence that large points were collected and continued to be used for both utilitarian activities, such as cutting, scraping, and drilling, as well as symbolic activities.

The small projectile point collection demonstrates substantial diversity in morphology, with forms commonly present in artifact collections from the Sinagua, Cohonina, Prescott, and Hohokam culture areas. Quantitative statistical comparisons of the three most common types with points from Northern Sinagua sites indicate that the unnotched point morphologies are similar, but both low and high side notched points exhibit differences. Verde Valley points generally exhibit lower notch placement on both high and low notched forms. We interpret the statistical differences in notch height as functional and may reflect slightly differing hafting techniques between the two regions or a preference for a longer blade in the Verde Valley.

Stone artisans in both areas employed similar materials in comparable frequencies. In particular, obsidian, which is the most common material in both

Table 5. Statistical Outcomes of Projectile Point Material Types and Sources Between Regions.

Variable	Region	n	Mean Rank	Sum of Ranks	Statistical Test	Outcome
			Dart Points			
Material	Flagstaff Area	41	34.71	1423.00	Mann-Whitney U	545.00
	Verde Valley	27	34.19	923.00	Wilcoxon W	923.00
	Total	68			Z Value	-0.116
					Asymp. Sig. (2-tailed)	0.908
Source	Flagstaff Area	41	26.05	1068.00	Mann-Whitney U	207
	Verde Valley	27	47.33	1278.00	Wilcoxon W	1068
	Total	68			Z Value	-4.399
					Asymp. Sig. (2-tailed)	0.000
			Arrow Points			
Material	Flagstaff Area	696	466.92	324978.00	Mann-Whitney U	82422.00
	Verde Valley	300	571.76	171528.00	Wilcoxon W	324978.00
	Total	996			Z Value	-7.291
					Asymp. Sig. (2-tailed)	0.000
Source	Flagstaff Area	696	528.08	367544.50	Mann-Whitney U	82135.50
	Verde Valley	300	429.87	128961.50	Wilcoxon W	127285.50
	Total	996			Z Value	-6.374
					Asymp. Sig. (2-tailed)	0.000

regions, originates from the same sources. These similarities suggest socioeconomic interactions occurred between the two areas. Overall, the projectile point collections from the Verde Valley sites show similarities to the point types present at the Northern Sinagua sites of Elden and Wupatki Pueblos. While distinct in some respects, the Southern Sinagua shares overall similarities with Northern Sinagua projectile points. To paraphrase Alison Wylie (2002), although flaked stone is only one strand in the metaphorical cable necessary to support a scientific hypothesis, the bifacial tool collection from the Verde Valley National Monument sites suggests that there is, indeed, a Southern Sinagua cultural tradition.

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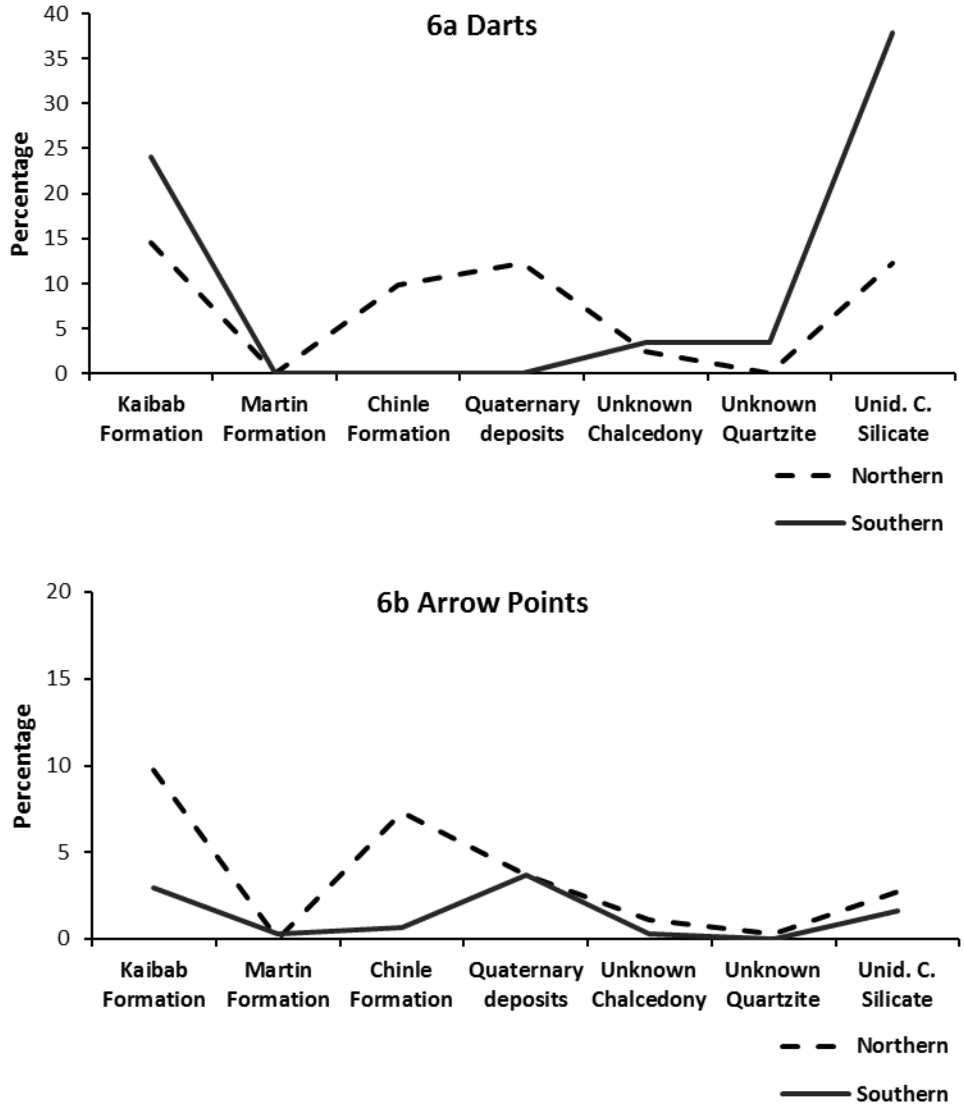

Figure 6. Percentages of general cryptocrystalline silicate sources used in the manufacture of dart (6a) and arrow (6b) points by region.

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