University of Nevada, Reno

A Stone's Throw from the Source: An Examination of Fine-Grained Volcanic Toolstone Use in the Pah Rah Range, Western Nevada

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ABSTRACT

Prehistoric use of the Pah Rah Range in western Nevada has resulted in a diverse record of hunting, processing, and residential sites, many of which contain artifacts manufactured from fine-grained volcanic (FGV) toolstones. Using data from the X-ray fluorescence analysis of 303 FGV artifacts from 18 sites in the Pah Rah Range and surrounding areas, this thesis assesses whether prehistoric groups in the Pah Rah Range utilized primarily local or exotic FGV sources and how their procurement and use of FGV toolstone fits within regional models of toolstone conveyance and settlement. Results indicate that during the Middle to Late Archaic (5,000-700 cal BP) local FGV sources were overwhelmingly preferred. Compared to obsidian data from the same region, FGV toolstone reflects shorter-distance conveyance and east-west rather than north-south movement, suggesting that groups in the Pah Rah Range likely combined residential and logistical patterns of mobility with a variety of toolstone procurement strategies.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 – INTRODUCTION

In this thesis I examine FGV toolstone use in the Pah Rah Range uplands as the means for exploring patterns of mobility and settlement in the western Great Basin. Specifically, I assess (1) whether prehistoric groups utilized primarily local or exotic FGV sources; (2) if there are patterns of toolstone source use that correspond to certain tools classes; (3) whether lithic technological organization differed substantially between sites in the Pah Rah Range and those on the nearby valley floor; and (4) if Pah Rah Range sites reflect broader conveyance zones developed using data from other sites in the western Great Basin.

Technological advances in methods of sourcing archaeological materials over the past 20 years have allowed for a rapid expansion of our understanding of Great Basin toolstone distribution, and with it, an expanded ability to investigate overarching research questions regarding mobility, settlement, and technological organization. Though sourcing is now a regular facet of both academic and cultural resource management (CRM) projects, there is still much work that can be done to locate and characterize toolstone sources throughout the Great Basin. From a geologic standpoint, the western Great Basin is particularly well-suited for further obsidian and fine-grained volcanic (FGV) source provenance studies. The mountain ranges on the western edge of the Great Basin are predominantly the product of intrusive and extrusive geological processes (Fiero 1986:16), providing a rich supply of volcanic toolstone such as obsidian and basalt. Obsidian has received widespread attention in many locations, but for certain areas of the Great Basin, and for certain time periods in its history, obsidian artifacts are rare. Instead, basalt, andesite, dacite, and other FGV toolstones dominate assemblages. Such is the case in the Pah Rah Range of western Nevada (Figure 1.1).

Prehistoric use of the Pah Rah Range has resulted in a diverse record of hunting, processing, and residential sites complete with rock art, hunting blinds, rock rings, and numerous flaked and ground stone tools, many of which were manufactured from basalt and other FGV toolstones. Previous work in the Pah Rah Range has primarily been concentrated on the rock art and rock rings present in the Dry Lakes Basin area and nearby Spanish Springs Canyon (McLane 1980, 1999; Pendegraft 2007; Rusco 1969a, 1969b, 1981; Stephenson 1968), with more recent work resulting from transmission and pipeline projects (Delacorte 1997a, 1997b; Delacorte et al. 1995a, 1995b; McGuire 2002; Young and McGuire 2003). The earliest known sites in the Dry Lakes Basin area date to the Late Martis Phase of the Middle Archaic Period (5,000-1,300 cal BP) and appear to reflect systematic logistical hunting forays with a likely shift towards more residential use of the area during the Early Kings Beach Phase of the Late Archaic Period (1,300-700 cal BP) (Zeanah 2009:15).

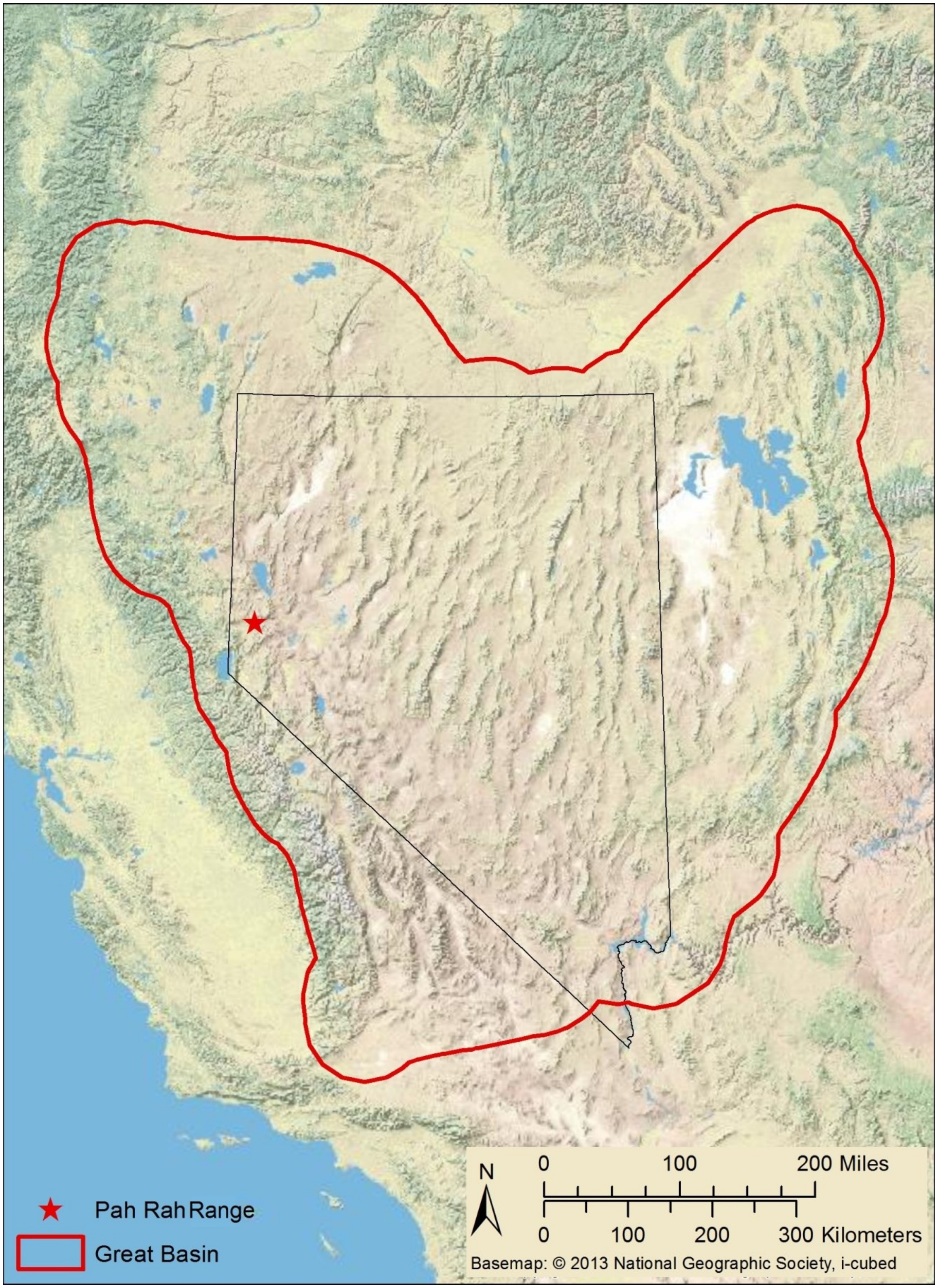

Figure 1.1. Location of the Pah Rah Range.

The underlying stratigraphy of the Pah Rah Range is almost entirely volcanic, and many artifacts from sites in the Pah Rah Range are made from basalt and other FGV toolstones, making it an excellent choice for a FGV sourcing study. This geologic potential, combined with the range of documented obsidian and FGV sources in the region, provides an opportunity to re-examine and geochemically characterize artifact assemblages at sites in and around the Pah Rah Range and refine mobility and settlement models developed by previous researchers (e.g., Delacorte 1997a, 1997b; Delacorte et al. 1995a, 1995b; McGuire 2002; Rusco 1969a, 1969b, 1981; Stephenson 1968; Young and McGuire 2003; Zeanah 2009; Zeier and Elston 1986). The Middle to Late Archaic age of many Pah Rah Range sites provides an opportunity to examine important regional shifts in mobility and technology. Sourcing studies in particular can be helpful in providing important spatial data (e.g., quarry to site distance) that may inform our understanding of how mobility changes and technological shifts (e.g., from the atlatl to bow-and-arrow) may be related, particularly as changes in raw material selection (such as that from basalt to chert) often accompany such shifts (Zeanah 2009:11-13).

Research Background

Toolstone Provenance Studies

Source provenance studies link lithic artifacts discarded at sites to the locations on the landscape from which the raw material used to make them originated. The success of lithic source provenance research is predicated on the physical and geochemical characteristics of the lithic material, an understanding of the geologic distribution of those materials, prior sourcing work conducted in the region, and the method(s) used to characterize materials (Tykot 2003:63). Lithic materials that are "desirable" as toolstone tend to be homogenous, brittle, and elastic (Whittaker 1994:12-14). It is the first of these characteristics that makes chemical sourcing efforts possible. Toolstone sources need to be relatively homogeneous with regard to the trace element composition within each source, while still having enough inter-source variability to distinguish one source from another.

Lithic materials commonly used to produce stone tools include obsidian, chert and other cryptocrystalline silicates (CCS), basalt, rhyolite, and other FGV rocks. The unique geological origins of these materials are central to the relative success of sourcing efforts for each. Igneous rocks like basalt and obsidian, produced when magma cools and solidifies, are classified based on texture and chemical composition (Andrefsky 2005:47-50). The texture of igneous rocks is controlled by the rate at which the magma cooled. Igneous rocks that cool faster tend to have a more uniform, homogenous, and fine-grained texture, with obsidian (a natural glass) at the extreme end of the spectrum. Chemically, igneous rocks are primarily composed of potassium feldspar, plagioclase feldspar, quartz, biotite, amphibole, pyroxene, and olivine. The homogenous texture and variable chemical composition of FGV toolstones make them well-suited for source provenance studies.

According to Glascock et al. (1997:19), for a chemical sourcing process to be useful, it "must be quantitative, capable of simultaneously measuring several elements, sensitive to the elements of interest, independent of sample matrix, and independent of artifact size and shape." Of the several methods capable of characterizing lithic materials (e.g., optical emission spectroscopy, atomic adsorption spectroscopy, proton-induced x-ray emission-proton-induced gamma ray emission, neutron activation analysis, x-ray fluorescence spectrometry), x-ray fluorescence spectrometry (XRF) is one of the most commonly used (Glascock et al. 1997; Shackley 1998).

X-ray fluorescence spectrometry takes advantage of fluorescence to identify the elemental chemical composition of a sample. Samples are irradiated with x-rays of a particular known wavelength, causing electrons to be ejected from the inner shells of the atoms in the sample. When an outer shell electron fills the void that has been produced, an x-ray is emitted from the atom at unique, characteristic energies which can be measured to determine the concentrations of elements within the sample. These can then be compared to known samples, allowing for the probabilistic characterization of geochemical source groups (Latham et al. 1992; Shackley 1998). X-ray fluorescence spectrometry can use either wavelength-dispersive or energy-dispersive detectors to measure the energy of photons emitted as a result of x-ray fluorescence. Provided the sample is of sufficient size, both methods can produce valid and comparable results (Shackley 1998:268). Additionally, XRF is relatively affordable, does not result in radioactive samples, and can even be performed in the field through the use of a portable handheld x-ray spectrometer (Thomsen and Schatzlein 2002).

Traditionally, XRF has been a destructive process whereby samples were often crushed to a micron-sized powder prior to analysis to reduce inconsistencies that could result from an uneven sample surface (Latham et al. 1992:83). Latham et al. (1992) were the first to show that non-destructive XRF characterization of volcanic (or igneous) rocks for the sourcing of FGV toolstone sources was possible. They proposed that by examining the relationship between heavy trace elements with similar atomic numbers with a given sample, such as Zr (Z=40) and Sr (Z=38), the errors produced by not having a smooth surface would essentially be the same for each element, and would be negated by using the ratio of the two elements (Latham et al. 1992:83). This method allows for rapid, non-destructive, and relatively inexpensive characterization of lithic materials. Building on that work, Jones et al. (1997) examined andesite and dacite cobbles and flakes from eastern Nevada to determine what the effects of surface topography and lack of homogeneity of samples might be in XRF analysis. They found that the geological sources could be adequately and effectively discriminated based on both chemical composition and x-ray spectral lines without destroying the samples (Jones et al. 1997:938).

The development of non-destructive methods of XRF spectrometry-based sourcing has resulted in a much better understanding of toolstone sources throughout the Great Basin. The majority of toolstone sourcing efforts thus far in the region have focused on obsidian (e.g., Amick 1997; Basgall 1989; Beck and Jones 1990; Harbottle 1982; Hughes 1983, 1984, 1985, 1986, 1989, 1990) and it is only within the last 20 years that XRF has been used to characterize FGV sources (e.g., Day 2002; Day et al. 1996; Jones and Beck 1999; Jones et al. 1997; Latham et al. 1992; Page 2008). As a result of such studies, the known source catalog for the Great Basin and California now contains more than 150 known obsidian and FGV chemical source groups.

Though these sourcing efforts continue to expand the range of known lithic sources in the Great Basin, sourcing FGV materials still presents challenges. Because the amount of comparative data available for an area of study factors heavily in the success of a sourcing effort (Glascock et al. 1997:19), FGV is still at a comparative disadvantage to obsidian with respect to the range of known sources. Though sourcing efforts are now a regular component of many projects, many FGV sources remain unknown. Groups of artifacts can still be shown to be chemically similar and thus likely from the same source, but without the connection to the landscape, the actual source of the toolstone is still unknown. Further, basalt flows and other FGV formations are often geographically extensive, potentially reducing researchers' ability to isolate a particular quarry location within larger formations.

Applications of Sourcing Studies

Source provenance studies alone can ultimately only indicate the straight line distance that a toolstone or artifact traveled from a quarry and the final direction that it traveled (Kelly 1992). Even these seemingly simple measures are complicated by difficulties in determining if artifacts were manufactured from toolstone collected from primary sources or secondary contexts (e.g., streambeds, alluvial fans) that could move materials many miles from the actual source, obscuring the "actual" direction and distance of travel between the source and the discard location for an artifact. Despite this, how far and in which direction toolstone traveled can provide vital information with which to reconstruct prehistoric land-use patterns (Waechter 2002:105). Researchers in the Great Basin have used source provenance studies to examine a wide range of prehistoric topics including mobility and settlement systems, trade and exchange, and occupation span (e.g., Duke and Young 2007; Eerkens et al. 2007, 2008; Hughes 1994; 2001a; Jackson and Ericson 1994; Jones et al. 2003, 2012; Kelly 2011; Smith 2010, 2011).

Mobility. Source provenance studies are vital to our ability to investigate prehistoric mobility and settlement, especially in places like the Great Basin where stratified sites are few, palimpsest surface sites are many, and direct evidence of settlement patterns such as house structures, storage features, and middens is generally lacking. Jones et al. (2003:5) describe mobility as "the manner in which humans move across the landscape in relation to properties of the environment, particularly the distribution of subsistence resources." Various schemes have been used to describe hunter-gatherer mobility, but most recent researchers focus on the concepts of residential mobility and logistical mobility (*sensu* Binford 1980). Residential mobility is focused on moving the entire band or group to resource patches, while logistical mobility involves small task-specific groups or individuals traveling back and forth from a residential camp to various resource procurement locations. These two concepts are not meant to be mutually exclusive settlement types, but are instead points along a continuum (Binford 1980). Bundled with the notion of residential vs. logistical mobility is the differential mobility of individuals and groups, allowing for discussions of gender-differentiation of labor and possible group size constraints.

Applying optimal foraging theory to mobility (primarily in an attempt to explain the mechanisms of Numic expansion), Bettinger and Baumhoff (1982) developed the idea of "travelers" and "processors." They describe a traveler strategy as one that is low cost but dependent on higher ranked resources (Bettinger and Baumhoff 1982:487). A processor strategy is one that is high cost and dependent on lower ranked resources. As the names suggest, the main cost of each strategy is either in traveling to a resource or in processing the resource. The authors predict that in competitive situations, such as during an ethnic spread, the processor strategy will be more likely to prevail. They reason that in situations of higher population density, travel and search times increase, placing greater stress on groups employing a traveler strategy. Because processors utilize the same resources as travelers, but only face competition from travelers for a portion of these resources, travelers are at a competitive disadvantage (Bettinger and Baumhoff 1982:488; but see Grayson 2011:325-326).

Kelly (2007:120) points out that such schemes are not concerned so much with the movement through the landscape as with “the organization of camp movement to food-getting activities.” To better describe mobility, Kelly (2007:120-121) delineates five variables to measure dimensions of mobility and better describe the various ways in which people move across the landscape. These variables include the number of residential moves per year, the average distance traversed during each move, the total distance moved each year, the total area a group uses over the course of a year, and the average length of a logistical foray. Not all variables are visible in the archaeological record and source provenance studies alone cannot adequately address each one.

Jones et al. (2003:5) suggest that sourcing efforts may be able to address the range of territory through which a group might have moved; however, Kelly (1992:55) argues that this is only a rough indication. Source provenance studies alone cannot determine whether toolstone moved as a result of residential or logistical mobility or whether the material was obtained through trade or direct procurement (see Hughes 2011a for a recent compilation of studies addressing this problem).

Instead, source provenance studies should be combined with other methods of archaeological inquiry. Numerous researchers (e.g., Beck et al. 2002; Bright et al. 2002; Jones et al. 2003; Kuhn 1994; Parry and Kelly 1987; Shott 1986) have suggested that patterns and shifts in mobility may be evident in lithic assemblages; however, Andrefsky (1994a) challenges the idea that there is a predictable link between mobility and tool technology unless raw material availability (both abundance and quality) is also taken into account. To this end, Smith and Kielhofer (2011:3568) suggest that technological data and multi-site comparisons, when combined with source provenance data, may provide a productive route to understanding prehistoric mobility.

Jones et al. (2003) used source provenance studies for both obsidian and FGV toolstone and lithic technological analyses to reconstruct the scale of terminal Pleistocene-early Holocene mobility in the Great Basin. They noted that prior studies of human adaptation during that period centered on information derived from climatic and environmental studies, with settlement patterns described in terms of differential use of landforms through time and how those landforms controlled the distribution of food resources (Jones et al. 2003:6-7). By examining patterns of distance and direction between sources and artifact assemblages, Jones et al. (2003:31) delineated five distinct lithic “conveyance zones” within the Great Basin, interpreted to be coterminous with terminal Pleistocene-early Holocene hunter-gatherer foraging territories (Jones et al. 2003:32). They also noted that toolstone moved generally north-south within each zone and only rarely east-west between zones. The authors inferred that the limited amounts of toolstone moving between conveyance zones may have been indicative of similarly limited communication between groups in each of these foraging territories (Jones et al. 2003:32).

Smith (2010) tested the conveyance zone model developed by Jones et al. (2003) with a sourcing study of Paleoindian and Archaic projectile points in northwest Nevada. Smith (2010:867) set out to answer whether Paleoindian mobility patterns were as extensive as Jones et al.'s (2013) model suggested. An extensive XRF sourcing effort of obsidian and FGV artifacts did not support the presence of a single Paleoindian foraging territory in the western Great Basin. Instead, sourcing data indicated that during the terminal Pleistocene-early Holocene, there may have been a northern territory that encompassed portions of northwest Nevada, northeast California, and southeast Oregon, and a southern territory that covered central-eastern California and a portion of western Nevada, with a boundary somewhere in the vicinity of the Carson Desert (Smith 2010:879). Smith's sourcing study indicates that while Paleoindian foraging territories were larger than those for later groups, they were probably not as large as the conveyance zones originally modeled by Jones et al. (2003). Further, in comparing early- middle- and late-period projectile point samples, Smith (2010) determined that the smaller, northern foraging territory contracted during the transition from Paleoindian to Archaic periods, and was the most expansive earlier in time.

In light of such analyses, Jones et al. (2012) reexamined their eastern conveyance zone with particular focus on its southern end. They hypothesized that if the eastern conveyance zone represented a single foraging territory, then artifacts from northern and southern sources should be found throughout the zone. This proved not to be the case, prompting Jones et al. (2012) to revise the eastern conveyance zone into two smaller zones overlapping near the Sunshine Locality (Beck and Jones 2009).

Based on the basalt XRF sourcing study completed for the Alturas Intertie Electric Transmission Line Project, Waechter (2002) re-evaluated a model of Middle Archaic mobility for the western edge of the Great Basin. This model posited that the distribution of basalt artifacts in the Tahoe region reflected at least two procurement patterns suggesting distinct interaction spheres (Waechter 2002:110). This model also delineated an east-west pattern of movement west of the Tahoe Basin and north-south movement along the eastern Sierra Front. The results of Waechter's (2002) sourcing effort indicate that for some Tahoe Basin sources, there was much more movement north and south than had been previously predicted. For the Steamboat and Lagomarsino sources, there was less movement north-south; instead, these sources had a strong east-west trend that matched ethnographic Washoe patterns (Waechter 2002:112). The movements of North Dry Valley and Siegfried Canyon Ridge basalt sources seemed to match the north-south pattern predicted for the eastern flanks of the Sierras. Though Waechter (2002) focused more on the overall distribution of basalt in the region and only touched tangentially on mobility, her study provides a good example of how a better understanding of the overall lithic landscape allows researchers to refine existing mobility and settlement models.

Eerkens et al. (2007) explored the importance of including multiple artifact types (e.g., both formal tools and debitage) in sourcing studies to best model mobility. Based on a model for small, residentially mobile populations, they predicted that formal tools and small flakes should have the greatest source diversity and that these sources would be overall more distant from the sites. Conversely, local sources should be represented in all stages of artifact manufacture (Eerkens et al. 2007:586). Results from three sites on the western margin of the Great Basin support their prediction, which has implications for mobility studies. In particular, the similarity in diversity and average source-to-site distance between formal tools and late stage debitage may provide a means for gaining insight into original source diversity for sites where formal tools have been removed through curation or looting (Eerkens et al. 2007:593). This is not always the case, as further work in Owens Valley has suggested that different artifact classes might reflect procurement and mobility patterns in different ways (Eerkens et al. 2008:674).

Eerkens et al. (2008) further confirm the importance of including different sizes of debitage in sourcing studies with an examination of Newberry and Marana occupations at CA-INY-30 in Owens Valley, California. Previous models of mobility for the region show a transition from high residential mobility during the Late Newberry Period (ca. 2,000-1,500 cal BP) to semi-sedentary settlement during the Marana Period (600 cal BP to present) (Eerkens et al. 2008:671). Based on a simplified model of settlement patterns and toolstone acquisition, they predicted that assemblages resulting from more mobile Newberry occupations should show greater distance to source for flakes, that flakes from more distant sources would be larger and more diverse within mobile contexts and smaller within residential contexts, and that Newberry assemblages would have a higher diversity of sources. Obsidian flakes at CA-INY-30 supported their first two predictions but surprisingly, the Marana Period assemblages were just as diverse as those from the Newberry Period. They suggest that the Newberry assemblages reflect a residentially mobile society that traveled with specific locations and resources in mind, rather than stopping to exploit resources as they were encountered. Eerkens et al. (2008) point out that these patterns could also reflect a system in which portions of the group were residentially stable, with smaller sub-groups traveling more. In contrast, Marana assemblages indicated overall reduced residential mobility, with the higher than expected diversity of sources possibly reflecting trade or exchange (Eerkens et al. 2008:677).

Occupation Span. An aspect of mobility that is less obvious in archaeological assemblages is occupation span. Drawing from technological organization and toolstone sourcing, Duke and Young (2007) examined the duration of occupation of mobile Paleoindian groups in the Wild Island Dune Field in the Bonneville Basin. They noted that obsidian artifacts were made on materials from sources 85-500 km away, with some expedient points made from small blanks of Topaz Mountain obsidian. These artifacts were often reworked and resharpened. Basalt artifacts reflected less raw material conservation, with limited flaking and differential reduction strategies. Thinness grading, in which flake blanks were chosen for their initial thickness, allows for faster reduction to a bifacial tool, but results in bifaces that appear more “crude” (Duke and Young 2007:133). They concluded that basalt and obsidian played very different roles within the artifact assemblage at Wild Island, with obsidian reflecting a more residentially mobile aspect of the settlement strategy and basalt reflecting logistical mobility during basin occupations (Duke and Young 2007:132-133). Duke and Young concluded that while Paleoindians ranged farther than later groups, the amount of time spent in individual basins could be considerable.

Occupation span was also the focus of a study conducted in the northwestern Great Basin (Smith 2011). The crux of this study is the notion that short-term occupations should be reflected in assemblages with more non-local than local toolstone

(Smith 2011:463). As occupation spans increased, local toolstone in an assemblage should also increase as tools from more distant sources acquired prior to arrival at the site were discarded and replaced. Smith examined projectile points from early-period (pre 7,500 ^{14}C BP), middle-period (7,000-1,300 ^{14}C BP), and late-period (post 1,300 ^{14}C BP) occupations to determine whether this approach could be used to determine if relative occupation spans changed through time. Smith found that early-period sites had a higher proportion of non-local toolstone, middle-period sites showed more local toolstone, and late-period sites evidenced increased non-local toolstone. When taken with the supposition linking toolstone ratios with mobility and occupation span, Smith (2011:466-467) concluded that early-period sites reflect high residential mobility and short occupations that shifted to longer occupations in the middle-period. The increased sedentism during the middle period corresponds to sites from other locations in the region that evidence greater sedentism during this period (e.g., O'Connell 1975). The increase in non-local toolstone during the late period could either reflect a return to higher degrees of residential mobility or an overall change in toolstone procurement strategies that could mimic a pattern of higher residential mobility. Overall, Smith (2011) showed that changes in toolstone source use could be used to infer relative occupation span and examine how Paleoindian and Archaic mobility patterns in the western Great Basin shifted through time.

Complications of Trade and Exchange. Eerkens et al.'s (2008:677) supposition that the diversity of obsidian sources used during the Marana period at CA-INY-30 may reflect wide-ranging trade networks raises an important issue in source provenance studies. Such studies can only indicate overland distance and straight line direction between a site and source. This relationship obscures the actual path that raw materials may have been transported between source and final point of discard, and essentially cannot address means of transport at all. Furthermore, sourcing data present researchers with an issue of equifinality in which different interpretations of the same data set are equally plausible or equally supported by that data set. This is the case for comparisons of trade and direct procurement to describe the presence of exotic toolstone sources in an assemblage. Researchers often choose one or the other interpretation without empirical evidence to support their position, or default to the idea that long distances are automatically indicative of trade (Hughes 2011b:xvii; Meltzer 1989:37).

Researchers who focus on Paleoindian sites often fall back on the idea that Paleoindians were highly mobile and see exotic toolstone as reflecting that mobility (*sensu* Jackson and Ericson 1994). Jones et al. (2003:9) note that coordinating trade or exchange during times of lower population in the Great Basin would have been too risky for such procurement strategies to have been used to obtain a critical resource like toolstone. Though they do not completely discount the role that trade played in conveyance of non-local toolstone, Jones et al. (2003) argue that direct acquisition can be assumed for most of their assemblages. This position has been echoed by other researchers (e.g., Eerkens et al. 2007; Smith 2010).

Disentangling the respective archaeological signatures of indirect and direct procurement in source provenance studies and the subsequent implications for research into patterns of prehistoric trade and mobility is not straightforward. Using examples from central-eastern California, Basgall (1989:124) argues that "exchange-related acquisition will be marked by the regularized occurrence of source types, and by their equitable representation in both tool and waste classes." However, Kelly (2011) points to the use of obsidian in the Carson Desert and suggests that assemblages in which a particular toolstone type is limited to certain artifact classes (e.g., complete bifaces) with little accompanying debitage are more reflective of trade than direct procurement. To complicate matters further, both researchers may be correct. The sites on which Basgall (1989) based his conclusions occur within a rich lithic landscape, with both immediate and more distant toolstone sources available within what may be considered reasonable lifetime foraging territories. This is not the case for the Carson Desert, where there are no known obsidian sources within either ethnographic or presumed prehistoric lifetime ranges (Kelly 2011).

Kelly (2011) and others have depended on ethnographic analogy to predict which cases may reflect trade and which may reflect direct procurement, but this too is problematic. Just because ethnographic research (e.g., Steward 1938) indicates that trade relations existed in the Great Basin, it does not automatically follow that such relationships existed in the same configuration or to the same extent prior to contact. Kelly (2007:Table 4-1) has noted that there is considerable variation in measurements of the different aspects of mobility among hunter-gatherer populations. Taking such variability into account, it is problematic to resort to ethnographic analogy to describe Paleoindian or later hunter-gatherer populations; we simply do not know how much more or less mobile such populations were.

Most researchers currently focused on the trade vs. direct procurement issue indicate that ultimately, arguments for how non-local lithic materials were obtained are best made in conjunction with other lines of evidence. Waechter (2002:116) suggests that certain combinations of obsidian and basalt might move together as "packages" and their presence together at sites within the same region could be indicative of trade. Hughes (1994:371) notes that patterns of raw material use in an assemblage could indicate not only trade, but also some level of socio-ceremonial connection. He points to the Gunther Island site in northwestern California and the Gold Hill site in southwestern Oregon. At both sites, large ceremonial bifaces were manufactured on distant obsidian types while utilitarian tools were made almost exclusively from local obsidian, which he suggests supports the idea that the sites were part of the same socio-ceremonial system connecting southwestern Oregon and northwestern California. Groups at both sites depended on direct and indirect procurement of obsidian, with toolstone use decisions tied to the cultural importance of the tools to be manufactured.

Toolstone Sourcing Studies in the Western Great Basin

Much source provenance work in the Great Basin has focused on the northern, eastern, and western parts of the region (e.g., Day 2002; Delacorte 1997a, 1997b; Jones and Beck 1999; Jones et al. 2003; Latham et al. 1992; Page 2008). Obsidian sources within the Great Basin are relatively well-described, but FGV sourcing studies are still in their infancy. Recent work in the western Great Basin, and the interface between the Great Basin and California in particular, has further illuminated the range of lithic sources available and utilized, but sourcing efforts often return unknowns (e.g., Neidig and Clay 2009; Waechter 2002). Much of the work in the region has been in the form of linear CRM surveys for roads, pipelines, and powerlines (e.g., Delacorte 1997a, 1997b;

Delacorte et al. 1995a, 1995b; Matranga and DeBunch 1968; Miller and Elston 1979; Neidig and Clay 2009; Stoner et al. 2006; Zeier and Elston 1986), which have provided valuable insights into regional prehistory, but have been limited in areal scope and have not always included comprehensive sourcing efforts.

From a geologic standpoint, this portion of the Great Basin is well-suited for further source provenance studies, particularly with respect to possible FGV sources. The intrusive and extrusive geological processes that helped form the mountain ranges at the western edge of the Great Basin, including the Sierra Nevada and Pah Rah ranges, are the same processes that produced basalt, andesite, rhyolite, and other FGV rocks used as prehistoric toolstone. Many of the best-documented FGV sources in the western Great Basin are in and around the Tahoe Basin. As a result of focused work in the last two decades by archaeologists from the Tahoe and Eldorado National Forests and Northwest Research Obsidian Studies Laboratory, nearly 20 geochemical groups have been identified within the Tahoe Basin and surrounding areas (Day 2002; Day et al. 1996). Of these, Steamboat Hills/Lagomarsino is closest to the Pah Rah Range. This chemical group includes Steamboat Hills and Lagomarsino; two chemically similar basalt source localities south and southeast of Reno (Waechter 2002:107). Elston et al. (1994:74) speculated that these quarries were of paramount importance to people in the Steamboat and Huffaker localities.

As part of the Alturas Intertie Electric Transmission Line Project between Reno, Nevada and Alturas, California, 181 basalt artifacts and two stream cobbles were submitted to Northwest Research Obsidian Studies Laboratory for XRF analysis (Waechter 2002). Though nearly half of the samples could not be assigned to a known source at that time, artifacts manufactured from known sources were split between Siegfried Canyon Ridge, Gold Lake, and North Dry Valley. The Steamboat Hills and Alder Hill source groups were also represented but in much smaller quantities (Waechter 2002:111). The unknown samples represented 49 potentially distinct basalt sources, three of which could possibly be major or local sources.

Potential Research Issues in the Pah Rah Range

The geologic and cultural history of the Pah Rah Range, combined with the range of known toolstone sources, provide a significant opportunity to re-examine previously described sites and assemblages with a focus towards completing XRF sourcing for artifacts from those sites. In this thesis, I provide a detailed description of FGV toolstone sources utilized in the area. A primary focus on the Middle to Late Archaic periods is particularly productive, as this time span covers the technological shift from the atlatl (as represented by Elko and Martis projectile points) to the bow-and-arrow (as represented by Rosegate projectile points), as well as changes in raw material preferences from basalt to chert (Zeanah 2009:11-13).

The source provenance study reported here also helps refine current models of toolstone conveyance in this portion of the Great Basin. This part of Nevada lies within Jones et al.'s (2003) western conveyance zone. Smith's (2010) work in northwestern Nevada has indicated that the western conveyance zone may actually be two zones, with the boundary near the Carson Desert. The Pah Rah Range is situated near the convergence of Smith's (2010) proposed northern and southern conveyance zones, allowing for the possibility that groups utilizing this area may have foraged within either of these territories, or both, at different times (McGuire 2002:102). Previously sourced artifacts from the Pah Rah Range and along the Truckee River indicate that obsidian was obtained from sources up to 200 km to the north and south (Delacorte 1997a, 1997b; McGuire 2002; Sibley 2013; Stoner et al. 2006), suggesting that "both" is a distinct likelihood, as is the possibility of trade and exchange. With an expanded examination of toolstone use in this region, it is also possible to further test Delacorte's (1997b) and Smith's (2010) models and see how interactions between California and the western Great Basin may have influenced these toolstone conveyance zones.

Source provenance studies in the region may also shed light on cultural interactions in the area. The Pah Rah Range is along the boundary between three historically identified ethnic groups: the *Tasiget Tuviwarai* and *Kuyuidokado* Northern Paiute bands and the *Wel mel ti* Washoe. As such, interpretations of sites in the area may be complicated by the need to distinguish technological/settlement shifts from ethnic shifts. Recognizing patterns in toolstone use that could reflect differential access to toolstone sources in the immediate region and beyond may allow for research into whether ethnicity can be identified in lithic assemblages. If this is the case, then it may also be possible to discern culturally determined differences in toolstone source use between assemblages along the eastern Sierran Front as compared to the Pah Rah Range and farther east into the Great Basin.

Research Goals

The primary goal of this research is to determine the FGV sources present at archaeological sites within the Pah Rah Range as a means for examining prehistoric land use and lithic technological organization in the western Great Basin. Through XRF sourcing of FGV artifacts, I will be able to determine the geochemical source groups that were utilized at sites in the Pah Rah Range, and the straight-line distances between the sources and sites. By combining this sourcing data with simple lithic analysis, I expect to be able to determine whether there are correlations between different geochemical sources and certain artifact types. Finally, by comparing these data to that from other sites in the region, I will be able to determine how the Pah Rah Range fits into regional patterns of FGV toolstone use. To this end, I consider the following research questions and testable hypotheses:

1. What is the range of FGV sources used by prehistoric peoples within the Pah Rah Range?
    a. Hypothesis: Groups in the Pah Rah Range primarily utilized local FGV toolstone.

2. Are there identifiable and significant patterns of source use that are unique to sites within the Pah Rah Range?
    a. Hypothesis: Certain FGV sources were preferred for certain tools, whether due to toolstone quality or proximity to source; and

b. Hypothesis: Lithic technological organization differed substantially between sites in the Pah Rah Range and those on the nearby valley floor.

3. Based on this source information, how does FGV use in the Pah Rah Range fit with current models of toolstone conveyance in the western Great Basin?

    a. Hypothesis: Pah Rah Range sites reflect similar conveyance zones developed using data from other sites in the western Great Basin.

CHAPTER 2 – ENVIRONMENTAL AND CULTURAL OVERVIEW

The Great Basin is an environment of extremes. The topographic relief of the region cartwheels between high mountain ranges and wide valley basins, with shifting ecological boundaries controlled by a complex interaction of climate, elevation, and latitude. The Great Basin encompasses approximately 200,000 sq mi of the western United States, stretching across nearly all of Nevada and portions of California, Utah, Idaho, and Oregon (Grayson 2011:11). The Pah Rah Range lies at the western edge of the Great Basin, east of the Sierra Nevada Range and immediately northeast of Reno and Sparks, Nevada. The range is roughly crescent-shaped, opening to Spanish Springs Valley and Warm Springs Valley to the west and overlooking the Truckee River floodplain and Pyramid Lake to the east and northeast, respectively (Figure 2.1). At its southern end, the Pah Rah Range is separated from the Virginia Range by the Truckee River, while Mullen Pass separates the Pah Rahs from the Virginia Mountains to the north. The highest point within the Pah Rah Range is Virginia Peak at 8,367 ft above sea level (ASL). Other peaks include Spanish Springs Peak (7,404 ft ASL), Pond Peak (8,035 ft ASL) and Pah Rah Peak (8,249 ft ASL). The eastern front of the range is relatively steep with short canyons that drain into the Truckee River and Pyramid Lake. By contrast, the western slopes are relatively gentle, with numerous hills, canyons, and drainages resulting in a more complex topography.

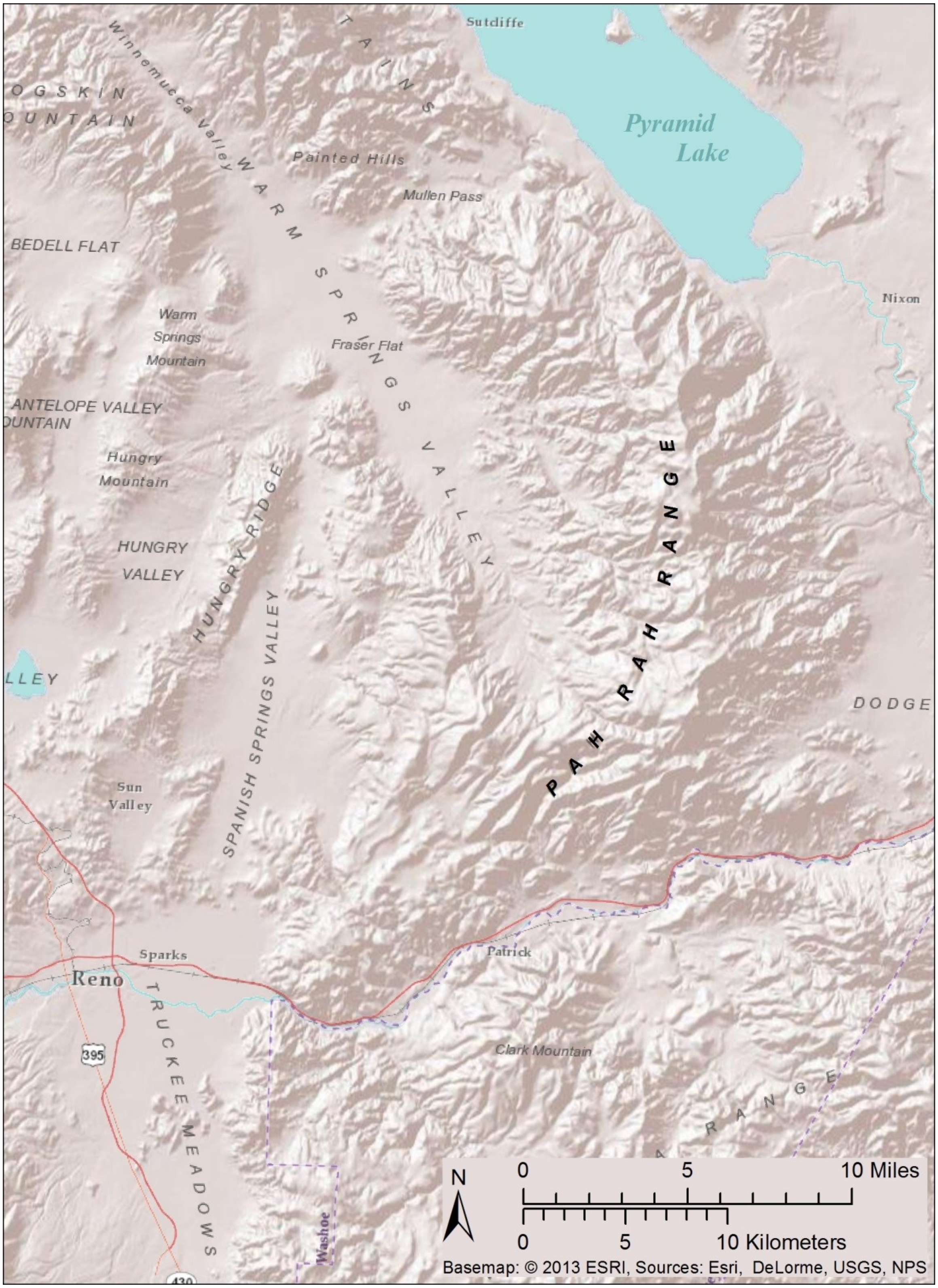

Figure 2.1. Overview of the Pah Rah Range.

