TRACKING CHANGES IN EARLY PALEOINDIAN TECHNOLOGY AND ADAPTATIONS ON THE SOUTHERN PLAINS PERIPHERY

A Dissertation

by

THOMAS ANDREW JENNINGS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2012

Major Subject: Anthropology

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Approved by:

Chair of Committee,	Michael Waters
Committee Members,	Ted Goebel
	David Carlson
	Tom Hallmark
Head of Department,	Cynthia Werner

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ABSTRACT

Tracking Changes in Early Paleoindian Technology and Adaptations on the Southern Plains Periphery. (May 2012)

Thomas Andrew Jennings, B.S., Southern Methodist University; M.A., University of Oklahoma

Chair of Advisory Committee: Dr. Michael Waters

This dissertation presents new data on early Paleoindian stone technologies in the Southern Plains periphery. Analyses of lithic artifact assemblages show that significant technological changes occurred between the transitions from pre-Clovis to Clovis and from Clovis to Folsom/Midland.

After an initial introduction to the problems in chapter one, a detailed technological description of the pre-Clovis assemblage from the Debra L. Friedkin site, Texas is presented. Site-scale and general technological comparisons to Clovis reveal similarities and differences. I conclude that the pre-Clovis assemblage at Friedkin cannot be considered Clovis, but could represent an ancestral technological assemblage. I next present the analysis of Clovis bifaces from the Hogeye site, Texas. I identify patterns in the biface reduction process and suggest that these patterns could be use to distinguish between regional Clovis cultural signatures and the idiosyncrasies of individual Clovis flintknappers. I then compare Clovis and Folsom/Midland technologies and site-use at a single site, the Debra L. Friedkin site, Texas. I show that while late-stage biface reduction and point production were the focus of both occupations, Folsom/Midland groups also reduced some early- or middle- stage bifacial cores. More broadly, the Friedkin site shows that Clovis and Folsom/Midland settlement along Buttermilk Creek varied.

Ultimately, this dissertation provides new evidence of possible Clovis origins, documents Clovis biface reduction signatures, and identifies site-use and technological similarities and differences between Clovis and Folsom/Midland. Defining and comparing early Paleoindian adaptations and technologies is key to understanding how humans dispersed into North America and how they adapted to new and changing environments during the last Ice Age.

DEDICATION

To my parents, John and Linda, my brother, Jim, and the love of my life, Ashley.

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CHAPTER I

INTRODUCTION

Since the discovery of stone tools associated with extinct, ice-age mammals in the central United States, the peopling of the Americas has been a topic that has captured the attention of North American archaeologists. When humans first dispersed into and through North America and how adaptations and cultures changed through time remain unanswered questions, and this dissertation adds new information to our understanding of the early Paleoindian record.

Clovis, which began 12,710 calendar years before present (BP) and lasted to 13,020 (Waters and Stafford 2007) or 13,450 BP (Haynes 1992), is the most widely recognized early archaeological complex in the New World, but where Clovis people came from and how their technology developed remains a mystery. No sites in the Old or New Worlds have assemblages that possess technological traits that are unequivocally immediate antecedents to Clovis. Identifying Clovis origins entails clearly defining Clovis technology and tracing its technological signatures to a precursory archaeological complex.

While bone and other technologies were surely important (Frison 1991; Tankersley 2004), the present discussion focuses on stone technologies. Clovis lithic technological organization revolves around two formal core reduction strategies, bifacial

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This dissertation follows the style of Journal of Archaeological Science.

and blade. Finished bifaces were reduced from large bifacial cores or sometimes on flake blanks, and finished Clovis points exhibit distinctive basal fluting (Bradley 1982; Bradley et al. 2010; Huckell 2007; Smallwood 2010; Waters et al. 2011). Overshot flaking and endthinning were important biface reduction techniques (Bradley et al. 2010; Smallwood 2010; Waters et al. 2011). Blade production is a second formal core reduction strategy, and Collins (1999) has shown that macroblades are made from conical and wedge-shaped cores. Blades are large, long, exhibit high degrees of curvature, and were used as unifacial scrapers and knives. Finally, from formal bifacial and blade core technologies and, occasionally, informal cores, Clovis people made and used a variety of informal unifacial stone tools including multiple scraper types, gravers, notches, and other flake tools (Ferring 2001; Huckell 2007; Tankersley 2004).

The search for Clovis technological origins has centered on finding links beyond North America. Currently, the debate involves two proposed points of origin, Siberia (Goebel 2004; Straus et al. 2005) and Iberia (Stanford and Bradley 2012). Proponents on both sides of the debate have attempted to identify suites of characteristics shared by Clovis and either Solutrean or Siberian Upper Paleolithic stone technologies.

A key problem facing Clovis origins research may lie in the over-emphasis on identifying Alaskan or Old World relationships. What if Clovis origins occurred in North America? Although the potential importance of pre-Clovis North American sites is often noted (Bradley and Stanford 2004; Straus et al. 2005), pre-Clovis and Clovis lithic technologies have not yet been systematically compared. If the immediate Clovis progenitor was in North America already, for as long as 1000-2000 years or more, then unlocking the mystery of Clovis origins may require comparing pre-Clovis and Clovis technologies, and, ultimately, searching for pre-Clovis origins in the Old World.

The discovery of archaeological materials dated to 14,600 BP at Monte Verde in southern Chile (Dillehay 1997) established the likelihood that people occupied the Americas prior to the time of Clovis. In the years since, broad acceptance of Monte Verde has reinvigorated the search for evidence of pre-Clovis occupations. While "pre-Clovis" can take on other meanings, I use it here only a temporal definition: pre-Clovis is defined as sites with artifacts potentially dating older than the 13,450 BP maximum age of Clovis. Pre-Clovis sites fall into two groups, early sites that are many thousands of years older than Clovis and later sites that date to within two to three thousand years before Clovis.

Sites in the oldest group include Cactus Hill, La Sena, Lovewell, and Topper. Evidence for pre-Clovis occupation at these sites remains highly debated. Cactus Hill, Virginia produced an assemblage of approximately 1,000 lithics below Clovis levels (McAvoy and McAvoy 1997), including two projectile points, numerous flakes, potentially utilized flakes, small blade-like flakes and possible blade cores. While the artifacts from this lowest component may date to between 20,000-18,000 BP (Feathers et al. 2006b), questions remain regarding the possibility of post-depositional mixing and secondary association of dated charcoal and artifacts (Haynes 2005). At La Sena, Nebraska and Lovewell, Kansas, two sites with mammoth remains dating to between 22,000 and 19,000 BP, Holen (2006) has argued that damage and breakage patterns on mammoth bone reflect human bone quarrying; however, no lithic artifacts have been recovered from these sites (Goebel et al. 2008), and similar bone surface damage and bone flaking has been shown to have been produced naturally (Haynes 2002). At Topper, South Carolina, Goodyear (2005) has reported the discovery of artifacts from deposits dating to a minimum of 20,000 BP, but the archaeological evidence from Topper has not been fully published, precluding objective evaluation of these materials and the acceptance of this potential pre-Clovis site (Goebel et al. 2008). Recently, Waters et al. (2009) have suggested that the proposed artifacts were produced naturally.

The second group of sites includes Meadowcroft Rockshelter, Schaefer, Hebior, Page-Ladson, and Paisley Caves. These sites are two to three thousand years older than Clovis and, taken together, provide tantalizing evidence of a more recent pre-Clovis occupation of North America. Meadowcroft Rockshelter, Pennsylvania yielded unequivocal lithic artifacts from sediments dating to between 15,200 and 13,400 BP (Adovasio and Pedler 2004). In total the pre-Clovis assemblage consists of approximately 700 artifacts including one biface (a Miller lanceolate point) and numerous pieces of debitage, among them biface thinning flakes and small prismatic blades. Schaefer and Hebior, Wisconsin yielded cut-and-pry-marked mammoth remains associated with lithic artifacts and dated to between 14,800 and 14,200 BP (Joyce 2006; Overstreet 2005). The lithic assemblages from these sites consist of only two and four pieces, respectively, and Hebior shows evidence of bifacial technology. The early component at Page-Ladson, Florida dates to about 14,400 BP (Webb 2005). Seven flakes, one utilized flake, and a hammerstone were found in association with battered and cut mastodon remains. Finally, human coprolites from Paisley Cave date to about 14,100 BP (Gilbert et al. 2008; Jenkins 2007).

Two important points, however, emerge from the preceding discussion. First, evidence is mounting for human occupation in North America dating to two to three thousand years before Clovis. Second, The lithic assemblages from many of these potential pre-Clovis sites are decidedly sparse, geographically widespread, and have no definitive diagnostic artifacts. Only Meadowcroft and Cactus Hill have produced more than a handful of lithic artifacts, but detailed technological comparisons of these emerging assemblages are still lacking, precluding direct comparisons to Clovis.

Once fluted Clovis points were invented, the technology (as well as associated stone tool technologies) spread across the continent. In addition to searching for the origins of Clovis, archaeologists are refining our understanding of Clovis stone reduction strategies and identifying regional variation *within* the Clovis archaeological complex.

Many studies have focused on documenting stylistic variation in Clovis point morphology. Morrow and Morrow (1999a) show that fluted point shapes transition from straight-sided lanceolates with deep basal concavities to boat-shaped forms with decreased basal concavities as one moves from north to south across the continent. Subsequent studies have identified sub-regional differences between points from the Southern Plains, Northern Plains, Southeast, and Northeast (Ellis 2004; Smallwood 2012; Smith 2011), and Smallwood (2012) suggests these differences are best explained as evidence of emerging regional cultural traditions. Buchanan and Collard (2007) go a little further and argue that spatial variation in point morphology can be used to track the spread of Clovis technology across the continent.

The identification of stylistic variation in fluted points raises an important question, does regional variation also exist in Clovis biface reduction? In other words, did people in the Southern Plains follow the same series of steps to make Clovis points that people in the Southeast or Northeast used? The successful characterization of the entire sequence of Clovis point manufacturing steps, however, was initially hindered by the dominance of kill and open camp sites in Clovis archaeology (Bamforth 2009). These sites produced an important but incomplete picture of Clovis technology because they do not capture the full range of Clovis behavior. Recent work at assemblages from quarry-camp sites such as, Gault, Texas (Collins 1999, Waters et al. 2011), Carson-Conn-Short, Tennessee (Broster and Norton 1993; Smallwood 2012) and Topper, South Carolina (Smallwood 2010, 2012) has helped in reconstructions of Clovis reduction strategies from initial nodule reduction to final Clovis point production.

To date, only a handful of studies have identified regional variation in the Clovis reduction process. Morrow and Morrow (1999b) use differences in the platform set-up for final flute removal and flute-scar morphology to distinguish Gainey from Clovis as a Great Lakes fluted point variant. Examination of bifaces and debitage from Great Lakes assemblages, however, shows that Gainey point makers still used overshot flaking to thin bifaces (Ellis and Deller 2000; Eren et al. 2011), a flaking technique considered diagnostic of Clovis biface reduction (Bradley et al. 2010; Smallwood 2012; Waters et al. 2011). Smallwood (2012) has conducted the most comprehensive regional comparison of Clovis biface reduction techniques in her analysis of Clovis assemblages from Tennessee, Virginia, and South Carolina. Her study is the first to document sub-regional variation in biface reduction strategies between the early, middle, late, and finished point stages, and these differences again provide strong evidence of the emergence of regional cultural traditions. These studies are refining our understanding of Clovis and showing that we still have much to learn about how Clovis people made stone tools across North America.

In the Great Plains, the Folsom/Midland archaeological complex immediately follows Clovis. Folsom/Midland dates to 12,730-11,730 BP (Collard et al. 2010) and is defined by the distinct, fully-fluted Folsom point and its unfluted Midland counterpart (Hofman 1992; Meltzer 2006). Significant environmental changes at the end of the last Ice Age served as the backdrop to the archaeological transition from Clovis to Folsom/Midland. Clovis groups lived at the end of the last Ice Age at a time when numerous large mammals, or megafauna, such as mammoths, mastodons, camels, horses, and bison roamed North America. In all, 35 total genera of North American mammals went extinct (Faith and Surovell 2009; 65 Grayson 2007; 45 Grayson and Meltzer 2002), and some of these extinction events overlap with the timing of Clovis. Folsom/Midland emerged after these extinctions when bison was the only remaining large mammal on the Great Plains. The dramatically different environments inhabited by Clovis and Folsom/Midland groups had a profound impact on Clovis and Folsom adaptations, from subsistence to settlement to the organization of stone technologies.

The sites I will be discussing in this dissertation lie on the southern periphery of the Plains. At a broader, regional scale, clear differences in Clovis and Folsom/Midland subsistence, settlement, and technology across the Plains are evident. While Clovis subsistence consisted of large-mammal (mammoth, mastodon, bison) hunting (Haynes 2002; Kelly and Todd 1988; Surovell and Waguespack 2009, 2008; Waguespack and Surovell 2003) supplemented by a variety of additional small animal resources (Anderson 1996; Cannon and Meltzer 2004; Collins 2007; Grayson and Meltzer 2002; Stanford 1999), Folsom subsistence is dominated by bison hunting (Amick 2000; Bement 1999; Collins 2007; Hofman 1992; Hofman and Todd 2001; Meltzer 2006). Clovis and Folsom/Midland megafauna kill sites are found throughout the Plains, demonstrating the importance Plains resources. Camp site settlement patterns, however, differ. While Clovis camp sites have been found only in the southern Plains periphery [e.g. Blackwater Draw, New Mexico (Hester 1972), Gault, Texas (Collins 2007; Waters et al. 2011)], Folsom/Midland camp sites occur throughout the Plains (Andrews et al. 2010). These differences imply that Clovis groups may have only seasonally exploited Plains resources before returning to southern base-camps while Folsom/Midland groups established full-time residential settlement throughout the Plains. Finally, adaptive differences are also evident in the organization of Clovis and Folsom/Midland stone technologies (Jennings et al. 2010). Clovis groups relied on bulky and transport-inefficient bifacial and blade core technologies for tool production throughout the Plains (Collins 2007; Kilby 2008; Waters et al. 2011) while Folsom/Midland groups relied on bifacial cores in the Southern Plains (Boldurian 1990; Hofman et al. 1990) but switched to more transport-efficient informal and discoidal cores in the Central and Northern Plains where stone sources are more variable (Bamforth 2002; Surovell 2009).

These differences demonstrate that environmental changes at the end of the Pleistocene indeed had an impact on human adaptations within the Plains. Fully understanding adaptive differences between Clovis and Folsom/Midland, however, requires comparisons at multiple scales of reference. While regional and sub-regional differences are evident, site-level evidence is under-represented. Few direct site-level comparisons at places visited by both Clovis and Folsom/Midland groups have been conducted because only four sites have Folsom/Midland components directly overlying Clovis components.

This dissertation is organized as a series of independent chapters linked by Clovis as a central theme. The chapters contribute to three key questions discussed above. Where did Clovis originate and how does pre-Clovis stone technology compare to Clovis? Can we identify Clovis tool production signatures that differ regionally or sub-regionally and provide evidence of emerging cultural traditions? Finally, how does Clovis technology and site-use compare to those of Folsom/Midland groups that immediately followed?

In Chapter II, I present the technological analyses of stone tools recovered from the pre-Clovis component of Block A at the Debra L. Friedkin site. Debra L. Friedkin is a multicomponent site located outside of Salado in central Texas. The pre-Clovis component dates to between approximately 13,200 and 15,500 BP (Waters et al. 2011) and is overlain by a Clovis component (ca. 13,000 BP), a Folsom/Midland component (ca. 12,000 BP), as well as late Paleoindian, Archaic, and late Prehistoric components. I describe the pre-Clovis assemblage which includes bifacial tools, flake tools, and debitage from multiple types of core reduction. I then compare pre-Clovis to Clovis in terms of 1) site-level behaviors and 2) general technological traits. For site-level comparisons, I use the Clovis assemblage from Friedkin and the Clovis assemblage from Excavation Area 8 of the Gault site, Texas. For trait-list comparisons, I use traits considered diagnostic of Clovis. These comparisons provide new evidence regarding potential culture-historical connections between pre-Clovis and Clovis.

In Chapter III, I present the technological analyses of Clovis bifaces recovered from the Hogeye site. Hogeye is a multicomponent site located outside of Bastrop in central Texas. A total of 52 Clovis bifaces were cached at Hogeye, and these include late-stage projectile point preforms, finished points, and knives/cores. From these bifaces, I quantify size and shape goals, the tempo of reduction, and flaking strategies and patterns. These allow for the characterization of unique Hogeye technological signatures which can then be used in comparisons to identify regional variation in the nuances of Clovis biface reduction.

In Chapter IV, I compare the Clovis and Folsom/Midland assemblages from the Friedkin site. Because Friedkin is one of only five sites with vertically separate Clovis and Folsom/Midland assemblages, it provides a unique opportunity to compare activities at a site visited during both periods. I compare reduction stages, tool types, and core reduction strategies. These comparisons provide new information on how Clovis and

Folsom/Midland groups used the Friedkin site, which, in turn, informs on Clovis and Folsom/Midland adaptations in the region.

Finally, Chapter V concludes the dissertation. I summarize each chapter, discuss the potential culture-historical relationship between pre-Clovis and Clovis technologies, characterize Clovis biface reduction signatures, and compare Clovis and Folsom/Midland site-use and technologies. It is my hope that this dissertation provides new and valuable information for understanding early Paleoindian adaptations in the region.

CHAPTER II

PRE-CLOVIS LITHIC TECHNOLOGY AT THE DEBRA L. FRIEDKIN SITE, TEXAS: EVALUATING CLOVIS CONNECTIONS

1. Introduction

Clovis, which developed 12,710 BP (Waters and Stafford 2007) to 13,450 BP (Haynes 1992; Taylor et al. 1996), is the most easily recognized archaeological complex in North America. Where Clovis technology came from and how it developed and spread remain in question because no sites or technologies have been shown to be unequivocally ancestral to Clovis. Identifying Clovis origins entails clearly defining Clovis technology and tracing technological signatures to a precursory archaeological complex.

While bone and other organic technologies were important (Bradley et al. 2010; Frison 1991), the present discussion focuses on Clovis lithic technologies. Clovis lithic technological organization includes two formal core-reduction strategies, bifacial and blade. Finished bifaces were reduced from large bifacial cores or, less commonly, made on flake blanks, and finished Clovis points exhibit distinctive fluting (Bradley 1982; Bradley et al. 2010; Huckell 2007; Smallwood 2010; Waters et al. 2011). Overshot flaking was an important technique, but its frequency and significance continues to be debated Bradley and Stanford 2004; Straus et al. 2005). Endthinning was also an important flaking strategy throughout the biface reduction process (Smallwood 2012; Waters et al. 2011). Blade production (Green 1963) is a second formal core-reduction strategy, and Clovis blades are made from conical and wedge-shaped cores (Collins 1999; Waters et al. 2011). Blades are large, long, exhibit high degrees of curvature, and were used as unifacial scrapers and knives. Finally, the Clovis toolkit includes a variety of unifacial stone tools including scrapers, gravers, notches, and other tools produced from flakes derived from formal biface and blade technologies and informal cores (Ferring 2001; Haynes 2002; Huckell 2007; Tankersley 2004; Waters et al. 2011). Clovis is a distinctive suite of technologies and tools made in a prescribed way.

The search for Clovis technological origins has centered on finding ancestral links beyond North America, and Beringia is viewed as the mostly likely source area (Goebel 2004; Goebel et al. 1991; Goebel et al. 2008; Hamilton and Goebel 1999; Hoffecker et al. 1993, 2009; Pitblado 2011; Straus 2000; Straus et al. 2005, but see Bradley and Stanford 2004; Stanford and Bradley 2012). To date, however, although complexes of sites are known in Beringia that pre-date Clovis (Goebel et al. 2008), no unequivocal Clovis progenitor has been identified in the region (Beck and Jones 2010; Faught 2008; Goebel 2004; Shott 2011; Waguespack 2007). A key problem facing Clovis origins research may lie in the over-emphasis on identifying Alaskan or Old World linkages. What if Clovis technology developed directly from a pre-existing North American technology?

