LITHIC TECHNOLOGICAL ORGANIZATION AT THE BAKER SITE: A RHYOLITE QUARRY ON THE MARGINS OF PLUVIAL LAKE MOJAVE, CALIFORNIA

A Thesis By

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Abstract:

A sample of 794 artifacts from the extant Baker site (CA-SBR-541) chipped stone assemblage, a well-known central Mojave Desert rhyolite source, was analyzed to understand how prehistoric hunter-gatherers organized their stone tool technology around pluvial Lake Mojave (today's Soda and Silver Lake playas) and how this site fits into regional patterns of lithic procurement and production across the Mojave Desert and Great Basin. Analysis of the tools, cores, and debitage suggests the Baker site primarily functioned as a rhyolite quarry and workshop where hunter-gatherers emphasized the production of early- to middle-stage bifaces and flake blanks for transport to off-site locations. The outcropping of Baker rhyolite boulders, the high proportion of early-stage reduction debris, and the presence of exhausted, technologically finished tools supports this study's interpretation that the Baker site was a source for raw material procurement and biface and flake blank production with occasional opportunistic tool manufacture. A Levallois-like core reduction technique evident on nearly 18% of the analyzed cores suggests this strategy was a work-around to produce flake blanks from the available small raw material packages and less-than-ideal stone quality. Comparison of 50 cores from the nearby Soda Mountains felsite quarry/workshop complex show many similarities between the lithic technological strategies associated with the procurement and use of felsite and rhyolite around pluvial Lake Mojave, with raw material package size representing the most substantial difference. Attempts to geochemically trace Baker rhyolite across the Mojave Desert landscape fails to show movement of toolstone originating from the site outside of the Lake Mojave area.

TABLE OF CONTENTS

Chapter

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGMENTS

Completion of this study and subsequent thesis was not possible without the help of many prominent figures in my life who either guided me along the way or supported me behind the scenes. My thesis advisor, my thesis committee, my loving family, my childcare helpers, fellow archaeologists and professionals, my boss, and my university all played pivotal roles in the completion of this thesis.

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I also must acknowledge the help of other professionals who contributed to my thesis in various ways. Dr. Wendy Teeter, Curator of Archaeology for the Fowler Museum at University of California, Los Angeles (UCLA), loaned Dr. Knell the Baker site collection on a long-term basis. This long-term loan ultimately provided me with the time required to analyze this collection. Additionally, Melanie Spoo, Joshua Tree National Park Curator and Curator-of-Record for the Mojave National Preserve, provided me with access to the Campbell collection and went out of her way to facilitate the geochemical sourcing study conducted as part of this thesis. I am very appreciative to both.

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CHAPTER 1

INTRODUCTION

This master's thesis undertakes an in-depth analysis of a 25% sample of the entire, previously collected (extant) chipped stone assemblage from the Baker site (CA-SBR-541) in California's Mojave Desert. The goal of this study is to determine the site's function(s), interpret the technological strategies employed by the prehistoric toolmakers at this site, and compare those technological strategies to other archaeological assemblages located around pluvial Lake Mojave. I use what some researchers refer to as a "flow model" (Collins 1975; Kelly 1988; Knell 2012, 2014; Knell and Becker 2017; Schiffer 1976) to reconstruct the organization of technology for the Baker site. A flow model considers a series of systematic behaviors that begin with the initial procurement of lithic raw material, followed by tool production, use, maintenance, and discard patterns that, when considered together, document the range of technological strategies employed at a site (Binford 1973, 1979; Carr and Bradbury 2011; Nelson 1991; Schiffer and Skibo 1987). Together, each component of the flow model illuminates the "flow" of lithic raw materials and tools into, at, and through an archaeological site and can be used to establish the range of behaviors that ultimately formed that site. This thesis not only uses a flow model to draw meaningful conclusions regarding technological strategies that occurred at the Baker site, but also provides a meticulous update for a site that has been virtually absent from the archaeological literature for nearly a half-century.

The Baker Assemblage

The Baker site assemblage was collected by N. Noboru Nakamura and associates in 1964-1965 as part of salvage archaeology efforts during expansion of the Interstate 15 west of Baker, California. Nakamura wrote a report for the site in 1966 that remained unpublished until 1991 (Nakamura 1966 [1991]; also see Sutton 1991), which primarily focused on the chipped stone assemblage and site function. Nakamura unfortunately provided few details regarding the survey and excavation procedures used to collect this assemblage. The San Bernardino County Museum (SBCM) reevaluated the site in 1970 and 1976, reporting the Baker site as a crude rhyolite quarry containing bifaces and choppers (Benton 1976; Reynolds 1970). Given that Nakamura's 1966 report was not published until 1991, Glennan (1972, 1974) effectively produced the earliest publication on Baker site in which he analyzed the extant lithic assemblage as part of his dissertation.

The Baker site chipped stone (accession number 506) is housed at the Fowler Museum at the University of California, Los Angeles (UCLA). The collection is currently on-loan to my thesis advisor, Dr. Edward Knell, and resides in his lab at California State University, Fullerton (CSUF). The assemblage contains 2,902 reported artifacts in 20 banker's boxes, the majority of which are rhyolite, a fine-grained volcanic lithic raw material. Initial inspection of the boxes reveals that each contains a similar number of artifacts distributed between somewhat evenly between tools, cores, and debitage.

The Baker site is situated along the western margin of present-day Soda Lake and Silver Lake playas, which together formed pluvial Lake Mojave (originally referred to as "Mohave"; Figure 1.1) and near the city of Baker, California. Lake Mojave resides in the central Mojave Desert in the southern end of the Great Basin culture area. Extensive archaeological work conducted around pluvial Lake Mojave since the early 20th century largely sought to establish a culture history for the area (Antevs 1937, 1952; Bode 1937; Brainerd 1953; Campbell et al. 1937; Glennan 1974; Nakamura 1991 [1966]; Rogers 1939; Wallace 1962; Warren and True 1961), establish shoreline chronologies, and uncover surface and subsurface deposits (Heizer 1965, 1970; Warren and De Costa 1964; Warren and Ore 1978; Warren and Schneider 2003). More recently, the research focus in the region has shifted to understanding the organization of lithic technology of the lake's past residents (e.g., Knell 2014; Knell et al. 2014; Semenza 1984).

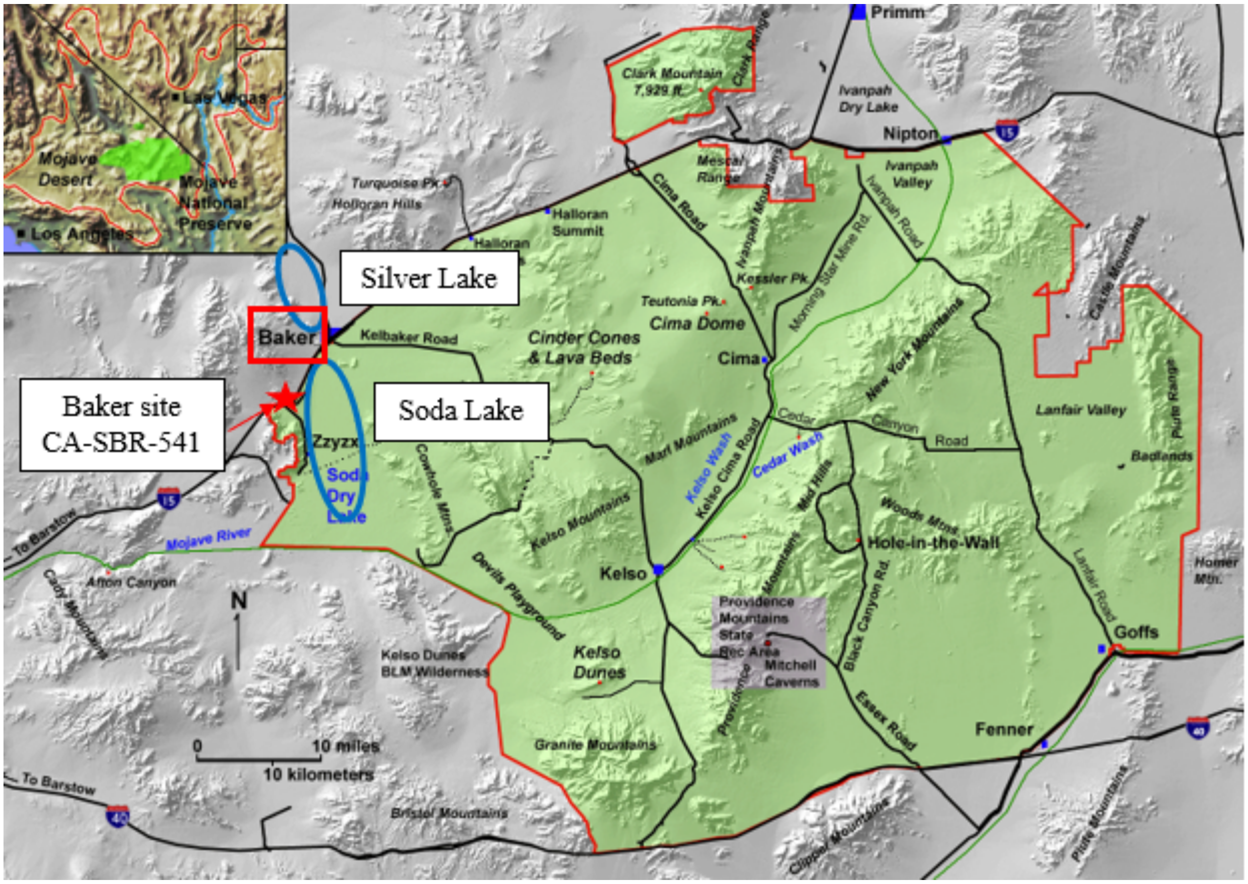


Figure 1.1. Location of the Baker site (star) in relation to the city of Baker (polygon) and the approximate location of Soda and Silver Lake playas (ellipses) that once comprised pluvial Lake Mojave. Soda Lake playa is located in the northwest corner of the Mojave National Preserve. Note that Interstate 15 separates the dry lakes, with the city of Baker on the north side. Modified from Google Images.

Two previous lithic analysis studies were conducted on the Baker site assemblage by Nakamura (1991 [1966]) and Glennan (1972, 1974). The initial reports focused primarily on establishing the culture history of the site and determining its affiliation with a known cultural complex. Both studies analyzed a sample of the assemblage biased towards tools. The results of each study were consistent in their inability to determine a function for the Baker site or definitively assign it to a cultural complex. Nakamura (1991 [1966]) thought the site represented a quarry and workshop with a specialization in either: 1) tool production and subsequent off-site transport, 2) blank production and off-site transport, or 3) tool production for on-site use. Glennan (1972, 1974) also proposed multiple functions for the Baker site, including a quarry, workshop, specialized task area other than quarry or workshop, or a habitation area with a workshop component. The previously suggested range of possible site types leaves much to be desired in terms of the Baker site's actual function. Both previous studies also inconclusively determined a cultural affiliation for the assemblage, stating it is possibly associated with the now defunct Manix Lake Industry (see Bamforth and Dorn 1988), the Lake Mojave complex, or any group post-dating the Lake Mojave complex. In light of recent advances in lithic analytical techniques since the publication of these two studies, a reanalysis of the Baker assemblage is warranted. Specifically, this thesis will analyze a sample of tools, cores, and debitage to evaluate the Baker assemblage in a manner distinct from the two previous studies.

To evaluate the assemblage in a manner unique from the two previous studies, I assess the Baker site from an organization of technology perspective, and particularly one that uses a flow model approach. The flow model allows for behavioral inferences to be made about the site and reveals technological strategies undertaken there based on the observed tools, cores, and debitage. Unlike the prior studies that focused on tool typologies to document the site function, more can be gleaned about the past behaviors that occurred by understanding how those tools arrived at the site, if alterations were made to the tools while at the site, and what items were manufactured for transport off-site. I argue that this can only be achieved using a whole assemblage approach that includes analysis of the finished and unfinished tools, cores, and debitage. An organization of technology approach, much like what is employed in this thesis, considers these and other factors, and uses them to establish a detailed picture of the Baker site as a whole, not just the sum of its parts. The results of this thesis reveal that the Baker site functioned primarily as a rhyolite quarry and workshop, with some tools opportunistically created, used, and discarded on-site. A small number of jasper artifacts were likely transported into the site from local sources and used to produce flake blanks and potentially flake tools for off-site transport.

Thesis Organization

In this section, I provide the general framework for this thesis. Chapter 2 explains the local and regional setting for the Baker site, including a description of the Great Basin physiographic province and how the Great Basin is defined for this thesis. The chapter then addresses the paleoclimate, ecology, geology, and fluvial history of the Great Basin, Mojave Desert, and pluvial Lake Mojave area. The cultural setting is then outlined following the most recent Mojave Desert cultural chronologies (Sutton 2018; Sutton et al. 2007) to understand possible cultural affiliations for the Baker site. Finally, a description is provided of the previous work conducted at the Baker site and previous attempts at classifying the site function and cultural affiliation.

Chapter 3 develops the theoretical framework, and specifically the organization of technology approach, upon with this thesis is scaffolded. After establishing why the organization of technology approach is applicable to a lithic analysis of the Baker site, I provide a detailed review of nine Great Basin/Mojave Desert quarry studies to show the range of technological strategies used in this region and to provide a basis for creating testable site function- and technology-based research questions in Chapter 4.

Chapter 4 outlines the research design used to analyze the Baker site chipped stone assemblage and the methods used to carry out the research. Several research questions are proposed in Chapter 4 that, when answered in Chapter 6, address the flow of lithic raw material and tools through the Baker site and ultimately demonstrate the organization of lithic technology at the Baker site. The methods establish the selection process implemented to sample the Baker assemblage and describe the typological- and attribute-based variables used during analysis. The terminology used in this thesis is also defined, including those terms related to artifact types and morphologies, artifact attributes, and raw material quality imperfections.

Chapter 5 provides the analytical results, which are described in terms of artifact types (i.e., tools, cores, and debitage) and the individual morphologies within each type. This chapter also provides the results of a raw material quality study—conducted to determine whether the lithic material from the Baker site is good, moderate, or poor quality toolstone—and a geochemical sourcing study to see if raw material from the Baker site was transported only around the Lake Mojave area, elsewhere in the Mojave Desert region, or both. Implications of these studies are discussed further in Chapter 6.

Chapter 6 answers the research questions posed in Chapter 4 using the results from Chapter 5. Answers for the research questions are ultimately synthesized to address the flow of lithic raw material and tools through the Baker site and establish the range of technological strategies used by the site inhabitants. After establishing the technological strategies at the Baker site, I compare these strategies to those previously identified at the Soda Mountains quarry and workshop complex to determine whether the strategies employed at the Baker site were unique or something common to the Lake Mojave area. Similarly, I also address whether the Levallois-like core reduction strategy identified at the Baker site is unique to just this site or something also present in the Soda Mountains felsite quarry/workshop area. The final component of Chapter 6 is a geochemical sourcing study that considers the final tool form of Baker implements after off-site transport, the movement of Baker site lithic raw material across the landscape, and any means to tie the Baker site to a cultural complex and establish when it was used.

Chapter 7 summarizes the primary takeaways of this thesis and considers how the Baker site might be viewed in the archaeological literature moving forward. The Baker site function and technological organization strategies are reviewed, as are avenues for potential future research using the extant Baker site assemblage.

CHAPTER 2

BAKER SITE BACKGROUND AND SETTING

Before delving into the lithic technology of the Baker site, it is pertinent to understand the site's geography, geology, cultural, and historic setting. I discuss the Baker site's location within the Mojave Desert, as well as its proximity to pluvial Lake Mojave and environmental setting. I also covered the geologic formation on which the Baker site is situated. Following this, I describe the culture-history framework of the Mojave Desert to consider which cultures or cultural complexes potentially frequented the Baker site. Lastly, I describe the previous archaeological work around pluvial Lake Mojave, including the two prior studies of the Baker site.

Environmental Setting

The Baker site resides in the intermountain west of North America, and specifically the central Mojave Desert. The Mojave Desert itself is located at the southern end of the Great Basin geographic province (Figure 2.1). To better understand the Great Basin geographic province, Grayson (2011) explains the four ways scholars characterize the extent of the Great Basin, which varies by hydrographic, physiographic, floristic, and ethnographic characteristics (Figure 2.2). Hydrographically, the Great Basin spans from the crest of the Sierra Nevada and Cascade Mountains along its western edge to the crest of the Uinta Mountains and Colorado Plateau on the east, and from the Columbia River drainage to the north and the Colorado River to the south (Figure 2.2a). The hydrographic Great Basin is approximately 200,000 square miles (Grayson 2011). The Great Basin is characterized by internally or inward-flowing drainages that form rain-fed lakes in the bottoms of its smaller basins and valleys and is what the hydrographic Great Basin definition is based on (Goebel et al. 2011; Grayson 2011). It also explains the presence of its many pluvial lakes, or paleo-lakes, that formed during the Pleistocene Epoch due to periods of increased precipitation and decreased evaporation (Reheis et al. 2014).

Figure 2.1. Relation of the Mojave Desert boundary to the hydrographic Great Basin boundary within the western United States. Adapted from Sada and Lutz (2016).

The physiographic Great Basin lies in the northern portion of the Basin and Range physiographic province (Figure 2.2b; Repasch et al. 2017). Like the hydrographic Great Basin, the Sierra/Cascade Range, Wasatch/Colorado Plateau, and Columbia drainage define the western, eastern, and northern limitations, respectively, of the physiographic Great Basin. The southern boundary is more arbitrarily defined as the Basin and Range pattern extends into the Mojave Desert and northern Mexico, though physiographers generally draw a line between the Mojave River and Las Vegas, Nevada, as the southern Great Basin physiographic limit (Grayson 2011). This reduces the size of the physiographic Great Basin and, conveniently, cuts through pluvial Lake Mojave.

The floristic Great Basin (Figure 2.2c) is more loosely defined since it follows the presence of specific vegetation communities. Biologists frequently disagree on which vegetation communities to include, but the most common floristic Great Basin definition has saltbush and sagebrush biomes dominating the lowlands, and pinon and juniper woodlands dominating the surrounding mountainous uplands (Cronquist et al. 1972). These parameters nicely correspond to the western edge of the hydrographic and physiographic Great Basin but adds a large swath of Oregon and Idaho and subsequently excludes most of the Mojave Desert where the creosote scrubland community intermixes with saltbush and sagebrush (Grayson 2011). The eastern boundary also becomes somewhat muddled when defining the Great Basin by floristic communities.

The ethnographic Great Basin is defined by the geographic distribution of Numic-speaking native people at the time of European contact (Figure 2.2d). The grouping of linguistic families and similar cultural practices described in ethnographies and oral histories are used, in large part, to determine the ethnographic Great Basin. Since the boundaries of cultural territories are often subjectively defined, more than one ethnographic group can claim ancestry to a particular swath of land, making the ethnographic Great Basin difficult to define. Grayson (2011) specifies the ethnographic Great Basin as roughly the same geographic area as the hydrologic Great Basin, but with the northern boundary extending farther north into central Idaho and the southern boundary slightly past the Mojave Desert into the Colorado Desert of southern California. Of the four Great Basin definitions, the hydrographic Great Basin is the most widely accepted and used (Grayson 2011), and for the sake of this thesis “Great Basin” shall refer to the hydrographic Great Basin.

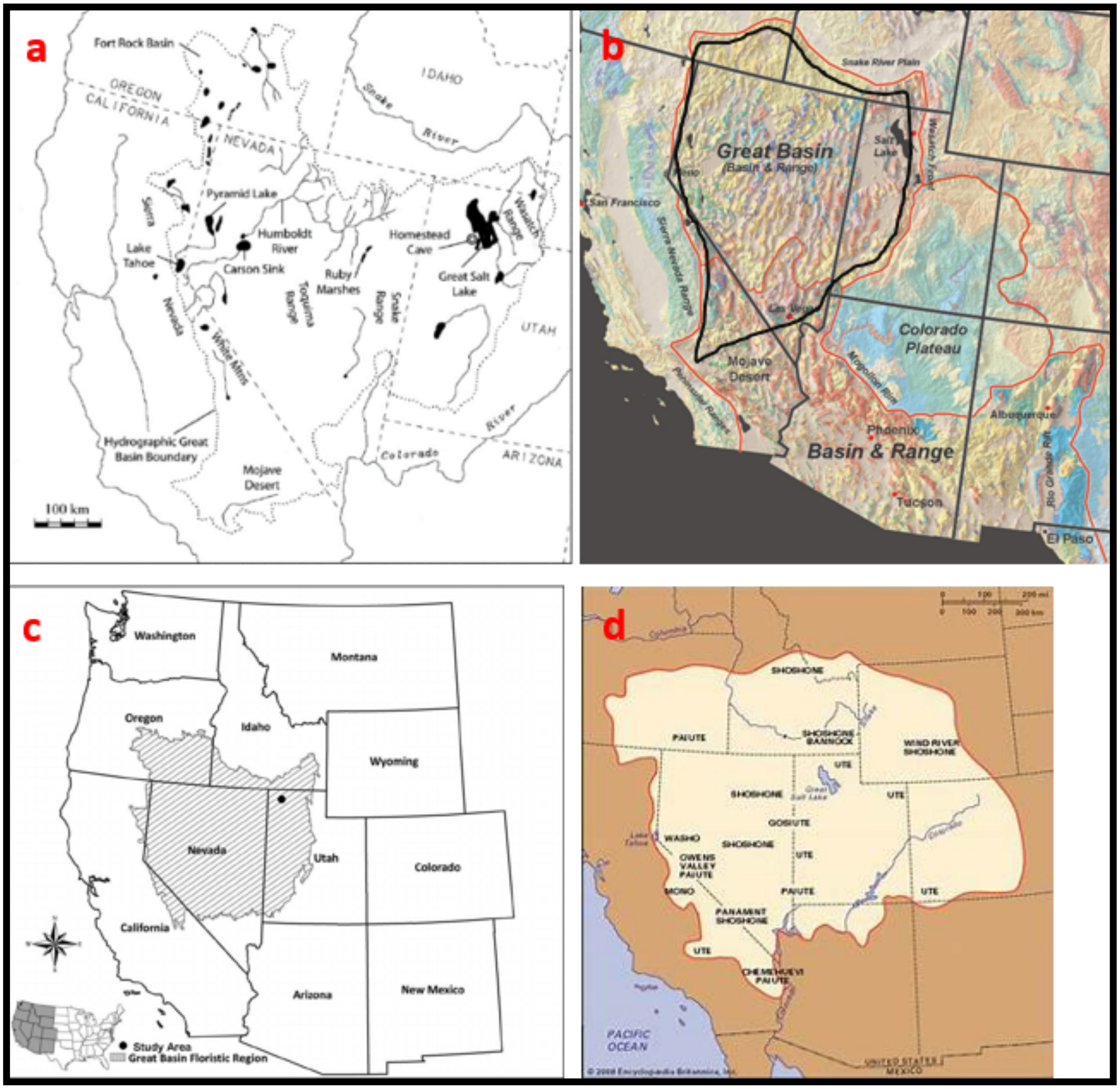


Figure 2.2. Comparisons between the (a) hydrographic, (b) physiographic (black line), (c) floristic, and (d) ethnographic Great Basin. Image credit to [a] Grayson 2006, [b] https://gotbooks.miracosta.edu/geology/regions/western_desert_provinces.html, [c] Morris et al. 2013, and [d] Fowler and Fowler 2020.

Paleoclimate

The Great Basin ebbed and flowed between cold and warm conditions since the Late Glacial Maximum approximately 19,150 calendar (cal) years BP (Holliday and Miller 2014) and persisted since the Great Basin was first likely occupied by humans as early as ~16,000 to ~14,000 cal BP (e.g., Davis et al. 2019; Jenkins et al. 2014). From 12,900 to 11,600 cal BP, after the relatively warm and dry Bølling-Allerød interstadial (14,700-12,900 cal BP; Minckley et al. 2004), the Younger Dryas cold snap dramatically cooled and dried much of the Great Basin (Kirby et al. 2015; Smith and Barker 2017). The Early Holocene followed (~12,000-7600 cal BP; Jenkins et al. 2004) and brought slightly warmer yet still cool conditions, and a general influx of moisture. Many of the pluvial lakes in the Great Basin approached their glacial high stands at this time. The Middle Holocene (7600-3000 cal BP; Jenkins et al. 2004) became substantially warmer and drier than today, rendering large swaths of the Great Basin inhospitable for humans and reducing many standing pluvial lakes to mudflats (Grayson 2011). The Late Holocene (3000 cal BP to historic contact; Jenkins et al. 2004) cooled the Great Basin and temporarily refilled some of the large pluvial lakes, though to nowhere near their terminal Pleistocene high stand (Grayson 2011). The onset of the Late Holocene brought with it the climate conditions generally seen across the Great Basin today, although climactic variations such as the comparatively warm Medieval Climactic Anomaly (1000-700 cal BP) and cold Little Ice Age (550-250 cal BP) caused substantial short-term thermal fluctuations (Mann et al. 2009). As the Great Basin continued to warm into Late Prehistoric and historic times, the large pluvial lakes mostly diminished into playas. The Great Basin supported approximately 80 pluvial lakes during the late Pleistocene, though today just 45 modern lakes still contain water during any given part of the year (Grayson 2011).

Pluvial lakes, such as those shown in Figure 2.3, typically formed in response to two climatic occurrences during the Late Pleistocene: depressed temperatures and increased precipitation (Harvey et al. 1999). Grayson (2011:20) emphasizes, however, that many Great Basin lakes were filled by river outlets originating outside of the geographic Great Basin and not necessarily by precipitation alone. The same pattern is true for the Mojave Desert lakes, including Lake Mojave (discussed below), receiving much of their standing water from river flow in addition to precipitation (Honke et al. 2019). Regardless, Grayson states that the numerous “rivers” or streams that flow within the Great Basin and Mojave Desert drain internally with no outlet to the ocean, thus confirming the idea that the Great Basin is one large inwardly draining geographic pocket.

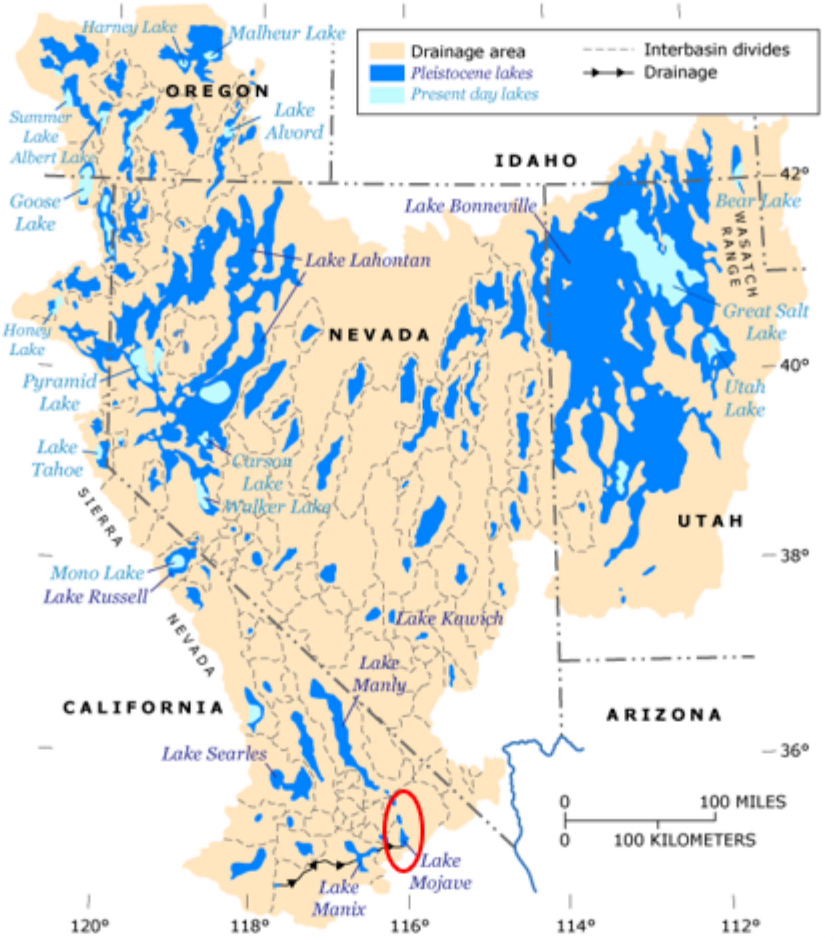


Figure 2.3. Great Basin and Mojave Desert pluvial lakes. Red ellipsis indicates the location of pluvial Lake Mojave, which is today's Soda and Silver Lake playas. Image credit to https://serc.carleton.edu/download/images/51472/pleistocene_pluvial_lakes.png.

Pluvial Lake Mojave

Pluvial Lake Mojave occupied Soda Lake Basin and Silver Lake Basin in the Mojave Desert (Figure 2.4). These basins are trans-tensional tectonic basins (i.e., physiographic low points) that join the Soda-Avawatz fault system with the Bristol-Granite Mountain fault system and are associated with the eastern California shear zone (Honke et al. 2019; Langenheim and Miller 2017). Soda Lake Basin ranges from 270 meters in the basin bottom to almost 700 meters in the surrounding mountain ridges, with a similar basin bottom elevation for Silver Lake (Honke et al. 2019). The topography of both basins and elsewhere around the Mojave Desert is characterized as robust, bare-sloped mountain ranges, broad valleys, sandy washes, narrow, boulder-ridden canyons, and salt-encrusted dry lakes (Wallace 1962:172).

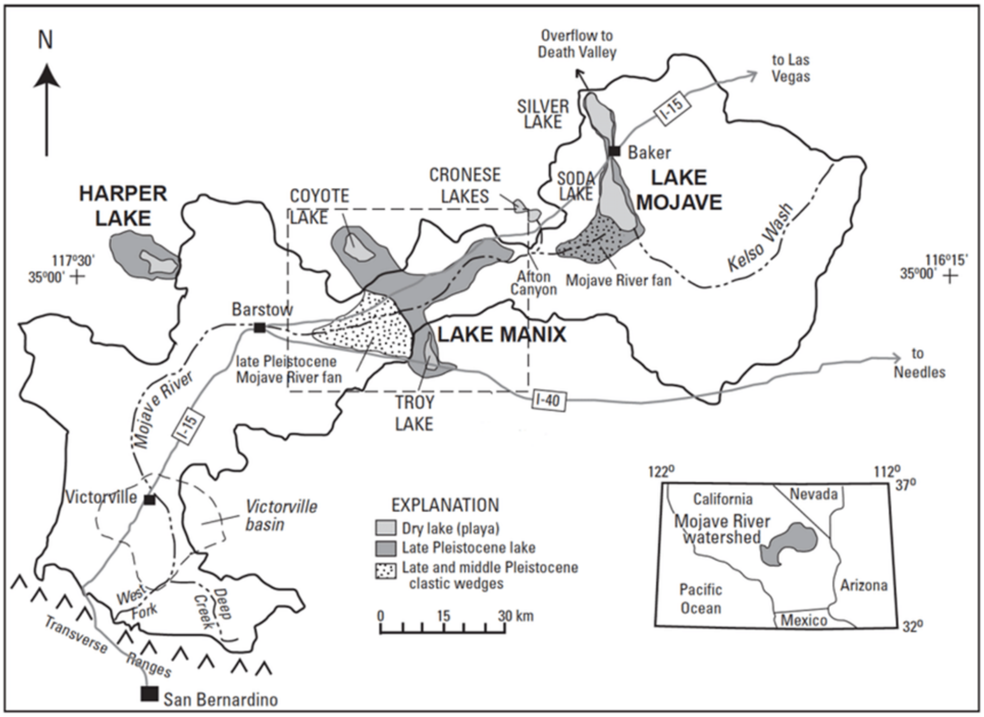


Figure 2.4. Mojave River drainage flowing into Soda Lake at the southern end of pluvial Lake Mojave. Image credit to Wells et al. (2003:Figure 1).

Lake Mojave received most of its water from the now-underground Mojave River, which originates in the San Bernardino Mountains to the south (Kirby et al. 2015; Wells et al. 2003). Wells et al. (2003) suggest Lake Mojave first filled sometime before 27,000 cal BP, with intermittent flooding and draining until roughly 21,900 cal BP. Kirby et al. (2015:180) found that during the Bølling–Allerød period approximately 14,800-14,400 cal BP, Lake Mojave experienced a period of enhanced aridity with a generally lower lake level and few high-energy run-off events. Lake Mojave then saw wetter conditions and higher lake levels around 14,400-13,600 cal BP (Kirby et al. 2015). The onset of the Younger Dryas (13,600-11,600 cal BP) again brought dryer conditions to the region and subsequent lower lake levels. The lake then gradually and episodically diminished to the playa that it is today by roughly 7800-7400 cal BP, with some Late Holocene recurrences of standing water in Soda and Silver Lake playas (Kirby et al. 2015; Knell et al. 2014). At its late Pleistocene maximum, Lake Mojave covered 300 km^2 and held upwards of 7 km^3 of water (Wells et al. 2003).

By the Late Pleistocene and/or Early Holocene when Paleoindian occupation began around Lake Mojave (Brainerd 1953; Campbell et al. 1937; Knell 2014; Knell et al. 2014; Warren and Ore

1971, 1978; Warren and Schneider 2003), the local vegetation was lusher than today's arid desert shrubland (Kirby et al. 2015). Pollen from preserved packrat middens from the central-Mojave area near Lake Mojave indicate a temperate desert shrubland including shadscale, bursage, and brittlebush (Forester et al. 1998; Grayson and Livingston 1993; Koehler et al. 2005; Spaulding 1986, 1991; Wells and Berger 1967; Wells and Woodcock 1985). These lowlands (below 800-1,000 meters) likely supported a variety of small fauna, including lizards, snakes, tortoise, mice, rats, rabbits, and squirrels that were exploited by native populations for food. Larger fauna, such as mule deer, desert bighorn sheep, antelope, coyote, badger, kit fox, and occasionally ringtail cat and bobcat also frequented the desert shrubland ecozone in the central-Mojave (Basgall 1993:23-24).

Areas of the Mojave Desert and Great Basin with elevations ranging from 800 to 1,000 meters supported pinyon-juniper woodland (Koehler et al. 2005). At these elevations, pygmy rabbit, yellow-bellied marmot, bushy-tail woodrat, northern pocket gopher, and pika flourished alongside the larger mule deer and bighorn sheep; however, this biome never extended down to Lake Mojave itself (Grayson 2006:2964). Climatic shifts during the Late Pleistocene and Holocene brought sub-alpine forest (e.g., white fir and limber pine) below 1,900 meters, but none of the mountains surrounding Lake Mojave are high enough to have harbored these plants (Harvey et al. 1999).

The dominant shrubland and woodland biozones around Lake Mojave progressively shifted upward in elevation until the Middle Holocene (around 6000-7000 cal BP), when the Great Basin and Mojave Desert became hotter and drier, and the pinyon-juniper woodland and desert shrubland receded upslope. Around the same time, thermophilus desert scrub and creosote brush expanded across the Mojave Desert lowlands, replacing the desert shrubland to elevations up to 800 meters by 4000 years cal BP (Harvey et al. 1999). Lake Mojave vegetation has remained largely unchanged since 4000 cal BP (Grayson 2011).

Cultural Setting

The evolution of the Mojave sequence, or the culture history of the Mojave Desert, has changed on multiple occasions as new archaeological discoveries shed light on the native peoples that occupied the region. Early sequences identified patterns in material culture, such as the Basket-Maker, Malpais, and Amargosa (Rogers 1939), that are no longer recognized in the current Mojave Desert chronology. A newer chronology produced by Sutton et al. (2007; Table 2.1) includes seven prehistoric (pre-European contact) cultural complexes and one proposed complex that occupied the Great Basin and Mojave Desert between the terminal Pleistocene/Early Holocene and the Late Holocene (Table 2.1). These techno-complexes—groups determined by their technological differences—constitute the most, or among the most, accepted Mojave Desert chronology to-date and includes Pre-Clovis, Paleo-Indian (or Paleoindian; although see below), Lake Mojave, Pinto, Deadman Lake, Gypsum, Rose Spring, and Late Prehistoric. However, more recent reevaluation of the Mojave Desert chronology by Sutton (2018; see Table 2.2) has altered the Paleoindian phase to include the Clovis, Lake Mojave, and Pinto techno-complexes and renamed these Paleoindian cultural complexes as the Lakebed phase.

Pre-Clovis is assigned to archaeological remains predating the Clovis complex, which Waters et al. (2020) suggest dates between 12,750 and 13,050 cal BP. Many archaeologists now think that humans inhabited the New World before Clovis, with dates on the order of at least 14,000 cal BP. Monte Verde II in Chile (Dillehay 1997), for example, may be ~14,500 cal BP and Paisley Caves in Oregon possibly as early as 14,525 cal BP (Jenkins et al. 2014). Recent studies at Cooper’s Ferry, Connolly Cave, and Bonneville Estates Rockshelter (see Davis et al. 2019) are finding that Western Stemmed Tradition points (WST, a.k.a. Great Basin Stemmed Tradition; Tuohy and Layton 1977; Smith et al. 2020) in western North America are contemporaneous, if not earlier, than Clovis. The Cooper’s Ferry site, for example, has radiocarbon dates on WST points that are 16,560-15,280 cal BP (Davis et al. 2019). More research is needed, however, before this issue can be resolved. Regardless, no evidence exists to suggest that the archaeological sites around pluvial Lake Mojave are pre-Clovis in age.

