

FROM MOUNTAINTOP TO VALLEY BOTTOM

**Understanding Past Land Use
in the Northern Rio Grande
Valley, New Mexico**

**edited by
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Archaic Foraging Technology and Land Use in the Northern Rio Grande, New Mexico

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The Northern Rio Grande includes an area from the San Luis Valley and adjacent foothills of the San Juan Mountains in the north to the Santa Fe area and the Jemez Mountains in the south. Archaic foragers roamed over this ancient landscape while hunting and gathering a variety of plant and animal species. These annual rounds involved a seasonal pattern of movement up and down the valley and between lowland and upland areas. The region contains a diverse array of resources across elevations ranging from about 1,600 to 4,260 m (5,200 to 14,000 ft). Lithic raw materials also abound in the area, including obsidian, fine-grained dacite, chalcedony, chert, and quartzite. This chapter presents the results of a preliminary study of the possible relationship among changes in climate, resource structure, foraging strategies, and Archaic projectile point technology in the Northern Rio Grande.

In order to spatially delineate my sample, I divided my study area into three separate zones (Figure 9.1). Zone 1 is located at the southern end of the region including the Santa Fe–Abiquiú area, Zone 2 includes the Taos–Tres Piedras area, and Zone 3 consists of the San Luis Valley and Rio Grande headwaters. Zone 3 was included in a previous study conducted by Jodry, Shackley, and myself for the Late Paleoindian and Early Archaic time periods (Vierra et al. 2012). In contrast, this study will focus on the Early, Middle, and Late Archaic periods in Zones 1 and 2. A total of 139 Early Archaic, 87 Middle Archaic, and 172 Late Archaic

projectile points provide the temporal database used herein. Figure 9.2 illustrates the frequency distribution across the 10 separate point types identified.

Archaic Chronology and Environment

The projectile point chronology used here follows the Oshara tradition sequence defined by Irwin-Williams (1973). The Early Archaic includes Jay and Bajada points, the Middle Archaic consists of San Jose and possibly large side-notched points, and the Late Archaic includes Armijo and five other distinctive point types. These latter types consist of corner-notched, side-notched, stemmed, leaf-shaped, and contracting-stemmed varieties. Chapin's (2005) review of the radiocarbon-dated point sequence indicates a paucity of accurate dates for Jay projectile points but suggests that the type may be as old as 8000 to 7000 BP. Bajada points, on the other hand, may date to ca. 6000 to 5000 BP but possibly as early as 7000 BP and as late as 4000 BP. San Jose points appear to range from 6000 to 4000 BP, while the large side-notched points are poorly dated, generally between ca. 4200 and 3200 BP. Armijo points date from about 3500 to 2500 BP, and a range of Late Archaic point types date to ca. 3500 to 1600 BP.

Recent studies of pollen cores in the Jemez Mountains by Scott Anderson and his students (Anderson 2008; Anderson et al. 2008; Brunner Jass 1999) indicate that these Late Paleoindian and

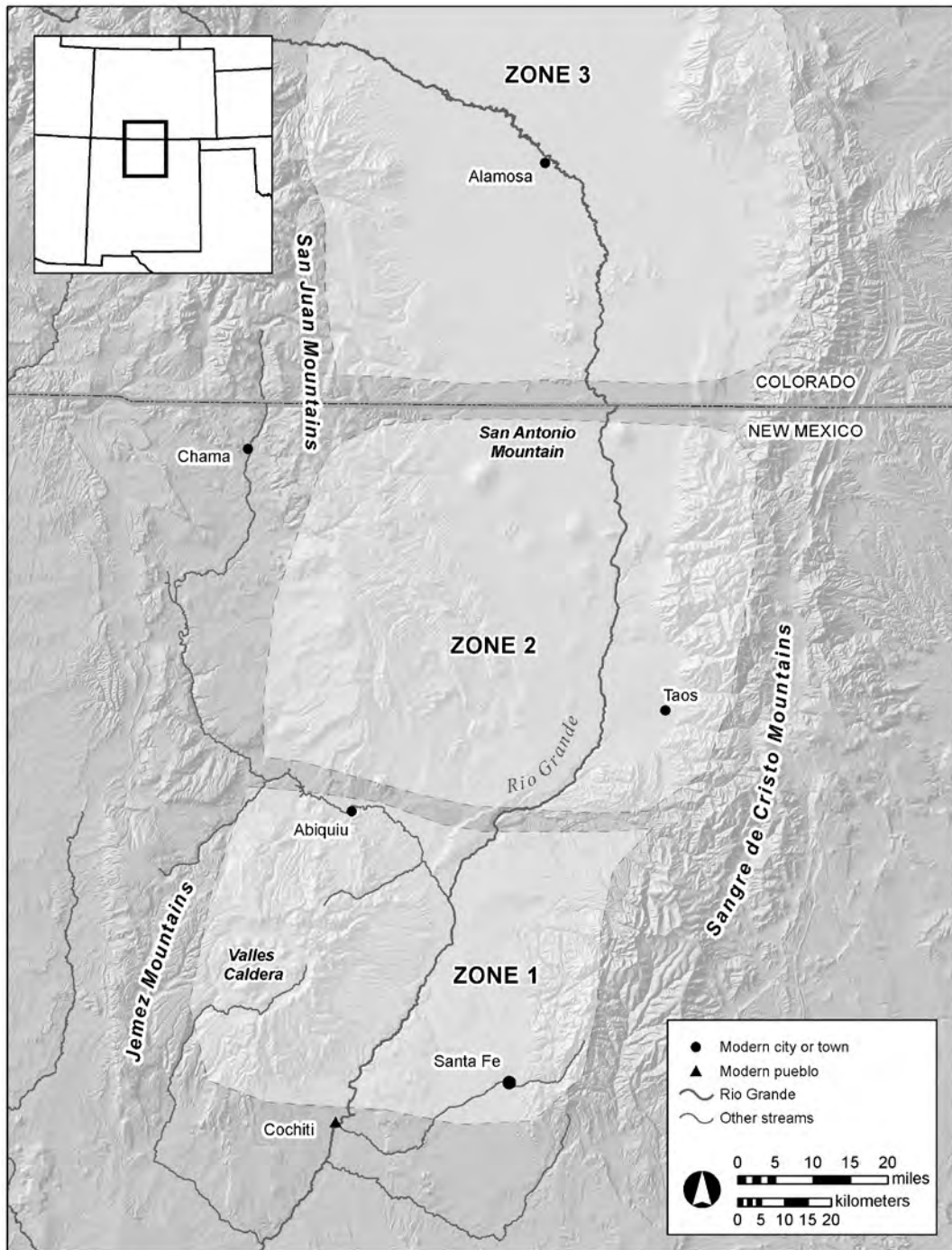


FIGURE 9.1. Location of study area Zones 1–3.