This thesis focuses primarily on the Dry Lakes area in the southwestern Pah Rah Range. This series of upland basins is located just northeast of Spanish Springs Canyon and is situated between parallel, northeast trending ridges. The basins form a horseshoe shape with two remnant lakebeds (from which the area gets its name) within the eastern arm. The upper lakebed is 5,110 ft ASL. The second lakebed, at 5,040 ft ASL, is southwest of the first and a narrow pass separates the two. The Pah Rah Range and surrounding environment is arid, with most moisture falling during the winter. During the last 50 years, this area has averaged less than 20.32 cm (8 in) of precipitation per year, with most months averaging well below an inch (WRCC 2012). Though these lakebeds are not fed by permanent water sources and regional precipitation is limited, during wet years they are still capable of holding shallow, ephemeral lakes that support limited fauna, such as fairy shrimp (Pendegraft 2007:44).

Geologic Setting

The underlying stratigraphy of the Pah Rah Range is comprised primarily of Tertiary volcanic and sedimentary rocks with an aggregate thickness of over 12,000 ft (Bonham 1969:51) (Figure 2.2). The southern half of the range is dominated by Pliocene basalt and basaltic andesite and pyroxene andesite flows overlying and interfingered with fluviatile and lacustrine sedimentary rocks of the upper portion of the Pliocene Coal

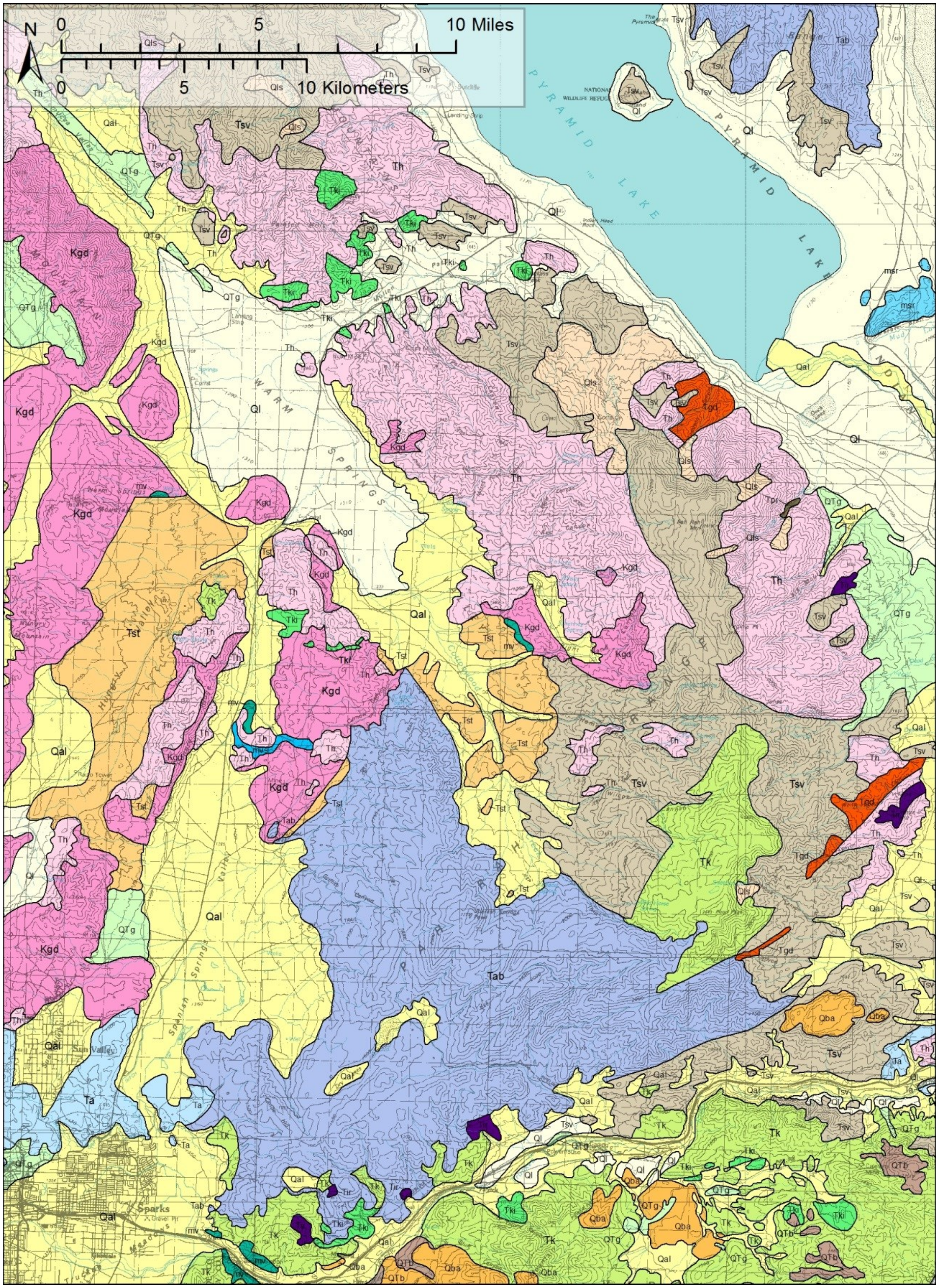

Figure 2.2. Geologic map of the Pah Rah Range and surrounding region (after Bonham 1969).

Valley Formation (Bonham 1969:Plate 1). These basalts are mostly medium to dark gray, weathering to dark gray brown and brownish black (Bonham 1969:39). Many contain small (<1 mm) olivine and plagioclase phenocrysts, with textures ranging from intergranular to trachytic. The southern end of the Pah Rah Range also contains exposures of Mio-Pliocene Kate Peak Formation and Pliocene rhyolite (Bonham 1969:Plate 1). The Kate Peak Formation is a thick sequence of andesite to rhyolite flows and flow breccias, with dacite flows most common (Bonham 1969:33). The Kate Peak Formation is also present in the central portion of the Pah Rah Range.

The geology of the northern half of the Pah Rah Range is more varied. It is dominated by Hartford Hill Rhyolite and the Pyramid Sequence, both of which are Miocene in age (Bonham 1969:Plate 1). Hartford Hill Rhyolite is predominantly composed of ash-flow tuffs, while the Pyramid Sequence is composed of basalt, andesite, and dacite flows with breccias, mudflow breccias, agglomerates, tuffs, and associated intrusives (Bonham 1969:Plate 1). Smaller areas of Mesozoic metavolcanic and metasedimentary rocks and intrusive Mesozoic granitic rocks are also present. These Mesozoic basement rocks are exposed at elevations roughly 4,000 ft lower than Mesozoic basement elevations in the ranges to the west, indicating that the Pah Rah block is overall structurally depressed with respect to the Sierra Nevada (Bonham 1969:51).

The Pah Rah Range is at the southeastern end of the Pyramid Lake domain of the Walker Lane; a transitional zone between the Cascade-Sierra Mountains and the Basin and Range physiographic provinces (Bonham 1969:43; Stewart 1988). The Walker Lane is a zone of predominantly Cenozoic-age right-lateral strike-slip faulting that separates the Sierra Nevada from the extensive normal faulting that has produced the basin-range topography that characterizes much of the Great Basin (Bonham 1969:43; Stewart 1988). Stretching approximately 700 km from northeastern California to southwestern Nevada and east-central California, the Walker Lane is tectonically significant, as it accommodates the portion of right lateral motion between the Pacific and North American tectonic plates that is not taken up by the San Andreas fault systems (Delwiche 2007:1). The northern portion of the Walker Lane has been deformed by multiple northwest-striking right-lateral faults, north- to north-northeast-striking normal faults, east-northeast-striking left-lateral faults, east-striking normal faults, and belts of east-trending folds and reverse faults, resulting in a diverse topography that is in contrast to the more regular, linear mountain ranges that typify the rest of the Great Basin (Delwiche 2007:10). The Pyramid Lake domain, which is dominated by northwest-striking right-lateral faults, falls within this northern portion.

The Pah Rah Range is a complexly faulted, northwest-trending block that "occupies a left-step between the Pyramid Lake fault to the east and the Warm Springs Valley fault to the west" (Delwiche 2007:47). Southwest-tilted strata along the western flank and northeast-dipping strata along the eastern flank indicate that the interior of the Pah Rah Range forms a broad, discontinuous west-to-northwest-trending anticline (Delwiche 2007:47, 66). These structural characteristics, combined with the underlying stratigraphy, have resulted in a varied landscape of broad upland valleys and plains, major and minor drainages, steep ridges, and gentle hills.

The geologic history of the Pah Rah Range follows that of much of the western Great Basin, in which mountain building has been the result of repeated intrusive and extrusive volcanic events interspersed with periods of complex tectonic activity. As such, the mountain ranges along the western periphery of the Great Basin are composed primarily of granite, diorite, basalt, rhyolite, and other volcanic rocks. Though igneous rocks are also present throughout much of the Great Basin, the ranges in the central portion and at the eastern edge are predominantly composed of uplifted sedimentary sequences of limestone, sandstone, and other marine sediments (Fiero 1986:18; NBMG 1999). These contrasting geologic histories also strongly influence the presence and availability of various lithic raw materials, which has been acknowledged by many researchers (e.g., Andrefsky 1994a, 1994b; Bamforth 1986; Gould 1980; O'Connell 1977) as a key factor influencing lithic technological organization.

Recognizing the influence that these differing geologic frameworks can have on long-term raw material procurement patterns and archaeological assemblages, Thomas (2012:256-258) examined projectile points from 151 sites within the Great Basin with respect to raw material type. By plotting the percentage of obsidian utilized at each site with variations in shading to depict the percent utilization, Thomas illustrates that assemblages at the edges of the Great Basin are dominated by obsidian while assemblages in the central portion of the Great Basin are nearly devoid of obsidian. In describing this pattern, Thomas (2012:258) uses the terms "Obsidian Rim" and "Chert Core." The Pah Rah Range falls within the western edge of the "Obsidian Rim"; however, this portion of the Great Basin is not as dominated by obsidian use as regions immediately to the north (i.e., northwest Nevada, northeast California, and southeast Oregon) or south (i.e., southeastern California) (McGuire 2002).

The geologic history of the Pah Rah Range likely influenced prehistoric raw material utilization. Obsidian can be produced within most volcanic environments, but toolstone quality obsidian is relatively rare (Shackley 2005:10-15). Obsidian forms when high temperature (ca. 1,000°C) rhyolitic or silicic liquids (or lava) rapidly cool. As Shackley (2005:14) points out, many volcanic glass-forming liquids are rich in water or volatiles that result in the formation of pumice, tuff, and other non-toolstone quality glasses. Because obsidian hydrates, obsidian formed during older (generally >10 mya) volcanic events may no longer be suitable for tool production. Within the Pah Rah Range, much of the volcanism is Pliocene to Miocene in age (ca. 2.6 to 23.0 mya) and dominated by ash flow tuffs and basalt, andesite, rhyolite, and dacite flows. As such, though obsidian occurs close to the Pah Rah Range (e.g., the C.B. Concrete, Patrick, and Sutro sources), it is not nearly as available as elsewhere in the Great Basin.

Lithic Terrane of Pah Rah Range Sites

Elston (1990:155, 165-174; 1992) uses the concept of lithic terranes to describe the occurrence, abundance, distribution, and quality of lithic raw materials. Borrowing from the geologic definition of a terrane as "the area or surface over which a particular rock or group of rocks is prevalent" or "an area or region considered in relation to its fitness or suitability for some specific purpose" (AGI 1976:429), a lithic terrane encompasses the absolute availability of lithic raw material within a particular landscape. Elston notes that lithic terranes can vary in quality depending on geology and physiography, as well as the scale of the region examined with respect to the site. In particular, he explains that the lithic terrane of a site close to a single high quality lithic source may be thought of as rich with respect to a daily foraging radius, but poor with respect to larger logistical radii.

The lithic terrane for archaeological sites in the Pah Rah Range varies by scale in a similar manner. For the purposes of this research, the lithic terrane for the Pah Rah Range is examined at three scales: local, extra-local, and regional. Additionally, only toolstone sources that can be geochemically characterized are examined in any detail. Though several cryptocrystalline sources are known throughout the Great Basin (e.g., Tosawihi chert, Steamboat Sinter), it is still not possible to definitively identify them in archaeological contexts beyond the source locations. The local scale includes all available known sources <15 km from the Pah Rah Range (Figure 2.3). This distance is at the far end of what is generally considered to be a single-day's round-trip journey, or a daily foraging radius (Kelly 2007:133). The extra-local scale includes all sources within 100 km of the Pah Rah Range (Figure 2.4). The regional scale includes sources >100 km away and encompasses sources that may be within lifetime ranges for a particular group or that could be accessed through exchange (Figure 2.5). Jones et al. (2003:32) noted that toolstone within the Great Basin tended to move more generally north-south, and only rarely extensively east-west. As such, the lithic terrane described here does not extend as far east-west as it does north-south. A summary of the known source lithic terrane for the Pah Rah Range is presented in Table 2.1.

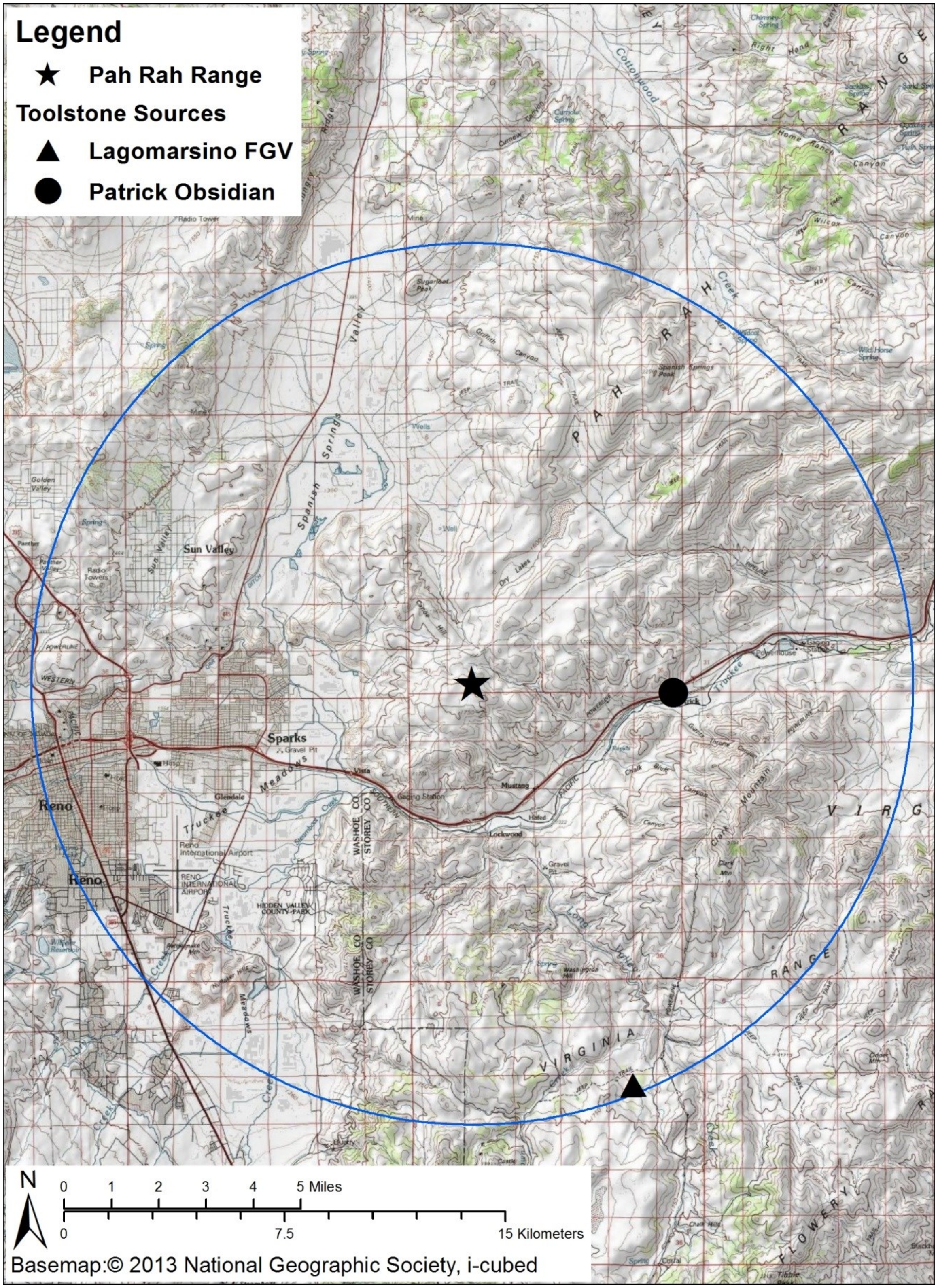

Figure 2.3. Local (<15 km) lithic terrane for the Pah Rah Range.

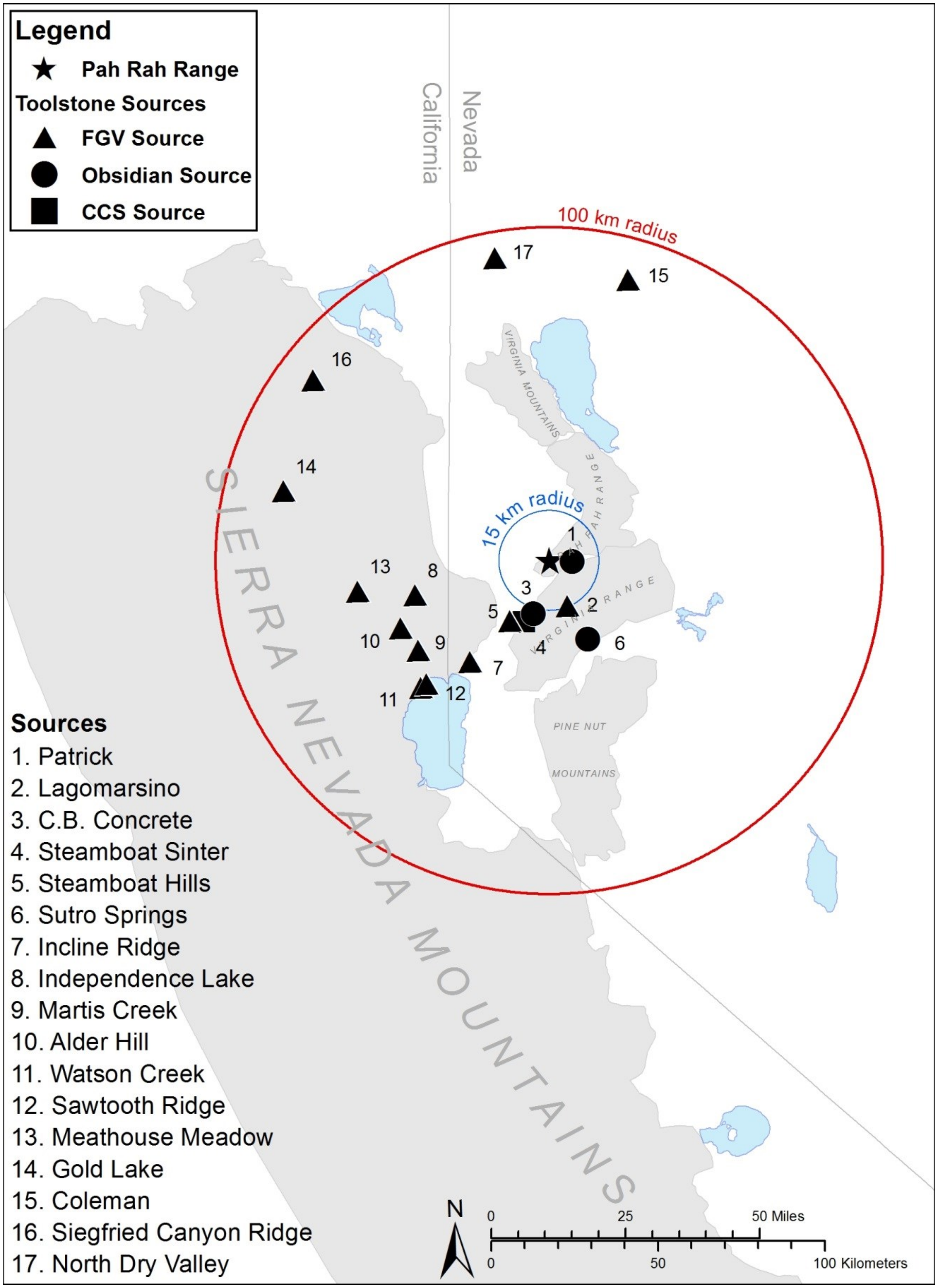

Figure 2.4. Extra-Local (<100 km) lithic terrane for the Pah Rah Range.

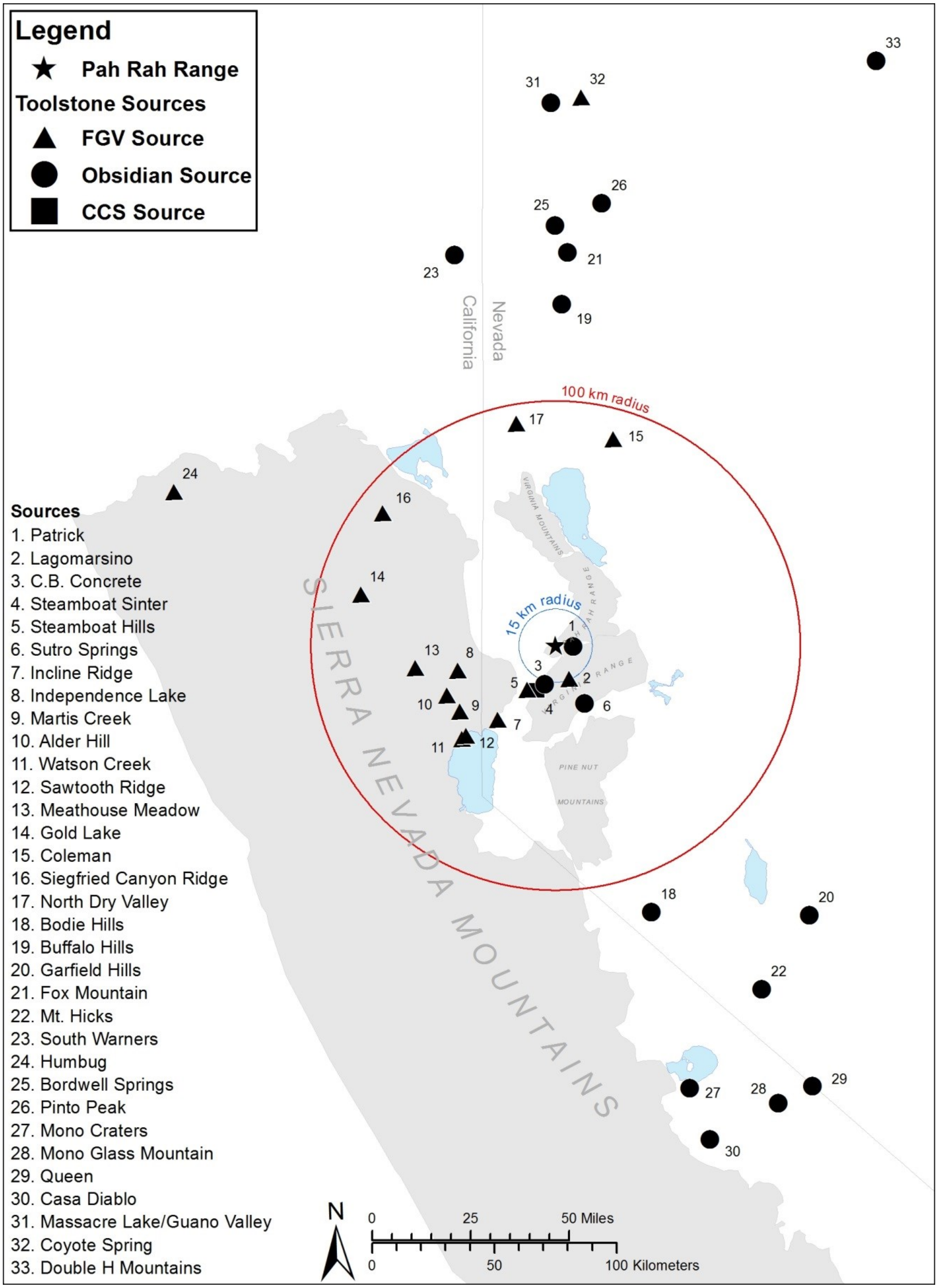

Figure 2.5. Regional (>100 km) lithic terrane for the Pah Rah Range.

Table 2.1. Known Toolstone Sources within the Lithic Terrane of the Pah Rah Range.

Source Name	Material Type	Distance (km)
Local (<15 km)		
Patrick	Obsidian	7
Lagomarsino	FGV	15
Extra-Local (<100 km)		
C.B. Concrete	Obsidian	17
Steamboat Sinter	CCS	20
Steamboat Hills	FGV	22
Sutro Springs	Obsidian	27
Incline Ridge	FGV	39
Independence Lake	FGV	42
Martis Creek	FGV	48
Alder Hill	FGV	49
Watson Creek	FGV	52
Sawtooth Ridge	FGV	54
Meathouse Meadow	FGV	58
Gold Lake	FGV	82
Coleman	FGV	87
Siegfried Canyon Ridge	FGV	89
North Dry Valley	FGV	92
Regional (>100 km)		
Bodie Hills	Obsidian	116
Buffalo Hills	Obsidian	140
Garfield Hills	Obsidian	151
Fox Mountain	Obsidian	161
Mt. Hicks	Obsidian	164
South Warners	Obsidian	165
Humbug	FGV	168
Bordwell Springs	Obsidian	172
Pinto Peak	Obsidian	182
Mono Craters	Obsidian	189
Mono Glass Mountain	Obsidian	208
Queen	Obsidian	208
Casa Diablo	Obsidian	211
Massacre Lake/Guano Valley	Obsidian	222
Coyote Spring	FGV	224
Double H Mountains	Obsidian	272

At the local scale, the lithic terrane for the Pah Rah Range is limited. Only two known sources – Patrick obsidian and Lagomarsino FGV – fall within the local range (see Figure 2.3). At the extra-local scale, the lithic terrane is richer with two additional obsidian sources (CB Concrete and Sutro Springs), a known chert source (Steamboat Sinter), and 11 additional FGV sources occurring. Among these are all of the major Sierran FGV sources.

It is only at the regional scale that obsidian becomes available in any quantity (see Figure 2.4). In contrast to the extra-local radius, the regional scale terrane is dominated by obsidian, with only two additional FGV sources included. This distribution reflects Thomas' (2012) "obsidian rim." The two closest obsidian sources at the regional scale, Buffalo Hills to the north and Bodie Hills to the south, are separated by ca. 300 km, leaving the Pah Rah Range in an area with only a handful of known obsidian sources, but numerous FGV sources.

Of the known FGV sources within the local and extra-local lithic terrane, a handful that includes Alder Hill/Watson Creek, Gold Lake, Siegfried Canyon Ridge, and Steamboat/Lagomarsino are among the most significant FGV toolstone sources used prehistorically in the western Great Basin and Sierras (Day 2002; Day et al. 1996; Elston et al. 1994; Waechter 2002). The Alder Hill/Watson Creek source is comprised of two quarries. Alder Hill is located near Truckee, California and Watson Creek is located near the northwest shore of Lake Tahoe (Waechter 2002:107). Basalt from these quarries is gray-black in color and has a "sugary" crystalline texture and small elongate plagioclase feldspar microlites (Duke 1998:14). The Watson Creek chemical group is known from at least 17 different quarry sites, and may have been transported farther than the Alder Hill component during the Middle Archaic Period (5,000-1,300 cal BP) (Waechter 2002:107).

Gold Lake is comprised of four individual quarries (Gold Lake, Mohawk Valley, Church Meadows, and Oakland Pond) that may be distinct exposures of the same basalt flow (Waechter 2002:105). Gold Lake is recognized as the finest-quality basalt toolstone source in the north-central Sierra (Edwards 2000). It ranges in texture from aphanitic to microcrystalline and is distinctly black in color with small "vugs" that are often filled with quartz and other fine-grained silica minerals (Duke 1998:16). These vugs do not seem to hinder reduction, and it seems to be more workable than other FGV toolstone sources in the Tahoe region (Waechter 2002:107). The Siegfried Canyon Ridge chemical group includes both Siegfried Canyon Ridge and Squaw Valley Drainage quarries located just west of Sierra Valley (Waechter 2002:107).

Steamboat/Lagomarsino is a geochemical group that includes two FGV source localities: Steamboat Hills at the southern end of Reno and Lagomarsino in the Virginia Range. The Steamboat Hills locality is an extensive complex of quarries, lithic processing sites, and short-term base camps (Elston 1994:65). Steamboat Hills FGV is highly vitreous black andesite to andesitic basalt with colorless to white quartz phenocrysts and appears on the surface as cobbles up to 30 cm in diameter (Elston 1994:65). Lagomarsino is chemically similar, but can sometimes be distinguished from Steamboat Hills based on its trace element composition (Waechter 2002:107).

Other documented FGV sources in the western Great Basin include North Dry Valley and the Coleman Locality. North Dry Valley is a toolstone quarry near the Smoke Creek Desert (Waechter 2002:107). It is a rhyodacite source with at least seven different localities, all with the same geochemical fingerprint. The Coleman Locality, near Falcon Hill at the north end of Winnemucca Lake, was described by Tuohy (1970); the artifact assemblage was later analyzed by Graf (2001). The site consists of basalt "workshops," a possible camp site, and a basalt quarry. Basalt from the site is very fine grained with a glassy grey matrix that is quarried from a high quality basalt flow <1 km from the site (Graf 2001:131). Tuohy (1970:148) suggested that it may be visually distinct from other basalts used in the Lower Truckee and Winnemucca Basins.

Cultural Setting

The Sierran Front chronology, as revised by Elston et al. (1994), has been developed to address cultural change along the east slope of the Sierra Nevada and adjacent western Great Basin. This chronology splits five adaptive periods – Pre-Archaic (>10,000-8,000 cal BP), Early Archaic (8,000-5,000 cal BP), Middle Archaic (5,000-1,300 cal BP), Late Archaic (1,300-700 cal BP), and Terminal Prehistoric (700 cal BP to Contact) – into six phases. These six phases are: Tahoe Reach (11,500-8000 cal BP), Spooner (8,000-5,000 cal BP), Early Martis (5,000-3,000 cal BP), Late Martis (3,000-1,300 cal BP), Early Kings Beach (1,300-700 cal BP), and Late Kings Beach (700-150 cal BP) (Table 2.2). These periods are briefly described below.

Table 2.2. Chronology for the Sierran Front (from Elston et al. 1994).

Adaptive Period	Phase	Date Range (cal BP)	Representative Diagnostic Artifacts
Pre-Archaic	Tahoe Reach	11,500-8,000	Great Basin Stemmed Concave-base lanceolate points Fluted points
Early Archaic	Spooner	8,000-5,000	Northern Side-notched[a]
Middle Archaic	Early Martis	5,000-3,000	Martis Contracting Stem Martis Split Stem Steamboat Point

Table 2.2. Chronology for the Sierran Front (from Elston et al. 1994).

Adaptive Period	Phase	Date Range (cal BP)	Representative Diagnostic Artifacts
	Late Martis	3,000-1,300	Martis Corner-notched Elko Series
Late Archaic	Early Kings Beach	1,300-700	Rose Spring Eastgate Small stemmed points M1a shell beads
Terminal Prehistoric	Late Kings Beach	700-150	Desert Side-notched Cottonwood Triangular

[a] data from McGuire (2002)

Pre-Archaic Period (>10,000- 8,000 cal BP)

Diagnostic artifacts from Pre-Archaic (>10,000-8,000 cal BP) sites include concave-base lanceolate and fluted projectile points (similar to Clovis and Folsom), Great Basin Stemmed series projectile points, and crescents (Delacorte 1997b:13; Zeanah 2009:10). Other artifacts common in Pre-Archaic toolkits include blades, large bifacial knives, heavy choppers, and formalized flake tools. Sites from this period tend to be scattered along relict Pleistocene lake shorelines and are distinctive for their lack of evidence for long-term occupation (e.g., midden accumulations, residential and/or storage features), suggesting small, territorially-expansive mobile populations (Delacorte 1997b:13; Zeanah 2009:10-11). However, based on recent investigations at the Dietz site in the northern Great Basin, Pinson (2011:308-309) has argued that Far Western Clovis foragers may have been “estate settlers” who focused on effective utilization of smaller territories rather than being highly residentially mobile, transient foragers. Pinson (2011:307) suggests that the relatively lower abundance of Pleistocene megafauna in the

Great Basin during this period may have allowed Clovis foragers there to develop a more regionally specific adaptation focused on locally abundant artiodactyls and small game. The geographic diversity of toolstone source locations utilized by Pre-Archaic foragers seems to imply wide ranging foraging territories, many of which are several orders of magnitude larger than those known ethnographically (Jones et al. 2003; Smith 2010). Smith's (2010) examination of lithic sources of Pre-Archaic projectile points suggests that early foragers in the northwestern Great Basin traveled through much larger territories and utilized a higher diversity of sources than later populations; however, those territories may not have been nearly as expansive as those proposed by other researchers or for other regions in North America (e.g., Amick 1996; Jones et al. 2003).

Locally, the Pre-Archaic Period is represented by the Tahoe Reach Phase (Elston et al. 1994). Defined based on excavations at Squaw Valley, California (Elston et al. 1977), Tahoe Reach components have been noted in Martis Valley (Heizer and Elsasser 1953), the Truckee Meadows (Elston and Turner 1968), Pyramid Lake (Tuohy 1988), Spanish Springs Valley (Delacorte et al. 1995a; McGuire et al. 2008), and at a number of sites in the Sierras (e.g., Bloomer et al. 1997; Davis and Shutler 1969; Elston 1979; Martin 1998). Other local finds include isolated concave base points collected in the early 1950s near Peavine Mountain and Washoe Lake (Pendelton et al. 1982:76).

Early Archaic Period (8,000-5,000 cal BP)

Temporal markers for the Early Archaic Period (8,000-5,000 cal BP) include Northern Side-notched and Gatecliff projectile points (Elston 1986; Thomas 1981).

Northern Side-notched projectile points are typically recovered from sites in the northwestern Great Basin and are only very rarely found near the Pah Rah Range (Zeanah 2009:11). Shifts in settlement and subsistence strategies during this time period were likely related to climatic warming in the Middle Holocene, though Early Archaic components are generally more similar to earlier occupations than later ones (Delacorte 1997b:14; Zeanah 2009:11). The large pluvial lakes that had characterized the Pleistocene had dried up and pinyon-juniper woodlands began expanding into central Nevada by ca. 5,400 cal BP (Grayson 2011:255). Elston (1986:138) has noted that large, Early Archaic sites tend to be associated with permanent streams and springs in valley bottoms; however, upland resources were also exploited. There is an increase in the types and abundance of groundstone during this period. In the vicinity of the Pah Rah Range, Gatecliff series points are often found at upland sites (Delacorte 1997b:14).

The Early Archaic Period is represented along the eastern Sierra Front by the Spooner Phase. Originally conceived by Elston (1971, 1982) as a placeholder between the better described Tahoe Reach and Early Martis phases, Spooner Phase components are still poorly understood and lack locally temporally diagnostic projectile points or other typological markers (Zeanah 2009:11). Though well-known at sites such as those in Surprise Valley (O'Connell 1975), the Madeline Plains, and near Honey Lake, the Spooner Phase is not well represented along the eastern front of the Sierra Nevada and no securely dated components are known from around the Pah Rah Range (Zeanah 2009:11).

Middle Archaic Period (5,000-1,300 cal BP)

Within the Middle Archaic Period (5,000-1,300 cal BP), both material culture and settlement patterns shifted markedly. Increasing cultural complexity is evidenced by a variety of textiles and other perishable artifacts, increased rock art, and a rise in trade goods such as marine shell ornaments and other exotic items (Delacorte 1997b:15). Temporally diagnostic projectile points for the Middle Archaic Period include Gatecliff and Elko series projectile points. Groundstone and other processing tools are common and caches of specialized gear dated to this period have been found throughout the western Great Basin (Delacorte 1997b:15; Elston 1986). Lithic diversity appears to have decreased, though foraging ranges may have remained extensive (Delacorte 1997b:15-16).

The focus on valley bottom settlements near permanent water sources shifted to residential camps along the pinyon ecotone (Elston et al. 1994); however, pinyon did not reach the Carson Desert until ca. 1,500 cal BP and the Virginia Range until ca. 1,000 cal BP (Grayson 2011:Table 8-4; Kelly 1997:13). Seasonal shifts in habitation types are also apparent: both summer and winter camps can be defined and appear to have been occupied on a recurrent basis (Clay 1996; Elston 1986). Winter sites contain storage pits, house pits with internal hearths, and burials, while summer habitation sites are smaller and less substantial (Elston 1986). Middle Archaic subsistence strategies appear to have increased in variety. Upland resources were more intensively exploited, as were small mammals, but large mammals remained a significant portion of the diet (Elston 1986; Zeanah et al. 1995).

Recent environmental studies and archaeological evidence indicate a noticeable increase in the exploitation and abundance of artiodactyls populations during this period (Broughton et al. 2008; Byers and Broughton 2004; Hildebrandt and McGuire 2002; McGuire et al. 2004; McGuire and Hildebrandt 2005). McGuire and Hildebrandt (2005) focus on a shift from big game hunting for calories to hunting for prestige as a way for men to increase their reproductive success. They also hypothesize that during the Middle Archaic Period, gender-differentiated subsistence strategies led to a split in settlement patterns, with male adults focused on long-distance, logistically-based, large-game hunting and hunting-related activities and women, children, and older males focused on a "trend toward residential stability" at locations taking "advantage of a wide range of generally lower-ranked but abundant resources" (McGuire and Hildebrandt 2005:705).

In the western Great Basin and along the eastern Sierran Front, the Middle Archaic Period is split into the Early Martis (5,000-3,000 cal BP) and Late Martis (3,000-1,300 cal BP) phases. Early Martis projectile points include Martis Contracting Stem, Martis Split Stem, and Steamboat points, while the Late Martis Phase is defined by Martis Corner-notched points (Elston et al. 1994:16). Occurrences of Martis Series points are viewed as the eastward expansion of 'Martis Peoples' onto the eastern slope of the Sierra Nevada. The distinguishing attribute of Martis appears to be the intensive use of basalt (Kowta 1988; Moore and Burke 1992); however, Delacorte (1997b:16) suggests that the use of basalt from prominent local sources may be less of a distinct "Martis" signature and more a function of resupply of toolkits as part of a regularized Middle Archaic settlement pattern. Evidence from habitation sites in the region include excavated pit houses with supporting structures and shallow dish-shaped areas of staining

(Archaeological Research Services 1997; Elston and Davis 1972; McGuire 2000). Assemblage density and variability within habitation sites suggest more egalitarian use of space over longer spans of time. Recent researchers (e.g., McGuire et al. 2008; Zeanah 2009:12) have suggested that the Martis pattern may have been residentially stable but logistically mobile.