Numerous pre-Clovis (here, "pre-Clovis" is used only as a temporal term to refer to North American sites and assemblages that date older than the accepted age of Clovis) sites have been proposed, but only a handful remain in discussion (Goebel et al. 2008; Meltzer 2009; Pitblado 2011). Current evidence suggests people were in North America

1000-2000 years before Clovis (Dillehay 2009; Goebel et al. 2008; Pitblado 2011). Although the potential importance of these pre-Clovis North American sites is often noted (Bradley and Stanford 2004; Straus et al. 2005), pre-Clovis lithic technologies have not yet been systematically compared to those of Clovis. This is largely because small lithic sample sizes from buried pre-Clovis contexts have greatly limited the reconstruction of pre-Clovis technological organization and hindered comparisons, and many pre-Clovis assemblages have not been adequately presented (Goebel et al. 2008). The Debra L. Friedkin site contains the largest pre-Clovis lithic assemblage yet found in North America, termed the Buttermilk Creek Complex (BCC), offering an opportunity to reconstruct pre-Clovis strategies for core reduction and tool production strategies and compare these to Clovis lithic technology.

In this paper, I present a detailed technological description of the Debra L. Friedkin site's BCC assemblage. I then 1) compare the BCC assemblage to Clovis assemblages from the Friedkin and Gault sites, Texas to evaluate site-level lithic reduction behaviors and 2) compare BCC technologies to more general definitions of Clovis in terms of the lithic technological traits used to define it. What stone-tool-related activities occurred during the BCC occupation of Friedkin and how do these activities compare to those of Clovis at Friedkin and at the nearby Gault site? Given what we know of Clovis technological organization, is Friedkin BCC lithic technology "Clovis" in nature?

2. Materials

2.1 The Debra L. Friedkin site

The Debra L. Friedkin site lies along the Balcones Escarpment in central Texas (Figure 1). Artifacts have been recovered in alluvial deposits of Terrace 2 above Buttermilk Creek (Waters et al. 2011), and high-quality Edwards Formation chert outcrops in the adjacent uplands. Excavations at Friedkin began in the summer of 2006 and continued in 2007, 2008, 2009, and 2011. Work has been concentrated in Block A which is located on an upper terrace of Buttermilk Creek. Waters et al. (2011; see also Keene 2009; Lindquist et al. 2011) utilized multiple lines of evidence to describe Block A depositional history and demonstrate that artifacts occur within an intact, unmixed floodplain deposit. Diagnostic artifacts from Clovis through late prehistoric periods have been recovered from the deposits above the pre-Clovis-age sediments, and artifacts have also been recovered from below the Clovis layers. Only artifacts recovered during the 2007-2009 field seasons, comprising a 44-m^2 block of contiguous 1-m^2 units, are discussed here.

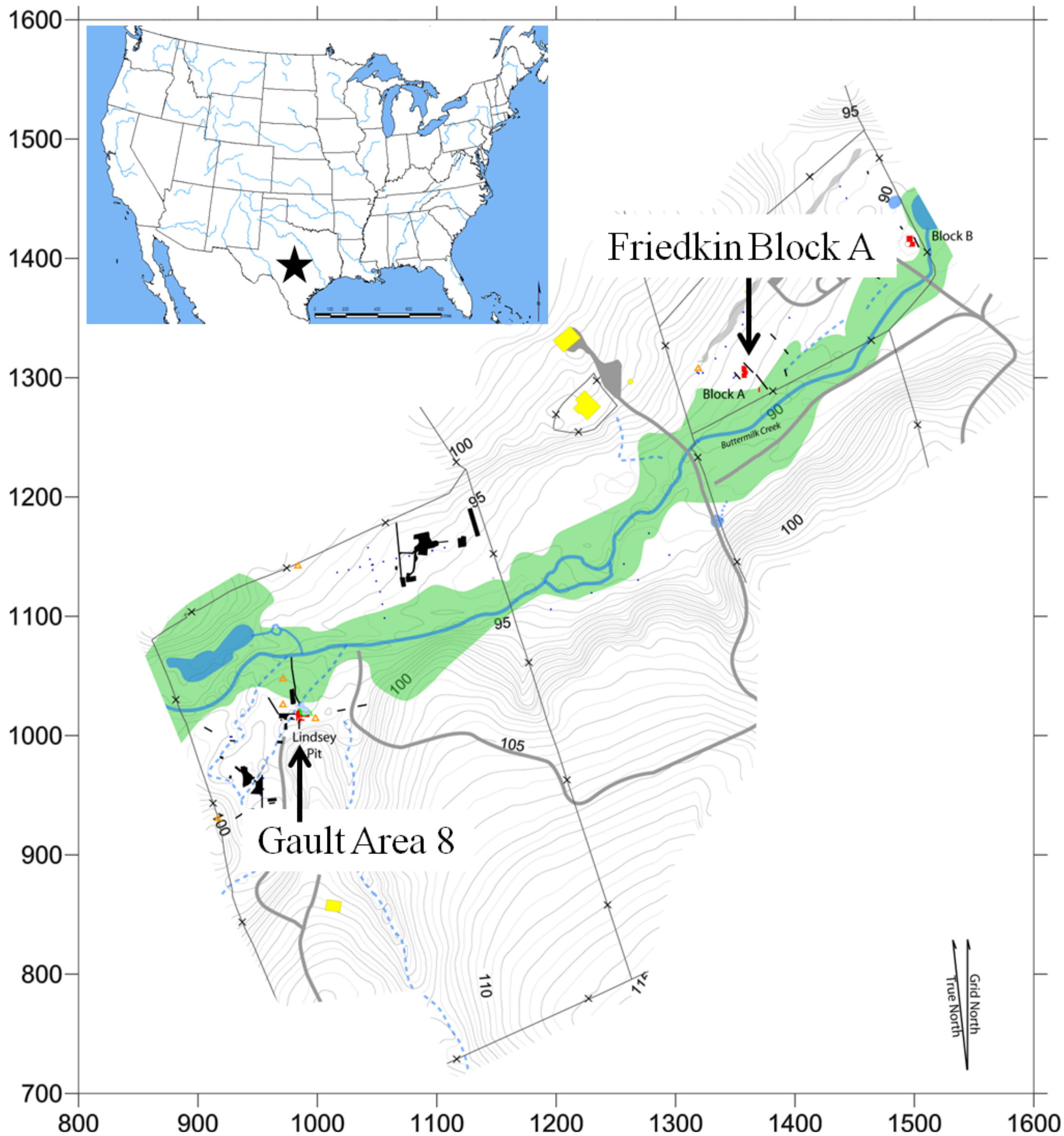

Figure 1. Map showing the locations of the Debra L. Friedkin and Gault sites. Scales are in meters.

Clovis artifacts occur within Level 32b, a 2.5-cm thick level defined by the presence of Clovis artifacts and confined by Folsom/Midland artifacts and Folsom-aged optically-stimulated luminescence (OSL) dates directly above this level, and by OSL dates older than the currently accepted temporal span of Clovis below this level. Five ages in the Folsom/Midland horizon date to 11,870 ± 760, 12,000 ± 770, 12,100 ± 860, 12,240 ± 800, and 12,925 ± 845 BP, and these dates are consistent with the currently accepted age of Folsom/Midland (Collard et al. 2010). Two ages at the top of the Clovis horizon date to 13,090 ± 8350 and 13,780 ± 885 BP and are consistent with the currently accepted age of Clovis (Haynes 1992; Waters and Stafford 2007).

Artifacts also occur below the Clovis component in the 20 cm of deposits encompassing levels 33a-36b, and these have been assigned to the Buttermilk Creek Complex (BCC). Two OSL ages immediately below the Clovis horizon date to 14,070 ± 910 and 14,350 ± 910 BP. Three OSL ages at the base of the BCC deposits date to 17,530 ± 1140, 16,270 ± 1040, and 16,575 ± 1075 BP. Eighteen total OSL dates conservatively bracket the age of the BCC component to ~13,200 to 15,500 BP (Waters et al. 2011).

2.2 The BCC Assemblage

The Friedkin BCC chipped-stone assemblage analyzed in this paper includes 15,528 artifacts (Table 1) recovered between 2007-2009. This assemblage consists of biface fragments, a discoidal core, unifacial tools, and debitage from blade and bladelet production and biface and discoidal core reduction.

Two bifaces provide evidence of at least two production goals. One is a long, thin fragment that, based on the angle of curvature from the end and the relatively straight edge, appears to have a lanceolate shape (Figure 2, c). This piece is technically a burin spall from a biface. The burination removed an entire edge, producing the fragment. The platform from this apparent burination remains, but it is unclear whether the fracture was accidental, perhaps created during an endthinning attempt, or whether burination was the ultimate goal. Flaking along the edge is minimally invasive on both faces but is not the fine retouch often seen on finished Paleoindian projectile points. A portion of a large, flat scar is evident on one face. This is interpreted to be the remnant ventral surface of a flake, suggesting the biface was made on a flake blank rather than reduced from a nodule. The lanceolate shape and thinness are suggestive of a projectile point preform; however, no finished projectile points have yet been recovered, and the burination must be explained.

Table 1. Total artifact counts from the Buttermilk Creek Complex assemblage.

Class	Type		Buttermilk Creek Complex
Debitage[1]			
	Microdebitage total		13200
	Macrodebitage total		2287
		Fragments and Shatter	1425
		Normal Flakes	399
		Biface Thinning Flakes	433
		Endthinning Flakes	10
		Discoidal Core Flakes	1
		Burin spalls[2]	4
		Blade	5
		Bladelet	14
Tools and Cores			
	Biface		
		Point Preform	1
		Chopping Tool	1
		Late-Stage Fragments	8
		Radially Broken Fragment	2
	Discoidal Core		1
	Edge Modified Tool		
		Side Scraper	4
		Convergent Scraper	3
		End Scraper	4
		Notch	4
		Retouched Flake	4
		Retouched Radial Break	1
		Graver on Radial Break	1
Total Artifacts			15528

[1] Microdebitage consists of artifacts that fell through a screen with mesh size 0.95 cm. Macrodebitage consists of artifacts trapped in this screen.

[2] The burin spalls were not previously described by Waters et al. (2011).

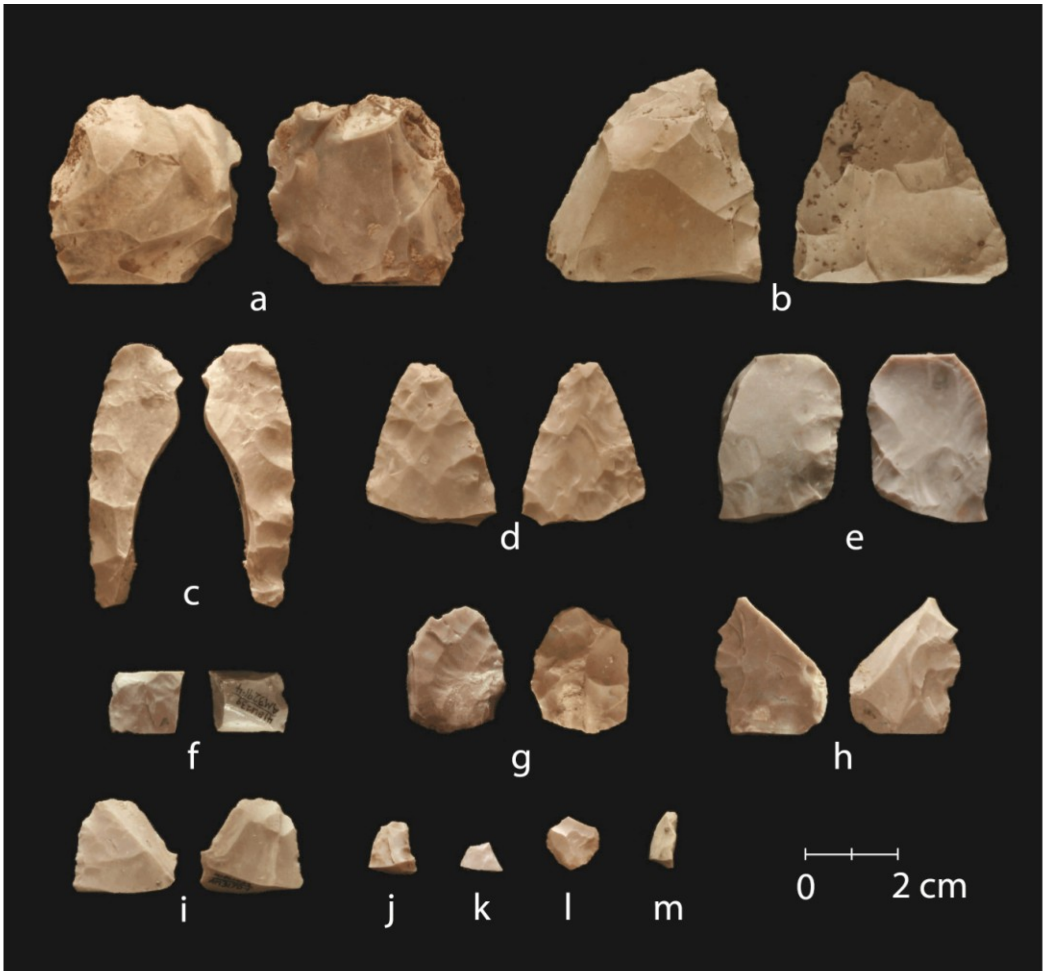

Figure 2. BCC assemblage discoidal core and bifacial tools.

A second biface is a large, thick distal fragment of a biface demonstrating a reduction goal distinct from the lanceolate fragment (Figure 2, b). Although it is nearly as long as the lanceolate fragment, this piece is much thicker and has a plano-convex cross-section. Both faces have large flake scar remnants that travel past the midline. Multiple, scalar step fractures line the tip, and these could be from either use or resharpening. The combination of thickness, cross-section, and flaking around the tip suggests this piece is a finished and utilized tool, not a preform for a bifacial point. It's most likely function was as a chopping tool or adze-like tool.

The ten remaining biface fragments offer few clues regarding ultimate production goals but do provide evidence of flaking strategies. One is a late-stage biface tip with to-the-midline flaking (Figure 2, d). Seven are all late-stage biface fragments with minimally invasive flaking (Figure 2, g-m). The ninth is a late-stage biface fragment with one bending and two radial breaks (Figure 2, e). One break has an *eraillure* scar in the center suggesting intentional fracture (Jennings 2011). The tenth is a late-stage biface fragment with one bending and two radial breaks (Figure 2, f). An *eraillure* scar on one radial-break surface and rings of force from impact on the adjacent radial-break surface suggest this piece was also intentionally fractured.

One discoidal core fragment was recovered (Figure 2, a). The core has been bifacially flaked, but no opposing bifacial edges have been established. Instead, flakes have been removed from multiple platforms around the core edge, and flake scar directions are variable.

Twenty-three flake tools have been recovered (Figure 3), and none are formally shaped for hafting. Eight tools retain the platforms of the original flake blank. One is a tool fragment on a biface thinning flake (Figure 3, c). Retouch is on the dorsal flake edge, and the tool is classified as a side scraper fragment. Another is a tool on a biface thinning flake (Figure 3, d). Retouch along the flake edge continues onto its termination, and this tool is classified as a convergent scraper. Another is a tool on a biface thinning flake (Figure 3, v). Retouch occurs on the lateral edge, and this tool is classified as a side scraper. Another is a flake tool on a biface thinning flake (Figure 3, u). Retouch is on the termination and this tool is classified as an end scraper on a flake. Another is a tool on a biface thinning flake (Figure 3, j). Retouch runs along the lateral edge, and the tool is classified as a single straight side scraper. Another is a biface thinning flake with two radial breaks (Figure 3, m). One radial break is finely retouched along the entire break surface, and this tool is classified as a retouched flake. Another is a notch on a biface thinning flake (Figure 3, e). The last is a notch on a normal flake (Figure 3, i).

Fifteen tools are on flake fragments. Three are tools on flake fragments with retouch on the distal terminations (Figure 3, h, q, s), and they are formally classified as end scrapers on flakes. The retouch on one (Figure 3, s) is on a bend-break fracture surface, but this fracture resulted from step termination during flake removal and was not intentionally produced. Another tool is a retouched flake fragment classified as a convex side scraper (Figure 3, f). Two tools have retouch on the flake edge that continues to the termination, and these are classified as convergent scrapers (Figure 3, o, w). Another tool is a retouched proximal flake fragment (Figure 3, g). Retouch occurs

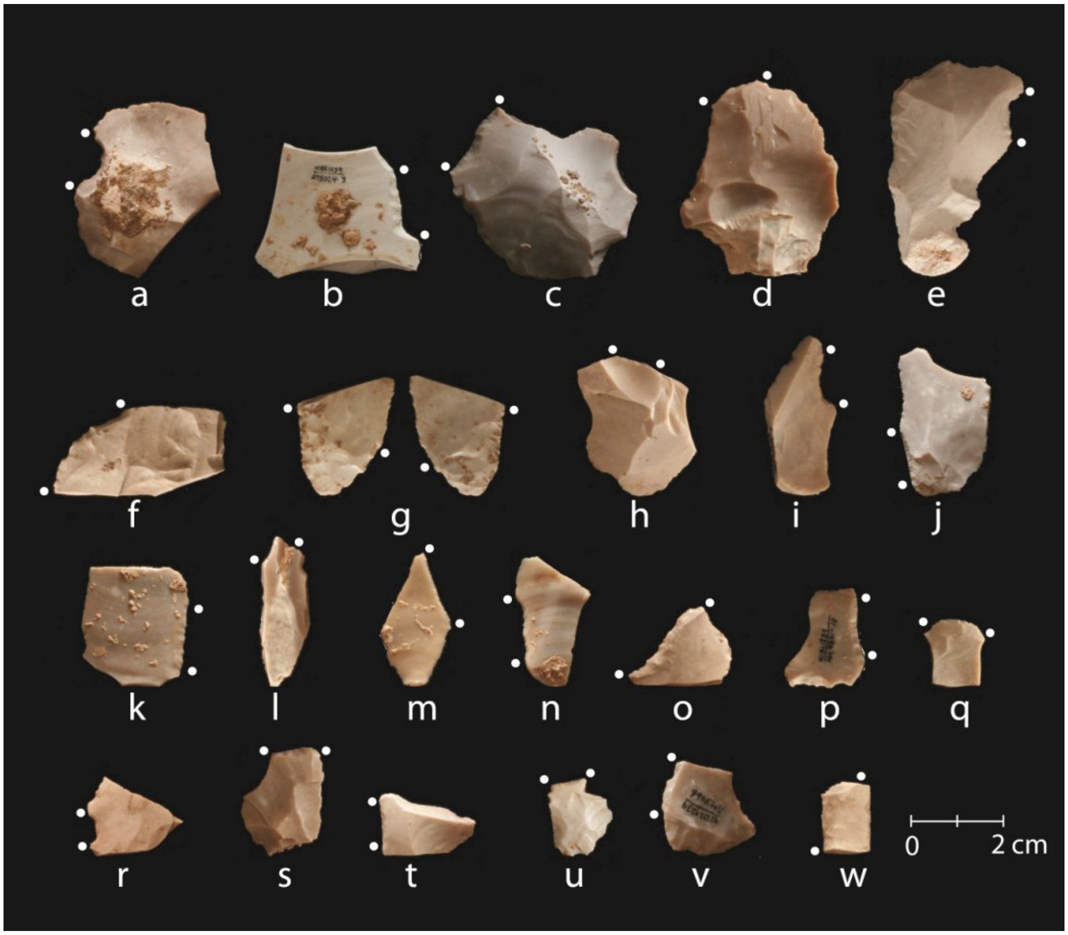

Figure 3. BCC assemblage flake tools. Dots indicate extent of retouch.

along both faces of both edges, removing the flake platform, and the tool is classified as a convergent scraper. Another tool has retouch along the lateral edge and is classified as a side scraper (Figure 3, b). Four tools are retouched on the flake edge and are classified as a retouched flakes (Figure 3, t, n, k, p). Two tools are are notches (Figure 3, r, a). Opposite the notch on the latter are two bending and two radial breaks. One partial Hertzian cone on a radial break suggests intentional fracture. Finally, one tool, is a graver/perforator on a flake fragment. The retouched graver spur occurs along two radial breaks that converge (Figure 3, l).