Table 2.1. Proposed Mojave Desert Cultural Chronology following Sutton et al. (2007).

Temporal Period	Cultural Complex	Approximate Dating	Previously Known As	Marker Artifacts
Pleistocene	Pre-Clovis (hypothetical)	Pre-11,950 cal BP	Early Man; Early Humans; Pre-Projectile Point	Unclear
	Paleo-Indian	11,950-9950 cal BP	Clovis; Early Systems; Big Game Hunting Tradition; Malpais	Fluted points (Clovis)
Early Holocene	Lake Mojave	9950-7950 cal BP	Western Pluvial Lakes Tradition; Western Lithic Co-tradition; Western Stemmed Tradition; Playa Complex; San Dieguito Complex; Lake Mohave Complex; Early Archaic; Death Valley I; Period I	Stemmed points (Lake Mojave, Silver Lake)
Middle Holocene	Pinto	8950-4950 cal BP	Little Lake; Amargosa I; Period II; Death Valley II	Pinto series points
	Deadman Lake		N/A	Contracting stemmed and leaf-shaped points
Late Holocene	Gypsum	3950-1750 cal BP	Newberry; Elko; Amargosa II; Period II; Death Valley II	Gypsum and Elko series points
	Rose Spring	1750-850 cal BP	Saratoga Springs I; Period III, Phase II; Late Rose Spring; Haiwee; Death Valley III; Period III; Saratoga; Amargosa I; Amargosa III	Rose Spring and Eastgate series points
	Late Prehistoric	850 cal BP – Contact	Yuman; Hakataya; Patayan; Period IV; Prehistoric; Shoshonean; Protohistoric; Shoshonean; Marana; Cottonwood	Desert series points, ceramics

The terminal Pleistocene (~12,000-10,000 cal BP; Sutton 2018) Paleoindian pattern (Sutton et al. 2007) or Lakebed pattern chronology is not entirely agreed upon for the Mojave Desert. Although Paleoindian-age projectile points (Clovis, concave base, WST) have been found, an insufficient amount of temporal data limits the ability to establish a coherent and integrated archaeological pattern for this complex (Sutton et al. 2007). Many of the fluted points recovered from the Mojave Desert are attributed to the Clovis complex (Byerly and Roberson 2015; Dillon 2002; Sutton and Wilke 1984; Sutton et al. 2007; Warren and Phagan 1988:123), but other fluted or basally thinned, concave base points may represent a separate and possibly later cultural complex (Basgall 1993:88; Pendleton 1979:246; Rosencrance 2019; Sutton et al. 2007:233-234). The Paleoindian pattern also includes WST points (also referred to as Great Basin Stemmed points), of which at least nine varieties are recognized across the Great Basin (Beck and Jones 2010; Bryan 1980; Knell et al. 2021; Smith et al. 2020; Willig and Aikens 1988). It is generally believed that most WST point varieties were used primarily during the early Holocene (Rosencrance 2019).

Focusing on the Lake Mojave complex, there are two temporally diagnostic WST projectile point types: Lake Mohave and Silver Lake. Dates associated with the Lake Mojave complex are from the terminal Pleistocene/Early Holocene (~10,200-8500 cal BP; Sutton et al. 2018), and Rosencrance (2019; also see Knell et al. 2021) suggests the Lake Mohave and Silver Lake types are early Holocene in age. Besides the two projectile point types, Lake Mojave complex sites have abundant bifaces, steep-edged unifaces and scrapers, crescents, the occasional cobble-core tool and groundstone implement (Pratt et al. 2020; Sutton et al. 2007). These flaked-stone tools exhibit traits characteristic of long-term curation and transport and are commonly manufactured from extra-local materials, suggesting extensive annual foraging ranges (Sutton et al. 2007). The Lake Mojave settlement pattern appears to resemble a forager-like strategy, except where groups were organized in small social groups around lacustrine habitats (Sutton et al. 2007:237).

Table 2.2. Reevaluation of the Late Pleistocene/Early Holocene Mojave Desert Chronology following Sutton (2018:35).

	Previous Models			Mojavean Tradition	
General Climactic Period	Phases (E. Davis 1974)	Mojave-Pinto Tradition Periods (Warren 1994)	Complexes (Sutton et al. 2007)	Patterns (Sutton 2018)	Phases
Middle Holocene	Unnamed (after ca. 6000 BP)	Mojave-Pinto 3 (6500-4000 BP) Mojave-Pinto 2 (9300-6500 BP)	Pinto and Deadman Lake (ca. 8500-5000 BP)	Pinto	Pinto III (ca. 5000-4000 BP) Pinto II (ca. 7500-5000) Pinto I (ca. 8500-7500)
Early Holocene	Late Paleoindian (ca. 10,000-8500 BP)	Mojave-Pinto 1 (10,200-8500 BP)	Lake Mojave (ca. 10,000-7500 BP)	Lake Mojave	Lake Mojave II (ca. 9300-8500 BP) Lake Mojave I (ca. 10,200-9300 BP)
Late Pleistocene	Middle Paleoindian (ca. 12,000-10,500 BP)	NA	Clovis (ca. 12,000-10,000 BP)	Lakebed	Lakebed II (ca. 11,000-10,200 BP) Lakebed I (ca. 11,600-11,000 BP)

The Pinto complex is typically associated with the Middle Holocene (8000 and 5000 cal BP) but may overlap with the latter end of the Lake Mojave complex (Sutton 2018). Flaked stone technology for the Pinto pattern is similar to the Lake Mojave pattern (Sutton et al. 2007), but with more groundstone implements (Basgall and Hall 1993), marine shell beads that likely were obtained through trade (Sutton 2018), and the Pinto point itself that has a bifurcated stem. Other tools at Pinto sites include large leaf-shaped knives (bifaces), unifaces, and groundstone (Vaughan and Warren 1987:201-202). Pinto complex groups inhabited a broad range of ecozones, including remnant pluvial lakeshores, fossil streams and spring/seep locations, and higher elevation upland areas (Sutton et al. 2007:238).

The Deadman Lake complex, as proposed by Sutton et al. (2007), is another Middle Holocene pattern that postdates the Pinto complex. According to Sutton et al., the primary difference between the proposed Deadman Lake complex and Pinto complex is the presence of small and medium-sized stemmed points and lozenge-shaped points (Sutton 2018). The Pinto complex also spans across the Mojave Desert, whereas the Deadman Lake complex has only been recorded near Twentynine Palms in the southeastern Mojave Desert. While Pinto complex people tended to occupy some pluvial lake basins, Deadman Lake groups mostly occupied higher elevation resource niches. Other material culture associated with the Deadman Lake complex includes concentrations of battered cobbles and core tools, abundant bifaces, simple flake tools, and some milling implements (Sutton et al. 2007:239).

Between 5000 and 4000 cal BP, temperature spikes in the Mojave Desert resulted in substantially drier conditions that led to a relative reduction in the frequency of preserved archaeological sites. The Gypsum complex is evident in the archaeological record following an approximate 1000-year hiatus after the Deadman Lake complex (Sutton et al. 2007:241). The Gypsum complex is recognized by the presence of corner-notched Elko points, concave base Humboldt points, and contracting-stemmed Gypsum points with defined shoulders. The Gypsum pattern is seen in the archaeological record at sites dating to the Late Holocene from 4000 to 1500 cal BP. Sites associated with this pattern arose after the post-Middle Holocene return to cooler temperatures and wetter climates. As a result, Gypsum settlement and subsistence areas generally occur near streams. Gypsum sites also tend to be smaller in size and occur more frequently than the previous complexes. Gypsum lifeways are also assumed to be more ritualistic judging by the presence of quartz crystals, paint, and rock art at Gypsum complex sites (Sutton et al. 2007:241).

The following Rose Spring complex saw the introduction of the bow and arrow (Yohe 1998:27). Sutton et al. (2007:241) note that archaeological sites from this complex, which began around 1500 cal BP, also coincide with large population increases, dramatic shifts in the toolkit (e.g., Eastgate and Rose Spring series projectile points, stone knives, drills, pipes, bone awls, various milling tools, marine shell jewelry, and larger quantities of obsidian) and well-developed midden soils, which together suggest longer-term habitations or a more settled lifeway. The Medieval Climatic Anomaly occurred in the Mojave region around the middle of the Rose Spring period and desiccated many of the remaining lakes utilized by Mojave Desert cultures. This climatic shift to a much warmer, drier environment led to a focus on ephemeral water sources. Around AD 1, some evidence of contact with agricultural peoples (most likely the Ancestral Puebloans) is noted in the eastern Mojave region (cf. Sutton et al. 2007:242). This agricultural influence is observed throughout the Late Prehistoric period. The Rose Spring complex is generally agreed to have ended around 900 cal BP (Sutton et al. 2007).

As the Medieval Climatic Anomaly continued to change the Mojave Desert's ecosystems, the transition to the Late Prehistoric period saw a dramatic shift in site types and technologies, as well as a decrease in population size. The Late Prehistoric period, which began around 900 cal BP, represents the origins of some presently known ethnographic groups. Ancestral Puebloan influence in the Mojave Trough and Patayan influence from around the Colorado River diversified this region, as did the Numic Paiute and Shoshone expansion from the western Mojave Desert (Sutton et al. 2007:242). Village sites with associated cemeteries and special purpose seasonal sites now occur with some regularity (Gardner 2006). Artifact assemblages consist of Desert series (triangular) arrow points, knife blades, flake scrapers, buffware and brownware ceramics, shell and steatite ornaments, slate pendants, incised stone, and a large variety of milling tools (Sutton et al. 2007:242). Additionally, organic remnants from Late Prehistoric sites include plant fiber used for basketry and wooden elements. Burials found with these sites are typically cremation-style (Wallace 1962:177).

Spanish contact in the Mojave Desert occurred as early as 1604 by Juan de Onate, who encountered the Mohave people along the Colorado River while exploring the American Southwest in search of the fabled southern sea (Weber and deBuys 2017). The Spanish continued documenting the Mojave Desert and its affiliated native groups with the onset of the missions. In 1775-1776, Spanish influence further expanded through the Mojave Desert as Father Francisco Garcés and Captain Juan Batiste de Anza traveled from Tucson to the San Gabriel Mission (Galvin 1967). Contact with Europeans throughout California reshaped the organization of Native American cultures that developed pre-contact. Ethnographically known groups in the Mojave Desert region include the Southern Paiute, Panamint Shoshone (Koso), Mono, Chemehuevi, Kawaiisu, Tubatulabal, Desert Cahuilla, Serrano, Mojave, Kitanemuk, and Halchidoma (Heizer and Whipple 1971; Kroeber 1976; Sutton et al. 2007). Eerkens (1999) suggests that four or five aboriginal groups including the Kawaiisu, Vanyumé (Serrano), Chemehuevi, Las Vegas (Southern) Paiute, and possibly Western (Panamint) Shoshone resided in the north-central Mojave near Soda and Silver Lake playas.

Previous Research at Lake Mojave

Pluvial lakes, such as Lake Mojave, formed important resource patches for prehistoric populations because they offer a wide array of flora and fauna in marsh-like settings. Archaeological sites are frequently discovered around the perimeters of pluvial lakes in the Mojave Desert. Extensive archaeological assemblages have been found along the ancient shorelines of pluvial Lake Thompson on Edwards Air Force Base in the Antelope Valley (Basgall and Overly 2004; Porter-Rodriguez 2017; Sutton 2018), and around China Lake on the Naval Air Weapons Station, China Lake in the Owens Valley (Davis 1975; Gilreath and Hildebrandt 1997, 2011; Sutton 2018). Pluvial Lake Mojave has also been a major area of archaeological investigation given its extensive assemblages of chipped stone artifacts along the ancient shorelines and was the focus of a wave of early research from the 1930s to

1960s (Antevs 1937, 1952; Bode 1937; Brainerd 1953; Campbell et al. 1937; Rogers 1939; Wallace 1962; Warren and True 1961). These early studies attempted to establish the lake's culture-history based on the limited understanding of the shoreline chronology. A second wave of archaeological research in the 1960s and 1970s improved the existing maps of Lake Mojave's shorelines and began the search for remnants of surface and subsurface cultural deposits along its banks (Heizer 1965, 1970; Warren and De Costa 1964; Warren and Ore 1978). These geomorphology-based studies confirmed the presence of artifact assemblages on the terminal Pleistocene-Early Holocene (TP/EH) shorelines and on shorelines thought to date through the end of the Early Holocene (Warren and Ore 1978).

During the early 2000s, CRM-based archaeological studies at the northern end of Silver Lake were undertaken as part of the Kern River 2003 Expansion Project (Blair et al. 2004). Specifically, Claude Warren, Henry Ore, and colleagues undertook mitigation measures, including data recovery projects, at seven prehistoric sites (CA-SBR-140, CA-SBR-6566, CA-SBR-264, CA-SBR-6470, CA-SBR-2162, CA-SBR-6605, and CA-SBR-4908) and two multicomponent sites (CA-SBR-1590(H) and CA-KER-385(H)). Four sites—CA-SBR-140, CA-SBR-1590(H), CA-SBR-6566, and CA-SBR-264 (Benchmark Bay)—all occur along the ancient shorelines of Lake Mojave. CA-SBR-140 has few remaining artifacts due to extensive collecting by the Campbells, Malcolm Rogers, and sporadic collection throughout the 20th century. CA-SBR-1590(H) has a prehistoric rockshelter and an associated surface artifact scatter, as well as some historic debris (Blair et al. 2004:336). CA-SBR-6566 is a biface production site situated on a piedmont with primarily discarded bifaces and flaking debris produced from basalt raw material. CA-SBR-264 (Benchmark Bay) is a basalt lithic scatter that emphasizes biface production and another scatter of cryptocrystalline silicate (CCS) raw material that emphasizes unifacial tool production.

More recently, Knell led multiple pedestrian surveys around pluvial Lake Mojave's shorelines from 2009-2018 to locate TP/EH-age sites, evaluate shoreline ages, and understand the overall archaeology (see Knell 2014, 2015; Knell et al 2014; Kirby et al. 2015). His surveys covered an approximate 13.6 km^2 area of Soda and Silver Lake, including a 2.6 km^2 parcel around the Baker site (Edward Knell, personal communication 2021). Knell relocated sites documented by the Campbells, Brainerd, and Warren, as well as recorded many new sites along the shorelines of pluvial Lake Mojave and near the Baker site.

Attempts to document technological strategies, lifeways, and settlement patterns of Lake Mojave's past occupants has drawn several researchers to analyze the known fine-grained volcanic (FGV) quarry sites situated near the lake (Glennan 1972, 1974; Knell 2014; Knell et al. 2014; Nakamura 1991 [1966]; Semenza 1984). Semenza (1984), for example, identified a quarrying and early-stage biface manufacturing strategy at a felsite quarry (CA-SBR-5193) in the nearby Soda Mountains. Her analysis found, using Callahan's (1979) biface reduction stages, a predominance of Stage 1 blanks and Stage 2 bifaces, some Stage 3 and 4 bifaces, and a substantial amount of production debris in a dense, homogenous (one raw material type) lithic scatter. Knell (2014) expanded on Semenza's analysis by determining that felsite was procured and reduced at multiple quarry and workshop sites in the Soda Mountains. Here, knappers manufactured early-stage bifaces and flake blanks for transport to off-site locations. Knell (2014) identified a similar pattern as Semenza, recording primarily Stage 2 and Stage 2-3 bifaces, as well as some Stage 3 and Stage 4 bifaces from 14 separate locales within a 1.2 km^2 area that includes CA-SBR-5193. Unlike Semenza, Knell identified a small number of flake tools in the assemblages he analyzed. Semenza and Knell introduce valuable observations about the technological strategies past inhabitants of the Lake Mojave area used to procure and initially process felsite raw material. This contrasts with the two previous Baker site studies by Nakamura (1991 [1966]) and Glennan (1972, 1974), who offered little about the technological strategies undertaken at the Baker site.

Baker Site

The Baker site is located west of the prehistoric limits of Lake Mojave, near the town of Baker (Figure 2.5). The site is situated approximately 341 meters (1120 feet; Glennan 1974) above mean sea level on a weathering bedrock ridge and adjacent small alluvial fan that formed during erosion of the surrounding Soda Mountains. Grose (1959) maps the hills and fans that constitute the Baker site as Lower Pliocene fanglomerate comprised of poorly bedded boulders and cobbles (see Figure 2.6). The site was initially discovered by a University of California, Los Angeles (UCLA) archaeological survey crew in 1964 during efforts to widen and expand Interstate 15 (I-15) west of Baker. The initial 1965 site excavation and subsequent 1966 report by N. Noboru Nakamura (published in 1991) mentioned subsurface deposits at the site buried some 2-3 inches deep. Artifacts collected during these excavations by Nakamura comprise what I refer to as the Baker assemblage and constitute accession number 506. In 1970, William Glennan excavated eight random locations at the Baker site, digging 5x5 square foot units that ranged from 20-24 inches deep—none produced a substantial subsurface deposit. Glennan's excavations were exclusively exploratory units conducted as part of his 1972 dissertation to check for subsurface deposits and did not add any new artifacts to the Baker assemblage. The overwhelming majority of artifacts collected by Nakamura and observed by Glennan are thus from the site surface (see Figure 2.7). According to Glennan (1972, 1974), all of the recovered artifacts are Baker rhyolite, except two jasper cores.

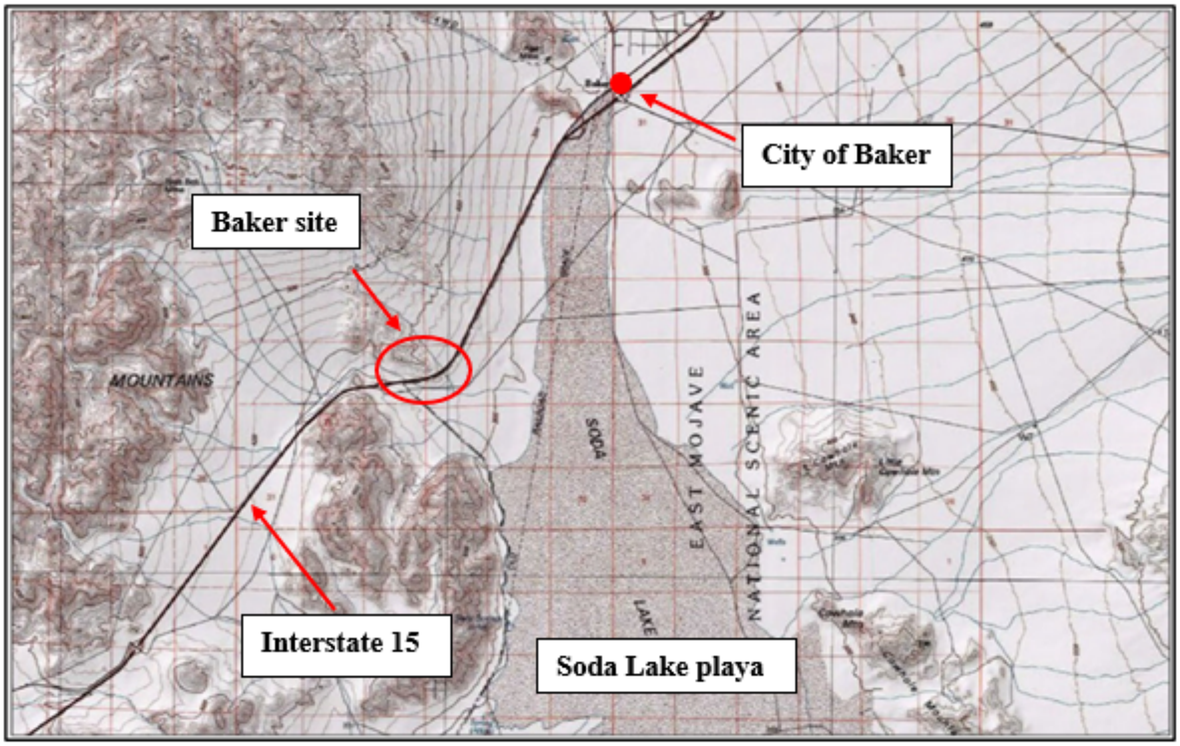


Figure 2.5. General location of the Baker site (CA-SBR-541). Note the proximity to the city of Baker and Soda Lake playa. Modified from Google Images.

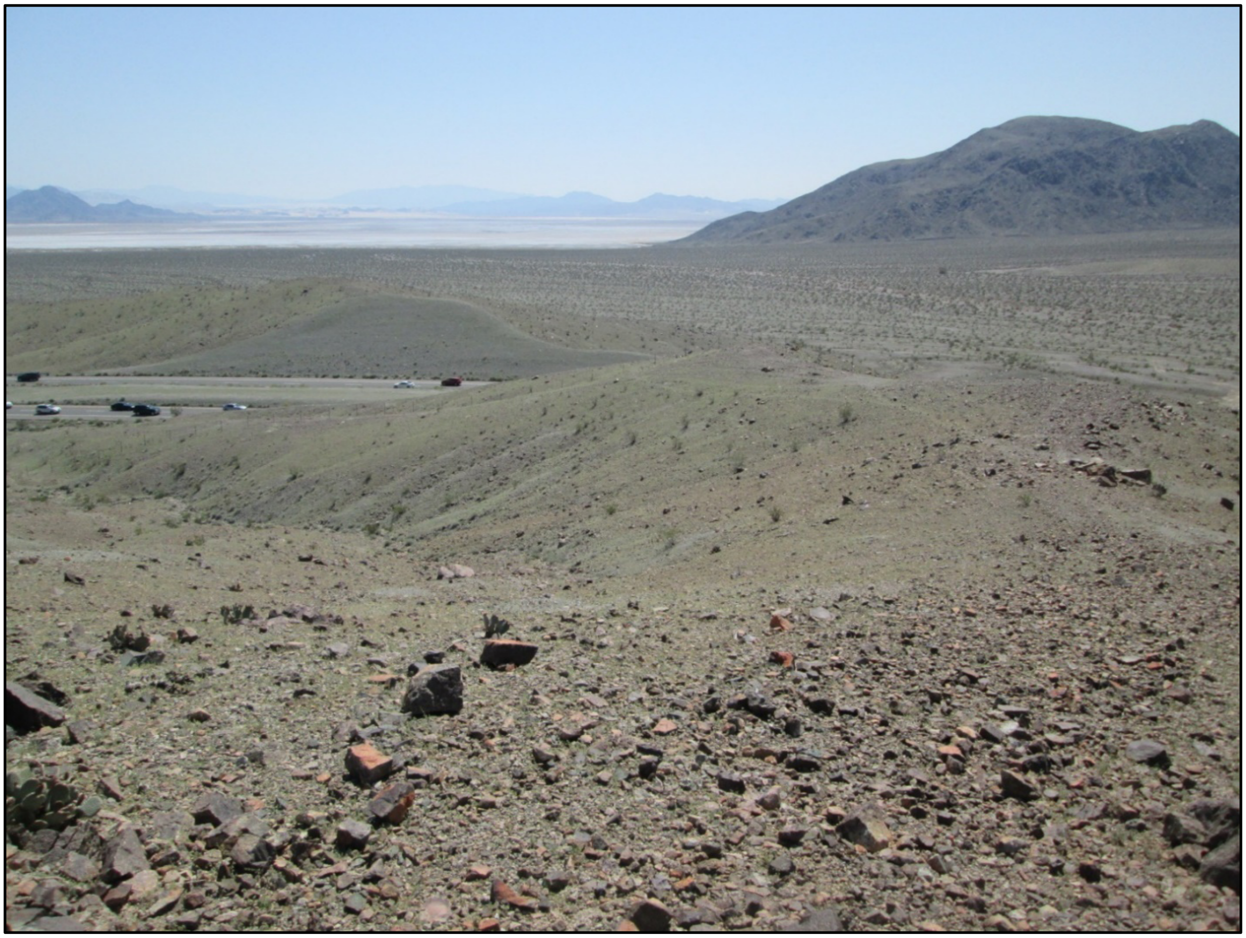


Figure 2.6. Overview of the Baker site (CA-SBR-541) facing southeast. The site extends along multiple finger ridges and erodes into the lower washes of a fanglomerate geologic deposit. The mountains (top right) are part of the Soda Mountains and Soda Lake playa is visible to the top left. Interstate 15 (with vehicles) is visible towards the southern end of the site, which continues south of the I-15. Image taken by the author during a field visit in 2019.

The artifacts collected by Nakamura were recovered within the interstate's expansion area, which destroyed a portion of the archaeological site. Glennan (1974:19) speculated that the interstate widening project destroyed the Baker site entirely, although recent surveys by Dr. Edward Knell from CSUF relocated the site and recorded several new (previously undocumented) sites and artifacts within and near the site boundary. Though the actual size of the Baker site boundary from the initial survey reports (Benton 1976, Reynolds 1970) is unclear, the recorded boundary, as mapped at the at the South Central Coastal Information Center (SCCIC) at California State University, Fullerton, is approximately 1,000 m east-west by 500 m north-south.

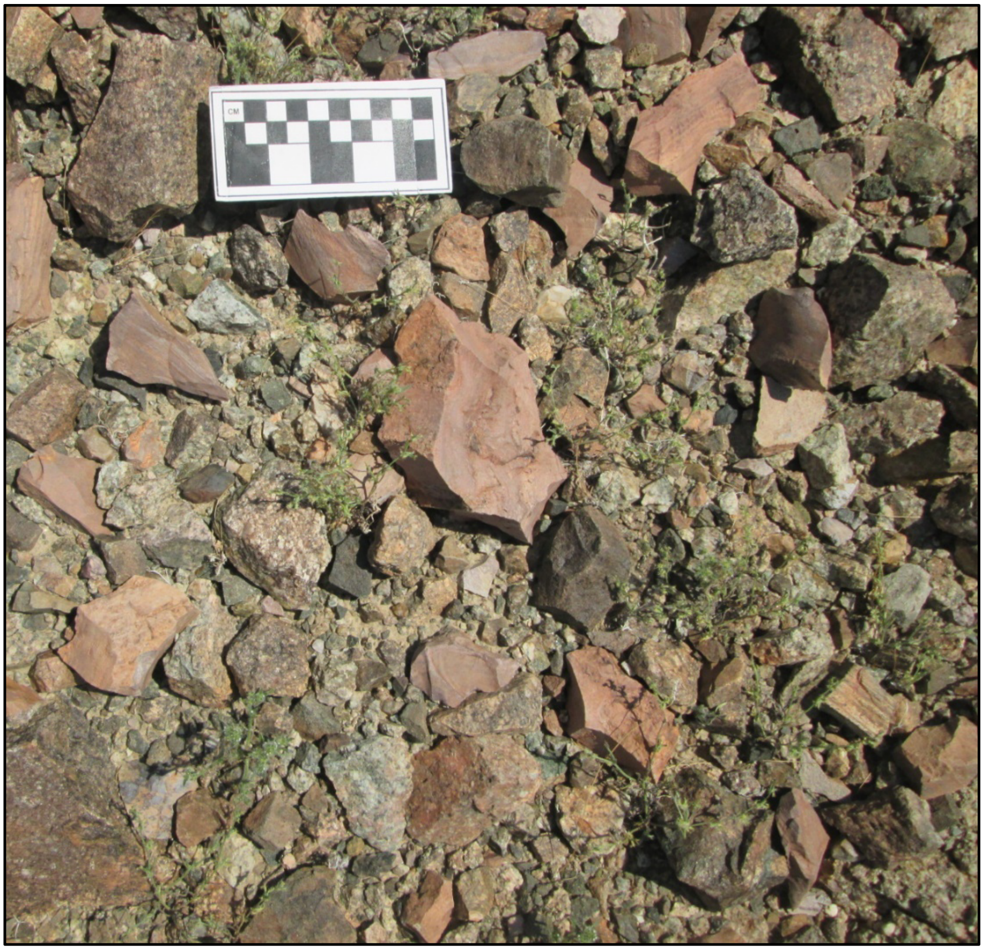


Figure 2.7. Example of the Baker rhyolite and lithic artifact density on the surface of the Baker site. Image taken by the author during a field visit in 2019.

The research conducted by Nakamura and Glennan largely sought to determine the culture-history of the site and to establish which known cultural complex the site was affiliated. Both authors suggest the site was part of the Manix Lake Industry based on the types of artifacts and thinking at the time. Simpson (1958, 1960, 1964) proposed the Manix Lake Industry based on the high number of crude bifaces observed around pluvial Lake Manix, which is located approximately 30 km southwest of Lake Mojave. The Manix Lake Industry is characterized by large, early-stage bifaces, simple retouched flake tools, hammerstones, “Clactonian” flakes, and discs (Simpson 1958, 1960, 1964). Simpson believed that these artifacts derived from a late Pleistocene hunter-gatherer culture that inhabited the shorelines of Lake Manix around 17,000 cal BP. Bamforth and Dorn (1988:215), however, showed that the “technologically crude bifaces” that characterize the Manix Lake Industry are not temporally diagnostic in the Mojave Desert. This implies that using the Manix Lake Industry to infer a temporal range for the Baker site is not viable. The current age for the Baker site is still unknown, and the lack of diagnostic artifacts within the assemblage make it unlikely that an age range can be securely established; however, efforts are made in this study to determine an age for the Baker site through geochemical sourcing of diagnostic projectile points.

Nakamura, the first to collect and analyze Baker site artifacts, unfortunately did not provide meaningful conclusions about the site technology or function. He primarily analyzed a sample of artifacts biased towards tools and tool-like forms. His report considered 627 artifacts, consisting of flakes (*n* = 493), flake tools and utilized flakes (*n* = 101), cores and core tools (*n* = 14), burins (*n* = 8), and a relative few pick axes, hand axes, and non-cultural stones (Sutton 1991:Table 1). Nakamura concludes that the Baker site is either: (1) a quarry-finishing workshop where raw material was procured and manufactured into completed tools for use elsewhere; (2) a quarry-trimming workshop where raw material was procured and manufactured into “quarry” blanks (hereafter “flake” blanks) to be transported elsewhere; or (3) a quarry-finishing workshop and utilization site where raw material was procured and manufactured into completed tools for use on-site. His analysis did not definitively determine where the Baker site fits temporally, classifying it either as a pre-Lake Mojave non-tool-using lithic industry (like the Manix Lake Industry) or a tool manufacturing site for groups belonging to the Lake Mojave complex or later.

Glennan, the second and only other archaeologist to formally study the Baker assemblage, posited in his 1972 dissertation a similar site function and temporal affiliation. Glennan used an explicitly tool-focused sample, with no consideration of the manufacturing debris. He analyzed 202 tools, which he identified as including 99 bifaces, 37 flake scrapers (scrapers produced from amorphous flakes of varying sizes and containing retouch along one or more margins), 33 “plano convex series” tools (possibly poor attempts to produce bifaces; Glennan 1974:25), 12 choppers, and 21 cores. Glennan (1972:131) determined that the Baker site served one of four functions: (1) a quarry area; (2) a workshop area; (3) a specialized activity site other than a quarry or workshop; or (4) a habitation area with a workshop component. Glennan attempted to explain the lack of diagnostic tools by proposing that the Baker site could represent a cultural regression in technology where hunter-gatherers for a time stopped producing specialized stone tool types (e.g., projectile points). Temporally, Glennan agreed with Nakamura that the Baker site could represent any cultural complex in Mojave Desert prehistory, including a crude stone tool-using complex that pre-dates Lake Mojave (e.g., Manix Lake), or with the Lake Mojave or a later complex with no specified inclination toward a particular time period.

Chapter Summary

The Baker site (CA-SBR-541), the focus of this master's thesis, is a predominantly rhyolite lithic assemblage located near pluvial Lake Mojave in the central Mojave Desert. The site is situated in a lithic landscape with multiple FGV raw material sources adjacent to a lacustrine ecological zone, though resource availability associated with lake marshlands likely fluctuated with the changing climate throughout the Late Pleistocene and Holocene. Previous studies conducted around or near Lake Mojave show a long history of human occupation. The two previous studies of the Baker site focused on tools to determine the site's cultural-historic setting, neither of which conclusively answered this question. A re-evaluation of the Baker assemblage is warranted given new developments in lithic analysis and paradigmatic shift to behavior-based analyses that were uncommon at the time. For this master's thesis I use the organization of technology approach to establish the movement of lithic raw materials into, at, and through the Baker site (i.e., flow model) and understand how the Baker site relates to other prehistoric sites in the nearby Soda Mountains.

CHAPTER 3

THEORETICAL FRAMEWORK AND SITE EXPECTATIONS

This thesis follows the organization of lithic technology approach to interpreting lithic assemblages and their past behaviors. Understanding how lithic technologies were organized at a site can reveal the range of strategies past toolmakers utilized in procuring lithic materials, and manufacturing, using, recycling, and transporting lithic toolkits. A detailed review of the lithic technological organization literature shows why that approach applies to this thesis and forms the foundation of the research design and methods discussed in the next chapter (Chapter 4). Given the previous identification of the Baker site as a raw material quarry (Nakamura 1991 [1966]; Glennan 1972, 1974), this chapter provides a thorough review of studies at nine Great Basin quarry sites with varying types of lithic raw material. The outcome of each quarry study is used to establish expectations for the technological strategies that should be present if the Baker site truly functioned as a quarry; variations from these expectations would imply another function for the Baker site beyond, or in addition to, raw material procurement.

Organization of Lithic Technology

Studies addressing the organization of technology largely developed from the processual paradigm of archaeology. Processual archaeology follows the idea that humans respond to the environment in a systematic, measurable, and predictable way, and that human responses can be identified in the archaeological record (Binford 1977, 1978, 1979, 1980; Schiffer 1976). Lewis Binford (1973, 1977) first used the concept of technology to understand inter-assemblage variation and to show that hunter-gatherer survival strategies varied in different environments (see Nelson 1991:58). Binford’s early ethnographic work with the Nunamiut revealed that human behaviors and decisions can be interpreted from archaeological assemblages, which led to many experimental archaeology studies in the 1970s and 1980s which identified the types of tools and debitage that resulted from certain behaviors (Carr and Bradbury 2011). The increased number of experimental studies refined the methods used to analyze lithic assemblages and helped create the approach known today as the organization of lithic technology. Carr and Bradbury (2011) argue that the organization of technology approach became or is paradigm-like, with few archaeologists refuting its utility and many now using it to study lithic assemblages.

Kelly (1988:717; loosely based on Binford 1979 and Wiant and Hassan 1985) specifies that the organization of lithic technology “refers to the spatial and temporal juxtaposition of the manufacture of different tools within a cultural system, their use, reuse, and discard, and their relation not only to tool function and raw-material type and distribution, but also to behavioral variables which mediate the spatial and temporal relations among activity, manufacturing, and raw-material loci.” Nelson (1991:57) later revised this complex definition into a working one for lithic analysts to abide by as they document technological strategies, defining organization of technology as “the study of the selection and integration for making, using, transporting, and discarding tools and the materials needed for their manufacture and maintenance.” This master’s thesis follows Nelson’s definition in its approach to analyzing the Baker site. Nelson contends that environmental circumstances lead to variations in group social and economic strategies that manifest in kinship, politics, religion, subsistence, and settlement patterns. Technological strategies form as a response to variations in social and economic factors, leading to varied tool design strategies and activity distributions across the landscape. Lithic analysts determine tool design and activity distributions by analyzing artifact form and artifact spatial distribution, respectively, in the archaeological record, and work from the bottom up (see Figure 3.1; Carr and Bradbury 2011:312) to identify the technological strategies and responses to various environmental, social, and economic pressures.

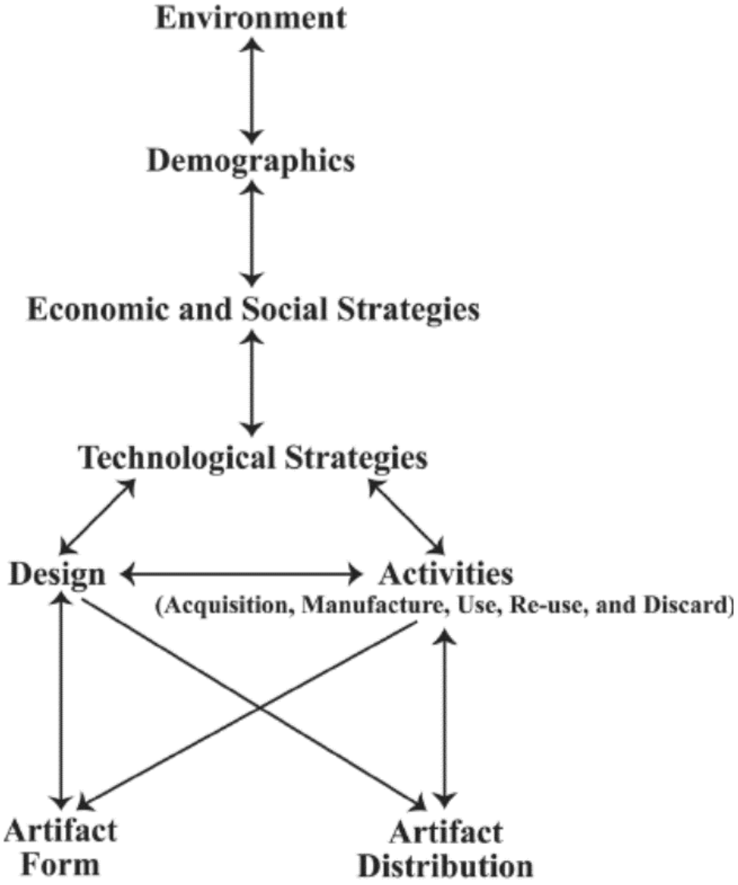


Figure 3.1. Factors that influence technological organization strategies. Image credit to Carr and Bradbury (2011:Figure 2).