Late Archaic Period (1,300-700 cal BP)

Late Archaic (1,300-700 cal BP) settlement patterns remained logistically oriented, though mobility patterns became more geographically constricted (Delacorte 1997b:16-17). Though settlement became more centralized, house structures decreased in size and substance. Other shifts included resource intensification, increased dependence on locally available subsistence resources, and increased use of local toolstone including lower quality sources that may have been ignored earlier, all of which suggest decreased mobility among Late Archaic peoples (Delacorte 1997b; Elston and Budy 1990; McGuire et al. 2004; Spencer et al. 1987). Carpenter's (2002) analysis of artiodactyl abundance during this period suggests that after dipping to their lowest levels near the Middle and Late Archaic transition, remains increased at Late Archaic archaeological sites. Temporal indicators include Rose Spring and Eastgate projectile points, which are indicative of the technological shift to the bow-and-arrow (Yohe 1998). Bifaces became smaller, less abundant, and less formal, while flake tools and more expedient technologies expanded (Delacorte 1997b:17).

The Late Archaic Period is recognized locally as the Early Kings Beach Phase

(Elston 1986; Elston et al. 1994). The Early Kings Beach Phase is believed to represent the archaeological manifestation of the ethnographic Washoe. Early Kings Beach sites are characterized by Rosegate and Gunther Series projectile points, seed hullers, and bedrock mortars (Elston 1986; Elston et al. 1994). In the Pah Rah Range, the Early Kings Beach Phase is accompanied by the first recognized habitation sites as well as abundant rock art, talus pits, and hunting blinds (Delacorte 1997b:16-17; Zeanah 2009:13).

Terminal Prehistoric (700-150 cal BP)

Terminal Prehistoric (700-150 cal BP) occupations in the western Great Basin show a distinct break from earlier periods. Occupations appear to have been sparser, with many villages, hunting camps, and other sites that had been occupied on a repeated basis or for long periods abandoned (Delacorte 1997b:18). Houses decreased in size and lacked internal features (Zeanah 2009:14). Settlement patterns reflect a more dispersed, decreased residential group size similar to those described ethnographically by Steward (1938). Several researchers (e.g., Delacorte 1997b; Delacorte and Basgall 2012; McGuire et al. 2007) see the shift in the archaeological record at the beginning of the Terminal Prehistoric as an indicator of population replacement by the Numa.

The Terminal Prehistoric Period is manifested locally by the Late Kings Beach Phase. Temporally diagnostic include Desert Series projectile points (Delacorte 1997b:18). Near the Pah Rah Range, the Late Kings Beach Phase is accompanied by shifts from thin to thick milling stones, from FGV to local chert and obsidian, and away from “Martis-style” bifaces (Elston et al. 1994; Zeanah 2009:14). At the Vista site (26Wa3017) in the foothills at the southern end of Pah Rah Range, Zeier and Elston (1986:379) indicate that population pressure may have resulted in a shift to a “processor” system as described by Bettinger and Baumhoff (1982).

Previous Archaeological Work in the Pah Rah Range

Most previous archaeological investigations in the Pah Rah Range have taken place in its southern portion. Many were centered on the upland basins of the Dry Lakes area. Among the earliest was a series of surveys and excavations conducted by the Amateur Archaeologists of Nevada (Am-Arcs) under the guidance of the Nevada Archaeological Survey (NAS). Between 1968 and 1970, 11 rock enclosures at four sites were partially or completely excavated, and test excavations were conducted at a fifth site (Rusco 1969a, 1969b, 1981; Stephenson 1968). Rusco interpreted these sites to be seasonal camps with intermittent Early to Late Kings Beach occupations, as reflected by the predominance of Rose Spring, Desert Side-notched, and Cottonwood Triangular points (Rusco 1981:9). One of these sites was recently tested to evaluate impacts from fire suppression efforts resulting from the Belmar Fire (Bowers 2006), resulting in the identification of three hearths radiocarbon dated to between 2980±40 ^{14}C BP (3,324-3,004 cal BP) and 3140±40 ^{14}C BP (3,449-3,247 cal BP) (both calibrated at 2 σ with CALIB Version 7.0 [Stuiver et al. 2013]).

Little additional work was conducted in the Dry Lakes area until the mid-1990s when data recovery for the Tuscarora Pipeline Project was completed (Delacorte 1997a, 1997b). That effort consisted of data recovery at four sites and testing at nine others. Along with data recovery at two sites for the Tracy to Silver Lake 120kV Transmission Line (McGuire et al. 2008), these investigations indicate that prehistoric use of Pah Rah Range uplands likely took the form of systematic logistical hunting forays during the Early and Late Martis phases, with more intensive logistical use of plant and animals resources on a seasonal basis during the Early Kings Beach Phase (Zeanah 2009:15). During the Late Kings Beach Phase, occupation in the Dry Lakes area shifted towards residential occupation and an intensification of plant resource exploitation.

Other work in the Pah Rah Range has been the result of field schools and thesis research. In 1985, the University of Nevada, Reno (UNR) conducted a field school at the Frear site at the mouth of Spanish Springs Canyon; however, results from the surface collection and excavations have not been published (Gary Haynes, personal communication, 2012). In 2005, California State University Sacramento (CSUS) conducted a systematic sample survey of approximately 740 acres in the High Basins area, and in 2005 and 2006, CSUS field school classes retuned to conduct test excavations at two sites near the head of Spanish Springs Canyon (Zeanah 2009). The results of these excavations echoed the findings of Delacorte (1997b) and McGuire et al. (2008), with Martis to Early Kings Beach occupations centered on short-term camps and plant processing locales, and more intensive, long-term habitation during the Late Kings Beach Phase (Zeanah 2009). Pendegraft’s (2007) thesis research focused on the rock art of the Pah Rah Range uplands, and provides an alternative interpretation for the function and timing of the petroglyph panels, suggesting that they were integrated into household activities of later periods. This interpretation contrasts with Delacorte (1997b), who indicates that they likely date to Martis Phases and may represent a form of hunting magic.

Though additional work has been conducted in the Pah Rah Range (e.g., Brewer 1984; Johnson 1981; McLane 1999), it is the artifact assemblages collected during the Am-Arcs, Tuscarora Pipeline, Tracy to Silver Lake, and Belmar Fire Rehabilitation data recovery and testing projects that provide the primary data set for my research. As such, the sites excavated during these efforts are examined in more detail in the following chapter.

CHAPTER 3 – METHODS AND MATERIALS

The principal goals of my thesis are to assess whether prehistoric groups in the Pah Rah Range utilized primarily local or exotic FGV sources and how their procurement and use of FGV toolstone fits within regional models of toolstone conveyance and lithic technological organization in the western Great Basin (e.g., Delacorte 1997b; McGuire 2002; Smith 2010). To this end, I use XRF sourcing results to determine which FGV sources are present at Pah Rah sites and in which form(s) they are represented. I then compare FGV use at Pah Rah sites to FGV use at sites on the adjacent valley floor.

Because I examine FGV source use in archaeological contexts, I requested a data cut from the Nevada State Historic Preservation Office Nevada Cultural Resource Information System (NVCRIS) and conducted a records search at the Carson City Field Office of the Bureau of Land Management (BLM) to determine the nature and location of sites that have been recorded, tested, and/or excavated within the Pah Rah Range. In consultation with James Carter, then the BLM archaeologist for the Carson District, we determined that no additional collection of artifacts from Pah Rah Range sites was necessary. At UNR and the Nevada State Museum (NSM), I identified collections from nine sites excavated within the Pah Rah Range which contained FGV artifacts. Vickie Clay at Far Western Anthropological Research Group provided me with the report and XRF data from a site they tested in the Pah Rah Range. I identified six sites on the valley floor to use as a comparative data set. Dr. Gary Haynes at UNR graciously provided me access to a seventh. Ed Stoner at Western Cultural Resources Management, Inc.

(WCRM) provided me with data from a winter village that WCRM excavated on the valley floor. Altogether, this allowed me to include artifacts from 10 sites in my Pah Rah data set and eight sites in my comparative valley data set. These sites are described later in this chapter; here, I outline how I sampled artifacts from them for additional technological and geochemical analysis.

Artifact Selection Criteria

A non-random sample of artifacts from each collection was selected for XRF analysis. The first consideration for selection was artifact size. While Davis et al. (1998) note that the relative element proportions of small samples (e.g., 8 mm in diameter and 0.5 mm thick) can remain intact enough to accurately characterize the chemical source of a sample, it is generally recommended that samples be at least 10 mm in diameter and 1 mm thick (and preferably larger than 15 mm diameter and 2 mm thick) for reliable sourcing (Lundblad et al. 2011; Northwest Research 2013). The second consideration for selection was artifact type. As noted in Chapter 1, researchers have noted the importance in XRF sourcing studies of analyzing all artifact types within an assemblage, as well as including a range of sizes for artifact classes such as debitage. As such, I included both formal and informal tools. Formal tools are those that have had effort expended towards their design, manufacture, and final form (e.g., projectile points, bifaces, drills). Informal (or expedient) tools are those that required little or no effort in their manufacture (e.g., informal flake tools, cobble hammerstones) (Andrefsky 2005:31). The final and overall less important consideration was the physical characteristics of the material. Qualities considered here include presence or absence of phenocrysts, fineness of crystallization, and to a lesser extent, color. Though it is not possible to reliably identify the chemical source of an artifact based on the visual characteristics, I made an effort to include as many visually distinct FGV types as possible.

With these considerations in mind, I applied the following selection criteria: (1) all projectile points and projectile point fragments that met the size limit were selected; (2) bifaces were selected with an effort to include as full a range of stages as possible; (3) any additional formed tools (e.g., drills, awls, scrapers) were also selected; (4) for larger tools such as cores, hammerstones, and choppers, selection was geared towards including both a diverse range of forms (e.g., unidirectional, bifacial, and multidirectional cores) and a variety of visually distinctive material types; and (5) an effort was made to select debitage both with and without cortex, and to include a range of sizes and technological forms and as many visually distinctive materials as possible.

Lithic Analysis

For all artifacts, I recorded artifact type, maximum length (mm), width (mm), thickness (mm), and completeness. I also examined and recorded additional variables that could be used to address specific characteristics of each artifact class, as described below. The artifact types examined included bifaces, projectile points, flake tools, drills and awls, cores, percussion tools, and debitage.

Bifaces

Bifaces are lithic pieces that have had flakes removed from two opposing faces, with the two worked faces meeting to form a single edge that circumscribes the artifact (Andrefsky 2005:177; Crabtree 1972:38). For the purposes of my analysis, bifaces that were modified into a more specific tool type (e.g., projectile points, knives, drills, etc.) were classified as such. Specifically, if hafting elements were identifiable, I classified such tools as projectile points. I classified bifaces with an end that had been narrowed or tapered to create an elongated tip as drills or awls.

The blank type for each biface (as determined by the presence or absence of a ventral detachment scar) was recorded as either a flake blank or other. Fragment type was recorded to describe both overall completeness and the portion of the original biface present at the point of discard. The fragment types described include proximal, distal, medial, lateral, interior, and indeterminate. Biface fragments that could not be determined to be proximal or distal fragments, but were clearly end fragments, were described as such.

The process of biface reduction is often divided by lithic analysts into a sequence of reduction “stages” (Callahan 1979; Muto 1971) that describe the changes in thickness and shape that a biface undergoes as flakes are removed. Though there is still discussion as to whether such stages are actual sequential steps during the biface reduction process (e.g., Callahan 1979; Whittaker 1994) or arbitrary divisions of a continuum (e.g., Muto 1971; Shott 1994), biface reduction sequences are useful in examining biface reduction trajectories and overall patterns of tool production, use, and discard. For this analysis, I used a modified version Callahan's (1979) reduction sequence, omitting the application of the width to thickness ratio. The ratio of width to thickness can be expected to increase as the biface is thinned and shaped into its intended tool form; however, basalt bifaces do not always conform to the expected ratios predicted by Callahan (1979) (Bloomer et al 1997; Duke 1998; Duke and Young 2007; Elston et al. 1977; but c.f. Beck et al. 2002).

The reduction sequence used here is more descriptive and geared towards evaluating the degree of shaping and effort invested in tool production (Table 3.1). Stage 1 bifaces include flake and cobble blanks and represent the initial shaping of the raw material. Stage 2 bifaces have been edged with minimal to no flaking crossing the centerline. The edges are sinuous and flake scars are widely spaced. Stage 3 bifaces have undergone initial thinning but do not exhibit patterned flaking. Most cortex has been removed, their edges are less sinuous, and most flake scars cross the centerline of the biface. Stage 4 bifaces have been thinned further and are moderately flat in cross-section. Their margins are only minimally sinuous and patterned flaking is often present. Stage 5 bifaces have straight edges with more refined and patterned retouch present along the margins.

Table 3.1. Biface Staging System (after Callahan 1979).

Biface Stage	Description
Stage 1	Flake or cobble blanks; few flake scars along edges
Stage 2	Edged biface with no (or minimal) flake scars crossing the center line; edges are sinuous; flake scars are widely spaced

Table 3.1. Biface Staging System (after Callahan 1979).

Biface Stage	Description
Stage 3	Biface is thinned, but flaking is not patterned; most cortex has been removed; flake scars cross the center line
Stage 4	Biface is moderately thin in cross section; margins are minimally sinuous; patterned flaking often present
Stage 5	Biface is refined; edges are straight; patterned retouch present along edges; hafting elements may be present

Projectile Points

Projectile points are bifaces that have been modified to be hafted through notching or grinding for use as arrows, darts, or spear tips (Andrefsky 2005:22-23). Projectile point attributes were measured following methods described by Thomas (1981) (Figure 3.1) and were typed using an adaptation of the Levanthal (1977) and Stornetta (1982) keys proposed by Drews (1986) in his analysis of projectile points from the Vista site (26Wa3017) (Appendix A). Projectile point series and types expected to occur in the Pah Rah Range and the Truckee Meadows are summarized in Table 3.2 and described below.

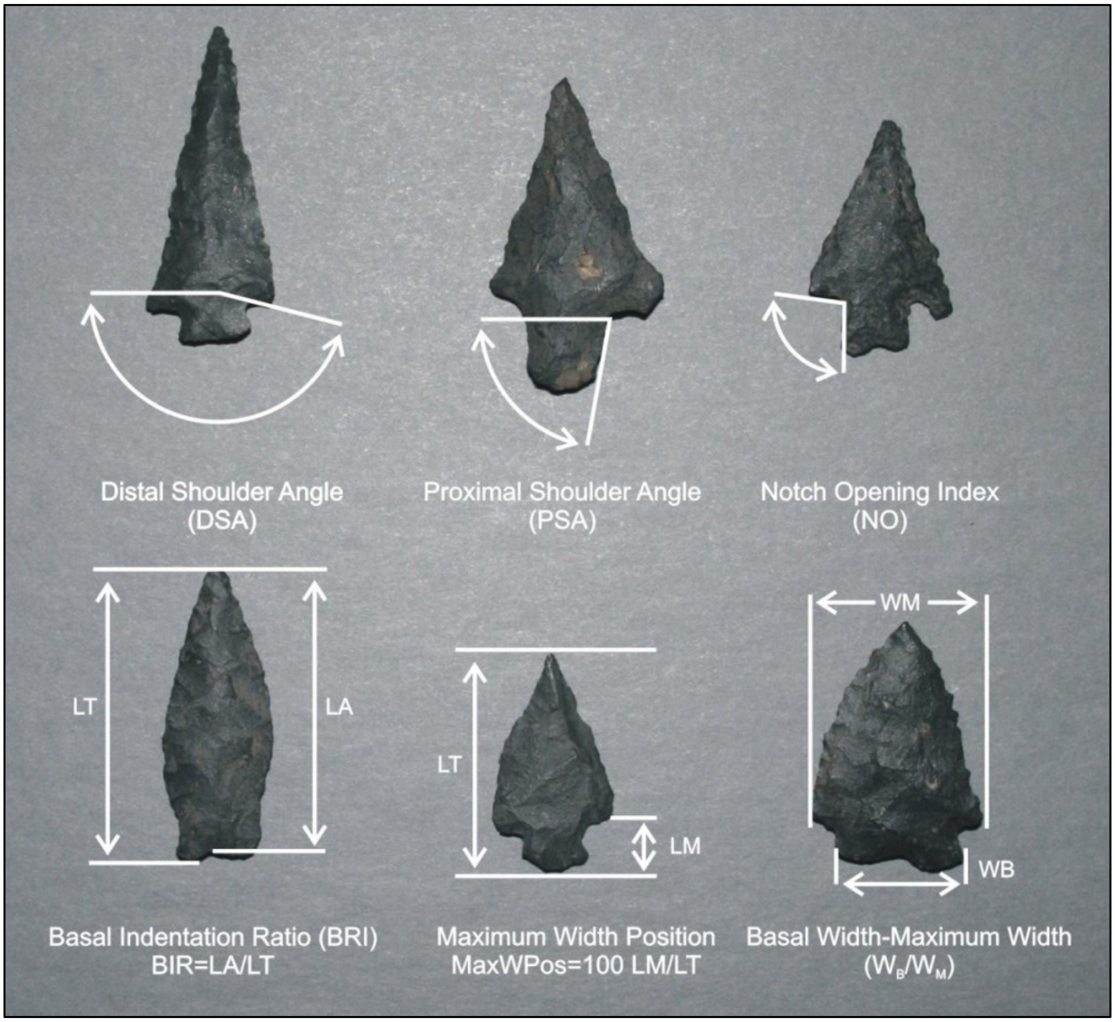

Figure 3.1. Projectile point attributes (adapted from Thomas 1981).

Table 3.2. Projectile Point Age Ranges.

Projectile Point Series	Subtypes	Approximate Date Range (cal BP)	References
Great Basin Stemmed	-	>9,000-6,000	Delacorte 1997b; Willig and Aikens 1988
Humboldt	Concave A; Concave B; Basal Notched	ca. 5,000-ca.1,250*	Bettinger 1975, 1978; Bettinger and Taylor 1974; Layton and Thomas 1979; Thomas 1981
Pinto	Shouldered; Shoulderless	5,000-1,200	Hester 1973; Heizer and Hester 1978

Table 3.2. Projectile Point Age Ranges.

Projectile Point Series	**Subtypes**	**Approximate Date Range (cal BP)**	**References**
Martis	Martis Corner-notched; Contracting Stem; Side-notched; Triangular; Leaf-shaped; Stemmed Leaf; Steamboat	5,000-1,300	Elston et al. 1977; 1994
Elko	Elko Eared; Elko Corner-notched; Elko Contracting Stem	3,500-1,300	Bettinger and Taylor 1974; Milliken and Hildebrandt 1997; Thomas 1981
Rosegate	Rose Springs; Eastgate	1,300-600	Bettinger and Taylor 1974; Thomas 1981
Gunther	Gunther Short-barbed; Gunther Abrupt-shoulder; Gunther Round-shouldered	1,450-700	Pippin et al. 1979; Clewlow et al. 1984
Desert	Desert Side-notched; Cottonwood Triangular; Cottonwood Leaf-shaped	600-contact	Bettinger 1991; Bettinger and Taylor 1974; Thomas 1981

*not considered a reliable time marker for Pah Rah Range (Delacorte 1997b)

Great Basin Stemmed Series. Though not discussed in the classification keys mentioned above, Great Basin Stemmed points are still known from along the Sierran Front. A number of morphological forms are recognized, but as a group they are generally large, weakly-shouldered with relatively long contracting stems, and possess rounded bases (Delacorte 1997a:71).

Humboldt Series. The Humboldt Series (Heizer and Clewlow 1968) comprises points that are unshouldered, unnotched, lanceolate, and concave-based (Thomas 1981). The series consists of three types: Concave Base A; Concave Base B; and Basal Notched. Concave Base A and Concave Base B Humboldt points both have shallow basal notches and are similar in overall shape, the difference being that Concave Base B points are smaller. Basal Notched Humboldt points are larger than either Concave Base types and have slightly more triangular outlines and deep, broad, basal notches.

Pinto Series. The Pinto series, as defined for the Sierra region and western Great Basin, includes two variants: Shouldered and Shoulderless (Elston 1971; Elston et al. 1977). Elston (1971:23-26) notes that Pinto points are typically lanceolate, but broad with respect to their length. Shoulderless Pinto points often exhibit a slight basal flaring due to indentations just above the base. The Shouldered variety has a slight notch rather than an indentation, though the shoulders are usually poorly developed.

Martis Series. Martis points were initially described by Heizer and Elsasser (1953). Elston (1971) condensed their 11 morphological types into three, before later expanding it again to seven (Elston et al. 1977:64-65): Martis Corner-notched; Contracting Stem; Side-notched; Triangular; Leaf-shaped; Stemmed Leaf; and Steamboat. Martis Corner-notched points are similar to Elko Corner-notched points but are lighter and have greater Notch Opening Index (NOI) values and Distal Shoulder Angles (DSA). The Contracting Stem type has a triangular body with a short, broad stem. Shoulders on Martis Contracting Stem points are usually straight but may be somewhat barbed. Martis Side-notched points have straight to slightly convex edges and basal indentations. Side notches are parabolic and are usually located about one-third the distance from base to tip. Martis Triangular points are medium sized with convex to straight bases. These are distinguished from Martis Leaf-shaped points, which have a Wb/Wm of less than 0.90. Stemmed Leaf points are nearly diamond shaped in outline. The Steamboat variant is leaf-shaped with convex edges. The majority have pointed, round, or flat bases.

Elko Series. Elko points are large corner-notched points with basal widths >10 mm (Thomas 1981). Within this series, three types are commonly recognized. Elko Eared points have a basal indentation ratios (BIRs) ≤0.93, while Elko Corner-notched points have BIRs >0.93. Elko Contracting Stem points have BIRs >0.89 and Wb/Wm ratios <0.35. Though Thomas (1981) proposed collapsing Elko Contracting Stem into the Gatecliff Series, it is retained within the Elko Series in Drews' (1986) key and is classified as such here.

Rosegate Series. The Rosegate series combines the Rose Spring (Lanning 1963) and Eastgate (Heizer and Baumhoff 1961) point types (Thomas 1981). In combining the two point types, Thomas (1981) indicated that they grade into each other morphologically. Rose Spring points tend to fall on the corner-notched side of the spectrum, while the notches on Eastgate points are more basal and the barbs are slightly squared. As a whole, Rosegate series points are small, triangular points with stems that expand slightly. The bases vary from straight to moderately convex. A third variation resembles miniature Gatecliff Split-stem points. These "split-stem Rosegates" are similar to O'Connell's (1971) Surprise Valley Split-stem points and are known from along the Sierra Front (Delacorte 1997b:87).

Gunther Series. Gunther (alternately Gunther Barbed) projectile points (Loud 1918; Treganza 1959) are broadly triangular points with small contracting stems, slightly curved lateral margins, and long, pointed barbs. Gunther Short-barbed points (Pippin et al. 1979; Pippin and Hattori 1980) have small corner notches, asymmetrical stems, and short tangs. Gunther Abrupt-shoulder points (Pippin and Hattori 1980) are as the name describes. Gunther Round-shouldered points (Clewlow et al. 1984) have straight to contracting stems and an obtuse shoulder angle.

Desert Series. The Desert Series includes Desert Side-notched, Cottonwood Leaf-shaped, and Cottonwood Triangular points (Thomas 1981). Desert Side-notched points are small points with triangular blades and side notches (Baumhoff and Byrne 1959). Four sub-types have been distinguished, based primarily on variations of the basal configuration. The General subtype has a concave to slightly convex base. It may also have a wide, V-shaped appearance. The Sierra subtype is similar, but has a central basal notch which gives the point diamond-shaped ears. The Delta subtype has a deep V-shaped base. The Redding subtype has a bell-shaped base with comma-shaped notches. Cottonwood Triangular points are small, thin, triangular points that lack notches (Thomas 1981). The base ranges from moderately convex to deeply concave. Cottonwood Leaf-shaped points can be distinguished from Cottonwood triangular points by their rounded bases and maximum width position (Thomas 1981:16).

For projectile points that could not be typed, I attempted to distinguish between dart- and arrow-sized points. A weight of 3.0 g has variously been put forth as a threshold between arrows and darts, with darts weighing >3.0 g and arrows weighing <3.0 g (Delacorte 1997b; Hughes 1998; Lyman et al. 2009). Shott (1997) and Rosenthal (2002) proposed neck width thresholds of 10 mm and 9.3 mm, respectively. More recently, Hildebrandt and King (2012) proposed a dart-arrow index that adds neck width to maximum thickness, with a threshold value of 11.8 mm. I used a combination of these methods depending on the degree of fragmentation of each indeterminate point.

Flake Tools

Flake tools are detached lithic pieces that have been modified by intentional retouch or deliberate use (Andrefsky 2005:79). For this analysis, I recorded the flake type (if it could be discerned) and degree of formality (i.e., formal or informal) of each flake tool as indicated by the type and degree of retouch along the working edge. Informal flake tools are those with simple retouch or other evidence of use along the working edge. Tools with simple retouch typically have working edges that have been modified with a continuous row of retouch flakes. Other indications of use include the development of polish, striations, or crushing along the working edge. A 14x hand lens was used to examine worked edges for use wear. Formal flake tools are those that have been deliberately shaped or show more investment in forming or rejuvenating the tool's working surface. Formal flake tools include the sub-category of scrapers. Scrapers are unifacial flake tools with a steep retouched edge between 60 and 90° (Andrefsky 2005:261). End scrapers have a retouched edge on the distal or proximal end and may show evidence of hafting. Side scrapers are retouched along one of the lateral margins.

Cores

Cores are masses of lithic material from which one or more flakes have been removed with the intention to supply flakes that can be used to produce other tools or can be used as tools themselves (Andrefsky 2005:14; Odell 2003:45). Following Andrefsky (2005:145), two main sub-types of cores were classified based on platform and flaking orientation: unidirectional cores and multidirectional cores. Unidirectional cores have had flakes detached in a single direction from a single platform. From this single platform, flakes could be removed from the same edge of the platform or around the platform periphery. Multidirectional cores have had multiple flake removals from more than one platform and in more than one direction.

Percussion Tools

The category of percussion tools is a somewhat broad grouping that encompasses all tools that exhibit battering from use, including hammerstones and choppers. Hammerstones have been battered on one or more surfaces as a result of being "used with forceful strokes against other surfaces" (Adams 2002:151). Hammerstones often begin as rounded cobbles or angular chunks of rock and can be purposefully shaped to allow for easier handling or used expediently with no further modification beyond what occurs from use. The category of hammerstones also includes multifunctional tools and tools that were reworked or reused for percussive purposes (e.g., hammer-choppers or hammer-cores). Choppers have been deliberately flaked to produce a working edge. As the name suggests, these tools would have been used for chopping and are robust with battering along the flaked edge. Choppers can be modified with finger grips to make them more comfortable to hold and resharpened by removing additional flakes (Adams 2002:153). For percussion tools, I recorded the types and number of worked surfaces/edges. I also noted indications of use wear including battering, crushing, smoothing, development of polish and rejuvenation of flaked edges.

Debitage

Stone tool manufacture and maintenance is a reductive process whereby material is removed from objective pieces. Detached pieces that are the byproducts of reduction are referred to as flakes or debitage. If a flake exhibited either use wear or additional flaking along a use-edge, they were classified as flake tools. I recorded the length, width, and thickness of each flake, as well as the presence and absence of cortex.

Individual flakes were classified into five technological categories based on platform morphology, number of flake scars on the dorsal surface, and degree of completeness. Core reduction flakes have simple (i.e., flat) platforms and generally simple dorsal surfaces with few or no additional flake removals. The bulbs of percussion are often (though not always) pronounced. Biface thinning flakes have complex (i.e., faceted) platforms and are often slightly curved along the long axis. Platforms are generally narrow with pronounced lips, the bulbs of percussion are diffuse, and the terminations are often feathered (Andrefsky 2005:123). Biface thinning flakes are further distinguished here as early or late based on dorsal surface complexity. Pressure flakes are generally smaller with angled platforms and little dorsal surface complexity. The platforms may also be crushed. Because of their generally small size, few pressure flakes were selected for chemical sourcing. Flakes with missing platforms were identified as flake fragments (if additional identifiable flake attributes were present) or shatter (if no additional flake attributes could be identified).

X-Ray Fluorescence Analysis

As discussed in Chapter 1, XRF analyses can help elucidate research issues concerning mobility, occupation span, and trade/exchange, as well as provide insight into lithic technological organization. I use X-ray fluorescence analysis to address questions about intra-assemblage and intra-site variation, as well as how the use of FGV in the Pah Rah Range fits into regional patterns of toolstone use and transport. Artifacts selected for XRF analysis were submitted to the Northwest Research Obsidian Studies Laboratory in Corvallis, Oregon. Northwest Research conducts nondestructive trace element analysis using a Spectrace 5000 energy dispersive X-ray fluorescence spectrometer (Skinner and Thatcher 2009). The diagnostic trace element values for Zn, Rb, Sr, Y, Zr, Nb, and Pb for each sample are then compared against known FGV sources that have been reported in the literature and with unpublished data from geologic source samples. According to Skinner and Thatcher (2009:1), artifacts are correlated to a source or geochemical source group "if diagnostic trace elements fall within about two standard deviations of the analytical uncertainty of the known upper and lower limits of chemical variability recorded for the source."

Statistical Methods

Chi-square tests were generally used to determine whether FGV source profiles within each data set and between the Pah Rah and valley data sets were significantly different. When sample sizes were too small to use chi-square tests (i.e., more than 20%

of the cells had expected frequencies of ≤5 or a cell has an expected frequency <1.0), Fishers exact tests were utilized. I also compared FGV source diversity between various tool classes within each data set and between the same tool class across both data sets. Direct comparisons of FGV source diversity between individual tool classes and data sets can be influenced by uneven sample sizes and the correlation of diversity with sample size (Grayson 1984; Kintigh 1984; Rhode 1988). To account for differing sample sizes, I followed Eerkens et al. (2007) in bootstrapping larger samples to produce diversity measurements that were adjusted for sample size. Bootstrapping draws a set number of random samples (in this case 1,000) equal in size to the smaller of the two samples being compared from the larger and presumably more diverse sample, counts the sources within the generated random samples, and averages those totals to produce the sample-size-adjusted measure of diversity. Bootstrapping was also used to determine whether these diversity comparisons were statistically significant.

Conversions of previously reported radiocarbon dates were done with Calib Version 7.0 (Stuiver et al. 2013) using the IntCal13 data set. Calendar ages provided encompass the entirety of the 2 sigma range.

Materials

The main data set for my research includes artifacts from sites within the Pah Rah Range. A second data set comprised of artifacts from sites located in the surrounding valleys was compiled to determine whether patterns discerned within the Pah Rah data set are unique to that location or are representative of a broader region.

The Pah Rah Data Set

The Pah Rah data set is comprised of 10 sites from the southern Pah Rah Range. One hundred and eighty-five artifacts from these sites were submitted for XRF analysis (Table 3.3). Seven sites (26Wa1604, 26Wa1608, 26Wa1609, 26Wa1612, 26Wa5610, 26Wa5611, and 26Wa5612) make up the main cluster of upland basin sites, while sites 26Wa1606, 26Wa5638, and 26Wa8451 are south of this cluster. All sites fall within a 14 km^2 area. Sites 26Wa1604, 26Wa1606, 26Wa1608, 26Wa1609, and 26Wa1612 were first described and excavated between 1968 and 1970 by members of Am-Arcs of Nevada under the direction of the Nevada Archaeological Survey (Rusco 1969a, 1969b, 1981; Stephenson 1968). Site 26Wa1609 was revisited and excavated as part of data recovery efforts accompanying the Tuscarora Gas Pipeline Project (Delacorte 1997a, 1997b; Delacorte et al. 1995a, 1995b). 26Wa5610, 26Wa5611, 26Wa5612 and 26Wa5638 were also excavated for the Tuscarora project. 26Wa1606 was revisited and tested in 2006 after fire suppression efforts during the Belmar Fire disturbed a portion of the site and exposed two subsurface charcoal stains (Bowers 2006). 26Wa8451 was originally recorded in 2003 as part of the Sierra Pacific Tracy to Silverlake 120-kV Transmission Line Project and tested during NV Energy's 105 Transmission Line rebuild and upgrade project in 2009 (Neidig and Clay 2009).

Table 3.3. The Pah Rah Data Set.

Site Number	Projectile points	Bifaces	Flake tools	Cores	Hammerstones	Debitage	Other	Total
26Wa1604	6	7	3	3	-	15	2	**36**
26Wa1606	1	1	1	2	1	9	1	**16**
26Wa1608	13	14	2	1	2	15	8	**55**
26Wa1609	4	5	13	1	-	9	-	**32**
26Wa1612	2	-	-	-	-	3	-	**5**
26Wa5610	1	4	1	1	-	3	-	**10**
26Wa5611	-	1	1	1	-	3	-	**6**
26Wa5612	1	3	1	1	-	3	-	**9**
26Wa5638	2	2	1	1	-	1	1	**8**
26Wa8451	1	-	-	2	-	4	1	**8**
Total	**31**	**37**	**23**	**13**	**3**	**65**	**13**	**185**

Sites within the upland basin are primarily habitation and resource procurement/processing sites (Delacorte 1997b; Rusco 1969a, 1969b, 1981; Stephenson 1968, Zeanah 2009). Most sites are on prominent ridges with volcanic outcrops. Nearly all include rock ring features, extensive petroglyphs, a wide variety of portable and non-portable milling gear, and extensive lithic scatters of tools and debitage. All but one site (26Wa5612) in the upland basin has rock rings. The other sites have between two and 12 rings, each composed of local rocks piled and stacked up to nine courses, creating walls 0.5-1.5 m high. The rock rings are 2-4 m in diameter and many abut natural outcrops which are used as part of the wall. Openings interpreted as entrances have been noted in the southeast or east walls of at least two rock rings (Stephenson 1968). In several instances, petroglyphs or milling equipment were incorporated into the rock ring walls.

Much of the cultural material collected during excavations came from inside the rock rings; these include projectile points, bifaces, flake tools, cores and core tools, ground stone, bone, bone tools, beads, shell, modified stones, and debitage. Delacorte (1997b) points out that this is consistent with the notion that entire families or household units may have conducted a wide range of subsistence tasks within these house structures.

All but one upland basin site (26Wa5612) contain petroglyph panels. Petroglyphs are predominantly Great Basin curvilinear with circles, concentric circles, wavy lines, zigzags, and various anthropomorphic and zoomorphic representations, including bighorn sheep at 26Wa1604, 26Wa1608 and 26Wa1612, and archers and a turtle at 26Wa1612 (McLane 1999; Stephenson 1968). Several curvilinear panels at 26Wa1612 appear to have later pecking superimposed over them (McLane 1999). At 26Wa1609, a deeply grooved rectilinear design is present on the west face of a 1.7 m-high boulder at the east edge of the site. The boulder itself lines up with Spanish Springs Peak. Delacorte (1997b) noted that the degree of weathering and repatination evident on some petroglyph panels at 26Wa1609 was not uniform throughout the site and did not appear to be a function of environmental factors, suggesting again that cultural materials accumulated over a considerable amount of time, and possibly longer than at most of the other rock ring and petroglyph sites within the Dry Lakes area.

The three southern sites share some elements with the upland basin sites but are distinct in both function and location. 26Wa1606 contains rock rings similar to those in the upland basin, as well as stacked rock features that may be hunting blinds (Bowers 2006; Rusco 1969b). The site is also distinct in that it is situated within a relatively constricted location (Spanish Springs Canyon). Both 26Wa5638 and 26Wa8451 are located within more open plains with no constructed features and mostly surficial deposits (Bloomer 1995; Neidig and Clay 2009). 26Wa8451 has a locus of non-portable milling features and several rock art panels (Neidig and Clay 2009) but not as extensive as the upland basin group of sites 26Wa5638.

Based on the artifact assemblages, obsidian hydration data, and radiocarbon dating, sites within the Pah Rah Range data set were occupied from the Early Archaic (8,000-5,000 cal BP) through the Terminal Prehistoric (700-150 cal BP) periods. Three hearths at 26Wa1606 produced conventional radiocarbon dates of 2980±40 ^{14}C BP (3,324-3,004 cal BP), 3070±40 ^{14}C BP (3,370-3,175 cal BP), and 3140±40 ^{14}C BP (3,449-3,247 cal BP) (Bowers 2006) (calibrated at 2σ with CALIB Version 7.0 [Stuiver et al. 2013]). A rock ring at 26Wa1609 yielded a radiocarbon date of 1380±100 ^{14}C BP (1,521-1,068 cal BP), while a later date of 500±90 ^{14}C BP (662-318 cal BP) was obtained from charcoal at the bottom of one of the rock rings at 26Wa5610 (Delacorte 1997b) (calibrated at 2σ with CALIB Version 7.0 [Stuiver et al. 2013]). Overall, there appears to have been intensifications in use during the Early to Late Martis phases (5,000-1300 cal BP) and again during the Late Kings Beach Phase (700-150 cal BP) (Delacorte 1997b, Zeanah 2009).

While most sites within the Pah Rah Range had occupations spanning the entire Archaic Period, two sites may have had more limited occupations. Based on diagnostic projectile point types and obsidian hydration data, 26Wa5612 appears to have only been occupied during the Late Archaic Period (1,350-700 cal BP) (Delacorte 1997b). Based on limited obsidian hydration data, the presence of a dart-sized point, and the character of the milling assemblage, Neidig and Clay (2009) cautiously suggest a Middle Archaic

(3,500-1,300 cal BP) age for 26Wa8451. At least three sites may have also had occupations into the historic period. The artifact assemblage at 26Wa1608 included a metal awl tip cached in one of the feature walls, a second piece of metal, and a button (Rusco 1981). Bone tools, metal, and a glass bead were recovered from 26Wa1609 (Delacorte 1997b). Finally, McLane (1994:4) notes that along with the prehistoric artifacts, cut nails and pre-1900s glass fragments were also present at 26Wa1612.

The Valley Data Set

The valley data set includes 118 artifacts from eight sites in the valleys below the Pah Rah Range (Table 3.4). This data set combines data from previously published works (Skinner and Davis 1996; Stoner et al. 2006) and artifacts submitted for XRF analysis specifically for this thesis. Four of the eight sites (26Wa1416, 26Wa2065, 26Wa3017, and 26Wa7522) have been interpreted as winter villages (Miller and Elston 1979; Stoner et al. 2006; Townsend and Elston 1975; Zeier and Elston 1986). The remaining four sites (26Wa2201, 26Wa5604, 26Wa5606 and the Frear site) are lithic scatters. The valley sites provide a diversity of site types, allowing for investigations into the roles that site type, location, and occupation intensity played in the selection, use, and discard of FGV toolstone and tools. Location is particularly noteworthy for two of the valley sites. 26Wa1416 is situated closest to a known raw material source (Steamboat Hills), providing an opportunity to examine the role that proximity to toolstone played in raw material procurement choices. The Vista site (26Wa3017) is also important because while it shares many characteristics with the other valley sites, it is technically within the

Pah Rah Range, albeit at a much lower elevation. As such, it may provide an interpretive link between two areas.

Table 3.4. The Valley Data Set.

