

Organization of Pipestone Pipe Technology at Great Bend Aspect Sites in Kansas

By

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ABSTRACT

This research is the study of the organization of pipestone technology at Great Bend Aspect (GBA, AD 1450-1700) sites in south-central Kansas. The goal was to determine the broader social and economic context of pipestone technology within this protohistoric society. Experiments were conducted in order to aid in the identification of pipestone use-wear and residue on chipped stone tools. Tools from four GBA sites were microscopically analyzed to identify pipestone use-wear and residue. Pipestone was analyzed and sourced using a portable infrared spectrometer at 22 GBA sites in Kansas and two protohistoric Wichita sites in Oklahoma.

The archaeological evidence indicates that pipes were the main use of pipestone at GBA sites. Pipestone pipes were prestige and ritual artifacts that were used in early protohistoric versions of the calumet ceremony. Pipes were minimally used before they were broken and made into pendants, beads, or figurines. Part-time craft specialists likely made the pipes. Pipe production was restricted to a small number of sites in Marion and McPherson Counties. Finished pipes were traded to other GBA sites and with contemporaneous neighbors. Pipe recycling was an activity conducted at the household level and was not specialized. Pipes were recycled into beads, pendants, or figurines possibly to commemorate the ceremonies in which they were used. The remaining pipestone scraps were discarded. At GBA sites in Cowley County, Kansas, pipestone was often discarded with other prestige artifacts such as turquoise, mussel shell, modified shell, bone, and other beads.

The organization of pipestone technology was relatively stable for the entire period of GBA occupation in south-central Kansas. Major changes in pipestone technology occurred when the occupants of GBA sites moved south into what is today Oklahoma. A shift in pipestone procurement strategies was identified at protohistoric sites in Oklahoma. Pipestone technology changed along with increased trade with Europeans, increased hostilities from surrounding tribes, and a more circumscribed settlement pattern. This evidence may reflect major economic and social changes occurring at the protohistoric Wichita sites at the beginning of the eighteenth century.

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CHAPTER 1: Introduction

INTRODUCTION TO THE PROBLEM

Historically, pipes played many roles in Plains Indian societies. Pipes could simultaneously be artistic representations of people and animals (Ewers 1986), ritualistic paraphernalia as part of a sacred bundle (Black Elk 1953; Catlin 1866; Hall 1997; Hennepin 1903; Lowie 2004; Sidoff 1977; Thomas 1941; Wissler 1912), media for political and social commentary (Ewers 1986:91), erotically themed carvings (Ewers 1979), objects to facilitate trade and outside interaction (Blakeslee 1975), and devices for recreational enjoyment (Catlin 1866, 1996). With historic pipes functioning in so many roles it is challenging to study archaeological pipes without considering these detailed ethnographic insights. At the same time, analogies limit our perspective on pipes to the observations and interests of the ethnographers and historical figures. The prime example of the gap in these accounts is seen in the almost total lack of documentation about pipe manufacture (with a few exceptions in Ewers 1963 and Weltfish 1965). As a consequence, archaeology throughout most of the twentieth century rarely considered pipes beyond basic descriptions. The goal of this dissertation is to build a more complex social and economic understanding of a protohistoric pipe technology.

Beyond the social, political, and ritualistic meanings, the definition of a pipe is rather simple. A pipe is defined as a device used to smoke botanicals materials. However, this uncomplicated definition disguises the variability of pipes in shape, material, and decoration. The context of use is potentially as complex as the material variability.

This research focuses on pipes made from red pipestone, a soft metamorphosed claystone that was commonly used to carve pipes and other objects in the North American Plains and Midwest. This research strives to situate red pipestone pipes into the larger technological organization of a particular past society. The Great Bend Aspect (GBA, AD 1450-1700) in south-central Kansas was chosen as the cultural-historical focus in this project for two main reasons. First, this archaeological complex has been the subject of a significant amount of previous research.

Blakeslee and Hawley (2006:166) state that the GBA “is easily the most studied... complex in Kansas.” This background information is helpful in defining the technological organization and the societal implications at GBA sites. Second, a significant amount of pipestone and pipestone manufacture has been documented at GBA sites (Blakeslee et al. 2012; Blakeslee and Hawley 2006; Lees et al. 1989; Wedel 1959) or is found in counties with GBA sites. Rice, Marion, and McPherson counties in Kansas, which have GBA sites, contain large amounts of pipestone from private surface collections and in the local county museums (Rohn and Emerson 1984:180). There is so much pipestone from Rice County, that it has been misidentified as a geological source for pipestone (i.e., Wisseman et al. 2012), although the only source for pipestone in the state is in the glacial tills in northeastern Kansas.

OBJECTIVES OF THE DISSERTATION

The main goals of this dissertation are to define the organization of red pipestone pipe technology and to determine the broader social and economic context of the technology within a protohistoric society. To understand the actual role of a pipe, it must be analyzed as part of an interconnected behavioral system, in which the context of manufacture, use, maintenance, and discard, can be used to inform us about ritualistic, social, political, and economic systems. In order to accomplish this goal, a combination of archaeological, experimental, ethnographic, and ethnohistoric data are employed in the following steps:

1. *Define pipestone use-wear and residue on stone tools.* To establish the types of use-wear and residue that are diagnostic to pipestone manufacture, a comparative collection was made. The creation of this comparative collection was useful on multiple analytical levels. First, the experimentation provided helpful observations on the processes of manufacture using stone on stone. Second, the collection helps us link archaeological observations to past behaviors.
2. *Identify the chipped stone tools used for working pipestone at GBA sites.* This portion of the research used microscopic use-wear and residue analysis and the comparative collection to determine the tools that were used in the manufacture of red pipestone objects.

3. *Define the life-cycle of red pipestone artifacts at GBA sites.* A large sample of red pipestone from GBA sites was analyzed to establish the geological sources and the types of modifications made to these materials. Additionally, I wanted to determine if there was a pattern in the use of this material and if there was an association of pipestone with particular activities, features, or other materials.

4. *Define the social and economic context of red pipestone pipe technology at GBA sites and determine if there was change over time.* This stage synthesized results from this study and the significant corpus of previous GBA research to determine the role of pipestone pipe technology in this protohistoric society. Additionally, I compared pipestone artifacts at two Oklahoma archaeological sites occupied by the descendents of the people from GBA sites. This was done to determine the changes in the technological organization of pipestone during the tumultuous changes of the seventeenth and eighteenth centuries.

THEORETICAL AND ANALYTICAL FRAMEWORK

The theoretical and analytical frameworks for this research are developed from previous archaeological studies in the organization of technology. Organization of technology is a research agenda that examines “the selection and integration of strategies for making, using, transporting, and discarding tools and the materials needed for their manufacture and maintenance.... [taking into consideration] economic and social variables that influence those strategies” (Nelson 1991:57). The theoretical basis and origin of this research strategy comes from processual and behavioral archaeology. A major influence is Schiffer’s (1972) seminal paper defining archaeological and systemic contexts (Bleed 2001:108). Schiffer’s (1972) definition of systemic context addresses the stages of a tool’s life-cycle (procurement, manufacture, use, maintenance, and discard) and encourages researchers to link the interpretations of these stages to “behavioral and organizational hypotheses” (Schiffer 1972:163). An essential strategy for organization of technology research is the use of experimental archaeology (Bleed 2001:108). A weakness of technological organization research is that the technological is not always grounded into the social,

economic, and political realms of the past.

The concept of *chaîne opératoire* is often used by archaeologists interested in technological organization because this approach is similarly concerned with the stages or life-history of artifacts (Bar-Yosef and Van Peer 2009; Bleed 2001). However, it differs in its focus on the cognitive aspects of technology also known as technopsychology (Bar-Yosef and Van Peer 2009:105; Bleed 2001:105; Sellet 1993:106). In North American archaeology, the *chaîne opératoire* became a popular approach for post-processual researchers with goals of identifying agency in the archaeological record (Dobres 1999, 2000; Dobres and Hoffman 1994, 1999). While the use of *chaîne opératoire* as a theoretical approach is not used in this research, I have found that the post-processualist adoption of this conceptualization of technology was beneficial in uniting the technological and societal systems. These researchers have produced a robust body of literature on the social aspects of past technologies (e.g. Cobb 2000; Dobres 1999, 2000; Dobres and Hoffman 1994, 1999; Dobres and Robb 2005; Hill 1978; Sinclair 2000). Archaeologists working on technology and agency theory identify technology as an expression of a society's world-view and as a dynamic shaper in social production and reproduction (Dobres and Hoffman 1994:216). This approach links technology to associated sociopolitical relations highlighting the importance of agents, relationships, and society in technological practice (Dobres 1999, 2000:131; Dobres and Hoffman 1999:3). A *chaîne opératoire* approach also facilitates the study of past rituals by including the social embeddedness of the materials (Carroll et al. 2004).

This research will borrow the analytical framework proposed by agency archaeologists, while maintaining a processualist and behavioralist theoretical basis on organization of technology studies. This is a flipped version of Hegmon's (2003) processual-plus research agenda (processual methods and post-processual theory). Agency archaeologists propose analyses that consider the materiality, scale, and context in data interpretation (Dobres and Hoffman 1994). The materiality is the recognition of the life-cycle of artifacts, while scale and context serve to structure the technological data in order to look for patterns and relationships in the archaeological assemblages. Additionally, agency archaeologists have recognized the difficulty in actu-

ally applying agency to data and thus, proposed the use of middle-range approaches in order to interpret the data (Dobres and Robb 2005). Although all of these methods have recently been suggested by agency archaeologists working on past technological systems, they are not unique to post-processual agendas, and are commonly applied to research encompassing many different theories including processualist agendas.

The theoretical basis for this research is based in processual and behavioral approaches to technology, which identifies the importance of technology in social processes but does not attempt to identify individual meaning and intention. While I am sure that protohistoric pipes had meaning and were an active part of an individual's existence, I do not believe that this is something that can be observed in the archaeological record (it can be theorized and discussed, but not seen with the remnants of the protohistoric archaeological record). The theoretical framework for this research shapes the nature of questions asked of these data. The application of this conceptual framework is seen in the organization of the questions about these rituals into two categories: technological and social. Technological questions include: 1) Where are the geologic provenances of the pipestone? 2) How, where, when, and by whom were the pipes made? Social questions to be addressed are: 1) What economic and social connections are indicated by the pattern of particular pipestones, pipe manufacture, use, and discard? 2) What other economic, political, or social activities are associated with this technology? 3) Are specialists involved at any stage of a pipe's life-cycle? 4) How did this technology change over time? The technological questions will provide the basis for evaluating the social questions, which will in-turn provide a more complete understanding of the broader social and economic contexts of pipestone pipe technology and how they have changed.

Most organization of technology studies focus on technologies that are primarily functional in nature. Archaeologists often humorously observe about themselves that if a feature or artifact lacks an obvious economic function then it must be associated with ritual (Wesler 2012:9). In such cases, ritual and religion are approached as realms that are problematic to access through empirical evidence (Howey and O'Shea 2006). This has been a common assumption in

the study of North American smoking pipe rituals, with previous research focusing on pipe typologies (e.g. Ewers 1986; Dunhill 1969; West 1934) and relying on ethnographic and ethnohistoric observations for interpretations of ritualistic smoking practices (e.g. Hall 1977, 1983, 1997). The result is an imprecise understanding of red pipestone pipe technology in past societies, including aspects of intended purpose and the social relations surrounding pipe production and use. By applying this combination of analyses proposed as useful to agency archaeologists with a processually and behaviorally grounded theoretical basis, stone pipe technology and the associated social and economic contexts can begin to be understood.

CULTURAL-HISTORICAL BACKGROUND

This research focuses on the protohistoric Great Bend aspect (GBA), A.D. 1400 to 1700, in the southern Plains. The people at GBA sites are believed to be ancestors of the historic Wichita tribe (Hoard 2012c; Vehik 1992; W. Wedel 1959). Waldo Wedel (1935, 1942, 1959) originally identified the Great Bend aspect using the Midwestern Taxonomic Method. While the original use of this classification method did not involve identifying the spatiotemporal context (McKern 1939:302-303), Wedel was able to situate the GBA within time and space (Loosle 1991:4). For this reason, the terms “aspect” and “focus” are still used in relation to GBA sites (Hoard and Banks 2006:6-9; c.f. Krause 1998:65). In addition to the GBA sites, pipestone artifacts from protohistoric Wichita sites in Oklahoma are used to understand changes in pipestone usage over time. Additionally, ethnohistoric documents provide an analogy for past stone pipe manufacture and smoking pipe ritual practices.

This research is centered during a time of significant changes in the culture history of Indians living in the southern Plains and neighboring regions (Hoard 2012c; Bell 1984; Hofman 1984; Vehik 2006, 2012). The earliest occupation of GBA sites was during the late prehistoric period. European contact in 1541 may or may not have changed lifeways at GBA sites. However, in the early seventeenth century the Spaniards occupied New Mexico and in the late seventeenth century the French began to explore and colonize the Mississippi River Valley (M. Wedel 1981).

These colonial activities affected the native groups in direct contact with the Europeans and likely indirectly affected the people at GBA sites. Despite the fact that colonization was affecting neighboring regions, the Wichita were on the “frontiers of European colonization” (Perkins and Baugh 2008:384) until the nineteenth century.

The sites in this research are referred to as part of the protohistoric period, as initially defined by Lightfoot and Simmons (1998:140) and modified by Perkins and Baugh (2008:383-384). Their combined definitions of protohistory is a time period that begins with early European encroachment into native territories and ends with the establishment of regular colonial settlements. This fluid definition recognizes that native populations were differentially affected by both direct and indirect contact with Europeans (Perkins and Baugh 2008:384). Specifically, Perkins and Baugh (2008:384) suggest AD 1450 as the beginning of the protohistoric period due to the significant cultural changes occurring at that time. In the case of the Wichita, AD 1450 marks the coalescence of multiple groups at large village sites (recognized archaeologically as GBA sites; Blakeslee and Hawley 2006; Hoard 2012c; Vehik 1992; W. Wedel 1959). The protohistoric period for the Wichita ended in AD 1846 with the beginning of this group’s particular confinement to reservations (Newcomb 2001; Perkins and Baugh 2008). The occupants of GBA sites and two eighteenth century Oklahoma sites regularly discussed below, Bryson-Paddock (34KA5) and the Longest (34JF1) sites, are all considered protohistoric Wichita under this definition. Additionally, references to GBA and these Oklahoma sites as either “protohistoric” or “historic” have not been consistent over the years of archaeological research. However, occupation areas, material cultures, and a significant amount of time easily differentiate the two. In order to not confuse the two in discussions, I refer to the GBA as “the people at GBA sites.” The occupants of the two Oklahoma sites lack any other archaeological name designation and are referred to here as “protohistoric Wichita.”