One approach analysts sometimes use to reconstruct the organization of technology at a site is what researchers refer to as a “flow model” (Collins 1975; Kelly 1988; Knell 2012, 2014; Knell and Becker 2017; Schiffer 1976), which views technological organization as a series of related behaviors that begins with the initial procurement of lithic raw material, tool production, use and maintenance, and ends with discard patterns (Binford 1973, 1979; Carr and Bradbury 2011; Nelson 1991; Schiffer and Skibo 1987). Each component of the flow model is best understood when tools, cores, and debitage are included in lithic artifact analysis, which analysts refer to as a whole assemblage approach (Andrefsky 2001, 2009; Bradbury and Carr 1999; Carr and Bradbury 2001, 2011; Kalin 1981; Odell 1989; Rasic and Andrefsky 2001; Root 2004).

From the initial boom of flintknapping and lithic experiments in the 1970s, archaeologists showed that the organization of technology approach can identify a wide array of behavioral attributes and strategies in artifact assemblages. Gould (1980), and later Andrefsky (1994), demonstrated that different tool types frequently correlate with different site functions. More heavily curated tool assemblages, or tools that are more heavily used compared to their overall potential utility (Shott 1996), tend to occur in greater quantities at shorter-term campsites, whereas less curated tool assemblages (used very little compared to their overall potential utility) usually indicate a special purpose task area such as a quarry or workshop (Binford 1979; Kelly 1988; McAnany 1988). That said, heavily curated tools are sometimes discarded at quarry sites during restocking of the lithic toolkit (Gramly 1980; Smith et al. 2013).

The amount of curation on a tool also frequently correlates with overall tool size. Less curated tools are generally larger than more heavily curated tools that undergo extensive resharpening (Buchanan et al. 2015; Clarkson 2002; Shott 1996; Shott and Seeman 2015). Therefore, used tools found at short-term campsites areas should be smaller on average than those found at special purpose task areas such as quarries or workshops (Beck et al. 2002; Newman 1994). Knell (2014) encountered this size relationship among tools and debitage in the Soda Mountains quarry/workshop complex compared to the Little Cowhole habitation area adjacent to Soda Lake playa—both areas are near the Baker site.

The organization of technology approach can also be understood by evaluating the various tool and debitage reduction stages observed in an assemblage. Callahan (1979) identified stages of biface reduction (Figure 3.2) that range from blank procurement to completed bifacial tools and projectile points. Similarly, Magne (1985) identified reduction stages for debitage (early, middle, late) that he tested using experimental studies. When analyzing reduction stages, technological patterns often emerge. A high proportion of early-stage production debris is usually found closer to the source where raw material was procured, while later-stage production debris typically occurs farther from raw material sources (Knell 2014; Nelson 1994; also see Bamforth 1990). Newman (1994) and others (Beck et al. 2002; Knell 2014) also showed that the farther lithic tools or production debris are found from their source area, the smaller they become in size (see Buchanan et al. 2015 for exceptions). Beck et al. (2002) revealed that the distance artifacts are transported to a site influenced artifact form;

stone tool makers reduced raw material more heavily at quarries in anticipation of long treks back to campsites, but reduced raw material at quarries less when the distance to camp was short. Brantingham et al. (2000) evaluated how raw material quality influences the way tool makers prepare cores in response to poor quality stone, finding that an abundance of “Levallois-like” cores (Davis et al. 2012; Eren et al. 2008; Kuhn and Zwyns 2014; Muto 1976)—prepared cores with preliminary flakes knocked off to create a pathway for large subsequent flake removals—were preferentially created in areas lacking good-quality lithic raw material. The Brantingham et al. study, and others like it (see Bamforth 1990), demonstrate the importance of measuring stone raw material quality to assess the potential range of reduction/production strategies in different lithic raw material landscapes or terrains.

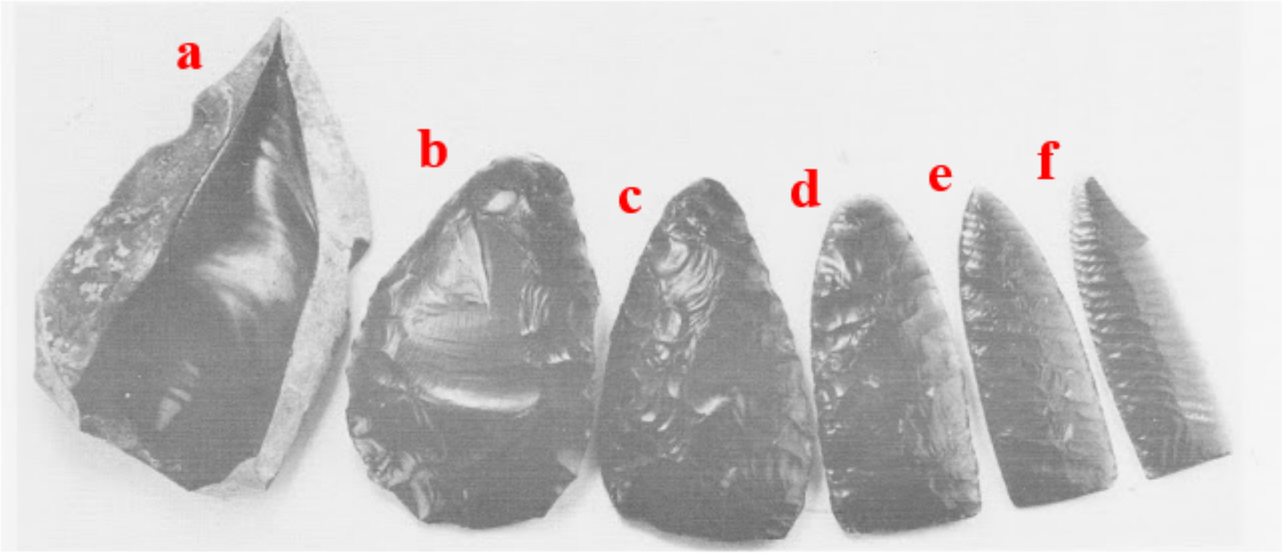


Figure 3.2. Representation of the five stages of biface reduction following Callahan (1979): a) Stage 1 - blank or large flake; b) Stage 2 - initial edging; c) Stage 3 - primary thinning; d) Stage 4 - secondary thinning; e) Stage 5 - shaping; f) completed projectile point. Image credit to http://flintknappingmag.blogspot.com/2016/04/flintknapping-magazine-march-2016.html.

Andrefsky (1994) also showed that the availability, abundance, and quality of lithic raw material influences the final form and design that tools take, the amount of energy expended in their manufacture, and the amount of time allotted to manufacturing tools. Higher-quality raw materials in his study area were generally utilized until depleted, while poorer-quality raw materials were minimally used at the time of discard. Other studies also recognize the influential role group mobility and raw material availability have on lithic technological organization strategies (Bamforth 1986; Barrientos and Catella 2017; Beck et al. 2002; Carr and Bradbury 2011; Kelly 1988; Knell 2014; McAnany 1988; Nelson 1991; Smith et al. 2013). Kelly (1988), for example, concluded that prehistoric bifaces have three uses: as long use-life cutting tools, a core to produce flake blanks, or as the byproduct of fitting a tool into a haft. This study was integral to showing that biface forms, and presumably other tool and core forms, have dynamic functions that can vary by level of group mobility and strategic needs. Kelly (1988:719) also proposes that bifacial cores maximize the total amount of stone cutting edge on detached flakes while minimizing the weight of stone carried and are therefore an important technology for more mobile populations. In an important study intended to validate Kelly's ideas about the greater cutting edge of biface thinning flakes (from bifacial cores) than core reduction flakes, Prasciunas (2007) showed that "amorphous" cores (also known as multidirectional cores) actually produce flakes with more usable cutting edge during reduction than those from bifacial cores. Because amorphous cores provide greater flake tool production efficiency, Prasciunas proposes that amorphous cores rather than bifacial cores are the ideal core type for highly mobile groups traversing raw material-poor areas. Both Kelly and Prasciunas demonstrate the importance of core type and core design when employing specific technological strategies.

Perhaps the most important development for this thesis is the new insights about how best to glean information from lithic debitage. Andrefsky (2009) and many others (e.g., Andrefsky 2001; Bradbury and Carr 1999; Carr and Bradbury 2001, 2011; Kalin 1981; Odell 1989; Rasic and Andrefsky 2001; Root 2004) have noted the importance of studying stone tools and cores as well as the debitage to evaluate the full range of reduction/production activities that occurred at a site (i.e., a whole assemblage approach). Completed stone tools and blanks are frequently carried away from raw material quarries and lithic workshops for use off-site, meaning that the broken or discarded tools and manufacturing debris recovered from quarry and workshop sites do not represent the full range of tools manufactured at the site (Larson and Kornfeld 1997). Additionally, utilized tools were frequently reworked and resharpened throughout their use-lives, often changing the shape of the tool and subsequently, the archaeological implications of its function (Buchanan et al. 2015; Clarkson 2002; Frison 1968; Root 2004; Shott 1996; Shott and Seeman 2015).

Analyzing flaked stone debitage can show occurrences of tool manufacture at a site, including remnants of broken or discarded tools and tools manufactured or retouched at the site before being transported off-site. For example, if a biface is manufactured at a raw material quarry and transported off-site after completion, that bifacial tool will no longer be visible in the archaeological record of that site. However, the remnant biface thinning flakes removed when producing the bifacial tool will remain within the site, and lithic analysists can use those biface thinning flakes to infer the production of a biface without recovering the transported bifacial tool. Minimum Analytical Nodule Analysis (MANA; Larson and Kornfeld 1997; also see Hurst et al. 2010; Knell 2012) is one way to identify such technological trajectories, especially when used in conjunction with a flake typology. MANA groups artifacts from an assemblage into raw material categories or “nodules” that vary by raw material type, color, texture, inclusions, and other notable visual differences (Larson and Kornfeld 1997:7). Some nodules may contain artifacts that partially or completely refit to reveal the exact lithic reduction processes, while others may not refit but can still show individual reduction events that are difficult to ascertain via entire assemblage analysis. When a flake typology (Andrefsky 2005:114-115) is included in the analysis it becomes possible to make immediate behavioral inferences for each nodule based on the presence of even a single piece of debitage (see Larson and Kornfeld 1997; also Knell 2012). Much like the example above, a single biface thinning flake can suggest that a biface was thinned at a site without observing any actual bifaces. Perhaps more convincingly, if a channel flake is observed, the inference is that a Clovis or Folsom point was manufactured at the site.

The main downside to flake typologies is the variation in how analysts define flake types and some subjectivity in the identification process. The way around this is to create detailed and replicable descriptions of flake types based on experiments, much as Root (2004; Root et al. 1999) did for the Lake Ilo, North Dakota, chipped stone. Ultimately, Andrefsky (2009) notes that attempts to study the organization of lithic technology without incorporating debitage will fail to determine the complete range of lithic reduction or production “activities” that took place at a given archaeological site.

The studies mentioned above are only a few examples of the ways the organization of lithic technology approach is used to ascertain information from lithic assemblages. Given the productivity and overarching acceptance of this approach among lithic analysts, the methods implemented in this master’s thesis follow and build on prior technological organization studies, including predominantly those of Knell (2007, 2014) and Knell and Becker (2017).

Previous Great Basin Technological Organization Studies

To assess technological organization strategies evident in the Baker assemblage, it is pertinent to review other lithic technology studies from around the Great Basin and Mojave Desert. Since both Nakamura (1991 [1966]) and Glennan (1972, 1974) identify the Baker site as a potential quarry, background is provided on nine Great Basin/Mojave Desert quarry sites (see Figure 3.3). The focus here is on lithic raw material type and stone quality, quarry type (e.g., primary bedrock versus secondary outcrop), and the intended product or products of manufacture. For this study, a primary outcrop is a location where toolstone occurs on the landscape in its originally deposited bedrock context; secondary outcrops consist of toolstone cobbles and boulders that eroded from their original context and were subsequently redeposited and accreted in their current context rather than at the initial bedrock formation. Stone quality and quarry type are thought to influence the technological strategies employed by hunter-gatherers, and here provide a baseline to establish expectations regarding the technologies used at the Baker site and the methods used to identify the technologies.

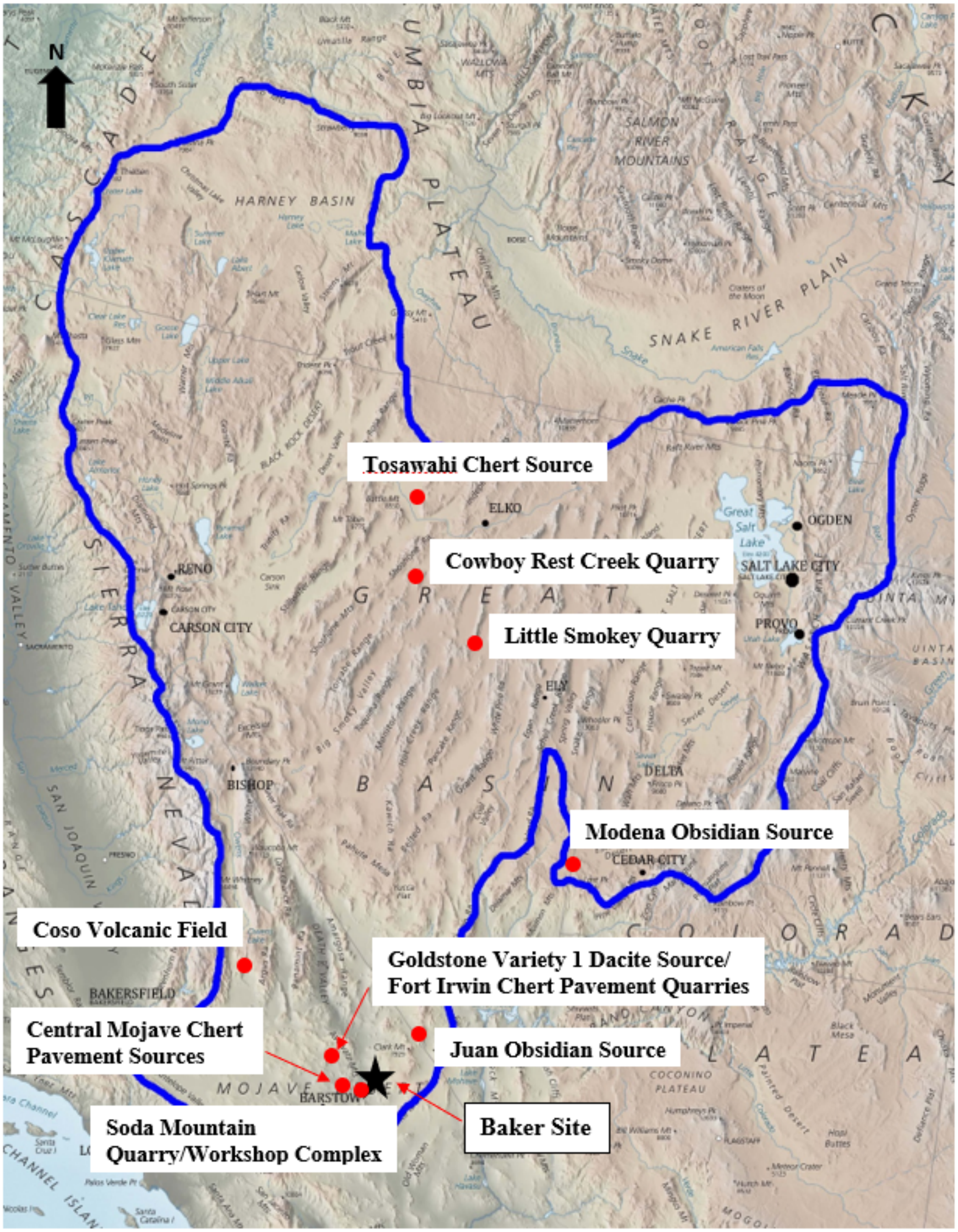


Figure 3.3. Location of the nine Great Basin and Mojave Desert quarries and the Baker site (star). Blue line represents Great Basin physiographic boundary. Image credit to https://greatbasinforkids.wordpress.com/2014/06/09/what-is-the-great-basin/.

Modena Obsidian Source

The Modena obsidian quarry is an extensive primary obsidian outcrop in southeastern Nevada. Shott and Seeman (2015) analyzed this raw material source to evaluate the degree of processing by stone toolmakers at the quarry prior to off-site transport. The degree of processing was assessed in connection with the total round-trip distance to known residential bases where Modena obsidian artifacts were discarded. Shott and Seeman's study employed the field processing model (see Beck et al. 2002, below) that relies on principles of the "Schlepp effect" (Perkins and Daley 1968). The field processing model uses central place foraging theory, which anticipates that people tethered to a central place often procure resources from further distances than residentially mobile groups. An important caveat, however, is that resources transported from distant areas require more processing to reduce weight or the transport of unneeded parts before being brought back to the central place residence. Shott and Seeman identified this pattern in his comparison of the Modena and Panaca obsidian sources (Shott and Seeman 2015:549).

Shott and Seeman (2015:553) compared the flake debitage, "biface preforms" (i.e., Stage 1 bifaces or bifacial blanks), and early-stage bifaces from the Modena obsidian source to previously collected lithic data from the Panaca Summit obsidian source and other habitation sites up to 70 kilometers away. Modena obsidian is located closer to the habitation areas Shott and Seeman studied than Panaca Summit obsidian, suggesting that more early-stage bifaces should be present at Modena than Panaca Summit. Indeed, Shott and Seeman found that Modena obsidian was mainly processed into early-stage bifaces (roughly Stage 2 or Stage 3 by Callahan's [1979] terminology), while obsidian at Panaca Summit was primarily reduced into middle-stage bifaces (Stage 3 and 4) before transport off-site. Supporting this finding, analysis of the flake debitage from both sites indicates that flakes were generally larger, had fewer facets on platforms, and statistically more exterior cortex at the Modena quarry than Panaca Summit quarry as expected if later stage biface reduction occurred at Panaca Summit than at Modena.

Group mobility is assumed to be the driving force behind the field processing model and Modena quarry results. Shott and Seeman (2015:566) state that when mobility frequency is high and distance of travel is moderate (i.e., a residentially mobile group or "foragers" per Binford [1980:5-10]), the demand for field processing is at its greatest. Alternatively, when mobility frequency is low and distance of travel is high (i.e., a logistically mobile group or “collectors” per Binford [1980:10-12]), toolmakers presumably have more regular access to quarry sources and therefore less need to extensively field process prior to off-site transport. In other words, a logistical strategy residence is presumably set up in areas where raw material sources are known and therefore logistical forays are regular and predictable occurrences; conversely, residentially mobile groups may settle in raw material-poor areas and require additional raw material processing to ensure maximum utility. No mention is given to whether raw material quality varied significantly between the Modena and Panaca Summit sources, which can also skew the amount of on-site processing (Beck et al. 2002).

To summarize the prehistoric use of the Modena obsidian quarry, all obsidian raw material was procured from within the quarry area itself rather than transported to it. The quarry area represents a biface preform (i.e., bifacial tool blank) and early-stage biface production source from which the manufactured goods were transported off-site for presumed additional reduction at habitation areas away from the quarry. Shott and Seeman did not mention any utilized bifaces or tools within the quarry area itself, suggesting tools manufactured at the Modena quarry were made for use elsewhere rather than at the quarry.

Coso Volcanic Field

The Coso Volcanic Field (CVF) in eastern California is a huge obsidian source area (roughly 10 miles by 5 miles) containing 350 separate primary and secondary obsidian quarries (Gilreath and Hildebrandt 2011). The CVF has obsidian hydration dates ranging consistently between 8500 and 200 ^{14}C BP or approximately 9500 and 280 cal BP (at 2 Sigma; Reimer et al. 2020). A massive spike in procurement occurred between 2300 and 1275 ^{14}C BP (approximately 2330-2767 cal BP at 2 Sigma; Reimer et al. 2020) during the late Middle Archaic or Gypsum period. Within the CVF, lag quarries or secondary deposits of poorer quality were generally exploited pre-2800 ^{14}C BP using non-bifacial core reduction with no preference toward any core type. However, around 2800 ^{14}C BP (approximately 2988 cal BP at 2 Sigma; Reimer et al. 2020) a shift in procurement occurred that favored the higher-quality primary seams of volcanic glass deposited within the CVF. Cores and unfinished bifaces were the byproduct of procurement at these higher-quality mines, with fewer variations in core form and a trend in producing triangular and wide-shouldered bifacial blanks. These cores and bifaces were larger in size than those procured pre-2800 ^{14}C BP from the secondary lag deposits. Around 1275 ^{14}C BP (approximately 2671 cal BP at 2 Sigma; Reimer et al. 2020), another shift in reduction occurred as the large bifacial blanks and bifaces underwent further reduction and more preparation prior to off-site transport, possibly in unison with a shift to greater group mobility. Over time at the CVF, stone toolmakers refined their quarry preferences and exploited fewer quarries with no visible decline in the quantity of obsidian artifacts produced (Gilreath and Hildebrandt 2011:178).

The primary product of procurement was bifaces and cores, although the Middle Archaic spike in Coso obsidian use saw the near exclusive manufacture and off-site transport of bifaces. Laser ablation-inductively coupled plasma-mass spectrometry analysis on Coso obsidian indicates that it was transported along the eastern Sierra Nevada range likely via direct procurement rather than exchange, suggesting a high level of residential mobility for groups traveling north to south along Owens Valley during the Early Archaic. Gilreath and Hildebrandt (2011:182-183) indicate, however, that the increased use of CVF obsidian during the Middle Archaic signals a shift to a higher level of residential stability. Middle Archaic groups tethered their movements to areas where logistical trips to procure CVF obsidian could occur often, likely in response to increased hunting of larger game and a subsequent increase in obsidian as an economic need.

To summarize, the prehistoric pattern of CVF obsidian use emphasized the procurement of obsidian from quarries within the source area rather than a reliance on obsidian transported to it. Bifaces and cores were the primary goal of manufacture early in time, with a marked increase in biface production and transport during the Middle Archaic but a marked decline in off-site core transport. Gilreath and Hildebrandt do not mention utilized tools within the quarry area, so presumably tools manufactured from CVF obsidian were made for use elsewhere (off-site) rather than within the quarries themselves.

Juan Obsidian Source

The Juan obsidian source is a secondary deposit of small obsidian clasts spanning several hundred meters of desert pavement in the eastern Mojave Desert. The clasts typically measure up to 4 centimeters (cm) in diameter (Torres 1998), although previous surveys of the source reported clasts upwards of 10 cm in diameter (Wilke and Schroth 1988). The primary strategy was simple bipolar reduction of small obsidian cobbles to produce Late Prehistoric arrow points. Experimental testing of Juan obsidian cobbles by Torres suggests that the primary manufactured good was a roughly 2 cm by 2 cm flake blank with initial edging. Excavations at a nearby rock shelter (CA-SBR-6055) revealed three strata that roughly date between 2900 cal BP and Late Prehistoric times (ca. 400 years ago to Euro-American contact). All three strata have artifacts made from Juan obsidian, although the amount of obsidian was low compared to locally available chert tools and debris in the older levels. The Archaic period strata consist of obsidian flakes produced via conchoidal core reduction flaking, while the Late Prehistoric component contains small bipolar core reduction flakes and arrow points manufactured from Juan obsidian. Therefore, even though Archaic people clearly knew about the Juan obsidian source and likely used it for flake tool manufacture, it only became a source of raw material for projectile points during Late Prehistoric times when point sizes decreased.

The shift from the atlatl to the bow and arrow during Late Prehistoric times dramatically changed the technological constraints for producing projectile points (Torres 1998). Arrow points are typically much smaller than dart points and can be manufactured from smaller blanks. This technological shift thus caused an increase in secondary cobble quarry use, including additional procurement from the Juan obsidian clast source.

The obsidian from this source is notably of higher quality, while the local cherts found at the CA-SBR-6055 rock shelter strata are of poor quality and required heat treatment to produce flakes suitable for manufacture into arrow points. Therefore, Torres argues that raw material quality played a role in the use of the Juan obsidian source. Juan obsidian was preferentially used for flake tools until a projectile point style came about that could be manufactured from such small obsidian cobbles, at which point the Juan source became the primary material for projectile points in the local area.

To summarize, obsidian raw material was procured from within the Juan obsidian cobble quarry area, not transported in. Core reduction flank blanks from multidirectional cores were likely the intended byproduct of procurement during the Archaic period, with a shift towards bipolar flake blanks with initial edging during the Late Prehistoric period. No utilized tools were mentioned in Torres's study, so the manufacture of tools for onsite use are not likely. The manufactured flake blanks were transported off-site to be reduced into Archaic period flake tools or Late Prehistoric period projectile points at locations away from the quarry source.

Tosawahi Chert Source

The Tosawahi quarry is a network of white chert quarry procurement and reduction sites that span roughly 9 km^2 in northcentral Nevada (Bloomer 1991). It is an excavated exposure of a chert bedrock outcrop, with occasional procurement of secondary surface cobbles. The primary use of this quarry was to manufacture early-stage bifaces for further reduction and presumed off-site use. Heat-treated debitage comprises approximately 25% of artifacts from residential sites just outside the Tosawahi procurement localities, suggesting that the quarry network (not the quarries themselves) were a secondary workshop for heat-treating flake blanks, Stage 2, and Stage 3 bifaces prior to long-distance transport. Additionally, some early-stage bifaces were cached near the quarry area, suggesting an alternate technological strategy for quickly restocking tools during future visit(s) to the source. Bloomer (1991:216) suggests that because quarrying activities, biface production, and the caching of bifaces were the main foci of human activities at the Tosawihi source, the technological variability in tool stone procurement efforts was likely linked to settlement and mobility strategies, whether logistical or partially embedded.

To summarize, Tosawahi chert was procured directly from within the Tosawahi bedrock outcrop or secondary chert cobbles, without raw materials from other sources transported into the quarry area. Tosawahi chert was reduced into large flake blanks via core reduction and subsequently manufactured into “large non-heat-treated Stage 3 bifaces” for transport away from the quarry (Bloomer 1991:204). Bloomer does not mention any utilized tools within the quarry itself, suggesting Tosawahi chert lithic tools were intended for use away from the quarry.

Central Mojave Chert Pavement Sources

Bamforth (1990) analyzed chert, chalcedony, and jasper cryptocrystalline silicate (CCS) artifacts from two separate unnamed desert pavement raw material sources in the central Mojave Desert. Each source was used consistently over time by the prehistoric occupants of the area. The quality of raw material varied greatly between sources, ranging from fractured, granular clasts to homogenous, fairly fine-grained pieces (Bamforth 1990:80). Variation in nodule size occurs between the quarries. Despite these differences, Bamforth found little evidence indicating a preference for one quarry over the other in terms of raw material reduction strategies or the range of material removed from the sites over time. He observed, however, that poorer quality stone with higher void (crystalline pocket) counts was reduced into later stages of reduction for artifacts dating earlier in time as expected if early stone toolmakers attempted to remove the undesirable portions of the stone prior to transport off-site. This strategy likely indicates more mobile groups attempting to reduce the cost of transport or the risk of core failure by removing flaws at the quarries.

No deviation exists in tools produced at each raw material source as flakes, cores, and bifaces are missing from each source in similar proportions during all occupation periods. Bifacial reduction occurred minimally in each study area, however, with on-site production emphasizing flake production from cores. Despite a notable difference in raw material package size between the quarries, the flakes were consistent in length as expected if similar goods were produced at both. This study ultimately reveals little specialized use of secondary pavement quarries with no indication that a particular quarry was preferred for manufacturing specific tools. Bamforth concludes that these raw material sources were used consistently as needed, but not extensively.

To summarize the prehistoric pattern of use at the unnamed desert pavement chert quarries, CCS raw materials were procured from secondary pavement deposits within the sites rather than having been transported from elsewhere. Cores of various morphologies and flake blanks were the primary manufactured items, with occasional biface production during certain times. The manufactured cores, flake blanks, and occasional biface were transported off-site for additional production and manufacture. Bamforth does not mention utilized tools found within the sites, so the cores and flake blanks produced were likely intended for use off-site.

Fort Irwin Chert Pavement Quarries

Byrd et al. (2009) analyzed multiple secondary chert pavement quarries from the Avawatz Expansion area of Fort Irwin in the Mojave Desert, which they humorously referred to as “the archaeological record’s step-child” because most archaeologists pay little attention to secondary quarries given their perceived ubiquity, general atemporality, and lack of complexity (Byrd et al. 2009:121). They found that pavement quarries saw increased use during the Late Holocene, and specifically in association with the Gypsum complex based on geoarchaeological analyses of well-dated Holocene landforms. Procurement at these sources emphasized biface and core production. Many cores were rejected after initial unidirectional or less frequently bifacial shaping (Byrd et al. 2009:130), leading the authors to conclude that core rejects likely represent forerunners to bifaces that were broken or discarded during manufacture. Therefore, core rejects imply more about the trajectory of biface production at these quarries than the production of transportable cores. Ultimately, these raw material sources were used for initial early- to middle-stage biface reduction (92.4% Stage 1 and 2, 7.6% Stage 3) to ensure material quality, to decrease the chance of failure during later reduction, and to reduce bulk weight and therefore the cost to transport. Byrd et al. suggest that the biface production strategy at Fort Irwin chert pavement quarries reflects a hunting specialization like that found at obsidian quarries during the late Gypsum period as people emphasized the procurement of large game (Gilreath and Hildebrandt 1997; Hildebrandt and McGuire 2002).

Byrd et al. (2009) argue that raw material quality can vary as much within secondary quarry localities as between entirely separate localities due to the highly erosional ex-situ nature of secondary quarries, so raw material selection was not a product of availability as much as it was human behavior. The authors also state that the use of secondary pavement quarries suggests an increase in residential stability (and a shift towards logistical mobility) for the Gypsum complex during the early part of the Late Holocene. As the exceedingly-warm Middle Holocene ended, increased spring activity, more frequent highwater episodes, and greater riparian production likely made the Mojave Desert a more hospitable area. Therefore, groups presumably spent less time on the move and more time tethered to areas with favorable resource structure. Decreased mobility is frequently paired with use of less desirable but more accessible quarries (see Duke and Young 2007), which explains the increased use of pavement quarries during the Gypsum period.

To summarize, chert raw materials were procured from within the secondary quarry deposits rather than transported from elsewhere. Cores and bifaces were the intended byproduct of manufacture, with early- to middle-stage bifaces representing the likely intended end-product before off-site transport (Byrd et al. 2009:130). No utilized tools were noted at the pavement quarry sources, so little to no use of tools likely took place at the quarries themselves.

Little Smokey Quarry and Cowboy Rest Creek Quarry

Beck et al. (2002) analyzed two fine-grained volcanic (FGV) dacite quarries in the central Great Basin (Little Smokey Quarry and Cowboy Rest Creek Quarry), both of which are secondary deposits of large dacite cobbles. Although a substantial number of artifacts and debitage was presumably collected from each quarry, the major artifact type noted by Beck et al. were bifaces. Prehistoric stone toolmakers at these quarries processed raw material cobbles into early-stage bifaces prior to off-site transport when the residential base, or central place, was closer distance-wise to the raw material source. Conversely, when the central place was further from the dacite source, toolmakers processed the raw material into middle and sometimes late-stage bifaces before transporting them off-site. Beck et al. determine this pattern occurs primarily to reduce transport costs of bifaces for longer journeys; bifaces reduced to later stages of reduction would “cost” less in energy consumption (due to decreased weight) to transport back to the central place.

To test their transport cost model, Beck et al. (2002:502) held toolstone quality, package size, and intended product (bifaces) constant. They note that one of the raw material sources may have been preferentially selected over the other if the package size or toolstone quality varied dramatically between the quarries. In the instance of toolstone variation, the cost of processing the material into later-stage bifaces would increase and potentially influenced quarrying strategies at one source or the other. The study by Beck et al. did not address this variable either, focusing solely on the model of transport cost.

Though Beck et al. (2002:492) only provide the final count for bifaces, both quarries may and likely did function as procurement areas for other tool types given the authors reporting that many artifacts were recovered from each site but only bifaces were analyzed to test their model. Those potential other tool types were not looked at for this study.

To summarize, dacite raw material from the Little Smokey Quarry and Cowboy Rest Creek Quarry was procured from secondary cobbles deposited within the two quarry areas. The primary end-goal of manufacture at each quarry was presumably bifaces, although potentially other underrepresented tool types were also manufactured. Early- to middle-stage bifaces represented the end goal of production within the Cowboy Rest Creek Quarry because the nearest habitation areas were only 9 km away. Middle- to late-stage bifaces represented the end goal of production at the Little Smokey Quarry because the habitation area containing Little Smokey dacite was 60 km away. The intended end-product varied greatly based on the distance of transport when all other variables were held constant. No bifaces were mentioned as having use-wear, which indicates that biface manufacture for use within the quarry areas was unlikely.

Goldstone Variety 1 Dacite Source

Ruby et al. (2010) conducted an in-depth analysis of several hundred artifacts from the Fort Irwin National Training Center Superior Expansion area in the Mojave Desert, including many artifacts sourced to the Goldstone Variety 1 dacite quarry. The quarry appears to be a secondary deposit of large dacite cobbles procured from the surface of Goldstone Drainage (Duke 2013). Goldstone

Variety 1 represents 75% of Early Holocene projectile points sampled for this technical report, indicating a strong preference for this raw material early in Great Basin prehistory. Two-thirds of stemmed projectile points and 90% of Pinto points from the Superior Expansion area are manufactured from Goldstone Variety 1 dacite. Analysis of the Goldstone 1 dacite quarry and other archaeological assemblages at Fort Irwin suggest the procured dacite was manufactured into serviceable tools (presumably bifaces and flake tools) and flake tool blanks prior to off-site transport. The quarry saw continued use through the Middle and Late Holocene, although manufactured and transported goods shifted exclusively to bifaces during that time.

Goldstone 1 dacite is considered a poor-quality raw material source compared to metasedimentary argillite (SBR-11099), other cryptocrystalline silicates (CCS) on Fort Irwin, and transported obsidian due to the often-indiscernible fracture planes that occur throughout the stone (Ruby et al. 2010:569). Regardless, Goldstone 1 dacite was clearly favored for use on large parts of the Fort Irwin base (Duke 2013). Though the metasedimentary argillite is more easily flaked and has greater utility (i.e., less waste of mass during flaking) than the Goldstone 1 dacite (Ruby et al. 2010:569), the interlocking matrix of dacite ultimately retains its cutting edge and is more durable than the argillite. Because the more flakeable argillite was not preferred over Goldstone 1 dacite, hunter-gatherers likely had other motivations for procuring Goldstone 1 dacite beyond the ease and predictability of tool manufacture. The emphasis on stone durability led Ruby et al. (2010:572; also see Duke 2013) to conclude that group mobility and tool function drove toolstone selection and tool form over raw material flakeability on Fort Irwin.

To summarize, dacite was procured from the Goldstone Variety 1 source itself, not transported in from elsewhere. The primary goal during the Early and Middle Holocene was to produce serviceable tools (i.e., early-stage bifaces and flake tools) and tool blanks that were transported off-site and subsequently reduced into functional tools away from the quarry. The Middle to Late Holocene, however, emphasized bifaces as the transportable end-product of manufacture. Since the goal of manufacture was generalized tools, tool blanks, and bifaces for further reduction off-site, the manufacture of tools for use within the quarry area itself is unlikely.

Soda Mountains Quarry/Workshop Complex

The Soda Mountains quarry/workshop complex described by Knell (2014) and Knell et al. (2014) contains multiple primary outcrops of black and green felsite and workshops near the raw material sources. Multiple lines of evidence suggest the Soda Mountains complex primarily dates pre-5000 cal BP and was probably used most heavily from the terminal Pleistocene through Middle Holocene (Knell et al. 2014). Knell (2014) analyzed roughly 10% of all artifacts observed during surveys within the Soda Mountain quarry/workshop complex and through his analysis, identified a preference for producing bifacial cores, bifacial tool blanks (unfinished early-stage bifaces), and flake blanks for transport away from the quarry/workshop complex. Although many bifacial cores were identified, they presumably functioned as objective pieces from which usable flake blanks were detached rather than as transportable items that were part of a mobile toolkit. The flake blanks, along with bifaces, were the byproduct of production in the quarry/workshop area.