Site Number	Projectile points	Bifaces	Flake tools	Cores	Hammerstones	Debitage	Other	Total
26Wa1416	2	2	-	-	-	2	-	**6**
26Wa2065(Glendale)	9	11	2	1	2	10	1	**36**
26Wa2201	3	1	-	-	-	-	-	**4**
26Wa3017 (Vista)	16	19	5	-	-	3	-	**43**
26Wa5604	2	-	-	-	-	-	-	**2**
26Wa5606	1	2	-	-	-	1	-	**4**
26Wa7522 (Daylight Site)	6	7	-	-	-	-	-	**13**
Frear Site	4	3	1	1	-	1	-	**10**
Total	**43**	**45**	**8**	**2**	**2**	**17**	**1**	**118**

The four sites identified as winter villages are all located near major streams and rivers in the Truckee Meadows. 26Wa1416 is located along Steamboat Creek in south Reno. The Daylight, Glendale, and Vista sites are located along the Truckee River at even intervals across the valley. Like the larger sites in the Pah Rah Range, specialized features and artifact types at these village sites reflect a variety of procurement and processing tasks. All four sites have storage and cache pits (Miller and Elston 1979; Stoner et al. 2006; Townsend and Elston 1975; Zeier and Elston 1986). Burials are present at 26Wa1416 and the Vista and Daylight sites (Stoner et al. 2006; Townsend and Elston 1975; Zeier and Elston 1986). Vista also has the first intact dog burial recovered in Nevada (Dansie and Schmitt 1986:241). The three sites along the Truckee – Vista, Glendale, and Daylight – each have house pits and hearths.

With the exception of 26Wa1416, these winter villages were occupied from at least the Early Archaic (8,000-5,000 cal BP) through the Terminal Prehistoric (700-150 cal BP) periods. Occupations at 26Wa1416 date to the latter end of this range, with the oldest deposits dating to the Late Martis Phase (3,000-1,300 cal BP) and continuing through historic contact (Townsend and Elston 1975:18). Glendale was occupied at least intermittently from the Spooner Phase (8,000-5,000 cal BP) through the historic period, with relatively high occupation during the Late Martis Phase (3,000-1,300 cal BP) and highest occupation during the Early Kings Beach Phase (1,300-700 cal BP) (Miller and Elston 1979). A date of 5,310-4,980 cal BP from a hearth in the lowest level of the Daylight site places its initial occupation at the end of the Spooner Phase (8,000-5,000 BP) (Ringhoff and Stoner 2011:32). The site was occupied intermittently throughout the Archaic Period, with intensive use during the Early Kings Beach Phase (1,300-700 cal BP) (Stoner et al. 2006). Analysis of temporally diagnostic projectile points indicated that the Vista site was likely only intermittently occupied prior to 3,250 cal BP (Zeier and Elston 1986). Radiocarbon dates from house pits at the Vista site range from 1320±230 ^{14}C BP (1,705-767 cal BP) to 770±70 ^{14}C BP (903-560 cal BP), supporting a primary occupation concomitant with the Early Kings Beach Phase (1,300-700 cal BP) (Zeier and Elston 1986).

Stoner et al. (2006) suggest that the location of hearths inside Early Kings Beach Phase house pits at the Daylight site reflects winter occupations while the large amount of flaked and ground stone artifacts reflects a stable residential pattern. An overall decrease in mobility was also noted at the Vista site. Zeier and Elston (1986:379) suggest that the overall assemblage and site settlement strategy there, especially during the Early Kings Beach Phase, best approximates Bettinger and Baumhoff's (1982) "processor" strategy in which low ranked, high cost resources are targeted; however, they stop short of suggesting that it was a shift from a "traveler" to a "processor" strategy that allowed the Washoe, whose territory still includes the Truckee Meadows today, to be the only group in the Great Basin not replaced during the proposed Numic expansion (Zeier and Elston 1986:379).

The remaining four sites in the valley data set are lithic scatters. 26Wa2201, 26Wa5604, and 26Wa5606 are within Spanish Springs Valley and are all generally sparse and surficial (Bloomer 1994; McGuire 1997; Price et al. 1994). 26Wa5604 is notable in that it provided the oldest projectile points in either data set (two Great Basin Stemmed points). The Frear site is a more extensive lithic scatter located at the mouth of Spanish Springs Canyon on the west front of the Pah Rah Range (Gary Haynes, personal communication, 2012). Like the Vista site, its proximity to the Pah Rah Range should provide a good comparison to the upland sites. Together, these four lithic scatters cover reflect a range of human occupation spanning from the Pre-Archaic (>10,000-8,000 cal BP) to the Late Archaic (1,300-700 cal BP) periods.

Summary

Human use of the Pah Rah Range dates from to at least the Middle Archaic (3,500-1,300 cal BP) to the Terminal Prehistoric (700-150 cal BP) periods, with both logistical and residential patterns of mobility within the upland areas somewhat distinct from the surrounding valleys (Delacorte 1997b). Delacorte (1997b) describes shifts in use of the Pah Rah Range from logistical hunting forays during the Middle Archaic Period to logistical exploitation of both plants and animals during the Late Archaic Period, and finally an intensification of use and increased residential occupations during the Terminal Prehistoric Period. The 10 sites selected for my thesis exemplify this range of use and include habitation sites with substantial rock rings and extensive petroglyphs as well as more task-specific resource procurement and processing sites. The sites are also situated within a series of distinct lithic terranes. There are only two toolstone sources within 15 km of the most southern site, and only three obsidian sources within 100 km of the sites. Of the other 13 known sources within 100 km of the Pah Rah Range, 12 are FGV. Of a sample of 16 regional sources that may have been used in the area, all but two are obsidian. In effect, the Pah Rah Range is situated in an almost exclusively FGV source area between two fairly well known obsidian source areas: one to the north that includes South Warners, Massacre Lake/Guano Valley, and Buffalo Hills and one to the south that includes Bodie Hills, Mt. Hicks, Mono and Casa Diablo. Based on this information, the research questions and hypotheses presented in Chapter 1 can be further developed with the following expectations (Table 3.5).

Table 3.5. Summary of Research Questions, Hypotheses, and Expectations.

Research Question	Hypothesis	Expectation(s)
What is the range of FGV sources used by prehistoric peoples within the Pah Rah Range?	Groups in the Pah Rah Range primarily utilized local FGV toolstone	Steamboat/Lagomarsino should dominate Pah Rah assemblages
Are there identifiable and significant patterns of source use that are unique to sites within the Pah Rah Range?	Certain FGV sources were preferred for certain tools, whether due to toolstone quality or proximity to source	The proportions of sources used for different tool classes should be significantly different, with higher quality FGV toolstone preferred for formal tools and both high and lower quality FGV toolstone used for informal tools
	Lithic technological organization differed substantially between sites in the Pah Rah Range and those on the nearby valley floor	The toolstone source profile for Pah Rah sites should differ significantly from the valley floor source profile
Based on this source information, how does FGV use in the Pah Rah Range fit with current models of toolstone conveyance in the western Great Basin?	Pah Rah Range sites reflect similar conveyance zones to those described for other sites in the western Great Basin.	FGV toolstone comes from sources in the same distances and directions as those used at other nearby sites, reflecting predominantly north-south long distance toolstone movement

CHAPTER 4 – RESULTS OF X-RAY FLUORESCENCE ANALYSIS

This chapter presents the results of XRF analysis of 303 artifacts from 18 sites in northern Nevada. The primary data set is comprised of 10 sites within the Pah Rah Range, the majority of which are habitation and complex resource procurement and processing sites. These sites share a similar environment and have many features in common including stacked rock rings and extensive petroglyph panels. They evidence a persistent, though varied, investment in place and provide a rich archaeological record from which to draw. Though prior research has been conducted in the Pah Rah Range (e.g., Delacorte 1997a, 1997b; Delacorte et al. 1995a, 1995b; Rusco 1969a, 1981; Stephenson 1968; Zeanah 2009), few efforts have included XRF sourcing of FGV artifacts. My research fills that gap and permits the hypotheses outlined in Chapter 3 to be tested.

The valley data set is comprised of eight sites from the valleys west and southwest of the Pah Rah Range. These sites are somewhat more diverse in function and environment and include several intensively occupied winter villages located along the Truckee River as well as smaller lithic scatters and resource procurement locations. The valley data set will help situate the patterns of FGV use in the Pah Rah Range data set within a broader regional context.

Pah Rah Data Set Results

The Pah Rah data set includes 185 artifacts collected from 10 sites (Table 4.1).

Table 4.1. XRF Source Results for the Pah Rah Data Set by Site.

Chemical Source Group	26Wa1604	26Wa1606	26Wa1608	26Wa1609	26Wa1612	26Wa5610	26Wa5611	26Wa5612	26Wa5638	26Wa8451	Total
Alder Hill	3	1	3	1	1	1	-	-	-	-	**10**
Gold Lake	3	-	3	-	-	1	-	-	-	-	**7**
Siegfried Canyon Ridge	-	-	1	-	-	-	-	-	-	-	**1**
Steamboat/Lagomarsino	9	4	33	17	2	3	-	3	4	1	**76**
Unknown A	6	3	7	7	-	2	3	3	1	-	**32**
Unknown B	1	-	2	-	-	2	1	1	1	3	**11**
Unknown C	2	-	1	-	-	1	-	-	-	-	**4**
Unknown D	2	1	-	-	-	-	-	-	-	-	**3**
Unknown F	-	1	-	-	-	-	-	-	-	-	**1**
Unknown G	-	1	-	1	-	-	-	-	-	-	**2**
Unknown	9	5	4	6	2	-	2	2	2	4	**36**
Not FGV	1	-	1	-	-	-	-	-	-	-	**2**
Total	**36**	**16**	**55**	**32**	**5**	**10**	**6**	**9**	**8**	**8**	**185**

Roughly half (n=94) of the artifacts are manufactured from four known chemical groups: Alder Hill, Gold Lake, Siegfried Canyon Ridge, and Steamboat/Lagomarsino. Steamboat/Lagomarsino is the most well-represented with 80% (n=76) of the artifacts belonging to this chemical group. In addition to the four known sources, six geochemically distinct but geographically unknown sources were identified by Northwest Research. These six unknown groups represent 28.6% (n=53) of the sample. Thirty-six artifacts could not be associated with either a known or distinct unknown chemical group and two were determined not to be FGV. Of the previously known chemical groups, Steamboat/Lagomarsino is the most common in the Pah Rah data set, showing up at all but one of the sites. Alder Hill is present at just over half the sites but in much lower frequencies. Of the chemically distinct unknown sources, Unknown A is the most common, both in terms of artifact number (n=32) and the number of sites at which it occurs (n=8). Unknown B is the next most common (n=11); it is present at seven sites.

When artifact type is considered, several patterns are evident (Table 4.2). Formal tools (e.g., projectile points, bifaces, drills) are predominantly manufactured on the four previously known chemical source groups. Informal tools and debitage are predominantly made on unknown sources and/or Steamboat/Lagomarsino. Only three chemically distinct unknowns are present as both cores and debitage.

Table 4.2. XRF Source Results for the Pah Rah Data Set by Artifact Type.

Chemical Source Group	**Projectile points**	**Bifaces**	**Flake tools**	**Cores**	**Hammerstones**	**Drills, Awls, Scrapers**	**Debitage**	**Other**	**Total**
Alder Hill	5	2	-	-	-	1	2	-	**10**
Gold Lake	3	3	-	-	-	1	-	-	**7**
Siegfried Canyon Ridge	1	-	-	-	-	-	-	-	**1**
Steamboat/Lagomarsino	20	30	8	-	-	6	12	-	**76**
Unknown A	-	-	8	8	2	-	14	-	**32**
Unknown B	-	-	-	2	-	-	9	-	**11**
Unknown C	-	-	-	1	-	-	3	-	**4**
Unknown D	-	-	-	-	1	-	2	-	**3**
Unknown F	-	-	-	-	-	-	1	-	**1**
Unknown G	-	-	-	-	-	-	2	-	**2**
Unknown	2	2	7	2	-	2	19	2	**36**
Not FGV	-	-	-	-	-	-	1	1	**2**
Total	**31**	**37**	**23**	**13**	**3**	**10**	**65**	**3**	**185**

Nearly all of the projectile points within the Pah Rah range data set are made on known sources (Table 4.3). These include Pinto, Elko, Martis, and Rosegate points, as well as several indeterminate dart- and arrow-sized points (Figure 4.1).

Table 4.3. XRF Source Results for Pah Rah Projectile Points.

Chemical Source Group	Pinto Series	Elko Series	Martis Series	Rosegate Series	Indeterminate Dart	Indeterminate Arrow	Total
Alder Hill	1	-	-	3	1	-	**5**
Gold Lake	-	-	1	1	1	-	**3**
Siegfried Canyon Ridge	-	-	1	-	-	-	**1**
Steamboat/Lagomarsino	-	7	4	1	7	1	**20**
Unknown	-	2	-	-	-	-	**2**
Total	**1**	**9**	**6**	**5**	**9**	**1**	**31**

Figure 4.1. Representative projectile points from the Pah Rah Range data set.

Steamboat/Lagomarsino is the dominant chemical source group represented among projectile points; however, when point type is taken into consideration, it appears that Steamboat/Lagomarsino may not have been used consistently through time. Of the 25 dart points in the data set, 72% (n=18) were manufactured from Steamboat/ Lagomarsino FGV. Of the six arrow points in the data set, only 33.3% were identified as Steamboat/Lagomarsino, while 50% were identified as Alder Hill. A two-tailed Fisher's exact test comparing the known sources for dart and arrow points indicates that there may be a slight decrease in the use of Steamboat/Lagomarsino as opposed to more distant sources later in time, although this difference is not statistically significant when $\alpha = .05$ (p=.056). The only two projectile points made from unknown sources within the Pah Rah Range data set are both Elkos (an Elko Corner-notched point from 26Wa1608 and an Elko Eared point from 26Wa1609). The remaining seven Elko points are all made from Steamboat/Lagomarsino FGV. If these two unknown points are included in the two-tailed Fisher's exact test, this possible shift away from Steamboat/Lagomarsino is still not statistically significant (p=.151).

The two Elko points made on unknown sources are particularly relevant because whether they are made from local sources or not affects the results of comparisons of local toolstone use across time. For instance, if both unknowns are distant sources, or if one is local and one is distant, then there is no significant difference in the use of local vs. distant sources across time (p=.151 and p=.067, respectively). However, if both unknowns are local sources, then a two-tailed Fisher's exact test indicates that there is a statistically significant decrease in local FGV source use for projectile point production across time (*p*=.043). Unfortunately, it is not possible to determine which of these possibilities is the case at this time.

Based on these results, Steamboat/Lagomarsino and Gold Lake FGV appear to have been used in the Pah Rah Range from at least the Early Martis Phase (5,000-3,000 cal BP) through the Early Kings Beach Phase (1,300-700 cal BP). Alder Hill was used from the Late Martis Phase (3,000-1,300 cal BP) to the Early Kings Beach Phase. Only one projectile point, a Martis Corner-notched point from 26Wa1608, was manufactured from Siegfried Canyon Ridge FGV. This artifact is notable in that it was broken and extensively reworked to produce a drill-like tip (Figure 4.2). Based on this single artifact, Siegfried Canyon Ridge FGV can be inferred to have been used in the Pah Rah Range at least during the Late Martis Phase.

Figure 4.2. Martis Corner-notched point reworked into drill, manufactured on Siegfried Canyon Ridge FGV (Artifact 1608-270).

The sample of bifaces within the Pah Rah data set is similarly dominated by Steamboat/Lagomarsino FGV (Table 4.4). Of the 37 bifaces, 81.1% (n=30) were manufactured from this chemical source group. Of the three more distant known sources, only Alder Hill and Gold Lake FGV are represented in the sample. Only two bifaces are made from unknown sources. The bifaces within the data set are predominantly mid- to late-stage, with 62.2% (n=23) classified as Stage 4 and Stage 5.

Table 4.4. XRF Source Results for Pah Rah Bifaces.

Chemical Source Group	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Total
Alder Hill	-	-	-	2	-	**2**
Gold Lake	-	1	1	-	1	**3**
Steamboat/Lagomarsino	-	3	7	10	10	**30**
Unknown	-	1	1	-	-	**2**
Total	**0**	**5**	**9**	**12**	**11**	**37**

Steamboat/Lagomarsino is also well represented for the other formal tool types within the Pah Rah data set (Table 4.5). The three awls have the greatest range of sources represented, with one specimen each made on Alder Hill, Gold Lake, and Steamboat/Lagomarsino FGV. Three of the five scrapers and both drills were manufactured on Steamboat/Lagomarsino FGV. The remaining two scrapers were made on material from unknown sources.

Table 4.5. XRF Source Results for Other Pah Rah Formal Tools.

Chemical Source Group	Awls	Scrapers	Drills	Total
Alder Hill	1	-	-	**1**
Gold Lake	1	-	-	**1**
Steamboat/Lagomarsino	1	3	2	**6**
Unknown	-	2	-	**2**
Total	**3**	**5**	**2**	**10**

The source profile of informal flake tools in the Pah Rah data set differs somewhat from that of formal tools. Whereas Steamboat/Lagomarsino FGV dominates the projectile point and biface samples, most (68.1%; n=15) informal flake tools were manufactured from unknown sources, with slightly more than half (53.3%; n=8) classified as Unknown A FGV (Table 4.6).

Table 4.6. XRF Source Results for Pah Rah Flake Tools.

Chemical Source Group	**Formal**	**Informal**	**Total**
Steamboat/Lagomarsino	1	7	**8**
Unknown A	-	8	**8**
Unknown	-	7	**7**
Total	**1**	**22**	**23**

Among bulkier artifacts such as cores, hammerstones, and choppers, the difference in lithic raw material choice is even more striking (Table 4.7). No known geochemical sources are represented in these tool classes. Instead, 87.5% (n=14) are grouped within four of the eight chemically distinct but geographically unknown FGV sources identified by Northwest Research during this study. Of these, Unknown A FGV is dominant, representing 62.5% (n=10) of the sample and 66.7% (n=8) of the cores.

Table 4.7. XRF Source Results for Pah Rah Cores, Hammerstones, and Choppers.

Chemical Source Group	Bifacial Cores	Unidirectional Cores	Multidirectional Cores	Hammerstones	Choppers	Total
Unknown A	1	2	5	2	-	**10**
Unknown B	1	1	-	-	-	**2**
Unknown C	1	-	-	-	-	**1**
Unknown D	-	-	-	1	-	**1**
Unknown	1	-	-	-	1	**2**
Total	**4**	**3**	**5**	**3**	**1**	**16**

Sixty-five pieces of debitage were included in the data set to determine which raw materials were reduced at the Pah Rah sites and what degree of reduction (e.g., initial cobble reduction vs. tool finishing) was completed before artifacts were transported to the study area (Table 4.8).

Table 4.8. XRF Source Results for Pah Rah Debitage.

Chemical Source Group	Exterior Core Reduction	Interior Core Reduction	Early Biface Thinning	Late Biface Thinning	Shatter	Fragment	No Data	Total
Alder Hill	-	1	-	1	-	-	-	**2**
Steamboat/Lagomarsino	-	1	5	3	1	2	-	**12**
Unknown A	2	6	2	1	3	-	-	**14**
Unknown B	2	5	-	-	-	-	2	**9**
Unknown C	-	3	-	-	-	-	-	**3**
Unknown D	-	2	-	-	-	-	-	**2**
Unknown F	-	-	1	-	-	-	-	**1**
Unknown G	-	-	1	-	-	1	-	**2**
Unknown	3	4	6	4	-	-	2	**19**
Not FGV	-	1	-	-	-	-	-	**1**
Total	**7**	**23**	**15**	**9**	**4**	**3**	**4**	**65**

Most flakes sampled (76.9%; n=50) are from unknown sources. Among these, 31 are assigned to six of the eight chemically distinct unknowns, almost half of which (45.2%; n=14) are classified as Unknown A FGV. An additional 29.0% (n=9) were classified as Unknown B FGV. A two-tailed Fisher's exact test comparing the three chemically distinct unknowns common to both cores and debitage (Unknowns A, B, and C) indicates no significant difference (p=.667), which may indicate that the cores were manufactured, used, and discarded at the sites rather than being transported to the sites in already reduced form. The general lack of debitage from known sources suggests that tools such as projectile points and bifaces were brought to the sites primarily in finished or nearly finished form.

Both core reduction and biface thinning are present at Pah Rah sites. Of the 29 FGV core reduction flakes sampled, only 7.4% (n=2) are from known sources. Of the 24 FGV biface thinning flakes, 60% (n=9) are from known sources. These data correspond with patterns in the tool sample, with projectiles, bifaces, and other formal tools predominantly manufactured from the four known source groups and more expedient tools and cores produced primarily from unknown FGV sources. Interestingly, the presence of biface thinning flakes from Unknown A suggests that even though no bifaces in the Pah Rah data set were identified from that source, it may still have been used to produce bifacial tools that were ultimately transported offsite (*sensu* Eerkens et al. 2007).

The "other" category includes a charmstone from 26Wa1606, a uniface from 26Wa1604, and a geologic sample from an outcrop at 26Wa8451. Of these, the uniface proved not to be FGV, and the charmstone and geologic sample could not be assigned to any known or distinct unknown chemical source groups. The geologic sample is of particular interest as it may be used to help identify, or rule out, the locations of the chemically distinct unknowns that were identified during this research.

Valley Data Set Results

The valley data set includes 118 artifacts from eight sites (Table 4.9).

Table 4.9. XRF Source Results for Valley Data Set by Site.

Chemical Source Group	**26Wa1416**	**26Wa2065**	**26Wa2201**	**26Wa3017**	**26Wa5604**	**26Wa5606**	**26Wa7522**	**Frear**	**Total**
Alder Hill	1	4	-	6	-	-	5	-	**16**
Gold Lake	-	3	1	4	1	1	4	1	**15**
Siegfried Canyon Ridge	-	-	1	3	1	-	-	-	**5**
Steamboat/Lagomarsino	4	16	2	16	-	2	2	6	**48**
Unknown A	-	-	-	-	-	-	-	2	**2**
Unknown B	-	-	-	1	-	-	-	-	**1**
Unknown C	-	-	-	3	-	-	-	-	**3**
Unknown E	-	-	-	3	-	-	-	-	**3**
Unknown F	-	-	-	1	-	-	-	-	**1**
Unknown H	-	1	-	2	-	-	-	-	**3**
Unknown	1	11	-	4	-	1	-	1	**18**
Not FGV	-	1	-	-	-	-	2	-	**3**
Total	**6**	**36**	**4**	**43**	**2**	**4**	**13**	**10**	**118**

As with the Pah Rah data set, most of the valley data set artifacts (71.2%; n=84) are made on the same four known chemical source groups: Alder Hill; Gold Lake; Siegfried Canyon Ridge; and Steamboat/Lagomarsino. Steamboat/Lagomarsino is again dominant, representing 57% of the artifacts from known chemical source groups and 40.7% of the entire data set. Six of the eight chemically distinct unknowns are present in the valley data set; however, the distribution of these is not uniform. Artifacts from only three sites (26Wa2065, 26Wa3017, and the Frear site) are made on those six unknowns, with the majority (83.3%; n=10) coming from 26Wa3017. This trend is undoubtedly partly a result of sampling bias. Many sites within the valley data set have smaller samples, and one, 26Wa7522, which has been included from previous research (Stoner et al. 2006), includes only projectile points and bifaces.

The effect of this sampling bias is even more apparent when the XRF results are sorted by artifact type (Table 4.10). Of the 88 projectile points and bifaces in the valley data set, 89.8% (n=79) are made on Alder Hill, Gold Lake, Siegfried Canyon Ridge, and Steamboat/Lagomarsino FGV.

Table 4.10. XRF Source Results for Valley Data Set by Artifact Type.

Chemical Source Group	**Projectile points**	**Bifaces**	**Flake tools**	**Cores**	**Hammerstones**	**Drills**	**Debitage**	**Total**
Alder Hill	7	8	-	-	-	1	-	**16**
Gold Lake	12	3	-	-	-	-	-	**15**
Siegfried Canyon Ridge	2	3	-	-	-	-	-	**5**
Steamboat/Lagomarsino	22	22	1	-	-	-	3	**48**
Unknown A	-	-	-	1	-	-	1	**2**
Unknown B	-	-	1	-	-	-	-	**1**
Unknown C	-	-	1	-	-	-	2	**3**
Unknown E	-	2	1	-	-	-	-	**3**
Unknown F	-	-	1	-	-	-	-	**1**
Unknown H	-	3	-	-	-	-	-	**3**

Table 4.10. XRF Source Results for Valley Data Set by Artifact Type.

Chemical Source Group	Projectile points	Bifaces	Flake tools	Cores	Hammerstones	Drills	Debitage	Total
Unknown	-	2	3	1	2	-	10	**18**
Not FGV	-	2	-	-	-	-	1	**3**
Total	**43**	**45**	**8**	**2**	**2**	**1**	**17**	**118**

As is the case with the Pah Rah Range data set, Steamboat/Lagomarsino is the most well-represented FGV source in the valley data set, comprising exactly half of the sample. In contrast to the Pah Rah Range data set, however, the proportions of the other three known source groups with respect to projectile points and bifaces appear more balanced. Alder Hill and Gold Lake FGV each represent 17.0% (n=15) of the sample and Siegfried Canyon Ridge FGV represents 5.7% (n=5); however, a two-tailed Fisher's exact test indicates that there is no significant difference in source distribution between the two data sets (*p*=.910). Only a handful of other artifacts within the valley data set are made from known chemical source groups. These include a drill manufactured from Alder Hill FGV (Figure 4.3), a flake tool, and three pieces of debitage made from Steamboat Hills/Lagomarsino FGV.

Figure 4.3. Formal drill manufactured on Alder Hill FGV (Artifact 2065-10).

Though the valley data set is smaller than the Pah Rah Range data set, it nevertheless contains both a larger number and wider range of projectile points (Table 4.11) including two Great Basin Stemmed points (Figure 4.4) and Humboldt, Pinto, Elko, Martis, Rosegate, and Gunther series points (Figure 4.5).

Table 4.11. XRF Source Results for Valley Projectile Points.

Chemical Source Group	Great Basin Stemmed	Humboldt Series	Pinto Series	Elko Series	Martis Series	Rosegate Series	Gunther Series	Indeterminate Dart	Indeterminate Arrow	Total
Alder Hill	-	-	-	3	2	2	-	-	-	**7**
Gold Lake	1	1	-	2	5	1	1	1	-	**12**
Siegfried Canyon Ridge	1	-	-	-	-	-	-	1	-	**2**

Table 4.11. XRF Source Results for Valley Projectile Points.

Chemical Source Group	Great Basin Stemmed	Humboldt Series	Pinto Series	Elko Series	Martis Series	Rosegate Series	Gunther Series	Indeterminate Dart	Indeterminate Arrow	Total
Steamboat/Lagomarsino	-	4	3	4	4	4	-	2	1	**22**
Total	**2**	**5**	**3**	**9**	**11**	**7**	**1**	**4**	**1**	**43**

Figure 4.4. Great Basin Stemmed points; 5604-3, manufactured from Siegfried Canyon Ridge FGV and 5604-6, manufactured from Gold Lake FGV.

Figure 4.5. Representative projectile points from the valley data set.

Steamboat/Lagomarsino FGV is represented in all point types except Great Basin Stemmed and Gunther and comprises 51.2% (n=22) of all points in the valley sample. Gold Lake FGV is also represented among most point types with the exception of Pinto, and was used to make 27.9% (n=12) of the valley data set. Alder Hill FGV is the next most common chemical source group at 16.3% (n=7) of the data set. It is only represented among Elko, Martis, and Rosegate series points. Only two points (a Great Basin Stemmed and an indeterminate dart-size point) are manufactured from Siegfried Canyon Ridge FGV.

With respect to FGV use through time, Gold Lake was used at valley sites from at least the Tahoe Reach Phase (11,500-8,000 cal BP) to the Early Kings Beach Phase (1,300-700 cal BP). Based on the two points made from Siegfried Canyon Ridge FGV in the data set, it was likely in use during the early portion of that range. Steamboat/Lagomarsino and Alder Hill FGV were used since at least the Early Martis Phase (5,000-3,000 cal BP) through the Early Kings Beach Phase. Unlike the Pah Rah Range sites, where a shift in FGV source use for projectile point manufacture may have occurred over time (though not significant at the $\alpha = .05$ level), a Fisher's exact test comparing darts and arrows from the four known FGV sources represented in the valley sample indicates that there was no significant change across time (p=.928).

The 45 bifaces within the valley data set reflect a wider range of chemical source groups than the Pah Rah Range data set and include a different distribution of biface stages as well (Table 4.12). All four previously known chemical source groups are represented in addition to two chemically distinct unknown FGV types (Unknowns E and H).

Table 4.12. XRF Source Results for Valley Bifaces.

Chemical Source Group	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**	**No Data**	**Total**
Alder Hill	-	1	-	1	3	3	**8**
Gold Lake	-	-	-	-	2	1	**3**
Siegfried Canyon Ridge	-	-	-	-	3	-	**3**
Steamboat/Lagomarsino	-	1	4	5	11	1	**22**
Unknown E	1	-	1	-	-	-	**2**
Unknown H	-	-	-	-	3	-	**3**
Unknown	2	-	-	-	-	-	**2**
Not FGV	-	-	-	-	-	2	2
Total	**3**	**2**	**5**	**6**	**22**	**7**	**45**

Bifaces manufactured from Gold Lake FGV have similar frequencies in both data sets (8.1% for the Pah Rah Range vs. 6.7% for the valley data set) but this is not the case for other materials. Whereas Steamboat/Lagomarsino FGV comprises 81.1% of the Pah Rah Range data set, it comprises only 48.9% (n=22) of the valley data set. Alder Hill FGV is more common in the valley sample (17.8% vs. 5.4% in the Pah Rah Range sample) and Siegfried Canyon Ridge FGV is present in the valley sample whereas it is absent in the Pah Rah Range sample. Unknown E and Unknown H FGV appear only in the valley data set and nearly exclusively as bifaces. Bootstrapping the valley data set bifaces (only known and chemically distinct unknown sources) produced a sample-size-adjusted diversity of 5.97, which is significantly more diverse than the three sources represented the Pah Rah Range biface sample (two-tailed test, p=.006).

The distribution of biface stages within the valley sample differs somewhat from the Pah Rah sample in that it is heavily weighted towards finished bifaces, but otherwise with a more even distribution of other biface stages. Interestingly, Gold Lake and Siegfried Canyon Ridge FGV are present only as Stage 5 bifaces (no information was available for the biface from 26Wa7255). Multiple stages of bifaces are made on Alder Hill and Steamboat/Lagomarsino FGV.

The sample of flake tools from the valley data set is substantially smaller than that from the Pah Rah sites, but it nevertheless has a wider range of sources (Table 4.13). All but one flake tool are informal, and the only previously known chemical source group represented is Steamboat/Lagomarsino FGV. All other flake tools are made from unknown sources, including one each from four of the chemically distinct unknown source groups (Unknown B, C, E, and F).

Table 4.13. XRF Source Results for Valley Flake Tools.

Chemical Source Group	Formal	Informal	Total
Steamboat/Lagomarsino	-	1	**1**
Unknown B	-	1	**1**
Unknown C	1	-	**1**
Unknown E	-	1	**1**
Unknown F	-	1	**1**
Unknown	-	3	**3**
Total	**1**	**7**	**8**

Of the two multidirectional cores and two hammerstones in the valley data set, only one core could be assigned to a chemically distinct source group (Table 4.14). It is also one of only two artifacts from the valley data set assigned to the Unknown A chemical group, which occurs at all but one Pah Rah Range site. Both of those artifacts – a core and an interior core reduction flake – are from the Frear site located at the mouth of Spanish Springs Canyon, which provides one of the main access routes into the southern Pah Rah Range.

Table 4.14. XRF Source Results for Valley Cores and Hammerstones.

Chemical Source Group	Multidirectional Cores	Hammerstones	Total
Unknown A	1	-	1
Unknown	1	2	3
Total	**2**	**2**	**4**

The sample of debitage from the valley data set is small (n=17) but it generally conforms to the patterns seen among other artifact types (Table 4.15). Of the four previously known chemical source groups within the data set, only Steamboat/Lagomarsino FGV is present and only as late biface thinning flakes. Two chemically distinct unknowns are present (Unknown A and C), but the majority (58.8%; n=10) of debitage is from unknown sources. When combined with the other artifacts in the data set, it is again apparent that though a fairly wide range of distinct FGV sources were used at the valley sites, groups depended on a handful of regionally important FGV sources to manufacture formal tools.

Table 4.15. XRF Source Results for Valley Debitage.

Chemical Source Group	**Exterior Core Reduction**	**Interior Core Reduction**	**Early Biface Thinning**	**Late Biface Thinning**	**Shatter**	**Fragment**	**No Data**	**Total**
Steamboat/Lagomarsino	-	-	-	3	-	-	-	**3**
Unknown A	-	1	-	-	-	-	-	**1**
Unknown C	-	1	-	-	-	1	-	**2**
Unknown	3	4	-	1	-	2	-	**10**
Not FGV	-	-	1	-	-	-	-	**1**
Total	**3**	**6**	**1**	**4**	**0**	**3**	**0**	**17**

Summary

Overall, the XRF data from both Pah Rah Range and valley sites are robust enough to address the research questions posed in this thesis and test the hypotheses outlined in Chapter 3 and revisited in the next chapter. Though only just over half (58.7%) of the artifacts could be assigned to a previously known source group, 80.5% of them could nevertheless be assigned to a chemically distinct, if still geographically unknown, source group. When only tools are considered, this number rises to 88.5% of artifacts submitted for geochemical characterization. For projectile points, 97% are made from previously known source groups.

Among the 178 artifacts from the combined Pah Rah Range and valley data sets made on previously known FGV chemical source groups, Steamboat/Lagomarsino FGV is the most dominant by far, representing 69.7% of artifacts from known chemical source groups and 40.9% of all artifacts. Alder Hill FGV is the next most common, representing 8.6% of all artifacts. Gold Lake FGV comprises 7.3% of the collection while Siegfried Canyon Ridge FGV represents only 2.0%. An additional eight geochemically distinct but geographically unknown source groups were identified. These unknown groups have not been described fully and their physical locations have yet to be identified; however, with 66 artifacts made on them, they represent a substantial proportion (21.8%) of the combined data set.

These 12 chemical source groups are not distributed evenly within or across the two data sets. Table 4.16 summarizes the distribution of these source groups within each site in the two data sets. A couple patterns are immediately evident. First, in addition to being the most common FGV type, Steamboat/Lagomarsino is the most ubiquitous source group and is present at all but two sites. Second, although more frequent in the valley data set, Alder Hill FGV is present at more Pah Rah sites (six vs. four sites). Third, Gold Lake FGV is present at all but one valley site and at twice the frequency as in the Pah Rah sites. Finally, Siegfried Canyon Ridge FGV is the least common of the four known chemical source groups, represented by only six artifacts at four sites.

Table 4.16. Chemical Source Group Distribution by Site.

	Pah Rah Data Set										Valley Data Set							
Chemical Source Group	**26Wa1604**	**26Wa1606**	**26Wa1608**	**26Wa1609**	**26Wa1612**	**26Wa5610**	**26Wa5611**	**26Wa5612**	**26Wa5638**	**26Wa8451**	**26Wa1416**	**26Wa2065**	**26Wa2201**	**26Wa3017**	**26Wa5604**	**26Wa5606**	**26Wa7522**	**Frear**
Alder Hill	+	+	+	+	+	+	-	-	-	-	+	+	-	+	-	-	+	-
Gold Lake	+	-	+	-	-	+	-	-	-	-	-	+	+	+	+	+	+	+
Siegfried Canyon Ridge	-	-	+	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-
Steamboat/Lagomarsino	+	+	+	+	+	+	-	+	+	+	+	+	+	+	-	+	+	+
Unknown A	+	+	+	+	-	+	+	+	+	-	-	-	-	-	-	-	-	+
Unknown B	+	-	+	-	-	+	+	+	+	+	-	-	-	+	-	-	-	-
Unknown C	+	-	+	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-
Unknown D	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown E	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Unknown F	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Unknown G	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown H	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-
Unknown	+	+	+	+	+	-	+	+	+	+	+	+	-	+	-	+	-	+

A chi-square test comparing all tools from all the known FGV sources is not valid because two cells have expected values less than 5. A two-tailed Fisher's exact test comparing just Alder Hill, Gold Lake, and Siegfried Canyon Ridge (the three extra-local FGV sources) indicates that there is no significant difference in the distribution of those sources between Pah Rah Range and valley sites (p=.717). A chi-square test combining all extra-local FGV sources to compare them with the distributions of Steamboat/Lagomarsino FGV indicates that Steamboat/Lagomarsino is overrepresented in the Pah Rah Range data set and underrepresented in the valley data set (χ^2=10.06, df=1, p=.002). This result is particularly interesting as the valley sites are as a whole closer to Steamboat/Lagomarsino quarries than the Pah Rah Range sites.

Within both data sets, Steamboat/Lagomarsino FGV is the dominant chemical source group for projectile points and bifaces; however, as noted the overall proportion and diversity of sources used differs between the two data sets (Figures 4.6 and 4.7).

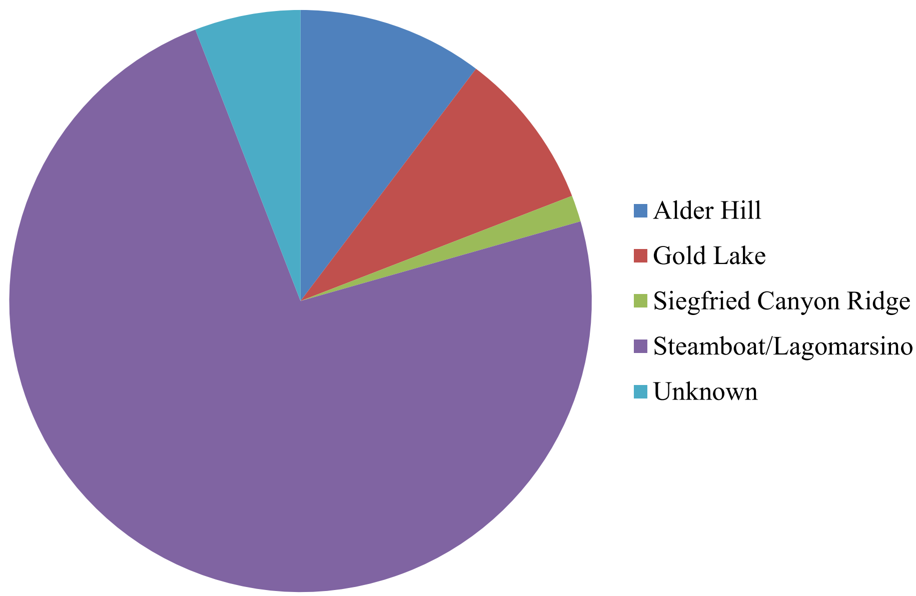

Figure 4.6. Proportional distribution of FGV chemical source groups within Pah Rah data set.

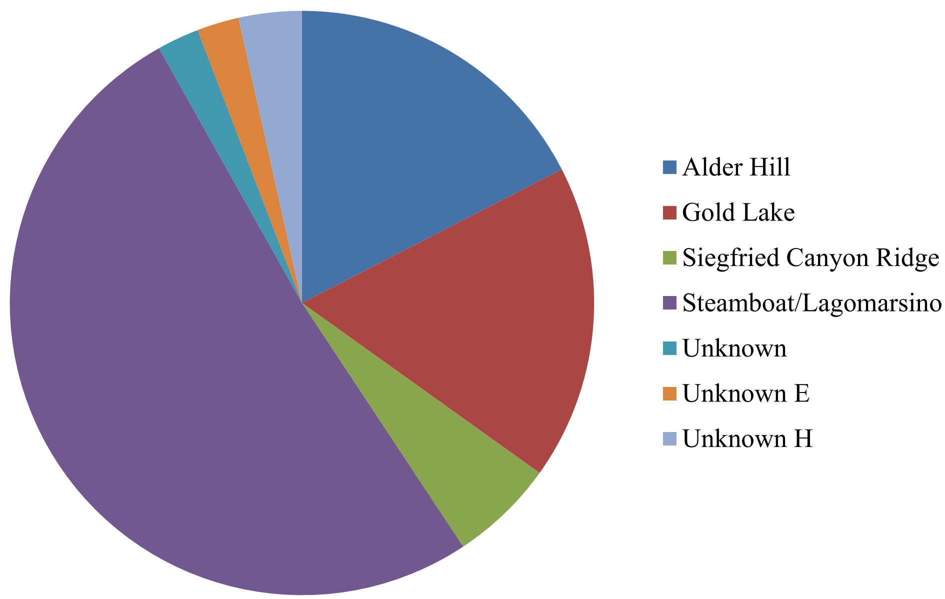

Figure 4.7. Proportional distribution of chemical source groups within valley data set.