Technologically informative debitage (Figure 4) includes blades and bladelets, overshot and partial overshot flakes, endthinning flakes, burin spalls, a discoidal core flake, and radial/bend-break flakes. Evidence of potential blade-core reduction is limited to five blade fragments and fourteen bladelets which are distinguished based on size differences. One blade (Figure 4, r) and two bladelets (Figure 4, h, i) are trapezoidal in cross-section with three dorsal scars. The other blades (Figure 4, s-u, w) and bladelets (Figure 4, a-g, j-n) are triangular in cross-section with only two dorsal scars. No blade cores, bladelet cores, or core tablet/rejuvenation flakes have been recovered, so information regarding the nature of the cores being reduced is limited. Although the sample size is small, the degree of width and thickness variation suggests the blades and bladelets were not produced from standardized cores as seen in other highly formalized blade industries such as Siberian microblades (e.g. Graf 2010).

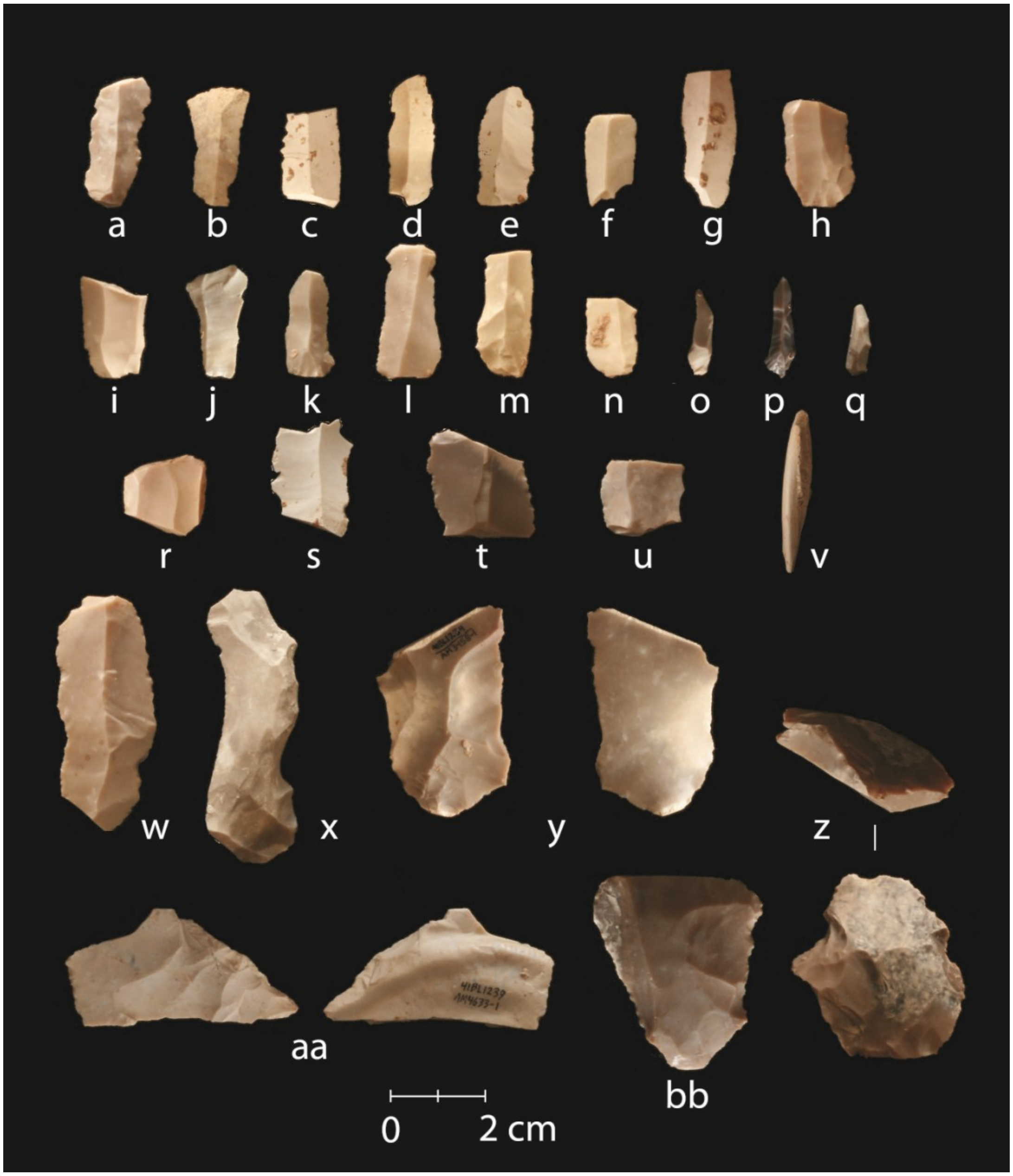

Figure 4. BCC assemblage technologically informative debitage.

Evidence of overshot flaking is limited to a single overshot fragment and two partial overshots (defined as a flake that reached the opposing core edge but did not remove a portion of the opposite face; Waters et al. 2011). One is a distal overshot flake fragment (Figure 4, aa). One is a complete partial overshot flake with a single-faceted, platform and multiple dorsal flake scars (Figure 4, y). The flake terminates in the squared, cortical edge common to local Edwards chert nodules. The third is a distal partial overshot fragment that also terminates in a cortical edge.

The ten endthinning flakes were removed from late-stage bifaces (Figure 4, x, bb). Each possesses at least one flake scar that runs perpendicular to the direction of flake removal. None possess the regular, fine flake scars typical of projectile-point-fluting channel flakes, defined by the presence of multiple, small flake scars (< 5 mm in width) on the lateral margins that run perpendicular to the direction of flake removal, such as those common to Clovis.

Evidence of burin production is limited to five artifacts. In addition to the lanceolate biface fragment described above, four other burin spalls have been identified (Figure 4, o-p, v). They are variable in size, and all appear to have been removed from flakes or flake fragments. Three are distal fragments, and the fourth has a crushed platform.

One flake is from a discoidal core (Figure 4, z). Two isolated core platforms are evident, one of which served as the platform for this flake removal. The two core platforms are adjacent to and at an approximately 130 degree angle to each other. The size of this flake (maximum length of 41.85 mm) suggests it came from a discoidal core that was larger than the core fragment, described above, which measures 42 mm by 41 mm.

Finally, radial and bend break flake tools may have been important technological components (Waters et al. 2011). As mentioned above, three retouched flake tools have been identified with retouch on bend-break surfaces, demonstrating use of bend-break edges as tools. On some unretouched bend/radial breaks, use-wear has been indentified (Waters et al. 2011). The lack of intentional fracture markers (Jennings 2011) on debitage with bend/radial-breaks suggests that these breaks were not created by percussion. Recent experiments show that the 1-2 m of predominantly clay sediment above these artifacts is insufficient to fracture flakes by sediment consolidation (Eren et al. 2011).

3. Methods

In considering the advantages and limitations of various methods and theories currently applied to the question of Clovis origins, Shott (2011) argues that comparative studies must account for both functional and historical sources of stone technology variation. Accordingly, comparisons of Friedkin BCC to Clovis in this paper follow two approaches designed to identify similarities and differences in 1) site-level reduction behaviors and 2) general lithic technological traits used to define archaeological complexes. Identifying behavioral and technological similarities and differences between those reflected in the Friedkin BCC assemblage and documented Clovis strategies provides a foundation for evaluating Clovis and BCC affinities.

First, site-level behavioral comparisons rely on general lithic analytical techniques for characterizing stone reduction and site-use activities (Andrefsky 2005; Odell 2004). To place the BCC occupation in perspective, I compare it to two previously analyzed Clovis assemblages representing different Clovis behavioral contexts, the Clovis assemblage from the Friedkin site and the Clovis workshop at Excavation Area 8 of the Gault site. The Clovis assemblage from the Friedkin site consists of 3374 artifacts and includes biface fragments, point-preform fragments, unifacial tools, and debitage from biface, blade, and bladelet production, and this assemblage is argued to represent a short-term occupation by locally-based bands who engaged in mostly late-stage reduction (Chapter IV). The Gault site is located approximately 500 m upstream from Friedkin (Figure 1). A total of 66,502 Clovis artifacts were recovered from Excavation Area 8 and the Clovis component at EA8 is argued to represent intensive occupation by locally-based bands who engaged in quarry-related early-, middle-, and late-stage reduction (Waters et al. 2011). For these three assemblages, artifact sizes, artifact densities, percents of cortical artifacts, and artifact-type frequencies are used to characterize and compare on-site lithic reduction activities. Statistical measures for detecting assemblage-level similarities and differences follow procedures outlined by Drennan (2009).

Second, I rely on technological trait-list comparisons to compare BCC technology to Clovis in more general terms. Trait-list comparisons are a commonly used qualitative technique to define Clovis and distinguish Clovis from other technological complexes. For trait-list comparisons, I combined five Clovis trait lists developed by

Haynes (2002), Tankersley (2004), Bradley and Stanford (2004), Straus et al. (2005), and Meltzer (2009) into a single trait list. These five trait lists are comprised of combinations of Clovis tool types and lithic core reduction techniques employed by Clovis knappers which are, together, considered representative of Clovis as an archaeological complex and have been used to explore culture-historical connections between Clovis and other archaeological complexes. Admittedly, trait list comparisons are subjective, relying on assumptions regarding which technological signatures can be considered representative or diagnostic of the Clovis archaeological complex (Straus et al. 2005). In spite of this flaw, trait list comparisons are used here as others have used them (Bradley and Stanford 2004; Buchanan and Collard 2007; Goebel et al. 1991; Straus et al. 2005), as a starting-point to assess and develop hypotheses regarding potential cultural connections. Individual Clovis traits in the combined trait list were recorded as either present or absent in the BCC assemblage. If BCC and Clovis share close culture-historical ties, most/all of the Clovis technological traits should be present in the BCC assemblage. Alternatively, if the two are unrelated, few/none of the traits should be present.

4. Results

4.1 BCC and Clovis Site-Level Lithic Reduction Behaviors

Site-level technological comparisons reveal important differences between the Clovis assemblage at Excavation Area 8 of the Gault site, the Clovis assemblage from the Friedkin site, and the BCC assemblage at Friedkin. In terms of general core-reduction debitage, relative counts of debitage types (Table 2) significantly differ between the three assemblages. The difference is driven by greater than expected frequencies of core tablet flakes, blades, and overshot flakes at Excavation Area 8 of the Gault site. Excavation Area 8 of the Gault site also has significantly greater frequencies of large debitage (Table 3) and a significantly greater frequency of cortical debitage (Table 4) than the Clovis assemblage from the Friedkin site and BCC.

Table 2. Debitage type counts and % (in parentheses) for Gault Area 8 Clovis (Waters et al. 2011), Friedkin Clovis, and Friedkin BCC. This table does not include burin spalls or discoidal flakes because these types are minor debitage assemblage components.

Assemblage		Normal Flakes	Biface Thinning Flakes	Blades, Bladelets, Core Tablets	Overshots and Partial Overshots	*Total*
Gault Clovis	Count	881 (47.5)	397 (21.4)	439 (23.7)	137 (7.4)	1854
	Expected	868.9	607.0	290.0	88.1	
Debra L. Friedkin Clovis	Count	110 (42.6)	141 (54.7)	6 (2.3)	1 (0.4)	258
	Expected	120.9	84.5	40.4	12.3	
Buttermilk Creek Complex	Count	399 (46.7)	433 (50.7)	19 (2.2)	3 (0.4)	854
	Expected	400.2	279.6	133.6	40.6	

Likelihood Ratio chi-square $p < 0.001$

Table 3. Macrodebitage counts by size class from Gault Clovis (Waters et al. 2011) and Debra L. Friedkin Clovis and Buttermilk Creek Complex assemblages. Percents within each assemblage are in parentheses.

Assemblage		Size Class				
		>3.75 cm	2.5-3.75 cm	1.875-2.5 cm	1.25-1.875 cm	*Total*
Gault Clovis	Count	1082 (9.9)	2405 (22.1)	2015 (18.5)	5393 (49.5)	10895
	Expected	932.0	2406.8	2444.0	5112.3	10895
Debra L. Friedkin Clovis	Count	14 (2.3)	140 (22.7)	239 (38.7)	225 (36.4)	618
	Expected	52	134.3	136.4	285.3	608
Buttermilk Creek Complex	Count	80 (3.6)	492 (21.9)	830 (37.6)	843 (37.6)	2245
	Expected	192.0	495.9	503.6	1053.4	2245

Likelihood Ratio chi-square $p < 0.001$

Table 4. Non-cortical and cortical debitage counts from Gault Clovis (Waters et al. 2011) and Debra L. Friedkin Clovis and Buttermilk Creek Complex assemblages. Because calcium-carbonate accumulations obscured the surfaces of some flakes, not all pieces could be classified as cortical or non-cortical.

Assemblage		Type		
		Non-cortical	Cortical	*Total*
Gault Clovis	Count	681	776	1457
	Expected	973.2	483.8	1457
Debra L. Friedkin Clovis	Count	471	141	612
	Expected	408.8	203.2	612
Buttermilk Creek Complex	Count	1745	523	2268
	Expected	1515.0	753.0	2268
		Likelihood Ratio chi-square		$p < 0.001$

Table 5. Tool type counts and percents (in parentheses) for Gault Area 8 Clovis (Waters et al. 2011), Friedkin Clovis, and Friedkin BCC.

Tool Type	Gault	Friedkin Clovis	BCC
Tested nodules and irregular cores	13 (9)	0	0
Blade cores	31 (21.5)	0	0
Bifaces	55 (38.2)	5 (45.5)	12 (32.4)
Projectile points	5 (3.5)	3 (27.3)	0
Chopper	1 (0.7)	0	1 (2.7)
Hafted end scrapers	10 (6.9)	0	0
Graver	2 (1.4)	0	1 (2.7)
Notch	5 (3.5)	0	4 (10.8)
Other modified flakes	16 (11.1)	3 (27.3)	18 (48.6)
Modified blades	6 (4.2)	0	0
Discoidal core	0	0	1 (2.7)

Tool and core frequencies (Table 5) differ between the assemblages driven by greater frequencies of informal cores, blade cores, and hafted end scrapers at Excavation Area 8 of the Gault site and greater frequencies of modified flakes at BCC. While the ratio of tools to debitage is the same for both Clovis assemblages, the BCC assemblage contains a significantly greater frequency of flake tools relative to debitage (Table 6). Finally, Gault modified flake tools are significantly larger than Friedkin Clovis and BCC (Table 7, Figure 5).

Clovis knappers at Gault used nodules and macroflakes as blanks for biface reduction (Bradley et al. 2010; Waters et al. 2011). Friedkin provides no direct evidence of these Clovis blank selection strategies either because BCC knappers did not select nodules and macroflakes for reduction or evidence for these blank-selection preferences are not represented in the BCC assemblage. One BCC biface shows that small flakes were occasionally selected as biface blanks, but the remaining biface fragments offer no evidence of original blank form.

The Clovis assemblage at Excavation Area 8 of the Gault site includes multiple types of bifacial tools. Bifacial cores, choppers, and fluted points have all been recovered (Bradley et al. 2010; Waters et al. 2011). The Clovis assemblage from the Friedkin site yielded only late-stage biface fragments, two point-preform fragments, and the basal corner of a concave-based point, but the channel-flake fragments suggests points were fluted on site. At least two bifacial reduction trajectories are evident in the BCC assemblage, the production of bifacial points and a chopping tool.

Table 6. Debitage (greater than 1.25 cm in size) and modified flake tool counts from Gault Clovis (Waters et al. 2011) and Debra L. Friedkin Clovis and Buttermilk Creek Complex assemblages (percentages in parentheses).

Assemblage		Type		
		Macrodebitage	Flake Tools	*Total*
Gault Clovis	Count	10895 (99.5)	51 (0.5)	10946
	Expected	10885	61	
Debra L. Friedkin Clovis	Count	618 (99.5)	3 (0.5)	621
	Expected	607.6	3.4	
Buttermilk Creek Complex	Count	2245 (99.0)	23 (1.0)	2291
	Expected	2255.4	12.6	
		Likelihood Ratio chi-square		p = 0.013

Table 7. Average size measurements of modified flake tools from Gault Clovis (Waters et al. 2011) and Debra L. Friedkin Clovis and Buttermilk Creek Complex assemblages.

Assemblage	Length (mm)	Width (mm)	Weight (g)
Gault (n=22)	70.4	58.0	58.4
Friedkin Clovis (n=3)	34.8	21.6	3.0
BCC (n=22)	28.2	21.5	4.6
ANOVA p-value	<0.001	<0.001	0.001

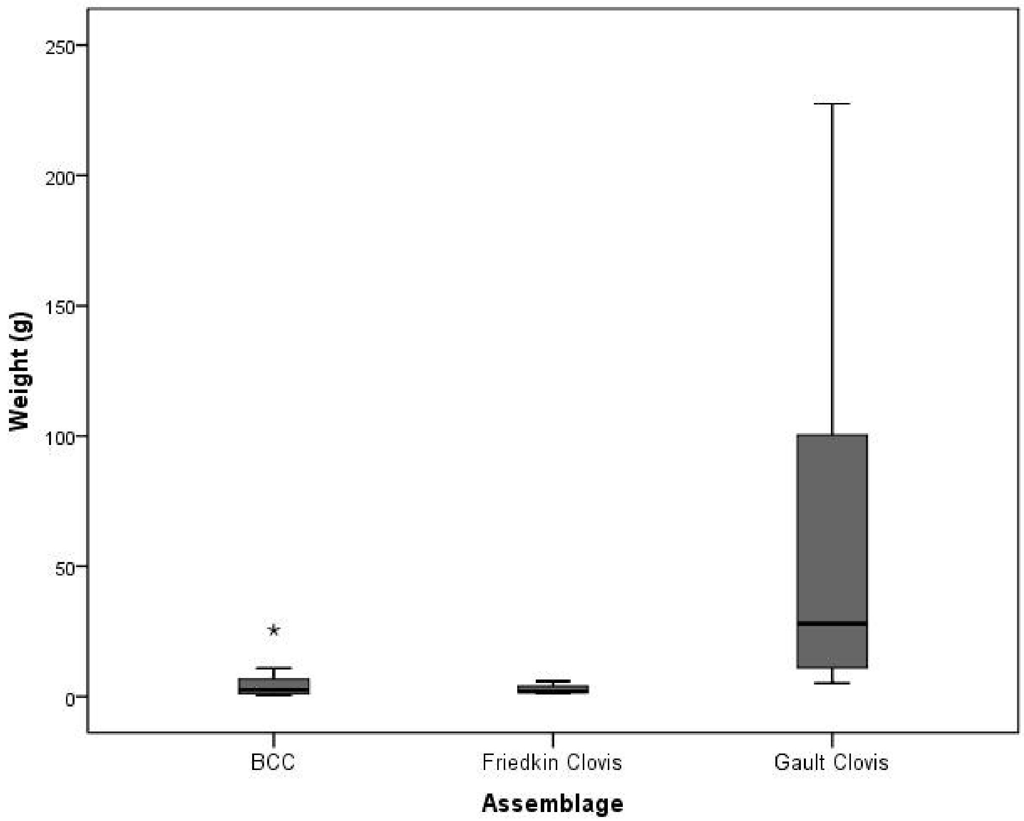

Figure 5. Box plot of Gault Clovis, Friedkin Clovis, and BCC flake tool weights.