Knell (2014) found the biface thinning flakes at a nearby habitation area (Little Cowhole survey area) to be smaller by weight than those from the Soda Mountains quarry/workshop complex. This suggests that most late-stage biface manufacture occurred at the habitation areas, not the quarry/workshop complex. Additionally, flakes bearing more cortex were detached at the Soda Mountains complex rather than the Little Cowhole habitation area. These flake attributes support the idea that heavier portions of the stone were removed prior to leaving the raw material source, likely as means for hunter-gatherers to reduce toolkit weight as they prepared for travel within and away from the Lake Mojave area. Although some flake tools (three utilized flakes, two end scrapers, two retouched flakes, and a multipurpose tool) were discovered at the Soda Mountain quarry/workshop area, Knell (2014:220) describes the overall assemblage as containing a “paucity of used tools”. Therefore, although the Soda Mountains complex has trace amounts of tools manufactured for use, this was not the primary trajectory.

To summarize, 99.9% of the analyzed felsite raw material was procured from within the Soda Mountain complex area. Only three artifacts were likely transported to the Soda Mountain complex from outside sources. The intended end-product of manufacture was bifacial cores, bifacial tool blanks, and flake blanks, which were transported away from the quarry/workshop complex to residential bases for further reduction into functional tools. Very little of the felsite procured from the Soda Mountains source area was manufactured into tools for immediate use.

A Synthesis of Technological Strategies at Great Basin Raw Material Sources

A review of the technological strategies from nine Great Basin raw material source areas reveals some common themes. Each source has artifacts overwhelmingly procured from within the respective quarry area, with little to no transport of raw material originating from elsewhere. This pattern is expected at archaeological quarry or quarry/workshop areas (Byrd et al. 2009; Knell 2014). The lack of outside raw materials suggests these quarries were strategically used for procurement and manufacturing. This differs from habitation sites where a range of other raw material types is typically present (see Knell 2014), except when habitation sites are in a region overwhelmingly provisioned by one raw material source (Gilreath and Hildebrandt 2011). Additionally, no utilized tools were reported from any of the raw material source areas except for the few Soda Mountains felsite artifacts. The scarce number of tools found in Great Basin quarries supports the idea that raw material sources in this region functioned primarily as lithic raw material acquisition areas, not everyday habitation activities. Therefore, Great Basin quarries typically served as logistical or residential destinations (“locations” according to Binford 1980:9) rather than residential bases or central places.

Another common theme among the nine Great Basin raw material procurement areas is the role that bifaces and bifacial implements played in hunter-gatherer lifeways. All procurement areas emphasized biface production at some point in time, regardless of raw material quality or availability. The degree of biface reduction at each source is thought to reflect the distance of transport back to residential bases or camps as a means of reducing weight and thus transport costs (Beck et al. 2002;

Bloomer 1991; Newman 1994; Shott and Seeman 2015). Thus, an assemblage containing primarily early- to middle-stage bifaces should result when transport distances are short and middle- to late-stage bifaces when the transport distance is long. However, increased reduction into middle- and late-stage bifaces may also occur at quarries as part of a provisioning individual strategy by residentially mobile groups when uncertainty exists regarding the next opportunity to replenish their toolkit (Burke et al. 2018). In such cases and to maximize toolstone utility, the additional time spent reducing early-stage items decreases the chance of failure during later reduction (Byrd et al. 2009).

Although all nine raw material sources have evidence of biface manufacture, Great Basin hunter-gatherers clearly preferred certain raw materials for bifaces at different points in time. Bifacial tools were produced during the terminal Pleistocene/Early Holocene (TP/EH) from fine-grained volcanic (FGV) and obsidian raw material (Duke 2013; Duke and Young 2007; Ruby et al. 2010), but during the Middle and Late Holocene, hunter-gatherers relied more heavily on chert and obsidian for bifaces (Gilreath and Hildebrandt 2011; Torres 1998) with a noticeable decrease in FGV biface production (Byrd et al. 2009; Duke 2013). Thus, FGV was strongly preferred by toolmakers during the terminal Pleistocene/Early Holocene to make bifaces, but post-5000 cal BP (Byrd et al. 2009; Duke 2013; Duke and Young 2007; Knell 2014) they preferred cryptocrystalline silicate bifaces.

The selection of raw material types as a distinct strategy noticeably diverges among the quarry areas when looking at core and flake tool/flake blank manufacture. For obsidian, only the CVF saw production of cores as one of the primary manufactured goods for transport, while only the Juan quarry produced flake blanks as a transportable good. Similarly, only one CCS source—the unnamed pavement quarries in the Mojave Desert—produced transportable cores, flake tool blanks and bifaces. This seemingly implies that obsidian and CCS were primarily used for biface and biface blank production in the Great Basin, with occasional procurement for use as flake tools. However, Byrd et al. (2009) and Knell (personal communication 2021) report substantial CCS, as well as FGV, flake tool manufacture during the TP/EH.

Economic and functional requirements also greatly influenced the type of raw material selected and the final form of tools. Economically, increased reliance on large game hunting (presumably big-horn sheep; Gilreath and Hildebrandt 2011) during the Late Holocene profoundly impacted the specialized production of bifaces at obsidian and CCS quarries, and likely caused an increase in biface production at the Goldstone Variety 1 dacite quarry during the Middle to Late Holocene (Ruby et al. 2010). Functionally, raw material quality and availability played little role in the procurement of specific raw materials throughout the Great Basin. Although these factors inevitably influenced procurement strategies (Andrefsky 1994; Bamforth 1990; Brantingham et al. 2000; Estes 2009), functional requirements for the inevitable tool form apparently play a large role in the type of raw material selected for use (Ruby et al. 2010). Loendorf et al. (2017) and others (Duke 2013; Duke and Young 2007) demonstrate that raw material quality is arbitrary though, since some raw material types may be considered very good quality for certain tasks or tool types but less than ideal for others.

In simplified terms, Great Basin quarries include primary and secondary raw material deposits of obsidian, chert, and fine-grained volcanic stone. Assemblages are relatively homogenous, dominated by one raw material type with little transport of other non-local stone to the quarries. Procurement from these sources often result in the production of bifaces. Discarded bifaces resemble early- to middle-stage implements except when manufactured for off-site transport to distant residential bases or habitation areas (Beck et al. 2002). Flake tools and transportable cores are also byproducts of production at quarry sites, but seemingly play a secondary role to biface production. Raw material quality played a minimal role in toolstone procurement compared to the function requirements for each raw material type. Quarry assemblages from the Great Basin contain tool types and production debitage that implies they function as logistical stops for resource procurement rather than everyday habitation tasks.

Chapter Summary

The organization of technology approach is widely used among lithic analysts to infer past behaviors. Understanding lithic technological organization provides important insights regarding the strategies used to procure, produce, use/reuse/recycle, and transport lithic artifacts. Evaluation of nine Great Basin quarry studies was used to predict what the organization of technology at quarries might look like. I will apply the synthesis of the quarry studies provided here to assess whether the Baker site functioned as a quarry as Nakamura and Glennan suggested, or if it also functioned as a workshop, habitation site, or some combination of these site types in the next chapter. Testable research questions will also be established in Chapter 4 to assist with site type classifications for the Baker assemblage and to determine the organization of technology for the Baker site.

CHAPTER 4

RESEARCH DESIGN AND METHODS

This chapter details the overall research design and accompanying methods of this thesis, with an emphasis on documenting the organization of lithic technology at the Baker site. The research design develops the procedures and four research questions that, when answered in Chapter 6, will indicate the lithic technological strategies employed at the Baker site. Following the research questions are the analytical methods used to test these questions.

Research Design

The Baker site artifacts were analyzed following the organization of lithic technology approach. A good, consistent, and scientific organization of technology study, according to Carr and Bradbury (2011:306), attempts to securely identify the past technologies present at a site, determine how those technologies were organized to meet social and economic needs, and examine how any technological changes correspond with cultural changes (see Chapter 3). Reconstructing the organization of technology requires multiple lines of evidence (Carr and Bradbury 2011; Morrow 1997), so a wide array of variables should be considered when analyzing artifacts using this approach. By evaluating the lithic technological strategies evident from tools, cores, and debitage, this thesis identifies the site activities related to procurement, production, use, reuse/maintenance, discard, and off-site transport (i.e., flow model) in the Baker assemblage. Table 4.1 shows the correlation between tools, cores, and debitage and their associated site types. Recognizing what form lithic raw material was brought to the Baker site and the associated site activities from production to discard and transport informs us about the flow of lithic raw materials into, at, and through the Baker site (Collins 1975; Kelly 1988; Knell 2012, 2014; Knell and Becker 2017; Schiffer 1976). The flow model approach used here provides a detailed account of the prehistoric behaviors that formed the Baker site, as well as the technological strategies past hunter-gatherers employed when using the Baker site as a component of their overall lifeway in the greater Lake Mojave area.

Table 4.1. Criteria Used to Distinguish between Quarry, Workshop, and Habitation Sites.

Site Type*	Raw Material	Tools	Debitage	References
Quarry	• Almost exclusively homogenous • Procured from within site area • Primary bedrock or secondary surface deposits	• Some unfinished tools and blanks • Few to no technologically finished tools • Many cores	• Core reduction, early-stage biface thinning flakes and possibly alternate flakes, shatter and other debris • Varies by production strategy	• Knell 2014 • Beck et al. 2002
Workshop	• Relatively homogenous • Raw material type, color, and texture matches nearby quarry area(s) • Not procured from within site area	• Many unfinished tools, blanks, and early-stage preforms • Few to no technologically-finished tools • Many cores	• Core reduction, early-stage biface thinning flakes and possibly alternate flakes, shatter and other debris • Varies by production strategy	• Knell and Becker 2017
Habitation Area	• Typically heterogenous • Local and/or nonlocal raw materials • Not procured from within site area	• Most tools technologically finished, but middle- to late-stage unfinished tools likely • Diverse range of tool types, many with signs of use	• Middle- to late-stage production and shaping debris	• Knell and Becker 2017

*This table in no way reflects all possible human site types or activities that occur across a lithic landscape.

Each subsection of the flow model, from initial procurement to off-site transport, contains embedded questions that when addressed together will reveal the technological organization for the Baker site assemblage. The driving questions of my thesis, which follow the flow model, are discussed below to set up testable site type and technological expectations for the Baker site (Table 4.1). Each question inquires about particular technological strategies that occurred within the site, and when answered together in Chapter 6, will reveal the organization of technology at the Baker site.

Were the Baker Site Artifacts Predominantly Procured as Seams/Boulders of Rhyolite Available Within the Site Area or Were They Transported from Multiple Source Areas to the Baker Site?

The first part of the flow model relates to lithic raw material procurement and specifically where it was acquired from and how it ended up in an archaeological assemblage. The way lithic raw material is procured varies between site types. Quarries, by definition, must contain one or more outcrops of lithic raw material within the site area, while workshops and habitation sites that lack a quarry component have raw materials brought from local and/or extra-local sources (Table 4.1). Primary quarries are the result of direct procurement from bedrock outcrops, while secondary quarries have toolstone collected from cobbles or boulders that eroded from their original context and reaccreted onto new landforms. Quarries typically have just one type of raw material (i.e., a homogenous assemblage) that is procured from the available source area, as do workshops that also have relatively homogenous raw material assemblages reflecting the range of color and texture variations from nearby outcrops (Table 4.1). Changes in the homogeneity of quarry and workshop assemblages can occur at secondary quarries due to the erosion and deposition of multiple stone types in secondary landform deposits (Bamforth 1990). Quarry and workshop assemblages sometimes have exhausted tools, often from extra-local sources, that are discarded once new tools/toolkits are produced at workshop or quarry areas (Gramly 1980; Smith et al. 2013). Habitation areas usually have heterogenous raw material assemblages from different source areas. Other differences between these site types are described below.

What Manufacturing Strategies Were Employed at the Baker Site and What Were the End Goals of Production?

The second part of the flow model concerns the goals of production and the manufacture strategy or strategies used to meet those goals. Understanding the manufacturing strategies at the Baker site can show how the site functioned (i.e., its site type[s]) and what items were ultimately produced (tools, blanks, cores). Production can be determined by recovering a technologically finished or discarded artifact (e.g., biface, flake tool, flake blank, projectile point) and/or by identifying lithic production debris indicative of tool, core, or blank manufacture. For this study, tools, cores, and debitage will be classified using typological and attribute-based analyses (Andrefsky 2001).

Artifact attributes will be used to identify different tool, core, and flake types. I use flake typologies because they can reveal distinctive behaviors from as little as a single piece of debitage. For example, the presence of biface thinning flakes suggests, at minimum, that a biface was thinned and was once present at a site, even without a biface being recovered (Andrefsky 2005:115). Similarly, an alternate flake suggests a biface was created by alternatively flaking a tabular piece of raw material, even if no bifaces are observed. The recovery of complete or discarded tools paired with the identification of flake typologies will be used to piece together manufacturing strategies at the Baker site.

Manufacturing strategies, like procurement, can vary by site type (Table 4.1). Habitation sites typically include some evidence of tool production, as well as production debris resulting from retooling and maintaining toolkits (Knell and Becker 2017). Quarry sites typically have core reduction and early-stage production debris and few finished tools, except perhaps for a small number of worn-out finished tools that were discarded when the toolkit was replenished (Gramly 1980; Smith et al. 2013). Therefore, manufactured goods at quarry sites tend to include early- to middle-stage bifaces (Beck et al. 2002; Bloomer 1991; Byrd et al. 2009; Gilreath and Hildebrandt 2011; Knell 2014; Shott 2015), flake blanks (Bamforth 1990; Ruby et al. 2010), transportable cores (Bamforth 1990; Byrd et al. 2009; Knell 2014; Torres 1988), and occasional middle- to late-stage bifaces (Beck et al. 2002). Alternatively, workshop assemblages are dominated by production debris and unused or unfinished tools that correspond with the manufactured tool types (e.g., biface thinning flakes and broken/rejected bifaces; Knell 2014). Goods manufactured at workshops run the gambit of potential core, tool or flake blank types, and are specific to the needs of the toolmakers. Workshop assemblages almost always contain lithic implements indicative of manufacture over maintenance but can serve as special purpose task areas where tools are resharpened or maintained rather than produced.

What Patterns of Tool Use, Reuse, and Discard are Evident at the Baker Site?

The third part of the flow model considers how tools were used, maintained, and discarded. Identifying used tools, whether produced on-site or brought from elsewhere, can imply much about site function and past behaviors. Utilized tools are often found in association with habitation areas where they presumably were used to complete everyday tasks (Table 4.1; Knell and Becker 2017). Quarries sometimes have used tools, but usually exhausted implements manufactured from extra-local raw material (Gramly 1980; Smith et al. 2013).

The way to identify tool use, and possibly reuse, is to check for evidence of use-wear and/or resharpening along the margins. In many cases, tools and artifacts intended for use are transported to or manufactured at a site, used (leaving signs of use-wear and possible resharpening), and discarded within the site area. Such tools should be visible in the archaeological record of the site, except when transported away (Larson and Kornfeld 1997; also see Knell 2012). Use-wear is best identified using a low- or high-power microscope (Odell 2004), but for various reasons this option was not available during my analysis. Though not ideal, use-wear was identified using a 10x hand lens. Consequently, the use-related identifications made here are hypotheses rather than solid determinations of use.

Discarded implements also imply much about the past behaviors at a site. In the context of the flow model, the term “discard” refers to an intentional action by toolmakers to leave a lithic implement behind. Discarded tools, cores, and debitage differ from incidental lithic debris produced during reduction events. Discarded items can include blanks, tools, or preforms broken or rejected during manufacture, or as the result of breakage or exhaustion. Quarry assemblages typically have few to no tools (unfinished or technologically finished), except for worn out and discarded tools that were replaced during toolkit restocking (Table 4.1). Workshops often have discarded unused or unfinished tools (blanks and preforms; Knell and Becker 2017) that failed to meet the knappers criteria for off-site transport. Habitation sites typically have a wide array of tool types (frequently technologically finished and used) that either broke during use or maintenance and were abandoned when exhausted.

What Artifacts Were Produced at the Baker Site and Transported Off-Site and What Does This Imply about the Baker Site's Role at Lake Mojave and the Mojave Desert Region?

The final part of the flow model deals with the transport of artifacts away from an archaeological site. Assuming for now that artifacts were produced at the Baker site using the available rhyolite, it is a worthwhile endeavor to reconstruct which artifact types were produced for consumption away from the Baker site and what this implies about the site's role in the Mojave Desert. Determining which artifacts were transported from the Baker site is difficult because they are no longer present. Tools, cores, and blanks manufactured for use away from the site should be invisible in the site's archaeological record, with debitage and perhaps manufacture rejects the only or main residue of this technological strategy (Larson and Kornfeld 1997; also Knell 2012).

Geochemical sourcing studies are one way to establish which artifact types were transported away from a site. To determine if and where Baker site rhyolite was transported and what tool types it eventually became, I compared artifacts from the Baker site to rhyolite artifacts of similar color and texture from other local and extra-local sites collected by the Campbell's and housed at Joshua Tree National Park (JTNP). These artifacts originated from archaeological districts (i.e., collections of associated sites) around Southern California and Nevada and are now housed as extant collections at JTNP. I visually inspected all accessible Campbell collection artifacts from JTNP on March 19, 2021—though the total number of artifacts inspected was not tallied—and ultimately selected 22 artifacts (including all temporally diagnostic projectile points) that appeared to be rhyolite for geochemical sourcing via Energy Dispersive X-Ray Fluorescence. I then sent those to Richard Hughes at Geochemical Research Laboratory in Portola Valley, California.

Energy Dispersive X-Ray Florescence (edXRF) is a non-destructive technique for measuring levels of trace elements in stone samples. Because the geochemical composition of each rock formation around the planet serves as a unique signature of that specific formation, edXRF has the capability to correlate rock samples with their respective parent outcrops, presuming the parent outcrop's geochemical composition is known. Richard Hughes has an extensive database of artifacts and geologic samples from the Mojave Desert and has previously determined the geochemical signatures for the Baker site rhyolite. Thus, if any matches for the submitted artifacts come back with a positive identification to the Baker site it can be assumed the artifact was originally procured at the Baker site. Moreover, these artifacts will indicate the potential end-result of what Baker site rhyolite raw material became after manufacture and use. Knowing how the Baker site stone was used and what it eventually became will provide insights into the production strategies and use-life of the artifacts manufactured from Baker rhyolite. If any of the diagnostic projectile points bear the same signature as Baker rhyolite, then those points can be used to infer a relative age-range for use of the Baker site.

To better understand how the Baker site compares to other Lake Mojave region quarries, I will compare the Baker site technological strategies to those inferred by Knell (2014; Knell et al. 2014) and Semenza (1984; CA-SBR-5193) in the nearby Soda Mountains felsite quarry/workshop area (see Figure 4.1). The Soda Mountains studies are the most complete fine-grained volcanic (FGV) quarry and workshop analyses for the area immediately surrounding Lake Mojave. Comparing the Baker site to other FGV studies should reveal whether the technological strategies at the Baker site—also situated near the western edge of Lake Mojave—are similar to the procurement, production, maintenance, use, reuse, and discard patterns in the Lake Mojave area. In doing so, I will consider whether the lithic procurement strategies, raw material package size, raw material shape (tabular/blocky versus rounded cobbles), reduction strategies (e.g., core preparation [presence of grinding/battering] and type [unidirectional, multidirectional, or bifacial core reduction], stage of biface reduction), and the intended products of manufacture (e.g., projectile points, bifaces, flake blanks, cores) varied between the Baker site and the other lithic procurement areas. Variations in these factors would suggest that the procurement and manufacturing strategies used to acquire Baker rhyolite was unique.

Methods

To address the questions described above, I used the following methods and procedures. Data collection began with an initial review of the Baker site artifacts, which revealed that the collection includes 1,502 catalog numbers and an estimated 2,902 artifacts (per the 1976 site report) stored in 20 banker's boxes. In many cases, multiple artifacts are attached to a single catalogue number. Initial inspection and informal preliminary analysis of the artifacts revealed that the contents of each of the 20 artifact boxes is relatively consistent, containing roughly 60-70% flaking debris and debitage, 25-30% cores, and 5-10% flake tools or other miscellaneous tools. It was decided that an approximate 25% sample of artifacts will have a high likelihood of encountering all artifact and debitage types associated with the collection. To obtain a 25% sample, five of the 20 boxes (see Table 4.2) were randomly selected using a random number generator. This sampling strategy resulted in the analysis of 839 specimens; however, 45 specimens were determined to be unmodified, natural pieces of stone, resulting in the analysis of 794 artifacts for this thesis. The remaining boxes were visually scoured for tool types not represented by the sample to confirm that all technologies are included in the analysis; no unique tools or tool types were observed in the unsampled boxes.

The artifacts were analyzed using typological and attribute-based techniques (Andrefsky 2001; Bradbury and Carr 1995). Preliminary visual inspection of the artifacts determined which specimens to classify as tools, cores, flake blanks, or debitage and which variables and attributes should be used during analysis. The typological and attribute-based traits chosen for analysis vary depending on whether the artifact is a tool, core, or debitage.

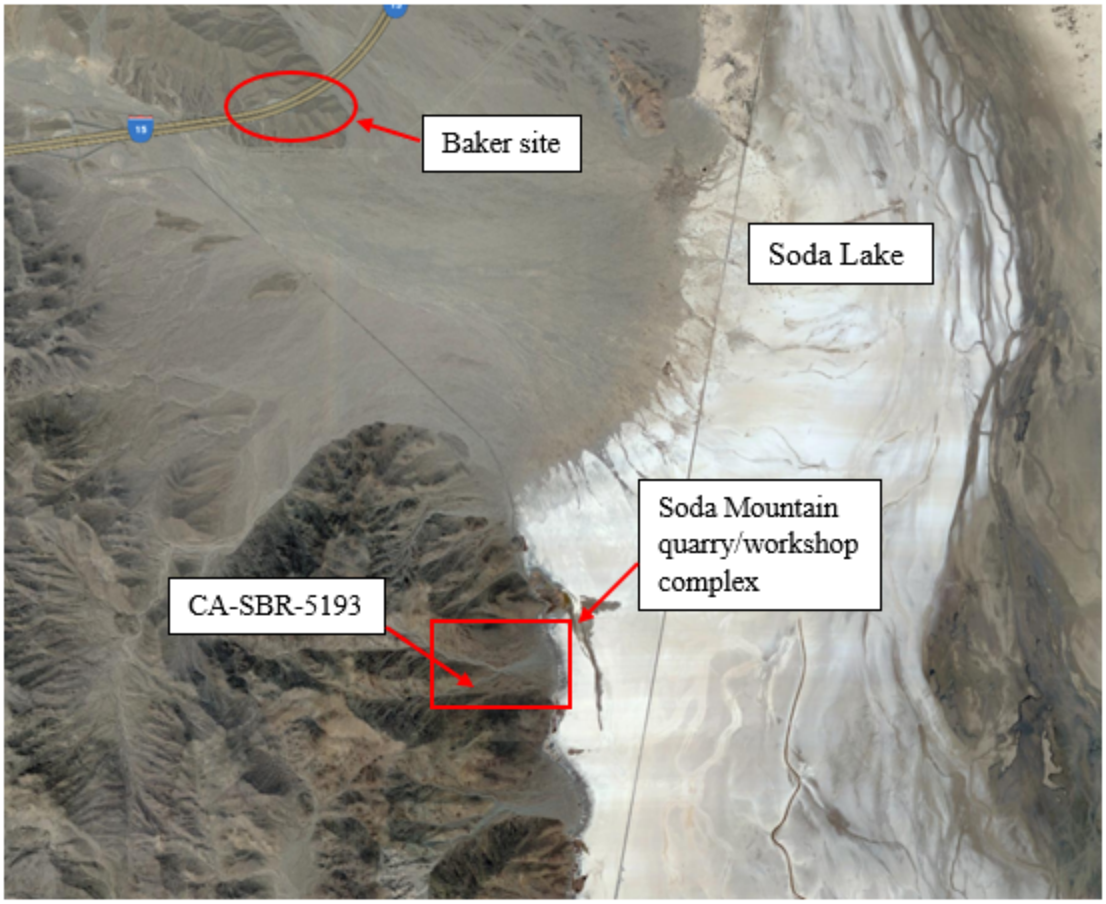


Figure 4.1. Approximate locations of the Baker site and the Soda Mountains felsite quarry/workshop complex, which includes CA-SBR-5193. Modified from Google Earth.

Tools are any non-core pieces with marginal retouch, macroscopically identifiable edge modification (non-heavily weathered tool edges were evaluated using a 10x hand lens/loop), or intentional thinning beyond the initial reduction scarring. Tool classes recognized in this study include projectile points, bifacial tool blanks (i.e., unfinished bifaces), and unifacial tools (e.g., end scrapers, side scrapers, gravers, spokeshaves, and edge-modified flakes/retouched flakes). Bifaces are classified based on their Callahan (1979) stage of reduction, which includes: Stage 1 - blank or large flake; Stage 2 - initial edging; Stage 3 - primary thinning; Stage 4 - secondary thinning; Stage 5 - shaping; and finally, the completed projectile point.

Table 4.2. Baker Site Boxes Selected Randomly for Analysis.

Box Number (out of 20)	Number of Specimens
2	242
3	123
6	125
7	131
8	173
Total = 794 Artifacts	

Cores are objective pieces for which the primary motive is to remove useable flakes (i.e., flake blanks) for manufacture into tools (Andrefsky 2005:12-14). Flake blanks are detached flakes, cobbles, nodules, or raw material chunks that are selected for reduction into bifaces or flake tools but remain unfinished and are identifiable by intentional flaking on the ventral surface or flake scars indicating a Levallois-like detachment (Bordes 1980; Copeland 1983). Core types used to create flake blanks include: bifacial cores (marginal flake removals from both faces of the stone without careful consideration of thinning the biface into a biface tool; Bamforth 2002:66); unidirectional cores (flakes removed in one direction from a single platform; Andrefsky 2005:15); multidirectional cores (flakes removed in multiple directions and from more than one platform [Andrefsky 2005:16; also sometimes referred to as amorphous cores]); flake cores (sizeable flake with large flakes removed from one or both faces without consideration of thinning the flake into a flake tool; Root et al. 1999:68); tested piece (one to three relatively small flakes removed to determine raw material quality; Root et al. 1999:66-67); and core fragment (broken core where the core type determination is unknowable; Root et al. 1999:68).

Debitage are defined as the unmodified flakes and flaking debris formed during core reduction, tool production, or biface thinning (Andrefsky 2005:16). Debitage include all unused flake types, blocky and unrecognizable shatter. Flakes must minimally have a distinct ventral surface, whereas shatter may include cubical (blocky) or irregularly-shaped fragments that lack a bulb of percussion, systematic alignment of flake scars on any face, striking platforms, or points of flake initiation (Root 2004:Table 4.1).

A host of other variables were analyzed and generally follow those used by Knell (2014, 2017; Knell et al. 2014), which in turn are derived from Root (2004), Root et al. (1999), and Tomka (1989). These include: raw material type; original objective piece (e.g., blocky or tabular core, cobble core, biface, flake; Root et al. 1999); number of flake scars on the dorsal surface (<3 or ≥3; Root 2004) for distinguishing simple flakes (<3 flakes scars) and complex flakes (≥3 flake scars); percentage of dorsal cortex (*0* = no cortex, *1* = 1-49% cortex, *2* = 50-99% cortex, and *3* = 100% cortex; Root 2004); presence/absence of cortex on the striking platform; platform type (natural, single facet, multiple facets); platform configuration (marginal or flat); platform preparation (none or ground/battered); presence of prepared flake removals that could indicate core preparation beyond grinding/battering (Davis and Willis 2018); artifact completeness (complete, proximal, distal, median, or margin fragment; Root et al. 1999:Table 6); and raw material quality (following Bamforth 1990). Following Root et al. (1999:Table 6), tools were also analyzed for their use-life class (*1* = complete blanks, preforms, or other unfinished tools, *2* = broken blanks or preforms or other unfinished tools rejected during manufacture, *3* = unbroken, technologically finished tools, or *4* = broken/worn out/discarded technologically finished tools), and the presence of resharpening or retouch on the margins to indicate potential use. Cores were also checked for the type of flake removals (core reduction flake, biface flake, blade-like flake, or a combination of the three; Root et al. 1999:Table 7) and core reduction stage (*1* = unmodified cobble, *2* = tested raw material or core with 1-3 small flake removals, *3* = core with clear indication of flake removals beyond a tested piece but not heavily flaked, or *4* = one or more relatively large flake removals indicating production of a blank; Root et al. 1999:Table 7).

Metrics including maximum length, width, and thickness were recorded to the tenths place using Fowler Sylvac Ultra-cal Mark III digital calipers, which were calibrated at the beginning of each work session and after every ten artifacts or so. In addition to maximum thickness, a secondary thickness measurement was taken at the midpoint of each artifact to account for varying thicknesses in individual artifacts. The maximum and midpoint thickness were then averaged to establish an adjusted thickness measurement that better reflects the overall thickness for each artifact. Artifacts less than 500 g were weighed to the tenths place on an Ohaus Scout SPX421 digital scale that was calibrated at the beginning of each analysis session and after every 20 artifacts or so. Artifacts over 500 g were weighed using an Ohaus mechanical balance.

To assess raw material quality, each specimen was inspected for the presence of inclusions, voids, cracks, or pits, and for signs of irregularly formed material with unpredictable breakage planes (Bamforth 1990:76). Figures 4.2.1 through 4.2.6 show examples of these raw material flaws on Baker site artifacts. The definition for each flaw is loosely based on Bamforth (1990:76) but expanded to match the imperfections observed in Baker site rhyolite. Inclusions (Figure 4.2.1) are visible phenocrysts (large crystals formed in porphyritic rock distinct from the rock’s groundmass), xenocrysts (foreign crystalline material in igneous rocks), or pockets of permeated deposited cryptocrystalline silicate material. Voids (Figure 4.2.2) are crystal-lined hollow pockets within the interior of the stone, much like small geodes. Cracks (Figure 4.3.3) are small linear occurrences of a separation in the raw material (i.e., a crack) that is visible on at least two exterior planes of the stone, indicating the crack travels somewhat into the stone rather than just appearing on the surface. Pits (Figure 4.2.4) are non-crystal lined porous holes or empty pockets within stone (similar to what occurs in pumice volcanic rock). Irregularly formed material (Figure 4.2.5) is categorized as the visible change in percussive energy force or direction within flake scars on the objective piece that is not caused by conchoidal fracturing or the presence of other raw material flaws (i.e., inclusions, voids, cracks, or pits). Changes in energy in irregularly formed stone often denote differences in raw material hardness or geochemical structure throughout the stone that disrupt the predictability of flake removals. For clarification in this study, pits and voids differ with the presence of crystallinity in the small hole in the stone. Percussive energy travels differently through crystalline pockets compared to non-crystalline empty pockets (see Bamforth 1990). For example, percussive energy used to detach flakes will change in intensity as it travels through a crystalline pocket where it encounters crystal and empty space (i.e., voids) along its path as opposed to encountering only empty space (i.e., pits). For this reason, voids and pits are categorized as different raw material flaws for this study. The presence or absence of step or hinge terminations on the dorsal flake scars (Figure 4.2.6) will also be assessed as these can be an indicator (although not explicitly) of poor raw material quality due to unpredictable flaking.

Figure 4.2.1. Examples of inclusions in Baker rhyolite (red circle indicates imperfection).

Figure 4.2.2. Examples of voids in Baker rhyolite (red circle indicates imperfection).

Figure 4.2.3. Examples of cracks in Baker rhyolite (red ellipses indicate cracked areas and red arrows indicate specific imperfection). Note how flake scars on each piece terminate at the cracks and frequently result in step or hinge terminations.

Figure 4.2.4. Examples of pits in Baker rhyolite (red shape indicates imperfection).

Figure 4.2.5. Examples of irregularly-formed material in Baker rhyolite. Some irregularly-formed material presents as spontaneous humps and ridges in flake scars that are not associated with conchoidal fracturing (left, red ellipsis), while others are banded straitions in the stone with textures alternating between fine/smooth and rough/granular (right, red ellipses).

Figure 4.2.6. Examples of multiple step and/or hinge fractures in Baker rhyolite. Some step/hinge fractures appear to be caused by other raw material imperfections in the stone, such as very small pits (left, red circles) or cracks (right, red ellipses and arrows).

The more occurrences of each flaw on an artifact, the worse the raw material quality. To quantify this, the number of raw material flaws evident on each artifact was calculated, which when summed range between 0 (no flaws) and 6 (all flaws present). The sum of raw materials flaws was then compared to an ordinal scale ranking system for establishing raw material quality: “0-1” represents relatively homogenous, good quality, workable material, “2 or 3” moderate quality stone with potential to fail during flaking due to imperfections, and “4 through 6” poor to extremely poor-quality raw material that is difficult to work with. Even one or two of the above attributes can cause concerns for stone tool makers as flaws can redirect the energy produced during flake fracture and result in breaks at unintended locations (Bamforth 1990:76).

All typological traits and attributes were recorded in a Microsoft Access database as the artifacts were analyzed. Several queries were run to evaluate the research questions and assess the associated technological strategies. The results of these tests and their implications are discussed further in the results chapter (Chapter 5) and discussion chapter (Chapter 6).

Chapter Summary

This chapter described the research design and accompanying methods that guide the analyses in the results chapter (Chapter 5). The research design ultimately established four testable questions that, when answered, will provide clues to the technological strategies employed at the Baker site in relation to the components of the flow model—procurement, production, use, reuse, discard, and off-site transport. Also discussed was how the information from the Baker site will be compared to other quarry/workshop sites situated around pluvial Lake Mojave, and my attempt to geochemically link artifacts from other parts of the Mojave Desert back to the Baker site to determine the likely life-history, distance/direction of transport, and potential age of use for Baker rhyolite. Finally, this chapter lays out the methods utilized in this thesis, which justify the 25% sample size of the Baker site artifacts and explains which typological and attribute-based variables were collected during analysis.

CHAPTER 5

RESULTS

A sample of 794 artifacts, or approximately 25% of the extant Baker site assemblage, was analyzed for this master's thesis. The artifacts include 69 tools (9% of the assemblage), 145 cores (18%), and 580 (73%) pieces of debitage. Table 5.1 provides the frequency of each artifact type by raw material, and Table 5.2 provides the average length, width, thickness, and mass for each artifact type. The Baker site artifacts are primarily (97.5%) rhyolite, with the remainder (2.5%) a dark red-brown jasper (Table 5.1). Each artifact class is described, with pictures of some specimens (including the catalog number) provided to demonstrate the artifacts class (also see the Appendix for many other pictures). The chapter concludes by discussing the results of a geochemical sourcing study on artifacts collected by Elizabeth and William Campbell to establish if and how rhyolite from the Baker site moved across the region and what tool types they became at discard.

Raw Material

The vast majority of raw material (97.5%, *n* = 774) is rhyolite, with jasper accounting for the remainder (2.5%, *n* = 20). Figure 5.1 shows large, unmodified rhyolitic boulders that were observed within the Baker site area during a field visit in 2019, suggesting rhyolite does outcrop at the site. The boulders appear to be in a secondary context, which is consistent with the erosional nature of the fanglomerate the site resides on. Fanglomerates are geologic units that contain accretions of cobbles, boulders, and sediment displaced through erosional processes. Nearly all stone in a fanglomerate should be in a secondary context (Grose 1959). The presence of rhyolitic boulders and the high frequency of rhyolite artifacts in the assemblage suggests rhyolite raw material is local to the Baker site.

Table 5.1. Frequency of Artifacts by Raw Material Type in the Baker Assemblage.

Artifact Type	Rhyolite	Jasper
Tools		
Bifacial tools		
Biface, Stage 2	21	–
Biface, Stage 3	14	–
Unifacial tools		
Graver/Perforator	3	–
Marginally-retouched tabular piece	5	–
Multipurpose tool	1	–
Retouched flake, patterned	10	–
Retouched flake, unpatterned	9	–
Spokeshave	1	–
Scraper	3	–
Utilized flake	2	–
Cores		
Bifacial	6	–
Fragment	7	–
Multidirectional	92	1
Unidirectional	37	2
Debitage		
Alternate flake	23	–
Biface thinning flake	4	–
Bipolar flake	2	–
Blank, flake	9	–
Core reduction flake	178	6
Flake, complex	109	3
Flake, simple	65	5
Preform, scraper	3	–
Primary decortication flake	29	–
Shatter, blocky	141	3
Column total	774	20
Sum	794	

Table 5.2. Frequency and Average of Metric Measurements for Tools (Complete Only), Cores, and Debitage by Type.