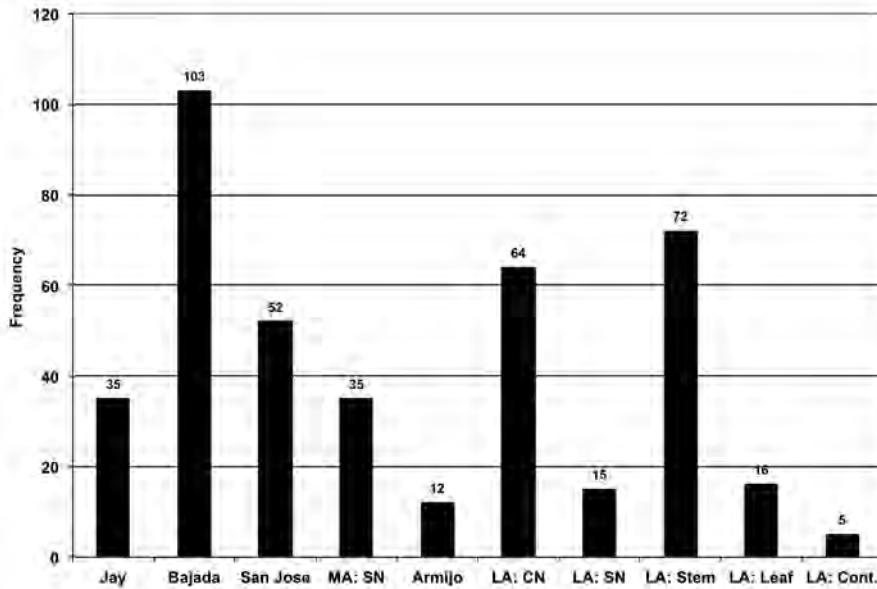


FIGURE 9.2. Distribution of Archaic point types. MA = Middle Archaic, LA = Late Archaic, SN = Side-notched, CN = Corner-notched, Stem = Stemmed, Leaf = Leaf-shaped, Cont. = Contracting-stemmed.

Early Archaic dates are separated by a period of decreased effective moisture indicated by the drying of Chihuahueros Bog between 8500 and 6400 cal BP and declining sedimentation rates of the Valle Santa Rosa Bog beginning about 8500 BP. Stewart Bog in the Sangre de Cristo Mountains experienced dry conditions between ca. 9000 and 5750 cal BP, with the driest period between 7100 and 5500 cal BP (Armour et al. 2002; Jiménez-Moreno et al. 2008). Pollen cores from basin lakes in the San Luis Valley show a similar trend, with a decline in lake and creek levels after about 8000 BP and a period of least effective moisture at roughly 6500 BP (Jodry 1999; Jodry and Stanford 1996; Shafer 1989). This obviously would have had a significant effect on the Early Archaic foragers in the area, with their settlement system shifting to a north-south pattern within the Northern Rio Grande (Vierra et al. 2012). A variety of large, medium, and small game was hunted, and there is evidence of bison hunting and fishing in the San Luis Valley (Jodry 2006; Vierra et al. 2012).

During the subsequent Middle Archaic (6000–3500 BP) there is evidence for moister conditions and the expansion of pinyon-juniper woodlands in the Northern Rio Grande. This evidence is represented by increased percentages of pinyon pollen after 6400 cal BP at Chihuahueros Bog, 6000

cal BP at Stewart Bog, 4300 BP at Alamo Bog, and ca. 4000 cal BP at Alta Alamo Bog (Anderson 2008; Anderson et al. 2008; Brunner Jass 1999; Jiménez-Moreno et al. 2008; Stearns 1981). It may be during the Middle Archaic that fall hunts in the Rio Grande Valley were becoming less successful, so these hunter-gatherers would have shifted their residence to the uplands where they could collect pinyon nuts and hunt deer. Rather than dried bison meat, stored pinyon nuts might have provided an important source of protein during the winter months (Vierra 2005).

The initial use of maize agriculture in the area of the Northern Rio Grande is dated to about 3000 BP, although it has also been dated as early as 3690 BP in west-central New Mexico, marking the beginning of the Late Archaic (3500–1500 BP). This period is characterized by increased effective moisture, with moister conditions continuing until about 1800 BP and the onset of drier conditions (Dello-Russo 1999, 2003; Ford, Chapter 4; Hall and Periman 2007; Vierra and Ford 2006, 2007). The cyclical nature of the rainfall conditions during the subsequent time period has been described in the El Malpais data (Grissino-Mayer 1996) and in the Northern Rio Grande (Towner and Salzer, Chapter 3). Late Archaic land use appears to be characterized by a lowland/upland



FIGURE 9.3. Jay (upper) and Bajada (lower) Early Archaic points.

pattern within restricted areas of the Rio Grande Valley. This involved movements from the juniper savanna in the early summer (to exploit Indian ricegrass), up to the ponderosa pine/mixed conifer forest in the mid- to late summer (for chenopods, wild onions, berries, and wild potatoes), and then down to the pinyon-juniper woodlands in the fall (for pine nuts, acorns, broadleaf yucca, and cacti). Riverine settings also appear to have been used for winter campsites (Ford, Chapter 4; Post, Chapter 5; Vierra 2003; Vierra and Foxx 2009).

Archaic Projectile Point Typology and Technology

A total of 409 Archaic projectile points provide the temporal database for this study. Previous systematic studies of Archaic projectile points have identified important changes in point technology through time (e.g., Chapin 2005, 2007; Moore 1994; Moore and Brown 2002; Thoms 1977; Turnbow 1997). Most notable of these are decreasing stem length, changes in basal morphology, and stem/base modifications (e.g., grinding and thinning).