Regarding biface thinning, the frequency of overshot flaking significantly differs between Clovis at Excavation Area 8 of the Gault site, the Clovis assemblage from the Friedkin site, and BCC (Table 8). The relative proportion of overshot and partial overshot flakes to biface thinning flakes is significantly greater at Excavation Area 8 of the Gault site, confirming that overshot flaking was an important biface flaking strategy at Gault. While overshot flake scars are present on three bifaces from the Clovis assemblage from the Friedkin site, none occur on BCC bifaces, and overshot flakes are rare in both debitage assemblages. Endthinning flakes occur in the Clovis assemblage at Excavation Area 8 of the Gault site (Waters et al. 2011), although endthinning flake counts and metric features are not reported, and endthinning flakes also occur in the the Clovis assemblage from the Friedkin site, and the BCC assemblage. However, while the Clovis assemblage from the Friedkin site includes channel flakes from projectile point fluting, no channel flakes occur in the BCC assemblage.

Table 8. Biface reduction debitage counts from Gault Clovis (Waters et al. 2011) and Debra L. Friedkin Clovis and Buttermilk Creek Complex assemblages. Percent in parentheses.

Assemblage		Flake Type		
		Biface Thinning	Overshot	*Total*
Gault Clovis	Count	397 (82.7)	83 (17.3)	480
	Expected	440.8	39.2	
Debra L. Friedkin Clovis	Count	141 (99.3)	1 (0.7)	142
	Expected	132.2	11.8	
Buttermilk Creek Complex	Count	433 (99.3)	3 (0.7)	436
	Expected	405.0	36.0	
		Likelihood Ratio chi-square		$p < 0.001$

At Excavation Area 8 of the Gault site, exhausted Clovis fluted points were discarded, and new fluted point preforms were made and occasionally broken during production. Complete, exhausted points average 62.4 mm long (Bradley et al. 2010:Table 3.7). The Clovis assemblage from the Friedkin site contains one corner fragment of a concave-based point as well as three final flute channel flakes. Despite missing a finished Clovis point, these artifacts still suggest that concave-based fluted points were part of the assemblage. The BCC lanceolate fragment is 59 mm long from end to end, but, while unfinished, does not appear to be concave-based. Thus far, then, there is no evidence that BCC knappers were creating fluted concave-based points, and the single lanceolate fragment is smaller even than typical exhausted Clovis points. These highlight potentially important differences in point-production technologies.

At Excavation Area 8 of the Gault site, blades were produced from conical and wedge-shaped blade cores. The platforms from these cores were rejuvenated by the removal of core tablet flakes. Blade cores, core fragments, core tablet flakes, and blades are all present in the Clovis assemblage from Gault (Bradley et al. 2010; Waters et al. 2011). Small blades have also been recovered from Clovis contexts at Gault, but no small-blade cores have been identified (Bradley et al. 2010). While no blade cores or core-tablet flakes have been identified in the the Clovis assemblage from the Friedkin site or the BCC assemblage, blades and bladelets do occur. Measurements of blades, small blades, and bladelets (Figure 6) reveal a continuum of sizes. Gault Clovis blades grade into small blades and overlap with Friedkin Clovis blades and bladelets. BCC blades and bladelets overlap with the small end of Clovis blades and bladelets.

Bradley et al. (2010:58-59) depict seven discoidal cores from Clovis contexts at Gault, and Smallwood (2010) reports one discoidal core from the Topper site in South Carolina. To date, these are the only discoidal cores ever reported from a Clovis site, and they distinctly differ from the BCC discoidal core in size and flaking patterns. While the BCC core measures 42 mm by 41 mm, the Clovis cores average approximately 143 mm by 110 mm. The Gault cores were prepared for the production of large flake-blank removals, and all have flake scars that travel more than half way across the core face. Flake scars on the BCC core are small and terminate at or before the core center. These size and flaking-pattern differences suggest that BCC and Clovis discoidal reduction reflect alternative reduction goals.

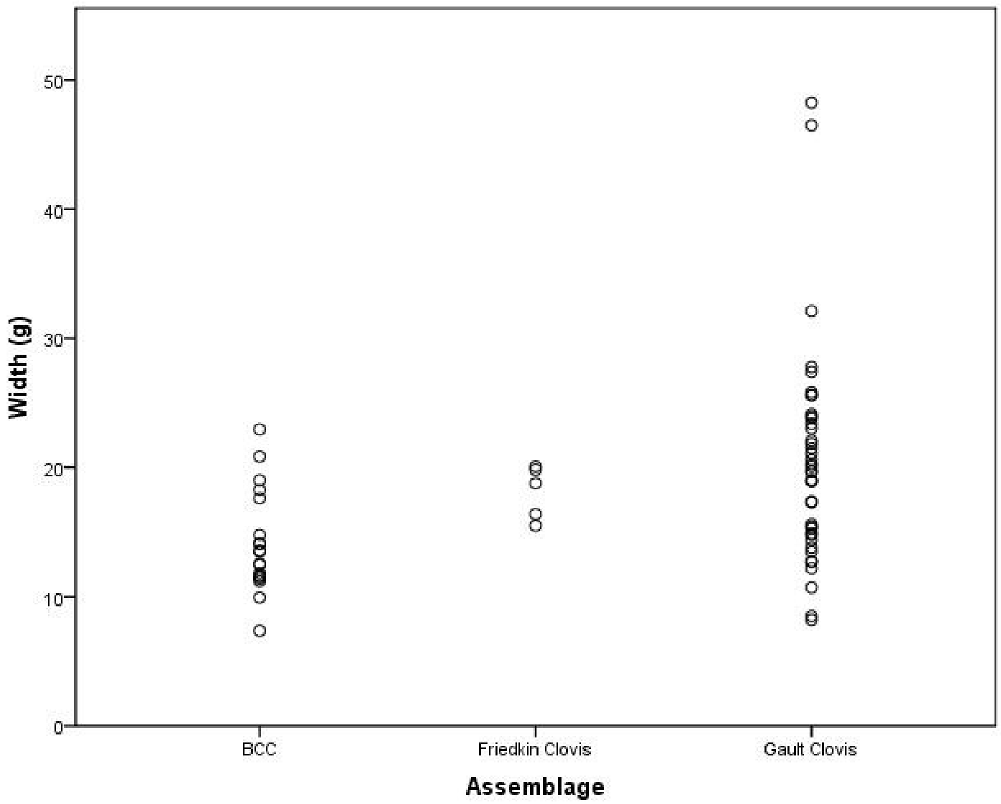

Figure 6. Scatter plot of blade, small blade, and bladelet measurements from Gault Clovis (Bradley et al. 2010; Waters et al. 2011) and Friedkin Clovis and pre-Clovis.

No intentional radial- or bend-fractured bifaces or flakes are reported in the most recent description of Gault Clovis technology (Bradley et al. 2010; Waters et al. 2011), although past researchers may not have been examining bifaces for intentional fracture markers. One broken biface fragment from Excavation Area 8 of the Gault site appears to have been used after fracture (Waters et al. 2011), but it is unclear whether the biface was intentionally fractured. Likewise, no radial- or bend-break tools have been identified in the Clovis assemblage from the Friedkin site. In the BCC assemblage, two broken biface fragments with impact markers are suggestive of intentional fracture.

No retouched bend/radial break flake tools have been identified in the Clovis assemblages from Excavation Area 8 at the Gault site or from the Friedkin site. Two flake tools in the BCC assemblage have retouch on bend/radial break surfaces. Unlike broken bifaces in the BCC assemblage, potential evidence of intentional flake fracture is limited to a single artifact, suggesting these breaks were not purposely created. The presence of these two retouched tools hint at potentially important differences between Clovis and BCC flake-tool blank preferences or tool-use activities. The discovery of Clovis bend/radial-break tools at other Clovis sites (Ferring 2001; McAvoy and McAvoy 2003) suggest activity differences provides the most plausible explanation.

No burins or burin spalls have been found or reported in the Clovis assemblage from Excavation Area 8 of the Gault site or the Clovis assemblage from the Friedkin site. However, five burin spalls occur in the BCC assemblage. Until burins are identified, the purpose of the BCC burin-spall removals will remain unclear, but their presence implies an important behavioral difference.

4.2 Trait-list Comparisons and Culture-historical Connections

Next I turn from site-level behavioral comparisons to general technological comparisons. Five Clovis technological and typological trait lists (Bradley and Stanford 2004; Haynes 2002; Meltzer 2009; Straus et al. 2005; Tankersley 2004) were combined into a single representative list (Table 9). The list includes eleven typological (e.g. side scrapers, end scrapers) and technological (e.g. overshot flaking, blade reduction products) traits. Of these, seven are present in the BCC assemblage. Shared traits include bifacial reduction, blades, and multiple flake tool types.

Table 9. Technological traits used to define Clovis and their occurrence in the Friedkin BCC assemblage.

Clovis Technologies and Tools	Present in BCC
Bifaces	X
Bifaces with overshot flaking	
Fluted projectile points	
Blade cores	
Retouched flakes	X
Retouched blades	
Notches	X
Side scrapers	X
End scrapers	X
Perforators	X

Four traits are absent in the BCC assemblage. These are, bifaces with overshot flaking, fluted projectile points, blade cores, and retouched blades. Are the absences of these traits simply the result of a small sample size of tools in the BCC assemblage? I use Drennan's (2009:251-254) confidence levels for concluding that absence from a sample indicates a low population proportion to evaluate the potential significance of these absences in the BCC sample. This requires first calculating the relative occurrence of bifaces with overshots, fluted points, blade cores, and retouched blades in Clovis tool assemblages. Tool and core counts from six Clovis camp sites (Table 10) were used to calculate the percentage occurrence of bifaces with overshot flaking and fluted points among total bifaces and the percentage occurrence of blade cores and retouched blades among total tools (Table 11). These percentages and artifact counts from the BCC assemblage were then used in Drennan's (2009) confidence level formula. The results show that the absence of retouched blades in the BCC assemblage is significant (Table 12). The absences of fluted points and blade cores are nearly significant. Finally, there is a 17.8% probability that the absence of bifaces with overshot flaking results from the small sample of BCC bifaces. In other words, it is highly probably that lack of fluted points, blade cores, and bifaces with overshots in the BCC assemblage may result from the small artifact sample size. The lack of retouched blades, however,

Table 10. Frequencies of tool types at Clovis sites.

Clovis Technologies and Tools	Freidkin Clovis[1]	Gault[2]	Blackwater Draw[3]	Murray Springs[4]	Aubrey[5]	Topper[6]
Total retouched tools and cores	11	144	127	57	41	257
Bifaces	8	55	24	27	4	69
Bifaces with overshot flaking	3	11	n/a	n/a	0	11
Fluted projectile points	0	4	16	17	1	1
Blade cores	0	31	0	1	0	14
Retouched blades	0	6	41	5	1	2

[1]Chatper III; [2]Waters et al. 2011; [3]Goebel et al. 1991; [4]Huckell 2007; [5]Ferring 2001; [6]Smallwood et al. 2012.

Table 11. Clovis assemblage totals and tool type percentages based on data from Table 10.

Biface Total (BT)	Bifaces with overshots (BwO)	Overshot Percent (100*BwO/BT)	Fluted Points (FP)	Fluted Point Percent (100*FP/BT)	Tool Total (TT)	Blade Cores (BC)	Blade Core Percent (100*BC/TT)	Retouched Blade Total (RB)	Retouched Blade Percent (100*RB/TT)
187	25	13.4	39	20.1	637	46	7.2	55	8.6

Table 12. Percent levels of confidence that the absence of specific Clovis technological tool types in BCC represent meaningful absences based on BCC artifact totals.

BCC Assemblage	BCC Artifact Totals	Percent Confidence (PC)[1]	p-value (100-PC)
Bifaces	12		
Bifaces with overshot flaking	0	82.2	0.178
Fluted projectile points	0	93.2	0.068
Total retouched tools and cores	36		
Blade cores	0	93.1	0.069
Retouched blades	0	96.1	0.039

[1]Calculated following Drennan (2009:251-254).

The Friedkin BCC assemblage also includes lithic technological traits that are not in the Clovis list. These are burin spalls, discoidal core reduction, and intentional radially fractured bifaces. Burins are extremely rare in Clovis, suggesting burin production was not an important Clovis reduction technique (Bradley and Stanford 2004; Straus et al. 2005). As noted, hints of discoidal core reduction in Clovis are evident (Bradley et al. 2010; Ferring 2001; Waters et al. 2011), but these appear to be rare and do not resemble BCC discoidal reduction. Radially fractured bifaces also occur in Clovis (Waters et al. 2011), but are rare, and it is unclear whether Clovis bifaces were intentionally fractured.

5. Discussion

5.1 Is Buttermilk Creek Complex "Clovis"?

This study compares BCC to Clovis on two analytical scales, 1) site-level behaviors and 2) general technological traits. Site-level behavioral comparisons show that Clovis and BCC groups engaged in some similar behaviors at both Friedkin and Gault. In general terms, Clovis and BCC knappers engaged in bifacial reduction, blade/bladelet production, and discoidal core reduction. Clovis and BCC bifacial reduction produced multiple tool forms such as chopping tools and possibly lanceolate points. Biface thinning flakes were used as flake-tool blanks in both industries. Finally, Clovis and BCC blade and bladelet sizes overlap, suggesting similar production goals.

Important site-level behavioral differences are also evident. Artifact and debitage size differences and proportions of cortical debitage demonstrate that lithic reduction at Gault included early- and middle-stage flaking while Friedkin Clovis and BCC reduction largely consisted of late-stage flaking. While Clovis knappers at Excavation Area 8 of the Gault site engaged in early-to-middle-stage reduction and discarded large flake tools and large, cortical debitage, Clovis and BCC knappers at the Friedkin site engaged in late-stage reduction, discarding small tools and small, mostly non-cortical debitage. Clovis and BCC tool production and use activities at Friedkin also clearly differ. Clovis groups at Friedkin focused on biface reduction, fluted point production, and occasional expedient flake-tool use. The Friedkin BCC assemblage and the ratio of tools to debitage suggests a much more diverse set of on-site activities took place, including bifacial and discoidal core reduction, radial fracture of bifaces, expedient flake-tool use, radial/bend break tool use, chopper use, and burin production. Excavation Area 8 at the Gault site, alternatively, is a large-scale Clovis lithic workshop where early-, middle-, and late-stage reduction occurred and numerous blade, biface, and discoidal cores, bifaces, points, and flake tools, including retouched blades, end scrapers, and adzes, were produced, used, and discarded. There is no evidence that BCC knappers produced fluted or concave-based points, and the possible BCC lanceolate point preform is smaller than exhausted and discarded Clovis points. Finally, Clovis knappers at Excavation Area 8 of the Gault site clearly relied on overshot flaking to reduce bifaces, and multiple bifaces from the Clovis assemblage at the Friedkin site retain overshot flake scars. Unlike the Clovis assemblage at the Friedkin site, evidence of BCC overshot flaking is limited to three debitage pieces but no bifaces with overshot scars, suggesting overshot flakes were not regularly removed.

On a broader scale, general technological comparisons also reveal important similarities and differences between Clovis and BCC complexes. Trait-list comparisons demonstrate that multiple technological traits considered to be representative of Clovis also occur in the Friedkin BCC assemblage. These include bifacial reduction, blades, and multiple flake tool types. However, the Clovis trait list also includes traits not present in the BCC assemblage. Notably absent from BCC are fluted points, blade cores, and retouched blades, and their absences do not appear to result from sample size issues. This suggests that the absence of fluted points, blade cores, and retouched blades represent real technological differences between BCC and Clovis. Based on the current BCC sample, the absence of bifaces with overshot flaking could result from the small sample of BCC bifaces and is, therefore, an inconclusive line of evidence. The trait list similarities suggest a potential culture-historical connection could exist between Clovis and BCC, but the differences also suggest some degree of separation.

Based on behavioral and trait-list technological comparisons, BCC cannot be called "Clovis." Grouping BCC under the Clovis umbrella would require, at a minimum, evidence of fluted-point manufacture and evidence that early- and middle-stage biface and blade core reduction and tool production followed Clovis trajectories with Clovis knapping strategies. In addition, a greater understanding of the nature and importance of burin, discoidal, and radial-break technologies within BCC technological organization is necessary. While acknowledging these important differences, the numerous similarities between BCC and Clovis technologies also cannot be ignored, and these suggest Clovis and BCC may share technological histories.

6. Conclusions

With an assemblage of over 15,000 lithic artifacts from deposits dating between 13,200 and 15,500 BP, the Debra L. Friedkin site provides new information on the site-level behaviors and technological organization of early North American inhabitants and offers an opportunity to begin directly comparing pre-Clovis and Clovis assemblages. In this paper, I compared the BCC assemblage from the Friedkin site to Clovis assemblages from the Friedkin and Gault sites using site-level behavioral analysis. I also employed a more general approach and compared BCC technology to Clovis using technological and typological trait-list comparisons. Based on key behavioral and technological differences, I argue that the BCC pre-Clovis assemblage cannot be considered "Clovis." The site-level behavioral comparisons between Friedkin and Gault, however, demonstrate that caution must be exercised when interpreting these differences. Given that assemblages from multiple sites including workshops, camps, kills, and caches are necessary to gain a full picture of Clovis site-level behavioral organization, there can be no doubt that we have much to learn about the full range of site-level BCC technological behaviors.

The behavioral and technological similarities outlined in this paper are consistent with hypothesis that Clovis could be derived from Friedkin BCC lithic technology (Waters et al. 2011). If BCC transitioned into Clovis, what did this process look like? Pre-Clovis discoidal reduction, burin production, and radial biface fracture became less important while blade and biface reduction became dominant in Clovis, and the endthinning of bifaces intensified, culminating in fluted Clovis projectile points. It is unlikely that the suite of archaeological signatures that we currently use to describe Clovis all developed instantaneously (Waguespack 2007). We should expect that certain technological traits, such as wedge-shaped blade core reduction, overshot thinning of bifaces, or fluted-point production, developed at different times. It stands to reason, therefore, that it will be difficult to distinguish the latest pre-Clovis sites from the earliest Clovis sites. Likewise, the earliest pre-Clovis sites may bear little resemblance to Clovis.

Friedkin is one of a growing number of sites that provide evidence for human occupation in North America by 14,000-15,000 BP (Goebel et al. 2008; Waters et al. 2011). Others include Meadowcroft Rockshelter, Pennsylvania (Adovasio and Pedler

2004), Schaefer and Hebior, WI (Joyce 2006), Page-Ladson (Webb 2005), and Paisley Caves, OR (Jenkens 2007). While the lithic assemblages from many of these sites are small, some patterns are emerging. Bifacial technology is evident at Friedkin, Hebior, and Meadowcroft, and bladelets have been recovered from Friedkin, Schaefer, and Meadowcroft. Documenting the cultural changes that took place between first colonization of North America and the Clovis fluorescence, and further testing the hypothesis that Clovis is descended from an ancestral North American pre-Clovis techno-complex will require continued efforts to expand our sample of pre-Clovis archaeological sites to provide a more complete picture of pre-Clovis behavioral and technological organization across space and time. Finally, to fully understand how the peopling of the Americas unfolded, we must begin to compare pre-Clovis to late Pleistocene Beringian and Siberian archaeological complexes (Straus et al. 2005).

CHAPTER III

THE HOGEYE CLOVIS CACHE: QUANTIFYING BIFACE REDUCTION SIGNATURES

1. Introduction

Clovis fluted points were first discovered and defined at sites in the Great Plains and Southwest (Howard 1933; Sellards 1952; Wormington 1957). Since these initial discoveries, Clovis points have been found across North and Central America (Bradley et al. 2010; Haynes 2002). The continental-scale Clovis distribution has sparked efforts to describe regional Clovis expressions.