In the Pah Rah Range data set, Steamboat/Lagomarsino FGV makes up nearly 75% of the toolstone used to make projectile points and bifaces, while Alder Hill and Gold Lake FGV make up approximately 10% each. Siegfried Canyon Ridge FGV and the category of general unknown FGV round out the distribution. For the valley data set, Steamboat/Lagomarsino FGV makes up just over half of the toolstone represented. As is the case with the Pah Rah Range sites, Alder Hill and Gold Lake FGV are present in similar numbers but at nearly double the proportion than that in the Pah Rah data set.

Interpreting the chemically distinct unknowns (Unknown A-H) is less straightforward. At first glance, it appears that the Pah Rah data set reflects greater overall use of these unknowns, but this may in part reflect sampling biases within the valley data set, which depended partially on existing information and collection availability. A two-tailed Fisher's exact test comparing all artifacts from the distinct unknown sources represented in both data sets (Unknowns A, B, C, and F) indicates that there is a significant difference in those distributions (*p*=.026).

Within the Pah Rah Range data set, formal tools are nearly exclusively manufactured from the four previously known chemical source groups, whereas informal and expedient tools are predominantly manufactured from unknown sources. Previous sourcing efforts (e.g., Skinner and Davis 1997; Stoner et al. 2006) disproportionately targeted projectile points and bifaces, and several of the available valley site collections from were smaller in size and variety of FGV artifacts. As such, the sample of informal and expedient tools from valley sites is smaller than that from Pah Rah Range sites.

The exception to this trend is the selection of artifacts from 26Wa3017. 20Wa3017 exhibits a pattern much more like the Pah Rah Range sites, where formal tools are predominantly made from the four previously known FGV source groups while expedient and informal tools are predominantly made from a range of currently unknown FGV sources many of which are also represented at Pah Rah Range sites. The location of 26Wa3017 in the foothills of the southern Pah Rah Range and overall similarity in general artifact distribution suggests that it may represent part of the same settlement and lithic procurement system; however, the lack of comparative material in the valley data set makes it difficult to determine if the pattern is a regional manifestation.

Of the chemically distinct unknown FGVs, Unknown A is the most common (10.9% of the combined data set), occurring at all but two Pah Rah sites as well as one valley site. Though it is only represented among informal and expedient tools, its abundant and concentrated distribution suggest that it may be a local source within the Pah Rah Range. Unknowns B, C, and D are also likely local FGV sources, but without a better sample of valley sites, it is less clear whether they might be located within, or at least more local to, the Pah Rah Range. Unknown E and Unknown H were identified only in the valley data set. Interestingly, Unknown H is represented only as Stage 5 bifaces at 26Wa2065 and 26Wa3017. With both data sets following a pattern of preferential use of certain sources for formal tools, it is easy to speculate that Unknown H may represent a preferred, likely extra-local or regional, FGV source.

CHAPTER 5 – DISCUSSION

The goal of my research has been to determine the range of FGV sources present at archaeological sites in the Pah Rah Range as a means of examining overall patterns of toolstone use and, in turn, mobility in the western Great Basin. Specifically, I have focused on identifying FGV sources used at sites in the Pah Rah Range, determining whether there are trends of source use unique to sites within the Pah Rah Range, and comparing the distribution of FGV sources utilized at these sites against current models of toolstone conveyance in the western Great Basin. To this end, I developed four hypotheses and corresponding expectations addressing my research questions:

1. Groups in the Pah Rah Range primarily utilized local FGV toolstone sources;

2. Particular FGV sources were preferred for certain tool types, whether due to toolstone quality or location;

3. Lithic technological organization differed substantially between sites in the Pah Rah Range and those on the nearby valley floor; and

4. Pah Rah Range sites reflect similar conveyance zones to those described for other sites in the western Great Basin.

Using the XRF data presented in Chapter 4, I evaluate these hypotheses below.

FGV Source Representation at Pah Rah Range Sites

My first research question concerns the range of FGV sources used at Pah Rah Range sites. The Pah Rah Range is in a region nearly devoid of obsidian sources but relatively rich in FGV sources. The local lithic terrane (<15 km) for the Pah Rah Range is sparse and includes a single FGV source (Lagomarsino) and a single obsidian source (Patrick). Within the extra-local terrane (<100 km), there are an additional 15 known toolstone sources which could have been accessible through multi-day foraging trips. Of these, two are obsidian (Sutro and CB Concrete), one is CCS (Steamboat Sinter), and 12 are FGV. The closest FGV source is Steamboat Hills (which is chemically indistinguishable from Lagomarsino), located just southwest of Reno. Though it is ~22 km from most Pah Rah Range sites, the most direct route follows the valley floor making for relatively easy travel. Most of the remaining FGV sources are within the Sierra-Tahoe region, though only a handful that include Alder Hill, Gold Lake, Siegfried Canyon Ridge regularly appear at sites along the eastern front of the Sierra (Waechter 2002). Alder Hill, Gold Lake, Siegfried Canyon Ridge (49 km, 82 km, and 89 km from the Pah Rah Range, respectively) are well within the extra-local range that I defined but involve elevation gains of up to and above 1,000 m to reach. Considering the distances and ease of travel between the closest (Steamboat/Lagomarsino) and next closest sources (e.g. Tahoe Basin sources), I expected that primarily local (and close extra-local) FGV sources would have been utilized in the Pah Rah Range.

This expectation was met: Steamboat/Lagomarsino was the dominant source identified at sites within the Pah Rah Range. Of the 185 artifacts within the Pah Rah Range data set, 147 were assigned to a chemically distinct source group (including both previously known and unknown sources). Of these, 41.2% (n=76) were identified as Steamboat/Lagomarsino FGV. The next most common source groups identified were Unknowns A and B, representing 17.3% (n=32) and 5.9% (n=11) of the sample, respectively. These two unknown FGV sources are present at nearly all Pah Rah Range sites sampled, but only two valley sites (26Wa3017 and the Frear site), both of which are at the base of the Pah Rah Range. As such, I believe these two unknowns represent local FGV sources that are either within, or proximal to, the Pah Rah Range. Unknowns C and D may also be located near the Pah Rah Range. Unknown D only shows up at two Pah Rah sites while Unknown C is represented at three Pah Rah sites and at 26Wa3017, again suggesting that those sources are located near or within the Pah Rah Range. Together, Steamboat/Lagomarsino and the four presumably local unknown sources account for 68.1% (n=126) of the total artifacts in the Pah Rah Range data set.

The remaining known chemical source groups within the data set (Alder Hill, Gold Lake and Siegfried Canyon Ridge) are all located within the extra-local lithic terrane. Alder Hill and Gold Lake FGV make up 5.4% (n=10) and 3.7% (n=7) of the data set, respectively. A single projectile point made on Siegfried Canyon Ridge was identified. Together, these three sources comprise only 9.7% (n=18) of the data set. No additional previously known chemical source groups were identified within the data set and none of the chemically distinct unknowns represented at Pah Rah Range sites could be definitively linked to other artifacts in Northwest Research's database (Craig Skinner, personal communication, 2013).

An important aspect of determining the range of FGV sources utilized in the Pah Rah Range is delineating the time range over which sources were utilized. Based on the XRF data reported in Chapter 4, Steamboat/Lagomarsino, Alder Hill, and Gold Lake FGV were used by groups visiting the Pah Rah Range from at least the Early Martis Phase (5,000-3,000 cal BP) to the Early Kings Beach Phase (1,300-700 cal BP). Of these, Steamboat/Lagomarsino FGV was the source group used most persistently through time. Siegfried Canyon Ridge FGV was used in the Pah Rah Range at least during the Late Martis Phase but because that source is only represented by a single artifact, the full extent of its use cannot be established at this time.

Although a diachronic shift in local and non-local FGV source use (as measured by comparing FGV types represented in dart and arrow points) is not statistically significant when $\alpha = .05$, there do appear to be trends in individual FGV source use (Figure 5.1). For example, following the introduction of the bow-and-arrow there appears to have been an accompanying decreased reliance on local Steamboat/Lagomarsino FGV and increased reliance on the more distant Alder Hill FGV. Although my sample of artifacts made on that geochemical type is small, there do not appear to be any substantial changes with respect to Gold Lake FGV.

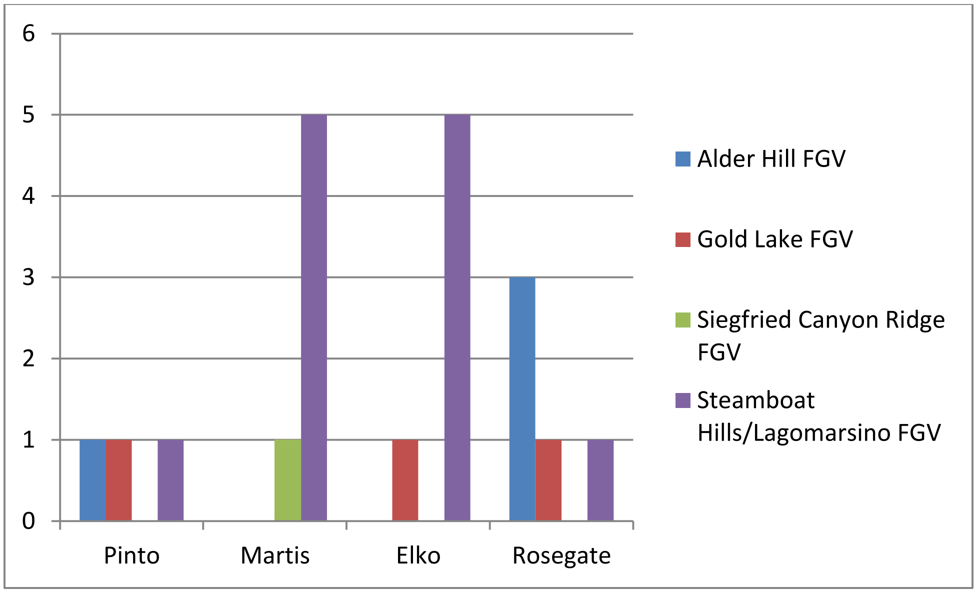

Figure 5.1. Pah Rah Range projectile points by FGV source.

Because they could not be firmly assigned to particular time periods, Figure 5.1 does not include the nine indeterminate dart points and one indeterminate arrow point in the Pah Rah data set; however, the sources of these indeterminate points fall within the pattern seen in the typeable points: indeterminate dart points include seven specimens made on Steamboat/Lagomarsino FGV and one each made on Gold Lake and Alder Hills FGV. The lone indeterminate arrow point is made on Steamboat Hills/Lagomarsino FGV. Including these indeterminate points would make the shift away from Steamboat/Lagomarsino FGV at the end of the Late Martis Phase even more evident (Figure 5.2).

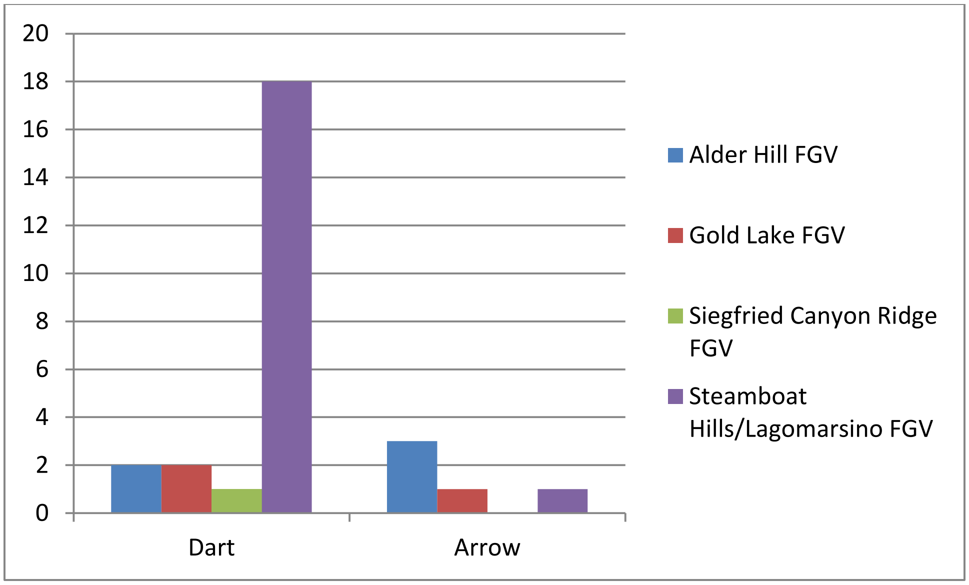

Figure 5.2. Pah Rah Range dart and arrow projectile points by FGV source.

The apparent shift away from local FGV source use between the Late Martis and Early Kings Beach phases is particularly interesting when obsidian data for the Pah Rah Range are also considered. The Tuscarora project obsidian data (Delacorte 1997a, 1997b) complement the FGV sourcing data compiled for my study, particularly as sourced obsidian artifacts come from several of the same sites including 26Wa1609, 26Wa5610, 26Wa5611, and 26Wa5612 (Table 5.1). Of the 113 obsidian artifacts (32 tools and 81 flakes) from Pah Rah Range sites geochemically characterized during the Tuscarora project, roughly one-third (35.3%, n=36) are made on sources located up to 222 km away (Delacorte 1997b). As with my FGV sourcing results, two local obsidian sources (Sutro and Patrick) account for over half (54.0%, n=61) of all characterized artifacts. Together, 11 known and two chemically distinct unknown obsidian sources were identified in the Tuscarora sample. Projectile points were made on five known sources (Sutro, Bodie Hills, Bordwell Spring, Buffalo Hills, and Mt. Hicks) and one unknown source. Interestingly, the majority of both FGV and obsidian Elko points are made on the most local sources (Steamboat/Lagomarsino FGV and Sutro obsidian).

Table 5.1. Tuscarora Obsidian Data (from Delacorte 1997b).

	Obsidian Sources														
Sites/Artifacts	**Bodie Hills**	**Bordwell Spring**	**Buffalo Hills**	**Massacre Lake/Guano Valley**	**Mono Craters**	**Mt. Hicks**	**Patrick**	**Pinto Peak**	**Queen**	**South Warners**	**Sutro Springs**	**Unknown**	**Unknown C**	**Unknown D**	**Grand Total**
26Wa1609															
Elko	-	-	-	-	-	-	-	-	-	-	2	-	-	-	**2**
Rose Spring	-	-	-	-	-	-	-	-	-	-	2	1	-	-	**3**
Biface	2	-	-	-	-	-	-	-	-	-	4	-	-	-	**6**
Core	-	-	-	-	-	-	3	-	-	-	-	-	-	-	**3**
Drill	-	-	-	-	-	-	1	-	-	-	-	-	-	-	**1**
Flake	1	8	-	-	-	4	2	-	-	2	9	-	2	-	**28**
26Wa1609 Total	**3**	**8**	**-**	**-**	**-**	**4**	**6**	**-**	**-**	**2**	**17**	**1**	**2**	**-**	**43**
26Wa5610															
Dart	-	-	-	-	-	1	-	-	-	-	-	-	-	-	**1**
Rose Spring	1	-	1	-	-	1	-	-	-	-	2	1	-	-	**6**
Biface	-	-	-	-	-	-	-	1	-	-	-	-	-	-	**1**
Flake Tool	-	-	-	-	-	-	-	-	-	-	-	-	1	-	**1**
Flake	5	2	-	-	-	1	1	-	1	-	14	-	5	2	**31**
26Wa5610Total	**6**	**2**	**1**	**-**	**-**	**3**	**1**	**1**	**1**	**-**	**16**	**1**	**6**	**2**	**40**
26Wa5611															
Dart	-	-	1	-	-	-	-	-	-	-	-	-	-	-	**1**
Rose Spring	-	-	2	-	-	-	-	-	-	-	-	-	-	-	**2**
Desert Side-notched	-	1	-	-	-	-	-	-	-	-	-	-	-	-	**1**
Flake Tool	-	-	-	-	1	-	-	-	-	-	-	-	-	-	**1**
Flake	-	1	-	1	-	-	2	-	-	-	1	-	-	-	**5**
26Wa5611Total	**-**	**2**	**3**	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**10**
26Wa5612															
Elko	-	-	-	-	-	-	-	-	-	-	2	-	-	-	**2**

Table 5.1. Tuscarora Obsidian Data (from Delacorte 1997b).

	Obsidian Sources														
Sites/Artifacts	**Bodie Hills**	**Bordwell Spring**	**Buffalo Hills**	**Massacre Lake/Guano Valley**	**Mono Craters**	**Mt. Hicks**	**Patrick**	**Pinto Peak**	**Queen**	**South Warners**	**Sutro Springs**	**Unknown**	**Unknown C**	**Unknown D**	**Grand Total**
Dart	1	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**
Flake	1	-	-	-	-	-	-	-	-	-	16	-	-	-	**17**
26Wa5612 Total	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**18**	**-**	**-**	**-**	**20**
Total of all Sites	**11**	**12**	**4**	**1**	**1**	**7**	**9**	**1**	**1**	**2**	**52**	**2**	**8**	**2**	**113**

By comparing obsidian hydration measurements with chronometric data from other regional sites, Delacorte (1997b:79-84) split the Tuscarora sample into Early and Late components, with the Early component further divided into older and younger artifacts (Delacorte 1997b:79-84) (Table 5.2). The Early component is primarily associated with Elko and Rose Spring points and dates to the Middle to Late Archaic periods (5,000-700 cal BP) and earlier. The Late component is primarily associated with Rose Spring and Desert series points and dates to the Terminal Prehistoric Period (700 cal BP to contact).

As with the FGV data, there is a pointed increase in local source use at the end of the Middle Archaic Period and continuing into the Late Archaic Period (Figure 5.3). There also appears to be fluctuations in the utilization of more distant sources to the north and south, with northern sources important both during the Middle Archaic and Terminal Prehistoric and southern sources utilized more during the Late Archaic Period.

Table 5.2. Tuscarora Obsidian Source Data by Hydration Dated Component (from Delacorte 1997b).

Source	Late Component	Early Component Young	Early Component Old
Bodie Hills	-	10	1
Bordwell Spring	8	1	4
Buffalo Hills	2	1	1
Massacre Lake/Guano Valley	1	-	1
Mono Craters	1	-	-
Mt. Hicks	2	1	4
Patrick	6	3	-
Pinto Peak	1	-	-
Queen	-	1	-
South Warners	-	-	2
Sutro Springs	5	45	1
Unknown	-	1	-
Unknown C	1	2	-
Unknown D	1	1	-
Totals	**28**	**66**	**14**

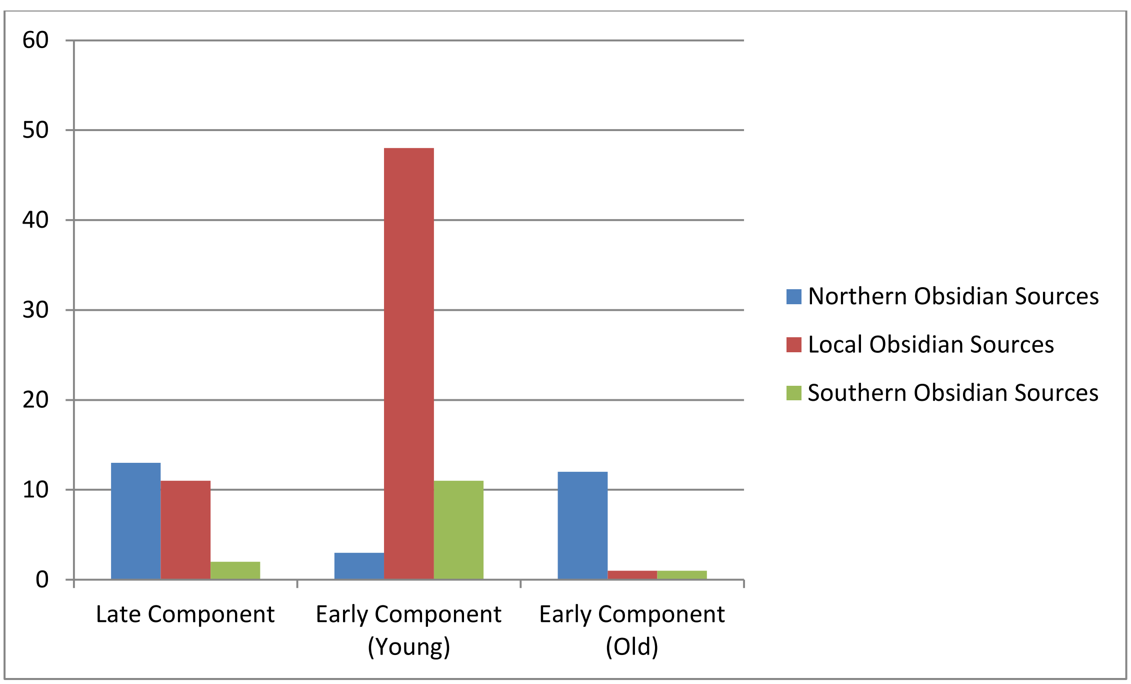

Figure 5.3. Pah Rah Range obsidian data from the Tuscarora project (data from Delacorte 1997b).

Together, FGV and obsidian data from the Pah Rah Range indicate that although local sources dominate the assemblages, this may not have been the case consistently through time. Specifically, the heaviest local source use in the Pah Rah Range appears to have occurred during the Middle Archaic Period, with continued lesser utilization into the Late Archaic and Terminal Prehistoric periods.

Patterns of FGV Source Use in the Pah Rah Range

Regarding the identification of patterns of FGV source use unique to sites within the Pah Rah Range, I developed two associated hypotheses. The first is that particular FGV sources were preferred for certain tool classes. The second is that lithic technological organization should substantially differ between the Pah Rah Range sites and those on the nearby valley floor.

Toolstone Source Preference

A number of factors including proximity to toolstone sources, toolstone abundance, and raw-material quality affected toolstone choice and toolkit production (Andrefsky 1994, 2005; Kelly 1988, 1992; Kuhn 1994; Parry and Kelly 1987). Though generally more durable, FGV types like basalt and rhyolite are more difficult to work than more cryptocrystalline or glassy materials like chert and obsidian. Some FGV sources are more aphanitic than others, allowing for greater predictability in flaking and easier production of formal tools such as projectile points. Among the FGV sources available in the western Great Basin, Gold Lake is considered to be higher quality than other regional FGV sources (Duke 1998; Edwards 2000). The proximity of Steamboat Hills/Lagomarsino FGV would also have made it an attractive choice. As such, I expected that the proportions of FGV sources used for different tool classes should differ, with formal tools manufactured from higher quality materials like Gold Lake or more local sources like Steamboat Hills/Lagomarsino, and informal tools manufactured from a mix of regionally dominant FGV sources and presumably local unknowns.

My first expectation is borne out in the XRF data. Of 79 formal tools, only six (two Elko points, two bifaces, and two scrapers) are made from unknown sources. The remaining 75 were manufactured (in descending order) from Steamboat/Lagomarsino, Alder Hill, Gold Lake, and Siegfried Canyon Ridge FGV. Less expected was the near complete absence of those FGV chemical source groups among informal tools. Of the 29 informal tools in the Pah Rah data set, only seven are manufactured from a previously known source group: Steamboat/Lagomarsino FGV. The remaining informal tools were manufactured from four chemically distinct unknown sources (Unknowns A, B, C, and D) and undifferentiated unknown FGV sources.

Of the previously known FGV chemical source groups, only Steamboat/Lagomarsino appears as debitage in any substantial amount at the Pah Rah Range sites. The debitage reflects predominantly biface thinning/finishing for known sources and both core reduction and biface thinning for unknown sources. The implication of this difference is that Steamboat/Lagomarsino FGV was likely brought to the sites both as finished and partially reduced tools (i.e., early to mid-stage bifaces) while raw material from unknown sources may have been acquired closer to the sites and/or was not substantially reduced prior to transport. The lack of Alder Hill, Gold Lake, and Siegfried Canyon Ridge FGV debitage suggests that tools made from those sources were brought to the sites in complete or nearly complete form. Beck et al. (2002) have argued that source to site distance was likely a primary influence on the degree to which raw materials were reduced prior to transport. The Pah Rah Range FGV artifacts may reflect similar decision-making processes.

The range of sources represented in the Pah Rah debitage sample, most of which are unknown (including six of eight chemically distinct unknowns identified during my research) is greater than that exhibited by formal tools, suggesting that not all tools manufactured from them were discarded at the Pah Rah Range sites. This pattern has been identified elsewhere at sites associated with mobile groups (Eerkens et al. 200:586). Interestingly, beyond the core made on Unknown A FGV at the Frear site, no tools from these sources have been identified at sites in the surrounding region (Craig Skinner, personal communication, 2013), suggesting that they did not play a significant role in regional toolstone conveyance systems.

Differences in Lithic Technological Organization

Based on the overall differences between the Pah Rah Range sites and nearby valley sites with respect to site function and location, I also hypothesized that lithic technological organization should have differed substantially between the two areas. Sites in the Pah Rah Range predominantly reflect resource procurement and processing activities with increased habitation during the Late Archaic Period (Delacorte 1997b; Rusco 1969a, 1969b, 1981; Stephenson 1968, Zeanah 2009). Middle Archaic occupations appear to have been temporary and seasonal, with small logistical groups exploiting resources such as ungulates and waterwort seeds (Delacorte 1997b:152). Conversely, sites in the valley are predominantly habitation loci and though they were part of the same settlement system, differences in site function, occupation span, and location suggest that assemblages in both areas should differ. Primarily, I expected that the source profile for the Pah Rah sites would differ significantly from the valley floor source profile. I also expected that the patterns of source use with respect to individual artifact classes seen in the Pah Rah Range would differ from those on the valley floor.

Though both the Pah Rah and valley data sets contain many of the same sources, their distribution within the Pah Rah Range sites differs in several key respects. Because the samples of bifaces and projectile points were the most similar with respect to count and artifact types selected, comparisons of those artifact classes should be those least likely to be affected by sampling bias. A chi-square test comparing the three extra-local sources (Alder Hill, Gold Lake, and Siegfried Canyon Ridge FGV) to the local source (Steamboat/Lagomarsino FGV) for projectile points and bifaces (see Table 4.2) shows that there is a significant difference in source representation between the Pah Rah Range and valley data sets (χ^2=6.93, df=1, p=.009). Steamboat/Lagomarsino FGV is overrepresented at Pah Rah sites and underrepresented at valley sites. A significant difference also exists when all tools are included in the comparison (χ^2=10.06, df=1, p=.002).

The overrepresentation of Steamboat/Lagomarsino FGV at Pah Rah sites is remarkable as one of the two known quarries for this geochemical type is actually closer to the valley sites. As such, Steamboat/Lagomarsino FGV should be more common on the valley floors than it is. One possible explanation for the overrepresentation of Steamboat/Lagomarsino FGV at Pah Rah sites may lie in the concept of "gearing up" (*sensu* Binford 1977, 1978, 1979) wherein prehistoric groups anticipating a logistical or residential move to a region deficient in high quality toolstone (e.g., the Pah Rah Range) bring more tools or toolstone than they would normally anticipate using. A similar provisioning technique is described by Thomas (2012) for Alta Toquima, where high quality tools and toolstone were brought up to the site and left there between visits. Though Alta Toquima is a more extreme example of such behavior, this approach would minimize the need to travel back and forth to the next closest FGV source (which is just at the edge of the local lithic terrane) and allow prehistoric groups to more intensively focus on the subsistence activities that drew them to the areas like the upland basins of the Pah Rah Range in the first place.

There is one additional difference between bifaces in the Pah Rah and valley data sets: valley site bifaces reflect a wider range of chemical source groups than Pah Rah bifaces. Valley bifaces are made on all four previously known chemical source groups, but Siegfried Canyon Ridge FGV is not represented in Pah Rah biface sample. Valley bifaces also include examples made on two chemically distinct unknowns (Unknowns E and H) that are not represented in the sample of Pah Rah Range artifacts. A Fisher's exact test indicates that the two samples have significantly different frequencies of Alder Hill, Gold Lake, Siegfried Canyon Ridge, and Steamboat/Lagomarsino FGV (p=.044). To ensure that these differences were not simply a function of sample size, following

Eerkens et al. (2007) I bootstrapped the valley biface sample (using only known and chemically distinct unknown sources), which resulted in a sample-size-adjusted diversity of 5.97, which is significantly more diverse than the three sources represented in the Pah Rah range biface sample (*p*=.006). The more diverse biface assemblage in the valley data set may reflect more regularized "gradual replacement" lithic procurement activities than occurred in the neighboring uplands (Thomas 2012:263).

An examination of the changes in FGV source utilization for valley projectile points provides another contrast to the Pah Rah Range sites (Figure 5.4). A Fisher's exact test comparing dart and arrow points made from the four known sources in the valley sample indicates that there is no significant change across time (*p*=.928); however, as with the Pah Rah Range sample there do appear to be more subtle shifts when the data are examined at a finer scale.

Though Steamboat/Lagomarsino FGV is significantly underrepresented in the valley data set relative to the Pah Rah Range data set, it appears to have been used more consistently across time. Whereas use of Steamboat/Lagomarsino FGV in the Pah Rah Range peaked during the Middle Archaic Period and dropped in the Late Archaic Period, its utilization at valley sites persisted into the Late Archaic Period. Further, both Alder Hill and Gold Lake FGV are represented throughout the Middle to Late Archaic periods and seem to have substantially different signatures at valley sites than Pah Rah sites. In the valley, Gold Lake use peaks during the Early to Late Martis phases, while Alder Hill use peaks during the Late Martis Phase. Both FGV sources are nearly absent during that time at Pah Rah sites (see Figure 5.1).

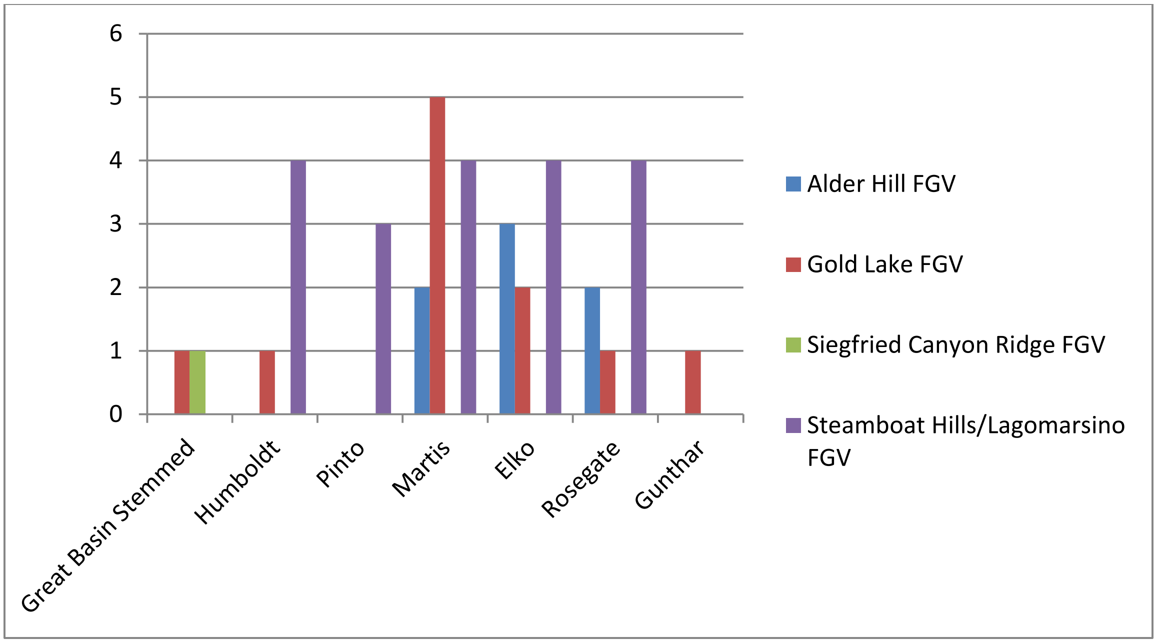

Figure 5.4. Valley projectile points by FGV source.

Toolstone Conveyance in the Pah Rah Range

My final hypothesis was related to FGV toolstone use and conveyance. Recent models of toolstone conveyance in the western Great Basin (e.g., Delacorte 1997b; Jones et al. 2003; Smith 2010) indicate that toolstone moved predominantly within a north-south zone along the Sierran Front. The extent, both temporally and geographically, of that zone continues to be refined through additional source provenance studies (e.g., Delacorte 1997b; Jones et al. 2003; McGuire 2002; Sibley 2013; Smith 2010; Stoner et al. 2006). Smith's (2010) work in northwestern Nevada suggested that Jones et al.'s (2003) western conveyance zone is actually two zones, with the boundary situated somewhere near the Carson Desert. The Pah Rah Range is situated near the convergence of Smith's (2010) proposed northern and southern conveyance zones, and similar sourcing work in the Truckee Meadows and Pah Rah Range (e.g., Delacorte 1997b; McGuire 2002; Sibley 2013; Stoner et al. 2006) has indicated that groups in that area foraged within both zones, obtaining obsidian from sources up to 200 km to the north and south. The timing of use and the sources included in those zones varies based on the region studied, but there appears to be general agreement that obsidian in the region overall moved in north-south oriented zones, with fall-offs that generally conform to what would be expected from direct procurement (Delacorte 1997b; McGuire 2002; Sibley 2013). This has led most researchers to equate these zones with foraging territories of prehistoric groups (*sensu* Jones et al. 2003). If FGV source use in the Pah Rah Range conformed to these models, then FGV should have originated from sources in the same directions and distances as the obsidians on which such models are based (e.g., Smith 2010, Delacorte 1997b, McGuire 2002, Sibley 2013). In other words, FGV data should also reflect predominantly north-south long distance movements.

This does not appear to be the case. In contrast to obsidian conveyance patterns identified along the Sierra Front, the suite of FGV sources utilized in the Pah Rah Range reflects pronounced east-west conveyance (Figure 5.5). The three extra-local FGV sources are all located to the west and northwest of the Pah Rah Range, suggesting some affinity between the Pah Rah Range and eastern Sierra Nevada. Sites in the Pah Rah Range contain obsidian from long distances to the north and the south, as well as two more local sources, Sutro and Patrick. The zones delineated in Figure 5.5 are atemporal, and only indicate the patterns of overall toolstone movement, not when the toolstone was moved.

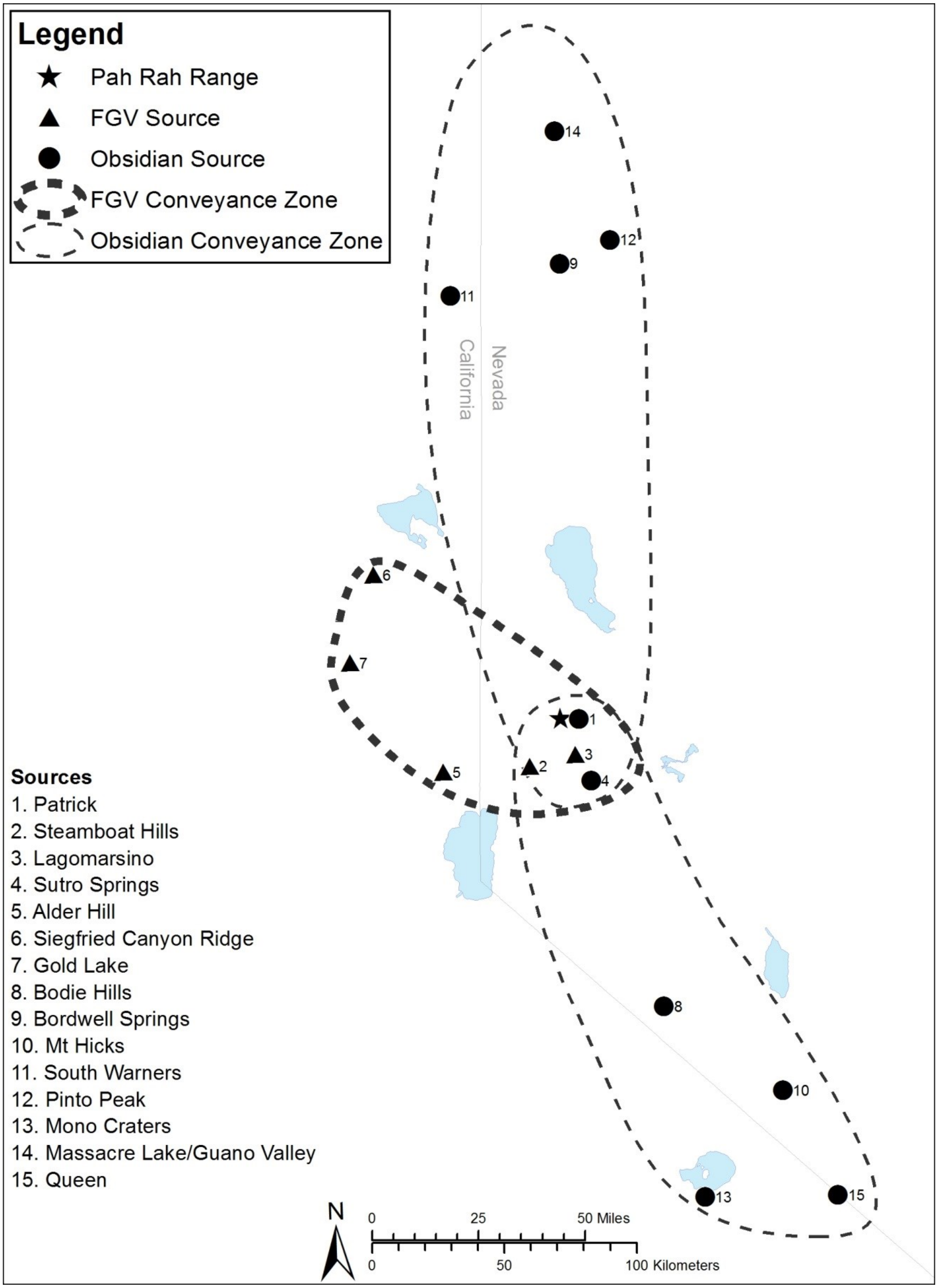

Figure 5.5. Toolstone conveyance in the Pah Rah Range.

Using obsidian sourcing and hydration data from the Tuscarora project and other Truckee Meadows assemblages, Delacorte (1997b) reconstructed settlement systems for the Pah Rah Range (Figure 5.6). He argued that the three periods delineated using hydration data (younger and older Early component and Late component) were marked by substantially different settlement systems. During the older Early component, toolstone use was highly variable with artifacts made from obsidian originating great distances (150+ km) to the north and south. Noting that regularized fall-off curves in obsidian source representation based on distance between quarries and sites reflect direct acquisition, he suggested that early populations utilizing the Pah Rah Range were highly mobile within expansive foraging territories (Delacorte 1997b:141). Subsequently, younger Early foraging territories contracted, a trend reflected by reduced use of northern obsidian sources and increased focus on southern and local sources (Figure 5.6).

Delacorte (1997b) argued that a further contraction in foraging territories marked the Late component. Specifically, he cited increased use of the lower quality Patrick obsidian source during the Late component as reflecting a more localized settlement subsistence system (Delacorte 1997b:112). Though sources to the north and south continued to appear in Pah Rah assemblages, Delacorte (1997b:112) suggested that much of this it was scavenged from earlier sites, as evidenced by obsidian artifacts with double hydration bands. This model of reduced territory fits well with the intensification and investment in residential structures (i.e., numerous rock rings) beginning during the Late Archaic Period and continuing into the Terminal Prehistoric (1,300-150 cal BP) Period in the Pah Rah Range (Bowers 2006; Delacorte 1997b; Rusco 1969a, 1969b, 1981; Stephenson 1968).