The Early Archaic points are large stemmed points with a long blade, slight shoulders, and a

contracting stem (Figure 9.3). Jay points (Figure 9.3, upper) are generally larger than Bajada points (Figure 9.3, lower), with the latter exhibiting basal thinning and concave bases and most of the former having straight or convex bases. Both of these points were made from large biface blanks with a mean thickness of 8.3 mm. The base and/or lateral edges usually exhibit grinding (96 percent), with blade resharpening and rebasing also being common (86 percent). My previous study (Vierra et al. 2012) indicates that Late Paleolithic groups often increased tool use life by refurbishing the proximal end of broken points while discarding the smaller base fragments, vs. Early Archaic groups, who resharpened the blade in conjunction with refurbishing the base. This may in part reflect a shift from the intercept hunting of large game in open settings to the increasing use of an encounter hunting tactic for medium to small game in wooded settings. This might also explain the shift to smaller-sized Bajada points.

Middle Archaic San Jose-style points are characterized by large to medium stemmed points with a shorter blade and stem (Figure 9.4, upper). The blade is serrated, with a concave base. The base and/or lateral edges often exhibit grinding (96 percent); however, the points are rarely re-

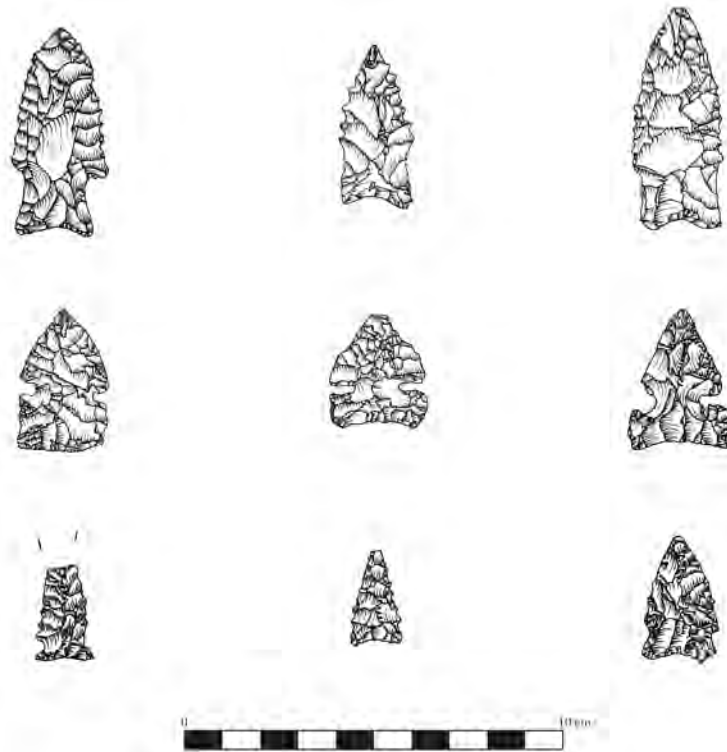


FIGURE 9.4. San Jose (upper), side-notched (middle), and Armijo (lower) Middle–Late Archaic points.

based, but the blades are often resharpened (66 percent). They are frequently discarded when exhausted, with about 50 percent of the points being whole. This point type was also made from a large biface blank, with a mean thickness of 6.9 mm. This change in point morphology could have allowed for greater efficiency while encountering hunting in upland wooded environments. On the one hand, serration may enhance penetration while creating a more irregular wound that would enhance a blood trail, something important for hunting in wooded settings (Christenson 1987:147; Hughes 1998:358). On the other hand, serration might also offset the decreased resharpening potential of the shorter blade, requiring fewer resharpening events. Black (1991) noted that serration is common on Archaic points in the Colorado Rockies and that these points were also used as hafted knives (also see Speth and Parry 1980:172). This includes Middle Archaic Hanna points, which are morphologically similar to San Jose and Pinto styles, although the Pinto points do not exhibit serration.

Vierra et al.'s (2012) study indicates that Early

Archaic points were designed for greater durability than Late Paleoindian points. Based on an experimental study, Cheshier and Kelly (2006) suggest that points with thickness:length ratios greater than .12 were significantly more durable than points with smaller ratios. Jay and Bajada points exhibit a ratio of .16 and .18, whereas Late Paleoindian points exhibit ratios from .10 to .14. San Jose (.19) and Armijo (.18) points fall within the Early Archaic range, whereas Late Archaic points (.15–.17) appear to be intermediate to these and the Late Paleoindian points. Therefore, Early–Middle Archaic and Armijo points tend to be more durable than Late Paleoindian points, with Late Archaic points being intermediate.

In summary, Early and Middle Archaic point technology appears to have been designed for durability and a lower tool replacement rate involving the production of points from biface blanks and heavy blade resharpening (also rebasing during the Early Archaic). On the other hand, there is low point diversity, with generalized points being used to hunt various large, medium, and small game. Changes in point size and design

presumably reflect the increasing importance of hunting medium- to small-size game in wooded settings. These Early and Middle Archaic points therefore appear to reflect a *replacement when exhausted* tactic, representing continuous use and high residential mobility (Kuhn 1989).

If the large side-notched points (Figure 9.4, middle) are roughly contemporaneous with San Jose-style points, then two very different technologies were being used at the same time. All are made on thinner flake blanks with a mean thickness of 5.0 mm. These points exhibit less blade resharpening (52 percent) and almost no basal grinding (3 percent). They are more often discarded when broken, with only 34 percent being whole. The side notching may have been designed to control the breakage pattern of the point and therefore leave the broken section in the animal (Zeneah and Elston 2001:100). In addition, thinner flakes are more prone to breakage due to impact and can continue to move through the animal as it runs away (Flenniken 1985). If so, this would account for the points being manufactured on flakes with high tool replacement rates. Therefore, this technology appears to be more similar to the technique used by Late Archaic groups.

Late Archaic Armijo points appear to represent a continuation of the San Jose style, with a shorter blade and stem and the presence of serration and a concave base (Figure 9.4, bottom). However, there are important differences. Armijo points are also made on thin flake blanks with a mean thickness of 5.1 mm. They also exhibit little resharpening (33 percent) but usually exhibit basal grinding (75 percent). Like the large side-notched points, they too are mostly discarded when broken, with only 33 percent being whole.