	Avg. Length (mm)	Avg. Width (mm)	Avg. Thickness** (mm)	Avg. Max. Thickness (mm)	Avg. Mass (g)	Frequency
Tool Metrics*						
Bifaces	83.06 ± 16.2	53.45 ± 11.3	26.78 ± 5.9	27.95 ± 6.1	116.73 ± 55.2	20
Retouched Flakes	70.00 ± 15.1	49.16 ± 8.3	20.52 ± 6.4	22.26 ± 6.4	68.60 ± 35.3	17
Marginally-Retouched Tabular Pieces	112.90 ± 45.8	42.98 ± 12.4	18.28 ± 5.4	22.5 ± 9.3	119.23 ± 121.6	5
Gravers	80.37 ± 24.5	37.51 ± 4.6	18.93 ± 2.9	22.26 ± 4.8	54.60 ± 30.7	3
Scrapers	79.95 ± 13.8	49.78 ± 1.7	18.51 ± 10.0	19.64 ± 9.7	76.73 ± 35.3	3
Spokeshave	46.03 ± 0	73.02 ± 0	14.47 ± 0	14.51 ± 0	45.10 ± 0	1
Utilized Flakes	64.11 ± 6.6	37.60 ± 14.3	15.49 ± 1.6	16.61 ± 1.4	31.75 ± 16.9	2
Multipurpose Tool	72.86 ± 0	55.87 ± 0	19.26 ± 0	20.38 ± 0	76.10 ± 0	1
Core Metrics						
Multidirectional (Complete)	89.97 ± 21.0	59.81 ± 14.4	34.05 ± 11.1	35.63 ± 11.4	188.84 ± 143.6	79
Unidirectional (Complete)	89.12 ± 27.7	54.61 ± 10.9	30.35 ± 9.1	31.68 ± 9.1	150.18 ± 95.8	37
Bifacial (Complete)	104.48 ± 11.8	60.97 ± 6.8	34.26 ± 5.6	35.54 ± 5.3	188.30 ± 65.3	5
Multidirectional (Frag.)	70.67 ± 11.4	57.57 ± 8.0	25.05 ± 5.4	25.74 ± 5.4	97.84 ± 37.8	5
Unidirectional (Frag.)	91.98 ± 0	47.84 ± 0	12.64 ± 0	12.87 ± 0	56.20 ± 0	1
Core Fragment (Unspecified Type)	68.92 ± 9.9	49.56 ± 7.8	29.28 ± 7.6	30.10 ± 7.6	99.79 ± 42.6	17

	Avg. Length (mm)	Avg. Width (mm)	Avg. Thickness** (mm)	Avg. Max. Thickness (mm)	Avg. Mass (g)	Frequency
Debitage Metrics						
Core Reduction (Complete)	63.93 ± 19.3	44.89 ± 13.7	18.84 ± 6.7	20.31 ± 7.3	58.39 ± 56.1	156
Core Reduction (Frag.)	47.70 ± 16.1	38.45 ± 14.1	14.02 ± 5.0	14.84 ± 5.1	33.20 ± 29.6	28
Blocky Shatter	52.92 ± 19.8	33.10 ± 13.8	18.98 ± 9.0	20.08 ± 9.4	44.18 ± 50.6	114
Complex Flake (Complete)	50.55 ± 13.7	39.02 ± 11.0	13.10 ± 3.9	14.13 ± 4.1	28.27 ± 21.0	29
Complex Flake (Frag.)	56.49 ± 21.8	38.58 ± 14.8	16.43 ± 7.4	17.42 ± 7.6	44.64 ± 47.2	83
Simple Flake (Complete)	35.52 ± 13.7	30.70 ± 11.1	12.27 ± 9.4	13.41 ± 9.7	15.07 ± 15.9	12
Simple Flake (Frag.)	41.82 ± 19.3	30.16 ± 16.0	13.38 ± 8.2	14.00 ± 8.3	28.74 ± 43.9	58
Primary Decortication Flake (Complete)	53.97 ± 18.2	42.08 ± 11.0	16.29 ± 7.4	18.79 ± 7.4	43.01 ± 33.3	24
Primary Decortication Flake (Frag.)	51.81 ± 16.6	41.60 ± 14.0	22.97 ± 11.5	24.24 ± 12.2	60.64 ± 53.7	5
Alternate Flake (Complete)	56.72 ± 18.8	41.99 ± 9.9	16.46 ± 5.2	17.65 ± 5.2	42.61 ± 35.5	19
Alternate Flake (Frag.)	40.31 ± 17.7	32.07 ± 10.5	12.13 ± 4.3	12.80 ± 4.5	22.55 ± 19.8	4
Biface Thinning Flake (Complete)	47.21 ± 8.7	37.81 ± 3.5	11.69 ± 1.7	12.33 ± 1.1	21.03 ± 9.6	3
Biface Thinning Flake (Frag.)	42.91 ± 0	40.28 ± 0	11.45 ± 0	12.77 ± 0	13.90 ± 0	1
Flake Blank (Complete)	82.84 ± 16.7	56.67 ± 10.3	25.24 ± 2.8	26.6 ± 2.8	110.92 ± 49.3	5
Flake Blank (Frag.)	75.10 ± 15.6	44.73 ± 8.2	19.84 ± 3.2	20.89 ± 2.9	62.03 ± 26.6	4
Scraper Preforms (Complete)	77.61 ± 10.1	55.95 ± 8.8	26.25 ± 4.4	27.41 ± 4.7	108.53 ± 31.3	3
Bipolar Flake (Complete)	56.78 ± 0	37.38 ± 0	25.11 ± 0	55.80 ± 0	28.29 ± 0	1
Bipolar Flake (Frag.)	44.99 ± 0	42.30 ± 0	22.60 ± 0	42.30 ± 0	22.6 ± 0	1

*Only complete tools were used to establish these metrics
**Average thickness calculated by averaging the maximum thickness with the artifact midpoint thickness

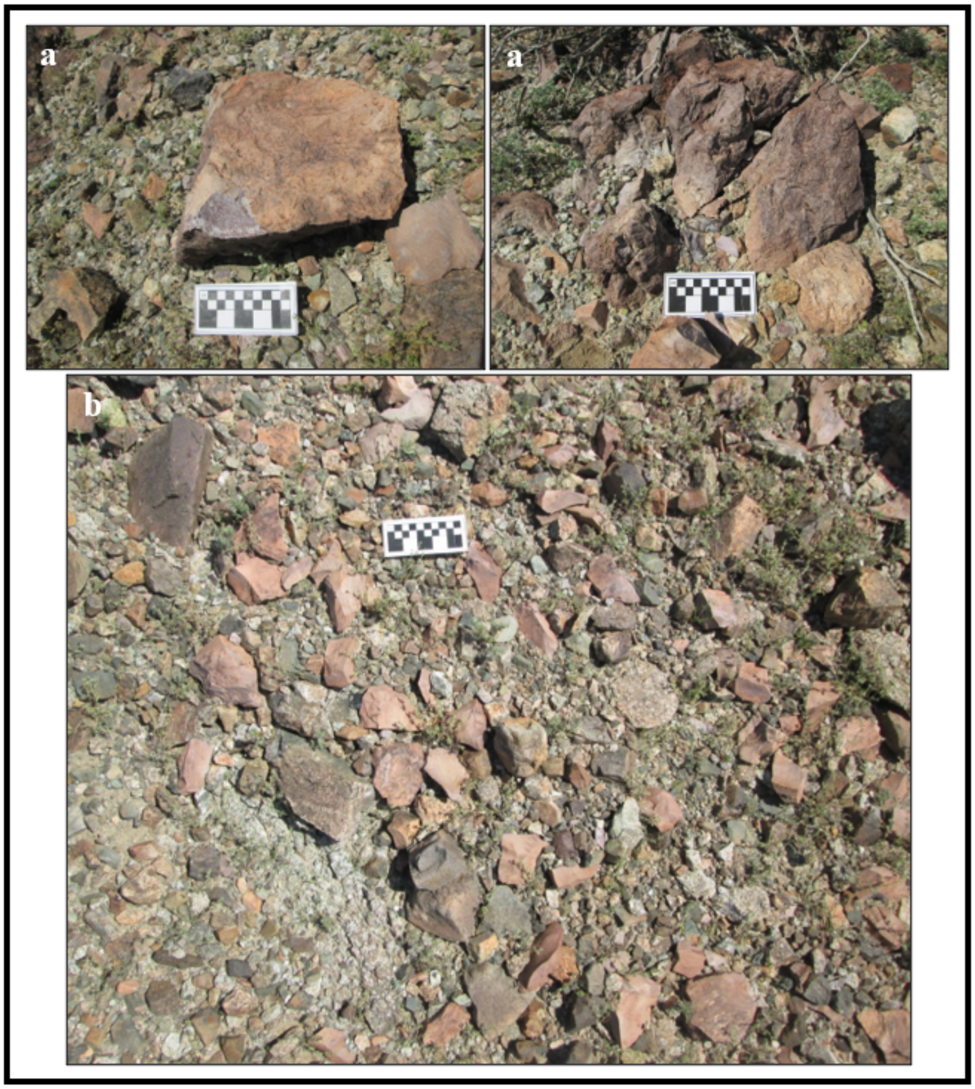


Figure 5.1. Examples of Baker rhyolite boulders outcropping from the secondary fanglomerate deposit within the recorded site boundary (a). Large flakes and cores were removed from the boulders and subsequently reduced on-site, leaving a dense scatter of flaking debris (b). Images taken by author during a field visit in 2019.

Though occurring in relatively low frequency, outcrops of jasper are present in the local area around Lake Mojave. Knell identified several small lithic scatters dominated by jasper and one large jasper boulder on the same fanglomerate as the Baker site (some at lower elevations to the west and others upslope to the north), though the color varieties are deep brown to brown/black (Figure 5.2; Edward Knell, personal communication 2019) rather than the dark red-brown color in the Baker assemblage. Dark red, orange, and orange-brown jasper also outcrop in Afton Canyon, approximately 28 km southwest of the Baker site. The availability of jasper in the surrounding area suggests that the jasper artifacts at Baker, like the rhyolite, were procured from the local area.

Figure 5.2. Examples of brown/black jasper flakes (top) observed upslope to the north of the Baker site, indicating jasper outcrops near the Baker site. Flakes were found near a large brown/black jasper boulder (bottom) that likely outcropped from the same fanglomerate formation as the Baker site. Images taken by author during a field visit in 2019.

Tools

Eight different tool types are recognized in the sample of the Baker site assemblage. These include 35 bifacial implements (Stage 2 and 3 bifaces) and 34 flake and tabular tools (gravers/perforators, a multipurpose tool, marginally-retouched tabular pieces, retouched flakes, scrapers, a possible spokeshave, and possible utilized flakes; Appendix). The frequency of each tool type is depicted in Figure 5.3. Note that bifaces (51%) and retouched flakes (28%) comprise more than three-quarters of the tool assemblage. All tools are manufactured from rhyolite raw material.

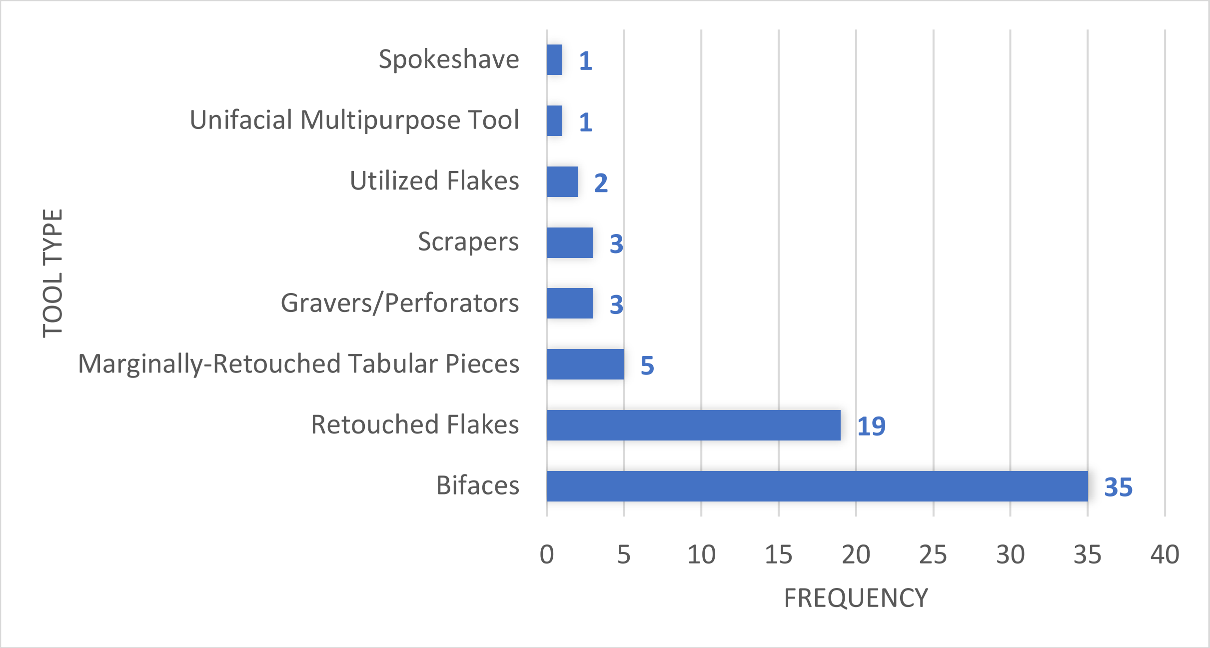


Figure 5.3. Frequency of tool types in the Baker site sample.

Bifaces

The 35 unfinished and unused bifaces (20 complete, 15 fragmented) are classified as either Stage 2 (initial edging; *n* = 21; Figure 5.4a) or Stage 3 (primary thinning; *n* = 14; Figure 5.4b) biface tool blanks following Callahan's (1979) reduction stages sequence. All bifaces were thus discarded during the early- to middle-stages of reduction (Figure 5.5). This interpretation is further supported by the fact that most (*n* = 32) bifaces retain cortex on the exterior surface, some (*n* = 11) of which have it along the sinuous edges as anticipated if they were discarded early in the manufacturing process (Root 2004:69). Tabular cortex is present on both faces of eight bifaces, suggesting they were manufactured from tabular slabs of raw material rather than flake blanks.

More than half of the bifaces (*n* = 23) were broken or rejected during manufacture because of flaws in the raw material or the knappers inability to thin the biface further by removing the existing step and/or hinge fractures. Seventeen of the complete bifaces are unfinished yet discarded for unknown reasons (Figure 5.6). One complete Stage 2 biface and one fragmented Stage 3 biface are retouched along one margin, although macroscopic analysis using a 10x power hand lens did not definitively reveal use-related retouch resulting in their classification as unfinished rather than technologically finished tools.

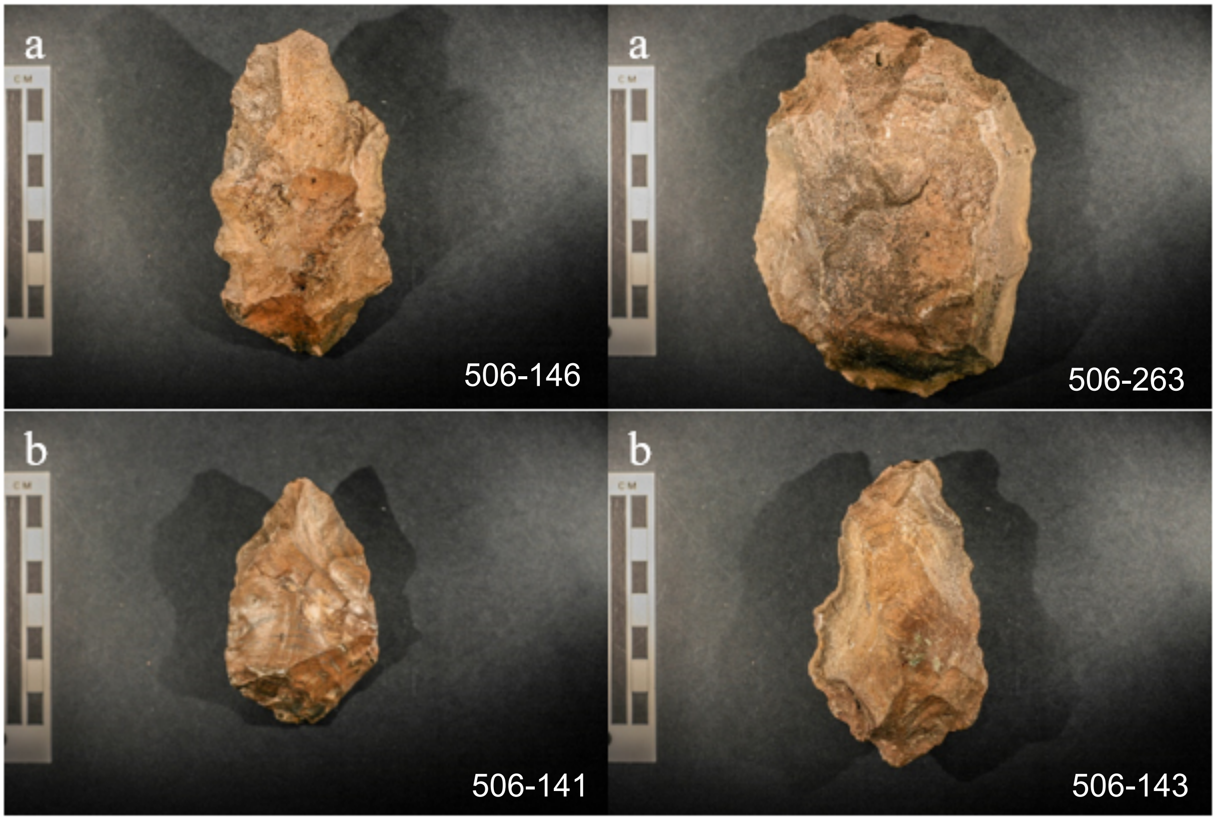


Figure 5.4. Examples of Stage 2 (a) and Stage 3 (b) bifaces.

Flake Tools and Tabular Tools

Flake tools and tabular tools constitute 4% (*n* = 35) of the Baker site sample. Six flake tool varieties were observed in the assemblage, including 19 retouched flakes, 3 gravers/perforators, 3 scrapers, 2 potential utilized flakes, 1 multipurpose tool, and 1 potential spokeshave (Figure 5.3). The tabular tools noted during analysis are all marginally-retouched tabular pieces (*n* = 5). Flake and tabular tool attributes are discussed below.

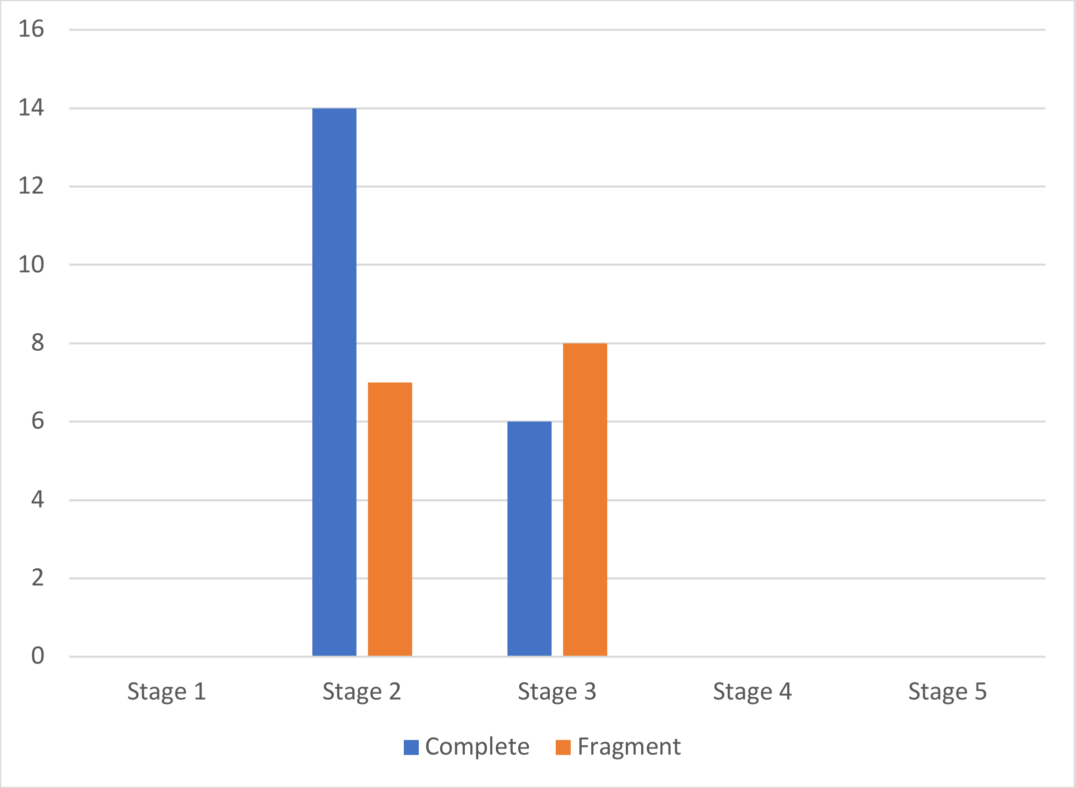


Figure 5.5. Frequency of unfinished complete and fragmented bifaces by manufacture stage.

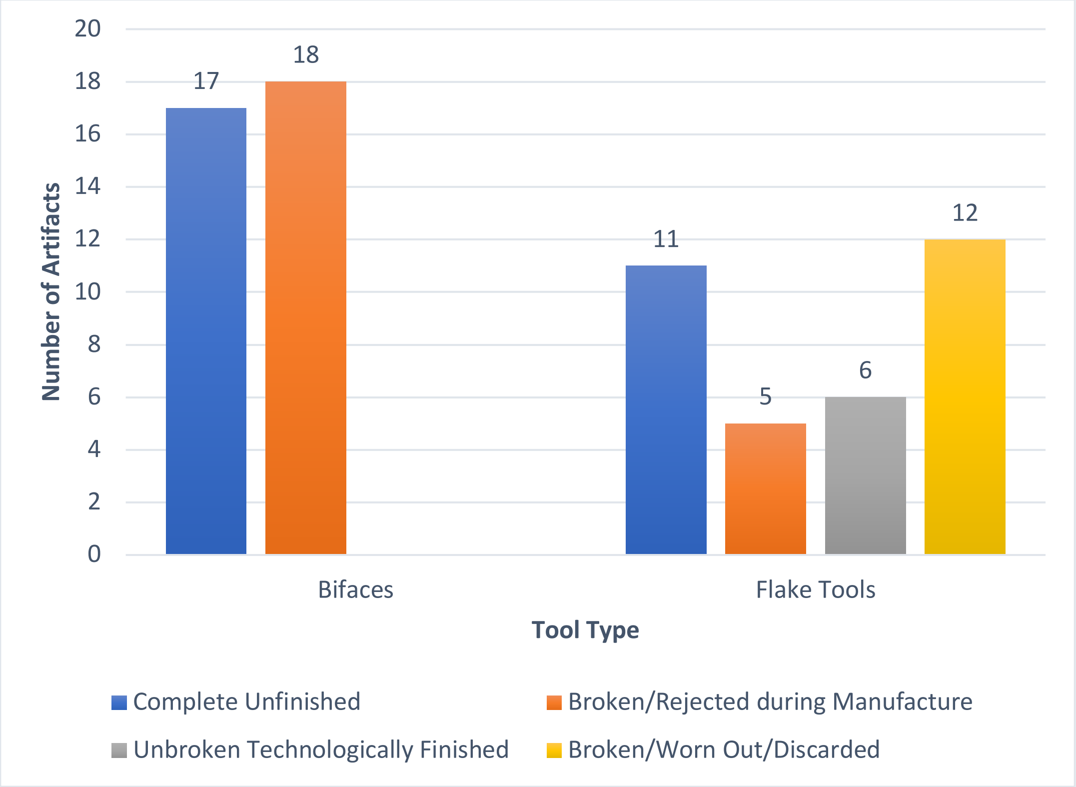


Figure 5.6. Use-life stages identified on Stage 2 and 3 bifaces (*n* = 35) and flake tools (*n* = 34).

Retouched Flakes

The 19 retouched flake tools are grouped into patterned retouch flakes (*n* = 10) whose initial form was intentionally modified into a premeditated shape that no longer represents the initial flake blank shape (Figure 5.7a), and unpatterned retouched flakes (*n* = 9) that though retouched, retain the original shape of the detached flake (Figure 5.7b). Nine patterned and unpatterned retouched flakes have evidence of utilization along one or more retouched margins. Fourteen are complete, two are distal fragments, two indeterminate, and one is a flake margin. Eight are made from a core reduction flake, five from unspecified flake types, four from technologically nondiagnostic flakes, and one from a unidirectional flake core (large core reduction flake with flake blank detachments and a retouched edge margin). The retouched flakes span the four types of use-life: nine are technologically incomplete, unbroken pieces; four were broken or rejected during manufacture; two are unbroken, technologically finished pieces; and six are technologically finished retouched flakes that either broke, wore out, or were discarded on-site at the end of their use-life.

Marginally-Retouched Tabular Pieces

Following Root et al. (1999), marginally-retouched tabular pieces are thin, tabular slabs of raw material (rhyolite in this case) with retouch on at least one margin. These tools resemble retouched flakes but have tabular cortex on the dorsal and ventral surfaces of the stone. The presence of intentional flaking and use-wear suggests these tools are technologically finished implements rather than broken tool blanks (Root et al. 1999:20). The five marginally-retouched tabular pieces (7% of the overall tool assemblage) have unimarginal (*n* = 2) or bimarginal (*n* = 3) retouch along one edge. The function of these tools is unknown, in part because only one (Figure 5.6) has macroscopically visible use-wear when viewed under a 10x hand lens. Four of the marginally-retouched tabular pieces are classified as complete blanks, preforms, or unfinished tools, while the one with potential use-wear is considered an unbroken, technologically finished tool.

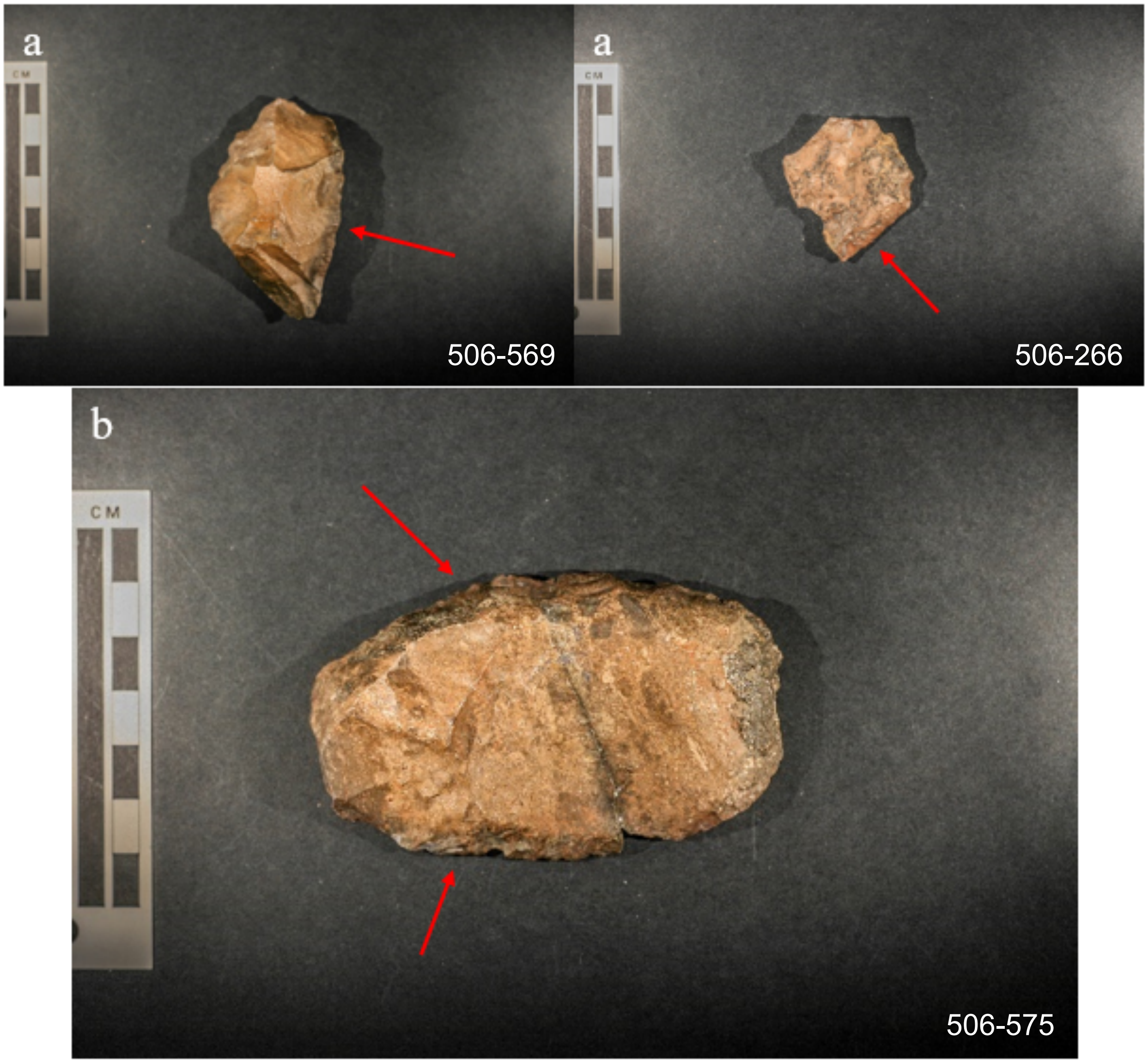


Figure 5.7. Examples of unpatterned (a) and patterned (b) retouched flakes. Red arrows indicate retouched margin(s).

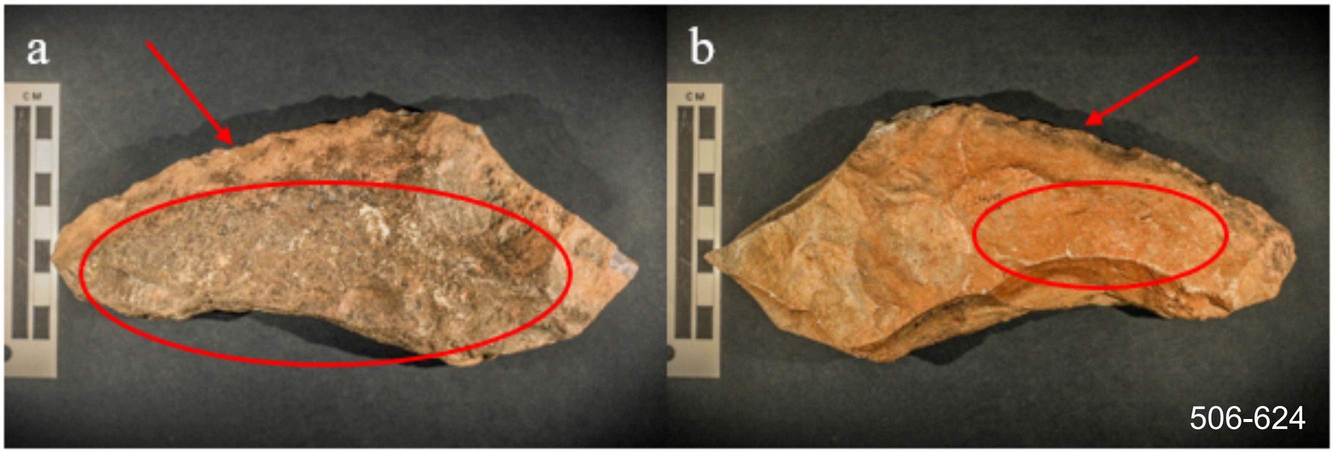


Figure 5.8. Example of a marginally-retouched tabular piece. Red arrows indicate margin of retouch along the dorsal (a) and ventral (b) sides of the tool, while red ellipses indicate tabular cortex.

Scrapers

The three scrapers (4%) are all identified as side-scrapers (Figure 5.9) given the formalized flaking along one margin (*n* = 2) or two margins (*n* = 1). Two were resharpened, suggesting some amount of use and maintenance. The other scraper, although not showing any macroscopically visible use-wear, is flaked beyond that of a patterned retouch flake and has the form of a side-scraper. All three scrapers are manufactured from flakes given the remaining traces of a ventral surface, and all are considered broken, worn out, or discarded implements.

Gravers/Perforators

The three single spur gravers/perforators constitute 4% of the total tool assemblage (Figure 5.10). Two retain evidence of resharpening around the spur, suggesting use and reuse prior to discard. Two are complete, technologically finished tools manufactured from core reduction flakes, and one is a worn out and discarded tool created from blocky shatter.

Utilized Flakes

The two possible utilized flakes comprise 3% of the Baker assemblage tools (Figure 5.11). Both are made from small core reduction flakes, one of which originated from a tabular cobble or pebble and one from a subrounded-to-rounded cobble or pebble. Each has macroscopically visible edge damage along the distal end that resembled neither retouch flaking nor modern edge damage from taphonomic processes (both of which were observed in the Baker assemblage sample).

Multipurpose Tool

The lone multipurpose tool is made from a tabular piece of rhyolite (Figure 5.12). It has a single spur graver/perforator at the distal end and a side scraper along one margin. Both the spur and flaked edge have unimarginal retouch. This tool is considered a complete, technologically-finished implement.

Spokeshave

Figure 5.13 depicts a potential spokeshave, with a single concavity along one margin. Although possible that the concave section occurred through taphonomic processes after the initial detachment of the flake, the interior of the concavity appears smoother and more polished than the rest of the edge of the flake (see Root et a. 1999) and resembles that of use-wear.

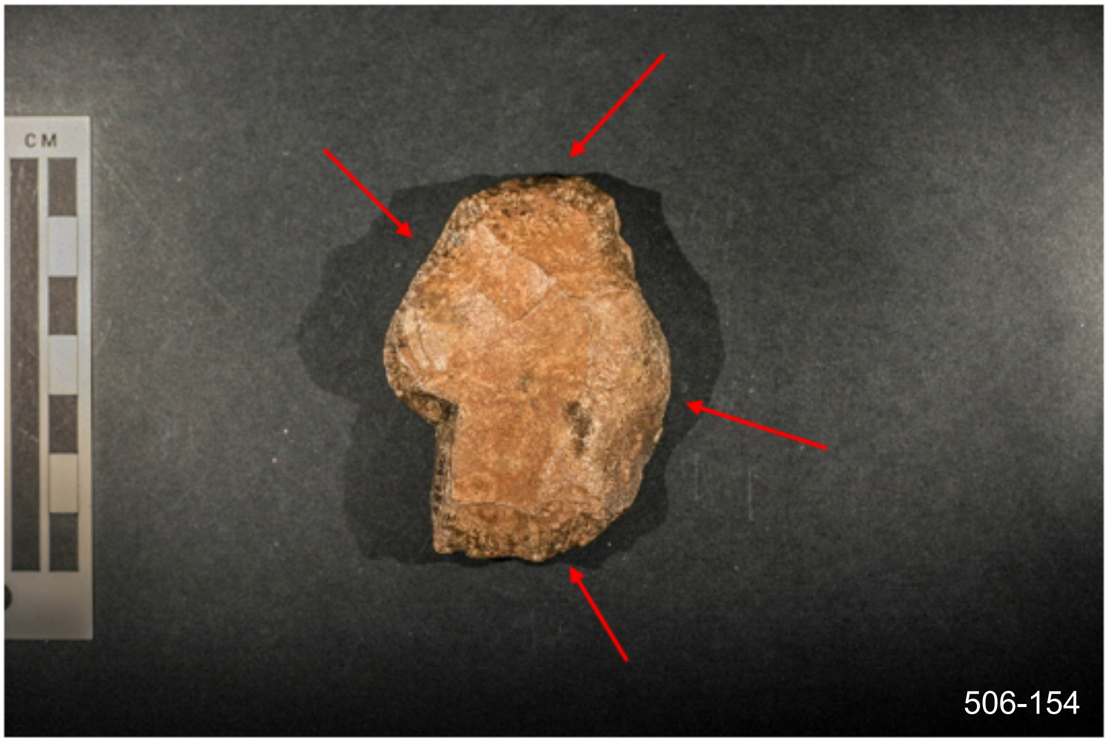


Figure 5.9. Example of a side scraper. Red arrows indicate retouched/used margin of the scraper.

Figure 5.10. Example of a single spur graver/perforator. Red arrow indicates retouched/used spur.

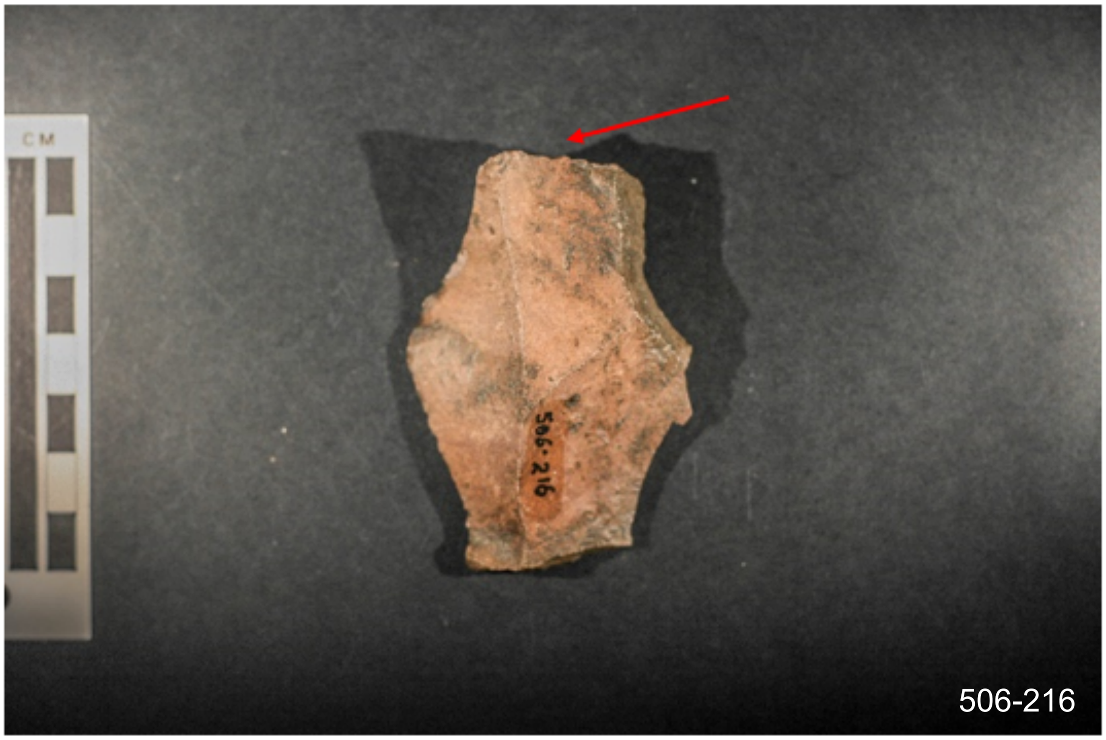


Figure 5.11. Example of a potential utilized flake. Red arrow indicates utilized distal margin.