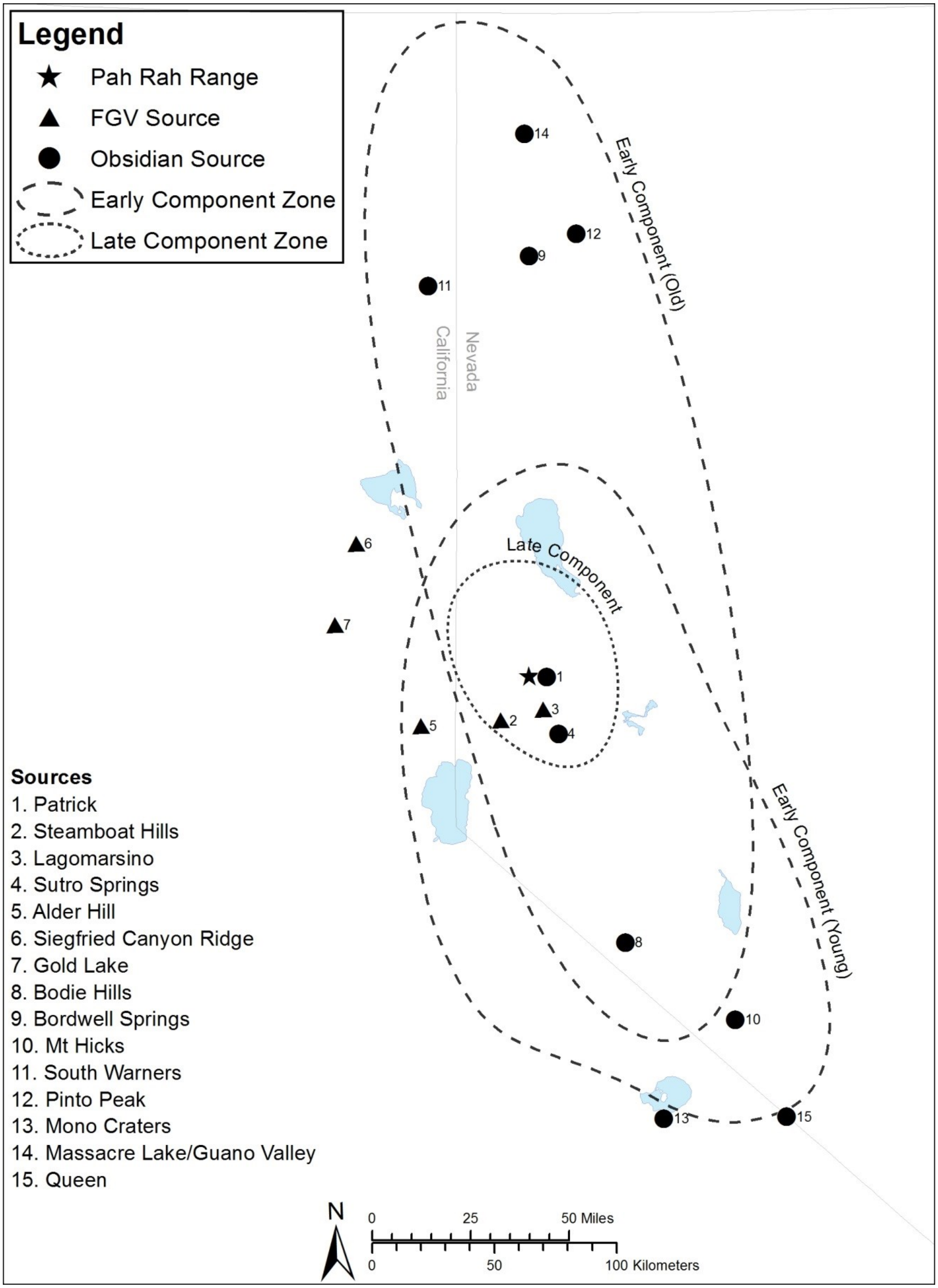

Figure 5.6. Reconstructed Pah Rah Range settlement systems (from Delacorte 1997b:141).

FGV sourcing data from the Pah Rah Range sites presented here has definite implications for Delacorte's settlement system reconstructions. Delacorte (1997b:142) stated that many Early component bifaces are made from non-local basalt, which he interpreted as reflecting a "logistically well-organized and highly mobile adaptation." This view is not supported by my data, which indicate that most (81.1%) Pah Rah bifaces are made on Steamboat/Lagomarsino FGV; only 13.5% are made on more distant Alder Hill and Gold Lake FGV. The latter two sources occur within the extra-local lithic terrane at distances of 42 km and 89 km from the Pah Rah Range, which is far closer than most obsidian sources identified at Pah Rah sites.

By combining the Pah Rah Range and valley data sets, a more complete picture of FGV toolstone use in the region emerges, which permits a better understanding of how including FGV data affects Delacorte's (1997b) settlement systems model (Figure 5.7). When combined, three trends are evident. First, local Steamboat/Lagomarsino FGV was utilized throughout the Middle to Late Archaic periods with a likely peak during the Late Martis Phase (3,000-1,300 cal BP). Second, Gold Lake FGV was the most persistently utilized FGV type but also reached a peak in use during the early Late Martis Phase before decreasing later. Third, Alder Hill FGV use increased through time, finally peaking during the Early Kings Beach Phase (1,300-700 cal BP). No FGV sources were identified in projectile points dating to the Terminal Prehistoric Period.

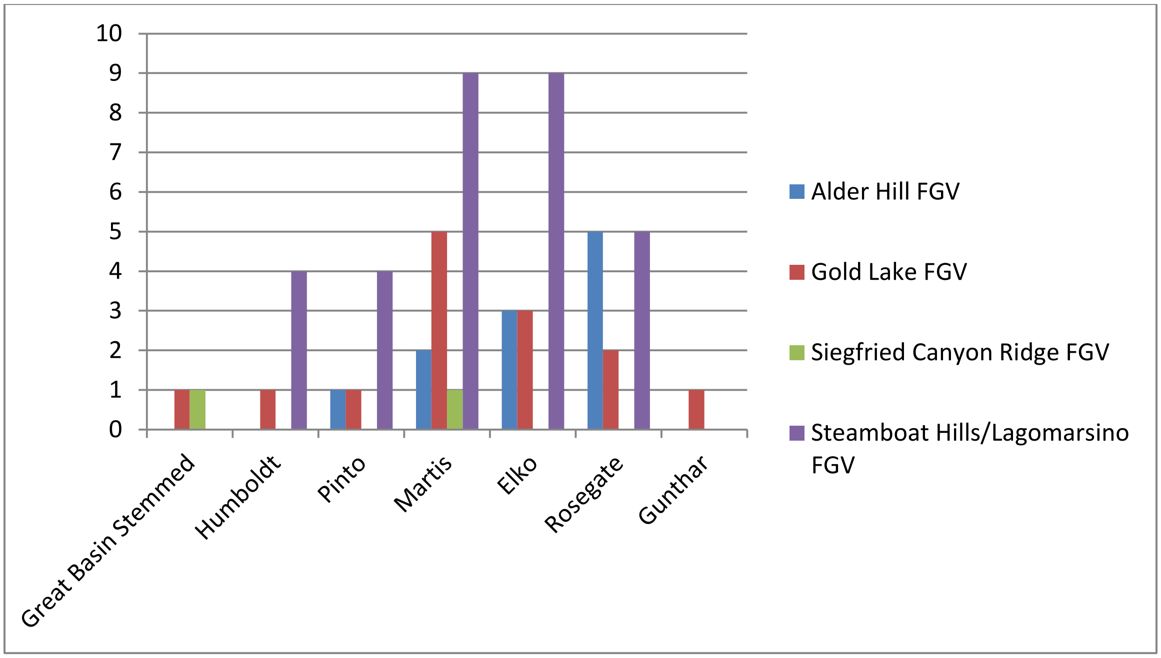

Figure 5.7. Combined Pah Rah Range and valley projectile point sources.

Including FGV data from the Pah Rah Range also expands Delacorte's (1997b) settlement zones to include the Alder Hill, Gold Lake, and Siegfried Canyon Ridge quarries to the west (Figure 5.8).

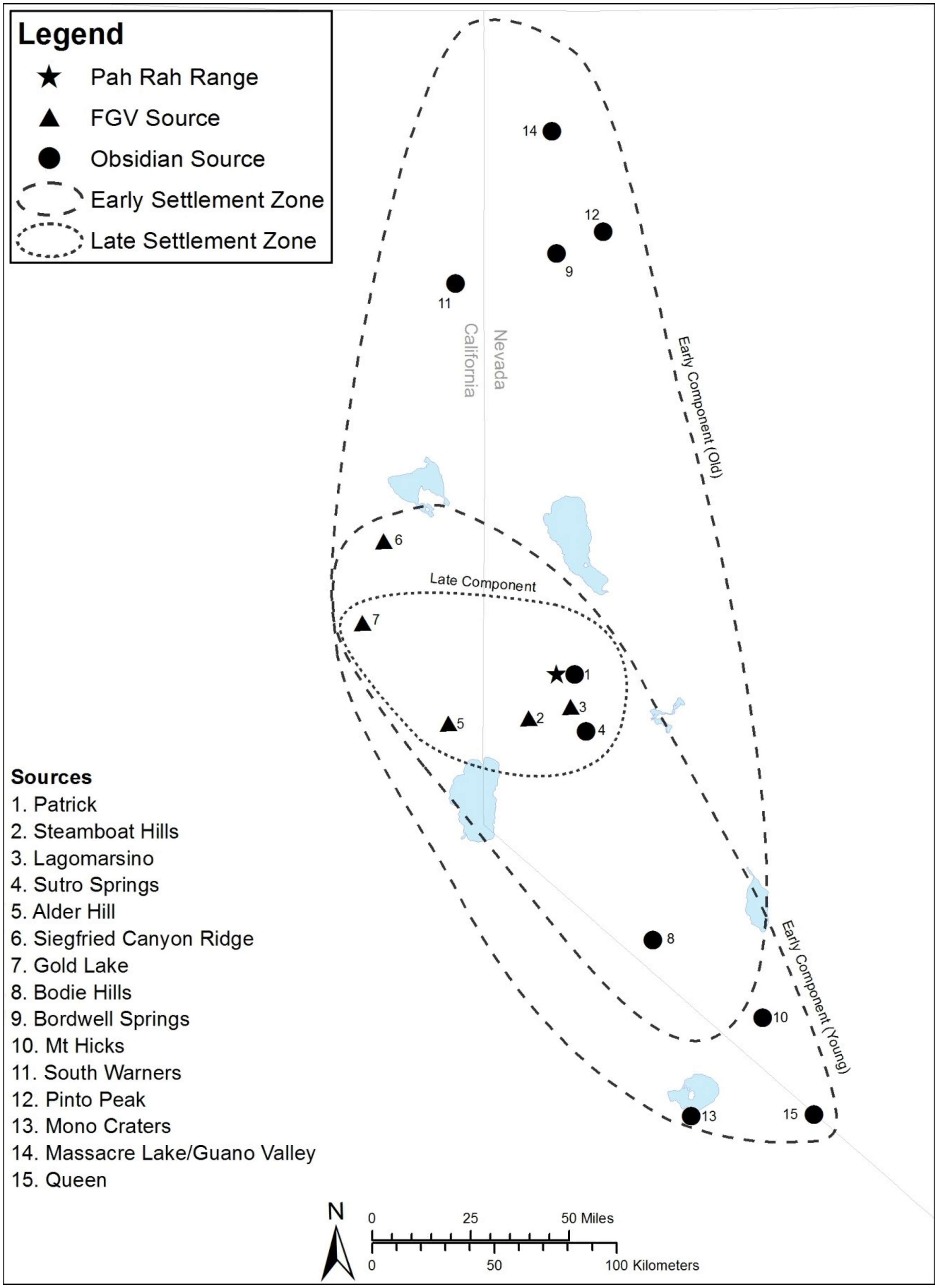

Figure 5.8. Reconstructed settlement systems for the Pah Rah Range (after Delacorte 1997b).

For the Early component settlement system reconstructions, this is not a substantial change. The Steamboat/Lagomarsino FGV quarries are located within the boundaries both the older and younger Early component systems, and Alder Hill was already within the proposed boundary of the younger Early component system. During the Late component, however, including the FGV data nearly doubles the size of Delacorte's proposed settlement system. This final reconstruction best illustrates the overall east-west conveyance of FGV toolstone to the Pah Rah Range.

This brings up an interesting point. For both the Pah Rah Range and the valley sites, there is no significant difference between the use of local and non-local FGV sources across time, although individual source use does appear to fluctuate. As such, the manner in which the settlement system and foraging territories functioned becomes important. Is the local FGV toolstone at Pah Rah and valley floor sites more prevalent because it was picked up at the end of long foraging trips that extended to the ends of the ranges, or does FGV conveyance closer resemble a group residential settlement system while obsidian reflects longer-distance logistical forays?

Combining regional data for the main four FGV types, Waechter (2002) reconstructed FGV conveyance in the Western Great Basin and into California (Figure 5.9). Based on my results, the spatial conveyance of Siegfried Canyon Ridge can be expanded to the southeast. Of particular interest is that, based on current sourcing data, the Pah Rah Range sits at the central-eastern edge of the overlapping distribution zones for these four sources.

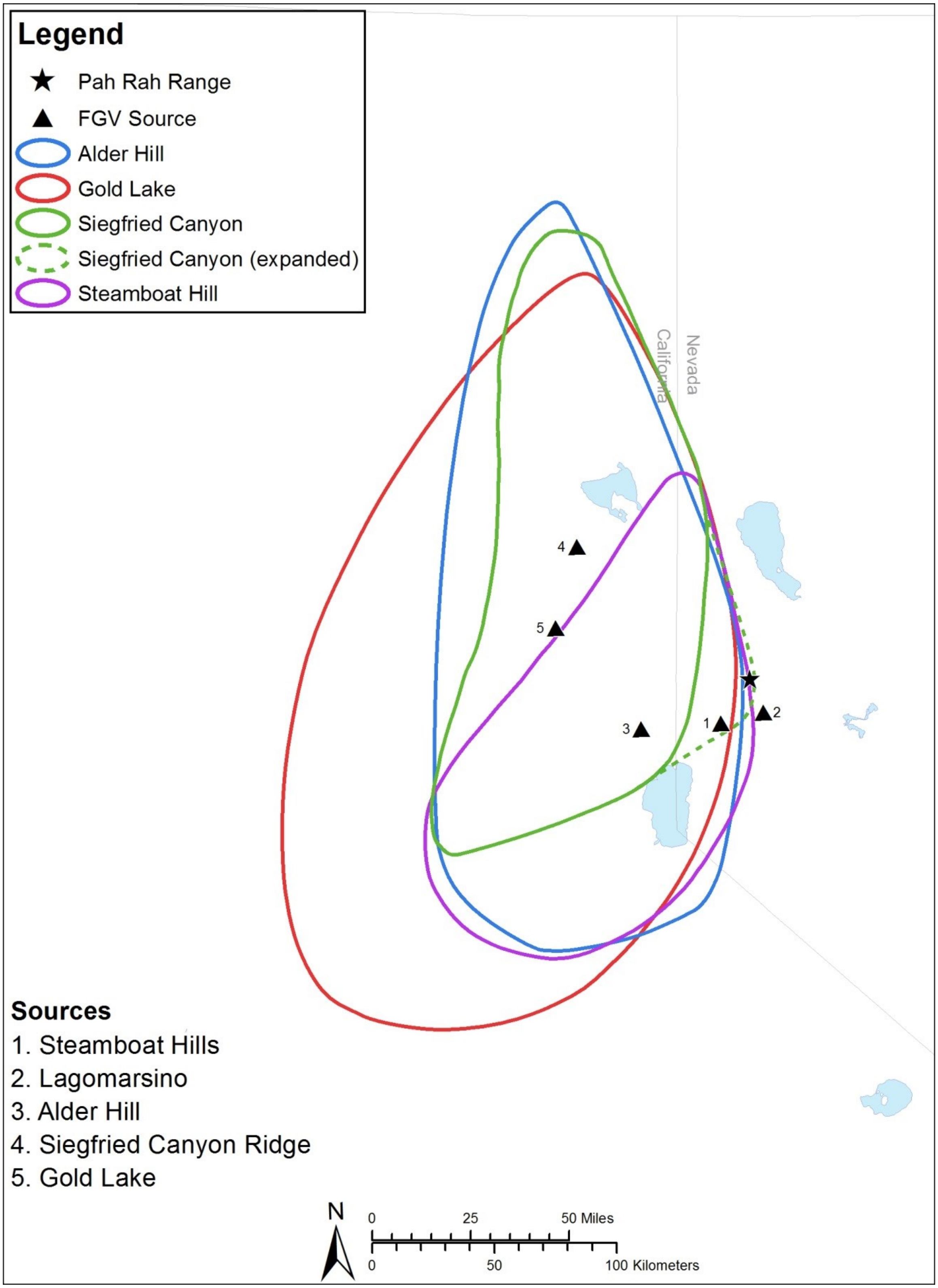

Figure 5.9. Combined FGV source distribution (after Waechter 2002).

Though these zones are shifted to the west and are centered more in the Sierras, the overall impression is still one of a north-south zone of FGV conveyance along the eastern Sierra interface. Waechter (2002:111) argued that there may have been a boundary of sorts between the Madeline Plains and Pit River Uplands of northeastern California. North of this boundary, most XRF data from the Alturas Intertie Project yielded predominantly unknowns. South of this boundary, many of the same sources utilized in the Pah Rah Range and surrounding valleys dominate assemblages. With this in mind, reconstructed settlement systems may not reflect overall group mobility but rather a combination of residential and logistical systems wherein the people using the Pah Rah Range and the Truckee Meadows mainly foraged in the zone extending just north of Honey Lake, to Pyramid Lake in the east, and Lake Tahoe to the southwest. Logistical forays could extend these ranges to the north and south to procure obsidian and/or other important resources as needed.

In any case, it is clear that including FGV sourcing data from Pah Rah Range and Truckee Meadows sites extends models of settlement and toolstone conveyance to the west and informs our understanding of what might be considered "local toolstone" in this region. Further, it helps clarify how different toolstone types moved through the region, allowing for a better understanding of how prehistoric peoples utilized this region.

CHAPTER 6 – CONCLUSION

The primary goal of my research has been to identify FGV sources present at archaeological sites within the Pah Rah Range of western Nevada as a means to better understand prehistoric land use and lithic technological organization in the region. I assessed whether prehistoric groups utilized primarily local or exotic FGV toolstone and how their procurement and use of FGV toolstone fits within regional models of toolstone conveyance and site settlement (e.g., Delacorte 1997b; Smith 2010). I used XRF data derived from the geochemical characterization of FGV artifacts from the Pah Rah Range and surrounding area to address the following research questions:

1. What is the range of FGV sources used by prehistoric peoples within the Pah Rah Range?;

2. Are there identifiable and significant patterns of source use unique to sites within the Pah Rah Range?; and

3. Based on source provenance data, how does FGV use in the Pah Rah Range fit with current models of toolstone conveyance in the western Great Basin?

To this end, I identified 10 habitation and resource procurement/processing sites within the Pah Rah Range and eight sites from the valley floors to the west and southwest of the Pah Rah Range for which I could obtain FGV sourcing data. By combining previous XRF data with 271 FGV artifacts sourced for this research, I compiled a total of 303 artifacts. Using these data, I tested the following hypotheses concerning FGV toolstone use in the Pah Rah Range:

1. Groups in the Pah Rah Range primarily utilized local FGV toolstone;

2. Certain FGV sources were preferred for certain tools, whether due to toolstone quality or proximity to source;

3. Lithic technological organization differed substantially between sites in the Pah Rah Range and those on the nearby valley floor; and

4. Pah Rah Range sites reflect similar conveyance zones developed using data from other sites in the western Great Basin.

Summary of Results

My primary data set was comprised of 10 sites within the Pah Rah Range, most of which are in an upland basin at the southern end of the range; these include habitation and complex resource procurement/processing sites (Delacorte 1997a, 1997b; Delacorte et al. 1995a, 1995b; Neidig and Clay 2009; Rusco 1969a, 1969b, 1981; Stephenson 1968; Zeanah 2009). Most of these sites are on prominent ridges with volcanic outcrops and nearly all include rock ring features, extensive petroglyphs, a wide variety of portable and non-portable milling gear, and extensive lithic scatters of flaked tools and debitage. Based on the artifact assemblages, obsidian hydration data, and radiocarbon dates, these sites were occupied from the Early Archaic through the Terminal Prehistoric periods, with intensified use during the Early to Late Martis phases (5,000-1300 cal BP) and again during the Late Kings Beach Phase (700-150 cal BP) (Bowers 2006; Delacorte 1997b; Neidig and Clay 2009; Rusco 1969a, 1969b, 1981; Stephenson 1968; Zeanah 2009). The eight valley sites are more diverse in function and setting and include several intensively occupied winter villages along the Truckee River as well as smaller lithic scatters and resource procurement locations. These sites range in age from the Pre-Archaic (>10,000-8,000 cal BP) to the Terminal Prehistoric (700-150 cal BP) periods (McGuire 1995, 1997; Miller and Elston 1979; Stoner et al. 2006; Townsend and Elston 1975; Zeier and Elston 1986).

Local Toolstone Use

Steamboat/Lagomarsino is the dominant FGV type identified at sites within the Pah Rah Range, comprising 76 of the 185 artifacts (41.2%). Steamboat/Lagomarsino FGV was used to make 54.2% of all sampled tools and 64.5% of all sampled projectile points. The two known quarries for Steamboat/Lagomarsino FGV are 15-22 km from most of the Pah Rah Range sites making it the most local known FGV type. Based on their distribution within the two data sets, I suspect that Unknowns A-D are also local to the Pah Rah Range. Representing 17.3%, 5.9%, 2.2%, and 1.6% of the data set, respectively, these sources occur primarily as informal tools and debitage. Together, Steamboat/Lagomarsino and these four presumably local but unknown FGV sources account for 68.1% (n=126) of all artifacts in the Pah Rah Range data set. Three additional known chemical source groups are also represented in the data set: Alder Hill, Gold Lake and Siegfried Canyon Ridge. These sources are at an intermediate (49-89 km) distance from the Pah Rah Range and together comprise only 9.7% (n=18) of the data set.

Of the 303 artifacts from both Pah Rah and valley floor sites included in my analysis, 40.9% are made on Steamboat/Lagomarsino FGV, while only 17.8% are made on other more distant known sources. The apparent focus on local FGV toolstone fits well the pattern of residential stability with high logistic mobility that has been suggested for this region during the Middle Archaic Period (e.g., Delacorte 1997b:150-152; McGuire et al. 2008; Zeanah 2009:12).

Preferential Toolstone Use

FGV selection in the Pah Rah Range is sharply divided between formal and informal tools. Of the 79 formal tools in the Pah Rah data set, only six are made on unknown sources. By contrast, only seven of the 29 informal tools in the Pah Rah data set are manufactured on previously known sources. These correlations between known sources and formal tools and unknown sources and informal tools suggest that a combination of toolstone quality and distance to source influenced decisions about raw material use. Specifically, Gold Lake is considered to be among the highest quality regional FGV sources (Duke 1998; Edwards 2000). Steamboat/Lagomarsino, Alder Hills, and Siegfried Canyon Ridge FGV all have fairly widespread distributions (Waechter 2002), indicating that those materials were known to prehistoric peoples and were of sufficient quality to warrant transporting them in the form of formal tools. For tools in which the final form was functionally important (e.g., projectile points, drills), flaking predictability would have been important. Conversely, for tools in which the production of a workable edge was more important than achieving a specific design (e.g., choppers, informal flake tools), a wider range of FGV raw materials may have been considered suitable; this may be reflected in the use of presumably local unknown sources for such tools.

Further highlighting the importance of proximity to source, my debitage analysis suggests that Steamboat/Lagomarsino FGV was brought to sites both as finished and partially reduced forms (i.e., early to mid-stage bifaces), while tools made on more distant Alder Hill, Gold Lake, and Siegfried Canyon Ridge FGV were likely brought to sites in complete or nearly complete form. Combined with evidence for the more expedient use of unknown and presumably local sources at these sites, it is clear that a variety of toolstone procurement strategies were employed and decisions about which strategy to employ were influenced by the complex relationships between tool form, raw material quality, and distance to the quarry.

Lithic Technological Organization

Pah Rah Range and nearby valley sites differ with respect to function, occupation span, and location on the landscape; however, the overall systems of lithic technological organization between the two areas are ultimately quite similar. The main differences lie in the distribution of sources and changes in source use through time – these differences are manifested in several ways. First, Steamboat/Lagomarsino FGV is significantly overrepresented at Pah Rah sites and underrepresented at valley sites among projectile points and bifaces. This difference may reflect different raw material procurement strategies, with groups in the Pah Rah Range employing a "gearing up" strategy (*sensu* Binford 1977, 1978, 1979). Such a strategy would have alleviated the need to travel back and forth to the next closest higher quality FGV source (in this case Steamboat/ Lagomarsino) while in the uplands.

Second, bifaces in the valley data set reflect a more diverse range of chemical source groups than those in the Pah Rah Range. In addition to the four previously known chemical source groups, valley bifaces include those manufactured from Unknown E and Unknown H FGV. Conversely, only three of the four known sources are represented in the Pah Rah Range biface sample. This greater diversity of sources in the valley data set may reflect more regularized "gradual replacement" lithic procurement activities than occurred in the neighboring uplands (Thomas 2012:263).

Third, although neither Pah Rah Range nor valley sites show significant changes through time with respect to FGV source use, due to sample size issues my analysis and corresponding results were based on a comparison of darts and arrows rather than more time-sensitive point types. This appears to obscure some subtle shifts in individual source use. Among Pah Rah Range sites, use of Steamboat/Lagomarsino FGV appears to have peaked during the Middle Archaic Period and dropped during the Late Archaic Period. In the valley sites, Steamboat/Lagomarsino FGV appears to have been used more consistently through time and persisted into the Late Archaic Period. Further, while both Alder Hill and Gold Lake FGV are nearly absent in the Pah Rah Range projectile point sample during the Early to Late Martis phases, Gold Lake and Alder Hill FGV are present at valley sites during this interval, with use of Gold Lake peaking during the Early to Late Martis phases and Alder Hill peaking during the Late Martis Phase.

Toolstone Conveyance and Site Settlement

Using FGV provenance data, I reexamined toolstone conveyance models for the western Great Basin and reevaluated settlement models for the Pah Rah Range. In contrast to the predominantly long-distance, north-south toolstone movement exhibited by obsidian artifacts (Delacorte 1997b; McGuire 2002), FGV artifacts reflect shorter-distance, east-west directionality. The three extra-local FGV sources represented in both Pah Rah and valley data sets (Alder Hill, Gold Lake, and Siegfried Canyon Ridge) are located west/northwest of the Pah Rah Range, suggesting some affinity between this region and the eastern Sierra Nevada. Though Steamboat/Lagomarsino quarries are southwest/southeast of the Pah Rah Range, the overall pattern of FGV conveyance for the area is strongly east-west. Even more striking are differences in the distances that obsidian and FGV were conveyed. While the most distant FGV source represented in the

Pah Rah Range sample (Siegfried Canyon Ridge) is 89 km away, the most distant obsidian source (Massacre Lake/Guano Valley) is 222 km north of the Pah Rah Range. The average straight-line distance from source to site for FGV sources represented in the Pah Rah Range sample is 51.4 km while the average for obsidian sources is 144.7 km.

Including FGV source data in regional models of toolstone conveyance and site settlement produces two main results. First, it is clear that future toolstone-sourcing based models for the area should include western FGV sources. Based on my further refinement of the regional distributions of Alder Hill, Gold Lake, Siegfried Canyon Ridge, and Steamboat/Lagomarsino FGV, using only obsidian data clearly does not tell the whole story. Second, for more regionally specific models such as those proposed by Delacorte (1997b) for the Pah Rah Range, FGV data both expand and clarify diachronic shifts that may have occurred. Though the addition of FGV data results in subtle shifts for the earlier periods modeled by Delacorte (1997b), including FGV data nearly doubles the size of his Late component settlement system.

Based on my results, I believe that such models may oversimplify patterns of toolstone conveyance in the western Great Basin. For both Pah Rah Range and valley sites, there is no significant difference between local and non-local FGV source use across time until the Terminal Prehistoric Period, when FGV use plummets. For at least some periods, the FGV toolstone conveyance zone that included the Pah Rah Range and Truckee Meadows at its eastern edge may be more reflective of residential settlement patterns. If this is the case, then obsidian may have been procured through longer-distance logistical forays while travelling to/from the northern and southern ends a central FGV zone. In either case, FGV sourcing data add another dimension to models of lithic conveyance and, in turn, socioeconomic networks in the western Great Basin.

Limitations and Further Research

Though the XRF data compiled for this thesis have generally been robust enough to assess my hypotheses, there are nevertheless some limitations. One of the main issues is a lack of temporal control over sourced artifacts. Though I was able to use projectile points as index fossils to define broad time ranges, and several sites have radiocarbon dates, many FGV artifacts in my sample cannot confidently be assigned to particular time periods. They come from a combination of undated and/or mixed assemblages that may span many several thousands of years. Though this low temporal resolution is not incompatible with my research questions, the overall lack of temporal control over artifacts other than projectile points is limiting. Further, because I focused much of my sourcing effort on Pah Rah Range sites, I was unable to include the same number and types of artifacts in the valley data set. While including sourcing data from previous projects allowed me to expand the number of sites I examined, those data were biased heavily towards formal tools. As such, direct comparisons between the Pah Rah Range and valley sites were somewhat difficult. Finally, although most (80.5%) artifacts submitted for geochemical characterization were assigned to either known or chemically distinct unknown sources, this high success rate is atypical for projects elsewhere in the western Great Basin. For instance, Waechter (2002) reported that north of the Madeline Plains in northeastern California, most XRF sourcing yielded predominantly unknowns. It is important to note, however, that additional attention has been devoted to sourcing

FGV artifacts and improving our understanding of FGV source locations in the decade since Waechter's work and as such, studies like mine will continue to improve our collective understanding of regional FGV source distribution and use.

My success rate in assigning FGV artifacts to particular geochemical types may indicate that that the Pah Rah Range and Truckee Meadows are in a "sweet spot" with respect to FGV sourcing studies. For example, all but two of 74 projectile points were assigned to previously known chemical source groups – an impressive 97.3% success rate. While the success rate was substantially lower for other artifact types (from 0% for cores and hammerstones to 29% for flake tools), my study and other similar sourcing efforts (e.g., Eerkens et al. 2007; Eerkens et al. 2008; Smith 2009) have demonstrated that selecting only formal tools (e.g., projectile points) has the potential to obscure lesser used sources in assemblages, producing skewed interpretations of land use patterns. Although submitting other artifact types may continue to return high rates of unknown sources, doing so will ultimately help analysts identify probable source locations based on frequencies of artifacts made on those sources. My thesis provides a case in point: high frequencies of Unknown A and B FGV at Pah Rah sites, represented primarily as informal tools and debitage, strongly suggest that those sources are situated somewhere within or very near that area. Further, the distribution of Unknown H FGV suggests that it may be another regional source. Though we have yet to refine our understanding of the geographic locations and distributions of such sources, identifying their presence and mode of use in lithic assemblages is a requisite first step towards that goal

Additional research into lithic conveyance and toolstone use in the area should also include sites east of the Pah Rah Range. Both archaeological (e.g., Delacorte 1997b;

Waechter 2002) and ethnographic (e.g., Lerch et al. 2010) data suggests that the Pah Rah Range may represent part of a boundary zone between groups utilizing the Truckee Meadows and lands to the east. The results presented here show that sites in the Pah Rah Range have a fairly strong affinity to both sites and FGV sources to the west. Conducting more complete sourcing studies for sites to the east and along the Truckee River corridor will help us better understand how long the Pah Rah Range has served as a boundary zone and how permeable this boundary has been through time.

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APPENDIX A – PROJECTILE POINT KEY

Key to Great Basin and Sierran Projectile Point Types (after Drews 1986)

1. Point is unshouldered. (DSA and PSA not applicable to both sides)…………………………………....2

1a. Point is shouldered……………………………………………………………………………………6

2. Basal width/maximum width ratio (Wb/Wm) exceeds .90; weight > 2.5 grams
   - 2a. Basal Indentation Ratio (BIR) < .96…………………………………Humboldt Basal Notched
   - 2b. BIR > .96; Maximum Width Position (MaxWPos) < 25%..................Martis Triangular

3. Basal width/maximum width ratio exceeds .90; weight < 2.5g
   - 3a. MaxWPos < 25%...Cottonwood Triangular
   - 3b. MaxWPos > 25%...Cottonwood Bipointed

4. Wb/Wm < .90; weight > 2.5g
   - 4a. BIR < .98…………………………………………………………Humboldt Concave Base A
   - 4b. BIR > .98; MaxWPos < 25%...Martis Leaf Shaped
   - 4c. 25% < MaxWPos < 40%..Steamboat
   - 4d. MaxWPos > 40%...Martis Stemmed

5. Wb/Wm < .90; weight < 2.5g
   - 5a. BIR < .98………………………………………………………….Concave Base B
   - 5b. BIR > .98; .50 < Wb/Wm < .98 ...……………………………….Cottonwood Leaf Shaped

6. Point is shouldered. (DSA and PSA measurable on both sides)

7. Notch Opening Index (NOI) > 60, BIR < .97; weight > 2.0g……………Pinto Series

8. PSA > 120; Wb/Wm > .90; weight < 2.0g
   - 8a. .90 < BIR < .98……………………………………………………Desert Side-notched
     - a. Concave shape……………………………………………..General Subtype

Key to Great Basin and Sierran Projectile Point Types (after Drews 1986)

b. Basally notched…………………………………………….Sierran Subtype

9. PSA > 120; Wb/Wm > .90; weight > 2.0g

9a. NOI < 20; BIR < .99………………………………………………Northern Side-notched

9b. NOI > 20

a. BIR > .98…………………………………………………...Elko Side-notched

b. .90 < BIR < .98……………………………………………..Martis Side-notched

10. PSA < 95; Wb < 10 or Wb/Wm < .90

10a. Weight > 2.5 grams

a. BIR > .89; Wb/Wm < .35…………………………………..Elko Contracting Stem

b. BIR > .89; Wb/Wm > .35…………………………………..Martis Contracting Stem

c. other

10b. Weight < 2.5 grams

a. BIR < .96; DSA < 160; Wb/Wm < .20 or Wb < 4.5………..Gunther Barbed

b. BIR > .96; DSA < 160; Wb/Wm < .20 or Wb < 4.5………..Gunther Short Barbed

c. BIR > .96; 160 < DSA < 185; .20 < Wb/Wm < .45………...Gunther Abrupt Shoulder

d. BIR > .96; DSA > 185; .20 < Wb/Wm < .45………………..Gunther Round Shoulder

11. 95 < PSA < 130; DSA < 195; Wb < 10.0

11a. BIR > .96…………………………………………………………Rosegate Series

11b. BIR < .96…………………………………………………………Surprise Valley Split Stem

12. 110 < PSA < 150; DSA < 195; Wb > 10.0 or Wb/Wm < .90

12a. BIR < .93………………………………………………………….Elko Eared

12b. BIR > .93………………………………………………………….Elko Corner-notched

13. 100 < PSA < 150; DSA > 195; Wb > 10.0; Wb/Wm < .90…………………Martis Corner-notched

APPENDIX B – XRF RESULTS

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
26Wa1416	1416-1	Biface	Steam/Lago		1894	790	2.40	55	89	549	18	242	9	1117	26	24.8	40.5
				±	102	33	0.14	17	4	9	4	7	2	25	6		
26Wa1416	1416-2	Biface	Steam/Lago		1714	745	2.62	111	91	609	23	255	9	1160	25	28.7	48.7
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1416	1416-3	Debitage	Steam/Lago		2010	711	2.62	91	89	593	24	245	8	1181	35	29.9	41.5
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1416	1416-4	Debitage	Unknown		3719	687	4.80	97	73	383	23	187	10	436	14	55.6	40.6
				±	105	33	0.14	16	4	9	4	7	2	24	6		
26Wa1416	1416-5	Projectile Point	Alder Hill		3944	503	3.63	79	67	754	20	230	14	1252	18	57.7	29.2
				±	107	33	0.14	17	4	10	4	7	2	25	6		
26Wa1416	1416-6	Projectile Point	Steam/Lago		1973	998	2.76	99	95	603	25	255	11	1437	33	22.6	44.6
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1604	1604-01	Projectile Point	Alder Hill		3973	404	3.56	89	61	725	17	229	18	1197	17	70.0	28.4
				±	106	33	0.14	17	4	10	4	7	2	26	6		
26Wa1604	1604-02	Awl	Gold Lake		2445	623	3.31	91	44	474	13	56	6	826	23	42.7	42.9
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1604	1604-03	Core	Unknown A		4465	727	4.77	123	36	802	22	184	8	1267	19	52.3	33.7
				±	106	33	0.14	17	4	10	4	7	2	25	6		
26Wa1604	1604-04	Projectile Point	Steam/Lago		2033	681	2.73	96	94	587	21	256	9	1182	17	32.5	42.7
				±	102	33	0.14	16	4	9	4	7	2	26	6		
26Wa1604	1604-05	Uniface	Not		2277	435	7.37	104	0	643	6	72	2	0	ND	132.7	100.4
				±	102	33	0.14	16	4	9	4	7	3	23	ND		
26Wa1604	1604-06	Core	Unknown A		4450	891	4.82	87	36	794	21	181	10	1342	25	43.2	34.1

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_2O_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	108	33	0.14	17	4	10	4	7	2	25	6		
26Wa1604	1604-07	Projectile Point	Steam/Lago		1982	641	2.60	104	91	632	21	244	12	1258	20	33.0	41.9
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1604	1604-08	Projectile Point	Alder Hill		3513	404	3.37	62	63	727	21	230	15	1333	25	66.4	30.5
				±	105	33	0.14	17	4	10	4	7	2	25	6		
26Wa1604	1604-09	Projectile Point	Gold Lake		2492	840	3.75	89	43	489	11	54	6	941	24	35.9	47.5
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1604	1604-10	Projectile Point	Steam/Lago		2344	930	3.48	81	90	569	22	227	11	1219	29	30.2	46.9
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1604	1604-11	Biface	Alder Hill		3336	413	3.39	67	59	671	19	214	15	1307	22	65.5	32.3
				±	104	33	0.14	16	4	9	4	7	2	26	6		
26Wa1604	1604-12	Biface	Steam/Lago		1914	627	2.38	86	91	546	20	239	9	1289	23	30.9	39.7
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1604	1604-13	Biface	Steam/Lago		2313	820	3.22	80	83	582	23	226	7	1228	9	31.8	44.2
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1604	1604-14	Biface	Steam/Lago		2119	882	2.78	68	88	583	22	238	9	1236	26	25.7	41.8
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1604	1604-15	Biface	Steam/Lago		2074	744	2.91	80	89	563	21	239	9	1221	28	31.7	44.6
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1604	1604-16	Flake Tool	Unknown A		4555	673	4.19	95	38	841	19	191	10	1205	14	49.7	29.1
				±	108	33	0.14	16	4	10	4	7	2	25	6		
26Wa1604	1604-17	Debitage	Unknown A		3875	521	3.90	68	41	818	21	182	8	1170	21	59.7	31.9
				±	106	33	0.14	17	4	10	4	7	2	25	6		
26Wa1604	1604-18	Flake Tool	Unknown		3111	775	4.97	92	3	1332	21	62	3	143	15	51.1	50.2
				±	103	33	0.14	18	4	11	4	7	2	25	7		
26Wa1604	1604-19	Flake Tool	Unknown		3861	921	5.38	111	15	760	18	126	6	664	10	46.6	43.7
				±	105	33	0.14	17	4	10	4	7	2	25	7		
26Wa1604	1604-20	Core	Unknown C		2879	606	3.90	43	59	529	16	156	10	779	12	51.4	42.7
				±	104	33	0.14	17	4	9	4	7	2	25	6		
26Wa1604	1604-21	Debitage	Unknown		2353	825	3.27	187	221	655	19	158	7	845	17	32.0	44.1