Late Archaic points are characterized by a shift away from the use of a few generalized point types to a variety of specialized point types. This includes at least five different types: corner-notched ($n = 64$), side-notched ($n = 15$), wide and narrow stemmed points with straight and concave bases ($n = 72$), leaf-shaped points ($n = 16$), and contracting-stemmed points ($n = 5$; Figure 9.5). All of these were made on flake blanks with mean thicknesses ranging from 5.4 to 5.9 mm, with evidence of the original ventral surface of the flake and plano-convex cross section being common. These points are rarely resharpened (0–30 per-

cent), with roughly half of the points being discarded when broken. They generally do not exhibit basal grinding (0–30 percent), which is especially true for the leaf-shaped points, which may have been hafted with mastic. The leaf-shaped and contracting-stem points also differ from most other Late Archaic points by being mostly serrated (75 percent and 60 percent, respectively).

This diversity of Late Archaic point types presumably reflects the implementation of a variety of hunting tactics designed to efficiently procure specific types of game. Whereas Early–Middle Archaic points were primarily designed for durability, it appears that Late Archaic points might have been designed to be more efficient at penetrating into game. Hughes (1998) suggests that thin ellipsoid-point cross sections are more efficient at penetration than conical cross sections. Following Hughes, a ratio of $\frac{1}{2} \text{ width} \times \text{thickness}$ (cm^2) was used to calculate point sectional area. Jay, Bajada, and San Jose points exhibit ratios of .92, .83, and .73, respectively, and were made on biface blanks. In contrast, large side-notched and Armijo points were made on flake blanks and have smaller ratios of .50 and .44, respectively. Last, Late Archaic corner-notched, side-notched, and stemmed points have ratios of .67, .62, and .62, respectively, whereas leaf-shaped and contracting-stem points have ratios of .49 and .50, respectively. Overall, points that are made on flake blanks are more efficient at penetrating into game, although the leaf-shaped and contracting-stem points appear to have been the most efficient. Finally, resharpening would have acted to decrease the penetration efficiency of a projectile and is uncommon among Late Archaic points (Hughes 1998:358; Sisk and Shea 2009:2044).

The use of a few generalized point types and low tool replacement rates due to resharpening during the Early and Middle Archaic were now replaced with a diversity of point types, penetration efficiency, and high tool replacement rates, with little blade resharpening to extend tool use life. Flake blanks could also reduce tool production costs and allow for a greater variety of smaller amounts of raw materials to be used, something important with restricted mobility. The common pattern of finding numerous Late Archaic points and fewer Middle Archaic points may not

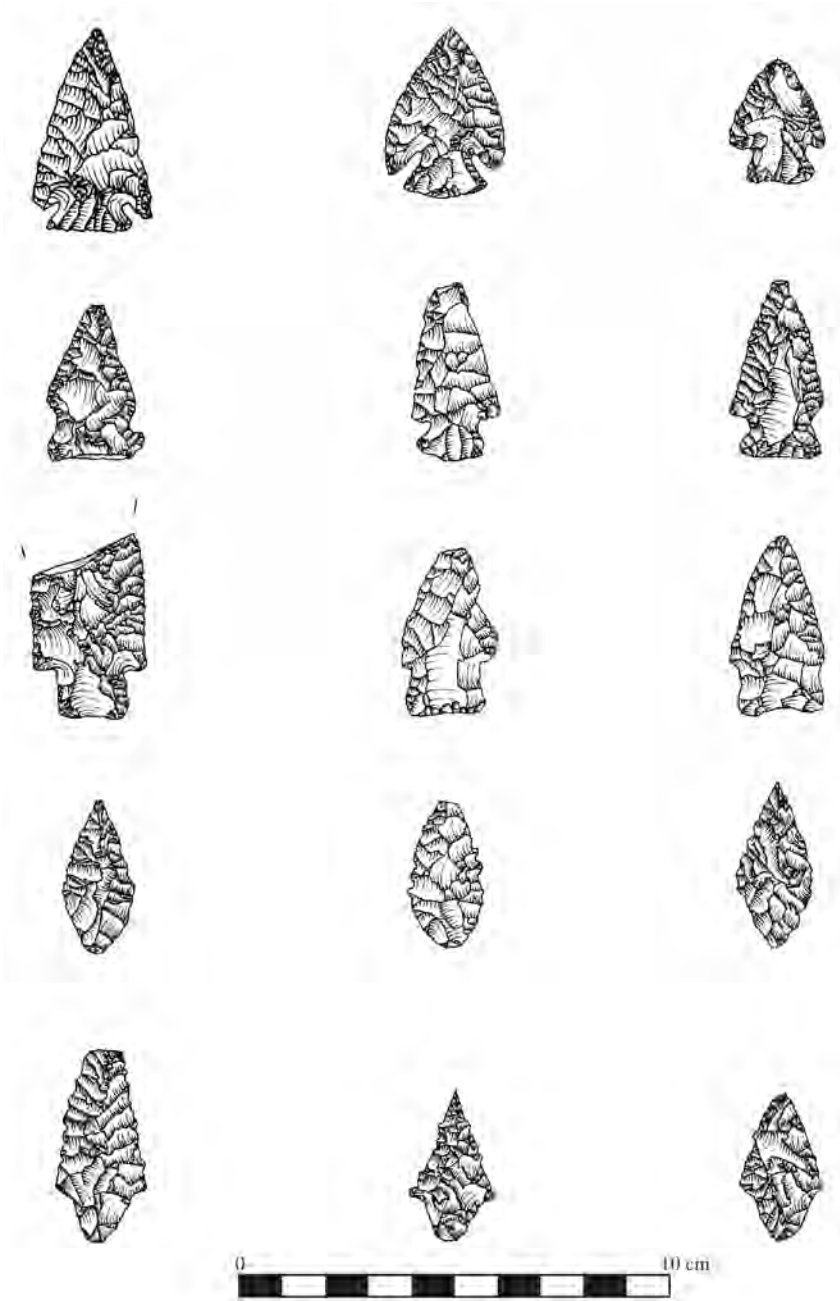


FIGURE 9.5. Late Archaic point types.

reflect increased levels of occupational intensity but, rather, shorter tool use life and higher discard rates. Late Archaic points therefore appear to reflect a *replacement prior to failure* tactic that increases the success rate for hunting while focusing on specific target species (Kuhn 1989).