The GBA is a late prehistoric/early protohistoric (A.D. 1450 to 1700) complex in southern and central Kansas (Blakeslee and Hawley 2006:167; Hawley 2000:243; Hoard 2012b:179; Roper 2000:173-174, 2011:360; Vehik 1992:325, 2006; Wedel 1959:585). The people at GBA

sites were composed of sedentary farmers living in three settlement concentrations in Rice, McPherson, Marion, and Cowley counties, Kansas (Blakeslee and Hawley 2006; Figure 1.1). The Rice and McPherson County concentration is known as the Little River focus (LRF) and

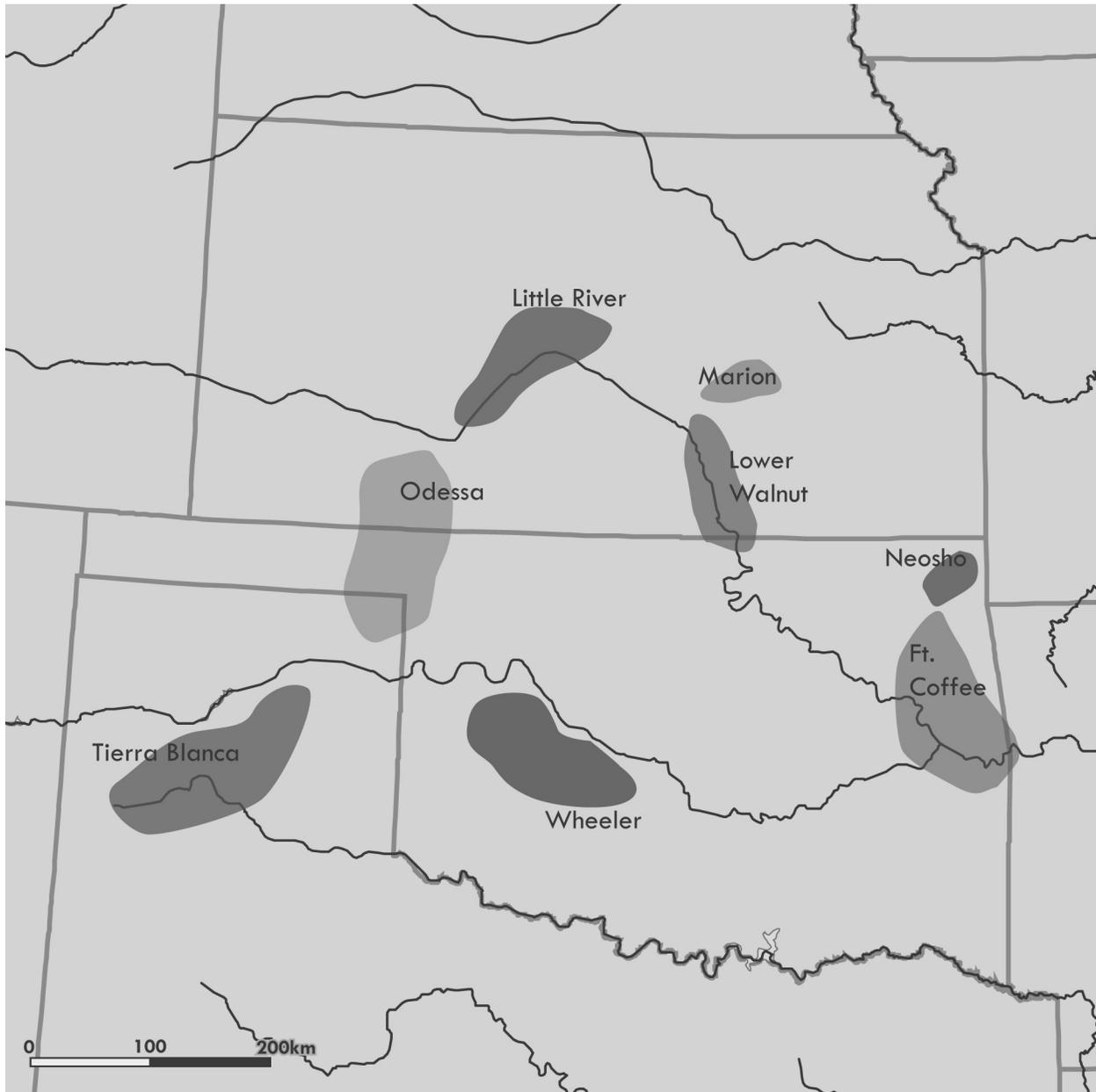


Figure 1.1 Cultural complexes discussed in the text, dating from approximately AD 1250 to 1700; Odessa phase is the earliest (AD 1250-1475) and is believed to be ancestral to the Little River focus (Brosowskie and Bevitt 2006:181); Wheeler phase, Tierra Blanca complex, and the Fort Coffee and Neosho foci (AD 1400-1700) are slightly earlier and contemporaneous archaeological complexes to the GBA (AD 1450-1700) and all but the Tierra Blanca complex have similar pipestone pipes (Rohrbaugh 1984:Figure 12.1; Vehik 2006:Figure 12.2); Map by Andrew M. Hilburn

the Cowley County cluster is known as the Lower Walnut focus (Wedel 1935, 1942, 1959). The Marion County concentration was defined later following extensive salvage excavations (Hughes and Lees 1991; Lees et al. 1989; Reynolds 1982; Rohn and Emerson 1984). Other village clusters likely existed in south-central Kansas that have not been as thoroughly documented. Additionally, ephemeral GBA campsites are found throughout the region (Peck 2003).

Some contemporaneous and earlier archaeological complexes that are briefly discussed require a short introduction. The Odessa phase (AD 1250-1475) is found in southwestern Kansas and the panhandles of Oklahoma and Texas (Brosowskie and Bevitt 2006). Odessa phase sites contain pipestone pipes that are similar to GBA pipes (Blakeslee 2012:303). The Wheeler phase (AD 1500-1725, Drass and Baugh 1997), Fort Coffee focus (AD 1450-1650), and the Neosho focus (AD 1400-1650, Rohrbaugh 1984) are significant because they share a similar pipestone pipe technology to GBA sites (Blakeslee 2012) and are also thought to be early Caddoan groups in Oklahoma (Rohrbaugh 1984). The Tierra Blanca complex (AD 1450-1650) was likely a protohistoric Plains Apache group whose ephemeral archaeological record has not yielded pipes resembling those at GBA sites (Habicht-Mauche 1992).

A combination of ethnohistoric and archaeological research has revealed detailed data on the lifeways of the people living in GBA villages. Historic documentation of GBA sites comes from the expeditions of Francisco Vázquez de Coronado in 1541 and Juan de Oñate in 1601, both of whom traveled from New Mexico to the area known as Quivira in search of riches (M. Wedel 1981, 1988b:14). A significant amount of data on these sites is from cultural resource management projects in Marion and Cowley counties. Excavations at GBA sites in Rice and McPherson counties were led by Waldo Wedel of the Smithsonian Institution, state archaeologist Tom Witty, and the Kansas Anthropological Training Program. The overall structure of the GBA sites were extensive villages with multiple grass houses separated by agricultural fields (Blakeslee and Hawley 2006:167; Hoard 2012c:487; M. Wedel 1988b:18). These grass houses, which are characteristic of the historic Wichita and Affiliated Tribes (Newcomb 2001), were round with poles tied at the top and an off-centered vent for smoke (Blakeslee and Hawley

2006:172; M. Wedel 1988b:18). In their fields, these villagers grew corn, beans, squash, sunflower, and tobacco (Adair 1989, 2012; Rohn and Emerson 1984; W. Wedel 1959). Bison hunting was prominently recorded by the Spaniards and French that first encountered the occupants of GBA and protohistoric Wichita sites (M. Wedel 1988a,b). Bison bones are the largest category of faunal remains at GBA sites (Haury 2012:341; Lees 1987:7). The primary lithic resources exploited by people at GBA sites included Florence chert, Smoky Hill Jasper, Alibates, and materials from the Ozarks (Blakeslee and Hawley 2006:174; Lees 1988). Long-distance trade is evident in the presence of Puebloan and Caddoan ceramics, obsidian, turquoise and turquoise-like materials, marine shells, and tubular pipes (Blakeslee and Hawley 2006:175; Hawley 2000; Hoard 2012c:495; W. Wedel 1959). Contact with Europeans, either directly or indirectly, is evident in the presence of glass beads, chain mail, gunflints made from Florence chert, gun parts, and lead balls and related materials (Hawley 2000; Udden 1900; W. Wedel 1959). There are fewer European artifacts in the Marion County cluster compared to the other GBA sites (Hoard 2012c:484; Lees et al. 1989:64; Rohn and Emerson 1984; Roper 2002:19).

The historic and contemporary Wichita are actually composed of multiple affiliated tribes including the Tawakoni, Taovaya, Iscani (Yscani or Ascani), Waco, Kitsai (Kichai), and Wichita proper (Bell 1984; Newcomb 2001; Parks 2001; Vehik 1992, 2006, 2012; M. Wedel 1981). These affiliated tribes share a common language in the Caddoan family and at various times in the past lived in their own segregated villages. Archaeologists and ethnohistorians believe that early in the eighteenth century the groups recognized as the GBA archaeologically moved to the south and established villages in north-central Oklahoma (Bell 1984:377). Here, the protohistoric Wichita lived a lifestyle similar to that of the people at GBA sites. Noted differences are an increase in contact with Europeans (Bell 1984; Hartley and Miller 1977; M. Wedel 1981). Additionally, for the first time these sites were fortified reflecting increased conflicts with their neighbors (Bell 1984; Hartley and Miller 1977). Fortification of villages persisted until the reservation period (Hoard 2012c; Newcomb 2001). By the mid-eighteenth century, the protohistoric Wichita abandoned northern Oklahoma and moved into the Red River Valley in south-central Oklahoma

and northern Texas (Bell 1984; Hartley and Miller 1977). Between 1830 and 1850, the Wichita moved or were forced to move by the U.S. government, eventually ending up in the Washita River region of central Oklahoma (Bell 1984:378; Newcomb 2001:558). The Wichita and Affiliated Tribes were removed to a reservation in 1872 and today live in the area of Anadarko, Oklahoma (Newcomb 2001).

Archaeological Sites and Collections used in this Research

The following research utilized many different collections for the pipestone analysis because pipestone is relatively uncommon in archaeological assemblages compared to other artifact classes. Due to pipestone's rarity, these artifacts are often pulled aside and clearly labeled making them easy to identify while searching museum collections. Additionally, because pipestone is a material that strikes the interest of many archaeologists, it is often separated and noted as significant in the curation process. For these reasons, pipestone was easily accessible during this research. Pipestone was analyzed from 22 GBA sites that have had varying amounts of archaeological investigations. The Arkansas Country Club (14CO1), Schrope (14CO331), Living the Dream (14CO382), Radio Lane (14CO385), and Killdeer (14CO501) sites are in the Lower Walnut focus area (refer to Figure 1.1). The 14MN308, 374 Quarry Corners (14MN326), and Mem (14MN328) sites are in the Marion county GBA concentration (refer to Figure 1.1). The Paint Creek (14MP1), 14MP401, 14MP404, Sharps Creek (14MP408), 14MP409, Major (14RC2), Malone (14RC5), Tobias (14RC8), C.F. Thompson (14RC9), Saxman (14RC301), Kermit Hayes #3 (14RC305), 14RC311, 14RC410, and Max Crandall (14RC420) sites are in the Little River focus of the GBA (refer to Figure 1.1). Included in the pipestone analysis were two large assemblages from surface collections, the Robb family collection and the McPherson County Museum collection. The majority of both assemblages are believed to have been collected in McPherson County, Kansas (Blakeslee 2012:305; Odell et al. 2011:4). A small amount of pipestone was analyzed from archaeological sites attributed to the Wheeler phase, Odessa phase, and Spiro or Fort Coffee Phase. Pipestone artifacts from two protohistoric Wichita sites were also included in the

following discussion. These artifacts were from Bryson-Paddock (34KA5) on the Arkansas River in northern Oklahoma and the Longest site (34JF1) on the Red River in southern Oklahoma.

In comparison to pipestone artifacts chipped stone tools are numerous in GBA assemblages. For that portion of the analysis the focus had to be on assemblages from four GBA sites, Mem (14MN328), Schrope (14CO331), and Tobias (14RC8), and the GBA component of the Lewis site (14PA307) (Figure 1.2). These four sites and the Bryson-Paddock (34KA5) and Longest sites (34JF1) are discussed in detail below and are important to the final interpretation of the data collected.

GBA Sites and Occupations

The Mem site (14MN328) is located in Marion County on the Walnut River in central Kansas. The GBA sites in Marion County were identified after the initial naming of the Little River and Lower Walnut foci, thus, this concentration of GBA sites is simply named for the county. The Mem site is a village that is notable for multiple midden mounds (Gould 1898; W. Wedel 1959:351). Evidence of structures at the site include a pit house, an arbor similar to that documented for the GBA components at the Lewis site, and multiple posts that lack hearths interpreted as possible racks or screens (Blakeslee and Hawley 2006:Table 10.1; Lees et al. 1989; Monger 1970). The site also contains evidence of horticultural activities and limited European contact (Lees et al. 1989). Mem was the first GBA site to have systematic flotation (Lees et al. 1989:105), which resulted in the recovery and subsequent identification of tobacco seeds (Adair 1989, 2012:470). Additionally, this site had the largest assemblage of pipestone artifacts of all GBA sites analyzed in this study. The artifacts analyzed were from excavations at the site in 1986 (Lees et al. 1989) and do not include the tests conducted in 1975 (Rohn and Emerson 1984).

The Schrope site (14CO331) is located in Cowley County and is part of the Lower Walnut focus. The site represents a village occupation on a terrace of the Walnut River (Hawley 1993). The site was identified and investigated in the 1990s (e.g. Hawley 1993, 1995; Hoard 2012a; Mandel 1994; Thies 1991; Wulfkuhle 1991). Despite significant historical disturbances

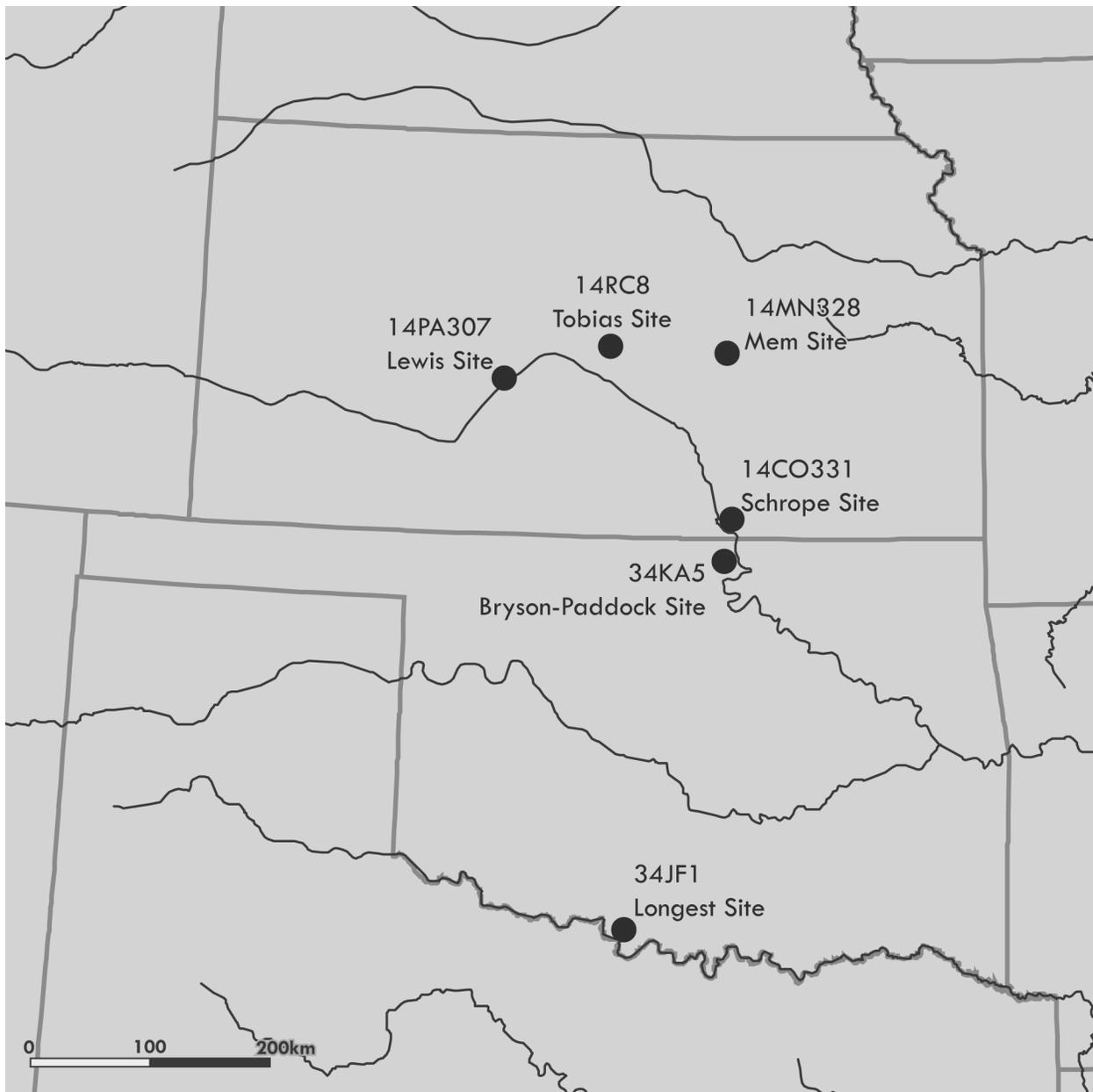


Figure 1.2 Archaeological sites that were central to the interpretation of the organization of pipestone pipe technology in this research; Map by Andrew M. Hilburn

forty-one intact features were identified, of which 23 were bell-shaped pits and eight were cylindrical pits (Schoen and Garst 2012a, 2012b). In 306 flotation samples from this site, a total of eleven tobacco seeds (*Nicotiana*) were identified (Adair 2012:Table 15.1). The only evidence of contact with Europeans at this site is from a glass bead that is similar to beads circulated in the late 1600 and early 1700s (Garst et al. 2012; Hawley and Stein 2005). Among the interesting artifactual material at this site are Caddo sherds (Stein 2012:Table 11.16), unmodified pieces

of turquoise (Blakeslee et al. 2012:Table 10.10), and two bald eagle wing elements (Haury 2012:434). It has been suggested that the Schrope site was one of the three Wichita villages with Deer Creek (34KA3) and Bryson-Paddock (34KA5), recorded by Frenchmen in 1749 on the Arkansas River in northern Oklahoma and southern Kansas (Hawley and Holland 1996:7; Vehik 2012:49). However, archaeological evidence supports the abandonment of the site around AD 1700 (Hoard 2012b).