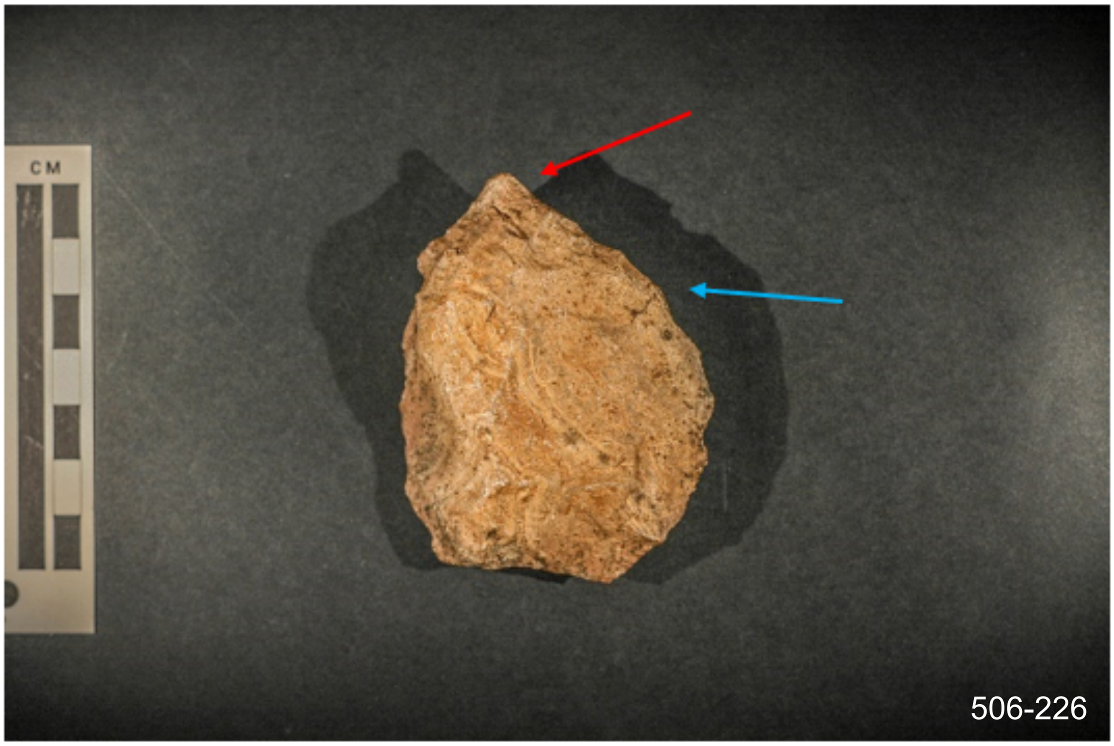


Figure 5.12. Multipurpose tool (graver/side scraper). The red arrow points to the graver and the blue arrow the retouched margin of a side scraper.

Figure 5.13. Possible spokeshave. Red arrow points to a possibly used concavity.

Cores

The Baker site sample includes 145 cores, including multidirectional, unidirectional, and bifacial cores, as well as unidentified complete and fragmented cores that do not fit a specific type (Figure 5.14; Appendix). All are manufactured from rhyolite (98%), except for two multidirectional cores and one unidirectional core made from jasper. Most cores (78%) are manufactured from tabular cobbles or pebbles with squared edges and flat cortical faces (n = 58, 40%) or blocky cobbles and pebbles (n = 55, 38%) with generally flat but not necessarily squared cortical surfaces. The remainder are made from core reduction flakes (9%, n = 13), technologically indeterminate flake types (5%, n = 7), blank forms (7%, n = 10), or split cobbles/pebbles (1%, n = 2). Sixty-three cores (43%) have large flake removals indicative of flake blank detachment, of which 14 (22%) were measured for their largest flake removal. Large flake detachment from these cores averaged 52.24 ± 7.9mm. A Levallois-like core reduction strategy was noted on 26 (18%) of the cores, the details of which are reported following the description of each core type.

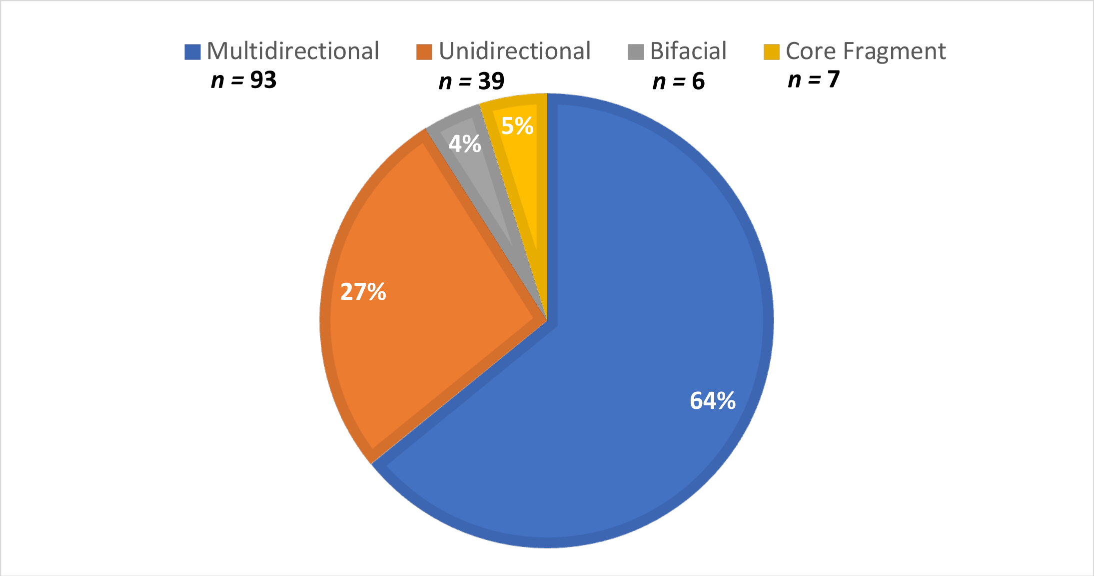


Figure 5.14. Percent of core types in the Baker site sample.

Core Types

Multidirectional Cores

Multidirectional cores comprise 64% (*n* = 93; Figure 5.15) of the analyzed sample. A multidirectional core is an objective piece with two or more faces from which flakes were removed (Andrefsky 2005; Root et al. 1999). The multidirectional cores include: 47 with unprepared platforms (i.e., unprepared core); 32 with prepared platforms (i.e., prepared core; some faceting, grinding, and/or other preparation for flaking); 5 tested pieces with 1-3 small percussion flake removals to determine stone useability without being reduced enough to produce usable flake blanks; and 9 flake cores (cores with remaining ventral surface indicating the original blank form was a large core reduction flake). Eight cores are fragments but retain enough diagnostics to identify them as multidirectional. Eighty-five of the multidirectional cores (91%) have flat platforms, suggesting they were designed to produce large core reduction flakes; the other eight (9%) have flat and marginal flake removals that might result in flakes reminiscent of core reduction and biface thinning flakes. Forty-nine cores were extensively flaked and have one or more relatively large flake removals suggesting they produced viable flake blanks or tool blanks. More than half of the multidirectional cores (51%, *n* = 47) are still considered useable; the remainder are exhausted based on small size, raw material flaws, or inability to reduce the stone further due to multiple step or hinge fractures.

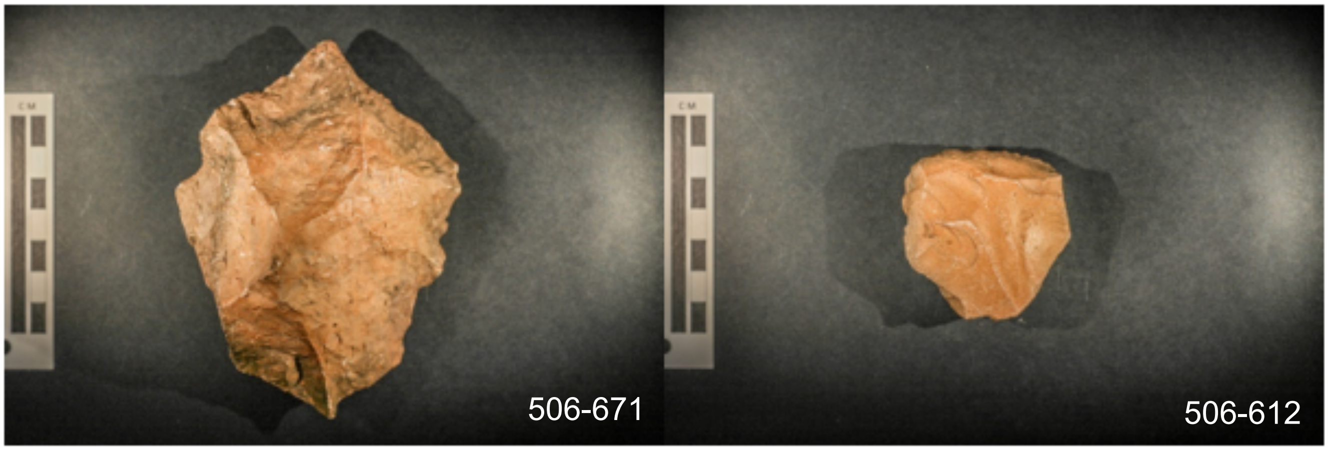


Figure 5.15. Examples of multidirectional cores. The core on the left is considered still useable, while the core on the right is exhausted due to small size.

Unidirectional Cores

The 39 unidirectional cores (Figure 5.16) account for 27% of the Baker site sample. Sixteen are unprepared and 3 are prepared cores, 10 are tested pieces, and 10 are flake cores. Three prepared unidirectional cores show evidence of grinding or battering along the striking edge, while one has preparation flaking to allow for predictable subsequent flake removals. One unidirectional core is an incomplete fragment but retains enough of the core to identify its morphology as unidirectional. Thirty-four (87%) of the unidirectional cores have flat flaking platforms, which are indicative of producing core reduction flakes; the other five unidirectional cores have flat and marginal flaking platforms as expected if the detached pieces will resemble core reduction and biface thinning flakes. Nineteen unidirectional cores are flaked beyond the specifications of a tested piece (1-3 flake scars) but not extensively flaked to exhaustion; nine are extensively flaked with one or more large flake removals. More than half (51%, *n* = 20) of the unidirectional cores remain usable, while 19 (47%) are exhausted due to small size, raw material imperfections, or the inability to reduce the stone further due to multiple step or hinge fractures.

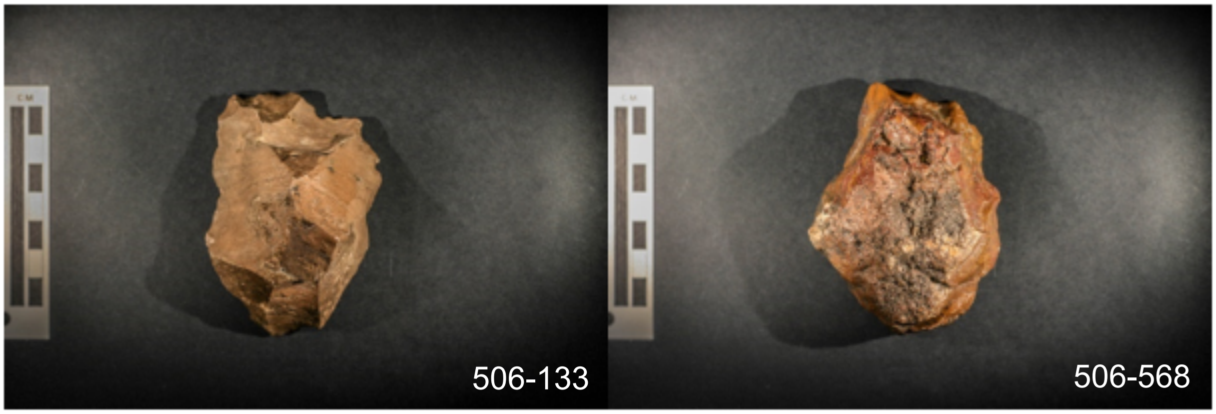


Figure 5.16. Examples of unidirectional cores. The core on the left is manufactured from Baker rhyolite, while the core on the right is manufactured from jasper.

Bifacial Cores

Six bifacial cores (4% of all cores) are present in the sample (Figure 5.17). Bifacial cores are morphologically similar to multidirectional cores since flakes are struck from multiple platforms around the objective piece, but bifacial cores have a somewhat sinuous margin with flakes struck from both faces. The Baker site bifacial cores are struck with an emphasis on producing one or more large flake blanks rather than maintaining the sinuous edge of the objective piece. One of the cores is an incomplete core fragment that retains enough of the objective piece to identify its morphology as bifacial. One bifacial core exclusively has flat flake platforms, suggesting the detached flakes would resemble core reduction flakes. Three have flat and marginal flaking platforms that would result in core reduction and biface thinning flake removals, and two have exclusively marginal flake platforms that produce flakes resembling biface thinning flakes. Two bifacial cores have prepared flaking platforms: one with faceting or battering and one with faceting/battering and preparation flaking to set up subsequent controlled flake removals. Three have unprepared platforms. The remaining bifacial core is a flake core manufactured from a large core reduction flake. Four bifacial cores (80%) remain useable for flake blanks, but two are exhausted due to small size, poor raw material quality, or the inability to removed step and/or hinge fractures.

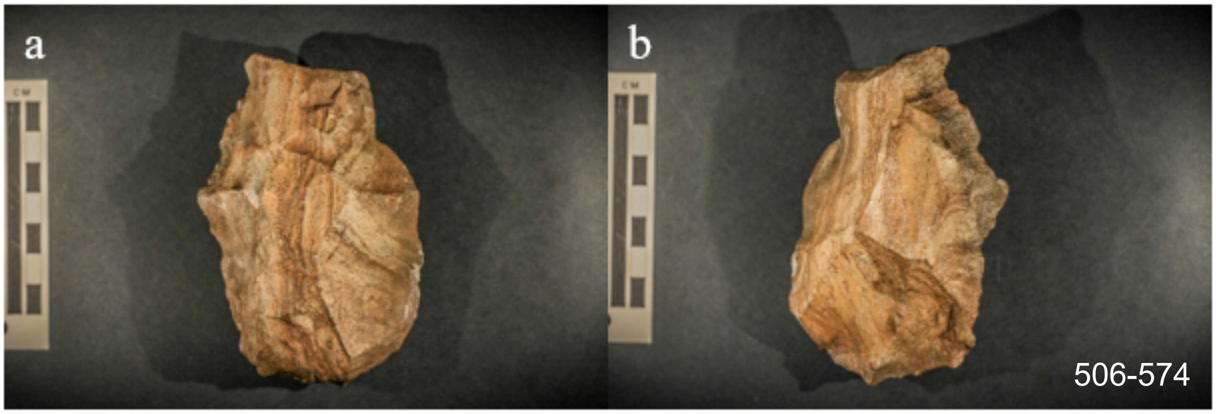


Figure 5.17. Example of a bifacial core. The dorsal (a) and ventral (b) surfaces both contain flake removals without consideration of maintaining a sinuous edge.

Core Fragments

Core fragments with unidentifiable morphologies comprise 5% of the Baker site sample (*n* = 7). All core fragments have flat striking platforms indicating the detached flakes would resemble core reduction debris. Each core fragment contains more than three flake removals but are not extensively flaked. All but one (86%) are exhausted due to their broken nature, small size, raw material defects, or inability to flake further because of multiple step or hinge fractures. Only one core fragment is large enough to still be considered usable.

Levallois-like Core Reduction

Twenty-six cores have evidence of preparation flaking associated with a Levallois-like core reduction strategy on at least one face of the objective piece: 23 multidirectional cores, 1 unidirectional core, and 2 bifacial cores (18% of the total cores; Figure 5.18). All cores prepared this way are manufactured from rhyolite. In this study, “Levallois-like” refers to a technique that relies on prepared flake removals to remove predetermined flakes that, while resembling the Levallois reduction strategies associated with the Mousterian culture (see Bordes 1961), is completely unrelated.

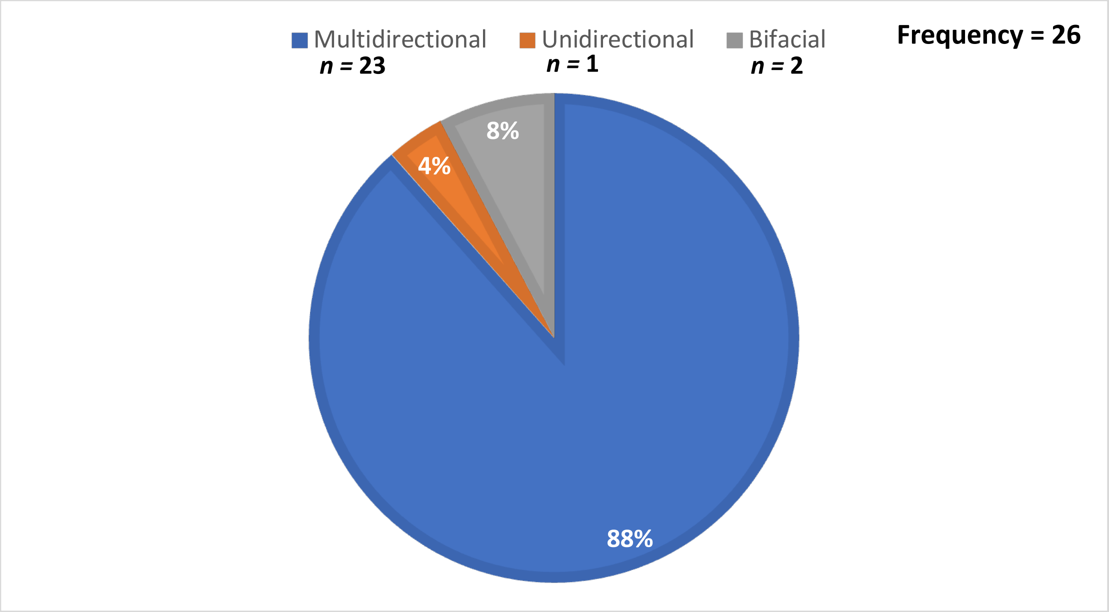


Figure 5.18. Levallois-like cores in the Baker site sample by core type.

Figure 5.19 shows an example of preparation flaking, commonly associated with Levallois or Levallois-like cores. For this study, Levallois-like (preparation) flaking is the concise removal of specific flakes from an objective piece to create a pathway from which a subsequent larger flake can be predictably removed. Boëda (1995) describes the Levallois technique on objective pieces as: 1) having a hemispheric division of two core faces, including a preparatory face and a production face, separated by a continuous convergent margin; 2) a convex production face intended for flake removal with centripetal flake removals at an oblique angle from the convergent margin; 3) a high-angle faceted flaking platform; and 4) the removal of macroflakes in a trajectory parallel to the convergent margin. Davis and Willis (2018:258) state that this last attribute is the most critical and diagnostic telltale sign that defines the Levallois technique and differentiates it from standard biface thinning or discoidal/centripetal core reduction flaking. Levallois-like cores bear similar attributes to discoidal cores (Fedje et al. 2011:327), but where discoidal cores have their larger controlled flake removals struck unidirectionally from the more convex face, Levallois-like cores use the less convex hemisphere as the production face (Boëda 1995; Davis and Willis 2018:255). All 26 of the cores in the Baker sample deemed “Levallois-like” contain indications of flaking parallel to the convergent margin (see Figure 5.20). Since over half of the Levallois-like cores (*n* = 14) are manufactured from tabular raw material slabs, both hemispheres of those cores tended to be roughly equal in convexity. However, on the other 12 cores, Levallois-like flakes were removed from the less-convex face of the stone.

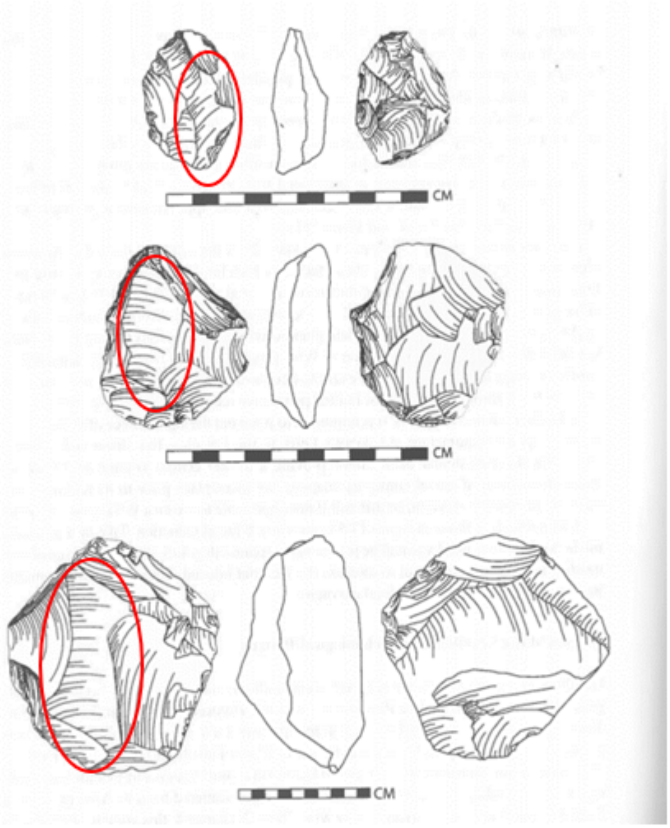


Figure 5.19. Examples of a Levallois-like reduction strategy on cores of varying sizes. The red ellipsis indicates the location of Levallois-like flake removals. Flakes are struck adjacent to the Levallois-like flake removal to help predict the general shape and size of the desired flake removal. Image credit to Davis and Willis (2018:Figure 13.3).

Brantingham et al. (2000) observed a Levallois-like reduction strategy at a chert raw material procurement area from the Lower Grotto at Tsagaan Agui cave in Mongolia. The authors determined that the Levallois-like reduction strategy formed in direct response to the poor-quality raw material procured on-site as a way to predictably flake an otherwise difficult-to-flake stone. Brantingham et al. (2000:257) use four factors to determine raw material quality in their study: percent crystallinity, average crystal size, range in crystal size, and abundance of impurities. Though crystalline structure was not evaluated for this study, Baker rhyolite contained on average 2.37 ± 1 raw material imperfections per artifact and is therefore considered a moderate quality stone based on raw material quality prerequisites established for this thesis (discussed below). The moderate raw material quality may indicate why nearly one of every five Baker site rhyolite cores are reduced using a Levallois-like method. Chapter 6 provides a comparative study that tests whether raw material quality is the driving factor behind use of Levallois-like reduction at the Baker site.

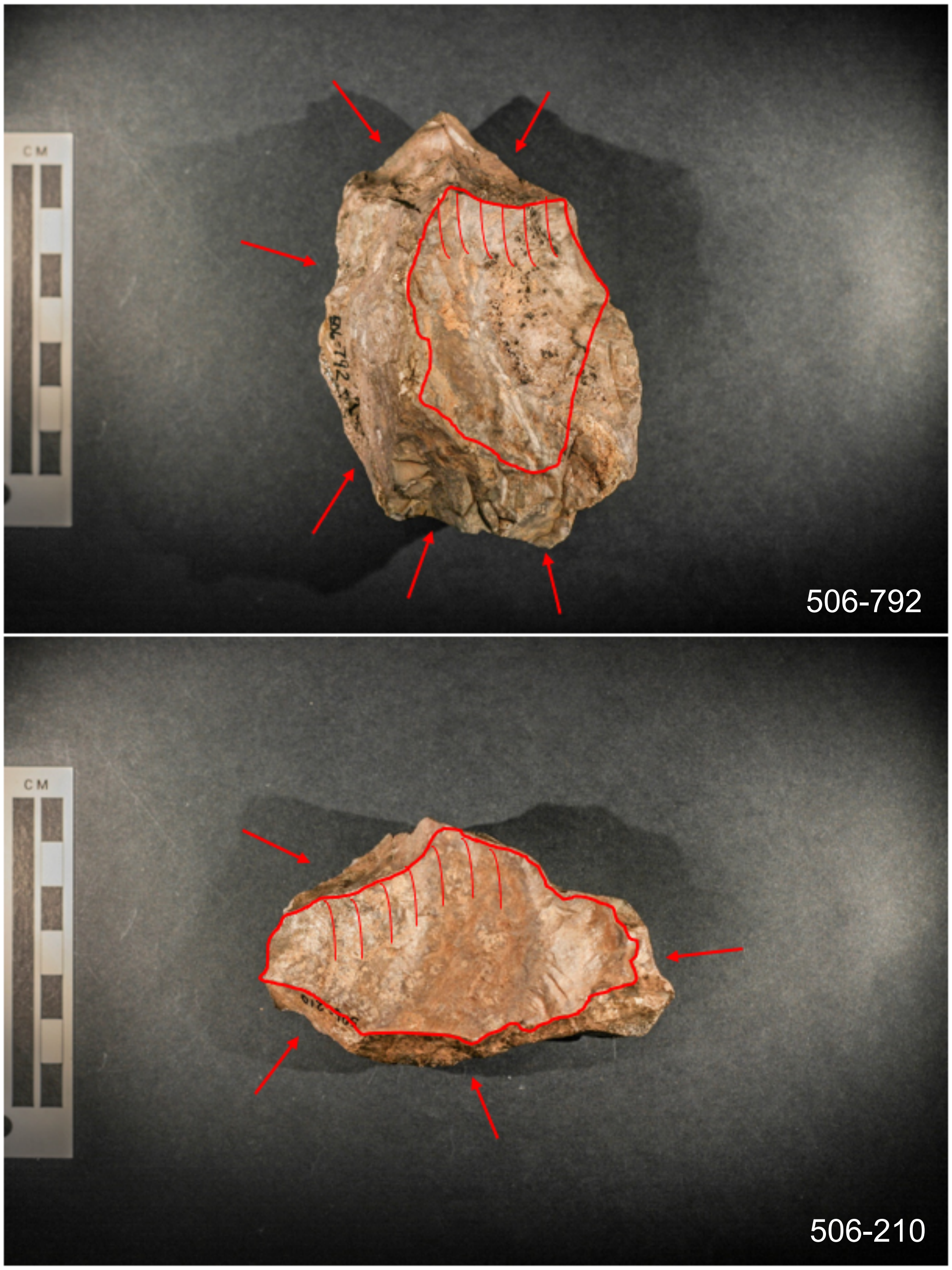


Figure 5.20. Examples of Levallois-like flaking on cores from the Baker assemblage. Red arrows indicate location and direction of preparation flaking. Red outline indicates Levallois-like flake removal.

Debitage

The 580 debitage specimens comprise 73% of the Baker site sample. The vast majority (88%, *n* = 510) of debitage are attributed to four types (Figure 5.21): 32% core reduction flakes; 25% blocky shatter; 19% complex flakes (≥3 dorsal flake scars); and 12% simple flakes (<3 dorsal flake scars). The remaining debitage types are present in small quantities: primary decortication flakes (100% dorsal cortex) comprise 5% of the debitage; alternate flakes (flakes having a triangular cross-section with a squared, often cortical edge adjacent to the striking platform that result from removing squared edges of tabular objective pieces; Root 2004:74) account for 4% of the debitage; and biface thinning and bipolar flakes each comprise <1% of the Baker site debitage. Most of the debitage (97%) is made of rhyolite raw material while the other 3% (*n* = 17) is jasper.

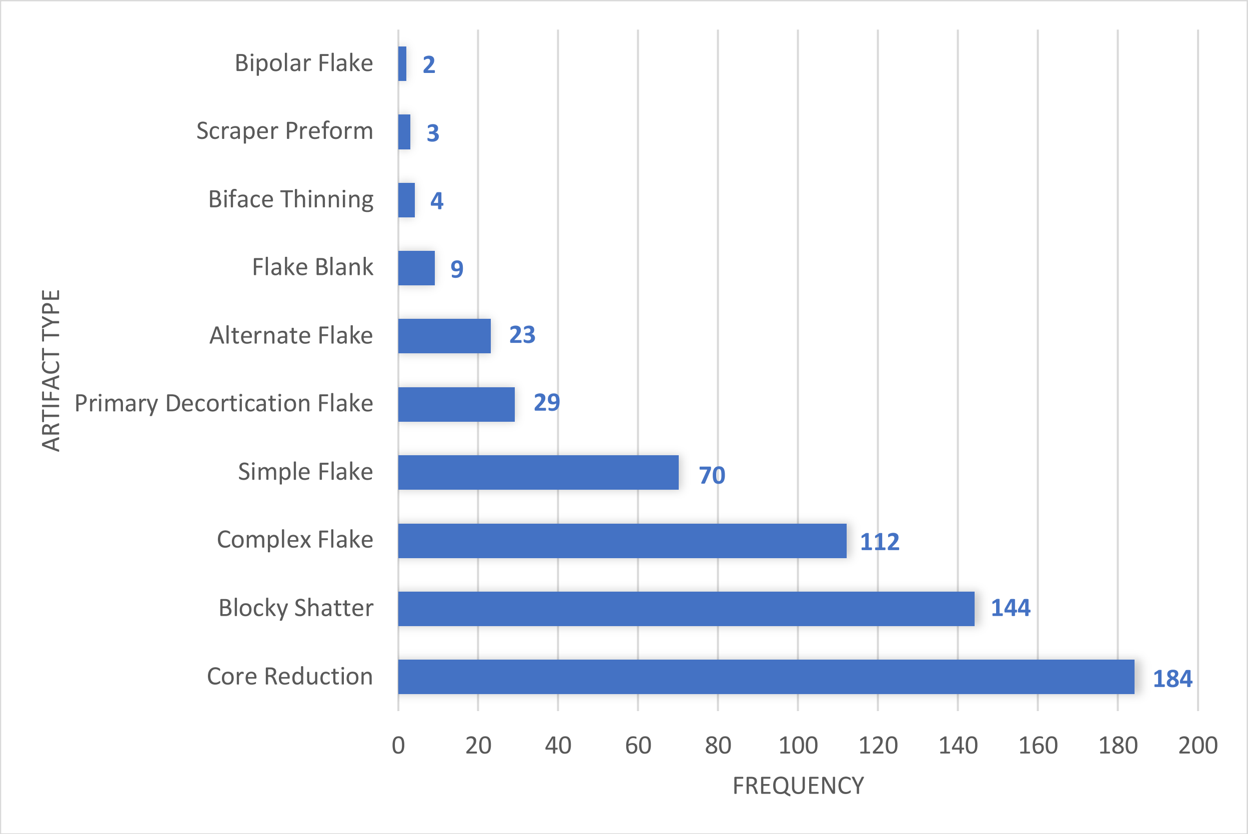


Figure 5.21. Frequency of debitage types present in the Baker site sample.

Blanks and Preforms

Blanks and preforms, though intentionally flaked, do not meet the criteria to be considered tools because they lack clear evidence of utilization, and are thus identified as debitage for this study. Nine flake blanks (2%; Figure 5.22) and three scraper preforms (<1%; Figure 5.23) are present. Five of the flake blanks are complete and eight have remnant tabular cortex. The three scraper preforms are flaked into the shape of scrapers but are classified as preforms because they lack marginal retouch or evidence of utilization as expected on finished scrapers. Two scraper preforms are manufactured from larger flakes, and the other from a tabular slab of rhyolite (see Figure 5.23 for example of tabular cortex).

Lithic Analysis Summary

Lithic analysis identified the typologies and attributes of 794 artifacts from the Baker assemblage, or approximately a 25% sample. The artifacts include 69 tools, 145 cores, and 580 pieces of debitage. The results will be used in the next chapter (Chapter 6) to infer the organization of lithic technology at the Baker site.

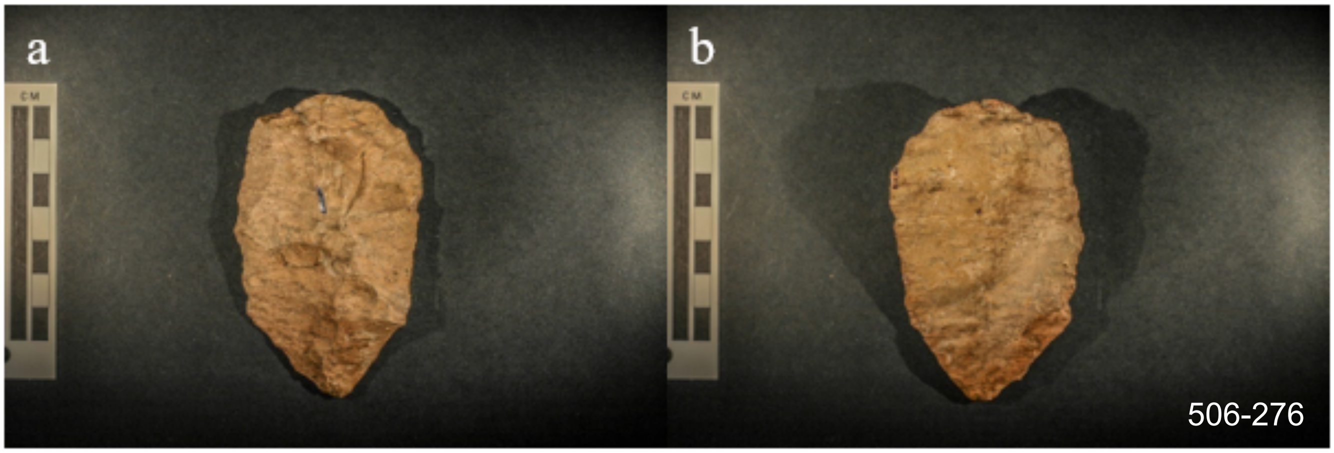


Figure 5.22. Example of a flake blank with flake removals on the dorsal surface (a) and some flake removals from the ventral surface (b).

Figure 5.23. Example of a scraper preform manufactured from tabular slab of rhyolite. Red arrow indicates margin of heavy flaking, but no retouch. Red ellipsis indicates tabular cortex.

Raw Material Quality and Availability

According to Andrefsky (1994, 2005:239), lithic raw material quality and availability play a role in the organization of stone tool technologies. Raw material quality was thus assessed for both toolstone varieties – rhyolite and jasper – used at the Baker site. Following Bamforth (1990), each of the 794 analyzed artifacts was given a grade for the quality of raw material it was made from. The raw material of each artifact was checked for the presence of inclusions, voids, cracks, pits, and signs of irregularly formed stone so that a count could be made of how many raw material flaws were present. Besides the criteria used by Bamforth, artifacts were also checked for the presence of ≥3 step or hinge fractures on the dorsal surface or primary flaking surface. Step and hinge fractures do not explicitly imply issues with raw material quality, but often form as a direct result of not applying enough force during flaking (Sollberger 1994:17) or are an indication of poor raw material qualities that affect the trajectory of energy traveling through the stone during flaking (Cotterell and Kamminga 1987:678-679). To assess raw material quality, each artifact was given a grade ranging from 0 to 6 that reflects a tally of how many of the raw material flaws that occur on an artifact. Presumably, the more imperfections the poorer the raw material quality.

The number of inclusions, voids, cracks, pits, irregularly formed stone, and multiple step and hinge fractures varies in the assemblage (see Chapter 4 for a description and images of each imperfection type). Inclusions are present in 249 artifacts, or approximately 31% of the Baker sample, and primarily on rhyolite (94.4%, *n* = 235) and then jasper (5.6%, *n* = 14) artifacts. Voids occurred in 121 of the sample artifacts (15% of the total), with all but one example occurring among the rhyolite artifacts. Cracks occur in 492 (62%) of the Baker artifacts, mostly among rhyolite artifacts (*n* = 487) but just five jasper artifacts. Pits occur on 276 rhyolite artifacts, or approximately 35% of the sample total, but no jasper artifacts. Irregularly formed material was noted on 561 artifacts, or nearly 71% of the sample, with 556 rhyolite and five jasper implements. Three or more step or hinge fractures were identified on 194 artifacts (24%), with 190 occurrences on rhyolite artifacts and four on jasper.