Corner-notched and stemmed points were

probably wrapped with sinew and designed to stay attached to the foreshaft. In contrast, leaf-shaped and contracting-stem points were presumably attached with a mastic and were likely to separate from the foreshaft, with the whole point remaining in the animal. Last, side-notched points were probably attached to the foreshaft with sinew

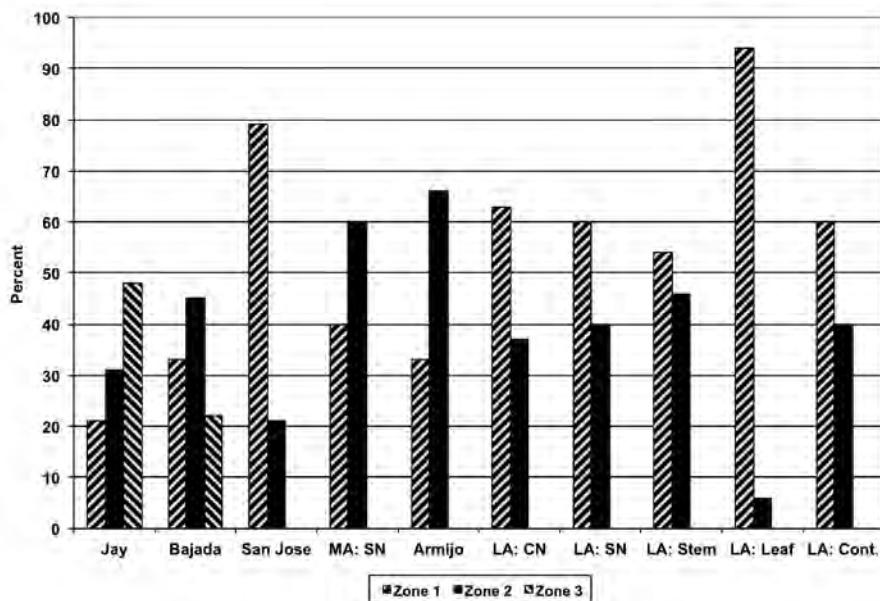


FIGURE 9.6. Distribution of Archaic point types by zone. MA = Middle Archaic, LA = Late Archaic, SN = Side-notched, CN = Corner-notched, Stem = Stemmed, Leaf = Leaf-shaped, Cont. = Contracting-stemmed.

and were likely to break and stay in the animal (Christenson 1987:145; Guernsey and Kidder 1921:85; Holmer 1986; Musil 1988:374; Plew and Woods 1985:221–222; Zeneah and Elston 2001). This interpretation is supported by the breakage patterns. That is, 46 percent of the corner-notched, stemmed, and side-notched points are whole, whereas 80 percent of the leaf-shaped and contracting-stem points are whole. Most of the leaf-shaped and contracting-stem points are serrated, which would have also enhanced penetration and the damage to the wound.

The use of a variety of Late Archaic specialized points does set the stage for the later adoption of the bow and arrow, ca. AD 400; however, the shift to flake-based projectile point technologies is associated with the use of Middle and Late Archaic darts, and not arrowpoints as suggested by Railey (2010). The projectile point sequence at Armijo Shelter indicates the gradual change from mostly Armijo dart points (Strata F–I), to contracting-stem/leaf-shaped dart points (Strata D–F), to corner- and side-notched dart points that are coterminous with arrowpoints (Strata A–D [Chapin 2005:94]). The latter pattern in part reflects mixing but may also indicate the contemporaneous use of both projectile point delivery

systems (also see VanPool 2006). Therefore, the diversity of Late Archaic point types may further reflect changes in hunting tactics through time that eventually included the use of the bow and arrow. The bow doubles the velocity of a projectile relative to a spear-thrower (Hughes 1998:351), so the use of a bow delivery system would reflect the culmination of a long-term process designed to increase point penetration efficiency.

Regional Land Use

The distribution of point types across Zones 1 to 3 for Jay and Bajada points and Zones 1–2 for the remaining point types is provided in Figure 9.6 (left to right). The number of Jay points increases from south to north, with more Bajada points in the southern zones. The prevalence of Jay points in the San Luis Valley could reflect the increased importance of large-game hunting in this area, vs. the case for later Bajada foragers who primarily exploited the wooded terrain in Zones 1 and 2. San Jose points are primarily represented in Zone 1, in contrast to the large side-notched points, which are mostly present in Zone 2. It would be nice to see if this pattern continues into Zone 3, thereby indicating that these side-notched points may actually represent foragers entering the Rio

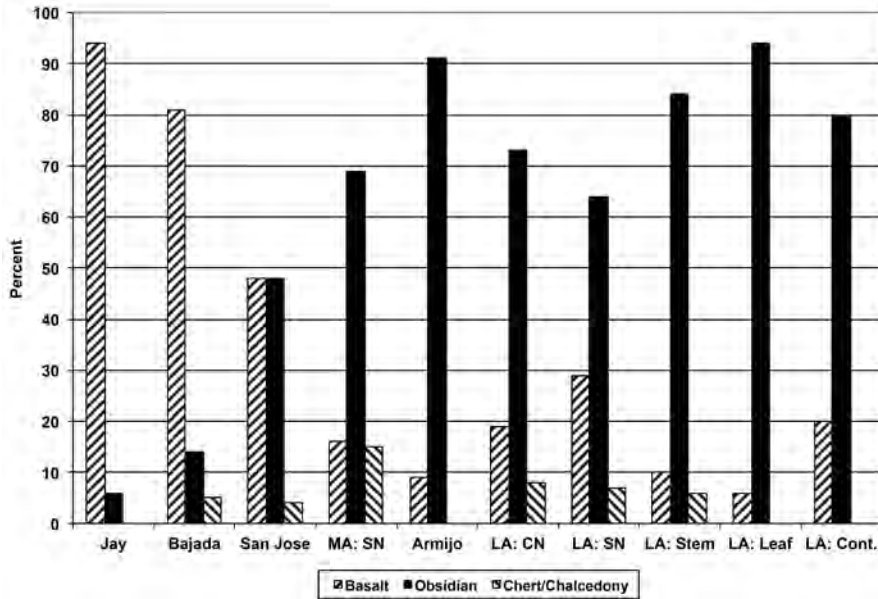


FIGURE 9.7. Distribution of material types for Archaic point types. MA = Middle Archaic, LA = Late Archaic, SN = Side-notched, CN = Corner-notched, Stem = Stemmed, Leaf = Leaf-shaped, Cont. = Contracting-stemmed.