The Tobias site (14RC8) is a Little River focus (LRF) village in Rice County, Kansas. Excavations were first conducted at Tobias by Wedel in 1940 and the 1960s and continued by Witty in 1977 and 1978 (Slattery 2006; W. Wedel 1959, 1967; Witty 2006). Wedel's excavated artifacts are curated at the Smithsonian Institution. The most complete report from these excavations is in Wedel's (1959) *Introduction to Kansas Archaeology* (Vehik 2002:52). The assemblage that was analyzed for this research was from the later excavations that were curated at the Kansas Historical Society. The LRF council circles, which are four curved subterranean structures that form a circular pattern, were first identified at Tobias and the nearby Thompson (14RC12) and Kermit Hayes 2 (14RC13) sites (Wedel 1959, 1967). The council circles have been interpreted as residences for ritual or political leaders based on the occurrence of exotic artifacts and alignment with other features (Loosle 1991:137; Vehik 2002:57; Wedel 1967:59). Artifacts associated with European trade were found at the site, including a glass bead similar to the one at Schrope (Hawley and Stein 2005:74), chain mail (Myers 1979:365; Witty 1977), and iron artifacts (Slattery 2006; Vehik 2002; Wedel 1959, 1967). The Tobias site had the largest assemblage of stone tools of all the sites in this study.

The Lewis site (14PA307, previously known as Larned site), located in Pawnee County, Kansas, was a short-term, seasonal occupation camp (Ranney 1994). The site contains three components, of which the GBA occupation was the only component used in this research. The site has been interpreted as a hunting campsite based on the abundance of bison processing artifacts and the lack of farming tools and storage pits (Monger 1970:8). Ranney (1994:87-88) suggests that due to the large percentage of Alibates in the lithic assemblage, the site was a camp for trips

to the quarry in the panhandle of Texas. There is no evidence of European contact at this site (Monger 1970). Additionally, there is no evidence of pipestone use on the site, although a steatite pipe and two clay pipes were found (Monger 1970:6). The lithics from the GBA component at the site were included in the use-wear and residue analysis in order to see if pipestone manufacture was occurring at a site that has not yielded pipestone.

Protohistoric Wichita Sites

The protohistoric sites in Oklahoma, Bryson-Paddock (34KA5) and the Longest site (34JF1), are both attributed to early subdivisions of the group that would historically be known as the Wichita (Bell 1984:364; Vehik 1992). Bryson-Paddock is located on the Arkansas River, in Kay County, Oklahoma (directly south across the state-line from Cowley County, Kansas) and was occupied between 1700 and 1750 (Vehik 1992:327). Bryson-Paddock is contemporaneous to but was likely abandoned before Deer Creek (43KA3) located approximately 2 kilometers downstream from Bryson-Paddock (M. Wedel 1981). Artifacts recovered at both sites are similar to those found at Lower Walnut focus sites (Hartley and Miller 1977:255). The biggest difference between Bryson-Paddock and GBA sites in Kansas is a major increase in the frequency of European-made artifacts (particularly gun parts) reflecting the early eighteenth century occupation of the site (Bell 1984; Hartley and Miller 1977; M. Wedel 1981). Deer Creek and Bryson-Paddock were abandoned in the mid-eighteenth century when the occupants moved to sites on the Red River in southern Oklahoma. Archaeologists and ethnohistorians hypothesize that the reasons for their southern migration was a combination of pressure from the Osage, population loss through measles and smallpox outbreaks, and a desire to relocate closer to French trading posts because native technologies (i.e. flintknapping and ceramic technology) were being replaced by European technologies (i.e. guns and metal containers) during this early fur trade period (Bell 1984:377; Drass 1998:447; Hartley and Miller 1977:257; M. Wedel 1981). The Longest site (34JF1) was one of these new Taovaya sites on the Red River. The Longest site was an important center for trade with the French in 1760 and this is reflected in its archaeological assemblage (Bell 1984;

Hartley and Miller 1977).

Assemblage Differences

The assemblages used in this research are from over eighty years of excavation, research, and surface collection. For this reason, there are many differences in the excavation strategies, sampling methods, and research agendas. These biases were taken into account during all stages of the analysis and are included in the final interpretations as possibly affecting some of the results. Despite this particular disadvantage of using large amounts of previously excavated or collected material, the advantages are access to a larger sample from which to make processual interpretations and comparisons. As demonstrated below, the existing assemblages can yield new information when studied with current methods and research goals.

Archaeology and Ethnohistory of Wichita Pipes and Pipe Rituals

Wichita smoking pipe rituals have not been the focus of any specific research project. The archaeological evidence of smoking pipe ritual activity at GBA sites is limited to the presence of stone pipes and tobacco seeds, and perhaps in the evidence for pipe manufacture. However, information on pipes and pipe rituals can be found in archaeological (Blakeslee 1975; Blakeslee and Hawley 2006; Blakeslee et al. 2012; Lees et al. 1989; W. Wedel 1959; Vehik 2002), ethnohistoric (M. Wedel 1981, 1982, 1988a-e) and ethnographic sources (Blaine 1982; Dorsey 1995[1904]). The most significant work on pipe rituals at GBA sites can be found with Vehik's (2002) study of late prehistoric trade patterns. In this article, she noted the presence of red pipestone pipes at sites containing council circles (Vehik 2002:54), LRF structures that are believed to be residences for ritual or political leaders (W. Wedel 1967).

The Spanish were the first Europeans to encounter the people at GBA sites in Kansas and although they documented their experience they did not record smoking pipe rituals (Bell et al. 1974; Blakeslee and Hawley 2006; O'Brien 1984; Vehik 1992; W. Wedel 1959). This omission has been interpreted not as the lack of smoking pipe rituals (particularly the calumet ceremony)

but in the paucity of information recorded by the Spaniards that dealt with Indian rituals and religion (Blakeslee 1981:760). Additionally, the Spanish expeditions were led with a militaristic (and evangelistic) mindset and the hostility of these first encounters likely did not lead to ceremonies to establish friendships (Blakeslee 1981:760; Hudson 1997).

The French encounters with protohistoric Wichita in the early eighteenth century also had economic goals driving their expeditions to the southern Plains (M. Wedel 1988d,e). The French knew that in order to establish trading posts to acquire furs and skins in these areas, they would need to rely on native suppliers, thus, requiring cooperation from both groups (M. Wedel 1988b:21). In the fall of 1719, the La Harpe expedition met with an affiliated tribe of the Wichita (likely the Tawakoni [Odell 2002:1] and a chief of the Iscani (Odell 2002:1; M. Wedel 1988b:26). This encounter is the first written account of a calumet ceremony being performed by protohistoric Wichita. La Harpe was greeted outside of the village with multiple chiefs and after a small gift-exchange and feast, he was placed on a horse and they rode into the village (M. Wedel 1988b:25). In the village he was carried on the shoulders of two men who took him to the 'chief.' Afterwards, the following events took place to start the calumet festivities (as interpreted and summarized by M. Wedel of LaHarpe's diary).

After the Frenchman was placed on a bison robe on a wooden platform, presumably shared with the chief, a number of principal men encircled him and each put his hands in those of La Harpe to indicate friendship. A gift exchange followed with La Harpe receiving an 'eagle feather crown' ... He was also given two feathered 'calumets' ...one signifying war and peace. He characterized them as the most valuable presents the Wichita could give (M. Wedel 1988b:25-26).

The subsequent ceremony involved exchanging more gifts, smoking, storytelling, feasting, and dancing which lasted for two days (M. Wedel 1988b:26). Ethnohistoric accounts of the calumet ceremony among the protohistoric Wichita are limited to La Harpe and Etienne Vaugine's accounts (La Vere 1998:78; M. Wedel 1988b:35, 1988e:140). The other historical account of a 1780 calumet ceremony was the participation of 180 Kitsai in a calumet ceremony with Cad-doan and other tribes in what is today east Texas and northwest Louisiana. The participants were

recorded by Vaugine, the Spanish commandant of the Natchitoches outpost, an important trade center for the Indians of the region (La Vere 1998:79).

The dearth of historical documentation of calumet ceremonies among protohistoric Wichita is a problem that has not been addressed. Mildred Wedel (1988:35) suggested that the ceremony might have stopped being practiced when there was more regular contact with French traders. However, this assumes that the calumet ceremony's only function was to facilitate trade with the French, when it is likely that the ceremony predates regular contact with Europeans (Blakeslee 1975).

In the early twentieth century over half a century after the start of the Wichita reservation period, George Dorsey (1995 [1904]) collected the mythology of the Wichita Indians. He also recorded social and religious customs, including information on the calumet ceremony. Dorsey noted that the deer dance was the most important ceremony, followed by the calumet.

Next in importance was the ceremony of the calumet pipe sticks, during which feathered pipe-stems were carried to some chief or other prominent individual of the tribe or to some neighboring tribe. This ceremony abounded in ritual and had its origin in one of the early myths, and its performance was supposed to confer lasting benefit upon the tribe. It is claimed by the Wichita, and there is evidence that their claim is valid, that they originated this ceremony, and that it was obtained from them by the Skidi, who, in turn, passed it on to the other tribes of the Pawnee (Dorsey 1995[1904]:17).

Other Plains Indians claimed to have originated the calumet ceremony including the Arikara, Pawnee, and Cheyenne, however, ethnohistoric documentation supports its origin with Caddoan-speakers, probably either the Pawnee or Wichita (Blair 1996:I,182; Blakeslee 1975:104, 1981:761). Beyond sharing a language family and the calumet ceremony, the Pawnee and Wichita also shared similar political, social, and economic traits (Odell 2002:17-19). Additionally, these two groups were in contact dating back to the Great Bend Aspect times (Roper 2006:246). The relationship between the present-day Wichita and Affiliated Tribes and the Pawnee is still important. Each year these two groups have a week-long visitation, alternating years between Anadarko and Pawnee, Oklahoma (Blaine 1982). During this Pawnee-Wichita visitation the tribal members gather for gift exchange (including tobacco), feasting, music, and dancing. This

annual pow-wow is open to the public and usually occurs in early July.

CHAPTER SUMMARIES

The following five chapters include one reviewing the relevant pipe literature research, one chapter on the experimental use-wear and residue comparative collection, two chapters on the types of data collected and analyzed (pipestone artifacts and chipped stone tools), and one chapter that contains the discussion and conclusion of the analysis. The literature review chapter focuses on previous pipe research in the Plains and Midwest that are relevant to this study. This chapter is organized by the different methods employed in studying pipes. Chapter three outlines the raw materials and methods used to create the experimental use-wear and residue comparative collection, which was used in the analysis of the chipped stone tools. Chapters four and five contain a detailed explanation of the methods used to collect data, the results of the analysis, and interpretations. The final chapter is a comparison of the various types of evidence, the spatio-temporal patterns, and a synthesis of results and the interpretation within GBA context. The final chapter also contains suggestions for future directions for this research

CHAPTER 2: Background of Previous Pipe Research

INTRODUCTION

Previous research on smoking pipes employ one of the following analytical perspectives: ethnography, ethnohistory, archaeology, or geology. Historical sources are employed in tracing the references of pipes throughout various cultures and time periods. Ethnohistorians are conscious of the historical and anthropological influences shaping those sources and bear those in mind while translating documents. Similarly, ethnographic sources reveal data about pipes that also require a cultural-historical context. Smoking pipe researchers also employ analytical techniques from archaeology and the natural sciences. Middle-range theory is becoming more commonplace in pipe research, as archaeologists identify the potential in identifying how pipes were made and used. A combination of these approaches is very helpful in understanding pipes in the archaeological record.

This chapter is a summary of the most influential research on Native American smoking pipes. The geographical focus is North America generally, with the majority of research from the Great Plains and upper Midwest. Previous research on pipes has been influenced by the major paradigm of the time. In the first half of twentieth century, archaeological studies of pipes were mainly described and listed among the “miscellaneous artifact” classes (Blanton 2013). Types of pipes were then employed as horizon markers at sites. In the second half of the twentieth century, pipe studies began to focus more on the technological aspects of pipes. The majority of this research dealt with the pipe material and sourcing the various stones used for pipes (e.g., Boszhardt and Gundersen 2003; Emerson and Hughes 2000, 2001; Emerson et al. 2003, 2013; Fishel et al. 2010; Gundersen 1981, 1987, 1988, 1993, 2002; Gundersen and O’Shea 1981; Gundersen and Tiffany 1986; Gundersen et al. 2002; Hollinger et al. 2009; Hughes et al. 1998; Mead 1999; Penman and Gundersen 1999; Sigstad 1970, 1973; Wisseman et al. 2002, 2010, 2012). Early in the twenty-first century, pipe researchers explored various analytical techniques, experimentation, and theoretical frameworks to understand prehistoric pipes (e.g., Blakeslee 2012; Bleed 2010; Bollwerk 2012; Carmody et al. 2013; Creese 2013; Hadley 2014, 2015; Hedden 2013; Ligman

2013; Odell et al. 2011; Tushingham et al. 2013). A review of previous pipe research was important in the overall development of my research plan and the following summary emphasizes this perspective.

PIPE TYPOLOGIES

Typological analysis of pipes relies on descriptions of the basic shape and form of the artifact. In the earliest pipe research, measurements and weights were infrequently taken as part of the typological analysis (e.g., Dunhill 1969; King 1977; West 1934). Typologies applied to archaeological pipes and their interpretation are often drawn from ethnographic analogies. The pipe typologies that are relevant for this research are by West (1934) and Ewers (1986) because both have detailed types of Plains' pipes. These early types are still applied to subsequent research on pipes.

West's (1934) book on smoking pipes is the foundational work for all subsequent archaeological pipe research. His volume is to date, the most comprehensive description of archaeological and ethnohistoric pipes. Through extensive analyses of museum collections, West found morphological patterns that varied over the eastern United States. West drew from these patterns to create a pipe typology. The majority of these specimens lacked stratigraphic context, which at that time, was the best tool for dating archaeological materials. Due to this limitation, West's typology lacks a temporal element. West characterized 22 types and 11 subtypes of North American pipes (Table 2.1) based on morphology, cultural affiliation, and ceremonial use. West defined two types by the particular Native American group that was associated with that pipe type (i.e., Micmac and Iroquoia). He also defined a pipe based on the activity associated with it (i.e., calumet). Many of these pipe types are still used today by archaeologists including the tube, monitor (but more commonly called platform), effigy, calumet, elbow, disk, pottery, Iroquois, and Micmac (West 1934:127-9). The scope of West's research is impressive and it is an indispensable reference in archaeological pipe research.

In the book *Plains Indian Sculpture*, Ewers (1986:45) illustrates and describes various forms of historical sculpture, including pipes. This is a coffee table book, written for a popular

Table 2.1 George A. West's (1934:127-129) Pipe Typology for North America

Type	Subtypes	Definition
Tube		Tubular shaped
Monitor	Flat-based, curve-based, modified	Bowl elevated on wide flat base
Effigy	Idol (human), animal, bird, reptile, heavy	Carved to representing a figure
Circular peace pipe		Circular with multiple stem holes
Calumet	Siouan	Defined by use in calumet ceremonies not form
Elbow		Bowl at right angle to base
Ovoid		Spherical
Lens-shaped		Thick, flat, lens-shaped
Keel-shaped		Bowl shaped like keel of boat, lacks base
Disk	War bundle	Bowl shaped like disk, base underneath bowl
V-shaped		V-shaped
Bridegroom		Two stem holes
Handle		Extension below the bowl forms a handle
Iroquoian		Trumpet or curved stem, sometimes with effigy bowl
Micmac		Acorn-shaped bowl attached to base with narrow neck
Double-conoidal		Stem and bowl holes cone-shaped
Trapezoidal		Bowl trapezoidal lacking base
Pottery	Tubular	Made from pottery
Coffee Bean		Bowl decorated with small projections
Long-Stemmed		Stem is very long bowl bell-shaped and short
Northwest Coast		Totemic with inlays, varies in material
Pebble		Pebbles with a drilled bowl and stem hole

audience with colorful photographs of Native American sculptures from the Smithsonian, including: pipes, pipe stems, ceremonial effigies, musical instruments, feast bowls, war clubs, children's toys, horse gear, and walking canes. Ewers focused on historic effigy pipes with a detailed subsection for each type of animal or human scene represented. In his survey of pipes, Ewers (1986:50) created a typology unique to pipes on the Plains. Ewers' five types were similar to West's with the inclusion of the tube, Micmac, calumet, and elbow pipes. His typology differed from most by including an elbow with prominent prow (Table 2.2). Ewers' typology is particularly relevant to this paper because it was developed specifically for Plains' pipes and takes into consideration spatiotemporal differences in types.