It soon became apparent that Clovis settlement and subsistence adaptations indeed varied regionally. While Clovis settlement patterns in the Plains reflect high residential mobility (Kelly and Todd 1988), patterns in the East suggest that Clovis groups settled into resource rich locations and were less residentially mobile (Anderson 1996). In the Northeast, settlement patterns instead reflect the colonization of recently deglaciated landscapes and seasonal resource exploitation (Ellis 2011). Regional subsistence differences are also evident. Large game, particularly mammoth, was a major component of Clovis diets in the Plains and Southwest (Surovell and Waguespack 2008), but Clovis diets in the Eastern Woodlands appear to have incorporated a broader range of resources (Cannon and Meltzer 2008; Gingerich 2011; Meltzer 1988).

Research documenting variation in Clovis lithic technology has centered on morphological analyses of finished fluted points. Morrow and Morrow (1999a) identified longitudinal and latitudinal clines in Clovis point stylistic variation across North and Central America. The existence of regional stylistic Clovis variation has been confirmed by additional morphometric studies (Buchanan and Collard 2007; Ellis 2004; Smith 2010).

The Clovis lithic reduction process, however, is a comparatively underutilized resource for investigating Clovis variation. Reconstructing Clovis flaking decisions *during the reduction process*, can potentially facilitate the identification of Clovis strategies for overcoming challenges presented by different stone packages. Further, in cases where raw material differences can be ruled out as a driving variable, flaking differences may help reveal local or regional Clovis knapping traditions.

Clovis lithic reduction strategies have been well-described in general terms (Bradley 1982; Bradley et al. 2010; Callahan 1979), and numerous individual Clovis assemblages have been thoroughly analyzed (e.g. Hester 1972; Huckell 2007; Waters et al. 2011), few studies have directly quantified Clovis lithic technological strategies throughout the reduction process for regional comparisons. Notable exceptions include Morrow and Morrow's (1999b) study in which they argue that evidence of Midwestern fluted-point variants can be identified by unique endthinning (flute) scar attributes. Recent analyses of the entire reduction sequence, however, demonstrate Midwestern fluted-point makers indeed employed overshot flaking during the early stages of reduction (Ellis and Deller 2000; Eren et al. 2011), suggesting that reconstructing the entire point production process is necessary to fully understand regional technological variation. Smallwood (2012) has produced the most comprehensive comparative technological study to date. By reconstructing the entire Clovis biface reduction process from three sub-regions in the Southeast, she provides the first evidence of unique sub-regional thinning and shaping signatures. These studies show that a clear need exists for the additional quantification of Clovis lithic reduction strategies and the development of regional-scale comparative methods.

This paper presents the technological analyses of 52 Clovis bifaces cached at the Hogeye site, Texas. The results help to define signatures of biface reduction which may then be used to identify potential sources of Clovis technological variation.

2. Materials

A total of fifty-two Clovis bifaces were recovered from the Hogeye site. Hogeye is a multicomponent site in the Gulf Coastal Plain of central Texas (Figure 7). The site is located approximately 40 km east of the Balcones Escarpment and sits at the confluence of two streams which ultimately drain into the Colorado River.

The cache was first discovered in 2003 during a sand quarrying operation. Above the site is a hill composed of sandstone, and the bedrock slopes gently towards the streams. The artifacts are contained within a colluvial fan comprised of sands eroding from the hill. The Clovis bifaces were removed from the base of the 3 m thick sand deposits.

In 2003, Clovis 36 bifaces were recovered by quarry employees. Following their discovery, the plant manager ordered all sand quarrying in that portion of the site to be stopped, and all remaining piles of sand were left unprocessed. In 2010, archaeologists

Figure 7. Map showing the location of the Hogeye site and Edwards Formation.

from Texas A&M University investigated the discovery site. Test excavations recovered no *in situ* Clovis bifaces, and no debitage from biface manufacture or Clovis blade reduction. When the unprocessed sand piles were screened, however, an additional 16 Clovis bifaces were recovered. Again, no debitage was recovered. The initial reports, which describe the bifaces as coming from the same, single location within the sand deposits, combined with the absence of any Clovis reduction debris suggest that the bifaces were intentionally cached at the site.

Bifaces in the 52 piece cache (Figure 8) display hallmark Clovis flaking elements including overshot flaking, endthinning, and some are classically shaped fluted Clovis points (Bradley et al. 2010; Smallwood 2010; Waters et al. 2011). Bifaces were assigned to two of the four reduction stages (early, middle, late, and finished point) employed by others (Smallwood 2010; Waters et al. 2011) based on the amount of cortex, extent of flaking, and edge sinuosity. The Hogeye cache includes only late-stage bifaces and finished points. Late-stage bifaces have no cortex, sinuous edges, and inconsistent edge retouch. Finished points have no cortex, minimally sinous-to-straight edges, and finely retouched edges around the entire piece. Two distinct reduction trajectories are evident, projectile point and knife/core. Point-trajectory bifaces dominate the assemblage and are distinguished by a lanceolate shape with a straight-to-concave base and a pointed tip. Of these, 33 are complete late-stage bifaces, one is a late-stage midsection, 12 are complete finished points, and one is a finished point base. None of the finished points exhibit evidence of resharpening, none have grounded basal edges, and all appear to represent

Figure 8. The 52 Hogeye Clovis cache bifaces (adapted from an image courtesy of Joshua L. Keene).

unused points. The final five Hogeye bifaces are classified as knife/core bifaces. These are distinguished by an ovoid shape, two rounded ends, and no clear base or tip. All bifaces are made from the same gray variety of Edwards chert, and the nearest chert outcrop lies 40 km west of the Hogeye site.

3. Methods

To identify potentially unique Clovis biface reduction signatures, a series of technological attributes were recorded and measured (Eren et al. 2011; Morrow 1995; Morrow and Morrow 1999a; Smallwood 2012). For each biface, weight, maximum length, width, and thickness were measured, width:thicknes and length:width ratios were calculated, and coefficients of variation (CV) were calculated. The incidence and directionality of overshot (scars that removed a portion of the opposite biface edge) and overface (scars that travel past the biface midline but either have terminations obscured by subsequent flaking or did not reach the opposite edge) flake scars were recorded on both faces of each biface. For bifaces with complete overshot scars, the width of the biface was measured along the scar midline. The presence/absence of endthinning flakes were recorded, and scar types were classified as simple, multiple, and composite. Endthinning scar measurements include length and width. Biface thicknesses were also measured 25 mm up from the base. These variables were used to measure the tempo of reduction, overshot and endthinning flake scar attributes, and patterns in overshot flaking directionality. Because two distinct reduction trajectories were identified, point-trajectory bifaces were analyzed separately from knife/core-bifaces.

Tempo of reduction was estimated following Smallwood (2012). Widths and thicknesses were averaged for each stage. These averages were then used to calculate the percent width and thickness loss between stages. The timing of last overshot flaking was estimated by identifying bifaces that retain overshot scars that cross an entire face. Within this subsample, the widths of the bifaces across these complete overshot scars, maximum biface widths, and maximum thicknesses were compared. These comparisons were then used to estimate when in the reduction process knappers stopped removing overshot flakes.

Finally, the following two equations were developed to quantify overshot and overface flaking directionality.

1) abs(#RL face A + #RL face B - #LR face A - #LR face B), and

2) abs(#RL face A + #LR face B - #LR face A - #RL face B)

For each biface, #RL is the total number of overshot and overface flake scars that travelled right-to-left across a face, and #LR is the number of scars that travelled left-to-right. The absolute value (abs) ensures both equations return positive values. Equation 1 quantifies the difference between the total number of right-left and left-right scars for both faces of a biface. Equation 2 quantifies the total number of flake scars on both faces that were removed from a single, shared bifacial edge.

Together, these equations are used to distinguish between three potential flaking patterns, alternate-opposed flaking, dual-edge serial flaking, and shared-edge serial flaking. As described by Bradley (1993; Bradley et al. 2010; also Waters et al. 2011), alternate-opposed flaking occurs when a flake is removed from one bifacial edge followed by a flake driven across the same face from the opposite edge, and the pattern is repeated on both faces. The biface is rotated between each flake removal. The two serial flaking patterns have never been quantified for Clovis biface reduction and are defined here. Serial flaking refers to the serial removal of flakes that travel in the same direction. Dual-edge serial flaking involves removing a series of flakes from one bifacial edge across one face followed by removing a series of flakes from the opposite bifacial edge across the opposite face. This is achieved by flaking one face and turning the biface like turning the page of a book to flake the opposite face. Page-turning results in flake scars that travel in the same direction on both faces. Shared-edge serial flaking involves the serial removal of flakes across one face followed the serial removal of flakes across the opposite face using the same bifacial edge as the platform for both sets of flake removals. This is achieved by flaking one face and flipping the biface end-over-end to flake the opposite face. End-flipping results in flake scars that travel in opposite directions on each face.

Returning to the above equations, it is expected that Hogeye cache bifaces with alternate-opposed flaking yield values of 0-3 for *both* equations. It is expected that bifaces with values of 4 or greater for equation 1 display the dual-edge serial flaking pattern and bifaces with values of 4 or greater for equation 2 display the shared-edge serial flaking pattern. As with many models developed to quantify patterns of human behavior, these equations are imperfect and conflicting values may arise. They do, however, provide a beginning for identifying distinct biface flaking patterns.

4. Results

4.1 Point Trajectory Tempo of Reduction and Thinning Techniques

Late-stage bifaces in the Hogeye cache are significantly larger than finished points (Table 13, Figure 9). Late-stage bifaces are heavier, longer, wider, and thicker. The shape ratios of width/thickness and length/width also significantly differ and demonstrate that late-stage biface to finished point production involved a greater reduction in biface width relative to both thickness and length. CV values show that by every size measure, finished points exhibit greater variability than late-stage bifaces (Table 14). Finished point shape ratios, however, are considerable less variable than late-stage biface shape ratios. CV comparisons show that while finished point sizes were allowed to vary, specific shape goals were achieved.

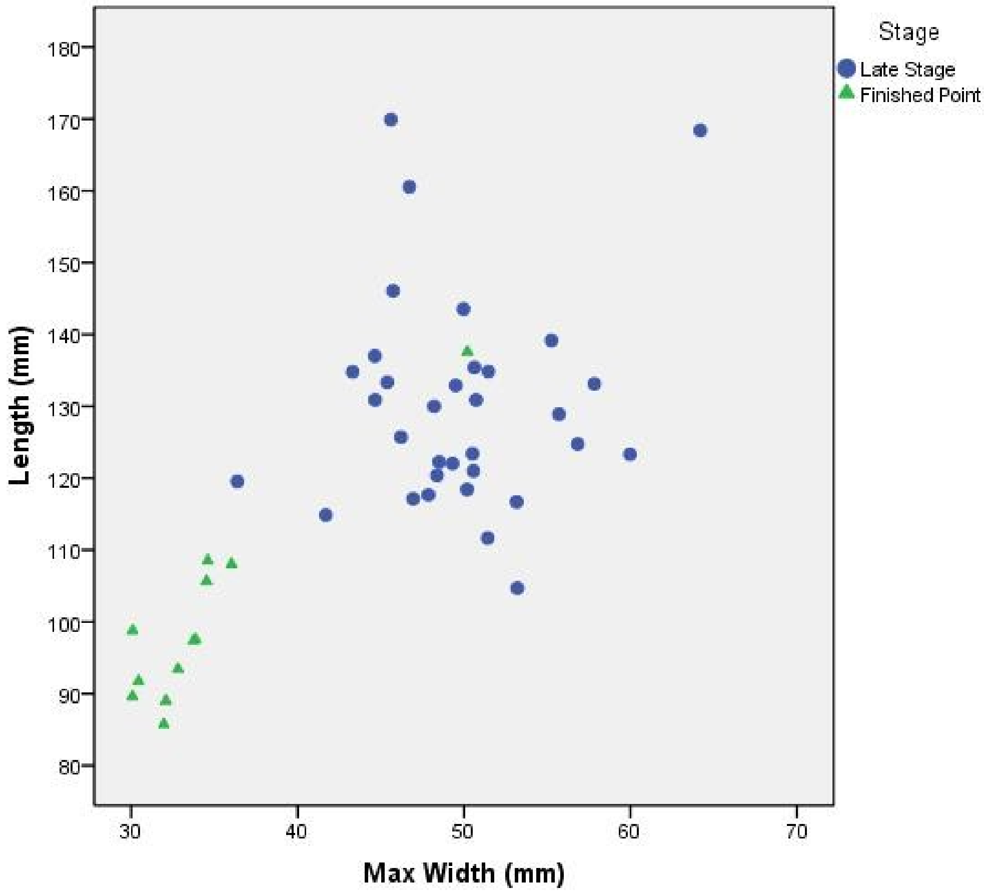

Figure 9. Scatter plot of late-stage biface and finished point lengths and widths.

Percent-loss provides a measure of the amount of reduction that took place between stages (Table 13). Between late-stage bifaces and finished points in the Hogeye cache, 57.1% of the mass was removed. This primarily involved the reduction of width (31.5% loss), but length (22.4% loss) and thickness (18.0% loss) were also reduced. The width and thickness losses correspond to Smallwood's (2012) fast and slow reduction tempos, respectively.

Table 13. Average late-stage and finished-point biface measurements.

Biface Group	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Width/Thickness	Length/Width
Late Stage	81.3	130.1	49.7	10.0	5.0	2.6
Finished Point	34.9	100.3	34.2	8.2	4.3	2.9
Mann-Whitney U p-value	<0.001	<0.001	<0.001	<0.001	<0.001	0.005
Percent-loss	57.1	22.9	31.2	18.0		

Table 14. CV values for late-stage and finished-point measurements.

Biface Group	Weight	Length	Width	Thickness	Width/Thickness	Length/Width
Late Stage	21.9	11.4	11.0	8.8	12.2	15.0
Finished Point	50.7	13.9	15.8	12.8	9.0	5.9

Table 15. Counts of late-stage and finished-point bifaces with evidence of at least one overshot scar termination.

Biface Group	Overshots Absent	Overshots Present
Late Stage (expected)	17 (20)	17 (14)
Finished Point (expected)	10 (7)	2 (5)
Likelihood ratio chi-square p-value	0.035	

In terms of the timing of last overshot flaking, nineteen point-trajectory bifaces in the Hogeye cache display evidence of at least one overshot flake scar termination (Table 15). Compared to late-stage bifaces, significantly fewer finished points have at least one overshot scar termination. Because many of these scars consist of only termination fragments, it is possible that they represent unretouched scars from overshot flakes that were removed earlier in the reduction process. In other words, a fragmentary overshot scar termination on a late-stage biface does not necessarily mean that the overshot flake was removed during late-stage reduction. Complete overshot scars with unretouched initiations and terminations, however, provide direct evidence of the most recent overshot flake removals. Eleven bifaces have complete overshot scars, and all are late-stage bifaces (Table 16). This demonstrates that overshot flaking indeed occurred during late-stage reduction but not during finished point production. Measurements of these bifaces suggest that overshot flaking ceased once bifaces reached approximately 55.4

mm wide and 9.8 mm thick, and the last overshot flakes average a minimum of 42.2 mm.

All but one point-trajectory biface have endthinning scars on at least one face (Table 17). Three late-stage bifaces have endthinning scars on only one face. All finished points have endthinning scars on both faces, and at this stage, these scars are by definition flutes. While scar lengths to not differ between point-trajectory biface categories, finished point scar widths are significantly narrower. Finished points are also significantly thinner 25 mm from the basal edge. Table 18 shows the counts of faces that have endthinning scars classified as none, simple, multiple, or composite, as defined by Morrow (1995). Interestingly, all four endthinning types are represented in the Hogeye cache. Most faces display simple endthinning scars followed by composite scars. These traits demonstrate that Hogeye Clovis bifaces were basally thinned before and during the final stages of point production.

Table 16. Measurements of bifaces with at least one complete overshot scar.

Hogeye Biface Number	Biface Group	Width within Overshot Scar (mm)	Width (mm)	Thickness (mm)
3	Late Stage	47.5	48.2	9.8
4	Late Stage	45.4	45.7	9.6
7	Late Stage	29.4	75.6	11.5
10	Late Stage	45.6	63.4	9.0
14	Late Stage	39.6	81.3	10.0
14	Late Stage	53.9	81.3	10.0
16	Late Stage	47.9	50.7	9.9
20	Late Stage	26.9	44.7	8.8
21	Late Stage	34.8	36.4	8.2
22	Late Stage	43.6	42.1	9.5
23	Late Stage	44.6	45.4	10.1
37	Late Stage	47.7	50.2	10.9
	Average	42.2	55.4	9.8

Table 17. Biface endthinning attributes.

Biface Group	Neither Face Endthinned	Single Face Endthinned	Both Faces Endthinned	Scar Length Avg. (mm)	Scar Width Avg. (mm)	Thickness at 25 mm (mm)
Late stage	1	3	29	36.4	24.0	6.4
Finished Point	0	0	12	30.5	19.6	5.6
Knife/Core	2	3	0			
Mann-Whitney U p-value[1]				0.051	<0.001	0.004

[1]Comparison does not include knife/core bifaces.

Table 18. Late-stage and finished-point biface endthinning types.

Biface Group	No Endthinning	Simple	Multiple	Composite
Late Stage	5	48	3	10
Finished Point	0	16	0	8

Table 19. Counts of overshot and overface flake scars by direction and flaking equation scores for complete bifaces that display alternate-opposed (AO), dual-edge-serial (DES), and shared-edge-serial (SES) flaking patterns.

Biface Group	#Side A Left-to-Right	#Side A Right-to-Left	# Side B Left-to-Right	# Side B Right-to-Left	Equation 1 Score	Equation 2 Score	Flaking pattern
Late-Stage	0	1	3	0	2	4	SES
Late-Stage	1	1	1	1	0	0	AO
Late-Stage	1	1	2	1	1	1	AO
Late-Stage	2	2	3	1	2	2	AO
Late-Stage	1	4	2	1	2	4	SES
Late-Stage	5	1	4	0	8	0	DES
Late-Stage	2	2	1	2	1	1	AO
Late-Stage	1	3	2	2	2	2	AO
Late-Stage	2	1	1	2	0	2	AO
Late-Stage	1	2	1	3	3	1	AO
Late-Stage	1	4	1	3	5	1	DES
Late-Stage	0	4	4	0	0	8	SES
Late-Stage	1	1	1	1	0	0	AO
Late-Stage	1	1	2	1	1	1	AO
Late-Stage	0	3	7	0	4	10	SES
Late-Stage	0	2	0	2	4	0	DES
Late-Stage	0	4	1	4	7	1	DES
Late-Stage	2	3	2	1	0	2	AO
Late-Stage	1	1	4	1	3	3	AO
Late-Stage	1	1	1	3	2	2	AO
Late-Stage	1	1	2	2	0	0	AO
Late-Stage	2	2	0	4	4	4	
Late-Stage	1	4	4	0	1	7	SES
Late-Stage	4	0	3	1	6	2	DES
Late-Stage	0	4	1	3	6	2	DES

Table 19. Continued.