Grande Valley from the north, vs. San Jose foragers moving up the south. Both Elyea and Hogan (1993) and DelBene and Branchard (1994) observed a prevalence of large side-notched points along the northern periphery of the San Juan Basin. Indeed, Elyea and Hogan (1993) suggested that these points may represent separate foraging groups from the north. The use of flake blanks for these large side-notched points may also reflect a “replacement prior to failure tactic” conditioned by the hunting of large game. Or it might be more accurate to characterize this tactic as a *replacement based on anticipated failure*. On the other hand, there are more Late Archaic Armijo points in Zone 2, but the sample size is only 12; meanwhile, all the other Late Archaic point types reflect a bias toward Zone 1, especially the leaf-shaped points.

A variety of lithic raw materials were available to these ancient foragers, and the data indicate that they were very selective in choosing which material fit their tool requirements. The distribution of the three primary lithic raw materials is presented in Figure 9.7. We see a general decrease in the use of dacite from Jay, to Bajada, to San Jose, to large-side notched and Armijo points, with a corresponding increase in the use of obsidian

through time. The increasing use of obsidian is probably a result of the importance of projectile point penetration efficiency and possibly fragmentation for increased bleeding, whereas the decreasing use of dacite is presumably related to the lessened importance of point durability through time (Hughes 1998:371–373). In addition, the use of obsidian appears to correspond with the systematic integration of upland resource areas into annual foraging ranges, whereas dacite is primarily situated in lowland settings (see Shackley, Chapter 1). Otherwise, very little chert/chalcedony is used for the production of most point types.

These data were then separated between Zones 1 and 2, with obsidian being visually segregated between the translucent central Jemez Mountain sources and the dusty El Rechuelos source situated at the northern end of the mountains. Figure 9.8 illustrates a similar pattern as observed in Figure 9.7, with the exception that most of the obsidian was derived from the central Jemez Mountain sources (i.e., Valle Grande and Cerro Toledo). In contrast, Figure 9.9 also shows a similar pattern as Figure 9.8, but in this case most of the obsidian was derived from the El Rechuelos source. The two exceptions are the San Jose– and Armijo-style

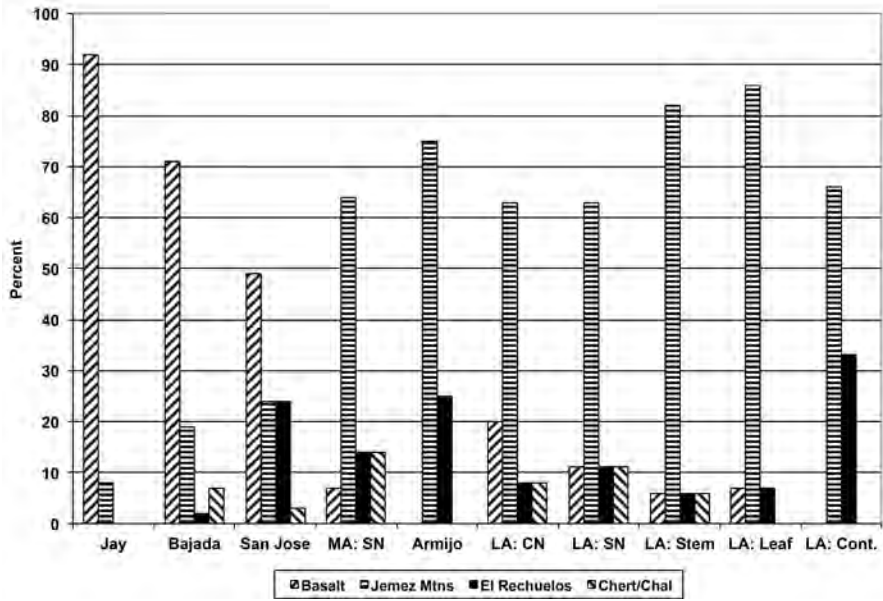


FIGURE 9.8. Distribution of material types for Archaic points in Zone 1. MA = Middle Archaic, LA = Late Archaic, SN = Side-notched, CN = Corner-notched, Stem = Stemmed, Leaf = Leaf-shaped, Cont. = Contracting-stemmed.

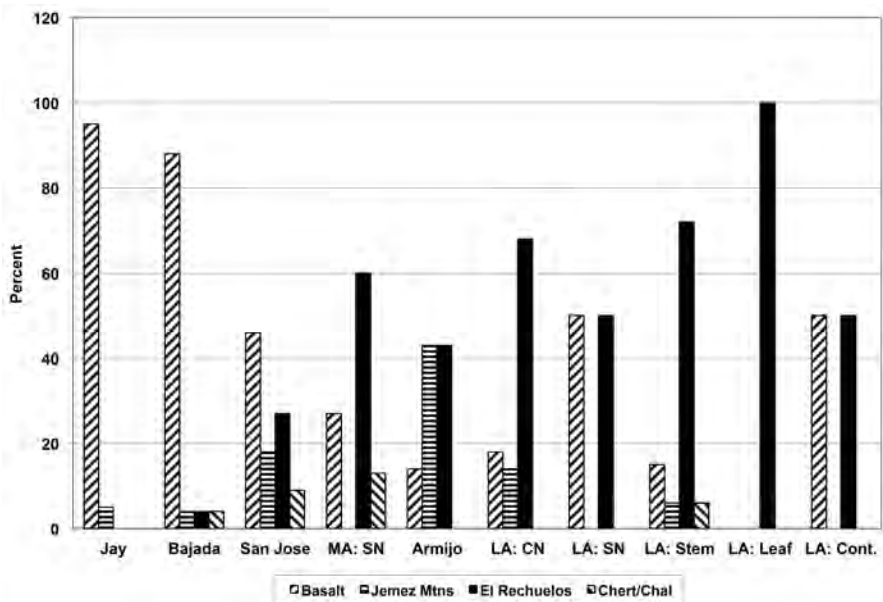


FIGURE 9.9. Distribution of material types for Archaic points in Zone 2. MA = Middle Archaic, LA = Late Archaic, SN = Side-notched, CN = Corner-notched, Stem = Stemmed, Leaf = Leaf-shaped, Cont. = Contracting-stemmed.