Table 2.2 John C. Ewers' (1986: 50-51) Plains Pipe Typology

Type	Definition	Cultural Affiliation
Straight Tube	Tubular sometimes with bulbous sides, requires a stem	Widespread through time on Plains
Modified Micmac	Acorn-shaped stem on a blocky base	Micmac and neighbors
Elbow	Horizontal bowl and vertical base at right angles	Widespread throughout Plains
Prowed pipe with flaring bowl	Elbow pipe with extension on the opposite side of base with flaring bowl	Sioux and Pawnee, with effigy elaboration
Calumet	Inverted T-shape	Originated among Sioux 1850

Both West (1934) and Ewers (1986) identified the calumet pipe as a prominent pipe type but they defined it differently. West (1934:128) defined the calumet pipe by its use in the ceremony, whereas, Ewers (1986:51) defined it by its most common morphology, an inverted T-shape. The origin of the term “calumet” actually originated with the French fur trader’s word for a reed used as a pipe stem (Blair 1996:I,182). The calumet pipe stem was long and highly decorated with porcupine quills and feathers (Ewers 1979). The calumet pipe ceremony was used to foster “fictive kinship ties” to strengthen alliances (Blakeslee 1975:83) but was conversely used to initiate war (Kellogg 1917:245). In general, the ethnohistoric accounts of the calumet ceremony documented feasting, speech-making, singing, reenacting battles through dance, and pipe smoking (Blair 1996; Kellogg 1917; Kinietz 1940; McWilliams 1988). A general homogeneity has been assumed for the historic calumet pipe type, as well as the ceremony.

The historic calumet pipe became the subject of much in-depth archaeological research in the last quarter of the twentieth century. The main goal of this research was to identify the pre-historic origin of the ceremony and trace its spatiotemporal diffusion (e.g., Blakeslee 1975, 1981; Brown 1989; Turnbaugh 1977, 1979). These researchers used ethnohistoric data to identify the calumet pipe during early colonialism. Historical documentation of the calumet ceremony is our best tool for identifying the ceremony in the archaeological record because the material left behind is not necessarily specific to the ceremony. The ceremony did not always employ a particular type of pipe although it included the inverted T-shaped pipe, assumed to be the calumet pipe

(Blakeslee 1975:83). Feasting may leave a material record, but identifying a calumet feast from another ceremonial feast would be difficult. Additionally, the other components of the calumet ceremony are non-material. However, the result of the ceremony, open trade relationships, has material consequences but distinguishing trade facilitated through the calumet may be impossible. This research minimally deals with the origins of the calumet according to ethnographic data, which is attributed to the Wichita, and considers the changes of pipe ceremonies from the Great Bend Aspect to protohistoric Wichita sites.

Typologies are necessary in order to productively analyze and interpret the archaeological record. Past pipe typologies have compiled massive amounts of valuable data from curated assemblages and attempted to make sense out of them. Without this foundation of pipe research, archaeologists could not have used pipes as horizon markers and then examined the role of pipes in past societies.

TECHNOLOGICAL STUDIES

Technological studies of pipes became the dominant approach to pipes in the late twentieth century and continue today. Technological studies are a holistic approach to understanding the way in which prehistoric objects are made, used, and discarded (Carr 1994; Nelson 1991). This research is rooted in lithic analysis, a reductive technology that allows archaeologists to study the steps of a reduction sequence. Margaret Nelson (1991) defines the organization of technology as “the selection and integration of strategies for making, using, transporting, and discarding tools and the materials needed for their manufacture and maintenance.” Archaeologists that adopt this approach also recognize that all technologies are intertwined with other economic and social aspects of a culture. Studying the multiple facets of technology will reveal significant information about how an object was made, used, discarded, and the associated social and economic relations. The majority of technological pipe research has focused on the materials, with less research on pipe manufacture, use, and discard. There are even fewer studies that concern the waste products from pipe manufacture and pipe recycling.

Material Studies

Lithic sourcing of pipes is conducted to determine the original provenance of the stone. The Euclidean distance is then calculated to determine the distance that the material traveled during its use life. These archaeological provenance studies with pipes often focus on red pipestone, although other materials such as steatite and limestone are used in pipe manufacture. Red pipestone is a metamorphic argillite (clay-rich) that is the focus of much research because of its historical documentation by George Catlin. Catlin romanticized Native American life on the Plains by painting beautiful pictures of pipestone quarries, calumet ceremonies, and chiefs with red pipes. Then in the twentieth century, geologists and archaeologists realized that there were multiple types of red pipestone in archaeological collections from Arizona to Ohio (Berg 1938; Gundersen 1981; Howell 1940; Wedel 1959). The following half-century of research focused on finding the best method for distinguishing the different pipestones.

Over the twentieth century, provenance methods evolved, however the goal to source these stones remained constant. Berg (1938) conducted the first geological study of pipestone using petrographic thin sections. Howell (1940) noticed that through a spectrographic analysis there were subtle chemical differences in pipestones from different regions. Sigstad (1970, 1973) conducted two different pipestone provenance tests. In the first study, he found that it was not possible to distinguish different red pipestones from a simple streak test. In the second, he used Neutron Activation Analysis (NAA) to find the chemical signatures of different pipestones. Mead (1999) tested Sigstad's work and found that he incorrectly interpreted his NAA results. All of these researchers were unsuccessful in finding the diagnostic mineral or chemical combinations or "signatures" needed to source specific materials.

The first successful pipestone sourcing attempts began in the early 1980s by Wichita State University geologist James Gundersen. Using X-ray diffraction (XRD), he defined the five minerals that are found in Plains pipestones: diaspore, kaolinite, pyrophyllite, muscovite, and quartz (Gundersen 1988:84). The shared red color in pipestones is due to the presence of hema-

tite (1988:82). Gundersen found that because of their chemical composition only four of these minerals could be present in a pipestone. Each general pipestone locality has a unique signature of these four minerals. The research value of Gundersen's findings have been significant in identifying the types of pipestones used at various sites and during particular times. A limitation of Gundersen's method is that XRD is damaging or destructive to artifacts.

Recent work by archaeologists in Illinois has shown an improvement in sourcing methods. Because pipestones are distinguishable at the mineral level, expensive chemical analyses (i.e., NAA) can be avoided (Wisseman et al. 2002). These researchers found that the best way to analyze pipestones was with a portable infrared mineral analyzer (PIMA; Emerson and Hughes 2000, 2001), which is similar to the machine used in this research. The PIMA uses the short wave infrared (1300-2500 nanometers) portion of the electromagnetic spectrum (Fishel et al. 2010:169). The advantages of this infrared spectrometry technique are: it is relatively inexpensive (compared to chemical analyses), requires little to no sample preparation, is fast, non-destructive, portable, and can be used to take readings on a variety of surfaces or materials (Wisseman et al. 2002:691, 2010, 2012). Their research demonstrated that accurate pipestone sourcing is possible without damaging the artifact.

Stone sourcing methods continue to be the most common way to study archaeological pipes. These studies shed light on the distance a raw material traveled during its use life, but little else has been revealed about the technological organization of stone pipes. Sourcing studies alone do not reveal information about the social relationships, contexts of manufacture and use, and economic trade mechanisms. Research needs to be conducted examining how, where, when, and why that raw material was shaped into a pipe to understand the related socioeconomic processes.

Pipe Manufacture

Evidence for stone pipe manufacture in the archaeological record exists, but it is rarely the focus of research. Finished pipes are more frequently the targets of archaeological analysis

(e.g., Chapdelaine 1992; Hall 1977, 1983, 1997; Kapches 1992; Mead 1999; Noble 1992; Otto 1992; Pendergast 1992; Smith 1992), with rare consideration of the manufacturing waste and tools (Scott and Thiessen 2005:151-152). Recent research by Bleed (2010) and Blakeslee (2012) demonstrate the utility of pipe manufacture as a subject of in-depth analysis. Bleed (2010) analyzed pipe refuse from an historic Oto or Ioway site (Bozell and Carlson 2010:1) in northeastern Nebraska and documented four stages of pipe manufacture (Blead 2010:112). Bleed's research is the first effort to identify the stages in pipe manufacture using an archaeological assemblage. However, because the pipe-makers used metal tools, there was no attempt to identify pipe production tools in the assemblage. Blakeslee (2012) has also explored the production trajectory of stone pipes, using the *chaîne opératoire* as an organizing concept. He defined the stages of the Windom pipe, a type of red pipestone elbow pipe that is specifically found at GBA sites, with six stages (blank, preform, decoration, shaping of interior passages, use, and dismantling for another use). Importantly, he addressed issues of who made the pipe, the tools used to make the pipe, and its spatial distribution. Blakeslee's study was important for this research because I was able to test his conclusions with the collections. Bleed and Blakeslee's research demonstrate the interpretive utility of studying more than just complete pipes. Because production trajectories deal with technology as a system as opposed to a typology (Bar-Yosef and Van Peer 2009; Bleed 2001), it is plausible to use them to identify social and economic influences on the technology.

There are multiple other studies that have replicated pipes in order to understand the amount of time and effort that went into carving pipes (e.g. Catlin 1975:247; Odell et al. 2011; West 1934:341-342). West (1934) conducted the first documented pipe replication experiments using George Catlin's (1975:247) observations of Sioux pipestone drilling. Employing ash wood drills with sand and water, West (1934:341-342) found that to make a 25-millimeter (mm) deep hole, it took 60 minutes in catlinite (pipestone from Pipestone National Monument, Minnesota), 66 minutes in Barron County, Minnesota pipestone, and 110 minutes in limestone. Odell et al. (2011:10) replicated a Minnesota pipestone pipe from a block of pipestone that was pre-cut to 9.5 centimeter (cm) long, 5.5 cm wide, and 6.5 cm thick. It took Odell et al. a total of 136.8 hours of

manufacture time to create a drilled and polished pipestone pipe.

Experiments have also been conducted to describe the diagnostic wear patterns on chipped stone tools used in working pipestone. Waggoner (2005) conducted experiments with Minnesota pipestone and limestone in order to describe the particular wear patterns on stone tools. Tools were replicated from local Kansas lithic materials, Florence and Smoky Hill Jasper, and used to saw and scrape pipestone. Casts were made of the used tool edges at intervals throughout the experiment. She found that Minnesota pipestone and limestone wear were distinguishable on stone tools, but she cautioned that experiments needed to be conducted with Kansas pipestone (Waggoner 2005:72). Odell et al. (2011) is central to this research because of their particular research methods. Odell et al. (2011) replicated tool motions on Kansas pipestone and they also found that pipestone wear was diagnostic under a low-power microscope (40X to 100X). Waggoner (2005) and Odell et al. (2011) demonstrate the utility of microscopic use-wear analysis in identifying the stone tools used in pipe manufacture.

Research on pipe manufacture, waste, and tools are creative new ways to study prehistoric pipes. The foundational work by Bleed (2010), Blakeslee (2012), Waggoner (2005), and Odell et al. (2011) is important in establishing how such work would proceed. This dissertation builds on their previous research and develops new questions for understanding past pipes and pipe rituals.

Pipe Use and Discard

Researchers organize the study of pipe use in two ways: direct and indirect (Haberman 1984). The direct approach to studying pipe use examines the plant remains or the burnt residue inside the pipe bowl. There are two indirect approaches to studying pipe use. One is to look for smokable botanical materials at the site. The other indirect approach analyzes and compares the archaeological contexts of used pipes. The archaeological context can also shed light on patterns of pipe discard in the past.

Direct Approach to Pipe Use

Burned residues in pipes are also called dottles (Haberman 1984) and have been tested in the past to determine if tobacco was smoked. Initially, the interest in pipe dottles was to trace the spatiotemporal distribution of tobacco. Early research was successful in identifying nicotine in pipe dottles (Dixon and Stetson 1922; Jones and Morris 1960), but the method has been improved in recent years. Gas chromatography/mass spectroscopy (GC/MS) is now used to successfully identify chemicals in pipe dottles (Rafferty et al. 2012). Rafferty (2002, 2004, 2007, 2008) has successfully identified a chemical signature for a degraded form of the alkaloid nicotine in Adena tubular pipes. Recently, Carmody et al. (2013) discovered nicotine and the chemical signature for the alkaloid camphor. The camphor likely came from smoking sassafras root bark, which can cause hallucinations among other physiological symptoms (Carmody et al. 2013:7-8). The Carmody et al. and Rafferty research demonstrate that pipe dottles are useful in identifying tobacco and other smoked botanicals.

Indirect Approach to Pipe Use

Another way to study pipe use is to examine the paleoethnobotanical remains in a pipe or at a site. Some have argued that if tobacco or pipes are not found together at a site, then the presence of one indicates the other was used (Haberman 1984:270). However, this assumption does not always work because there are many other plants that were smoked and tobacco had multiple uses, although smoking was likely its primary use (Asch and Asch 1985; Ford 1981; Yarnell 1964). Archaeologists refer to the ethnographic and ethnohistoric records to determine if a particular plant was used for smoking (e.g., Winters 2000; Yarnell 1964). Paleoethnobotanical research can inform archaeologists about the plants that were smoked and their physiological effects. Understanding the smoked botanical may give an indication into the types of ceremonies or activities involving the pipe.

At the Great Bend Aspect sites, tobacco seeds have been documented at six sites. These sites are: Mem (14MN328), the Larcom-Haggard (14CO1), Schrope (14CO331), Living the

Dream (14CO382), and Radio Lane (14CO385) sites (Adair 1989, 2012). Interestingly, pipestone was found at all of these sites (Blakeslee et al. 2012:Table 10.12; Lees et al. 1989).

Contextual Studies to Understand Pipe Use and Discard Patterns

Contextual studies attempt to map out the spatial and temporal distributions of pipes at multiple scales (regional, sites, activity areas, features) and compare the contexts of other artifacts, pipes, and features by using synthesized research that focuses on particular time periods, sites, or the pipes themselves. Vehik (2002) used distributional data with pipes and other artifacts to construct a new model for trade among Late Prehistoric groups on the Southern Plains. Vehik found pipestone pipes at Great Bend Aspect sites with and without council circles but worked fragments of pipestone and pipe blanks were found exclusively at council circle sites. This evidence indicates that pipestone manufacture occurred at these locations (Vehik 2002:54). Additionally, other exotic trade artifacts were found at the council circle sites (2002:54). Vehik's new trade model relied on the assumption that sites with council circles represented the residence of a leader, whether political, religious, or both and contemporary sites lacking council circles as non-leader residences. Thus, the distributional pattern demonstrated the leaders of the Little River Focus sites acquired exotic trade goods and manufactured pipestone pipes to reinforce their power, prestige, or wealth.

Loosle (1991) compared the contexts and contents of artifacts at the Major site (14RC2) and 14RC306, two Little River Focus sites. He wanted to examine potential patterns and relationship in trade at these sites. Loosle analyzed the pipes and pipestone artifacts from both sites. Loosle (1991:69) determined that "the small amount of pipestone at 14RC2 and the fact that it only occurs in finished forms indicates that it was probably finished somewhere else." Loosle also concluded that pipestone was acquired through direct access trade.