Table 5.3 provides the frequency of rhyolite and jasper raw material and the sum of raw material imperfections (also see Figure 5.24). The cumulative number of raw material imperfection types ranges from 0 to 6 and for rhyolite, forms a relatively nice bell-curve (mean 2.37 ± 1) with most artifacts having two or three imperfections. Less than 3% of the rhyolite sample has no imperfections and is considered very good quality raw material, 15% have only one raw material flaw, 37% two imperfections, 31% three imperfections, 19% four imperfections, 2% five imperfections, and none have all six flaws or imperfections. Zero to one flaw is considered very good to good quality stone, while two to three imperfections equate to moderate quality stone and four or more imperfections to poor quality stone (Table 5.3). The scale used in this thesis classifies Baker site rhyolite as moderate quality given the average number of raw material flaws.

Table 5.3 and Figure 5.24 show that jasper raw material quality is skewed towards fewer imperfections. Ten (50%) jasper artifacts have one imperfection, 6 (30%) two imperfections, 1 (5%) has three imperfections, 1 (5%) has four imperfections, and none have five or six imperfections. The average number of imperfections in the jasper is 1.45 ± 0.9, which is slightly lower than the rhyolite.

The scale used in this thesis classifies Baker site jasper as good-to-moderate quality given the average number of raw material flaws (see Table 5.3). A Chi-square test comparing differences in the scale or quality of rhyolite and jasper artifacts at the Baker site is significant (*Chi-square* = 22.2, *df* = 2, *p* ≤ .001), with the jasper being of significantly better quality than the rhyolite.

Table 5.3. Raw Material Quality of Rhyolite and Jasper Artifacts.

	Rhyolite Raw Material Quality			Jasper Raw Material Quality		
# of Imperfections	Good (0-1)	Moderate (2-3)	Poor (4-6)	Good (0-1)	Moderate (2-3)	Poor (4-6)
Artifact Frequency	140	524	110	12	7	1
Imperfection Average		2.37 ± 1			1.45 ± 0.9	

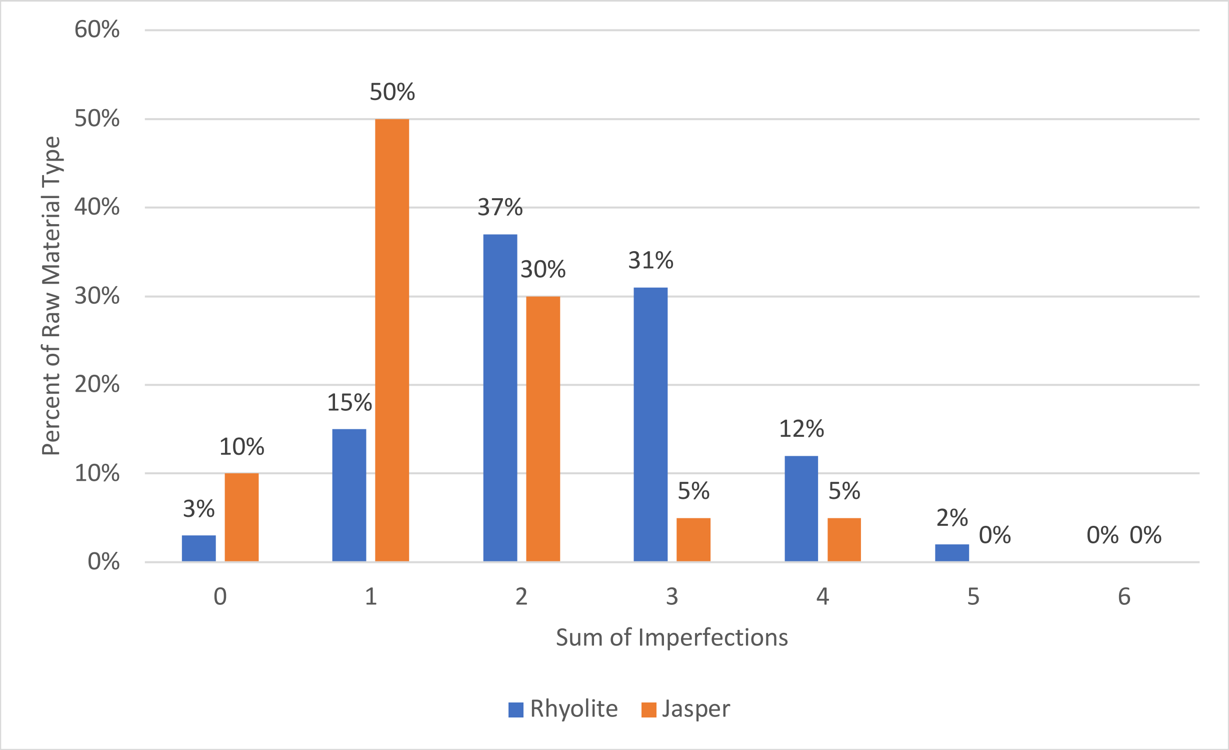


Figure 5.24. Percentage of rhyolite and jasper artifacts by sum of raw material imperfections. Blue bars cumulatively represent 100% of the analyzed rhyolite artifacts and orange bars cumulatively represent 100% of the analyzed jasper artifacts. Rhyolite and jasper raw materials varied significantly in quality (*Chi-square* = 22.2, *df* = 2, *p* ≤ .001), with jasper being of significantly better quality.

Campbell Collection Artifact Sourcing

To determine what direction and how far the rhyolite that outcrops at the Baker site was transported and what artifact forms it eventually became, I sent 22 artifacts from the Campbell collection housed at Joshua Tree National Park (JTNP) to Dr. Richard Hughes for geochemical sourcing analysis. Elizabeth and William Campbell were early 20th century pioneers of archaeology in the Mojave Desert and collected artifacts from all over California and other US states. Given that the Campbell's collected artifacts from multiple areas around Lake Mojave and the local region, I accessed their artifact collection at JTNP to evaluate whether any of those artifacts might source back to the Baker site. Ultimately, I selected artifacts from several of the Campbell's archaeological districts around southern California and Nevada: Beecher Canyon, Austin (NV), Big Smokey, Camp Cady, Copper Mountain River, Cove Spring, Crucero, Crucero (Mesquite Spring), Dead Cow, Harper Lake, Mesquite Spring (or Lost Horse), Milk Spring, Owens River Valley, Opal Mountains, Paradise River, Pilot Knob, and Superior Valley. The specific locations of these districts are on file at JTNP and not publicly accessible at this time.

Forty-six artifacts from JTNP were ultimately identified as or likely to be rhyolite. The 46 artifacts were then compared to a set of rhyolite geologic samples that represent the range of colors and textures at the Baker site rhyolite outcrop. Of these, 22 artifacts were selected and submitted for Energy Dispersive X-Ray Fluorescence (edXRF) at Geochemical Research Laboratory in Portola Valley (now located in Sacramento), California.

Figure 5.25 shows the artifacts submitted for edXRF analysis. Only 21 could be tested because one was too large to fit into the edXRF spectrometer and was therefore omitted from the analysis. The typical range of Strontium (Sr) to Zirconium (Zr) trace elements in rhyolite originating from the Baker site is approximately 200-230 parts per million (ppm) Sr to 80-110 ppm Zr (Hughes 2021). One artifact falls within these parameters, but its Barium (Ba) trace levels are far below that of typical Baker rhyolite, suggesting it did not originate from the Baker site. Two artifacts are, despite appearing to be rhyolite, not volcanic in nature and therefore did not come from the Baker site. One artifact contains similar Sr/Zr trace levels to Soda Mountain felsite, two have similar signatures to the Pink Canyon rhyolite source, and three fall within the range of the Iron Mountain I raw material source. However, much like the artifact with Baker rhyolite Sr/Zr signatures, the other trace elements in the sample (typically Ba, Rubidium [Rb] and Iron Oxide [Fe3O2]) did not meet the standard for these raw material sources. Therefore, none of the submitted artifacts originated from the Baker site rhyolite raw material source area. The source of the raw materials thus remains elusive, but it is fairly certain that they did not originate from the Baker rhyolite source area.

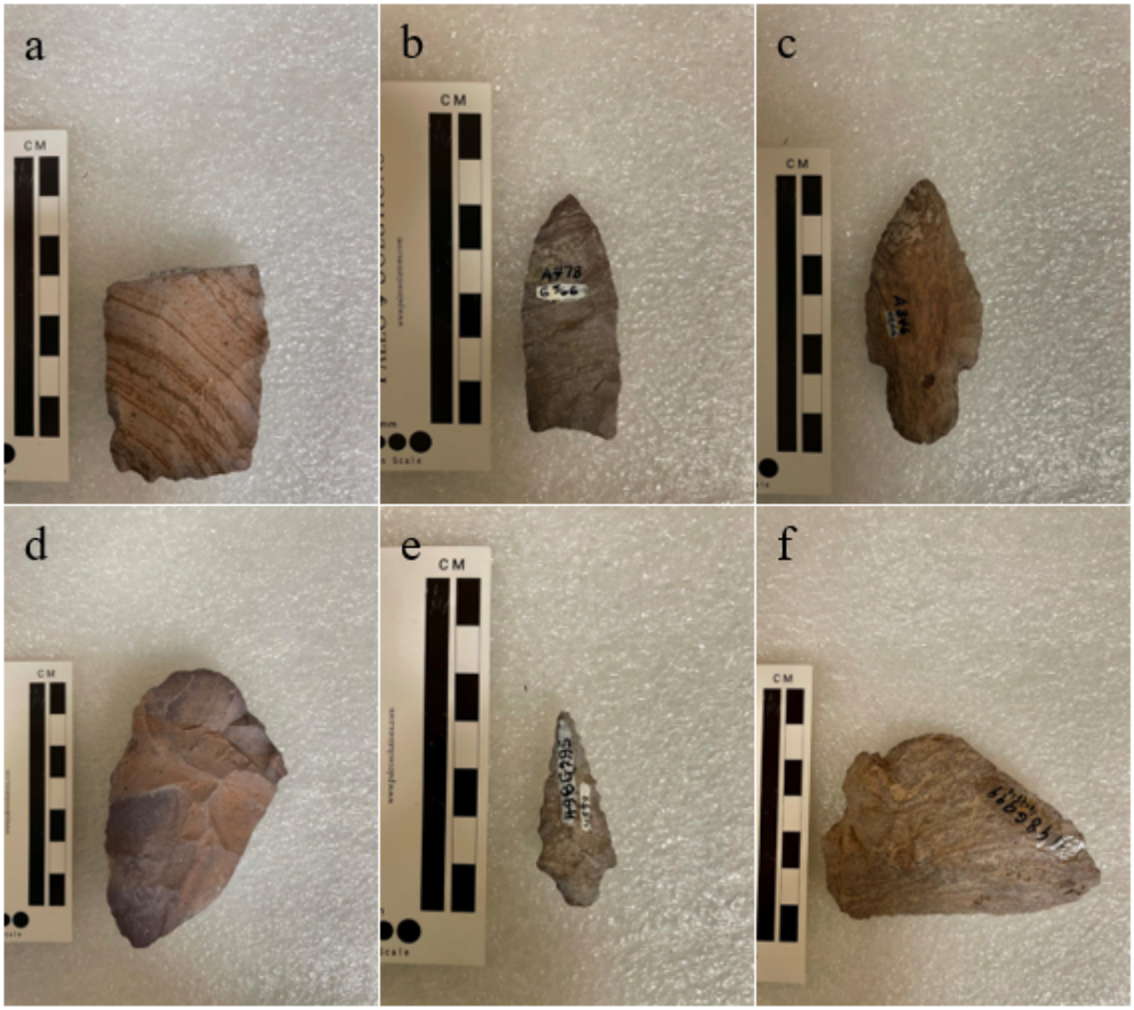


Figure 5.25. Examples of artifacts from the Campbell collection at JTNP submitted for edXRF analysis: a) Stage 3 biface (Paradise River district, #2962 [(498G2244]), b) Great Basin Concave Base point (Owens River Valley district, #6566 [A478]), c) Silver Lake point (Owens River Valley district, #6266 [A346]), d) Stage 3 biface fragment (Milk Spring district, #40121-02 [498G2322]), e) Gypsum point? (Crucero district, #4390 [498G295]), and f) large core reduction flake fragment (Cove Spring district, #4414 [498G999]).

Chapter Summary

An in-depth analysis of the 794 lithic artifacts from the Baker site assemblage was undertaken to determine the variety of tools, cores, and debitage present, as well as their associated lithic attributes. Eight tool types, three core types, and ten types of debitage were identified during analysis. Raw material types included 774 rhyolite and 20 jasper artifacts. Additionally, 21 rhyolite artifacts from different site areas in the Mojave Desert were geochemically analyzed to establish their source provenance—unfortunately, none traced back to the Baker site rhyolite outcrop. Rather than expand on the results here, I use the data derived in this chapter to establish the lithic technological strategies that were employed at the Baker site in the next chapter (Chapter 6).

CHAPTER 6

DISCUSSION

Where Chapter 4 established testable research questions about the Baker assemblage and Chapter 5 provided the analytical results to address those questions, this chapter answers the research questions and discusses the implications they construe about the organization of lithic technology at the Baker site. When considered as a whole, the answers to the research questions explain the flow of lithic raw material and tools through the Baker site. After answering the questions and providing corresponding results to support my claims, I will establish the primary function of the Baker site and characterize the technological strategies at this site. I then compare the technological strategies at the Baker site to other fine-grained volcanic (FGV) sites around Lake Mojave to determine whether the strategies identified at the Baker site are unique to the local region. Finally, I discuss the temporal and spatial patterns associated with the Baker site.

Lithic Technological Organization at the Baker Site

This section answers the research questions posed in Chapter 4 using the results from Chapter 5 to understand the flow of lithic raw material and tools through the Baker site. I conclude this section with a summary of Baker site lithic technological organization. Subsequent sections compare the Baker site technological strategies to those in the Soda Mountains.

Were the Baker Site Artifacts Predominantly Procured as Seams/Boulders of Rhyolite Available Within the Site Area or Were They Transported from Multiple Source Areas to the Baker Site?

The rhyolite artifacts were procured from cobbles and boulders that outcrop within or near the Baker site, which classifies the Baker site as a rhyolite raw material quarry. The overwhelming majority of artifacts (97.5%) were manufactured from rhyolite raw material—Baker rhyolite—that was procured from unmodified rhyolite boulders available within the site area (see Figure 5.1). Between the outcrops of Baker rhyolite and the high number of cores and early-stage manufacturing debris with conchoidal fractures, the Baker site clearly functioned as a quarry (see Table 4.1). Its location on a fanglomerate suggests the Baker rhyolite is a secondary deposit, which by definition means the rhyolite eroded from its original context, was redeposited, and then accreted in its current context rather than outcropping at the location of its initial formation. Past hunter-gatherers procured and reduced raw material from these rhyolitic boulders, leaving behind an assemblage (the sample anyway) that is 97.5% Baker rhyolite.

The remaining 2.5% of the Baker assemblage artifacts were manufactured from dark red-brown jasper. Knell (personal communication, 2019) documented sparse dark brown to brown/black jasper lithic scatters and a brown/black jasper boulder (see Figure 5.2) along the fanglomerate to the west and north of the Baker site during a one-square mile survey around the Baker site. Due to its large size, the jasper boulder likely outcropped from the fanglomerate deposit rather than being transported there. Additionally, large deposits of red, red-orange, and orange-brown jasper outcrop in Afton Canyon (approximately 28 km southwest of the Baker site), suggesting jasper is a locally available resource in the Lake Mojave area.

What Manufacturing Strategies Were Employed at the Baker Site and What Were the End Goals of Production?

Manufacturing strategies at the Baker site included an equal reliance on early- to middle-stage biface production and tool/blank production. Bifaces were reduced to Stage 2 or Stage 3 (early- to middle-stage) at the Baker site, which implies that these were the intended product of manufacture and that the later stages of production occurred elsewhere. This is supported by the debitage, which is also primarily associated with the early- to middle-stages of manufacture. The small number of biface thinning flakes (*n* = 4) and the absence of pressure flakes—artifacts expected during middle- to late-stage biface thinning and shaping (see Root 2004)—supports the interpretation of early- to middle-stage biface manufacture as the end goal of the production strategy. The 23 alternate flakes, which are correlated with initial efforts to create a sinuous edge from tabular raw materials (see Root 2004), further supports the interpretation that biface production was a primary goal of manufacture at this site.

The manufacturing strategy also included producing flake blanks and potentially flake tools. Flake blanks constitute only 2% of the analyzed debitage (*n* = 9), and 43% of the total cores analyzed (*n* = 63) had at least one large flake removal (average = 52.24 ± 7.9 mm, sample = 14) indicative of a potential detached flake blank. The presence of rhyolitic flake tools in the assemblage such as scrapers, retouched flakes, gravers/perforators, possible utilized flakes, and a possible spokeshave also suggests flake blanks were produced prior to the manufacture of such tools from said blanks. Evidence of tool manufacture in the assemblage implies flake tools were produced at the site rather than off-site. The three scraper preforms, when paired with technologically complete scrapers, represent the process of creating flake blanks for the purposes of creating functional tools within the site area. Most retouched flakes (68%) and one scraper were deposited at the site during the process of manufacture (as determined by breakage patterns). Since all of the flake tools are manufactured from Baker rhyolite rather than extra-local materials, it seems most plausible that these tools never left the Baker site and were subsequently discarded once they fulfilled their short-term use.

Jasper played a minimal role in the production strategy at the Baker site. The jasper artifacts include three cores (two unidirectional, one multidirectional) and 17 pieces of flaking debris. Since no jasper tools are present, the jasper cores presumably were objective pieces for flake tools and flake blanks that were subsequently transported off-site. The sample size of jasper artifacts is too small to make substantial determinations about its use in manufacturing strategies at the Baker site, but it is safe to say its role was minor in the overall manufacturing strategy.

Ultimately then, the presence of 35 rhyolite bifaces, 34 rhyolite flake tools and tabular tools, a small number of flake blanks and tool preforms, a high frequency of discarded cores, and a majority of early- to middle-stage production debris suggests the Baker site also functioned as a workshop. The workshop component emphasized rhyolite flake tool and blank production, though jasper was seemingly workshopped at the site to a lesser degree.

What Patterns of Tool Use, Reuse, and Discard are Evident at the Baker Site?

Baker site tools were seemingly produced for use within the site area and elsewhere off-site. Results of analysis imply that some artifacts were manufactured for use at the Baker site, like the scrapers, retouched flakes, gravers/perforators, marginally-retouched tabular pieces, possible spokeshave, and possible utilized flakes. In total, 15 tools (22% of all tools) have some retouch or potential macroscopic use-wear indicating utilization at some point in their life history. However, it is currently unclear whether those artifacts were used immediately after manufacture at the Baker site and then discarded, or if they were manufactured from Baker rhyolite, used elsewhere off-site, and then transported back to and discarded at the site. Eighty percent of the retouched or used tools (six retouched flakes, one graver, two utilized flakes, two scrapers, and the possible spokeshave) were broken, worn out, or discarded tools at the end of their use-life and therefore left at the Baker site. These tools may be representative of either: 1) a habitation component (perhaps a campsite) to the Baker site where tools were produced for use at the site, or 2) the effects of a gearing up strategy where hunter gatherers discarded their exhausted toolkits at raw material sources as they provisioned themselves with newly manufactured tools (see Gramly 1980; Smith et al. 2013). In the latter scenario, discarded tools should be manufactured from multiple raw material types and be extensively used, so this scenario is unlikely. Given that the tools are all Baker rhyolite with minimal use-wear, the former scenario more likely reflects a pattern of use, reuse, and discard at the Baker site. Thus, tools were seemingly produced for use at the site to fulfill short-term needs during procurement and workshopping at the site and were discarded once they were no longer required.

What Artifacts Were Produced at the Baker Site and Transported Off-Site and What Does This Imply about the Baker Site's Role at Lake Mojave and the Mojave Desert Region?

Stone toolmakers at the Baker site produced early- to middle-stage bifaces (Stage 2 and 3) for off-site transport and use given the lack of use-wear on the analyzed specimens. The absence of late-stage bifaces (i.e., Stages 4-5), paucity of middle- to late-stage biface production debris (i.e., biface thinning flakes), and lack of resharpening flakes or finished bifacial tools (e.g., projectile points, knives) supports the notion that early- to middle-stage bifaces were produced on-site and transported off-site for further reduction elsewhere.

Flake blanks were also likely produced with the goal of off-site transport. This is supported by the low number of flake blanks in the assemblage, yet presence of many cores and a dedicated Levallois-like core reduction strategy that produced controlled flake blanks of predictable sizes and shapes (see Chapter 5). It is likely that most of the finished flake tools were produced from flake blanks that were manufactured on-site but were ultimately used and then immediately discarded on-site after fulfilling their short-term required function. The manufacture of these tools from Baker rhyolite at the source of that rhyolite suggests their production was primarily for on-site usage.

Baker Site Technological Organization Strategies

Answers to the research questions help to establish the flow of lithic raw material and tools through the Baker site and are summarized in Table 6.1. Analysis of the Baker site lithic assemblage reveals a complex history of use. Regardless of its complexity, some of the key technological strategies employed at the Baker site were identified.

The site functioned primarily as a rhyolite quarry and workshop for biface and flake blank production for past toolmakers around Lake Mojave. Locally outcropping Baker rhyolite was quarried or procured from secondary deposits. Although jasper outcrops near the Baker site, the color variety in the Baker assemblage suggests it was brought in from elsewhere.

In terms of production, the site occupants selected rhyolite and jasper for different purposes. After procurement, early- to middle-stage bifaces and flake blanks were produced on-site using the available Baker rhyolite raw material. Most flake tools and tabular tools were seemingly produced at the Baker site for immediate use. Though no jasper tools are present in the analyzed sample, the cores and core reduction flakes indicate jasper was only used for flake blank manufacture.

Regarding use, reuse, and discard, toolmakers preferentially selected Baker rhyolite (likely due to accessibility) to produce tools. No jasper tools were observed which indicates jasper was minimally used in the Baker site. Tools such as gravers/perforators, marginally-retouched tabular pieces, utilized flakes, and a spokeshave all bear potential signs of use-wear implying they were used within the site. Tool use is also indicated by retouched edge margins on scrapers, retouched flakes, and marginally-retouched tabular pieces. Toolmakers discarded multiple rhyolite flake and tabular tools (retouched flakes, scrapers, gravers/perforators, marginally-retouched tabular pieces, utilized flakes, and a spokeshave), early- to middle-stage rhyolite biface rejects, and cores of rhyolite and jasper.

Table 6.1. Flow of Lithic Raw Material and Tools Through the Baker Site.

Flow Model	Rhyolite	Jasper
Procurement	• Procured within site area	• Likely procured elsewhere
Production	• Early- to middle-stage bifaces • Flake blanks • Flake tools • Tabular tools	• Presumably flake blanks • No manufactured tools
Use	• Graver/perforators, marginally-retouched tabular pieces, utilized flakes and spokeshave have potential use-wear • Scrapers, retouched flakes, and marginally-retouched tabular pieces all show marginal retouch	• None
Re-use	• Unknown, but not likely given short-term use of tools	• None
Discard	• Multiple types of flake tools worn out and discarded • Early- to middle-stage biface rejects • Cores	• Cores
Off-Site Transport	• Early- to middle-stage bifaces, flake blanks, and possibly flake tools/tabular tools	• Likely flake tools and/or flake blanks

The off-site transport pattern reveals that toolmakers took early- to middle-stage rhyolite bifaces and flake blanks with them to other locations, presumably around Lake Mojave. They potentially finished flake tools and tabular tools at the Baker site before transporting them elsewhere, but more likely produced flake and tabular tools to fulfill immediate needs within the site while procuring and manufacturing Baker site raw material. Jasper flake tools or flake blanks were potentially carried away from the site as well, though the small sample of jasper artifacts and lack of jasper tools makes it unclear what if any jasper artifacts were transported off-site.

The technological strategies identified in the Baker assemblage will be used in the next section as a basis to compare FGV raw material procurement strategies around Lake Mojave. Specifically, the goal is to see whether lithic technological strategies observed at the Baker site are consistent with other nearby FGV source areas, or if any strategies are unique to the Baker site.

Baker Site's Role at Lake Mojave and the Mojave Desert

To determine how the lithic raw material procurement strategies at the Baker site fit within the larger range of procurement strategies around Lake Mojave, I review the felsite quarry studies by Semenza (1984) and Knell (2014) in the Soda Mountains, which is located approximately 5 km [3.1 miles] southeast of the Baker site (Figure 6.1). The technological strategies at the two comparison study areas should resemble those at the Baker site given their proximity and similarities between felsite and rhyolite raw materials.

CA-SBR-5193

Semenza (1984) conducted an in-depth analysis of the 461,875 lithic artifacts from CA-SBR-5193, a 60 m E/W by 30 m N/S felsite quarry and dense lithic scatter (upwards of 1,500 artifacts per 50 cm^2) in the Soda Mountains. Identified at this site was a wide array of unfinished bifaces and quarry blanks (flake blanks and bifacially-worked tabular blanks), which she determined were quarry rejects (Semenza 1984:9).

In total, 528 bifacial implements were identified and categorized as biface fragments or "poorly executed bifaces" (1984:25). These bifacial implements were further sorted to 398 artifacts that met Semenza's prerequisites to be considered actual bifaces. The vast majority (97%) of bifaces are classified as Stage 1 or Stage 2 (following Callahan 1979), with only eight Stage 3 and four Stage 4 bifaces. Of the 398 bifaces, 96 have tabular cortex on both faces suggesting they were produced from quarried slabs of tabular raw material rather than from flake blanks. Large flakes—presumably core reduction flakes—were the original blank form for 94 of the bifaces. Based on the procurement of felsite from bedrock outcrops and large surface boulders, the homogenous felsite lithic assemblage, and clear trajectory of biface reduction, Semenza determined that CA-SBR-5193 best represents a quarry/workshop. She proposes that all blanks produced at the site are part of the biface production trajectory itself and not necessarily produced for off-site transport (i.e., bifaces were the primary product of workshopping the felsite).

Soda Mountains Quarry/Workshop Complex

Knell (2014) conducted an intensive survey of a 1.2 km^2 area in the Soda Mountains along the western edge of pluvial Lake Mojave and completed a detailed analysis of the felsite quarries and lithic scatters. Though briefly described in Chapter 3, a more detailed review of Knell's study is provided here to better compare the technological strategies at the Baker site to Knell's findings. Knell (2014:220) determines that the 14 sites he documented constitute a joint quarry/workshop area due to observed bedrock outcrops of felsite within or near the sites, the large amount of felsite raw material and early-stage manufacturing debris, and the scarcity of used tools. The Soda Mountains quarry/workshop complex saw lithic procurement by stone toolmakers primarily during the terminal Pleistocene/Early Holocene (based on dated alluvial fans, temporally sensitive lithic raw material types, and observed technological strategies; Knell et al. 2014) but also likely during the Middle Holocene Pinto complex and by later groups (2014:56).

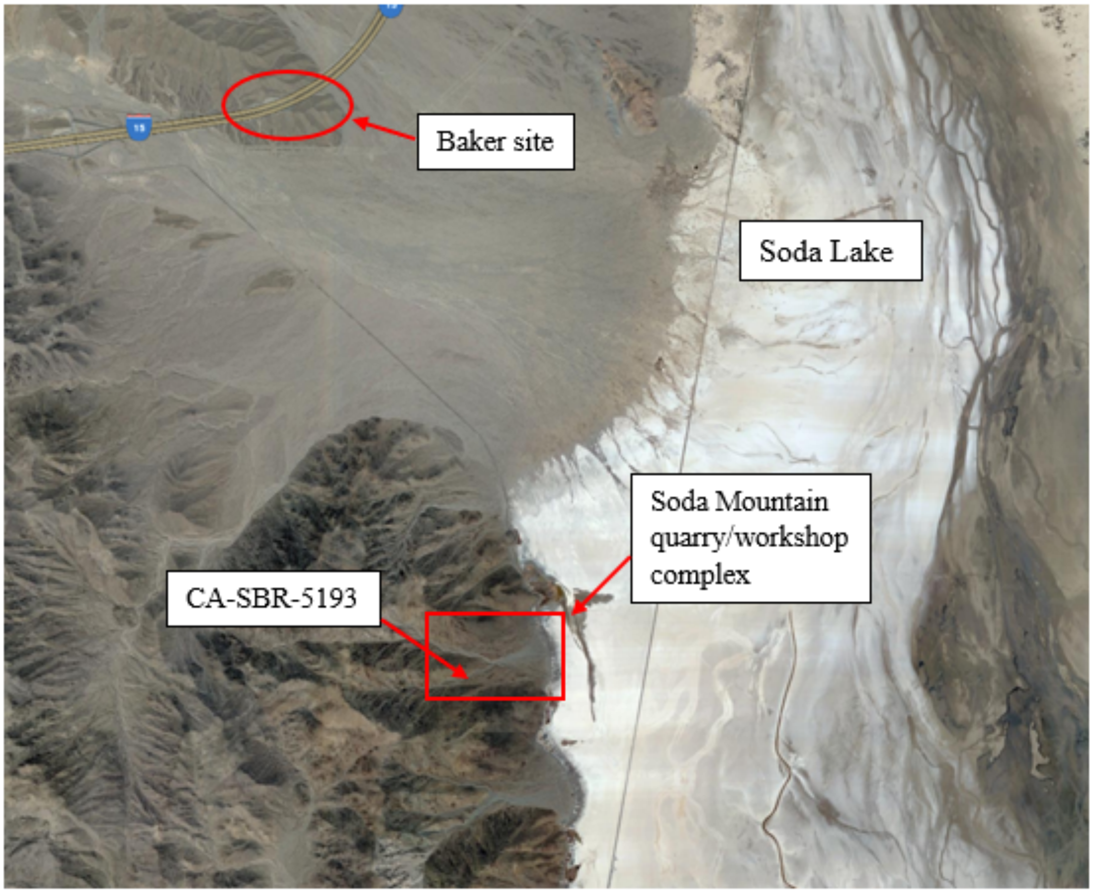


Figure 6.1. Proximity of the Baker site to the approximate locations of CA-SBR-5193 and the Soda Mountains felsite quarry/workshop survey area (red polygon). Modified from Google Earth.

More than 99.9% of the felsite was procured from tabular outcrops of black and green primary bedrock outcrops and secondary boulders. Tabular or square-edges are recorded on 175 of the bifacial and unifacial tools, cores, and debitage, suggesting those artifacts were manufactured from the procured tabular felsite. Knell (2014:220) mentioned that in many cases the tabular edges were removed using an alternate flaking technique, which led him to believe that stone toolmakers intentionally removed cortex from the bifacial tool blanks, flake blanks, and cores to reduce weight and test the quality of felsite raw material prior to off-site transport.

The observed tools, cores, and debitage all identify Knell's study area as a felsite quarry/workshop complex. Manufactured tools include a high percentage of unfinished bifacial tool blanks, a smaller number of non-projectile bifacial tools, and less than 10% retouched flakes, scrapers, and utilized flakes. Bifaces are primarily Stage 2 and Stage 2-3 (following Callahan 1979), with some Stage 3 and a few Stage 4 bifaces. The paucity of unifacial flake tools suggests tool use was incidental in the study area compared to the larger pattern of raw material procurement and blank production.

Cores are substantially larger in size (420.3g versus 264.6g) and number (21:1) than in the Little Cowhole habitation area along the eastern edge of Soda Lake playa (across Lake Mojave from the Soda Mountains study area; Knell 2014:222). Additionally, nearly all core reduction flakes and biface thinning flakes are in the highest debitage weight class, implying debitage produced in the Soda Mountain quarry/workshop area is large. Knell states that some of the larger flakes invariably became bifacial tools, blanks for bifacial implements, unifacial tools, or flake blanks intended for off-site transport. Other large flakes broke or were discarded during additional manufacture, while many were never modified or used (Knell 2014:222). The dominant activity in the Soda Mountains quarry/workshop area is felsite biface manufacture.

Knell (2014:220) deduces that hunter-gatherers seemingly prepared and transported bifacial cores, bifacial tool blanks, and flake tool blanks away from the Soda Mountain quarry/workshop complex "in anticipation of forays within and around the Lake Mojave area." Large (heavy) early- to middle-stage bifacial tool blanks and large flake blanks produced from bifacial, multidirectional, and unidirectional cores constitute much of the discarded debris in the sites. Many bifacial tool blanks were broken or rejected during early-stage manufacture at the quarries/workshops, while many others were successfully reduced into the early- to middle-stage and transported off-site for additional reduction and use. Manufactured tool blanks were also ostensibly produced with the intent of off-site transport to become bifacial cores, projectile points, and/or non-projectile bifacial tools.

Baker Site Technological Comparison

The Baker site, CA-SBR-5193, and the Soda Mountain complex all played similar roles in the resource procurement strategies of past occupants around Lake Mojave. Each site contains evidence of FGV raw material procurement indicative of a quarry site and discarded tools and flaking debris representing a biface and flake blank workshop. Toolstone in the Soda Mountains sites was procured from both primary bedrock outcrops and secondary surface boulders and cobbles, though only secondary deposits are present in the Baker site area. Early- to middle-stage bifaces are a primary end goal of manufacture and subsequent off-site transport from each site. Flake blanks are another primary motive for procuring Baker rhyolite, though flake blanks were less frequently discarded in the Soda Mountains. Knell (2014) reports only three flake blanks (<1% of the total sample) in his study area compared to the nine flake blanks (2% of the total sample) from the Baker rhyolite source. According to Knell, flake blank production took place as a strategy secondary to biface production, while Semenza (1984) focuses exclusively on bifaces and bifacial blank production.

The inclusion of flake tools and tabular tools (marginally-retouched tabular pieces) in the assemblage seems to somewhat differentiate the Baker site from the two Soda Mountains study areas. Semenza makes no mention of any tools in her assemblage apart from bifaces, while Knell states that based on the low frequency of flake tools (*n* = 8) from his study, flake tool manufacture and use was incidental to the overall production strategy. Flake tools and tabular tools occurred in much higher frequency at the Baker site (*n* = 34). Close to half of the Baker site tools (49%, *n* = 34) are flake tools and tabular tools, nearly matching the total number (*n* = 35) of early- to middle-stage unfinished bifaces in the Baker assemblage. Flake tools and tabular tools seemingly played as large of a role as bifaces in why Baker rhyolite was procured, though flake tools and tabular tools were primarily produced for on-site consumption while bifaces were produced for off-site transport. Soda Mountains felsite was not necessarily favored for immediate on-site use based on the lower frequency of flake tools in the Soda Mountains assemblage.

Another substantial difference between the Baker site and Soda Mountains studies is the core reduction strategies used to create flake blanks. A Levallois-like core reduction strategy emerged during analysis of the Baker assemblage that is not reported by either Semenza or Knell (see below).

Levallois-like Core Technology

The evidence for a Levallois-like core technology—unassociated with the Levallois artifacts from the Mousterian tool culture—at the Baker site was established in Chapter 5. Here I wish to determine if the Levallois-like core reduction strategy was isolated to the Baker site or was part of a broader reduction strategy around Lake Mojave. To assess this, my thesis advisor, Dr. Knell, and I, with the help of CSUF students Jan Taylor and Karla Gaspar, relocated and analyzed 50 cores from the Soda Mountains quarry/workshop area (Knell 2014; Knell et al. 2014). Knell did not explicitly look for the presence of a Levallois-like prepared core technology during his surveys, so this comparison served as a follow-up to check if this reduction strategy was possibly overlooked during the Soda Mountains study.

From May 3-5, 2019, we analyzed 50 cores from six previously identified quarry/workshop sites in the Soda Mountains. The six sites were selected because Knell's surveys identified these sites as having more cores than other sites. The relocated cores (Figure 6.2) were analyzed using the same typological and attribute-based variables employed in the Baker site analysis. Besides evaluating whether Levallois-like core reduction took place but was simply missed during the original study, I also newly assessed the raw material quality of Soda Mountains felsite as it compares to Baker site rhyolite.

Figure 6.2. Examples of a relocated multidirectional core (top left) and bifacial core (top right) from the Soda Mountains quarry/workshop complex. Some cores, like the large multidirectional core (bottom), produced very large flake blanks (indicated by red ellipsis). Images taken by author during a field visit in 2019.

I focused solely on complete cores at the Soda Mountains sites because they are more likely to retain evidence of a Levallois-like core reduction strategy. After analyzing the cores, only one of the Soda Mountains cores showed potential evidence for preparation flaking indicative of Levallois-like flake removals. Compared to the 18% of Baker cores with Levallois-like reduction, the one possible occurrence observed in the Soda Mountains is not enough to say Levallois-like reduction is a pattern in the Soda Mountains. Large core reduction flakes were invariably produced from Soda Mountains cores (see Figure 6.2), but not using a Levallois-like core reduction strategy.

Figure 6.3 and Table 6.2 compare the raw material quality of Baker rhyolite and Soda Mountains felsite. Baker rhyolite cores have an average of 2.92 ± 1 imperfections per artifact (compared to the 2.37 ± 1 for the whole assemblage), while Soda Mountain cores have an average of 3.14 ± 1 imperfections. Cracks are the most common imperfection (96%) observed in the Soda Mountains felsite cores, followed by inclusions (74%), step/hinge fractures (70%), and irregularly-formed material (68%). Pits were only observed in one Soda Mountains core (2%), and no cores have visible crystal-lined voids. Soda Mountains felsite classifies as moderate-to-poor-quality raw material according to this study. However, the difference in raw material quality between Soda Mountains felsite and Baker rhyolite is not statistically significant (*Chi-square* = 4.8, *df* = 2, *p* = .09).