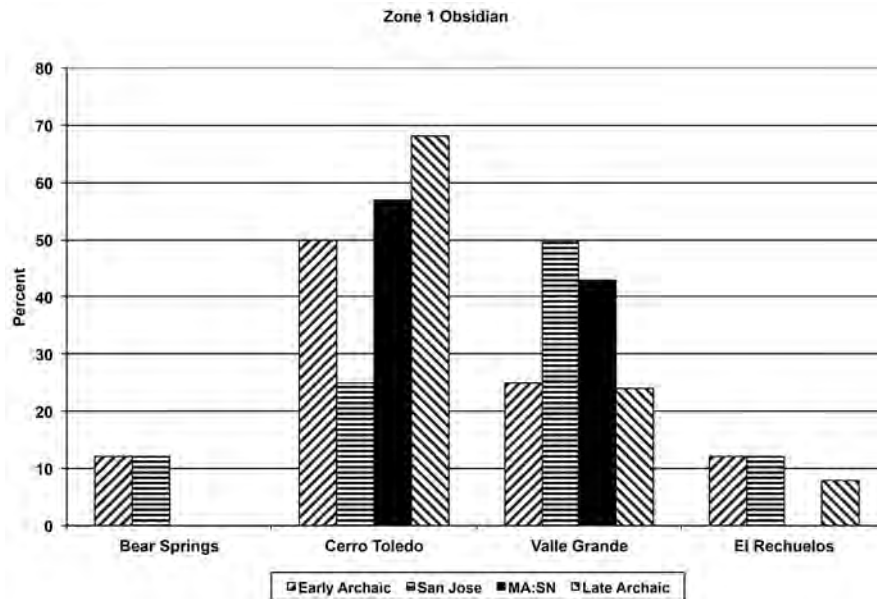


FIGURE 9.10. Distribution of obsidian types in Zone 1. MA = Middle Archaic.

points, which have a mix of Jemez Mountains and El Rechuelos obsidian.

An X-ray fluorescence analysis was conducted of a sample of 101 projectile points in order to further clarify this pattern. This sample consists of 72 obsidian and 29 dacite points. A previous study (Vierra et al. 2012; Shackley, Chapter 1) demonstrates that these “basalt” artifacts are actually a fine-grained black dacite, with three sources being identified: the Cerros del Rio source in Zone 1 at Bandelier National Monument and the San Antonio Mountain and Newman’s Dome sources near Tres Piedras in Zone 2. Shackley (Chapter 1) describes the regional obsidian sources.

Figure 9.10 illustrates the distribution of obsidian types in Zone 1. Due to the small samples sizes and similarities in distribution, the Early and Late Archaic samples have been merged into two single categories. On the other hand, the San Jose and large side-notched points are shown separately because of important differences in these two distributions. Nonetheless, the central Jemez Mountain sources dominate Zone 1, with mostly Cerro Toledo and Valle Grande obsidian. However, the Early Archaic and San Jose-style points are also represented by obsidian derived from the southern Bear Springs source and include a few items from the northern El Rechuelos source. On the other hand, both San Jose and the

large-notched points dominate the Valle Grande source. It may be that both point types were actually being made by the same foraging groups but for different hunting tactics. Since the Valle Grande obsidian source is restricted to the caldera, this pattern provides support for the contention that these Middle Archaic foragers were integrating these upland areas into their summer and fall seasonal rounds and thereby collecting more of this obsidian directly from the source. This presumably reflects the growing importance of pine nuts to the diet and the declining returns of hunting game in the valley. In addition, Middle Archaic sites tend to occur at higher elevations when compared with the Late Archaic (Vierra et al. 2006:186). Otherwise, the Valle Grande source contrasts with the Cerro Toledo source, which is present along the eastern periphery of the caldera and in secondary deposits along the nearby canyons and Rio Grande Valley.

Figure 9.11 illustrates the distribution of obsidian types in Zone 2. In this case, most of the points are made of the northern El Rechuelos source. However, the Early Archaic again reflects a north-south pattern, with all three central and northern obsidian sources being represented. San Jose points continue to reflect the importance of Valle Grande obsidian, but now with El Rechuelos. Last, the large side-notched and Late Archaic

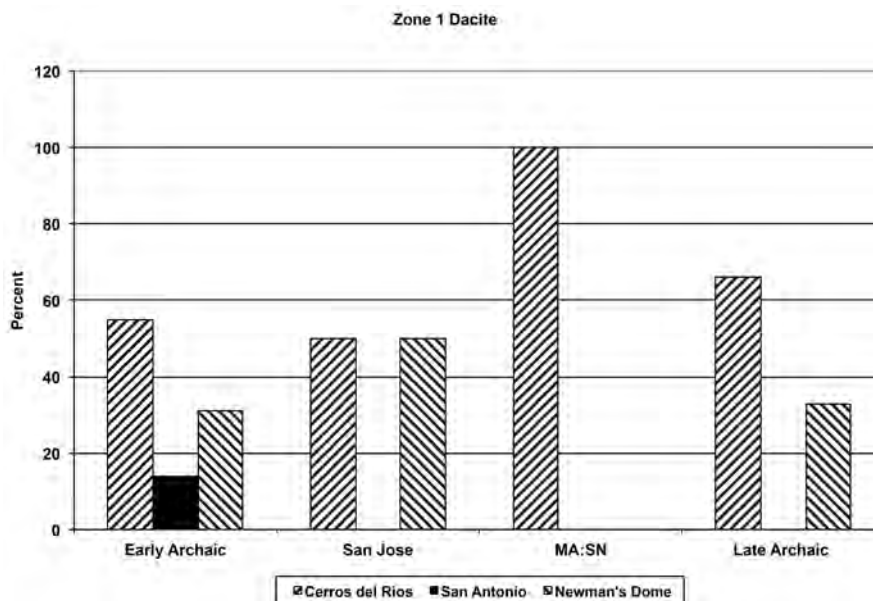


FIGURE 9.11. Distribution of obsidian types in Zone 2. MA = Middle Archaic.

points are primarily made of El Rechuelos obsidian. Together the obsidian data seem to support a north-south seasonal pattern of movement during the Early Archaic, with a more restricted north-south pattern during the Middle Archaic.