Vehik (2002) and Loosle (1991) examined the spatial distribution of pipes at various sites, but this is not the only way to examine the distribution of pipes. Less common in Great Bend Aspect research is to focus on the relationships of materials within a single site. One ex-

ample on this equally productive strategy is Sundermeyer's (2005) research, in which the goal was to test if the Crandall site (14RC420), a Little River Focus site, had evidence of economic specialization. He did this by examining the context, concentration, scale, and intensity of particular prestige goods at the site. Included in his analysis were pipestone artifacts, as well as hematite, modified shell, and exotic artifacts. Sundermeyer (2005:145) concluded that while pipe manufacture was occurring at the site, there was not enough evidence to support this activity as the work of specialists. Additionally, Sundermeyer did not find evidence of specialists with the other artifact categories.

Studies into the archaeological context of pipes have traditionally looked into how the pipe was used and how it was discarded. However, the context of pipes can also reveal information about the manufacturing process, the people involved in the process, and potential trade interactions.

SUMMARY OF PIPE RESEARCH

The methods for studying pipes have not changed dramatically over the last fifty years. The most basic and common methodological approach to studying pipes is a typological analysis. These analyses are descriptive and generally rely on morphological characteristics to define each type. Pipe types have been used to distinguish cultural groups and as horizon markers. Analysis of the raw material used in making pipes is another popular approach to studying this artifact. Over the last thirty years, researchers have investigated red pipestone use in prehistoric pipe manufacture. Despite the focus on raw material sourcing and procurement, few archaeologists have considered the entire manufacture trajectory of stone pipes. Bleed (2010) and Blakeslee (2012) examined stone pipes as lithic artifacts, which leave evidence of their reduction. Studying the associated botanicals and testing the pipe residue have the potential to reveal the types of plants that were smoked. Building from the past one hundred years of pipe research, archaeologists are now starting to explore the spatiotemporal distributions of pipes. This arena of research, combined with one or more of the aforementioned methods will reveal significant information

about the past cultures and pipe use. Alone these methods are useful, but combining them in the same study provides the best potential for deriving information about the role of pipes in the past.

CHAPTER 3: Pipestone Experimentation

INTRODUCTION

One goal of this research was to build a use-wear and residue comparative collection to aid in archaeological analyses. The experiments and analysis here specifically target the pipestone pipe manufacture from the late prehistoric and protohistoric periods on the central and southern Great Plains. Pipe manufacture produces waste and residue that can be reconstructed and examined to understand the stages of pipe material transformation and use. In the process of making the comparative collection, information was gained about the characteristics of the raw materials, the effectiveness of tools in particular actions, and various signatures of pipestone manufacture.

The following chapter discusses the process of building a use-wear and residue comparative collection. First, the relevant lithic raw materials are described including their provenances and attributes. Next, the processes of replicating the tools and using the tools on pipestone are outlined. Then, there is a detailed account of the observations from the microscopic analysis of the use-wear and residue on the experimental collection. Finally, observations from the experiment and the analysis of the experimental assemblage that were deemed most relevant to the archaeological assemblage are highlighted.

BUILDING A COMPARATIVE COLLECTION

In the following experiment, the stone tools and lithic material types relate specifically to those found at Great Bend Aspect (GBA) sites. The replicated chipped stone tools are modeled after pipestone carving tools that were previously identified by Odell et al. (2011) from the Robb Collection (Table 3.1). The Robb collection represents a family's surface collection efforts since 1917 from the areas around (and possibly on) the Paint Creek (14MP1) and Sharps Creek (14MP408) sites in McPherson County (Blakelsee 2012:305; Odell et al. 2011:4), both of which are GBA sites. Additionally, the major lithic types used in the chipped stone economy at GBA sites were identified by Blakeslee and Hawley (2006:174) and were used in this research. Future

research on pipe manufacture should consider the tools and materials that are specific to other geographic areas.

In order to create a use-wear and residue comparative collection, the following steps were used (further detailed in Table 3.2). First, the appropriate lithic materials were procured. Next, flintknapping was conducted to replicate multiple sets of tools from each material. Then, the finished tools were used in various activities on three different materials, Minnesota and Kansas pipestones and hematite. Next, the used tools were washed in order to recreate the curational procedures of the archaeological assemblages that were to be compared with this experimental collection. Finally, the tools were microscopically analyzed and the use-wear and residue patterns were documented. Finally, the comparative collection was used during the analysis of GBA artifacts to help identify pipestone-related residue and use-wear.

Lithic Materials

The first step was to collect samples of lithic materials represented in GBA archaeological assemblages (Figure 3.1). Based on previous research (Blakeslee and Hawley 2006; Stein 2006), there were four main types of lithic materials used at GBA sites: Florence chert, Smoky Hill Jasper (also known as Smoky Hill Silicified Chalk), Alibates Agatized Dolomite, and Undifferentiated Osagean cherts (following Ray 2007, 2013; Table 3.3). The worked materials for the experiment were Kansas pipestone, Minnesota pipestone, and hematite (Table 3.4). There are multiple sources of pipestone throughout the United States (i.e., Emerson and Hughes 2000, 2001; Emerson et al. 2003; Penman and Gundersen 1999; Scott et al. 2006:Table 3; Sigstad 1973; Wisseman et al. 2002, 2012) but the two primary types used at GBA sites are from Minnesota and Kansas (Gundersen 1993:561). Additionally, red pigments have been collected from multiple GBA sites in Kansas that may be either hematite or pipestone powder. Hematite was used in this experiment to help define its distinctiveness from pipestone wear, residue, and powders. Basic descriptions of each material and the location of procurement were recorded for each sample. Minnesota pipestone and Alibates Agatized Dolomite are protected lithic sources within National Monuments.

Table 3.1 Artifacts that were used at Great Bend Aspect sites to carve pipestone (identified and defined by Odell et al. [2011:Table 1])

Tools	Shape and Manufacture	Action	Retouch
End Scrapers	Rectangular or ovoid-shaped Uniface	Primarily scraping; some cutting	Unifacial
Tabular Tools	Rectangular or ovoid-shaped Biface	Cutting	None
Gouge	Club-shaped Biface	Carving a depression	Bifacial
Reamer	Small rectangular or ovoid-shaped uniface	Enlarging a depression by widening it and deepening it	Unifacial
Drill	Parallel-sided or slightly tapered biface	Deepening a depression	Bifacial

Table 3.2 Experimental design for the study

Objectives:	Steps:
Replicate GBA chipped stone tools	<ol style="list-style-type: none"> 1. Procure lithic materials from four local sources 2. Heat-treat the chert that is most commonly heat-treated prehistorically 3. Knap raw chert into five types of tools (as defined by Odell et al. 2011): end scraper, tabular tool, gouge, reamer, drill 4. Knap at least two tools for each chert type (refer to Table X.5 for total number of tools per chert type)
Replicate pipestone and hematite use-wear and residue on tools	<ol style="list-style-type: none"> 1. Use an end scraper from each chert type and scrape the Minnesota Pipestone, Kansas Pipestone, and hematite 2. Use a tabular tool from each chert type and cut a line into the Minnesota Pipestone, Kansas Pipestone, and hematite in the same area that was scraped 3. Use a gouge from each chert type and gouge a depression into both pipestones 4. Use a reamer from each chert type and enlarge the gouged holes in both pipestones 5. Use a drill from each chert type and drill the gouged and reamed holes deeper in both pipestones
Replicate archaeological curation activities that may affect the appearance of residue and wear on tools	<ol style="list-style-type: none"> 1. Wash all of the used tools with water and a soft toothbrush 2. Air dry the tools 3. Bag the tools into individual polyurethane bags
Describe the use-wear and residue	<ol style="list-style-type: none"> 1. Analyze each tool with a microscope ranging from 50X-100X magnification 2. Describe the residue and use-wear exhibited on each tool
Use tools as a comparative collection	<ol style="list-style-type: none"> 1. Refer to notes and tools during analysis of archaeological artifacts to aid in the identification of pipestone and hematite residue and wear. (The comparison with archaeological tools is not discussed in this paper.)

Table 3.3 Properties and characteristics of the materials used for the chipped stone tools

Chert Type	Geological Age	Colors	Texture	Source Location	References
Florence Chert	Permian	Gray and dark-gray to tan and brown, sometimes banded	Fine-grained, highly fossiliferous with quartz inclusions	Flint Hills of Eastern Kansas	Haury 1981, 1984
Smoky Hill Jasper (Silicified Chalk)	Cretaceous	Highly variable: green, red, black, white, yellow, and brown	Fine-grained, varies from lustrous to chalky	Northwestern Kansas	McLean 1998
Peoria (Undifferentiated Osagean) Chert	Mississippian	White, very light gray, and tan, with darker linear mottles lined by white	Fine-grained and brittle	Northeastern corner of Oklahoma	Ray 2007, 2013
Alibates Agatized Dolomite	Permian	Banded and mottled with red, pink, purple, brown, orange, blue, and white	Fine-grained lacking fossils, sometimes with veins of quartz	Texas Panhandle	Banks 1990; Haury 1981

Table 3.4 Properties of Worked Materials

Worked Material	Source Locations	Size cm (length x width x thickness)	Weight (kg)
Minnesota Pipestone	Southwestern Minnesota	12 x 10 x 7	2.2
Kansas Pipestone	Northeastern Kansas	17 x 11.5 x 10	2.2
Hematite	Throughout Kansas	4.5 x 3.5 x 1.8	0.028

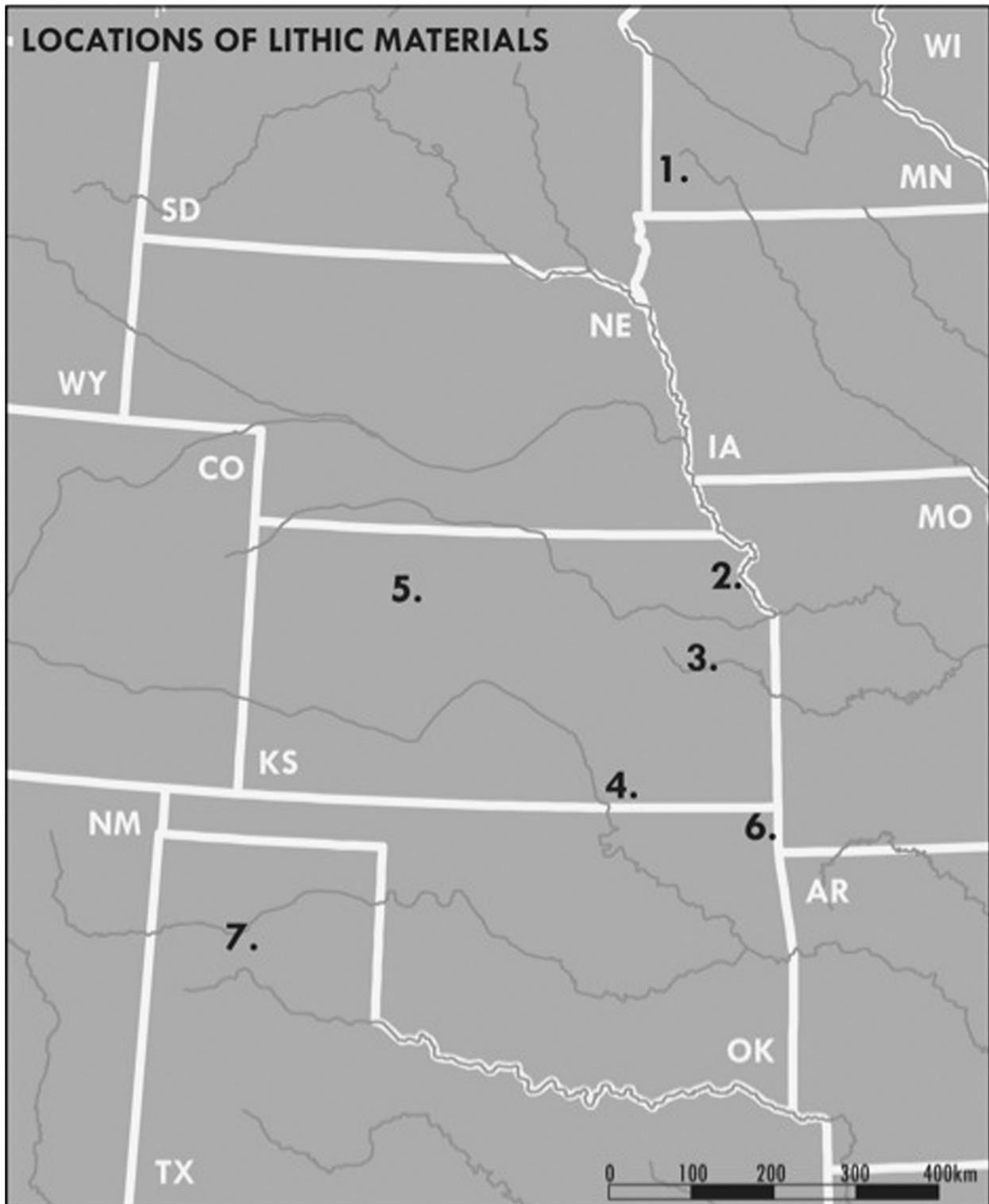


Figure 3.1 Approximate procurement locations for the lithic materials used in the study: 1. Minnesota Pipestone; 2. Kansas Pipestone; 3. Hematite; 4. Florence chert; 5. Smoky Hill Jasper; 6. Peoria chert (Undifferentiated Osagean [Ray 2013]); 7. Alibates Agatized Dolomite

The particular samples used in this experiment were not procured on the protected properties, but in outcrops elsewhere in the areas. However, the Minnesota pipestone and Alibates samples used were purchased for this experiment because of the limited access to these materials.

Worked Materials

Minnesota pipestone is a red argillite, defined as “a relatively soft compacted rock derived from shale or mudstone. Essentially [argillites] are a transitional rock, in terms of hardness and permeability, between slate and shale” (Scott et al. 2006:19). Pipestone interbeds with Sioux Quartzite in southwestern Minnesota (Gundersen 1988, 2002; Scott et al. 2006). Minnesota pipestone is most often associated with the outcrop in Pipestone National Monument (PNM). This particular pipestone, sometimes referred to as Catlinite, was historically quarried and carved into pipes that were traded throughout the Plains (Blakeslee 1975; Catlin 1975; Ewers 1979, 1986). The red color that is associated with pipestone is created by the presence of oxides, most commonly the mineral hematite (Gunderson 1988:82).

Kansas pipestone is also a red argillite that is found in glacial till deposits in northeastern Kansas, eastern Nebraska, and the extreme corners of northwestern Missouri and southwestern Iowa. Previous mineralogical sourcing research found that Kansas pipestone is distinctive from other pipestone in that it contains quartz (Gundersen and O’Shea 1981; Gundersen 1981, 1987:6). Both pipestone samples used in this study were between 5 and 6 on the Moh’s Hardness scale (can scratch with a knife or steel file). The two samples of pipestone differed mainly in their textures, with the Minnesota pipestone being very fine-grained and the Kansas pipestone sample with heterogeneous grains. The majority of pipestone artifacts that have been mineralogically tested at GBA sites are made from Kansas pipestone (Gundersen 1993:561).

The metamorphosed Minnesota pipestone is mineralogically distinctive from other pipestones, uniquely containing diaspore and muscovite (Gundersen 1987:2, 2002:37; Gundersen et al. 2002:110). Within PNM there are two variations of pipestone, one that contains equal amounts of muscovite and pyrophyllite and one that is primarily muscovite. Additionally, there

is evidence that pipestone in the surrounding counties may be mineralogically distinct from the material found within PNM and closer mineralogically to Kansas pipestone. Because the sample used in this experiment was purchased from a quarry outside of the park, it was assumed to be mineralogically identical to the classic Minnesota pipestone from PNM. However, during the mineralogical sourcing it was found that this sample is mineralogically identical to Kansas pipestone and may represent the original source of the glaciated Kansas pipestone. Indeed, in my research of Gundersen's pipestone samples at the Midwestern Archaeological Center, I found notes identifying Jasper, Minnesota, on the southern border of Pipestone County (southwest of PNM) as the source for Kansas Pipestone. Further sourcing of pipestone in the counties surrounding PNM is needed to confirm these results.

Hematite is abundant throughout the state of Kansas within beds of shale and clay and as a cementing agent in sandstones (Tolsted and Swineford 1984:72). The red hematite sample used in this experiment was collected in the uplands of Osage County, Kansas. It is the soft, earthy variety of hematite as opposed to the hard, specular variety that is metallic-colored. The sample of hematite was so soft that it could be scratched with a fingernail (2 on the Moh's Hardness scale). Specular hematite is much harder at 5-6 on the Moh's Hardness Scale, which can only be scraped with a knife or steel file (Rapp and Hill 1998:120). At archaeological sites in Kansas, hematite was carved and used as a source of red ocher (Stein 2006:264). This material was included in this study to test whether or not pipestone and red hematite are distinctive in terms of their use-wear evidence, residue, and powder.