Biface Group	#Side A Left-to-Right	#Side A Right-to-Left	# Side B Left-to-Right	# Side B Right-to-Left	Equation 1 Score	Equation 2 Score	Flaking pattern
Late-Stage	1	4	0	1	4	2	DES
Late-Stage	2	3	1	1	1	1	AO
Late-Stage	3	1	2	2	2	2	AO
Late-Stage	1	3	2	1	1	3	AO
Late-Stage	1	1	0	2	2	2	AO
Late-Stage	1	2	5	0	4	6	SES
Late-Stage	2	1	1	1	1	1	AO
Late-Stage	2	1	3	0	4	2	DES
Finished Point	1	3	3	1	0	4	SES
Finished Point	4	0	3	1	6	2	DES
Finished Point	4	1	4	1	6	0	DES
Finished Point	0	1	1	2	2	0	AO
Finished Point	2	1	3	1	3	1	AO
Finished Point	0	1	2	2	1	1	AO
Finished Point	1	3	3	0	1	5	SES
Finished Point	0	2	1	1	2	2	AO
Finished Point	2	0	0	1	1	3	AO
Finished Point	3	1	1	1	2	2	AO
Finished Point	1	1	0	0	0	0	AO
Finished Point	1	4	1	3	5	1	AO
Knife/Core	0	5	5	0	10	0	DES
Knife/Core	5	0	0	6	11	1	DES
Knife/Core	1	1	3	1	2	2	AO
Knife/Core	1	2	2	3	0	2	AO
Knife/Core	1	1	1	4	3	3	AO

4.2 Point Trajectory Flaking Directionality

All complete bifaces in the Hogeye cache have two or more total overshot and overface flake scars (Table 19). Based on dominant flake scar directionality as calculated by flaking equations 1 and 2, bifaces reduced by alternate-opposed, dual-edge-serial, and shared-edge-serial flaking were identified (Figure 10). Forty-four percent of the Hogeye bifaces display serial flaking. A single biface had values of 4 for both flaking equations and, therefore, could not be assigned to a specific serial flaking pattern.

All three flaking patterns are represented by individual bifaces within the late-stage and finished-point biface categories, suggesting all three flaking strategies were used to reduce bifaces and create Clovis points. The average measurements of late-stage bifaces and finished points do not significantly differ between the three flaking pattern groups (Table 20). Further, biface shapes, as reflected in width:thickness and length:width ratios, also do not significantly differ. Alternate-opposed, dual-edge-serial, and shared-edge-serial flaking were used to create bifaces with the same size dimensions and same relative forms.

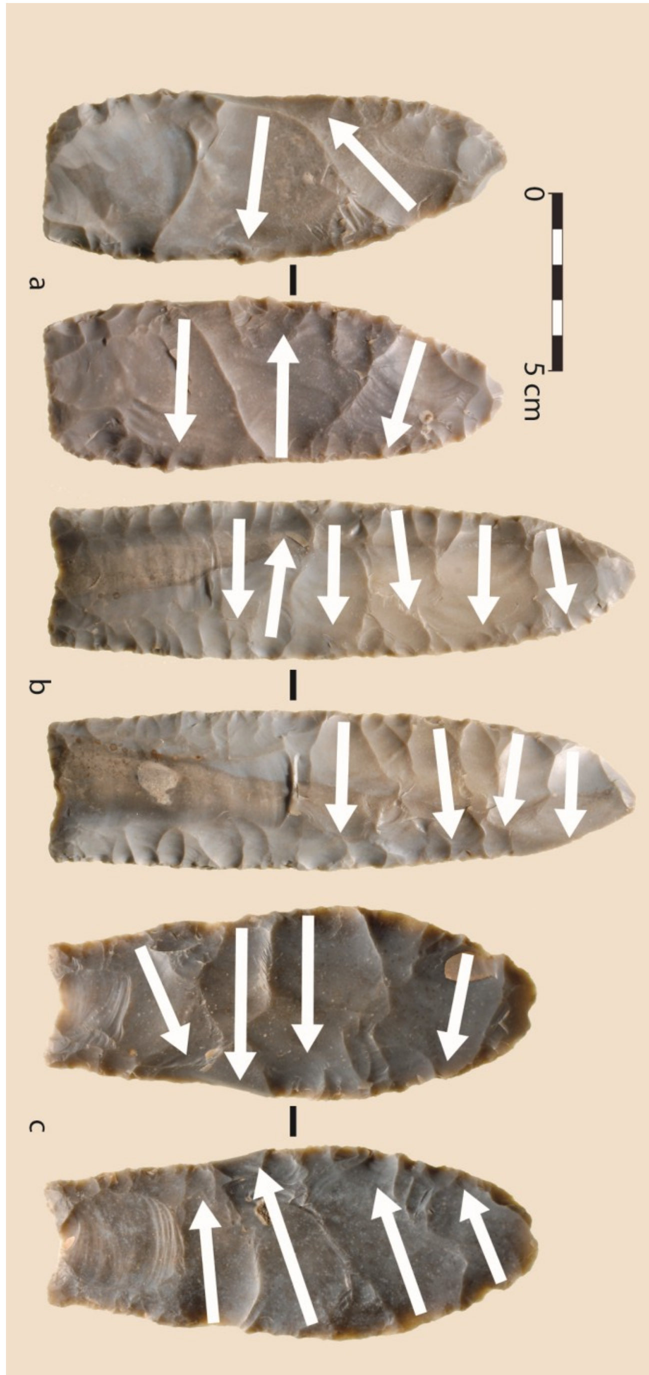

Figure 10. Examples of bifaces that display alternate-opposed (a), dual-edge-serial (b), and shared-edge-serial (c) flaking patterns (adapted from an image courtesy of Joshua L. Keene).

Table 20. Average measurements and shape ratios for point trajectory bifaces in the three flaking pattern groups.

Flaking Pattern	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Width/Thickness	Length/Width
Alternate-opposed (n=24)	64.5	117.7	44.4	9.4	4.7	2.7
Dual-edge serial (n=11)	77.4	129.7	48.0	9.4	5.1	2.7
Shared-edge serial (n=8)	72.4	127.0	46.2	9.8	4.7	2.8
Kruskal-Wallis p-value	0.494	0.401	0.560	0.880	0.512	0.987

Table 21. Measurements and shape ratios of bifaces/cores.

Biface Category	Weight (g)	Length (mm)	Max Width (mm)	Thickness (mm)	Width/ Thickness	Length/ Width
Knife/core	154.7	166.8	67.2	9.3	7.2	2.5
Knife/core	187.7	197.7	64.3	12	5.4	3.1
Knife/core	221.1	199.3	88.4	11.3	7.8	2.2
Knife/core	72.3	122.5	60.0	7.9	7.6	2.0
Knife/core	111.7	142	67.1	9.6	7.0	2.1

4.3 Kife/Cores

Five knife/core bifaces were identified in the Hogeye cache. While they are late-stage bifaces in terms of the extent of reduction and flaking, they differ from late-stage bifaces in the point production trajectory in both shape and size. In addition to their dual rounded ends, knife/core bifaces are generally heavier, longer, and wider than point-trajectory bifaces (Table 21). Knife/core thicknesses, however, fall within the range of point-trajectory bifaces. Three knife/cores have an endthinning removal on one face, two have no endthinning removals, and all have multiple overshot or overface flake scars. Flake scar directionality shows that bifaces in the knife/core trajectory were also reduced by both alternate-opposed and serial flaking.

5. Discussion

Analyses of the Hogeye Clovis cache provides new insights into Clovis knapping signatures. Bifaces from two separate reduction trajectories, projectile point and knife/core, were cached at the site. Reducing late-stage bifaces into finished Clovis points at Hogeye involved significant reduction in all biface dimensions, and while finished point sizes were allowed to vary, specific shape goals were achieved. The tempo of width reduction was fast, and the tempo of thickness reduction was slow. Bifaces were reduced using lateral overshot and overface flaking along with endthinning. Overshot flaking appears to have been abandoned as a thinning strategy after biface widths and thicknesses were reduced beyond 55.4 mm and 9.8 mm, respectively. Three lateral flaking patterns were identified, alternate-opposed, dual-edge-serial, and shared-edge serial, and these patterns were used to produce bifaces and finished points of equal sizes and shapes. Less can be said regarding the knife/core trajectory. These bifaces are long and wide but still exceptionally thin, and they were laterally thinned using the same techniques evident on point-trajectory bifaces.

What do these Hogeye technological signatures tell us about Clovis? Because caches capture behaviors at a narrow moment in time, Hogeye biface production was potentially guided by two scales of stylistic variation. On the one hand, because of the likelihood that the Hogeye bifaces were made by only a handful of knappers, technological traits may reflect idiosyncratic choices made by individuals with personal preferences for knapping techniques and biface sizes and shapes. On the other hand, the Hogeye bifaces also must possess elements of accepted cultural norms that defined how Clovis bifaces and points "should be made" at the band or regional scale.

Distinguishing between these two scales of stylistic variation is extremely difficult and cannot be accomplished by the analysis of a single cache or a single site. Identifying meaningful variation at the individual scale requires multiple site-level comparisons that define morphological and technological variants that are either unique to an individual site/assemblage or show no spatial patterning within and between regions or sub-regions. Identifying meaningful variation at the regional scale requires comparisons of multiple assemblages across space (c.f. Buchanan and Collard 2007; Ellis 2004; Morrow and Morrow 1999a; Smallwood 2012; Smith 2010). These studies define unique morphological and technological variants that are consistently expressed *within* individual regions and sub-regions but that are not shared *between* regions or sub-regions.

Without additional comparisons, I cannot say whether the Clovis technological signatures identified in this paper represent individual-scale or regional-scale stylistic signatures. It is clear, however, that the Hogeye cache bifaces do morphologically and technologically differ from Clovis points within the Texas sub-region as well as in from Clovis biface reduction signatures defined in other regions. The Hogeye finished points average 100.3 mm in length, providing additional evidence that 100 mm was the length goal for Clovis point production the region (Collins and Hemmings 2005). This differs from Clovis point production goals further east where point preform sizes vary considerably (Smallwood 2010). Finished points in Bever and Meltzer's (2007) Texas sample Smallwood's (2012) Southeastern sample also have considerably higher coefficients of variation than Hogeye points for all size and shape measures. These differences may reflect the relatively standardized production goals evident in unused Hogeye points and the accumulation of considerable variation that developed as points were used, broken, resharpened, and ultimately discarded. Smallwood (2012) reports reduction tempos for late-stage to finished point reduction at three eastern Clovis sites, Carson-Conn-Short (TN), Topper (SC), and Williamson (VA). Compared to these sites, the Hogeye bifaces display a unique combination of width and thickness late-stage reduction tempos. Finally, Hogeye average late-stage endthinning scar lengths (36.4 mm) are also much longer than average late-stage scar lengths from bifaces at Carson-Conn-Short (26.2 mm), Topper (10.83 mm), and Williamson (19.0 mm). Perhaps the longer Hogeye endthinning scars were necessary to successfully haft the 100 mm-long finished Hogeye Clovis points.

The timing of last overshot flaking and the alternate-opposed, dual-edge-serial, and shared-edge-serial flaking patterns identified in this paper from analysis of Hogeye bifaces have never before been quantified. While overshot flaking is considered a diagnostic Clovis reduction technique (Bradley et al. 2010; Waters et al. 2010), analyses in this paper suggest that overshot flaking ceased once biface widths were reduced beyond 55 mm. Likewise, while alternate-opposed flaking is often referenced in generalizations of Clovis flaking strategies (Bradley 1982; Waters et al. 2010), the 44 percent of Hogeye cache bifaces that display serial flaking patterns demonstrate that other important flaking patterns have been overlooked.

In addition to these point production signatures, the Hogeye cache informs on a second Clovis biface reduction trajectory, knife/core production. Large, ovoid Clovis bifaces have been recovered from a number of Clovis sites (Kilby 2008). The exact function of bifaces in the knife/core trajectory is unknown (Collins et al. 2007). Their large size suggests they could serve as cores for flake tools. However, their thicknesses suggest they may have been designed as knives. The width/thickness ratios are similar to those of Folsom ultrathin bifacial knives (Bamforth 2003). Finally, they could also be converted to point-trajectory bifaces with additional thinning and shaping. Regardless, their frequent occurrence in caches demonstrates knife/core bifaces were an important component of the Clovis logistical hunting toolkit in the Plains (Kilby 2008).

Assessing whether the Hogeye Clovis technological signatures identified in this paper reflect regional-scale norms or individual idiosyncrasies requires first comparing Hogeye to other sites in the Southern Plains and then comparing Southern Plains Clovis technological patterns to those identified in other regions. Size and shape goals, tempo of reduction, timing of last overshot flaking, lateral flake scar patterning, and endthinning attributes provide a collection of quantifiable technological measures that can be used to begin identifying regional- and individual-scale variation within Clovis biface reduction technologies.

6. Conclusions

Fluted Clovis points have been found across North America, and their similarities suggest remarkable technological continuity across the continent. New methodologies for measuring morphological variation and new techniques for identifying and quantifying patterns in the entire lithic reduction process, however, are revealing that significant regional variation exists within the technology of Clovis point production. Continued identification of regional Clovis technological signatures has the potential to help us understand how Clovis developed and spread across the continent (Beck and Jones 2010; Buchanan and Collard 2007; Smallwood 2012), how Clovis relates to other potentially contemporaneous techno-complexes (Ellis 2004; Eren et al. 2011; Morrow and Morrow 1999b), and how individual Clovis knappers left their marks on the bifaces they made.

CHAPTER IV

EARLY PALEOINDIAN OCCUPATIONS AT THE DEBRA L. FRIEDKIN SITE: CONTEXT, CHRONOLOGY, AND ASSEMBLAGES

1. Introduction

Clovis, Folsom, and Midland are three of the earliest archaeological complexes in North America. Each was initially defined and is readily distinguished by technological differences in stone projectile points and stone-tool production techniques. Clovis points are large, thick lanceolate bifaces that are fluted, but not fully-fluted (Bradley et al. 2010; Huckell 2007; Smallwood 2010; Waters et al. 2011), and the Clovis complex dates to 13,020-12,710 calendar years before present (BP) (Waters and Stafford 2007) but may span a longer window from 13,450-12,710 calendar years before present (Haynes 1992). Folsom points are small, thin, fully-fluted lanceolate bifaces (Meltzer 2006; Sellet 2004; Wyckoff 1999), and the most recent assessment of Folsom suggests it occurred from 12,730-11,730 BP (Collard et al. 2010). Midland is a third point-type that frequently co-occurs with Folsom. Less is known about Midland and its relationship to Folsom, but Midland is generally assumed to be an un-fluted point technology used in conjunction with Folsom points by the same people (Hofman 1992; Meltzer 2006). Here I consider Folsom/Midland to be part of the same archaeological complex.

The technological transition from Clovis to Folsom/Midland occurred during the terminal Pleistocene shortly after the onset of the Younger Dryas, which began 12,900 BP. Given changing environments during this period (Meltzer and Holliday 2010; Scott

2010), it follows that Clovis and Folsom/Midland adaptations may also have differed. Both Clovis (Fiedel 2004; Hamilton and Buchanan 2007; Haynes 2002; Kelly and Todd 1988; Waguespack and Surovell 2003) and Folsom/Midland (Amick 2000; Bement 1999; Hofman 1999; Kelly and Todd 1988; Meltzer 2006) have been traditionally viewed as highly mobile large-game hunters who employed specialized stone technologies to support this mobile lifestyle. However, increasing evidence is showing that substantial regional and even sub-regional adaptive variability may have existed *within* each archaeological complex (Anderson 1996; Andrews et al. 2008; Bamforth 2002; Bement and Carter 2010; Buchannan et al. 2011; Cannon and Meltzer 2008; Gingerich 2011; Prasciunas 2011; Smallwood 2012; Surovell 2009). These evolving views of Clovis and Folsom/Midland adaptations complicate cross-cultural interpretations. As a consequence, multiple scales of comparisons are necessary to identify the adaptive changes that may have taken place as early Paleoindians adjusted to terminal Pleistocene extinctions and the emerging Holocene climate.

In addition to comparing overall settlement patterns and lithic technological organization across multiple sites at regional or sub-regional scales, it is useful to compare Clovis and Folsom/Midland at smaller scales of reference. One important way to identify adaptive similarities or differences is to compare site-use strategies at places visited by both Clovis and Folsom/Midland. Until now, only three known sites have buried, vertically distinct Clovis and Folsom/Midland components, Blackwater Draw, NM (Hester 1972), Gault, TX (Collins 2007; Waters et al. 2011), and Jake Bluff, OK

(Bement and Carter 2010), and Lubbock Lake (Johnson 1987). The recently discovered Debra L. Friedkin site, TX is now a fifth (Waters et al. 2011).

This paper presents a technological and site-use comparison of a single site, the Debra L. Friedkin site, used by Clovis, and Folsom/Midland groups. Inter-assemblage comparisons are then used to identify similarities and differences in technological organization and site activities.

2. Materials

2.1 The Debra L. Friedkin site, Texas

Debra L. Friedkin is a multicomponent site with buried Clovis and Folsom/Midland components. The site lies along the Balcones Escarpment in central Texas (Figure 11), and is approximately 100 m downstream from the Gault site (Collins 2007; Waters et al. 2011). The site is situated in the ecotone between the Edwards Plateau and Coastal Plain, providing a diverse array of plants and animals. In addition, the site is located along a spring-fed creek, and high-quality Edwards chert is readily available in immediately adjacent uplands and as stream clasts along the creek. The combination of food, water, and stone in this area is likely one reason this drainage has yielded one of the largest concentrations of Paleoindian-aged materials in North America (Collins 2007). Two blocks of units, A and B, have been excavated at the Friedkin site. All artifacts analyzed in this paper were recovered from Block A, and the focus is on the Clovis and Folsom/Midland artifacts recovered during the 2007-2009 excavations comprising a 44 m^2 block of contiguous 1 m^2 units.

2.2 Geology and Dating

The Friedkin site is situated on a floodplain terrace of Buttermilk Creek; all artifacts are contained within the floodplain deposits, and multiple lines of evidence show that the artifacts are in place. While the full geoarchaeological interpretations and dating of the site are presented in detail elsewhere (Waters et al. 2011, also see Keene 2009; Lindquist et al. 2011), this section focuses on the geology and dating of the early Paleoindian deposits in excavation Block A.

Block A is located in the Buttermilk Creek floodplain. Limestone bedrock lies at the base of Block A, and this is overlain by a 2Bk colluvial horizon (Figure 12). Above this lies 1.4 m of -floodplain overbank clay deposits with minor slope-wash colluvial contributions (A-Bss horizons). Optically stimulated luninescence (OSL) ages demonstrate that floodplain deposition began around 33,000 BP (Waters et al. 2010). Nine OSL ages correspond to periods immediately before and during the Clovis and Folsom/Midland periods (Table 22). Two OSL ages immediately below the Clovis horizon date to 14,350 ± 910 and 14,070 ± 910 and two ages at the top of the Clovis horizon date to 13,780 ± 885 and 13,090 ± 830. These ages are in accord with the currently accepted age of Clovis (Haynes 1992; Waters and Stafford 2007). Five ages in the Folsom/Midland horizon date to 12,925 ± 845, 12,240 ± 800, 12,100 ± 860, 12,000 ± 770, and 11,870 ± 760. These dates are in accord with the currently accepted age of Folsom/Midland (Collard et al. 2010).

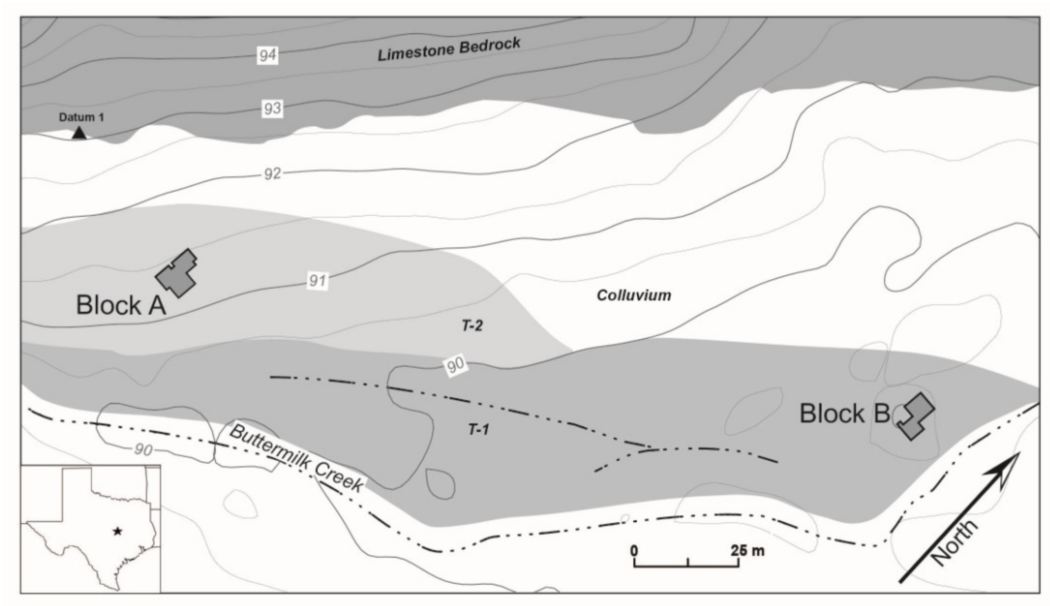

Figure 11. Debra L. Friedkin site map showing the location of Block A (adapted from Waters et al. 2011).