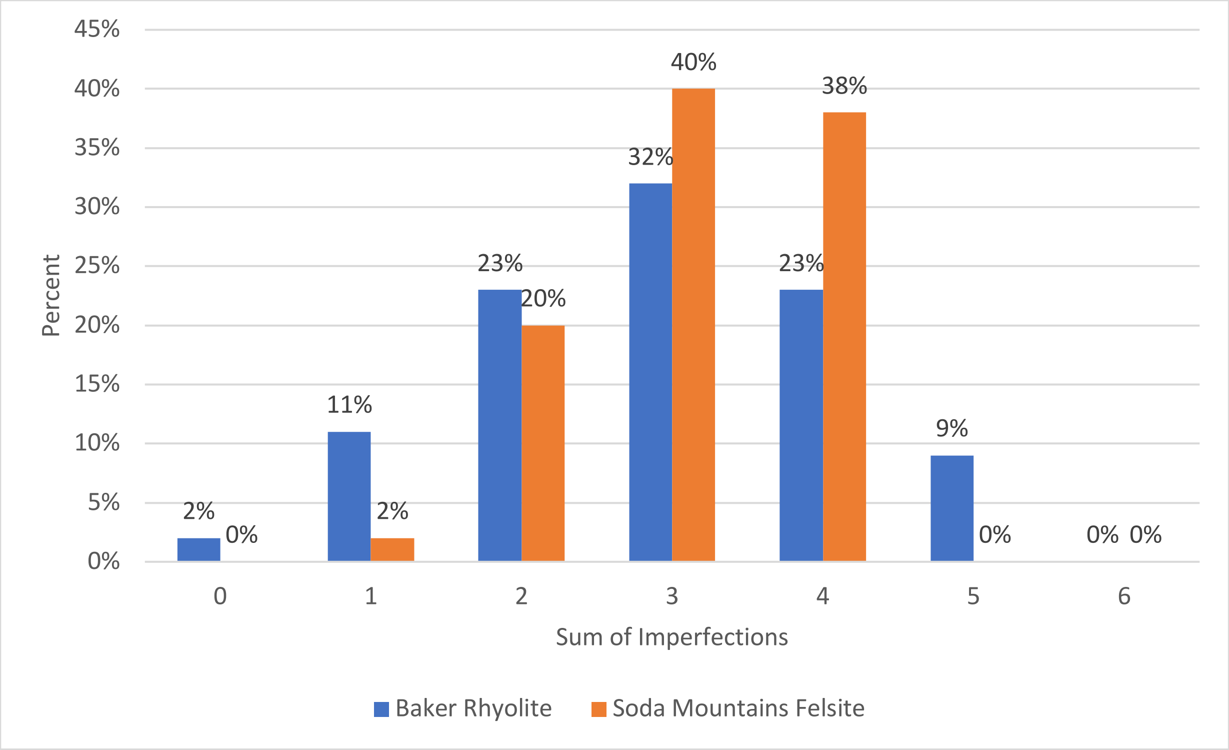


Figure 6.3. Percentage of rhyolite and felsite cores by sum of raw material imperfections. Blue bars cumulatively represent 100% of the analyzed Baker rhyolite cores (*n* = 142) and orange bars cumulatively represent 100% of the Soda Mountains felsite cores (*n* = 50). Rhyolite and felsite cores did not vary significantly in quality (*Chi-square* = 4.8, *df* = 2, *p* = .09).

Table 6.2. Raw Material Quality of Baker Rhyolite and Soda Mountains Felsite Cores.

	Bakery Rhyolite			Soda Mountains Felsite		
# of Imperfections	Good (0-1)	Moderate (2-3)	Poor (4-6)	Good (0-1)	Moderate (2-3)	Poor (4-6)
Core Frequency	18	78	46	1	30	19
Imperfection Average	2.92 ± 1			3.14 ± 1		

The only real difference between the cores from both study areas, apart from the presence of Levallois-like reduction, is raw material package size. The average mass of Baker site cores is 161.6 ± 118 grams, while Soda Mountains cores average mass is 513.1 ± 327 grams. In instances where cores exceeded the 1000-gram weight limit of the scale, core mass was set at 1000g. No cores from the Baker site exceeded the weight limit, whereas 11 of 50 felsite cores (22% of the sample) weighed >1000 g.

Soda Mountains felsite cores are over three times larger than Baker cores, leaving a lot of raw material to work with when knapping cores during flake blank and tool blank production. The smaller package size of the Baker rhyolite cores would require more careful planning to produce viable flake blanks, and likely explains why the Levallois-like core reduction strategy was used at the Baker site but not the Soda Mountains complex.

Spatial and Temporal Use of Baker Rhyolite

To determine the extent of Baker rhyolite transmission around pluvial Lake Mojave and across the Mojave Desert, a small collection of potential rhyolite artifacts from the Campbell collection housed at Joshua Tree National Park was submitted for geochemical sourcing. Any positive matches between the geochemical signature of the submitted artifacts and the known signature of Baker site rhyolite would suggest those artifacts originated from the Baker rhyolite raw material source. Positive matches would also imply what direction and how far Baker rhyolite was transported by determining which Campbell district the artifact was originally collected from and measuring the distance back to the Baker site.

Attempts to assign a cultural affiliation and therefore an age-range to the Baker site was also tested using the Campbell collection. Nine rhyolite projectile points of similar color to Baker rhyolite were identified in the Campbell collection (one Great Basin Concave Base point, three Silver Lake points, one Pinto point, one Pinto/Elko base fragment, two potential Gypsum points, and one small serrated arrow point) and submitted for energy dispersive X-Ray Fluorescence (edXRF) geochemical sourcing analysis. A positive match between a projectile point and the Baker rhyolite source would provide a potential age estimate for use of the Baker site.

Unfortunately, none of 21 geochemically analyzed artifacts matched the geochemical signature for Baker rhyolite. Though the sample size is very small, the absence of Baker rhyolite in any of the Campbell districts sampled for this analysis suggests that Baker rhyolite was not widely transported around the Mojave Desert. Instead, it likely had a local footprint associated primarily with the Lake Mojave area. Knell (2014:219) reported 23 artifacts (1 bifacial tool blank and 22 pieces of debitage) from the Little Cowhole habitation area (Figure 6.4) that visually resembled rhyolite from the Baker raw material source (see Figure 6.5 for relocated rhyolite artifacts from the Little Cowhole habitation area). The bifacial tool blank (i.e., unused biface) reported by Knell fits nicely with the results of the Baker site analysis, since early- to middle-stage bifaces were transported from the Baker site with at least one seemingly finding its way to the east side of Soda Lake. The edXRF study showed that visual identification of Baker rhyolite is not always accurate; however, the chance of encountering Baker rhyolite in the Little Cowhole habitation area seems much more plausible than in the Campbell's districts given their proximity to the Baker site.

Since the results of edXRF analysis proved inconclusive for all submitted artifacts, a definitive temporal age range for the Baker site still cannot be assigned at this time. All nine projectile points provided geochemical signatures that did not match Baker rhyolite, and since no diagnostic projectile points were encountered in the Baker assemblage, the Baker site lacks temporally diagnostic type artifacts to assign use of the site to a past cultural complex.

Figure 6.4. Proximity of the Baker site to the approximate locations of the Soda Mountains felsite quarry/workshop area and Little Cowhole habitation area. Small amounts of Baker rhyolite were reported by Knell at lithic scatters in the Little Cowhole habitation area (Knell 2014; Edward Knell, personal communication 2019). Modified from Google Earth.

Chapter Summary

The results of this study identify the range of technological strategies employed by the prehistoric inhabitants of the Baker site. The outcome of the flow model, which considers the flow of lithic raw material and tools into, at, and away from the Baker site, demonstrates that it functioned primarily as a rhyolite quarry and secondarily as a biface and flake blank workshop. Evidence of discarded Stage 2 and 3 biface rejects and flake blank production imply toolstone was not just procured from within the Baker site but also manufactured into transportable goods. The discovery of flake tools and tabular tools in the assemblage—some with use-wear or retouch—suggests the Baker site's function may have include a small degree of habitation (perhaps a campsite), where tools were manufactured for use in the site to meet short-term needs. However, the discard of these tools at the site after fulfilling their short-term uses suggests their manufacture was secondary to the overall procurement and biface and flake blank production strategies at the Baker site.

Figure 6.5. Relocated rhyolite flaking debris in the Little Cowhole habitation area on the east side of Soda Lake playa. Rhyolite visually matched color and texture varieties from the Baker site. Images taken by author during a field visit in 2019.

Jasper played a minimal role in the production strategy at the Baker site given that just 2.5% of all artifacts are jasper. Though no jasper tools were noted in the assemblage, the cores and detached flakes suggest jasper was used for flake tool and flake tool blank production.

The presence of a Levallois-like core reduction strategy in the Baker site sets it apart from other FGV raw material sources around pluvial Lake Mojave. This reduction strategy was seemingly employed as a response to smaller raw material package size (and perhaps raw material quality) based on the results of the Soda Mountain quarry/workshop comparison. Since Levallois-like core reduction implies the controlled removal of flake blanks, this strategy also confirms the production of flake blanks from the Baker site as a primary manufactured good.

Attempts to geochemically source rhyolite artifacts to the Baker site proved inconclusive and subsequently eliminated any ability to scientifically and empirically date Baker site artifacts at this time. Just as it was during the two initial studies on this assemblage, the age of the Baker site and its cultural affiliation remains unknown.

CHAPTER 7

CONCLUSION

For this thesis, I conducted an in-depth analysis of the extant Baker site chipped stone assemblage that was collected from an area near the shorelines of pluvial Lake Mojave, central Mojave Desert, California. My goal was to establish a definitive function for the Baker site, document the range of lithic technologies, and explain the site's role in the Lake Mojave area and regionally within the Mojave Desert. To accomplish this, I used principles of the organization of lithic technology approach to analyze a 25% sample of the entire CA-SBR-541 extant assemblage or 794 tools, cores, and debitage from the Baker site assemblage. Artifact typologies and attribute-based variables were considered during the analysis to assess not only the artifact type, but also the manufacturing strategies (e.g., Levallois-like reduction, alternate flaking, and biface thinning). Data from these analyses were then used to answer several research questions set up in Chapter 4, which together establish the flow of lithic raw materials and tools through the Baker site. The flow model considered the procurement of lithic raw materials at the Baker site, the manufactured items (bifaces, flake blanks, and flake tools) and byproducts of manufacture (cores and debitage), the use, maintenance, and discard of those goods, and the off-site transport patterns. The technological strategies at the Baker site were then compared to technological strategies evident at other procurement areas situated around pluvial Lake Mojave.

Results of the analysis reveal that the Baker site functioned primarily as a rhyolite quarry and workshop for early- to middle-stage biface and flake blank production. Rhyolite boulders outcrop in a secondary context and were the source of toolstone within the Baker site area. Jasper raw material potentially outcrops within or nearby the Baker site area, but more likely the jasper artifacts were transported from elsewhere. The procured Baker rhyolite was manufactured into Stage 2 and 3 bifaces and flake blanks (sometimes using a Levallois-like technique) for additional reduction or production elsewhere off-site. The large number of cores and early-stage reduction debris (core reduction flakes, blocky shatter, primary decortication flakes, and alternate flakes) in the Baker assemblage is consistent with the quarry/workshop site type classification. Middle- to late-stage reduction debris is entirely absent from the sample, suggesting middle- to late-stage production activities took place away from the Baker site. Flake tools and a few tabular tools were possibly used and/or retouched before being discarded in the site area. Though some tools were potentially transported into the site and discarded, a more likely scenario is that past hunter-gatherers opportunistically produced and used these tools to meet short-term needs while they procured materials and/or while they temporarily camped at the Baker site as they procured toolstone and manufactured bifaces and flake blanks. Since all of the flake tools and tabular tools are manufactured from Baker rhyolite, rather than extra-local material, it is likely these tools never left the Baker site before being discarded (i.e., they were not transported off-site).

Both Nakamura (1991 [1966]) and Glennan (1972, 1974), who previously analyzed the Baker site, were on the right track with their interpretation of the Baker site's function. Perhaps a sample that prioritized debitage as much as tools and cores paired with an understanding of lithic typologies and implied behaviors would have helped them refine their findings. Nakamura and Glennan conducted their research at a time when typology and chronology were the dominant paradigm. Intrinsically looking at behaviors that formed archaeological assemblages did not really occur until the 1980s with Binford, Schiffer, and others. Therefore, results from the previous studies by Nakamura and Glennan are consistent with the prevailing paradigm of their time.

Comparison to Great Basin/Mojave Desert Quarries

Now that I classified the Baker site as a quarry/workshop and summarized the range of technological strategies, I consider whether the organization of technology at the Baker site is consistent with the nine Great Basin quarries reviewed in Chapter 3. The primary similarity between the quarries is that raw material was entirely procured from within the site areas rather than brought from elsewhere, and the assemblages were mostly homogenous (i.e., contained few lithic materials from outside procurement areas). This is not unexpected since, by definition, procurement and production from within the site area defines a raw material quarry and workshop. A vast majority of the Baker assemblage (97.5%) was provisioned by rhyolite raw material that outcrops within the site area and is therefore consistent with the other quarries. The remaining 2.5% of jasper artifacts were seemingly transported to the site from elsewhere rather than procured from the site itself, which is inconsistent with the Great Basin quarries. However, it is likely that the jasper was procured from near the Baker site and was used only minimally. Its presence does not alter the overall consistency the Baker site has to other Great Basin procurement strategies.

Another dominant strategy among all nine quarries is an emphasis on biface production. Each Great Basin quarry has evidence for a biface production strategy, with most reduction ceasing by the early- to middle-stages before the bifaces were rejected during manufacture or transported off-site. This holds true for the Baker site, with early- to middle-stage biface production representing a primary goal of manufacture. Flake tool and flake blank production is reported in five of the nine Great Basin quarries and seemingly played a somewhat important role in raw material procurement strategies at other quarries. However, flake blank production was as much a primary goal of the Baker site as biface production, distinguishing it from some Great Basin quarries.

Where the Baker site really diverges from the other quarries is in how flake blanks were produced. The Levallois-like core reduction strategy observed in the Baker assemblage is not reported in any of the other studies and appears unique to the Baker site. The Soda Mountains comparative study described in Chapter 6 shows that strategy may be a response to small raw material package size, though it is unclear at this time how package size varies between the Baker site and other Great Basin quarries (excluding the Soda Mountains felsite quarry/workshop area). The presence of flake tools in the Baker site assemblage also differentiates it somewhat from the other quarry studies. Flake tools were only reported by Knell (2014) in the Soda Mountains felsite complex, but in low frequency. The near equal frequency of bifaces and flake tools in the Baker assemblage (51% versus 49%, respectively) shows that flake tools are present in the Baker assemblage in high numbers compared to bifaces, and that their discard at the Baker site is unusual compared to other Great Basin quarries. In summary, the Baker site resembles other Great Basin quarries in terms of raw material procurement and biface production, though flake blank and flake tool production distinguishes it somewhat and Levallois-like core reduction sets it apart from the other quarries.

Future Research Directions

This thesis provides a much-needed update for the Baker site after nearly a half-century of minimal attention in the archaeological literature. However, more can be done with the Baker site assemblage in future studies. The most obvious future work would be an entire assemblage analysis (100% sample) rather than the roughly 25% sample I analyzed. Analyzing the assemblage in its entirety may provide evidence for technological strategies not observed in this study. Another area where future research can greatly benefit understanding of the Baker site is by submitting more rhyolite artifacts from Mojave Desert archaeological sites for energy dispersive X-Ray Fluorescence (edXRF) analysis. Alternatively, analyzing rhyolite artifacts with a portable X-Ray Fluorescence (pXRF) device and publishing the recorded signatures can benefit the Baker site in much the same way. The geochemical sourcing study in this thesis contained a very small sample of artifacts ($n = 21$), which may explain why no Baker rhyolite artifacts were noted in the sample. A geochemical signature for the Baker site is currently established by Richard Hughes at Geochemical Research Laboratory, so any rhyolite artifacts—not just diagnostic points—submitted to him may have the signature for Baker rhyolite, which will greatly increase the understanding of where Baker rhyolite was transported to and what form(s) it eventually became. As of right now, that information is very limited.

A final avenue for future research concerns sample bias. This thesis acknowledges that the analyzed artifacts from the assemblage originate from an extant collection, and it is unclear what collection procedures took place during the initial recording of the Baker site. Smaller artifacts at the site were potentially skipped or overlooked during the collection process due to collection bias, especially if sediment screening was not employed or large-size mesh was used as was common during the 1960s and 1970s. It is thus possible that small biface thinning debris and pressure flakes were originally present at the site but were not collected, providing a biased story for the Baker site. The conclusions presented in this thesis are based only on what was actually collected for the extant

Baker assemblage but acknowledges that biases may exist that could skew this discussion. Future work with the Baker site assemblage would benefit from excavation focused on the remaining portion of the Baker site. Employing modern excavation techniques, including using a 1/8th inch mesh screen and perhaps artifact flotation, may determine that the range of artifacts from the site are more diverse than this assemblage currently represents. If new artifact types are observed during excavation, such as an abundance of smaller-size middle- to late-stage production debris or resharpening flakes, the results of this thesis may need to be altered in the future. For now, this thesis provides a detailed explanation of the Baker site's function and the organization of technology implied by the tools, cores, and debitage in the assemblage. My hope is that these new insights will update the current understanding of CA-SBR-541, the Baker site.

APPENDIX

BAKER SITE ARTIFACT TYPES

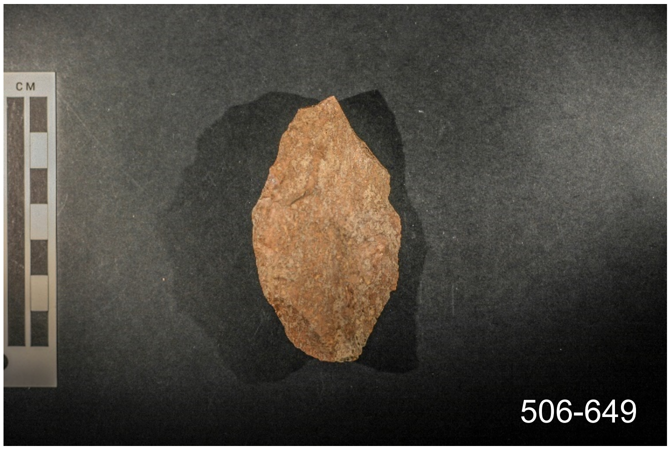
Bifaces, Stage 3

506-643

506-141

506-143

506-135a



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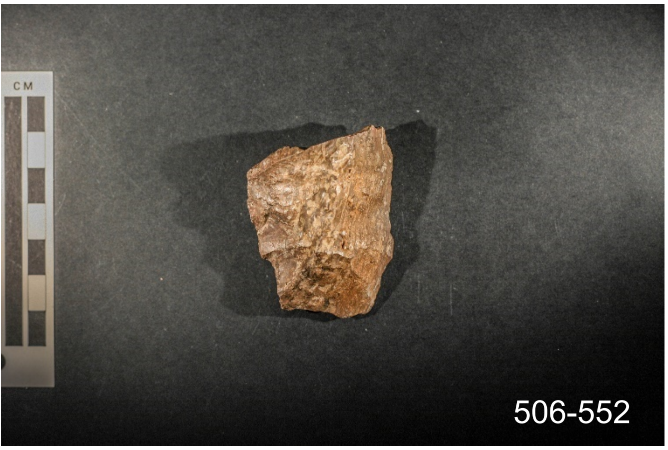


506-552

Bifaces, Stage 2


506-592


506-263


506-146

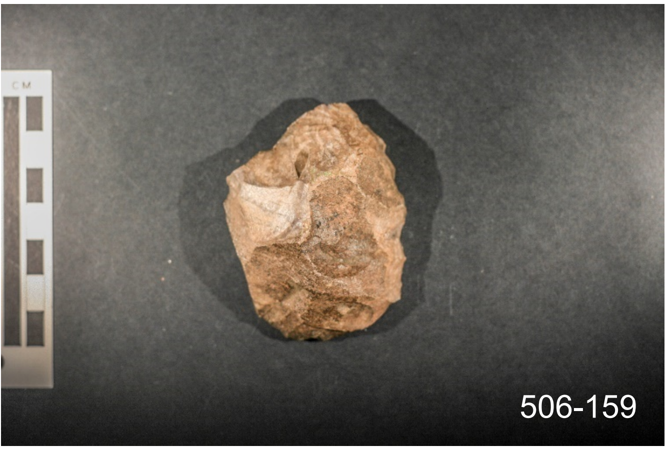

506-112


506-705


506-704

Flake Tools, Patterned Retouch

506-575



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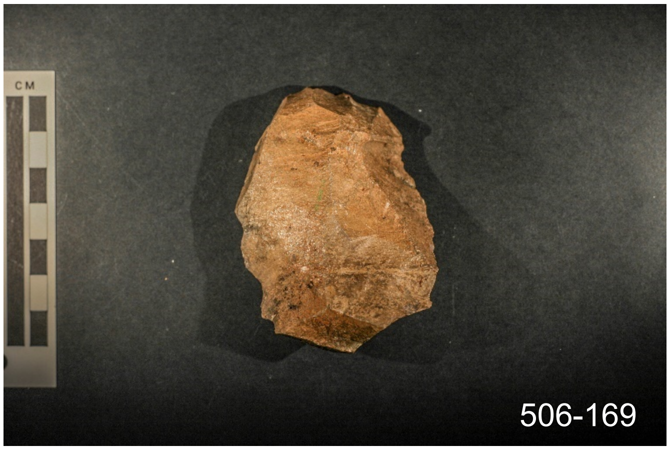
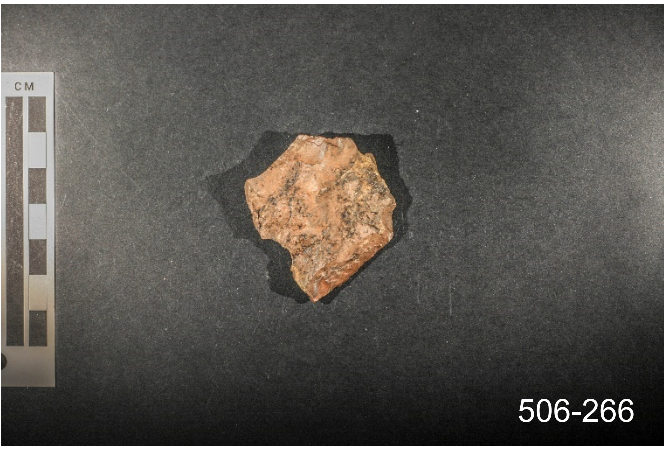


506-169

Flake Tools, Unpatterned Retouch

506-569

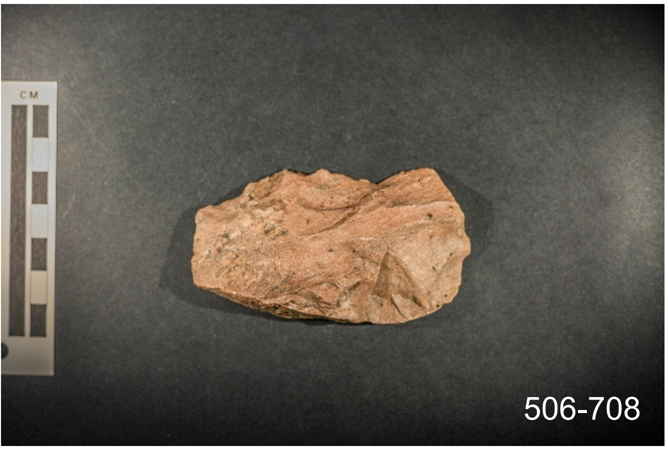


506-266

506-639

Flake Tools, Marginally-Retouched Tabular Pieces

506-624



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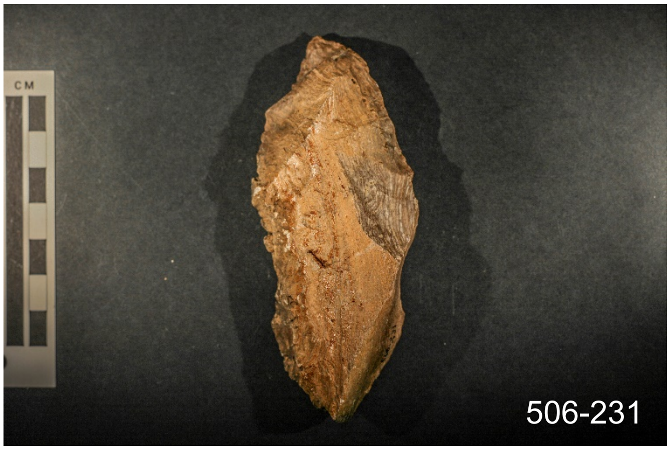
506-615

506-573

Flake Tools, Graver/Perforators (Top) And Utilized Flake (Bottom)



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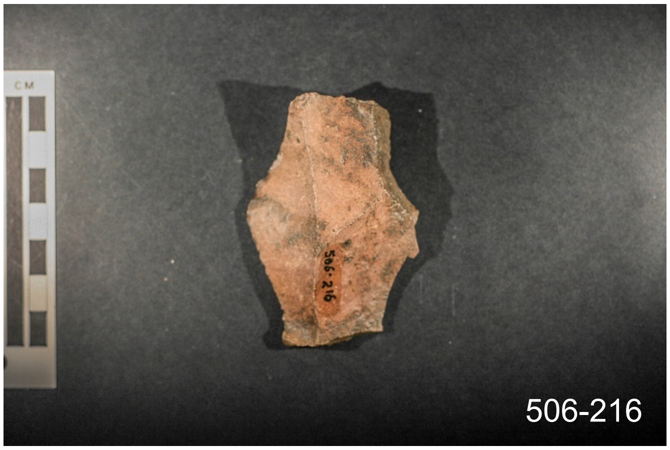
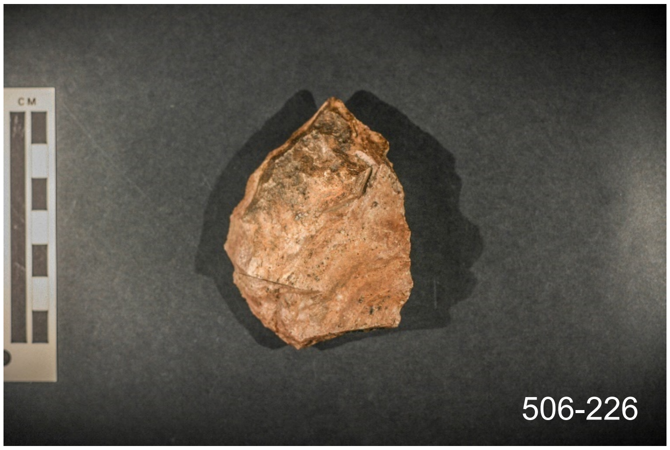


506-216

Flake Tools, Multipurpose Tool (Top) And Spokeshave (Bottom)



506-226

506-731

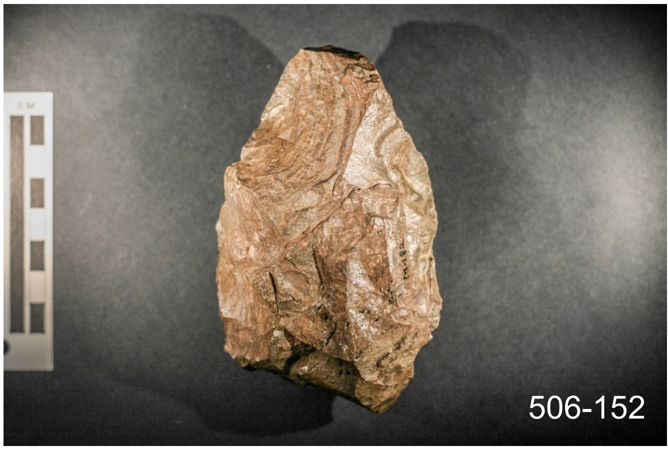
Cores, Multidirectional


506-612


506-177


506-176


506-243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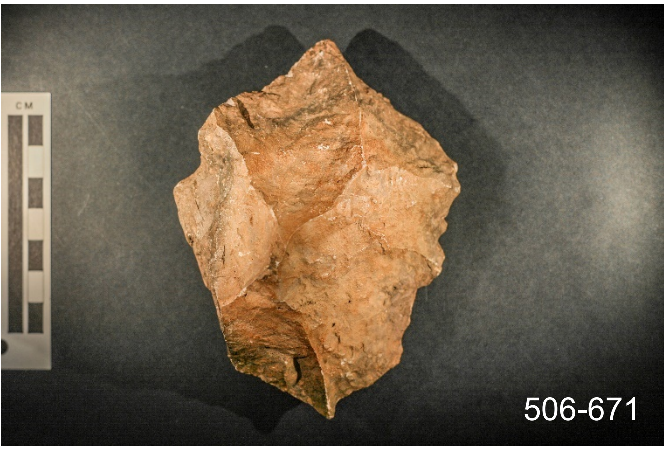
506-671

Cores, Unidirectional


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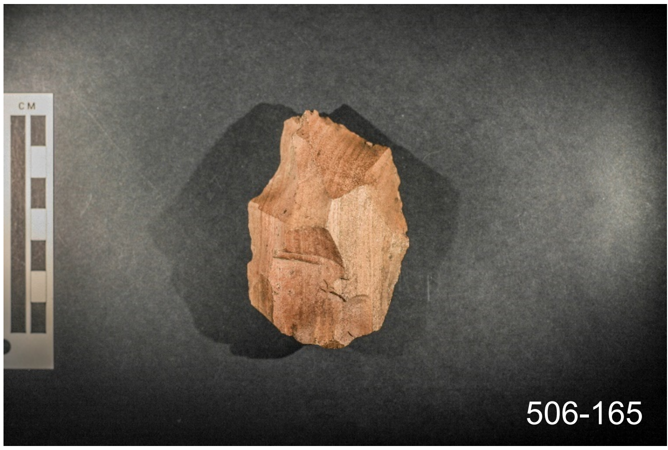
506-138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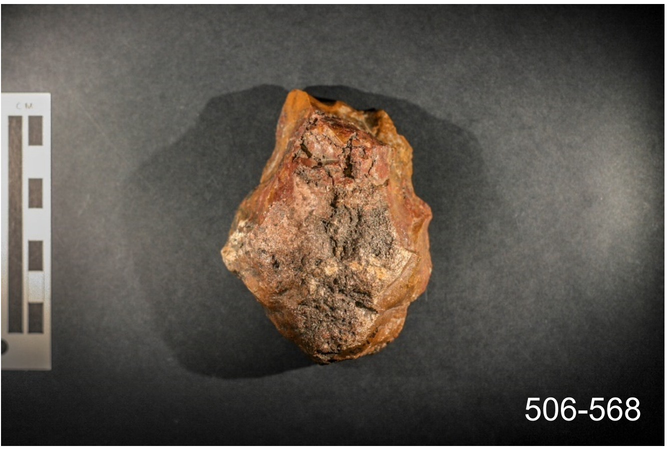
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506-609

Cores, Bifacial

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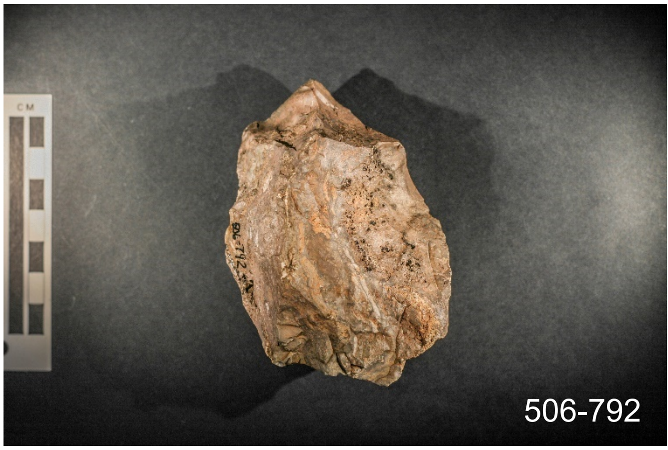
Cores, Levallois-Like Reduction



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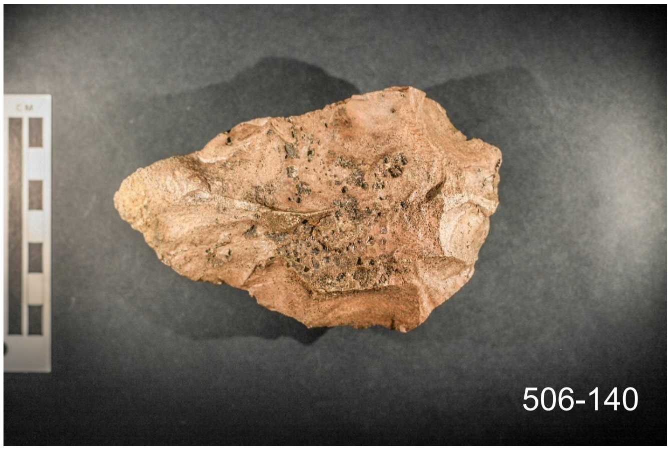

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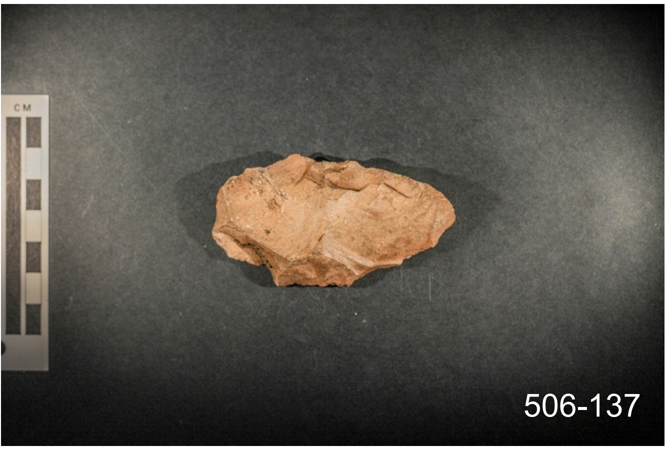

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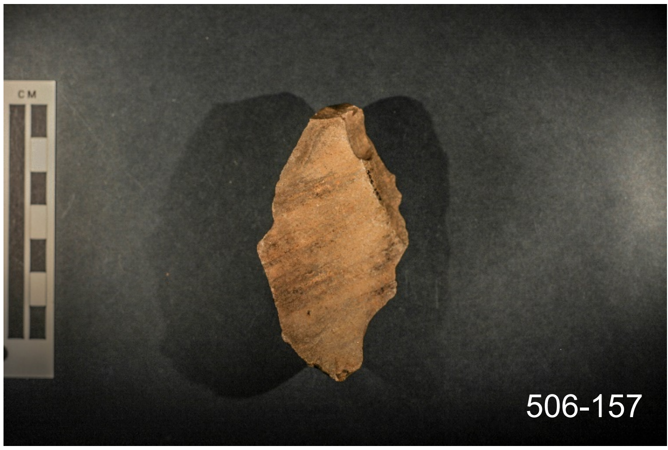
Debitage, Flake Blanks (Top) And Scraper Preforms (Bottom)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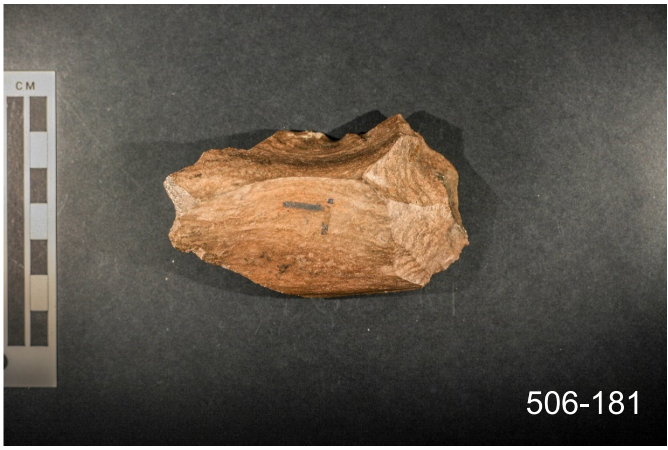
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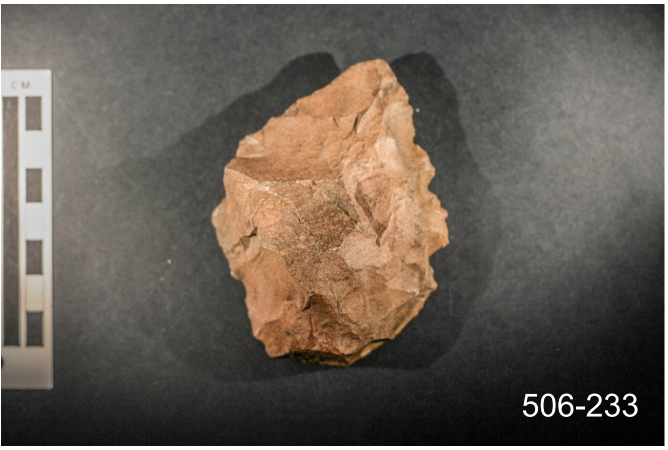
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