Materials Used for the Chipped Stone Tools

Florence chert is found throughout the Permian Limestone Formations in the Flint Hills of eastern Kansas. Florence varies in color from gray and dark-gray to tan and brown and is often banded (Haury 1981:46; see also Haury 1984 for a detailed list of characteristics). This material has a smooth texture despite being highly fossiliferous with complete and fragmented silicified fossils and quartz crystal inclusions (Haury 1984:72-73). The material used in this experiment

was specifically procured from a source near Maple City in Cowley County, Kansas. The extra tools made from this material were also used on hematite.

At GBA sites, Florence cherts are often heat-treated (Stein and Reynolds 1994:7), so it was necessary to replicate the change of the material's texture for the experiment. The target temperature was 260° Celsius (500° Fahrenheit), which had been previously identified as the "optimal high temperature" in a heat-treating experiment with Florence chert (Stein and Reynolds 1994:10). Blades and flakes that varied in length from 5 to 15 cm with thicknesses of less than 2 cm were buried in 4 cm of clean sand. This amount of sand covered all sides of the tools and the sand in general "helps to spread the heat slowly and evenly" (Whittaker 1994:73). The tools in the sand were then heated in a conventional oven to its lowest setting, 79°C (175°F). The temperature was slowly increased in the oven by 37.8°C (100°F) every hour. Rapidly increasing or decreasing the temperature was avoided because that can cause thermal shock and fractures in the chert (Whittaker 1994:73). Once the oven temperature reached 260°C (500°F) the tools were left at this temperature for three hours. Afterwards, the oven was turned off to let the chert cool overnight (approximately nine hours). The heat-treatment made the gray and tan flakes pink with slightly more luster.

Smoky Hill Jasper is another common lithic material used at GBA sites. This material occurs in tabular and nodular forms in northwestern Kansas (McLean 1998:187; Stein 2006). The Smoky Hill Jasper used in this experiment is a sample of unmodified nodules collected from a talus slope in Graham County, Kansas. Smoky Hill has highly variable colors (from green to red and all the neutral colors in between [McLean 1998]), but only white, yellow, and brown Smoky Hill nodules were used in this experiment. Smoky Hill has a fine-grained texture with a soft chalky cortex. The brown variety is lustrous and the white and yellow varieties are chalky.

Undifferentiated Osagean chert is an analytical term for cherts that are fine-grained and light-colored (white or light-gray) from Mississippian-age outcrops (Burlington, Keokuk, Elsey, Reeds Spring, Pierson) in southeastern Kansas, northeastern Oklahoma, much of southern Missouri, and northern Arkansas (McLean 1998:185; Ray 2007, 2013). Lithic artifacts made from

chert from these formations are commonly indistinguishable and thus, are placed in this broad category. For this experiment, chert that is highly localized to the extreme northeastern corner of Oklahoma was quarried and used. This Mississippian-aged material is Peoria chert, which was likely a part of either the Keokuk or Warsaw Formations (although the parent limestone is no longer present; Ray 2007:225). Peoria chert lacks fossil inclusions and is distinctive due to darker linear mottles and streaks that are lined with white (Ray 2007:226). The thin cortex, fine grain, and brittleness make this material excellent for flintknapping. The chert I used was obtained from a modern quarry near Quapaw, Oklahoma.

Alibates Agatized Dolomite is from the Canadian River Valley in the Texas Panhandle, approximately thirty-five miles north of Amarillo. The Alibates Flint Quarries National Monument contains a large portion of the outcrop. The material for this experiment was purchased from a rock collector who collects on private property adjacent to the monument. The material is fine-grained lacking fossils and highly variable in color, banded and mottled with red, pink, purple, brown, orange, blue, and white (Haury 1981:47). Occasionally, veins of quartz crystals are observed in the Alibates material (Banks 1990). This material can be exceptionally brittle, which made it difficult to flintknape, but excellent for working on pipestone.

Tools and Actions

The flintknapping was conducted by a novice flintknapper, thus, the resulting experimental tools are not as finely made as the original Great Bend Aspect artifacts after which they are modeled. To facilitate knapping, modern tools made from copper were employed as soft hammer and retouching tool (a quartzite gravel was used as a hard hammer). There were four steps in the flintknapping portion of this research. First, a hammerstone was used to remove large flakes from the blocks of raw material (Figure 3.2). Next, further reduction was conducted on flakes that still had cortex or prominent flake features such as platforms or bulbs of percussion, which would hinder its use as a tool. Then, flakes were further modified into one of five morphological categories that were previously identified as used in pipe manufacture at a GBA site by Odell et al. (2011). Finally, some edges of the flakes were modified by directly removing small flakes from



Figure 3.2 Flakes removed from a block of Peoria chert (Undifferentiated Osagean) with a hammerstone

the tool edge, making the edge more durable (Whittaker 1994:20).

A total of 75 tools were replicated, including: end scrapers, tabular tools, gouges, reamers, and drills (Table 3.5). Sixty-three tools (84 percent) were used in the experiments on the Kansas and Minnesota pipestones and hematite (Table 3.6). Each tool was used for an extended amount of time, with a goal of at least 2,000 strokes. One thousand strokes has shown to be sufficient in use-wear experiments (i.e., Tringham et al. 1974), however, that number was doubled because 1,000 strokes created very shallow marks on the pipestone and it was determined that

Table 3.5 Experimental Tool Types by Chert Materials

Tool Types	Flintknapped Chert Materials					Total
	Florence	Florence Heat-treated	Smoky Hill Jasper	Peoria	Alibated Agatized Dolomite	
End Scraper	4	2	6	4	1	17
Tabular Tool	3	2	4	3	3	15
Pipe Gouge	3	3	3	4	3	16
Reamer	2	2	3	3	2	12
Pipe Drill	3	1	5	3	3	15
Total	15	10	21	17	12	75

Table 3.6 Tool Types by the material in which they were used

Tool Types	Worked Material			Total
	Minnesota Pipestone	Kansas Pipestone	Hematite	
End Scraper	6	6	1	13
Tabular Tool	8	5	1	14
Pipe Gouge	9	6	0	15
Reamer	6	4	0	10
Pipe Drill	5	6	0	11
Total	34	27	2	63

realistically to carve a pipe more strokes would be needed. Eventually the tool edges would have been so damaged that it would have needed resharpening, but that particular threshold has not been determined for stone tools used on pipestone. The average number of strokes for all of the tools was 2,346. Not all tools were effective and so some were used for shorter amounts of time with fewer strokes. The reasons that some tools were not effective varied from the poor quality of a lithic material to the ineffective design and replication of the tools.

End scrapers are characterized by steep unifacial retouch on one end of the tool (Figure 3.3). Odell et al. (2011) determined that the Robb collection end scrapers were not hafted for use in a handle, thus in this experiment they were hand-held. Twelve end scrapers were used for scraping and one was used as a cutting tool. The end scrapers were efficient and easy tools to use because the size was large enough to fit into the hand. Scraping involved pulling the tool edge across the pipestone or hematite to create a flat surface. The scraped surface of the pipestone was



Figure 3.3 Alibates agatized dolomite end scraper

ideal for alteration during the subsequent stages of production.

Tabular tools are flake tools with usually straight, or slightly convex edges with acute edge angles (between 30° and 60°) that were ideal for cutting. Thirteen tabular tools were used for cutting and one was used for scraping. In general, these tools were not retouched. Cutting involved a sawing motion with the tool held at a 90° angle to the pipestone. Cutting was conducted on previously scraped surfaces of pipestone.

Gouges are small bifacial tools that were hand-held and exhibited a prominent end (Figure 3.4). This end was ideal for pressing into the pipestone and scooping-out a dimple into the pipestone. The small dimple or depression was the start of what would become a gouged and then drilled hole.

Reamers are small, unifacial tools that were also hand-held during use (Figure 3.5). Reamers were pressed into the gouged indentation in the pipestone. Then, using a semi-circular



Figure 3.4 Florence chert gouge

motion the indentation was enlarged and deepened.

Gouging and reaming are the most difficult stages of pipestone manufacture because of the small size of these tools. Initial experiments combined the gouging and reaming motion because it was easier on the experimenter's hand. However, later in the experiments, the two actions were separated to see if there was a different outcome in the wear and residue patterns. There was no discernable difference. During the experiment the small tools were hand-held, which contributed to the difficulty in their use. The artifactual gouges and reamers reported by Odell et al. (2011) were small (between 3-4 cm) and some were hafted. It was found that without a haft it was easier to use gouges and reamers that were longer than 5 cm.

The drills were long and narrow bifaces or trifaces (with three sides; Figure 3.6). It was important for the drills to be symmetrical because asymmetry made them difficult to control during use. Knapping the drills was so challenging that even the help of two experienced flintknappers resulted in rudimentary tools that only slightly resembled the GBA artifacts they were mod-



Figure 3.5 Smoky Hill Jasper reamer with chalky cortex on the side of the tool



Figure 3.6 Pipe drill made from heat-treated Florence chert

eled after. Often the drill blank would snap in half before it was appropriately narrow. All of the drills were placed into a hafted piece of dry cane and fixed with modern binder and mastic. The drilling was conducted in the gouged and reamed hole. Drilling was done by hand either twisting the cane between the palms or using a bow drill.

Microscopic Analysis

Once the 63 tools were used and washed with water and a soft toothbrush (to replicate post-excavation cleaning and curation), each was analyzed using a Nikon Eclipse LV150NL microscope at 50-power and 100-power magnification. All of the edges of the tools were initially analyzed at 50-power to define the extent and patterns of residue. Analysis of the used edges was then conducted at 100-power in order to describe the use-wear and residue patterns in detail. To aid this description, an eight-plane grid system was employed with a drawing of the tool, to systematically document the location of wear and residue (e.g. Odell 1979:331). The resulting data were archived with the comparative collection at the University of Kansas' Archaeological Research Center.

RESULTS

The following results are from the experimentation and the analysis of the experimental tools. The use-wear and residue patterns that were observed on the chipped stone tools are primarily descriptive. Additionally, while the experiments were being conducted observations were made about the effectiveness of particular tools and chipped stone materials. Although, previous pipe replication experiments have worked with Minnesota pipestone, this study was unique and enhanced by the inclusion of Kansas pipestone and hematite. Additionally, the revelation that the Minnesota pipestone sample is mineralogically identical to Kansas pipestone adds another layer of complexity. However, an important difference between the pipestones still exists, in that their textures are very different.

Use-wear

The use-wear on the chipped stone tool comparative collection had edges that were rounded, crushed, and occasionally scarred. Rounding is defined as the smoothing out of the surface or edge of the tool. Rounding was the most common wear type on tools used to work Kan-

sas and Minnesota pipestones. The tools used on hematite were very slightly rounded, compared to the extremely rounded edges of the tools used on pipestone. Rounding was observed on every experimental tool to some extent and often overlapped with dark red pipestone residue and striations.

Crushed and rounded edges occasionally overlapped on a tool. A crushed edge exhibited multiple overlapping step fractures, which appear under the microscope as tiny flake scars that are stepped and often filled with pipestone residue (Figure 3.7). Odell et al. (2011:5) defined such a surface as a comminution, where there are multiple overlapping step fractures that make the surface look pockmarked. Del Bene and Shelley (1979:245) also observed crushing after replicating a soapstone pipe, which they similarly defined. Crushed edges were most often observed on the tools that were used to gouge and ream the pipestone because the intense use was concentrated on a small area of the tool edge (Table 3.7).

The used tool edges were also scarred with step, hinge, and feather terminations, although these types of scars were not as common as crushing. Scarring that had hinge terminations were

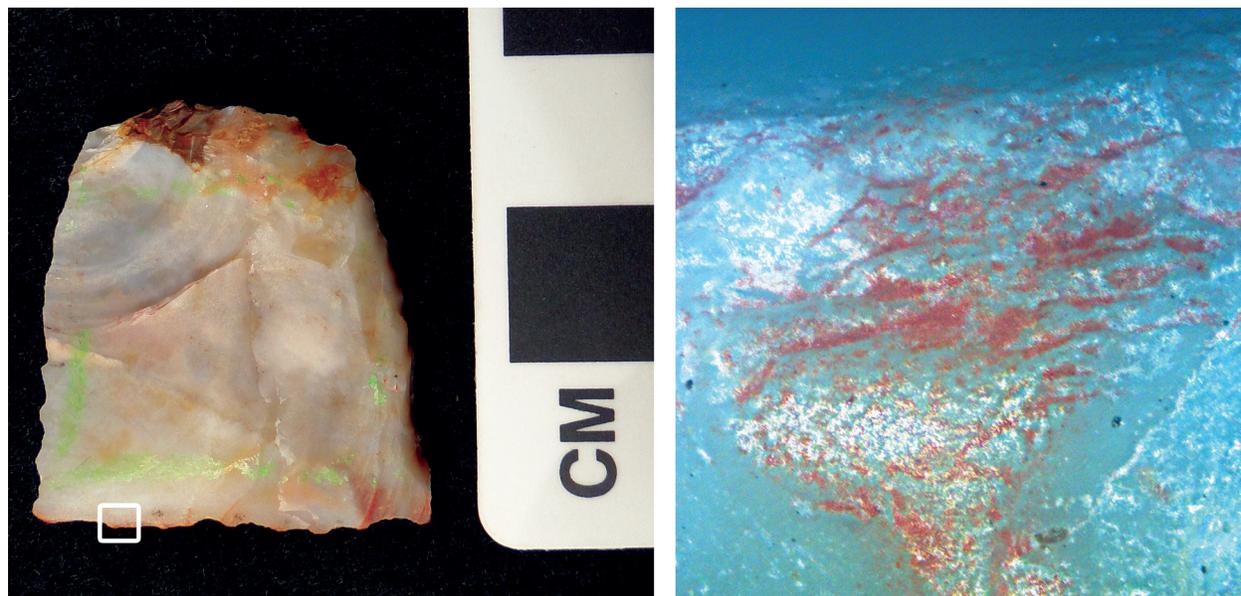


Figure 3.7 Alibates tabular tool used to cut Minnesota pipestone (left); A microscopic photo (at 100-power magnification) of the used distal edge of the Alibates tabular tool, demonstrating step fracture scars filled with pipestone residue (right)

Table 3.7 Actions and associated scarring and crushing of the tool edges

Action	Crushing and Scarring of Used Edges						Total
	Crushed	Crushed and Step Terminations	Step Terminations only	Step and Feather Terminations	Crushed and Hinge Terminations	Hinge and Step Terminations	
Scraping	1	2	0	1	1	1	6
Cutting	3	2	2	2	0	0	9
Gouging and Reaming	3	2	0	0	0	0	5
Gouging	2	1	1	0	0	0	4
Reaming	1	2	3	0	0	0	6
Drilling	3	0	2	0	0	0	5
Total	13	9	8	3	1	1	35

flakes that were removed and the resulting scar was rounded or blunt at its distal end. Scarring that had feather terminations had a very thin tapered termination on the distal end of the scar. The most common type of scarring occurred on the extreme margins of the used edge with step terminations. There were also multiple tools that had large isolated or discontinuous step fractures in the center of the used edge. Step scarring was not isolated to one particular type of action. Feather and hinge scarring, however, were only observed on tools used to scrape and cut pipestone. In general, there was no consistent or patterned difference in the rounding, crushing, and scarring of the tool edges used on Kansas versus Minnesota pipestones.