On the other hand, the large-side notched and Late Archaic points were made on flake blanks with shorter use lives. In this case, both sets of points are dominated by the most proximate obsidian source: that is, the central Jemez Mountains sources in Zone 1 and El Rechuelos in Zone 2. Yet the question is, Do these large side-notched points represent foragers moving down the Rio Grande Valley toward the Jemez Mountains and then turning north toward the San Juan Mountains? This is in contrast to the Late Archaic, which probably represents an even more restricted pattern of movement that involved mostly an east-west, lowland-upland pattern.

Figure 9.12 illustrates the distribution of dacite in Zone 1. As can be seen, the Early Archaic sample contains examples from all three dacite sources that are available in both Zone 1 and Zone 2. In contrast, the later periods are characterized by smaller samples but lack the San Antonio Mountain source, with some Newman's Dome. This also reflects a clear north-south pattern of movement between Zones 1 and 2 during the Early Archaic.

Figure 9.13 illustrates the distribution of dacite in Zone 2. Again, all three dacite sources are represented in the Early Archaic sample. In contrast, the San Jose points are represented by both local dacite sources, but the large side-notched and Late Archaic points are solely made from the local Newman's Dome source. Presumably this continues to represent a long pattern of decreasing north-south movement from Early to Middle Archaic, with a much more restricted range during the Late Archaic. We clearly need more data from the San Luis Valley (i.e., Zone 3) to fully clarify the possible relationship with the southern Rocky Mountains for these large side-notched points.

Conclusion

In conclusion, this chapter has taken a preliminary look at the possible relationships among changes in climate, resource structure, foraging strategies, and projectile point technology in the Northern Rio Grande. Changes in Early and Middle Archaic point typology and technology may be associated with the expansion of pinyon-juniper woodlands in the region and a shift from hunting large game in open settings to targeting more medium- to small-size game in wooded settings. The projectile point technology is characterized by durability, low point diversity, and low tool replacement rates. In contrast, the

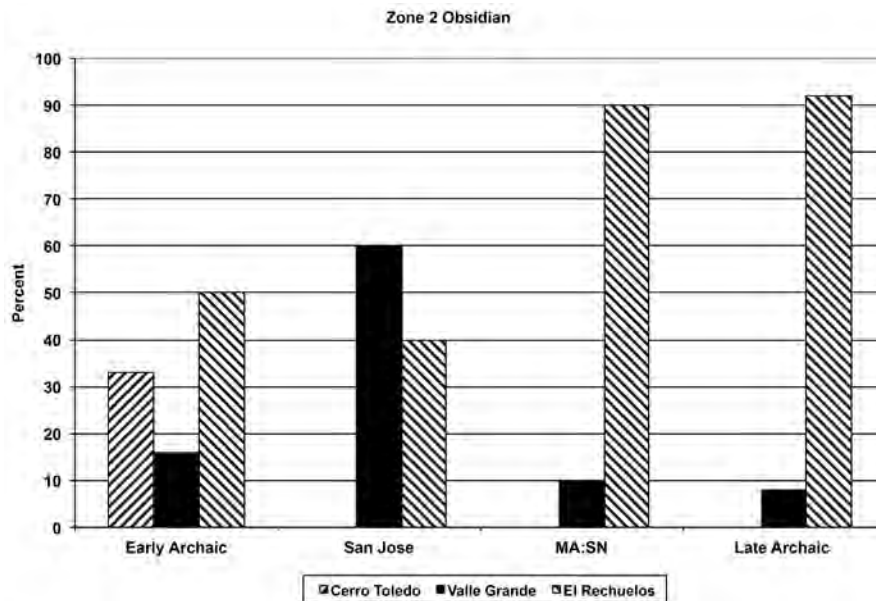


FIGURE 9.12. Distribution of dacite types in Zone 1. MA = Middle Archaic.

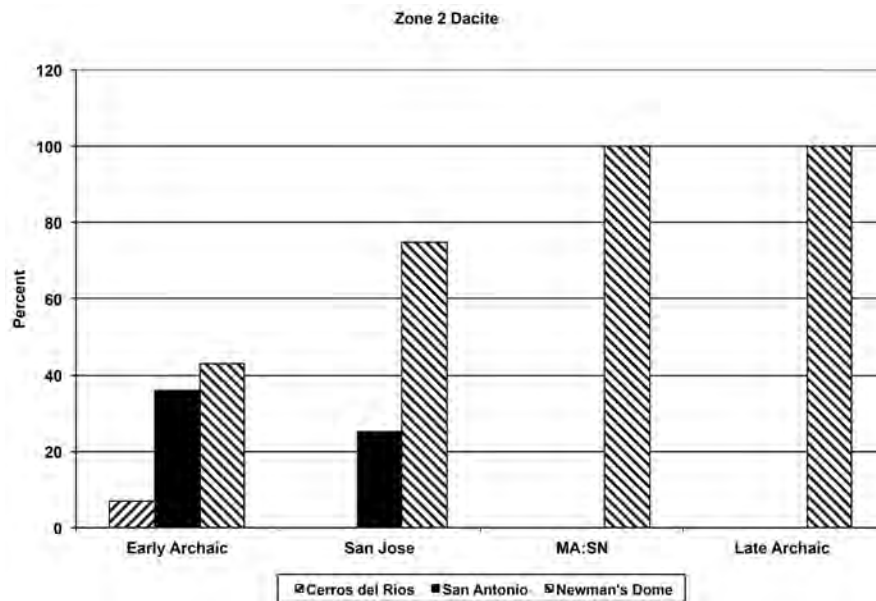


FIGURE 9.13. Distribution of dacite types in Zone 2. MA = Middle Archaic.

Late Archaic point technology is characterized by penetration efficiency, high point diversity, and high tool replacement rates. Annual movements became more restricted and oriented to a lowland–upland seasonal pattern. The long-term replacement of mostly dacite with obsidian lithic material is presumably associated with the in-

creasing use of these upland resource areas and the growing importance of point penetration efficiency. Overall, these changes in projectile point technology could reflect a *replacement when exhausted* vs. a *replacement based on a probability of failure* tactic (Kuhn 1989). That is, Early to Middle Archaic groups were more residentially

mobile, with a technology that was continuously being used. In contrast, Late Archaic groups were becoming more logistically organized while focusing on a greater variety of target species. Therefore, penetration efficiency and higher tool replacement rates could have been used as

a means of increasing tool reliability and hunting success rates (also see Vierra 1992:104). These changes in technology are presumably commensurate with increasing diet breadth (e.g., see Fitzhugh 2001:144; Vierra 2004).

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