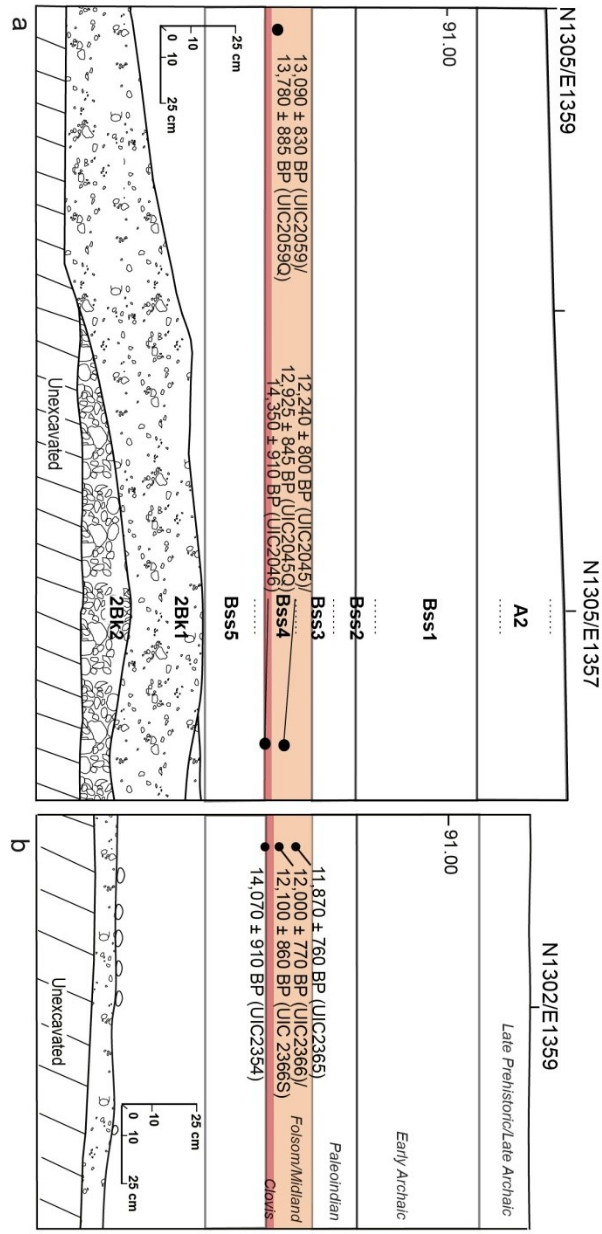

Figure 12. Generalized profile showing the Debra L. Friedkin cultural components and selected luminescence dates (black dots) from early Paleoindian levels (Waters et al. 2011). Vertical measurements are meters above datum.

Table 22. OSL ages from the Block A floodplain and Block B channel deposits of Buttermilk Creek.

Component	Lab No. [a]	Equivalent dose (Gy)[b]	U (ppm)[c]	Th (ppm)[c]	K20 (%)[c]	H20 (%)	Dose Rate (Gy/ky)	OSL age (yrs)[d]
Folsom								
Folsom	UIC2365	30.74±1.43	2.8 ± 0.1	12.9 ± 0.1	1.31 ± 0.02	38±5	2.59±0.12	11870±760
Folsom	UIC2366	32.58 ± 1.54	3.0 ± 0.1	13.2 ± 0.1	1.28 ± 0.02	38 ± 5	2.72 ± 0.12	12000±770
Folsom	UIC2366S	32.36 ± 1.80	3.0 ± 0.1	13.2 ± 0.1	1.28 ± 0.02	38 ± 5	2.67 ± 0.12	12100±860
Folsom	UIC2045	29.58 ± 1.39	2.6 ± 0.1	13.4 ± 0.1	1.22 ± 0.02	38 ± 5	2.42 ± 0.11	12240±800
Folsom	UIC2045Q	31.82 ± 1.56	2.6 ± 0.1	13.4 ± 0.1	1.22 ± 0.02	38 ± 5	2.46 ± 0.11	12925±845
Clovis	UIC2059	31.62 ± 1.46	2.4 ± 0.1	12.9 ± 0.1	1.18 ± 0.02	38 ± 5	2.42 ± 0.11	13090±830
Clovis	UIC2059Q	33.10 ± 1.56	2.4 ± 0.1	12.9 ± 0.1	1.18 ± 0.02	38 ± 5	2.40 ± 0.11	13780±885
Below Clovis	UIC2354	35.89 ± 1.71	2.9 ± 0.1	12.2 ± 0.1	1.15 ± 0.02	39 ± 5	2.55 ± 0.12	14070±910
Below Clovis	UIC2046	34.47 ± 1.58	2.6 ± 0.1	13.4 ± 0.1	1.13 ± 0.02	38 ± 5	2.40 ± 0.10	14350±910

[a] Equivalent dose determined by the multiple aliquot regenerative dose technique as described in Waters et al. (2011).

[b] 150 to 250 µm quartz fraction analyzed under blue-light excitation (470±20 nm) by single aliquot regeneration protocol (Murray and Wintle 2003)

[c] U, Th, and K20 content analyzed by inductively coupled plasma-mass spectrometry analyzed by Activation Laboratory LTD, Ontario, Canada.

[d] Ages calculated using the central age model of Galbraith et al. (1999). All errors are at 1 sigma and ages from the reference year 2010.

2.3 The Clovis and Folsom/Midland assemblages

The Clovis component occurs in Level 32b, a 2.5 cm thick level defined based on technological characteristics of recovered artifacts This level consists of 3,374 artifacts, all of Edwards chert. While no fluted Clovis points have been recovered, artifacts commonly considered technologically diagnostic of Clovis (Bradley et al. 2010; Waters et al. 2011) occur in this level. These are described in greater detail below and include bifaces with overshot scars, a partial overshot flake, blade segments, endthinning and channel flakes, and a concave-based projectile point ear.

Waters et al. (2011) defined the Folsom component as a 2.5-cm level based on the recovery of Folsom points in Level 32a and the absence of Folsom points above this level, but now we know that it also includes levels 31b, 31a, and 30. New debitage analyses of Level 31b, also 2.5 cm thick, have revealed the presence of channel flake fragments (c.f. Deller and Ellis 1992; Sellet 2004) produced during Folsom point fluting. Through 2009, no diagnostics had been recovered from Levels 30-31a had been recovered. Excavations in 2011 (not included in this paper) yielded two Midland points from level 31a and 30, documenting the presence of a previously unreported Midland component. Subsequent debitage analysis also identified channel flake fragments diagnostic of Folsom point manufacture in Levels 31a and 30 of the 2007-2009 assemblages. Based on these discoveries, The artifacts from levels 32a through 30, comprising a 12.5 cm group of levels, are classified as the Midland/Folsom component. All of these artifacts are manufactured from Edwards chert.

3. Methods

Individual artifact analysis was conducted to compare technological and site-use strategies between the Clovis and Folsom/Midland occupations. Waters et al. (2011) report artifact analyses based on artifact size sorting through nested screens. Here, only artifacts of size class 5 (screen size 0.95-1.25 cm) and larger are discussed, and this includes tools as well as debitage classified by Waters et al. (2011) as "macrodebitage". Following general lithic analyses (Andrefsky 2006; Odell 2003) and technological studies specific to Folsom (e.g. Frison and Bradley 1980; Root 2000; Surovell 2009) and Clovis (e.g. Bradley et al. 2010; Smallwood 2010; Waters et al. 2011), debitage and tools from each of the three assemblages were classified into technological and typological categories. Additionally, the size and weight of every artifact was recorded. Finally, Kuhn (1990; also Eren and Sampson 2009; Hiscock and Clarkson 2005) developed a geometric index of reduction to compare relative reduction intensities of flake tools. Kuhn's index, calculated by measuring the height of retouch scars above the ventral flake face (t) and dividing this by the maximum flake thickness (T), serves as a proxy for relative differences in flake tool curation. Assemblage differences were compared using analysis of variance (ANOVA) and chi-square tests.

4. Results

4.1 Clovis component

The Clovis component consists of 3,374 total artifacts, including 618 pieces of macrodebitage and 11 tools and tool fragments (Table 23, Figure 13). Three artifacts are point and point preform fragments. The first is an ear fragment of a point with ground edges (Figure 13, f). Its morphology suggests it came from a concave-based point consistent with Clovis points, but the fragment is so small that no portion of the flute scar is present. The second is a midsection fragment of a point preform (Figure 13, c). No overshot scars are present, and again the flute scar is not evident on this piece. The third is a tip fragment of a point preform (Figure 13, g).

Five bifaces are late-stage fragments. Three of these have overshot scars diagnostic of Clovis biface manufacture. One is a late-stage biface midsection with an overshot scar on one face (Figure 13, e), another is a late-stage biface tip with an overshot scar on one face and overface flake scars (defined as flake scars that extend beyond the midline but have terminations obscured by subsequent flaking) on both faces (Figure 13, d), and the third is a late-stage biface tip with an overshot scar on one face and overface scars on both faces (Figure 13, b). The fourth is a lateral margin fragment of a small late-stage biface (Figure 13, h). The fifth is a late-stage biface fragment with relatively unpatterned flaking (Figure 13, a). Based on the presence of a Hertzian scar along the break face, it may have been intentionally broken (cf. Ellis and Deller 2002; Jennings 2011).

Figure 13. Clovis artifacts. Point fragment (c, f, g), late-stage biface (a, b, d, e, h), flake tool (i-k), channel flake (r-t), endthinning flake (u), partial-overshot flake (v), blade (l-o, q), bladelet (p).

Table 23. Artifact counts by excavation level.

Level	Point	Point Preform	Late Stage Biface Fragment	Large Secondary Biface Fragment	Straight / Convex Edge Tool	Notch	Drill	Bifacially Shaped Flake
30a-b	1 (Midland)	1	6	1	1	1		
31a	1 (Midland)	1	1	1			1	
31b		1	5		1	1		1
32a	2 (Folsom)	2		1	1	1		
32b	3		5		3			

Table 23. Continued.

Level	Combination Tool	Endthinning Flakes and Fragments	Channel Flake	Partial Overshot	Blade	Bladelet
30a-b	1	4	5		1	1
31a		2				1
31b		2	2		3	1
32a		3	4			
32b		4	3	1	5	1

Three flake tools were recovered in the Clovis component. All were made on biface thinning flakes. The termination of one flake served as the tool edge (Figure 13, k), while lateral margins of the other two were the use-edges (Figure 13, i, j).

Technologically informative debitage includes channel flake fragments, a partial-overshot flake fragment, blades, and a bladelet. Five endthinning flake fragments, defined by the presence of dorsal flake scars that run perpendicular to the direction of flake removal (Figure 13, u), were recovered. Three of these are interpreted as channel flake fragments produced during point fluting based on the presence of multiple, small flake scars (< 5 mm in width) on the lateral margins that run perpendicular to the direction of flake removal (Figure 13, r-t). One partial-overshot, defined as a flake that traveled across the biface to the opposite edge, but did not fully wrap around to the opposing face, was recovered (Figure 13, v). Although no blade cores or core tablet flakes were recovered, five blades and one bladelet, defined as flakes or fragments with parallel or near-parallel lateral margins and dorsal scars, were recovered. The morphology of three blades suggests they came from blade cores. The first is a strongly curved blade midsection with two blade scars on the dorsal surface (Figure 13, q). The other two are medial blade fragments with three blade scars on the dorsal surface and trapezoidal cross-sections (Figure 13, l, o). Given that the lateral margins and dorsal scars are only near-parallel on the remaining blades (Figure 13, m-n) and the bladelet (Figure 13, p), these may have come from bifaces rather than blade cores. Two are proximal fragments, each with two scars on the dorsal surface, and the third is a proximal bladelet fragment with three scars running down the dorsal surface.

4.2 Folsom/Midland component

The Folsom/Midland component consists of 17,888 total artifacts, including 3587 pieces of macrodebitage and 31 tools and tool fragments (Table 23, Figure 14). These are distributed evenly throughout the Folsom/Midland levels. In addition, the two Midland points recovered in 2011 are described. Two artifacts are fluted Folsom point fragments (Figure 14, f, g). Both are midsections with flute scars on both faces. Marginal

Figure 14. Folsom/Midland artifacts. Folsom point (f, g), Midland point (h, j), bifacial core (a, c), late-stage biface (b, e), core fragment (d), flake tool (i, l, s, t), drill (k), channel flake (m-o), blade (p-q), bladelet (r).

lateral pressure flakes were removed after fluting and extend into the channel flake scars. Two Midland point bases (Figure 14, h, j) have ground basal edges suggesting they were hafted and used. Three bifaces are point preform fragments. The first is a distal late-stage lanceolate preform (Figure 14, e). Flaking is to the midline, although the medial ridge is more pronounced on one face, and the ridge is slightly off center. No evidence of endthinning/fluting is present on this piece. The second is a point preform tip fragment. No channel flake scars are evident. The third is a late-stage point preform base (Figure 14, b). The base is straight, but a platform for fluting has not yet been isolated.

Thirteen bifaces are late-stage fragments. Five are distal fragments with to-the-midline flaking creating strong medial ridges. Another is a medial fragment with two bending breaks and a small, possible eraillure scar between them, suggesting the piece was intentionally fractured (cf. Ellis and Deller 2002; Jennings 2011). The seventh is a late-stage biface fragment with a bending break and radial break. The presence of an eraillure scar on the bending break and a possible impact scar on the adjacent surface also suggest this piece may have been intentionally broken. Three are fragments without strong medial ridges or evidence of intentional fracture. The remaining three late-stage bifaces are all small fragments.

One artifact is a middle-to-late-stage biface fragment with relatively large flake scars Figure 14, c). The width-to-thickness ratio of 4.65:1 suggests this piece served as a bifacial flake core (see Bamforth 2003). Two large, secondary bifaces and one core fragment were also recovered. One is a thick distal fragment of a middle stage biface covered with relatively large flake scars and no refined edge trimming or shaping

(Figure 14, a). Though incomplete, the width-to-thickness ratio of 3.1:1 suggests this piece is a fragment of a bifacial flake core (see Bamforth 2003). The other is a biface fragment with large, relatively unpatterned flaking, suggesting that it is also a bifacial core fragment. Another early/middle stage core fragment has cortex on one end (Figure 14, d), and the fragmentary nature of this piece makes it difficult to say anything definitive about the original core orientation.

Nine flake tools were recovered from the Folsom/Midland component, and three retain the complex patforms of biface thinning flake blanks. One is a small leaf-shaped bifacial tool made on a flake blank (Figure 14, t). Pressure flaking occurs across the tip and along the edges on both faces, but the ventral flake-blank surface was not completely removed. Another is a formal drill fragment (Figure 14, k). The dorsal surface has received most of the retouch, and the flake blank remnant ventral surface remains down the entire drill length. The tip has been broken. Three are notches (Figure 14, s), and three are flake fragments with modified edges (Figure 14, l). Finally, one artifact is a large combination tool with two expediently used edges (Figure 14, i). Its flake blank has multiple dorsal scars, a cortical platform, and cortex at the termination. The first working edge is along the flake lateral margin, used as a convex-edged tool. The other working edge is at distal end of the flake. Based on the presence of multiple, stacked stepped terminations on the used edge, this appears to be an informal end scraper.

Technologically informative debitage includes channel flake fragments, blades, and a bladelet. Four are channel flake fragments that removed preform tips (Figure 14, m). These preform tip channel flake fragments provide evidence knappers were fluting the entire Folsom point face (c.f. Amick 2002: Figure 9.7; Deller and Ellis 1992:Figure 24; Sellet 2004), a technique not used by Clovis knappers. Seventeen additional endthinning flake fragments were recovered, seven of which are channel flake fragments (Figure 14, n, o). Bend- and radial-break flake tools have been reported from Folsom sites (Frison and Bradley 1980), and debitage with bend and radial fractures have also been recovered from the Friedkin Folsom/Midland component. None show evidence of intentional fracture, and use-wear analyses are needed to determine whether any were used as tools. Finally, four blades (Figure 14, p, q) and three bladelets (Figure 14, r) were recovered. Given that only one blade fragment has parallel lateral margins and dorsal scars, it is probable that most if not all were produced during bifacial reduction.

4.3 Cross-component comparisons

General assemblage comparisons reveal that relative proportions of tools and cores to debitage do not significantly differ between the Clovis and Folsom/Midland assemblages (Table 24, χ^2=3.700, p=0.054), and each tool assemblage is characterized by late-stage biface fragments and expedient flake tools. The presence of point preform fragments and channel flakes demonstrate that point production was an important activity represented in both components.

Table 24. Counts of tools and debitage.

	Tools and Cores	Debitage
Folsom/Midland	31 (0.9)	3589 (99.1)
Clovis	11 (1.7)	618 (98.3)

Table 25. Counts of tools and debitage, cortical and non-cortical debitage, and average debitage measurements. Percentages are in parentheses. Because calcium-carbonate accumulations obscured the surfaces of some flakes, not all pieces could be classified as cortical

	Non-cortical Debitage	Cortical Debitage	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Folsom/Midland	2833 (78.9)	759 (21.1)	20.6	19.6	4.3	1.9
Clovis	471 (77.0)	141 (23.0)	20.0	18.4	4.0	1.6
Mann-Whitney U p-value			0.013	0.012	0.001	0.029

For both components, the debitage assemblages are dominated by non-cortical pieces (Table 25, χ^2=0.994, p=0.319). Comparative cortical debitage data has been reported from two other Clovis sites in the region, and the 22.9% and 21.1 % cortical debitage for the Clovis and Folsom/Midland occupations at Friedkin are less than the 53.3% cortical debitage from the Clovis workshop at Gault Area 8 (Waters et al. 2011). The Friedkin cortical percentages are also similar to the 25.8% cortical debitage from the Clovis open-air campsite occupation at the Blackwater Draw site, NM (Hester 1972:94). Debitage sizes are also generally small (Figure 15), with macrodebitage weights averaging less than 2 g (Table 25), but as populations, they significantly differ. This is due to the presence of some large flakes in the Folsom/Midland assemblage driving up the average debitage size. The relatively small percentages of cortical debitage and small debitage sizes provide further evidence that the three assemblages are dominated by late-stage reduction debris. The presence of large flakes in the Folsom/Midland component, however, again suggests some early or middle stage reduction occurred during this occupation.