Striations were observed at both 50-power and 100-power magnification on 22 percent of the tools (Figure 3.8). Of the fourteen tools with striations, twelve were tools used for scraping or cutting (Table 3.8). The striations were so obvious that in all cases it was possible to determine the direction of scraping and cutting from the alignment of the striations to the tool edge from microscopic analysis. Scraping resulted in striations perpendicular to the used edge. Cutting created striations that were parallel or oblique with the used edge. Striations also consistently overlapped with dark red residue on the tools. Striations were identified on eight tools or 30 percent of tools used on Kansas pipestone and six tools or 18 percent of tools used on Minnesota

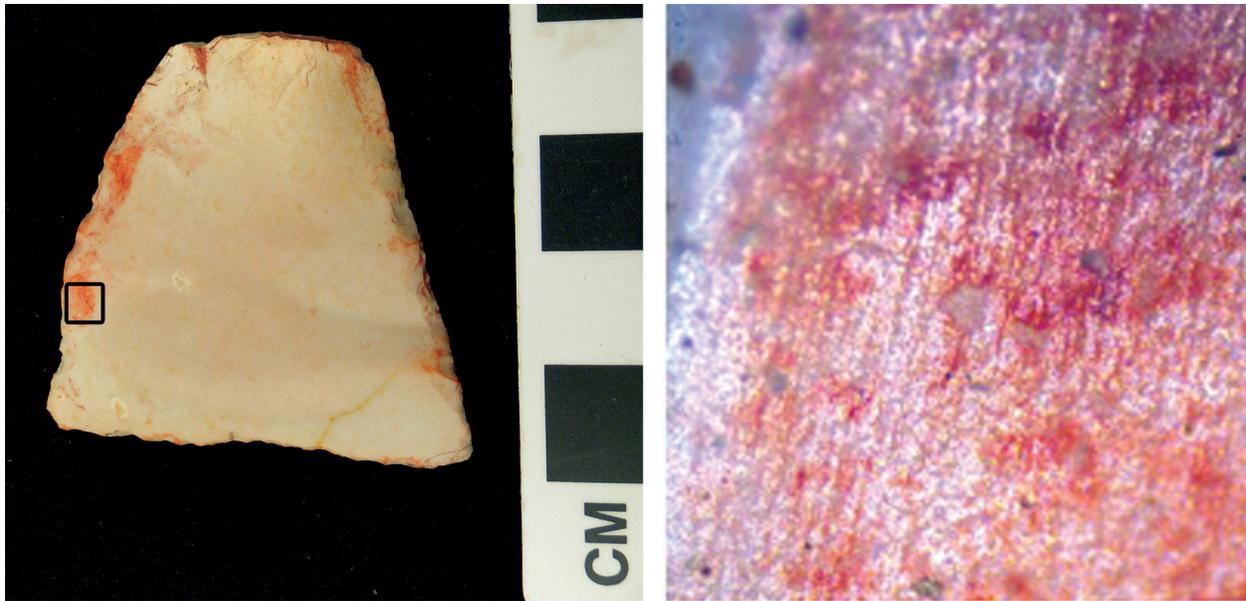


Figure 3.8 Peoria chert tabular tool that was used to cut Minnesota pipestone, with macroscopic pipestone residue evident on the tool margins (left); A microscopic photo (at 50-power magnification) of the tabular tool with striations that are parallel to the tool's edge and pipestone residue (right)

Table 3.8 Tool Actions and Striations

Action	Striations Present	None	Total
Scraping	5	8	13
Cutting	7	9	16
Gouging and Reaming	0	5	5
Gouging	1	8	9
Reaming	0	10	10
Drilling	1	9	10
Total	14	49	63

pipestone. The two tools used on hematite, lacked striations as viewed at 100X.

Pipestone Residue

Two types of residue patterns were observed in this experimental assemblage and were identified by their color and texture: a dark red polish-appearing residue and a pink powdery residue (Hadley 2014). Both types of pipestone residue were easily observed at 50-power magnification after the experimental tools had been cleaned. The dark red residue and the rounding

together gave the edge a polished appearance under magnification. The pink residue contains a powdery appearance and was most often observed in flake scars and in natural crevices. Residue was also macroscopically visible on the light-colored tools. All 61 tools that were used to work Kansas and Minnesota pipestones contained the dark red polish-type pipestone residue and 53 of those tools also had the diagnostic pink powdery residue. Tools made from Alibates and the white variety of the Smoky Hill Jasper had the least amount of pipestone residue, which may be attributed to the hardness and softness respectively of these materials. The dark red residue always occurred on rounded edges where a tool experienced the most intensive wear, but was also present on some of the non-worked edges. It was much more common, however, for the pink powdery residue to occur on non-worked edges. A total of 40 tools had pipestone residue on the non-worked edges (Figure 3.9). Pink residue was observed on a total of 38 tools (95 percent of the tools with pipestone residue on the non-worked edge). Only 25 tools had red residue on the non-worked edges (62 percent of the tools with pipestone residue on the non-worked edges). Essentially, tools used on pipestone were covered in microscopic pipestone residue.

Distinguishing between red residue and red inclusions in the chert was difficult and initially proved problematic. The dark red pipestone residue was easy to confuse with red inclusions in the heat-treated Florence and red spots of the Alibates. Heat-treatment of Florence chert created a highly oxidized cortex that without microscopic examination could be confused with the dark red pipestone residue. The used edges of the brown Smoky Hill tools appeared to be reddened possibly due to friction. Separating pipestone residue from the red used edge of the brown variety of Smoky Hill tools was very difficult even with a microscope. Previous observations of this pattern have been made with Smoky Hill Jasper tools (i.e., Hadley 2014) and further experimentation is needed with other soft stones (such as limestone and preferably not a red stone) to confirm whether or not friction can cause reddening of the brown Smoky Hill tools.

A combination of analysis and experiments is suggested to overcome the difficulties in distinguishing between natural red areas in a lithic material and pipestone residue. First, analysis needs to be conducted at multiple magnification levels. The analyst should become familiar with

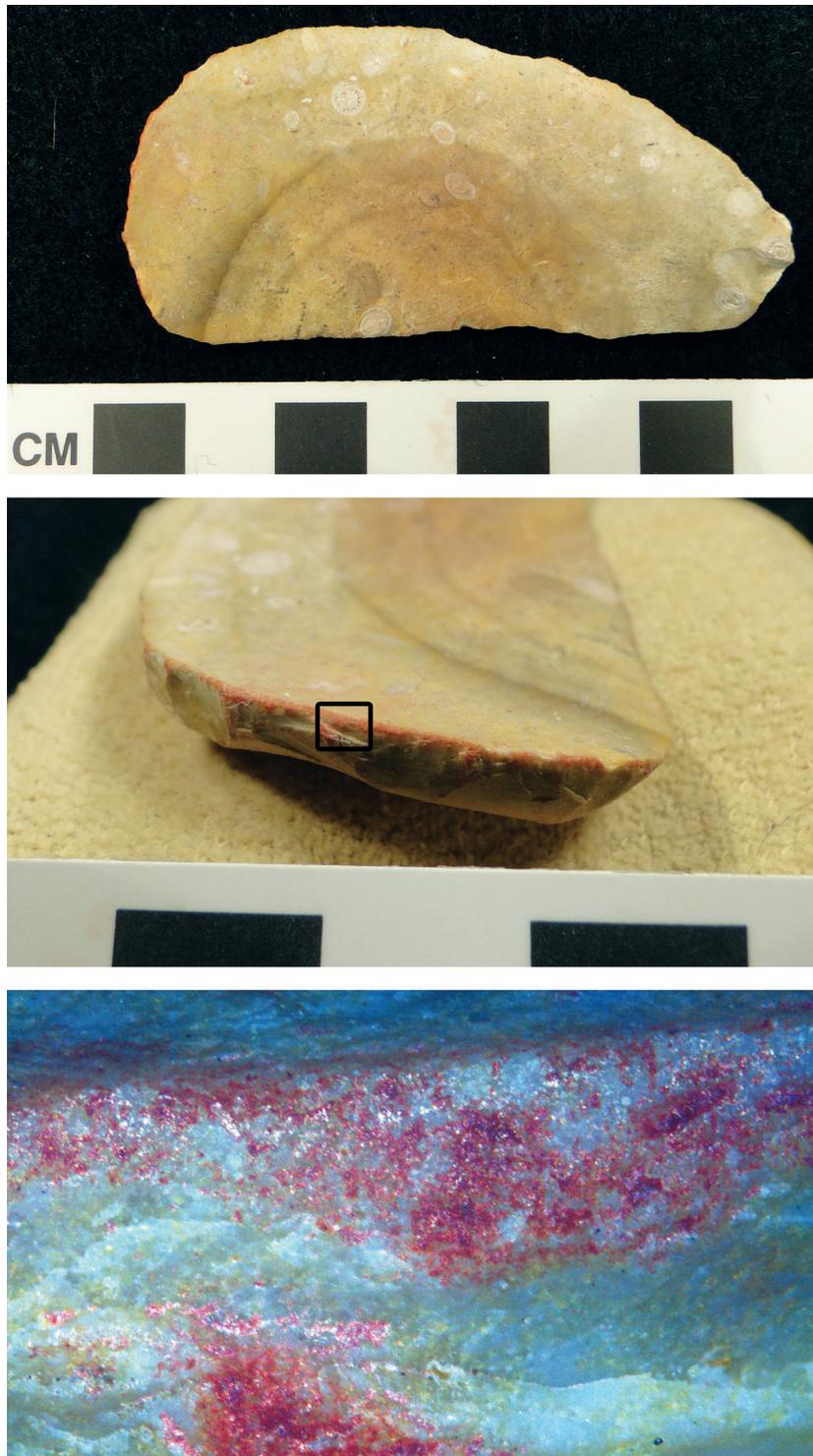


Figure 3.9 An end scraper made from Florence chert that was used to scrape Minnesota pipestone (top); The distal used edge of the end scraper (middle); Microscopic photo (at 50-power magnification) of the rounded used edge and both types of pipestone residue (bottom)

color variations in the raw material at a macroscopic level and at high and low magnifications. Flintknapping and heat-treatment experiments will further familiarize the analyst with color variations inherent in chipped stone materials.

Material Differences

The Alibates and the brown variety of Smoky Hill Jasper were very effective in pipestone-working activities. Neither of these materials exhibited obvious macroscopic use-wear and residue from the pipestone. The tools made from the white variety of Smoky Hill Jasper were inefficient because they were extremely soft and the edges wore down quickly against the pipestone. The Smoky Hill tools also had the least amount of dark red pipestone residue on the worked edges. One of the white Smoky Hill tools was so ineffective on the gritty Kansas pipestone that the tool was actually creating white chalky residue on the pipestone rather than creating pipestone residue on the tool. The inefficiency of these white Smoky Hill tools suggests they will rarely appear in a past pipe-maker's tool-kit.

A notable observation made in this experiment, was the difference in Kansas and Minnesota pipestones, not so much in their identical mineralogy, but in their textures. The sample of Kansas pipestone had a grainy texture, with macroscopically visible and heterogeneously dispersed quartz and feldspar grains within the fine-grained argillite matrix. The grains were as large as 1 mm in diameter and are subrounded (grains that are mostly rounded with some angular edges). In contrast, there are no visible grains in the Minnesota pipestone. The textures of both pipestones were apparent in the powder samples that resulted from the experiments. The Kansas pipestone powder was gritty compared to the fine powder from the Minnesota pipestone. The resulting pipestone powders differentially coated the non-worked edges of the tools (Table 3.9). Although there was very little difference in the rounding, crushing, and scarring of tools used on the pipestones, striations were more often observed on the tools used on Kansas pipestone, which can be attributed to its grittier texture. These results may not be representative of all Kansas and Minnesota pipestone samples and additional experimentation will further clarify these observa-

tions.

There was concern at the beginning of the experiment that the use-wear and residue from pipestone might be indistinguishable from hematite. To test this, a scraper and tabular tool were used to scrape and cut a piece of earthy hematite. Because this piece of hematite was so soft, the only resulting use-wear was a slightly rounded tool edge. The residue from the hematite was located on the rounded edge, and was abundant during the scraping and cutting. Two significant

Table 3.9 Types of pipestone residue that were observed on non-worked parts of the tools

Worked Material	Types of Pipestone Residue			Total
	Red residue	Pink residue	Both	
Kansas Pipestone	1	3	6	10
Minnesota Pipestone	1	12	17	30
Total	2	15	23	40

differences were observed between the hematite and pipestone powder. First, the hematite residue was a brownish-color compared to the pipestone powder under both 50-power and 100-power magnification (Figure 3.10). Second, the hematite residue was a single brown color, whereas there were two colors of pipestone residue (red and pink). The experiment demonstrated that it is possible to distinguish the difference between hematite and pipestone residues, based on the color and overlap with wear patterns. One problem with this experiment is that soft hematite was used instead of the harder specular hematite, which is closer in hardness to pipestone. While the residue colors would not be different, it is likely that the harder hematite would create more significant use-wear patterns that would be similar to the use-wear from the pipestones. However, the differences in the residues should be enough to distinguish tools used on pipestone and red, earthy hematite.

DISCUSSION AND CONCLUSION

This experiment created a collection of stone tools used on Minnesota and Kansas pipestones and hematite. The comparative collection was used to aid accurate and reliable identifica-



Figure 3.10 A Florence tabular tool that was used to cut hematite demonstrating macroscopic residue (top); Used distal edge of the tabular tool (middle); Microscopic photo (at 50-power magnification) of the slightly rounded used edge and hematite residue (bottom)

tion of tools used in the manufacture of pipestone pipes at archaeological sites. This experiment provides three unique contributions to the study of pipestone pipe technology: 1) the differences in use-wear and residue between pipestones and hematite; 2) the importance of pipestone powder in identifying pipe manufacture; and 3) the diagnostic nature of pipestone wear traces and residue types.

1. Differences in Use-Wear and Residue

A key observation from this experiment involves the differences between the Kansas pipestone, Minnesota pipestone, and hematite. Although the pipestones were mineralogically identical, the textures were different. Importantly, it was observed that this sample of Kansas pipestone had a grittier texture, with visible quartz and feldspar grains whereas Minnesota pipestone was a homogenous argillite. The two stone powders also had very different textures. The result was that tools used on Kansas pipestone had less pink powdery residue on non-worked edges than the tools used on Minnesota pipestone. Despite the different textures in the pipestones, there was no observable difference in their use-wear patterns, except more striations resulted from the Kansas pipestone. These experiments also demonstrated that hematite residue can be distinguished from pipestone residue. Hematite created a homogeneous reddish-brown residue that was very different from the red and pink residues from pipestone.

2. Pipestone Powder

Another important observation made in this experiment was the ubiquity of pipestone powder as a major byproduct of pipestone manufacture. Pipestone manufacture is a reductive process like chipped stone technology. Pipestone powder is equivalent to debitage from chipped stone technology. Ethnographic accounts of Plains tribes document the use of pipestone powder for pigments (Weltfish 1965:395) and to mix with other materials to repair accidental holes made in stone pipes (Ewers 1963:46-7). If pipestone manufacture is taking place in one particular part of a site or if the powder is collected and used for other purposes, then we should be able to find

evidence for this in the archaeological record.

For the Great Bend Aspect sites in the southern and central Plains, there are hundreds of red powder samples that have been collected in the field (according to the online Smithsonian artifact catalog, 2014). Such samples need to be tested with a nondestructive infrared spectrometer to determine if they are pipestone or hematite. Consequently, archaeologists may be able to identify areas of pipestone manufacture and uses of pipestone powder that have previously not been considered.

3. The diagnostic nature of pipestone wear and residue types

This experiment has demonstrated that pipestone creates diagnostic wear and residue on chipped stone tools and these are diagnostic at low-level magnification even after the artifacts have been thoroughly washed with water and a toothbrush. Therefore, it is possible to identify both pipestone residue and wear in an archaeological context (see also Blakeslee 2012; Hadley 2014; Odell et al. 2011; Waggoner 2005). Additionally, pipestone and hematite create very different residue on chipped stone tools, making it possible to distinguish the two in the archaeological record.

In conclusion, this replication study systematically documented the wear and residue characteristics on tools that are made from various materials, used in different actions, and employed on different stones. This comparative collection and the observation made will aid the search for archaeological stone tools that were used in the manufacture of pipes and other pipestone objects. Once tools used in pipe production are identified, we can begin to learn more about how the pipes were made and by whom. We can begin to explore pipe manufacture activities and see if they coincide with other forms of craft production or may be restricted to particular sites or areas of sites (i.e., Vehik 2002). Framing our understanding of pipes within a larger technological context will provide a better foundation for interpreting their position within past societies.

CHAPTER 4: Pipestone Sourcing

INTRODUCTION

Pipestone is a soft, red stone that has been used in North America to carve pipes and other objects for thousands of years. The earliest pipestone use was documented 5,000 years ago in the upper Midwest (Hughes et al. 1998:711). In Kansas, the earliest use of pipestone was approximately 2,000 years ago at Early Ceramic sites (Hadley and Hilburn 2009). Pipestone artifacts are well-documented in publications and state records because of the special interest archaeologists have always had in the stone.