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	103	33	0.14	17	5	9	4	7	2	25	6		
26Wa1604	1604-22	Debitage	Unknown D		3636	1268	5.86	112	38	968	24	144	5	876	6	36.9	50.5
				±	105	34	0.14	17	4	10	4	7	2	25	7		
26Wa1604	1604-23	Biface	Gold Lake		2204	804	3.35	88	49	491	10	59	8	963	20	33.6	48.1
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1604	1604-24	Debitage	Unknown		2416	737	2.96	79	167	589	19	144	7	811	16	32.5	38.9
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1604	1604-25	Biface	Steam/Lago		2207	904	2.86	80	88	595	20	238	8	1190	13	25.7	41.2
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1604	1604-26	Debitage	Unknown		4342	560	4.22	82	27	783	19	147	7	985	4	60.0	30.7
				±	107	33	0.14	16	4	10	4	7	2	25	7		
26Wa1604	1604-27	Debitage	Unknown A		3865	580	3.99	105	35	864	24	174	10	1212	29	54.9	32.6
				±	106	33	0.14	16	4	10	4	7	2	25	5		
26Wa1604	1604-28	Debitage	Unknown		3917	856	5.69	97	50	684	24	150	12	1012	16	52.9	45.5
				±	106	33	0.14	16	4	10	4	7	2	25	6		
26Wa1604	1604-29	Debitage	Unknown		5739	718	5.55	105	34	615	37	240	20	1037	3	61.4	30.4
				±	109	33	0.14	17	4	10	4	7	2	25	8		
26Wa1604	1604-30	Debitage	Unknown		2450	705	2.87	88	134	596	21	130	8	790	19	33.0	37.3
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1604	1604-31	Debitage	Unknown B		3673	897	4.89	93	19	678	18	105	4	663	15	43.6	41.9
				±	105	33	0.14	16	4	9	4	7	2	25	6		
26Wa1604	1604-32	Debitage	Unknown		4355	787	5.13	59	29	671	22	160	9	955	15	51.9	37.1
				±	107	33	0.14	18	4	10	4	7	2	25	6		
26Wa1604	1604-33	Debitage	Unknown A		3659	698	3.76	97	41	828	19	186	10	1136	11	43.2	32.5
				±	105	33	0.14	16	4	10	4	7	2	25	6		
26Wa1604	1604-34	Debitage	Steam/Lago		2210	769	2.96	108	92	603	22	248	11	1167	31	31.1	42.5
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1604	1604-35	Debitage	Unknown D		4373	713	4.39	110	28	947	21	146	10	1072	19	49.2	31.7
				±	107	33	0.14	17	4	10	4	7	2	25	7		
26Wa1604	1604-36	Debitage	Unknown C		3465	490	4.15	58	68	551	20	148	9	854	21	67.4	37.8

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	105	33	0.14	16	4	9	4	7	2	25	5		
26Wa1606	1606-01	Chopper	Unknown		NM	NM	NM	108	24	724	18	135	8	1228	28	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa1606	1606-02	Debitage	Unknown F		2072	690	2.66	93	92	616	19	136	10	758	22	31.3	40.9
				±	102	33	0.14	16	4	9	4	7	2	24	6		
26Wa1606	1606-03	Debitage	Unknown		3598	672	4.45	170	15	828	21	145	10	1061	17	52.8	39.0
				±	105	33	0.14	17	4	10	4	7	2	25	6		
26Wa1606	1606-04	Biface	Steam/Lago		1914	697	2.57	87	91	607	21	257	12	1229	19	30.0	42.9
				±	102	33	0.14	17	4	9	4	7	2	25	6		
26Wa1606	1606-05	Debitage	Unknown		3512	938	4.79	114	29	762	23	154	8	1072	11	40.9	42.9
				±	105	33	0.14	16	4	10	4	7	2	25	6		
26Wa1606	1606-06	Debitage	Unknown A		4053	898	4.17	97	39	845	21	177	9	1296	20	37.2	32.5
				±	107	33	0.14	17	4	10	4	7	2	25	6		
26Wa1606	1606-07	Hammerstone	Unknown D		3251	537	3.65	113	29	996	22	143	7	993	19	54.4	35.6
				±	104	33	0.14	16	4	10	4	7	2	25	6		
26Wa1606	1606-8	Debitage	Steam/Lago *		NM	NM	NM	78	86	588	21	253	8	NM	17	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	NM	6		
26Wa1606	1606-9	Debitage	Steam/Lago *		NM	NM	NM	86	84	592	24	241	8	NM	27	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	NM	5		
26Wa1606	1606-10	Debitage	Unknown G		3992	1044	5.48	97	18	747	19	127	3	846	ND	41.9	43.1
				±	107	34	0.14	17	4	10	4	7	2	25	ND		
26Wa1606	1606-11	Debitage	Unknown *		2445	610	4.22	77	6	2072	20	106	8	97	13	55.2	54.3
				±	102	33	0.14	17	4	12	4	7	2	25	6		
26Wa1606	1606-12	Debitage	Steam/Lago *		NM	NM	NM	119	89	622	26	274	7	NM	27	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	NM	6		
26Wa1606	1606-13	Charmstone	Unknown		2889	13432	4.09	96	50	601	22	165	9	1724	38	2.5	44.6
				±	111	49	0.14	17	4	10	4	7	2	26	6		
26Wa1606	1606-14	Flake Tool	Unknown A		3369	867	4.31	86	28	674	23	183	7	922	26	39.8	40.3
				±	106	33	0.14	17	4	10	4	7	2	25	6		
26Wa1606	1606-15	Projectile Point	Alder Hill		NM	NM	NM	90	67	721	21	242	19	NM	13	NM	NM

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	NM	NM	NM	16	4	10	4	7	2	NM	6		
26Wa1606	1606-16	Core	Unknown A		3735	625	3.97	104	40	811	20	208	11	1131	20	50.8	33.6
				±	107	33	0.14	17	4	10	4	7	2	25	6		
26Wa1608	1608-1	Projectile Point	Steam/Lago		1982	767	2.47	138	90	581	19	241	9	1231	29	26.3	39.8
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-1001	Flake Tool	Steam/Lago		NM	NM	NM	146	71	524	38	222	16	866	30	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa1608	1608-13	Projectile Point	Steam/Lago		2002	686	2.68	96	92	620	22	249	11	1251	31	31.7	42.6
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-14	Biface	Steam/Lago		2114	710	2.79	119	90	620	23	251	12	1247	20	31.9	42.0
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-140	Hammerstone	Unknown A		3771	688	3.57	62	33	753	21	190	10	1185	21	41.7	30.1
				±	107	33	0.14	18	4	10	4	7	2	25	7		
26Wa1608	1608-155a	Debitage	Unknown C		3368	492	4.43	50	65	535	17	141	9	828	12	71.5	41.5
				±	105	33	0.14	17	4	9	4	7	2	25	6		
26Wa1608	1608-155b	Debitage	Steam/Lago		1735	668	2.17	72	83	530	24	225	4	1203	27	26.6	40.2
				±	101	33	0.14	16	4	9	4	7	2	26	6		
26Wa1608	1608-155c	Debitage	Unknown B		3973	991	4.97	233	21	721	18	108	4	681	16	40.1	39.3
				±	105	33	0.14	17	4	10	4	7	2	25	6		
26Wa1608	1608-16	Drill	Steam/Lago		2294	732	2.86	100	87	596	20	238	8	1225	24	31.6	39.6
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-162	Hammerstone	Unknown A		NM	NM	NM	103	36	818	23	193	9	NM	24	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	NM	6		
26Wa1608	1608-170	Debitage	Steam/Lago		2158	749	2.98	181	90	588	21	238	9	1216	33	32.2	43.8
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-174	Biface	Steam/Lago		2103	707	2.87	121	92	580	23	238	11	1225	31	32.9	43.4
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-187	Debitage	Steam/Lago		2051	721	2.61	114	87	576	21	237	6	1186	27	29.4	40.6
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-188	Projectile Point	Gold Lake		2613	878	3.53	84	44	470	15	56	4	943	19	32.4	42.7

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-19	Core	Unknown A		NM	NM	NM	90	37	782	22	200	8	1056	22	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa1608	1608-194	Projectile Point	Steam/Lago		2124	875	2.86	120	91	600	22	253	7	1246	26	26.6	42.9
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-2	Biface	Steam/Lago		2015	625	2.46	119	92	590	21	256	6	1182	29	32.0	39.1
				±	102	33	0.14	18	4	9	4	7	2	25	6		
26Wa1608	1608-20	Projectile Point	Unknown		2642	896	3.00	96	46	489	23	267	10	1107	22	27.1	36.1
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-203	Biface	Steam/Lago		1955	766	2.69	105	96	590	22	241	8	1269	23	28.5	43.8
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-228	Projectile Point	Steam/Lago		2539	933	3.21	125	92	601	20	242	6	1285	24	27.8	40.1
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-231	Biface	Steam/Lago		2549	770	3.03	161	84	550	21	231	7	1193	27	31.8	37.7
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-233	Flake Tool	Steam/Lago		2354	656	2.86	101	88	584	24	243	12	1160	31	35.3	38.7
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-256	Flake Tool	Steam/Lago		2318	771	3.09	76	83	626	20	222	9	1233	26	32.4	42.3
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-262a	Biface	Gold Lake		2388	698	3.47	101	42	455	15	56	7	954	27	40.0	46.0
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-262b	Debitage	Unknown B		3848	725	5.17	101	17	686	20	102	9	674	8	56.7	42.2
				±	105	33	0.14	17	4	10	4	7	2	25	7		
26Wa1608	1608-268	Projectile Point	Steam/Lago		2107	827	2.74	142	88	567	19	229	7	1201	26	27.0	41.5
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-269	Biface	Steam/Lago		2088	683	2.68	129	89	560	19	241	9	1281	23	31.8	40.9
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-270	Projectile Point	Siegfried CR		2636	988	3.83	135	23	1256	18	87	6	947	29	31.2	45.8
				±	103	33	0.14	17	4	10	4	7	2	25	6		
26Wa1608	1608-274	Biface	Steam/Lago		2042	753	2.69	233	92	593	21	245	10	1215	35	29.0	41.9

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-291a	Debitage	Unknown A		5293	740	5.00	171	36	848	21	193	12	1709	25	53.9	29.8
				±	109	33	0.14	17	4	10	4	7	2	26	6		
26Wa1608	1608-291b	Debitage	Unknown		3696	902	6.56	282	44	353	20	119	8	957	17	57.7	55.4
				±	105	34	0.14	18	4	9	4	7	2	25	6		
26Wa1608	1608-291c	Debitage	Steam/Lago		2518	871	3.55	83	91	613	24	250	6	1259	17	32.9	44.6
				±	104	33	0.14	17	4	9	4	7	2	25	6		
26Wa1608	1608-291d	Debitage	Unknown		2473	754	3.14	110	172	638	22	137	7	967	21	33.6	40.3
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-310	Scraper	Unknown		3513	195	4.00	105	114	351	21	136	6	2446	21	158.0	36.0
				±	108	32	0.14	16	4	9	4	7	2	26	6		
26Wa1608	1608-314	Biface	Steam/Lago		1936	714	2.65	97	93	572	21	239	12	1125	22	30.2	43.6
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-319	Flake Tool	Alder Hill		4828	1002	4.49	78	54	700	21	209	15	1304	31	36.0	29.4
				±	108	34	0.14	17	4	10	4	7	2	25	6		
26Wa1608	1608-335	Debitage	Unknown A		4078	1076	4.16	111	32	762	19	178	8	1304	24	31.1	32.2
				±	107	34	0.14	17	4	10	4	7	2	25	6		
26Wa1608	1608-340	Scraper	Steam/Lago		2132	735	2.77	104	95	616	22	241	8	1190	29	30.6	41.4
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-341	Projectile Point	Steam/Lago		2095	673	2.65	115	95	582	25	254	9	1218	26	32.0	40.3
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-344	Flake Tool	Steam/Lago		1861	706	2.62	149	98	621	25	255	8	1194	24	30.2	44.8
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-370	Biface	Gold Lake		2347	691	3.20	84	44	453	13	54	8	1007	23	37.3	43.3
				±	102	33	0.14	17	4	9	4	7	2	25	6		
26Wa1608	1608-412	Debitage	Not		704	1292	2.11	48	ND	12	16	20	1	53	80	13.5	94.4
				±	98	34	0.14	15	ND	9	4	7	3	25	4		
26Wa1608	1608-426	Projectile Point	Alder Hill		3880	500	3.83	131	64	670	17	212	16	1272	23	61.0	31.2
				±	106	33	0.14	17	4	9	4	7	2	25	6		
26Wa1608	1608-428	Flake Tool	Steam/Lago		2064	916	2.70	99	87	577	20	242	10	1173	33	24.0	41.6

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-430	Debitage	Alder Hill		6151	862	6.08	109	37	702	29	205	13	1245	23	56.1	31.0
				±	110	33	0.14	17	4	10	4	7	2	25	6		
26Wa1608	1608-47	Biface	Steam/Lago		2317	863	3.08	121	84	551	20	230	8	1220	24	28.9	42.2
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-52	Biface	Steam/Lago		2398	780	3.12	92	87	582	21	242	12	1199	28	32.3	41.3
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-58	Projectile Point	Steam/Lago		2219	704	2.89	89	92	611	22	249	7	1213	29	33.3	41.5
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-59	Biface	Steam/Lago		2820	724	3.42	99	96	611	23	255	9	1306	25	38.0	38.4
				±	104	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-60	Biface	Steam/Lago		2614	644	3.15	126	93	625	24	249	9	1244	28	39.4	38.2
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-67	Projectile Point	Steam/Lago		1989	579	2.30	128	100	599	23	257	6	1198	25	32.4	37.2
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1608	1608-68	Biface	Steam/Lago		2193	685	2.81	101	98	614	21	252	9	1166	25	33.3	40.8
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-69	Projectile Point	Steam/Lago		2135	654	2.77	115	87	645	19	245	11	1240	25	34.4	41.4
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1608	1608-80	Debitage	Unknown A		4303	872	4.12	99	42	771	19	176	9	1462	16	37.9	30.3
				±	107	33	0.14	17	4	10	4	7	2	25	6		
26Wa1608	1608-83	Debitage	Unknown A		4210	726	4.24	108	37	831	23	184	10	1582	35	46.7	31.8
				±	107	33	0.14	17	4	10	4	7	2	26	6		
26Wa1609	1609-1000	Core	Unknown A		4068	1043	5.25	100	24	684	23	191	11	1071	11	40.2	40.5
				±	108	34	0.14	17	4	10	4	7	2	25	6		
26Wa1609	1609-1001	Debitage	Unknown		6209	2807	7.51	153	15	596	20	164	15	451	10	21.4	37.8
				±	112	36	0.14	18	4	10	4	7	2	24	7		
26Wa1609	1609-1002	Debitage	Steam/Lago		1994	620	2.55	284	89	602	22	264	8	1163	34	33.5	40.9
				±	103	33	0.14	17	4	9	4	7	2	25	6		
26Wa1609	1609-1003	Debitage	Steam/Lago		1737	974	2.54	81	90	559	22	249	9	1131	19	21.3	46.7

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_2O_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1609	1609-1004	Debitage	Unknown		5604	948	5.04	67	1	502	26	165	9	444	7	42.5	28.3
				±	109	33	0.14	17	4	9	4	7	2	25	6		
26Wa1609	1609-13	Projectile Point	Steam/Lago		2245	998	3.32	347	85	579	19	255	8	1189	35	26.9	46.8
				±	104	33	0.14	18	4	9	4	7	2	25	6		
26Wa1609	1609-142	Projectile Point	Steam/Lago		NM	NM	NM	101	91	609	21	265	9	1178	21	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa1609	1609-15	Projectile Point	Unknown *		NM	NM	NM	72	46	522	26	304	13	1127	19	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	25	6		
26Wa1609	1609-16	Projectile Point	Steam/Lago		NM	NM	NM	118	97	609	25	263	9	1156	20	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa1609	1609-19	Flake Tool	Unknown		4256	828	4.02	99	48	904	20	212	10	1299	33	39.0	29.9
				±	108	33	0.14	16	4	10	4	7	2	25	6		
26Wa1609	1609-20	Flake Tool	Unknown A		4348	895	4.42	212	39	786	17	196	11	1238	23	39.6	32.1
				±	108	33	0.14	18	4	10	4	7	2	25	6		
26Wa1609	1609-21	Flake Tool	Unknown A		4536	706	4.52	301	37	807	19	209	10	1493	28	51.1	31.4
				±	108	33	0.14	18	4	10	4	7	2	25	6		
26Wa1609	1609-22	Flake Tool	Unknown		5914	1094	6.13	88	3	617	23	135	9	412	16	44.6	32.5
				±	110	34	0.14	17	4	10	4	7	2	24	6		
26Wa1609	1609-23	Flake Tool	Unknown A		4095	989	4.37	153	37	770	19	199	10	1273	27	35.4	33.7
				±	109	34	0.14	17	4	10	4	7	2	25	6		
26Wa1609	1609-24	Flake Tool	Unknown A		4201	754	4.23	179	39	779	22	200	8	1214	27	44.9	31.8
				±	108	33	0.14	17	4	10	4	7	2	25	6		
26Wa1609	1609-25	Flake Tool	Steam/Lago		1945	1026	2.93	341	96	631	26	273	10	1180	27	23.2	47.8
				±	103	33	0.14	17	4	9	4	7	2	25	6		
26Wa1609	1609-26	Flake Tool	Unknown A		3714	492	3.25	116	38	844	21	209	9	1496	33	52.9	27.8
				±	106	33	0.14	17	4	10	4	7	2	26	6		
26Wa1609	1609-27	Flake Tool	Steam/Lago		2113	858	3.29	107	93	571	19	253	11	1146	25	31.0	49.2
				±	104	33	0.14	16	4	9	4	7	2	25	6		
26Wa1609	1609-28	Flake Tool	Steam/Lago		2286	861	3.35	173	89	579	23	261	9	1158	23	31.4	46.3

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	103	33	0.14	17	4	9	4	7	2	25	6		
26Wa1609	1609-333	Biface	Steam/Lago		NM	NM	NM	86	91	615	21	261	8	1116	22	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa1609	1609-42a	Debitage	Unknown		11242	449	7.09	63	32	165	19	365	24	425	10	123.8	19.8
				±	122	33	0.14	17	4	9	4	7	2	24	6		
26Wa1609	1609-42b	Debitage	Alder Hill		NM	NM	NM	94	68	711	19	236	16	NM	20	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	NM	6		
26Wa1609	1609-42c	Debitage	Unknown A		4178	1111	4.45	118	43	816	17	206	9	1143	29	32.2	33.6
				±	108	34	0.14	17	4	10	4	7	2	25	6		
26Wa1609	1609-42d	Flake Tool	Steam/Lago		2131	937	3.25	198	88	579	22	260	12	1149	24	28.1	48.3
				±	104	33	0.14	17	4	9	4	7	2	25	6		
26Wa1609	1609-42e	Debitage	Steam/Lago		2041	918	3.01	128	88	553	18	253	10	1146	22	26.6	46.8
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1609	1609-42f	Debitage	Unknown G		4146	1202	5.99	214	16	725	22	125	5	734	12	39.7	45.2
				±	108	34	0.14	18	4	10	4	7	2	25	6		
26Wa1609	1609-43	Biface	Steam/Lago		1802	829	2.36	142	90	596	23	256	10	1173	34	23.3	41.9
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa1609	1609-433	Biface	Steam/Lago		NM	NM	NM	100	97	624	25	254	8	1121	21	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa1609	1609-589	Biface	Steam/Lago		NM	NM	NM	105	100	658	22	258	9	1121	19	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	5		
26Wa1609	1609-590	Biface	Steam/Lago		NM	NM	NM	119	84	581	22	240	8	1089	17	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa1609	1609-6	Flake Tool	Steam/Lago		2183	909	3.02	109	88	566	21	251	8	1156	26	26.9	43.9
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa1609	1609-8	Flake Tool	Steam/Lago		1935	692	2.55	113	86	552	24	249	7	1097	18	30.0	42.0
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa1612	1612-1	Projectile Point	Alder Hill		3956	464	3.32	85	62	696	20	229	16	1202	15	57.2	26.7
				±	107	33	0.14	17	4	10	4	7	2	25	6		
26Wa1612	1612-2	Projectile Point	Steam/Lago		2006	769	2.85	101	90	617	23	258	9	1156	19	30.1	45.1

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_2O_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa1612	1612-3	Debitage	Unknown		3152	910	4.60	91	88	1205	24	145	11	1262	13	40.4	45.9
				±	106	33	0.14	18	4	11	4	7	2	25	7		
26Wa1612	1612-4	Debitage	Unknown *		NM	NM	NM	107	31	664	22	134	8	NM	14	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	NM	6		
26Wa1612	1612-5	Debitage	Steam/Lago *		NM	NM	NM	159	85	577	20	250	14	NM	20	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	NM	6		
26Wa2065	2065-1	Flake Tool	Steam/Lago		2338	930	3.11	99	85	648	19	252	10	1114	23	27.1	42.2
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa2065	2065-10	Drill	Alder Hill *		3504	393	3.02	76	61	661	17	226	13	1206	16	61.4	27.5
				±	105	33	0.14	17	4	10	4	7	2	25	6		
26Wa2065	2065-11	Biface	Steam/Lago		1827	924	2.57	104	89	541	19	251	9	1171	15	22.7	44.9
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa2065	2065-12	Hammerstone	Unknown		NM	NM	NM	76	13	568	28	204	16	308	4	NM	NM
				±	NM	NM	NM	18	4	10	4	7	2	24	8		
26Wa2065	2065-13	Debitage	Unknown		3483	446	4.38	39	93	111	26	147	10	296	3	77.6	39.6
				±	105	33	0.14	17	4	9	4	7	2	24	8		
26Wa2065	2065-14	Biface	Alder Hill *		3854	535	3.21	82	59	692	19	238	15	1216	11	48.2	26.5
				±	105	33	0.14	17	4	10	4	7	2	26	6		
26Wa2065	2065-15	Projectile Point	Alder Hill		NM	NM	NM	83	64	699	20	240	16	NM	18	NM	NM
				±	NM	NM	NM	16	4	10	4	7	2	NM	6		
26Wa2065	2065-16	Debitage	Unknown		6932	959	6.47	100	3	482	24	146	8	504	10	53.6	29.3
				±	111	33	0.14	18	4	9	4	7	2	25	7		
26Wa2065	2065-17	Core	Unknown		4902	1086	5.70	154	61	424	27	156	10	486	14	41.9	36.5
				±	107	34	0.14	18	4	9	4	7	2	25	7		
26Wa2065	2065-18	Projectile Point	Steam/Lago		2219	881	2.99	95	86	570	22	250	6	1178	14	27.5	42.8
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa2065	2065-19	Debitage	Unknown		3128	1714	7.40	120	2	466	39	173	11	199	8	34.4	73.6
				±	104	35	0.14	17	4	9	4	7	2	24	7		
26Wa2065	2065-2	Biface	Steam/Lago		1751	540	2.12	83	80	551	21	246	7	1056	30	32.0	38.9

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	**Mn**	**$Fe_20_2^+$**	**Zn**	**Rb**	**Sr**	**Y**	**Zr**	**Nb**	**Ba**	**Pb**	**Fe:Mn**	**Fe:Ti**
				±	101	33	0.14	16	4	9	4	7	2	25	6		
26Wa2065	2065-20	Flake Tool	Unknown		2703	2213	8.76	111	40	319	19	163	11	256	16	31.5	100.5
				±	104	35	0.14	18	4	9	4	7	2	24	7		
26Wa2065	2065-21	Debitage	Unknown		5247	1157	6.49	99	0	564	25	164	10	246	10	44.6	38.7
				±	109	34	0.14	18	4	10	4	7	2	24	7		
26Wa2065	2065-22	Hammerstone	Unknown		3037	612	4.57	111	37	451	16	152	6	503	19	59.4	47.3
				±	104	33	0.14	17	4	9	4	7	2	24	6		
26Wa2065	2065-23	Debitage	Unknown		4002	683	4.60	106	5	550	19	135	6	262	8	53.7	36.2
				±	106	33	0.14	18	4	10	4	7	2	25	8		
26Wa2065	2065-24	Debitage	Unknown		3704	1010	5.06	157	45	453	20	125	11	492	32	40.1	42.9
				±	106	33	0.14	17	4	9	4	7	2	25	6		
26Wa2065	2065-25	Debitage	Steam/Lago		2047	929	2.94	88	82	558	20	253	10	1147	26	25.7	45.6
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa2065	2065-26	Biface	Steam/Lago		1874	875	3.19	69	88	528	19	241	8	1212	27	29.5	53.8
				±	103	33	0.14	17	4	9	4	7	2	25	6		
26Wa2065	2065-27	Projectile Point	Steam/Lago *		NM	NM	NM	96	90	578	23	260	12	NM	23	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	NM	6		
26Wa2065	2065-28	Biface	Steam/Lago *		NM	NM	NM	95	92	564	21	250	7	NM	21	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	NM	6		
26Wa2065	2065-29	Projectile Point	Gold Lake		2766	1068	3.94	65	47	450	10	67	7	964	29	29.7	45.0
				±	104	33	0.14	17	4	9	4	7	2	25	6		
26Wa2065	2065-3	Debitage	Unknown		3803	1043	4.46	120	78	695	20	118	4	648	24	34.3	37.0
				±	105	33	0.14	17	4	10	4	7	2	25	6		
26Wa2065	2065-30	Biface	Steam/Lago		1951	918	2.68	103	90	575	24	258	9	1142	24	23.8	43.7
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa2065	2065-31	Debitage	Steam/Lago		2153	852	3.06	84	95	598	25	259	9	1130	21	29.1	45.1
				±	103	33	0.14	16	4	9	4	7	2	26	6		
26Wa2065	2065-32	Biface	Gold Lake *		NM	NM	NM	82	48	482	14	61	8	NM	27	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	NM	6		
26Wa2065	2065-33	Projectile Point	Steam/Lago *		NM	NM	NM	118	98	617	21	262	8	NM	23	NM	NM

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	**Mn**	**$Fe_20_2^+$**	**Zn**	**Rb**	**Sr**	**Y**	**Zr**	**Nb**	**Ba**	**Pb**	**Fe:Mn**	**Fe:Ti**
				±	NM	NM	NM	16	4	9	4	7	2	NM	6		
26Wa2065	2065-34	Projectile Point	Alder Hill		NM	NM	NM	116	63	759	20	232	15	NM	23	NM	NM
				±	NM	NM	NM	16	4	10	4	7	2	NM	6		
26Wa2065	2065-35	Biface	Steam/Lago		2035	964	3.08	80	94	579	20	241	8	1174	26	25.9	47.9
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa2065	2065-36	Biface	Unknown H *		NM	NM	NM	92	107	699	23	270	11	NM	19	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	NM	6		
26Wa2065	2065-4	Projectile Point	Gold Lake		2323	736	3.00	96	41	444	15	66	6	865	33	33.0	41.0
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa2065	2065-5	Biface	Steam/Lago		NM	NM	NM	83	84	535	18	252	11	NM	26	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	NM	6		
26Wa2065	2065-6	Debitage	Not		3417	115	2.98	27	0	24	3	124	4	702	33	194.9	27.8
				±	104	32	0.14	17	4	9	5	7	2	24	5		
26Wa2065	2065-7	Biface	Steam/Lago		1999	619	2.34	91	89	578	22	257	7	1131	25	30.9	37.5
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa2065	2065-8	Projectile Point	Steam/Lago		1872	679	2.19	101	89	561	23	252	10	1120	37	26.4	37.6
				±	101	33	0.14	16	4	9	4	7	2	26	6		
26Wa2065	2065-9	Projectile Point	Steam/Lago *		NM	NM	NM	96	88	541	20	247	11	NM	20	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	NM	6		
26Wa2201	2201-1	Projectile Point	Siegfried CR		NM	NM	NM	92	27	1192	19	80	5	836	22	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa2201	2201-10	Biface	Steam/Lago *		NM	NM	NM	55	86	555	19	240	10	944	30	NM	NM
				±	NM	NM	NM	18	4	9	4	7	2	26	6		
26Wa2201	2201-2	Projectile Point	Steam/Lago		NM	NM	NM	95	85	639	23	246	8	1052	31	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa2201	2201-4	Projectile Point	Gold Lake		NM	NM	NM	74	48	484	14	58	6	869	32	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa3017	3017-1	Projectile Point	Gold Lake		2254	668	3.17	73	35	481	14	60	7	851	17	38.3	44.6
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa3017	3017-10	Biface	Steam/Lago		2044	815	2.99	85	94	600	20	266	10	1166	27	29.7	46.3

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_2O_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	103	33	0.14	17	4	9	4	7	2	26	6		
26Wa3017	3017-11	Biface	Siegfried CR*		NM	NM	NM	97	23	1219	16	103	6	NM	29	52.8	47.3
				±	NM	NM	NM	17	4	10	4	7	2	NM	6		
26Wa3017	3017-12	Biface	Unknown		1221	465	4.62	343	86	213	29	183	4	787	23	78.6	117.4
				±	100	33	0.14	17	4	9	4	7	2	25	5		
26Wa3017	3017-13	Biface	Steam/Lago		2082	786	2.87	80	87	577	21	248	9	1178	31	29.6	43.9
				±	103	33	0.14	16	4	9	4	7	2	25	5		
26Wa3017	3017-14	Biface	Steam/Lago		2181	1119	3.40	109	98	605	26	267	10	1205	23	24.6	49.3
				±	103	34	0.14	16	4	9	4	7	2	25	6		
26Wa3017	3017-15	Biface	Alder Hill		4542	740	4.26	89	63	703	18	234	18	1296	13	46.0	29.6
				±	108	33	0.14	17	4	10	4	7	2	25	6		
26Wa3017	3017-16	Biface	Siegfried CR		2701	935	4.39	86	25	1188	16	95	3	922	11	37.6	51.1
				±	104	33	0.14	17	4	10	4	7	2	25	6		
26Wa3017	3017-17	Biface	Alder Hill *		NM	NM	NM	70	66	697	18	222	14	1202	24	58.2	27.3
				±	NM	NM	NM	17	4	10	4	7	2	26	6		
26Wa3017	3017-18	Biface	Unknown H		1302	665	1.60	124	115	698	24	280	12	1095	23	20.1	40.1
				±	100	33	0.14	18	5	10	4	7	2	26	7		
26Wa3017	3017-19	Biface	Steam/Lago		1727	1016	2.86	92	83	592	25	248	7	1169	18	22.9	52.5
				±	102	33	0.14	17	4	9	4	7	2	25	6		
26Wa3017	3017-2	Projectile Point	Steam/Lago		1967	790	2.93	87	96	611	22	263	7	1157	28	30.1	47.3
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa3017	3017-20	Debitage	Unknown C		3286	628	4.42	63	69	534	20	165	8	835	12	56.1	42.3
				±	105	33	0.14	17	4	9	4	7	2	25	6		
26Wa3017	3017-21	Flake Tool	Unknown F		1923	719	2.67	89	94	638	19	141	6	719	25	30.2	44.2
				±	102	33	0.14	16	4	9	4	7	2	25	5		
26Wa3017	3017-22	Biface	Steam/Lago		1612	786	2.24	118	110	659	24	276	14	1200	30	23.3	44.4
				±	101	33	0.14	16	4	9	4	7	2	26	6		
26Wa3017	3017-23	Biface	Unknown E		3206	479	4.97	43	43	616	17	163	12	1007	18	82.2	48.7
				±	105	33	0.14	18	4	10	4	7	2	25	6		
26Wa3017	3017-24	Flake Tool	Unknown C		2830	469	3.92	55	65	528	22	179	12	680	22	66.4	43.7

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	104	33	0.14	16	4	9	4	7	2	25	6		
26Wa3017	3017-25	Flake Tool	Unknown B		2751	619	3.79	93	19	687	19	107	6	656	8	49.1	43.6
				±	103	33	0.14	17	4	10	4	7	2	25	7		
26Wa3017	3017-26	Flake Tool	Unknown		3140	777	7.44	129	53	262	31	159	10	811	15	75.7	73.8
				±	105	33	0.14	16	4	9	4	7	2	25	6		
26Wa3017	3017-27	Biface	Unknown E		3741	860	5.50	104	75	600	24	170	12	1133	19	50.9	46.1
				±	107	33	0.14	16	4	9	4	7	2	25	6		
26Wa3017	3017-28	Debitage	Unknown C		2583	634	4.73	56	56	507	16	142	7	737	2	59.3	57.4
				±	104	33	0.14	17	4	9	4	7	2	25	11		
26Wa3017	3017-29	Flake Tool	Unknown E		3991	892	5.26	77	63	606	22	164	9	1128	11	47.0	41.4
				±	107	33	0.14	17	4	9	4	7	2	25	6		
26Wa3017	3017-3	Projectile Point	Alder Hill		4438	561	3.29	96	71	751	19	270	23	1391	23	47.0	23.6
				±	108	33	0.14	16	4	10	4	7	2	26	6		
26Wa3017	3017-30	Biface	Unknown		3139	626	4.10	95	50	704	16	161	7	1050	23	52.2	41.2
				±	104	33	0.14	16	4	9	4	7	2	25	5		
26Wa3017	3017-31	Debitage	Unknown		4726	731	5.00	95	29	1047	19	167	7	1140	22	54.5	33.3
				±	108	33	0.14	17	4	10	4	7	2	25	6		
26Wa3017	3017-32	Projectile Point	Gold Lake		2321	756	3.17	92	39	472	11	57	6	802	15	33.9	43.4
				±	102	33	0.14	16	4	9	4	7	2	25	6		
26Wa3017	3017-4	Projectile Point	Steam/Lago *		NM	NM	NM	80	102	595	24	259	12	NM	36	29.5	53.5
				±	NM	NM	NM	17	4	9	4	7	2	NM	6		
26Wa3017	3017-5	Biface	Alder Hill		4248	567	3.97	97	66	706	17	228	19	1243	10	55.9	29.6
				±	108	33	0.14	16	4	10	4	7	2	25	6		
26Wa3017	3017-6	Biface	Steam/Lago		1830	825	2.89	94	93	620	23	260	11	1166	25	28.4	50.1
				±	103	33	0.14	16	4	9	4	7	2	25	6		
26Wa3017	3017-7	Biface	Siegfried CR		2249	593	3.47	111	28	1365	19	99	5	993	28	46.9	48.7
				±	103	33	0.14	17	4	11	4	7	2	25	6		
26Wa3017	3017-8	Biface	Alder Hill		3409	446	3.21	71	63	704	20	215	19	1191	24	57.6	30.0
				±	105	33	0.14	16	4	10	4	7	2	25	6		
26Wa3017	3017-9	Biface	Unknown H *		NM	NM	NM	156	110	694	22	281	11	NM	36	29.1	50.3

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	NM	NM	NM	16	4	10	4	7	2	NM	6		
26Wa3017	353-2	Projectile Point	Gold Lake		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	373-10	Projectile Point	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	87-2	Projectile Point	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	366-3	Projectile Point	Alder Hill		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	137-1	Projectile Point	Gold Lake		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	142-1	Projectile Point	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	212-9	Projectile Point	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	362-7	Projectile Point	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	171-2	Projectile Point	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	308-5	Projectile Point	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa3017	656-7	Projectile Point	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa5604	5604-3	Projectile Point	Siegfried CR		NM	NM	NM	79	25	1232	18	87	4	806	28	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa5604	5604-6	Projectile Point	Gold Lake		NM	NM	NM	59	43	491	15	57	6	842	30	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	25	6		
26Wa5606	5606-1	Biface	Gold Lake		NM	NM	NM	95	41	448	11	52	8	818	31	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	5		
26Wa5606	5606-11	Debitage	Unknown		NM	NM	NM	28	-2	490	8	68	2	2	6	NM	NM
				±	NM	NM	NM	19	52	9	4	7	2	23	7		
26Wa5606	5606-2	Biface	Steam/Lago		NM	NM	NM	74	90	608	19	240	9	1068	36	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	25	6		
26Wa5606	5606-3	Projectile Point	Steam/Lago		NM	NM	NM	57	91	558	19	256	8	1216	26	NM	NM
				±	NM	NM	NM	18	4	9	4	7	2	25	6		
26Wa5610	5610-121	Biface	Steam/Lago		NM	NM	NM	80	85	554	20	241	10	1197	17	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa5610	5610-131	Biface	Steam/Lago		NM	NM	NM	90	98	632	25	260	8	1142	32	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	5		
26Wa5610	5610-166	Debitage	Unknown B		NM	NM	NM	88	14	696	15	112	8	707	11	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	7		

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
26Wa5610	5610-237	Flake Tool	Unknown A		NM	NM	NM	98	36	823	18	188	6	1221	15	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa5610	5610-241	Debitage	Unknown B		NM	NM	NM	119	20	725	18	113	7	709	11	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	7		
26Wa5610	5610-25	Projectile Point	Gold Lake		NM	NM	NM	86	45	470	13	69	8	921	43	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa5610	5610-255	Biface	Alder Hill		NM	NM	NM	84	60	714	20	212	16	1247	12	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa5610	5610-274	Core	Unknown A		NM	NM	NM	70	37	760	29	223	15	1425	24	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	26	6		
26Wa5610	5610-40	Biface	Steam/Lago		NM	NM	NM	74	87	600	24	263	10	1162	26	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	25	6		
26Wa5610	5610-426	Debitage	Unknown C		NM	NM	NM	57	58	577	14	151	6	894	16	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	25	6		
26Wa5611	5611-12	Core	Unknown A		NM	NM	NM	87	26	829	26	176	9	984	23	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa5611	5611-16	Debitage	Unknown A		NM	NM	NM	108	38	873	22	197	10	1429	21	NM	NM
				±	NM	NM	NM	16	4	10	4	7	2	26	6		
26Wa5611	5611-23	Flake Tool	Unknown		NM	NM	NM	55	82	503	19	139	12	889	10	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	25	6		
26Wa5611	5611-60	Debitage	Unknown B		NM	NM	NM	160	18	754	20	114	7	672	18	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa5611	5611-8	Biface	Unknown		NM	NM	NM	117	102	665	24	260	11	1275	36	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa5611	5611-87	Debitage	Unknown A		NM	NM	NM	71	33	630	26	172	12	1079	19	NM	NM
				±	NM	NM	NM	18	4	10	4	7	2	26	6		
26Wa5612	5612-161	Biface	Unknown		NM	NM	NM	164	59	1001	22	178	16	1034	39	NM	NM
				±	NM	NM	NM	27	6	15	5	9	3	27	13		
26Wa5612	5612-170	Biface	Steam/Lago *		NM	NM	NM	98	98	648	24	250	7	NM	26	NM	NM