Flake tools made on biface thinning flake blanks in both components and bifacial core fragments in the Folsom/Midland component (Table 26) provide evidence that bifacial cores were technologically important during both the Clovis and Folsom/Midland occupations of the site. Comparison of biface thinning flake weights (Figure 16) shows that while most biface thinning flakes are small (less than 5 grams), multiple biface thinning flakes weighing larger than 10 g were recovered from the Folsom/Midland component. This difference suggests that while Clovis reduction

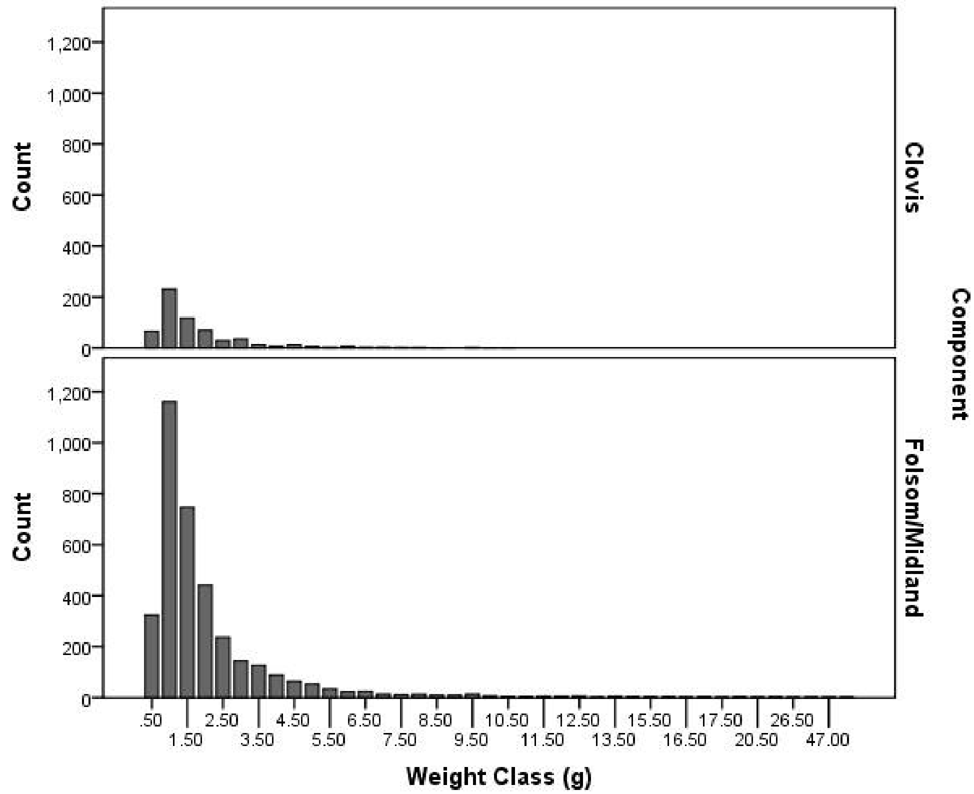

Figure 15. Frequencies of debitage weights grouped in 1 g weight classes.

involved late-stage bifaces only, some larger, early or middle-stage bifaces were reduced on-site by Folsom/Midland knappers. In spite of the absence of informal flake core fragments, the presence of Folsom/Midland flake tools made on normal flakes suggests informal cores may also have played a role. Finally, intentionally fractured bifaces were identified in the Midland/Folsom assemblage, and one of the Clovis bifaces appears to have been purposefully broken.

Table 26. Evidence for the importance of bifaces as cores (percent in parentheses).

	Flake Type		Flake Tool Blank		
	Biface Thinning	Normal	Biface Thinning	Normal	Bifacial Core
Folsom/Midland	956 (73.0)	354 (27.0)	2	3	3
Clovis	141 (56.2)	110 (43.8)	3	0	0

Table 27. Flake tool reduction indices. Measurements are in mm.

Component	Specimen	Max Thickness (T)	Edge Thickness (t)	Kuhn's Index (t/T)
Folsom/Midland	6033-15	8.11	3.46	0.43
Folsom/Midland	5956-1 (edge 1)	14.95	2.62	0.18
Folsom/Midland	5956-1 (edge 2)	14.95	5.04	0.34
Folsom/Midland	4455-1	3.37	1.8	0.53
Folsom/Midland	3051-5	7.98	2.57	0.32
Folsom/Midland	6045-4	8.30	5.69	0.69
Folsom/Midland	3106-2	3.75	3.17	0.85
Clovis	3016-1	3.02	1.47	0.49
Clovis	5842-8	4.22	3.81	0.90
Clovis	6135-3	4.02	2.16	0.54

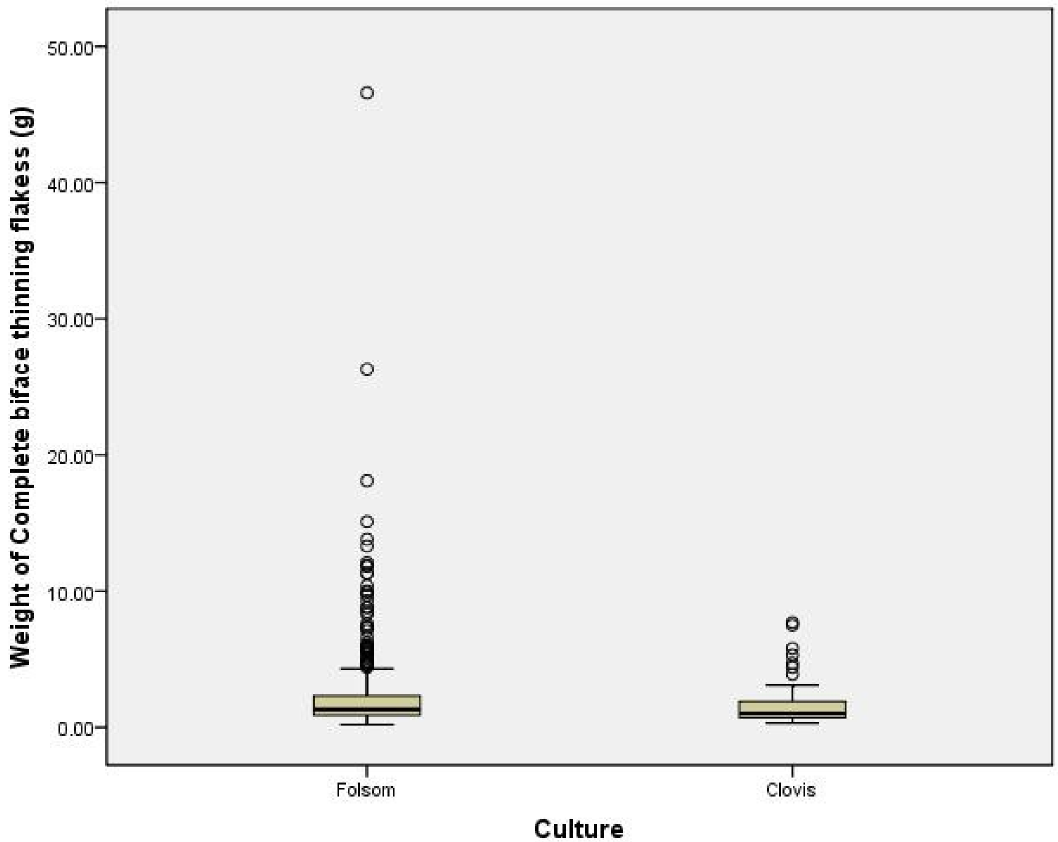

Figure 16. Box plot of biface thinning flake weights.

Flake tool reduction indices provide further evidence of assemblage similarities (Table 27). All but one of the Friedkin tools have reduction indices below 0.6. Flake tool reduction experiments have shown that reduction indices below 0.6 correspond to less than 10% weight loss of the flake edge (Hiscock and Clarkson 2005) , suggesting these Friedkin tools were not highly curated. Three tools have Kuhn's Index values greater than 0.6, suggesting these tools underwent multiple resharpening episodes. Two of these tools came from the Folsom/Midland component, and one came from the Clovis component.

5. Discussion

These results provide new insights into early Paleoindian occupations at Debra L. Friedkin. Did Clovis and Folsom/Midland groups use the Friedkin site in the same way, or did site-use change as adaptations change? The technological analyses conducted in this paper show that Clovis groups at the site discarded a broken point ear, broke some late-stage bifaces, and fluted new points, leaving behind debitage and channel flakes from fluting events. Three of the Clovis bifaces retain overshot flake scars, and these are the only bifaces with overshot scars identified at the site to date. However, overshot flaking was not a primary activity in this portion of the larger Friedkin-Gault site complex, as is evident by the near-absence of overshot flakes. In addition to point production, Clovis groups also discarded two expediently used and one more curated flake tool, all on biface thinning flakes. Blade segments were also discarded, but blade reduction did not occur on-site.

Above Clovis lies a Folsom/Midland component. The association of Midland points with fragmented Folsom points and debitage related to fluting provides additional evidence that both Folsom and Midland points were made and used by the same groups of people (Hofman 1992; Meltzer 2006). The lack of Midland points in the deeper levels of this component can be explained in two ways. First, it is possible that Midland points were made and used throughout the Folsom occupation, but early on the points simply were not discarded in this portion of the site. Alternatively, perhaps Midland point production was a "late" Folsom phenomenon. The elevational separation of Midland points above Folsom points at Friedkin and also at Gault (Waters et al. 2011) suggests that the earliest Folsom groups in the region may not have been making and discarding Midland points. Midland point production may have been developed towards the end of the Folsom interval. The Folsom/Midland component also contains channel flakes, indicating that point manufacture was a primary activity. The channel flake distal fragments that removed preform tips demonstrate efforts to fully flute the entire face of the preform, a technique not exhibited in Clovis point technology. The recovery of bifacial cores, flake tools on biface thinning flakes, and intentionally fractured bifaces show the importance of bifacial technology to Folsom groups. Intentionally fractured bifaces have been identified at Folsom sites in the Northern Plains (Frison and Bradley 1980; Root et al. 1999; Surovell 2009) and may reflect efforts to recycle bifaces into other tool types.

Comparisons of these assemblages reveal some important similarities and differences between the Clovis and Folsom/Midland. Both occupations are predominantly characterized by late-stage reduction, however, larger, early- or middle-stage cores were also reduced during the Folsom/Midland occupation. Bifacial reduction was the dominant activity during the Clovis and Folsom/Midland occupations, bifacial cores were used for tool production, projectile points were fluted and taken away from the site. The larger percentage of biface thinning flakes in the Folsom/Midland assemblage, however, again reveals dissimilarities in on-site core reduction. Finally, minimally retouched flake tools and more intensively retouched flake tools suggest that both expediently used and relatively more curated tools were discarded during the Clovis and Folsom/Midland occupations.

In terms of site occupation strategies along Buttermilk Creek, the Friedkin site results presented here necessitate amending current interpretations of early Paleoindian settlement in the area. Descriptions of the nearby Gault site rightly emphasize the incredibly dense Clovis lithic workshop, and previous analyses suggest Clovis groups repeatedly occupied Gault for relatively extensive occupation spans (Collins 2007; Waters et al. 2011). However, Clovis and Folsom/Midland groups used Friedkin primarily as a late-stage biface reduction and point production camp site. Collins (2007) suggests Clovis and Folsom/Midland site-use at Gault markedly differ, but while some site-use differences are evident at Friedkin, Clovis and Folsom/Midland site-use, as a predominantly late-stage biface reduction and point production camp site, was largely similar. Friedkin demonstrates that, at least during the Clovis period, the Buttermilk Creek drainage was used for different purposes in different places. Analyses of other occupations along Buttermilk Creek are necessary to determine whether Clovis and Folsom/Midland drainage-use indeed differ.

More broadly, the technological similarities have important implications for comparing Clovis and Folsom/Midland adaptations. Although other early Paleoindian core technologies, such as informal and discoidal reduction, may have been more important on the Central and Northern Plains (Bamforth 2002, 2003; Bamforth and Becker 2000; Surovell 2009), the Friedkin assemblage confirms the importance of bifaces as cores in the Southern Plains for both Folsom (Bement 1999; Hofman 1992, 2003) and Clovis groups (Ferring 2001; Huckell 2007; Kilby 2008; Waters et al. 2011). Friedkin also shows that Clovis and Folsom/Midland groups in the Southern Plains favored bifacial cores over more transport efficient alternatives (Jennings et al. 2010). Additional detailed assemblage-level comparisons at other sites and at sub-regional and regional scales are necessary to help identify where Folsom/Midland and Clovis adaptations and technological strategies converge or diverge.

6. Conclusions

The Debra L. Friedkin site expands our understanding of Clovis and Folsom/Midland archaeological complexes by providing an opportunity for direct site-level comparisons. Some technological differences such as Clovis overshot flaking and Folsom full-fluting are evident. In terms of site-use, late-stage biface reduction was the dominant activity during both occupations, but Folsom/Mildand groups also reduced some larger, middle-stage biface cores. During each occupation, projectile points were fluted and removed from the site. A few flake tools from these cores were discarded, and minimally retouched and more intensely retouched tools were discarded during the Clovis and Folsom/Midland occupations. These results have two important implications. First, early Paleoindian activities along Buttermilk Creek drainage varied. Gault was an intensively occupied workshop and camp site, while Friedkin was a short-term, primarily late-stage reduction camp site. Second, the bifacial cores were important components of the Clovis and Folsom/Midland toolkits on the Southern Plains periphery.

CHAPTER V

CONCLUSIONS

Clovis is one of the earliest and most widely recognizable archaeological complexes in North America. Dating to between 12,710 BP and 13,450 BP, Clovis was initially thought to represent the first people to enter the continent. Archaeologists are still trying to understand where Clovis technologies originated, how to identify and interpret continental variation within Clovis, and the changes that occurred as Clovis transitioned to later archaeological complexes. To help answer these questions, this dissertation provides new information on early Paleoindian technologies and adaptations in the Southern Plains periphery.

Because northeast Asia served as the source area for Native American ancestral populations, the search for the origins of Clovis technologies has focused on comparisons to the Siberian and Alaskan archaeological records. The absence of Clovis points in these regions provides strong negative evidence that Clovis points were invented in North America. The relatively recently discovered and growing pre-Clovis record in North America presents a new potential source for Clovis technological origins, but pre-Clovis sites have produced so few stone artifacts that comparisons to Clovis have yielded no conclusions. Chapter II presented the analysis of the pre-Clovis assemblage from the Friedkin site in central Texas and comparisons of pre-Clovis to Clovis. The Friedkin site has yielded a pre-Clovis assemblage with over 15,000 artifacts dating between 13,200 and 15,500 BP. Comparisons with Clovis were made at two levels, 1) site-level behavioral comparisons and 2) general technological traits used to define Clovis as an archaeological complex. Site-level comparisons reveal both similarities and differences. Both Clovis and pre-Clovis groups used the Friedkin site for late-stage reduction dominated by biface reduction. Blades and bladelets were discarded during both occupations, but the absence of blade cores or core tablet flakes suggests blades were not being produced on-site. Finally, some expedient flake tools were used and discarded during both occupations. Differences are also evident. Pre-Clovis groups engaged in a greater diversity of activities. This includes both tool use, as evidenced by the graver, notches, and chopping tool, as well as reduction activities evidenced by the discoidal core and burin spalls. In terms of general technological trait-list comparisons, I also found similarities and differences between Clovis and pre-Clovis. Similarities include biface reduction, endthinning of biface, blade production, and shared expedient tool types. Differences include the absence of fluted points, overshot flaking, and retouched blades in pre-Clovis but the presence of discoidal reduction and burin production in pre-Clovis. Based on these two comparisons, I conclude that pre-Clovis is not "Clovis" based on current definitions, but the two could share a culture-historical connection. Comparisons to the Clovis assemblage from the Gault site, Texas, however, shows that we must exercise some caution before fully accepting these conclusions. At Gault, the entire Clovis biface and blade reduction sequences are represented, and these are critical to fully defining Clovis lithic technologies. With the Friedkin pre-Clovis assemblage, we are only capturing a picture of the end of the reduction process. We are missing the early and middle stages of pre-Clovis reduction. Fully evaluating potential connections between pre-Clovis and Clovis will require finding additional sites and reconstructing start-to-finish pre-Clovis reduction strategies.

Once Clovis fluted points and associated technologies were invented, they spread across the continent. Because of the remarkable similarities between Clovis points, Clovis is often described as a continental that spread far and fast. Recent comparisons of point morphologies and stone reduction strategies, however, have revealed that significant differences exist *within* Clovis. Regional and sub-regional variation within Clovis is providing the earliest evidence of emerging regional cultural traditions. To define regional Clovis biface production signatures, Chapter III presented the analysis of 52 Clovis bifaces that were cached at the Hogeye site, TX. Two separate biface production trajectories were identified, fluted point production and knive/core production. Within the point trajectory, bifaces were sub-divided into late-stage preforms and finished points. These two sub-stages reveal important clues to Clovis point production goals. At Hogeye, late-stage to finished-point reduction primarily involved width reduction, while thickness reduction was less pronounced. In terms of thinning and flaking strategies, I demonstrate that Hogeye knappers stopped removing overshot flakes once bifaces were reduced beyond approximately 50 mm in width and 10 mm in thickness. This represents the first quantified evidence of when in the reduction process Clovis knappers stopped removing overshot flakes. I also present the first quantification of Clovis lateral flaking patterns. Clovis flaking is traditionally described as alternate-opposed flaking. While this pattern was identified on Hogeye bifaces, two types of serial flaking patterns, which have never before been quantified, were also identified. Finally, endthinning scar types and measurements were also recorded. These Hogeye signatures are unique when compared to those described from Clovis sites in the Southeastern United States, providing further evidence of regional variation in biface reduction. In terms of the knife/core trajectory, little can be said because so few have been recovered. These bifaces do appear to represent a western Clovis expression, and they are frequently associated with caches. Hogeye is providing new information on regional Clovis technological variation and nuances of Clovis biface reduction, and great potential exists for applying these comparative measures to additional Clovis biface collections.

In the Great Plains, Clovis technologically transitioned to Folsom/Midland. The shift occurred at the end of the last Ice Age, and changing environments led to changes in adaptations. Pleistocene mammals such as mammoths and mastodons, which were important components of the Clovis diet, went extinct during the Clovis period. Bison became the dominant land mammal during the Folsom/Midland period, and Folsom/Midland adaptations were centered around bison hunting. These resource changes led to changes in how Clovis and Folsom/Midland groups utilized the Plains. The Friedkin site is one of only five sites with Folsom/Midland components directly overlying a Clovis component, and Chapter IV presented the results of site-level comparisons between the Clovis and Folsom/Midland occupations at Friedkin. Debitage analyses show that late-stage reduction was the dominant activity during both the Clovis and Folsom/Midland occupations. Channel flake fragments show that Clovis and Folsom/Midland points were fluted at Friedkin. The presence of some larger debitage, however, indicates that middle-stage reduction also occurred during the Folsom/Midland occupation. Clovis and Folsom/Midland flake tools are made on biface thinning flakes, and three Folsom/Midland bifacial core fragments demonstrate the importance of bifaces as cores. These Friredkin site analyses show that Clovis and Folsom/Midland settlement along Buttermilk Creek varied. While Gault, located five hundred meters upstream, was an extensive quarry-camp site where numerous tool production activities took place, Friedkin was a less heavily occupied campsite where projectile points were finished, and bifacial cores were reduced to make a few flake tools. More broadly, Friedkin confirms the importance of bifacial cores to Clovis and Folsom/Midland groups living on the southern Plains periphery. As Clovis and Folsom/Midland bands left Friedkin to hunt large game on the Plains, they carried with them bifacial cores to broken or exhausted tools.

The Debra L. Friedkin and Hogeye sites are providing new information on early Paleoindian technologies and adaptations in the southern Plains periphery. The Friedkin pre-Clovis assemblage possesses characteristics that may be ancestral to Clovis. While additional sites and assemblages are necessary to expand our understanding of pre-Clovis lithic technologies and test this hypothesis, Friedkin is one of a growing number of sites that are providing evidence of Clovis origins within North America. The Hogeye Clovis biface cache shows that once Clovis technologies were invented, unique regional traditions quickly emerged. Applying the analytical techniques developed in this dissertation and those developed by others to additional Clovis biface assemblages will help to refine our understanding of variation within Clovis. I suspect we will eventually be able to define regional and sub-regional Clovis expressions. Finally, the Friedkin site provides a unique opportunity to directly compare Clovis and Folsom/Midland site-use at a place visited by both groups. In the southern Plains periphery, where Clovis and Folsom/Midland bands had access to plentiful outcrops of large, high-quality Edwards chert, both relied on bifaces as cores for flake tools. This stands in contrast to evidence from other regions, and additional regional and sub-regional comparisons are necessary to tease out adaptive similarities and differences between Clovis and Folsom/Midland.

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