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	**Mn**	**$Fe_20_2^+$**	**Zn**	**Rb**	**Sr**	**Y**	**Zr**	**Nb**	**Ba**	**Pb**	**Fe:Mn**	**Fe:Ti**
				±	NM	NM	NM	16	4	9	4	7	2	NM	6		
26Wa5612	5612-185	Debitage	Unknown B		NM	NM	NM	96	16	691	18	103	4	626	22	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa5612	5612-193	Projectile Point	Steam/Lago		NM	NM	NM	96	90	583	21	242	11	1277	30	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	25	6		
26Wa5612	5612-218	Biface	Steam/Lago		NM	NM	NM	171	82	560	18	226	8	1230	23	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa5612	5612-253	Debitage	Unknown A		NM	NM	NM	99	39	796	24	169	9	1286	21	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa5612	5612-284	Flake Tool	Unknown		NM	NM	NM	22	77	47	11	75	3	498	20	NM	NM
				±	NM	NM	NM	19	4	9	4	7	2	24	6		
26Wa5612	5612-287	Debitage	Unknown A		NM	NM	NM	59	38	780	17	161	12	1246	9	NM	NM
				±	NM	NM	NM	18	4	10	4	7	2	25	7		
26Wa5612	5612-45	Core	Unknown A		NM	NM	NM	73	36	754	20	161	15	1129	25	NM	NM
				±	NM	NM	NM	18	4	10	4	7	2	26	7		
26Wa5638	5638-12	Biface	Steam/Lago		NM	NM	NM	106	93	587	24	248	8	1142	23	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	25	6		
26Wa5638	5638-120	Debitage	Unknown A *		NM	NM	NM	111	31	784	20	165	10	1218	23	NM	NM
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa5638	5638-34	Projectile Point	Steam/Lago *		NM	NM	NM	84	88	608	20	240	7	NM	25	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	NM	5		
26Wa5638	5638-59	Flake Tool	Unknown		NM	NM	NM	119	43	810	19	124	7	949	27	NM	NM
				±	NM	NM	NM	16	4	10	4	7	2	25	5		
26Wa5638	5638-77	Biface	Steam/Lago *		NM	NM	NM	94	91	614	21	243	11	1139	28	NM	NM
				±	NM	NM	NM	16	4	9	4	7	2	25	6		
26Wa5638	5638-87	Core	Unknown B		NM	NM	NM	100	19	702	23	118	10	590	7	NM	NM
				±	NM	NM	NM	18	4	10	4	7	2	25	8		
26Wa5638	5638-94	Projectile Point	Steam/Lago *		NM	NM	NM	102	87	574	22	244	10	1139	25	NM	NM
				±	NM	NM	NM	17	4	9	4	7	2	26	6		
26Wa5638	5638-98	Flake Tool	Unknown *		NM	NM	NM	70	76	620	21	114	8	614	26	NM	NM

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_20_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
				±	NM	NM	NM	17	4	10	4	7	2	25	6		
26Wa7522	2758	Projectile Point	Alder Hill		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	2768	Projectile Point	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	2753	Projectile Point	Gold Lake		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	2755	Projectile Point	Alder Hill		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	2756	Projectile Point	Gold Lake		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	2759	Projectile Point	Gold Lake		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	2853	Biface	Not		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	4099	Biface	Alder Hill		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	4107	Biface	Steam/Lago		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	4113	Biface	Not		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	4162	Biface	Alder Hill		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	4188	Biface	Gold Lake		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa7522	4189	Biface	Alder Hill		-	-	-	-	-	-	-	-	-	-	-	-	-
26Wa8451	11	Projectile Point	Steam/Lago		2132	1023	3.27	90	94	589	20	261	10	1184	28	26	49
				±	103	34	0.14	17	4	9	4	7	2	25	6		
26Wa8451	13	Core	Unknown		1758	692	2.57	46	41	438	17	124	7	577	11	30	47
				±	101	33	0.14	16	4	9	4	7	2	24	6		
26Wa8451	14	Core	Unknown		3950	1085	5.37	113	11	742	17	119	8	778	28	40	43
				±	106	34	0.14	17	4	10	4	7	2	25	6		
26Wa8451	30	Debitage	Unknown		NM	NM	NM	115	23	788	19	119	7	668	23	39	36
				±	NM	NM	NM	16	4	10	4	7	2	25	6		
26Wa8451	56	Debitage	Unknown		3683	921	5.35	107	16	725	18	117	5	636	ND	46	46
				±	105	33	0.14	17	4	10	4	7	2	25	ND		
26Wa8451	59	Debitage	Unknown		1860	261	2.75	16	36	465	18	121	7	496	ND	83	47
				±	101	32	0.14	22	4	9	4	7	2	24	ND		
26Wa8451	63	Debitage	Unknown		4928	1730	4.65	82	31	1053	20	169	12	1339	24	22	30
				±	109	35	0.14	17	4	10	4	7	2	25	6		
26Wa8451	101	Geol Sample	Unknown		5218	1822	7.68	116	0	362	18	97	4	1844	27	34	46
				±	109	35	0.14	17	4	9	4	7	2	26	6		

X-Ray Fluorescence Data

Site Number	Catalog Number	Artifact Type	Geochemical Source		Trace Elements (in ppm)											Ratios	
					Ti	Mn	$Fe_2O_2^+$	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Fe:Mn	Fe:Ti
Frear Site	FS-1	Projectile Point	Steam/Lago		2055	807	3.01	95	86	591	23	244	11	1179	27	30.2	46.5
				±	103	33	0.14	17	4	9	4	7	2	25	6		
Frear Site	FS-10	Debitage	Unknown A		4169	537	4.06	104	40	803	16	181	12	1126	14	60.3	30.8
				±	107	33	0.14	17	4	10	4	7	2	25	6		
Frear Site	FS-2	Projectile Point	Steam/Lago		1711	588	2.18	100	92	600	24	260	9	1145	27	30.3	40.9
				±	101	33	0.14	16	4	9	4	7	2	25	5		
Frear Site	FS-3	Projectile Point	Steam/Lago		2306	1048	3.27	85	91	602	23	250	9	1273	24	25.3	44.9
				±	103	34	0.14	17	4	9	4	7	2	25	6		
Frear Site	FS-4	Biface	Steam/Lago		NM	NM	NM	100	90	562	22	245	9	NM	23	30.9	34.6
				±	101	33	0.14	16	4	9	4	7	2	NM	6		
Frear Site	FS-5	Projectile Point	Gold Lake		2011	758	2.75	69	43	488	13	67	6	943	26	29.5	43.6
				±	102	33	0.14	16	4	9	4	7	2	25	6		
Frear Site	FS-6	Biface	Steam/Lago		2393	738	2.90	82	87	586	21	251	7	1176	29	31.8	38.6
				±	103	33	0.14	16	4	9	4	7	2	25	6		
Frear Site	FS-7	Flake Tool	Unknown		3466	643	4.61	87	25	844	19	123	5	735	14	57.1	41.9
				±	105	33	0.14	17	4	10	4	7	2	25	7		
Frear Site	FS-8	Core	Unknown A		2672	452	2.29	66	37	693	18	174	11	1077	15	41.1	27.6
				±	103	33	0.14	18	4	10	4	7	2	25	6		
Frear Site	FS-9	Biface	Steam/Lago		2205	637	2.53	62	85	525	20	234	8	1203	28	32.2	36.6
				±	103	33	0.14	17	4	9	4	7	2	25	6		

APPENDIX C – ARTIFACT DATA

Appendix C: Artifact Data - Bifaces

Site Number	Artifact Number	Stage	Fragment	Blank	Other Description	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa1416	1416-1	Stage 4	Distal	Indeterminate	-	24	17	6
26Wa1416	1416-2	Stage 3	End	Indeterminate	Cortex present	57	33	17
26Wa1604	1604-11	Stage 4	Distal	Indeterminate	Elongate distal end; slight polish on high spots and tip	28	14	7
26Wa1604	1604-12	Stage 4	Lateral	Indeterminate	-	23	22	9
26Wa1604	1604-13	Stage 4	Distal	Indeterminate	-	24	23	7
26Wa1604	1604-14	Stage 5	Distal	Indeterminate	-	20	21	5
26Wa1604	1604-15	Stage 4	Midsection	Indeterminate	-	29	23	10
26Wa1604	1604-23	Stage 5	Midsection	Indeterminate	-	22	16	6
26Wa1604	1604-25	Stage 5	Midsection	Indeterminate	-	28	24	7
26Wa1606	1606-04	Stage 3	End	Indeterminate	-	32	26	11
26Wa1608	1608-2	Stage 3	Lateral	Indeterminate	-	33	15	8
26Wa1608	1608-14	Stage 5	Complete	Indeterminate	Possible projectile point preform	35	21	8
26Wa1608	1608-47	Stage 3	End	Indeterminate	-	32	21	10
26Wa1608	1608-52	Stage 5	Proximal	Flake	Slight polish on margins; possible knife	40	30	9
26Wa1608	1608-59	Stage 4	Indeterminate	Indeterminate	Slight polish on one margin	37	32	9
26Wa1608	1608-60	Stage 4	Complete	Flake	-	42	20	11
26Wa1608	1608-68	Stage 4	Proximal	Indeterminate	Cortex present	30	19	8
26Wa1608	1608-174	Stage 2	End	Flake	Cortex present; most flaking to dorsal surface	40	38	11
26Wa1608	1608-203	Stage 2	End	Flake	Cortex present	28	29	10
26Wa1608	1608-262a	Stage 2	Midsection	Indeterminate	-	31	22	15
26Wa1608	1608-269	Stage 5	Midsection	Flake	Small amount of cortex; possible small corner-notched dart-sized point	26	25	9

Appendix C: Artifact Data - Bifaces

Site Number	Artifact Number	Stage	Fragment	Blank	Other Description	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa1608	1608-274	Stage 5	End	Flake	-	22	24	6
26Wa1608	1608-314	Stage 5	Midsection	Indeterminate	-	30	23	6
26Wa1608	1608-370	Stage 3	Complete	Flake	Curved; use wear along margins	52	19	12
26Wa1609	1609-43	Stage 5	Lateral	Indeterminate	-	20	18	5
26Wa1609	1609-333	Stage 2	Complete	Flake	-	45	36	5
26Wa1609	1609-433	Stage 3	Proximal	Indeterminate	Cortex present	43	31	9
26Wa1609	1609-589	Stage 3	End	Indeterminate	-	21	25	7
26Wa1609	1609-590	Stage 3	Distal	Indeterminate	-	21	17	8
26Wa2065	2065-2	Stage 4	Distal	Indeterminate	-	27	15	10
26Wa2065	2065-5	Stage 5	Distal	Indeterminate	Possible arrow-sized point	24	13	5
26Wa2065	2065-7	Stage 4	End	Indeterminate	-	18	26	7
26Wa2065	2065-11	Stage 4	End	Flake	Polish along one margin	39	26	7
26Wa2065	2065-14	Stage 5	Midsection	Indeterminate	Possible projectile point	23	15	5
26Wa2065	2065-26	Stage 4	Distal	Flake	-	43	26	10
26Wa2065	2065-28	Stage 5	Distal	Indeterminate	Possible arrow-sized point	17	13	4
26Wa2065	2065-30	Stage 3	Complete	Flake	Cortex present; polish and crushing along margins	43	43	15
26Wa2065	2065-32	Stage 5	Midsection	Indeterminate	Possible arrow-sized point	26	12	4
26Wa2065	2065-35	Stage 5	Distal	Indeterminate	Possible dart-sized point	35	25	4
26Wa2065	2065-36	Stage 5	Midsection	Indeterminate	-	13	14	5
26Wa2201	2201-10	Stage 5	Midsection	Indeterminate	-	21	13	5
26Wa3017	3017-5	Stage 5	Distal	Flake	Side notches	30	20	4
26Wa3017	3017-6	Stage 5	Midsection	Indeterminate	Possible hafted knife; polish and crushing on edges	52	24	8
26Wa3017	3017-7	Stage 5	Distal	Indeterminate	Knife; polish on edges	49	20	8
26Wa3017	3017-8	Stage 5	Distal	Indeterminate	-	34	15	5
26Wa3017	3017-9	Stage 5	Distal	Flake	-	20	19	5
26Wa3017	3017-10	Stage 5	Distal	Flake	-	25	20	3
26Wa3017	3017-11	Stage 5	Distal	Indeterminate	-	22	15	5

Appendix C: Artifact Data - Bifaces

Site Number	Artifact Number	Stage	Fragment	Blank	Other Description	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa3017	3017-12	Stage 1	End	Indeterminate	Cortex present	37	20	9
26Wa3017	3017-13	Stage 5	Midsection	Indeterminate	Possible hafted knife	28	23	7
26Wa3017	3017-14	Stage 3	End	Flake	-	25	42	10
26Wa3017	3017-15	Stage 2	End	Flake	-	36	30	7
26Wa3017	3017-16	Stage 5	Midsection	Flake	-	28	23	5
26Wa3017	3017-17	Stage 4	Distal	Indeterminate	-	23	17	8
26Wa3017	3017-18	Stage 5	Proximal	Indeterminate	-	32	16	4
26Wa3017	3017-19	Stage 5	Proximal	Indeterminate	Hafted knife	48	45	11
26Wa3017	3017-22	Stage 5	End	Flake	Reworking present	26	15	4
26Wa3017	3017-23	Stage 3	End	Indeterminate	-	44	52	17
26Wa3017	3017-27	Stage 1	Complete	Flake	-	48	31	9
26Wa3017	3017-30	Stage 1	Complete	Cobble	Cortex present	62	42	33
26Wa5606	5606-1	Stage 5	Proximal	Indeterminate	Slight patina	30	21	6
26Wa5606	5606-2	Stage 5	Proximal	Indeterminate	Polish and step fractures on margin	31	25	5
26Wa5610	5610-40	Stage 4	Midsection	Indeterminate	-	47	34	13
26Wa5610	5610-121	Stage 5	Midsection	Indeterminate	Polish on margins	27	20	9
26Wa5610	5610-131	Stage 5	Proximal	Indeterminate	-	30	33	11
26Wa5610	5610-255	Stage 4	Distal	Indeterminate	Weak patina	37	20	7
26Wa5611	5611-8	Stage 3	Complete	Indeterminate	Cortex present	49	17	10
26Wa5612	5612-161	Stage 2	Complete	Flake	Crushing along one margin	74	38	25
26Wa5612	5612-170	Stage 4	Midsection	Indeterminate	-	26	13	6
26Wa5612	5612-218	Stage 4	Distal	Indeterminate	Weak patina	33	22	7
26Wa5638	5638-12	Stage 3	Complete	Flake	-	43	25	9
26Wa5638	5638-77	Stage 4	Proximal	Flake	Proximal end slightly concave	34	23	8
26Wa7522	2853	no data	-	-	-	-	-	-
26Wa7522	4099	no data	-	-	-	-	-	-
26Wa7522	4107	no data	-	-	-	-	-	-
26Wa7522	4113	no data	-	-	-	-	-	-
26Wa7522	4162	no data	-	-	-	-	-	-

Appendix C: Artifact Data - Bifaces

Site Number	Artifact Number	Stage	Fragment	Blank	Other Description	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa7522	4188	no data	-	-	-	-	-	-
26Wa7522	4189	no data	-	-	-	-	-	-
Frear Site	FS-4	Stage 5	Distal	Flake	Possible projectile point tip	19	11	4
Frear Site	FS-6	Stage 3	Complete	Flake	-	48	29	14
Frear Site	FS-9	Stage 2	End	Flake	Cortex present	22	22	8

Appendix C: Artifact Data – Projectile Points

Site Number	Artifact Number	Series	Subtype	Condition	ML (mm)	MW (mm)	MTH (mm)	WT (g)	BW (mm)	NW (mm)	PSA	DSA	NOI
26Wa1416	1416-5	Martis	Martis Side-notched	NCO	45	21	12	10.7	17	15	120	220	100
26Wa1416	1416-6	Humboldt	Humboldt	NCO	39	15	5	3	12	-	-	-	-
26Wa1604	1604-01	Rosegate	Eastgate Expanding Stem	COM	22	20	3	1.2	1.1	10	100	120	20
26Wa1604	1604-04	Rosegate	Eastgate	DIS	23	15	4	1.1	-	9	50	140	90
26Wa1604	1604-07	Elko	Elko Side-notched	MED	30	20	7	5	-	16	120	230	110
26Wa1604	1604-08	Pinto	Pinto	PROX	39	20	9	7.3	17	-	-	-	-
26Wa1604	1604-09	Martis	Martis Side-notched	PROX	32	19	7	4.3	17	15	110	220	110
26Wa1604	1604-10	Martis	Martis Contracting Stem	PROX	31	22	7	5.4	16	16	90	220	130
26Wa1606	1606-15	Rosegate	Rose Spring	NCO	36	20	4	-	10	9	-	-	-
26Wa1608	1608-1	Martis	Martis Corner-notched	COM	27	17	6	2.6	12	11	120	220	100
26Wa1608	1608-13	Elko	Elko Side-notched	PROX	27	18	5	2.9	17	15	130	260	130
26Wa1608	1608-20	Elko	Elko Corner-notched	MED	28.6	22.2	5.3	3.1	-	11.2	110	160	50
26Wa1608	1608-58	Martis	Martis Contracting Stem	COM	32.4	22.8	6.7	4	13	12.7	90	210	120
26Wa1608	1608-67	Martis	Martis Corner-notched	NCO	32.2	17.4	8.3	3.2	17.2	15	120	230	110
26Wa1608	1608-69	Elko	Elko Corner-notched (Reworked)	PROX	21	19	5	2.2	13	13	100	160	60
26Wa1608	1608-188	Indeterminate	Corner-notched (Reworked)	DIS	23	25	5	2.2	-	13	90	170	80
26Wa1608	1608-194	Elko	Elko Contracting Stem	PROX	35.5	23.9	6.9	5.8	7.5	15.7	70	210	140
26Wa1608	1608-228	Elko	Elko Contracting Stem	MED	26	24	7	3.3	-	-	90	200	110
26Wa1608	1608-268	Indeterminate	Indeterminate Dart sized point	MED	40	21	6	4.6	-	-	110	220	110
26Wa1608	1608-270	Martis	Martis Corner-notched (Reworked into drill)	PROX	24	22	6	2.5	17	15	140	210	70
26Wa1608	1608-341	Elko	Elko Eared (Reworked)	NCO	22	13	5	1.6	-	13	120	180	60
26Wa1608	1608-426	Dart	Indeterminate stemmed dart sized point	DIS	23	23	6	4	-	-	90	210	120
26Wa1609	1609-13	Dart	Indeterminate dart sized point	PROX	30	24	7	-	18	16	-	-	-

Appendix C: Artifact Data – Projectile Points

Site Number	Artifact Number	Series	Subtype	Condition	ML (mm)	MW (mm)	MTH (mm)	WT (g)	BW (mm)	NW (mm)	PSA	DSA	NOI
26Wa1609	1609-15	Elko		PROX	18.2	18.4	5.3	1.7	18.4	12.7	141	-	-
26Wa1609	1609-16	Dart	Indeterminate dart sized point	COM	39.7	20.5	6.4	5.1	15.6	13.2	110	222	112
26Wa1609	1609-142	Dart	Indeterminate dart sized point	MED	22	20.8	4.1	2.5	-	13.8	-	194	-
26Wa1612	1612-1	Rosegate	Rose Spring	NCO	28	18	5	-	10	9	-	-	-
26Wa1612	1612-2	Indeterminate	Indeterminate	COM	29	22	5	-	7	9	-	-	-
26Wa2065	2065-4	Martis	Steamboat Variant	PROX	28	14.5	5.5	2.4	11	-	-	-	-
26Wa2065	2065-8	Rosegate	Eastgate	NCO	28	20	4	1.6	-	10	90	130	40
26Wa2065	2065-9	Humboldt	Concave Base B	COM	27	11	5	1.2	7	-	-	-	-
26Wa2065	2065-15	Rosegate	Rose Spring	COM	36	16	5	2.5	8	10	80	210	130
26Wa2065	2065-18	Elko	Elko Corner-notched	PROX	27	30	7	6.1	-	20	120	140	20
26Wa2065	2065-27		Surprise Valley Split Stem	NCO	33	17	5	1.9	8	7	100	160	60
26Wa2065	2065-29	Martis	Martis Corner-notched	LAT	32	18	5	3.4	15	11	140	190	50
26Wa2065	2065-33	Humboldt	Concave Base B	NCO	30	10	5	1.3	7	-	-	-	-
26Wa2065	2065-34	Elko	Elko Corner-notched	COM	38	22	5	4	17	16	120	190	70
26Wa2201	2201-1	Dart	Indeterminate dart sized point	MED	31.6	17.6	6.1	3.6	10.8	12.3	-	-	-
26Wa2201	2201-2	Dart	Indeterminate dart sized point	NCO	32.6	14.9	7.2	2.9	8.8	-	93	149	56
26Wa2201	2201-4	Dart	Indeterminate dart sized point	COM	45.2	22.1	6.6	4.9	8.7	9.8	66	206	140
26Wa3017	87-2	Elko	Elko	NCO	42.2	17	6.1	3.5	10.5	10.8	81	198	117
26Wa3017	137-1	Gunther	Gunther Round Shouldered/Shouldered Contracting Stem	COM	33	16	6	2	5.8	7.7	83	225	142
26Wa3017	142-1	Martis	Martis Contracting Stem	COM	41.2	23.1	7	4.3	9	9.7	76	173	97
26Wa3017	171-2	Pinto	Pinto	PROX	22.2	16.4	6.1	2.4	14.7	12.9	73	248	175

Appendix C: Artifact Data – Projectile Points

Site Number	Artifact Number	Series	Subtype	Condition	ML (mm)	MW (mm)	MTH (mm)	WT (g)	BW (mm)	NW (mm)	PSA	DSA	NOI
26Wa3017	212-9	Martis	Martis Contracting Stem	PROX	26.6	25.9	6.3	2.8	9	9.7	91	173	82
26Wa3017	308-5	Pinto	Pinto	COM	32.6	20.9	7.8	4.8	18.3	17.5	88	176	88
26Wa3017	353-2	Elko	Elko	NCO	35.9	27.9	6.8	5.7	-	12.3	60	173	114
26Wa3017	362-7	Martis	Martis Side-notched	NCO	42	26	8	6.5	-	19	130	220	90
26Wa3017	366-3	Elko	Elko Corner-notched	PROX	21.9	22.9	4.6	2	10	8.6	95	150	55
26Wa3017	373-10	Elko	Elko	NCO	39.5	29.7	5.7	4.4	9.3	9.6	74	134	60
26Wa3017	656-7	Pinto	Pinto	COM	38.1	14.6	4.7	2.5	11.2	10.6	-	-	-
26Wa3017	3017-1	Elko	Elko Contracting Stem	NCO	30.2	21.8	5.5	2	4.9	9.4	76	172	96
26Wa3017	3017-2	Rosegate	Eastgate	COM	31.4	20.1	4.4	1.2	9.3	9	98	135	37
26Wa3017	3017-3	Rosegate	Rose Spring	COM	25	19	4.5	1.6	8.7	7.7	102	165	63
26Wa3017	3017-4	Arrow	Indeterminate Arrow Sized Point	DIS	16	15	4	0.8	-	8	-	210	-
26Wa3017	3017-32	Rosegate	Rose Spring	COM	28.7	16.2	3.3	1.2	8.6	7.4	108	179	71
26Wa5604	5604-3	Great Basin Stemmed		PROX	26.6	20.8	5.8	3.9	12.5	-	88	-	-
26Wa5604	5604-6	Great Basin Stemmed		PROX	28.6	27.8	6	4.5	15.9	18.6	93	215	122
26Wa5606	5606-3	Dart sized points	Indeterminate dart sized point	PROX	27.3	22.8	6.6	3.8	12.9	12.9	82	187	105
26Wa5610	5610-25	Elko		COM	37.4	14.5	47	2.1	9.4	8.8	118	176	58
26Wa5612	5612-193	Elko	Eared	NCO	39	24.9	6.1	6.3	19.9	18.6	105	173	68
26Wa5638	5638-34	Dart	Indeterminate dart sized point	MED	14.2	24.4	4.5	1.3	10.7	-	104	180	76
26Wa5638	5638-94	Dart	Indeterminate dart sized point	PROX	17.1	19.2	4.4	1.5	14.6	14.2	107	223	116
26Wa7522	2753	Martis	Steamboat Variant	-	-	-	-	-	-	-	-	-	-
26Wa7522	2755	Martis	Steamboat Variant	-	-	-	-	-	-	-	-	-	-
26Wa7522	2756	Martis	Steamboat Variant	-	-	-	-	-	-	-	-	-	-

Appendix C: Artifact Data – Projectile Points

Site Number	Artifact Number	Series	Subtype	Condition	ML (mm)	MW (mm)	MTH (mm)	WT (g)	BW (mm)	NW (mm)	PSA	DSA	NOI
26Wa7522	2758	Elko	Elko Contracting Stem	-	-	-	-	-	-	-	-	-	-
26Wa7522	2759	Martis	Steamboat Variant	-	-	-	-	-	-	-	-	-	-
26Wa7522	2768	Humboldt	Concave Base B	-	-	-	-	-	-	-	-	-	-
26Wa8451	11	Dart	Indeterminate dart sized point	-	-	-	-	-	-	-	-	-	-
Frear Site	FS-1	Martis	Martis Side-notched	NCO	39	23	7	6.2	22	20	140	200	60
Frear Site	FS-2	Rosegate	Rose Spring	COM	43	13	5	2.3	10	9	125	170	45
Frear Site	FS-3	Elko	Elko Corner-notched	COM	33	23	6	3.9	17	16	120	190	70
Frear Site	FS-5	Humboldt	Humboldt	COM	45	14	5	3.2	8	-	-	-	-

COM=Complete; DIS=Distal; LAT=Lateral; MED=Medial ; NCO=Nearly Complete; PROX=Proximal
ML=Max Length; MW=Max Width; MTH=Max Thickness; WT=Weight; BW=Basal Width; NW=Neck Width;
PSA=PROX Shoulder Angle; DSA=DIS Shoulder Angle; NOI=Notch Opening Index

Source: 26Wa1608, 26Wa1609, 26Wa2201, 26Wa5604, 26Wa5606, 26Wa5610, 26Wa5612, and26Wa5638 data from Delacorte (1997a); 26Wa3017 data from Zeir and Elston (1986)

Appendix C: Artifact Data – Flake Tools

Site Number	Artifact Number	Formality	Flake Type	Other Description	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa1604	1604-16	Informal	Early biface thinning	Polish and flaking along lateral edge and distal end to dorsal surface	45	49	12
26Wa1604	1604-18	Informal	Early biface thinning	Well-developed polish along lateral edges, predominantly to dorsal surface	45	40	8
26Wa1604	1604-19	Informal	Interior core reduction	Weak polish along lateral edge and distal end	43	62	16
26Wa1606	1606-14	Informal	Interior core reduction	Use flaking along lateral edge to ventral surface	106	71	45
26Wa1608	1608-233	Informal	Early biface thinning	Polish and few flakes off lateral edge to ventral surface	31	30	8
26Wa1608	1608-428	Informal	Indeterminate	Entire edge used, flaking and polish to both dorsal and ventral surfaces	42	30	11
26Wa1609	1609-6	Informal	Indeterminate	Weak polish and step fractures on lateral edges to dorsal surface,	38	27	10
26Wa1609	1609-8	Informal	Indeterminate	Weak polish along lateral edge	21	20	4
26Wa1609	1609-19	Informal	Interior core reduction	Use wear on distal end to ventral surface	44	72	15
26Wa1609	1609-20	Informal	Interior core reduction	Use wear on lateral edge to dorsal surface	57	30	15
26Wa1609	1609-21	Informal	Indeterminate	Platform missing, use wear along all edges to dorsal surface	50	41	12
26Wa1609	1609-22	Informal	Interior core reduction	Use wear on lateral edges to dorsal surface, use edges no continuous, some polish	47	52	14
26Wa1609	1609-23	Informal	Interior core reduction	Polish and crushing along lateral edge	34	33	10
26Wa1609	1609-24	Informal	Interior core reduction	Use wear on lateral edge to dorsal surface	50	32	12
26Wa1609	1609-25	Formal	Indeterminate	Use and edge prep along lateral edges; steep edge on one ventral surface and flaking to opposite dorsal surface	42	31	5
26Wa1609	1609-26	Informal	Interior core reduction	Slight polish developed on distal end to ventral surface	32	40	7
26Wa1609	1609-27	Informal	Indeterminate	Polish along lateral edge to dorsal surface	26	20	6
26Wa1609	1609-28	Informal	Indeterminate	Use wear on lateral edges, to dorsal surface on one edge and to opposite ventral surface	32	21	6

Appendix C: Artifact Data – Flake Tools

Site Number	Artifact Number	Formality	Flake Type	Other Description	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa1609	1609-42d	Informal	Late biface thinning	Use wear on lateral edge	25	22	3
26Wa2065	2065-1	Informal	Indeterminate	Slight polish and flaking along lateral edge	24	23	7
26Wa2065	2065-20	Informal	Exterior core reduction	Polish and crushing on lateral and distal ends, edge not prepared	65	58	26
26Wa3017	3017-21	Informal	Early biface thinning	Polish along distal end	39	55	14
26Wa3017	3017-24	Formal	Early biface thinning	Small flake removals along edge of flake, weak polish and crushing	75	62	20
26Wa3017	3017-25	Informal	Interior core reduction	Polish on lateral edge, predominantly on ventral surface	81	37	21
26Wa3017	3017-26	Informal	Indeterminate	Use wear along lateral margins	48	38	14
26Wa3017	3017-29	Informal	Exterior core reduction	Crushing and light polish along lateral and distal end	48	39	17
26Wa5610	5610-237	Informal	Exterior core reduction	Use on lateral edge to dorsal surface	50	70	12
26Wa5611	5611-23	Informal	Interior core reduction	Some polish and flaking on lateral edge and distal end to ventral surface	55	65	21
26Wa5612	5612-284	Informal	Early biface thinning	Use wear on lateral edges	41	30	6
26Wa5638	5638-98	Informal	Interior core reduction	Polish on distal end to dorsal surface	61	55	18
Frear Site	FS-7	Informal	Interior core reduction	Polish and crushing along lateral and distal end	71	88	23

Appendix C: Artifact Data – Cores and Hammerstones

Site Number	Artifact Number	Artifact Type	Core Type	Other Description	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa1604	1604-03	Core	Multidirectional	<5 flake removals; cortex present	53	45	38
26Wa1604	1604-06	Core	Unidirectional core tool	On large flake/split cobble; no cortex; most battering on one end and on high spots	73	52	34
26Wa1604	1604-20	Core	Bifacial	Small amount of cortex	105	97	58
26Wa1606	1606-01	Core	Chopper core	Bifacially worked, sinuous edge; some crushing; cortex present	109	103	47
26Wa1606	1606-16	Core	Multidirectional	>5 flake removals; no cortex	47	46	31
26Wa1608	1608-19	Core	Bifacial core tool	Bifacially edged; 14 cm of use edge; some crushing on use edge; cortex present; smoothing from use; possible rejuvenation	90	92	45
26Wa1609	1609-1000	Core	Unidirectional	<5 flake removals	45	32	16
26Wa2065	2065-17	Core	Multidirectional	Most flakes removed from single platform; some battering	47	32	26
26Wa5610	5610-274	Core	Multidirectional	Cobble core; some polish and battering along margins; no cortex; ovoid shape	75	56	52
26Wa5611	5611-12	Core	Multidirectional	>5 flake removals; on large cobble; no battering or smoothing;	80	77	83
26Wa5612	5612-45	Core	Core tool	Multiple platforms; >5 flake removals; cortex present; three battered margins	73	55	42
26Wa5638	5638-87	Core	Unidirectional	>8 flake removals; pyramidal; small amount of cortex; no battering;	116	115	70
26Wa8451	13	Core	Bifacial core tool	Cobble core; cortex present; multiple use edges; edge battered; step fractured	72	72	41
26Wa8451	14	Core	Bifacial core tool	Cobble core; single use edge; cortex present; edge battered	100	82	65
Frear Site	FS-8	Core	Multidirectional	>5 flake removals; battering along multiple margins; cortex present	80	72	62
26Wa1606	1606-01	Chopper	-	Bifacially worked edge with some crushing, sinuous edge, cortex on back edge	109	103	47

Appendix C: Artifact Data – Cores and Hammerstones

Site Number	Artifact Number	Artifact Type	Core Type	Other Description	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa1606	1606-07	Hammerstone	-	On small cobble/core; slightly bifacial; ovoid shape; battering and step fractures most prominent on one end; some polish on opposite end;	70	61	50
26Wa1608	1608-140	Hammerstone	-	Hammerstone on cobble core; very little cortex; most edges crushed; some smoothing/polish on one side	62	55	45
26Wa1608	1608-162	Hammerstone	-	Hammerstone on multidirectional core; no cortex; one main margin with battering, smoothing, and crushing	61	60	43
26Wa2065	2065-12	Hammerstone	-	Hammerstone on river cobble; flakes removed from one side; battering along all margins; cortex on one side	82	79	46
26Wa2065	2065-22	Hammerstone	-	Hammerstone on small split cobble; battering on ends and high spots; few flake removals	75	63	35

Appendix C: Artifact Data – Other Tools

Site Number	Artifact Number	Artifact Type	Description	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa1604	1604-02	Awl	Elongate biface with well-developed polish along margins and end, striations on margins, weak polish on other high spots, end burined	46	18	8
26Wa1608	1608-319	Awl/punch	Elongate biface with narrow end, polish and crushing at tip, polish developed on all edges and high points, weak striations	43	18	10
26Wa1608	1608-344	Awl	Elongate flake fragment with bifacial flaking at one end, slight polish and crushing at tip	43	21	10
26Wa1606	1606-13	Charmstone	Smooth, spherical	24	16	18
26Wa1608	1608-16	Drill	Bifacial diamond shaped drill base, bit snapped at base of neck, neck/bit width 7 mm	29	24	5
26Wa1608	1608-231	Drill/Graver	Biface with elongate tip, polish and crushing along tip, may have been reworked	23	31	8
26Wa2065	2065-10	Drill	Formal drill, base is side-notched, complete	45	20	6
26Wa1608	1608-256	Scraper	Indeterminate flake blank, cortex along back edge of scraper, most flaking to dorsal surface, polish and crushing along edge, use angle 40°	30	29	9
26Wa1608	1608-310	Scraper	On a small cobble, use edge bifacially flaked, crushing and polish on use edge, opposite edge smoothed, use angle 8-20°	58	45	2
26Wa1608	1608-340	Scraper	May have been hafted, polish, crushing, and step fractures along use edge, use angle 40°	32	23	9
26Wa1608	1608-1001	Scraper	On large exterior core reduction flake, flaking to dorsal surface along use edge, crushing and step fractures on use edge, battering and smoothing on opposite edge, use angle 50°	127	120	40
26Wa5638	5638-59	Scraper	Flake blank, bifacial edge, additional flaking and polish to dorsal surface, use angle 40°	66	41	15
26Wa1604	1604-05	Uniface	Not FGV, not analyzed	-	-	-

Appendix C: Artifact Data - Debitage

Site Number	Artifact Number	Flake Type	Cortex	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa1416	1416-3	Late biface thinning	Absent	24	43	4
26Wa1416	1416-4	Exterior core reduction	Present	51	32	16
26Wa1604	1604-17	Interior core reduction	Present	30	33	12
26Wa1604	1604-21	Late biface thinning	Absent	31	36	10
26Wa1604	1604-22	Interior core reduction	Present	68	51	16
26Wa1604	1604-24	Early biface thinning	Absent	47	49	12
26Wa1604	1604-26	Exterior core reduction	Present	52	48	13
26Wa1604	1604-27	Shatter	Present	25	28	17
26Wa1604	1604-28	Early biface thinning	Absent	25	38	10
26Wa1604	1604-29	Early biface thinning	Present	35	24	5
26Wa1604	1604-30	Interior core reduction	Present	29	35	8
26Wa1604	1604-31	Interior core reduction	Present	32	17	4
26Wa1604	1604-32	Early biface thinning	Present	32	37	8
26Wa1604	1604-33	Exterior core reduction	Present	21	28	7
26Wa1604	1604-34	Early biface thinning	Present	25	35	7
26Wa1604	1604-35	Interior core reduction	Absent	53	22	13
26Wa1604	1604-36	Interior core reduction	Present	25	31	6
26Wa1606	1606-2	Early biface thinning	Present	53	51	12
26Wa1606	1606-3	Early biface thinning	Absent	70	52	17
26Wa1606	1606-5	Late biface thinning	Absent	23	26	6
26Wa1606	1606-6	Early biface thinning	Absent	35	43	9
26Wa1606	1606-8	Early biface thinning	Present	15	16	3
26Wa1606	1606-9	Interior core reduction	Present	16	28	9
26Wa1606	1606-10	Fragment	Absent	27	31	11
26Wa1606	1606-11	Late biface thinning	Absent	24	19	2
26Wa1606	1606-12	Fragment	Absent	11	20	2
26Wa1608	1608-80	Interior core reduction	Absent	37	48	18
26Wa1608	1608-83	Spall	Present	29	26	9
26Wa1608	1608-155a	Interior core reduction	Absent	49	60	24
26Wa1608	1608-155b	Early biface thinning	Present	39	28	7
26Wa1608	1608-155c	Interior core reduction	Present	27	29	9
26Wa1608	1608-170	Fragment	Absent	31	32	8
26Wa1608	1608-187	Late biface thinning	Absent	18	31	6
26Wa1608	1608-262b	Interior core reduction	Absent	49	26	8
26Wa1608	1608-291a	Exterior core reduction	Present	37	32	8
26Wa1608	1608-291b	Interior core reduction	Absent	38	52	14
26Wa1608	1608-291c	Late biface thinning	Absent	26	26	5
26Wa1608	1608-291d	Early biface thinning	Present	34	28	7
26Wa1608	1608-335	Interior core reduction	Absent	43	24	14
26Wa1608	1608-412	Interior core reduction	Absent	27	37	12
26Wa1608	1608-430	Interior core reduction	Present	72	64	26
26Wa1609	1609-42a	Interior core reduction	Absent	30	47	12
26Wa1609	1609-42b	Late biface thinning	Absent	27	40	7
26Wa1609	1609-42c	Late biface thinning	Absent	22	20	5

Appendix C: Artifact Data - Debitage

Site Number	Artifact Number	Flake Type	Cortex	Max Length (mm)	Max Width (mm)	Max Thickness (mm)
26Wa1609	1609-42e	Late biface thinning	Absent	25	25	5
26Wa1609	1609-42f	Early biface thinning	Absent	26	35	7
26Wa1609	1609-1001	Tested cobble	Present	70	50	20
26Wa1609	1609-1002	Early biface thinning	Absent	14	27	2
26Wa1609	1609-1003	Early biface thinning	Present	25	23	5
26Wa1609	1609-1004	Interior core reduction	Present	47	28	13
26Wa1612	1612-3	Exterior core reduction	Present	22	40	13
26Wa1612	1612-4	Late biface thinning	Absent	12	19	2
26Wa1612	1612-5	Shatter	Present	16	13	6
26Wa2065	2065-3	Interior core reduction	Absent	25	45	9
26Wa2065	2065-6	Early biface thinning	-	-	-	-
26Wa2065	2065-13	Interior core reduction	Present	30	51	12
26Wa2065	2065-16	Fragment	Absent	45	30	11
26Wa2065	2065-19	Spall	Present	51	33	1
26Wa2065	2065-21	Interior core reduction	Present	48	31	13
26Wa2065	2065-23	Fragment	Present	25	34	10
26Wa2065	2065-24	Exterior core reduction	Present	74	52	28
26Wa2065	2065-25	Late biface thinning	Absent	27	27	7
26Wa2065	2065-31	Late biface thinning	Absent	22	19	3
26Wa3017	3017-20	Interior core reduction	Absent	62	51	15
26Wa3017	3017-28	Fragment	Absent	43	36	16
26Wa3017	3017-31	Interior core reduction	Absent	41	47	12
26Wa5606	5606-11	Late biface thinning	Absent	31	25	4
26Wa5610	5610-166	Exterior core reduction	Present	50	40	17
26Wa5610	5610-241	Interior core reduction	Present	32	33	10
26Wa5610	5610-426	Interior core reduction	Absent	31	45	10
26Wa5611	5611-16	Early biface thinning	Absent	50	46	10
26Wa5611	5611-60	Exterior core reduction	Present	42	46	8
26Wa5611	5611-87	Interior core reduction	Present	65	55	19
26Wa5612	5612-185	Interior core reduction	Absent	85	68	12
26Wa5612	5612-253	Interior core reduction	Present	58	36	16
26Wa5612	5612-287	Interior core reduction	Absent	31	43	8
26Wa5638	5638-120	Shatter	Absent	32	25	8
26Wa8451	30	No data	-	-	-	-
26Wa8451	56	No data	-	-	-	-
26Wa8451	59	No data	-	-	-	-
26Wa8451	63	No data	-	-	-	-
Frear Site	FS-10	Interior core reduction	Absent	45	35	12