Initially, early archaeologists and historians thought that there was one source of pipestone, in southwestern Minnesota, the variety referred to as Catlinite (Catlin 1866; Scott et al. 2006). However, archaeological research has revealed that there are multiple distinctive types of pipestone across North America. The archaeological interest in pipestone has generally focused on identifying the geological sources for artifacts and documenting the artistry. While the following provenance research relied on this large body of previous literature, it departs from past studies, in that the manufacturing techniques of pipestone artifacts were also documented (see Chapter 5) and are included as an important element in the interpretation of the artifacts.

This chapter exclusively deals with the sourcing of red pipestone. The introductory section outlines basic pipestone geology and previous archaeological research on sourcing Great Bend Aspect (GBA) pipestone. Next, the methods used to analyze the GBA and historic Wichita pipestone artifacts are described. The methods are followed by the results of the mineralogical analysis. Finally, the chapter ends with a conclusion discussing the overall patterns in the types of pipestone used at GBA and historic Wichita sites.

Pipestone Geology

Pipestone is an argillite: a clay-rich mudstone that underwent low-grade metamorphism (Gundersen 1987, 1988, 2002). It is red because of very low concentrations of disseminated hematite throughout the rock (Ojakangas and Matsch 1982:229). There are multiple sources

of pipestone in North America (Figure 4.1). The pipestone formation in Pipestone National Monument (PNM) was a prominent source for stone pipe manufacture during historical times and quarrying operations continue today. This type of pipestone, which I refer to as Minnesota pipestone (also known as Catlinite) interbeds with Sioux Quartzite in southwestern Minnesota and eastern South Dakota and is late pre-Cambrian in age (approximately 1,470 million years ago; Ojakangas and Matsch 1982:47). Geologists believe that this pipestone and Sioux Quartzite began as a red clay layer overlain by stream or marine deposited sands (Scott et al. 2006:19-20; Ojakangas and Matsch 1982:47). Lithification occurred creating a mudstone from the clay and sandstone from the sands. The weight of glaciers on these rocks created some low-grade heat and pressure (metamorphism) transforming the sandstone into Sioux Quartzite and the mudstone into an argillite (Scott et al. 2006:20). There are many outcrops of pipestones and other argillites or pipestone-like materials identified in Minnesota, Wisconsin, South Dakota, Montana, Missouri, Arkansas, Illinois, Ohio, Arizona, and Ontario, Canada (Emerson et al. 2003; Gundersen 1987; Howell 1940; Scott et al. 2006:Table 3; Sigstad 1973).

The pipestone from PNM in Pipestone, Minnesota, has historically been referred to as Catlinite. This name was in honor of George Catlin the first person of European-descent to publish an account of the quarries and to have pipestone scientifically described (Scott et al. 2006:76). I do not refer to pipestone from the PNM quarries as “Catlinite” because the name emphasizes George Catlin as a “discoverer” rather than the hundreds of years of its use prior to Catlin. Instead, throughout this discussion I refer to the Catlinite pipestone as Minnesota pipestone (MNPS; e.g., Siemens and Gundersen 1982).

Kansas pipestone (KSPS) is also a mineralogically distinct variety of pipestone that is found in the glacial till deposits in northeastern Kansas, eastern Nebraska, and extending north into southeastern Nebraska (Gundersen and O’Shea 1981; Penman and Gundersen 1999:48). Kansas pipestone (KSPS) was used by Native Americans living in Kansas and Nebraska from the Early Ceramic to historic times (Hadley and Hilburn 2009). American traders in the Kansas Territory in the mid-nineteenth century also knew about and documented this source of pipestone

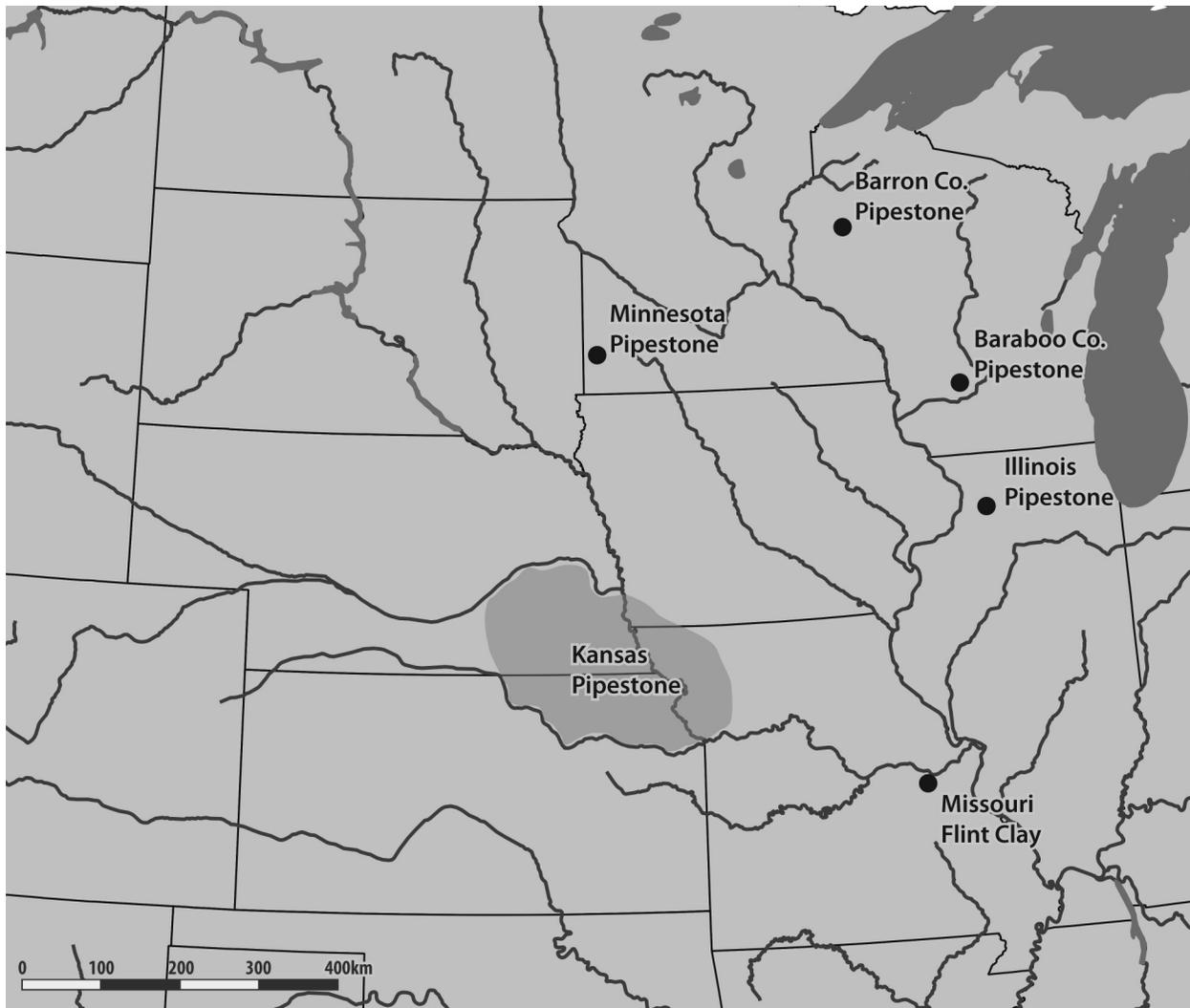


Figure 4.1 Locations of pipestone outcrops and of glacial till deposits with pipestone; Kansas Pipestone glacial till areas based field observations reported in Gundersen and O’Shea (1981); Map by Andrew M. Hilburn.

(Mead 2008:141). In Waldo Wedel’s (1959) *Introduction to Kansas Archaeology*, Wedel speculated that Kansas had its own variety of pipestone. However, it was not until the early 1980s that the unique mineralogy of KSPS was defined using X-ray Diffraction (XRD; Gundersen 1981; Gundersen and O’Shea 1981; Siemens and Gundersen 1982). Through Gundersen’s extensive research, he defined the geological source of the glacially deposited KSPS to be in Jasper, Minnesota, just south of PNM and on the border of Pipestone and Rock Counties. Previously, Gundersen alluded to this source for KSPS, stating, “a unique variety of quartzose pipestone...occurs, in outcrop, well outside Pipestone National Monument in the direction of the pipestones exposed in

South Dakota” (Gundersen and Tiffany 1986:54). However, he never published the exact location and his records and XRD samples are all that remain of this significant summary, both of which are curated at the Midwestern Archaeological Center (MWAC) in Lincoln, Nebraska. Despite KSPS’s likely Minnesota origin, its original Kansas name is retained because this was the location of its original mineralogical definition and this is the term archaeologists currently use.

There are multiple sources for pipestone in Wisconsin, however, the most well-known source is found in Barron County in northwest Wisconsin (47BN75; Penman and Gundersen 1999:47). The University of Kansas Archaeological Research Center’s Lithic Comparative Collection has a sample of pipestone from Barron County, Wisconsin, which was used in this analysis. Previous sourcing research has found that the mineralogical composition of the Barron County, Wisconsin pipestones (WIPS) is identical to pipestone found in very small outcrops in southeastern South Dakota (Gundersen and O’Shea 1981), both of which are almost entirely composed of the mineral kaolinite (Wiseman et al. 2012:Table 2). Because these materials are indistinguishable, I refer to them throughout this analysis as WIPS/South Dakota pipestone (SDPS).

Redeposited pipestone is also found in glacial tills in eastern Nebraska, southeastern South Dakota, and northwestern Iowa (Gundersen and O’Shea 1981; Gundersen and Tiffany 1986). Mineralogical testing of pipestones found in glacial tills in Nebraska and South Dakota revealed both KSPS and MNPS types (Gundersen and O’Shea 1981). Fortunately, the majority of pipestone in the southern extent of the glacial tills in Kansas is KSPS (Gundersen and O’Shea 1981; Siemens and Gundersen 1982). Wisconsin and South Dakota pipestones are also found in the glacial tills further to the north in northwestern Iowa and southeastern South Dakota, likely corresponding to the Wisconsin glaciation (Gundersen and O’Shea 1981). These redeposited pipestones can be challenging for archaeologists attempting to identify the original provenance of these materials.

Previous research by James N. Gundersen and archaeologists from Illinois (i.e., Emerson et al. 2003, 2013; Wiseman et al. 2002, 2010, 2012) identified the unique mineralogy of these

Table 4.1 Types of Pipestone that are Relevant to this Research

Pipestone	Distinguishing Minerals	Citations
Kansas	Dominated by Quartz and Pyrophyllite with minor amounts of Kaolinite	Gunderson 1987:6
Wisconsin and South Dakota	Dominated by Kaolinite, with minor amounts of Quartz, Pyrophyllite, and Muscovite	Gunderson 1987:6; Gundersen and O’Shea 1981
Catlinite (Minnesota)	Dominated by Diaspore, Pyrophyllite, and Muscovite with minor amounts of Kaolinite	Gunderson 1987:2, 2002:37
Missouri Flint Clay	Boehmite, Cookeite-like Chlorite, and Phosphates	Emerson and Hughes 2000:90, 2001:154

pipestones (Table 4.1). Kansas pipestone is dominated by pyrophyllite and quartz (see Appendix A for mineralogical details), which is why Gundersen refers to it as quartzose pipestone (Gundersen 1987:Figure 2). Minnesota pipestone from the national monument quarries contains the minerals diaspore and muscovite (Gundersen 2002:Figure 2). Wisconsin and South Dakota pipestones are predominantly kaolinite and quartz (Gunderson 1987:Figure 2; Gundersen and O’Shea 1981). The most common types of pipestone found at Great Bend Aspect sites are KSPS, MNPS, and WIPS/SDPS varieties (Gundersen 1993).

Gundersen found that all the pipestones he analyzed from Wisconsin to Kansas had the same five minerals (diaspore, kaolinite, pyrophyllite, muscovite, and quartz) (Boszhardt and Gundersen 2003:39). However, only four of these minerals could occur in a single pipestone because the fifth mineral made the stone chemically unstable. It is rare that four of the minerals are found together; most of the pipestones contain only three of them (Boszhardt and Gundersen 2003:39). Additionally, quartz, the defining mineral of KSPS, cannot be in the same stone as diaspore a mineral in MNPS (Boszhardt and Gundersen 2003:39).

The pipestone that was analyzed for this research came from 22 GBA sites and two Oklahoma protohistoric Wichita sites. Additionally, two large collections of pipestone were included in the analysis; one from a private collection (Robb family) and the other from the McPherson County Museum, consisting of privately collected and then donated pipestone. The Robb family pipestone collection has already been the subject of a technological analysis (i.e. Blakeslee 2012; Odell et al. 2011), however, it is included here because the materials were sourced and these pre-

vious studies were important in developing this research. Additionally, both the Robb collection and the McPherson County artifacts are from counties with clusters of GBA villages.

The largest possible sample of pipestone artifacts was used in this part of the analysis because the spectrometer was only available for a limited time and the four GBA sites that were the focus of the chipped stone tool analysis had only 65 pipestone artifacts. In all, a total of 466 pipestone artifacts were analyzed and are discussed below.

Previous Sourcing of Great Bend Aspect Pipestone Artifacts

The previous sourcing work conducted by Gundersen in Kansas and the surrounding regions are crucial for this research. His initial sourcing data provided the first description of Kansas pipestone mineralogy, distinguishing it from the more well-known Minnesota pipestone (Gundersen 1981). As Gundersen (1993:561) gathered much mineralogical data using X-ray Diffraction (XRD), and found that the majority of GBA pipestone artifacts tested were made from Kansas pipestone (Gundersen 1993). Gundersen tested a total of 418 GBA pipestone artifacts, 90 percent were KSPS, 8 percent were MNPS, and 2 percent were SDPS (Blakeslee et al. 2012:246). Throughout the mineralogical analysis, I documented those pieces that had been tested before by Gundersen and for some I was able to see the original XRD samples that he collected at the Midwestern Archaeological Center.

METHODS

The following pipestone analysis includes pipestone collections from four different curatorial facilities. The majority of pipestone was found by systematically searching boxes of groundstone in GBA site collections at the Kansas Historical Society. Pipestone artifacts from all but one GBA site were found in this way, including Arkansas Country Club (14CO1), Schroepe (14CO331), Living the Dream (14CO382), Radio Lane (14CO385), Killdeer (14CO501), 14MN308, 374 Quarry Corners (14MN326), Mem (14MN328), Paint Creek (14MP1), 14MP401, 14MP404, Sharps Creek (14MP408), 14MP409, Major (14RC2), Malone (14RC5), Tobias

(14RC8), C.F. Thompson (14RC9), Saxman (14RC301), Kermit Hayes #3 (14RC305), 14RC311, and 14RC410. This did not, however, include assemblages of groundstone pieces that were on display at various museums and a box of seven pipestone artifacts from the Arkansas City project that were overlooked. There is a large assemblage of curated material from GBA sites at the Smithsonian, which was not included in this analysis. The University of Kansas Archaeological Research Center curated the Malone site (14RC5) assemblage and those boxes were searched for pipestone. Access was given to pipestone that was on loan from KSHS while at the Oklahoma Archaeological Survey. This analysis included pipestone from a portion of the Max Crandall site (14RC420) on loan to Susan Vehik, protohistoric Wichita sites, and Oklahoma sites that are earlier and contemporaneous with the GBA. Also included in the analysis were two large surface collections of pipestone from the Robb family collection and the McPherson County Museum that were on loan to Don Blakeslee at Wichita State University. While this is a reasonably thorough study of Kansas and Oklahoma pipestone, it certainly does not include every curated GBA and protohistoric Wichita pipestone artifact.

The first analytical step was to record the attributes of the pipestone sample (attributes and steps will be detailed further in the following chapter). Surface treatment included anything on the surface of the artifact that could interfere with the infrared surface analysis and included both intentional labeling or modification and unintentional modifications. The most common surface treatments were ink and clear polish artifact labels, burning, dottle (carbonaceous coating from the act of smoking a pipe), soil, and carbonates. Once the attributes were recorded, each artifact was nondestructively scanned using an infrared reflectance spectrometer (ASD Terraspec 4; Figure 4.2). The spectrometer shines an infrared light to the surface of the pipestone and a sensor records the reflected spectrum (Figure 4.3). Artifacts were scanned using a wand with a sensor and placing the window directly on the pipestone artifact. No sample preparation was necessary for solid artifacts. Powder samples were tested in a quartz petri dish, making sure that the powder completely covered the bottom (Figure 4.4). The round sensor window fit directly into the petri dish, which was roughly 30 mm in diameter. After about ten seconds the sensor detects the

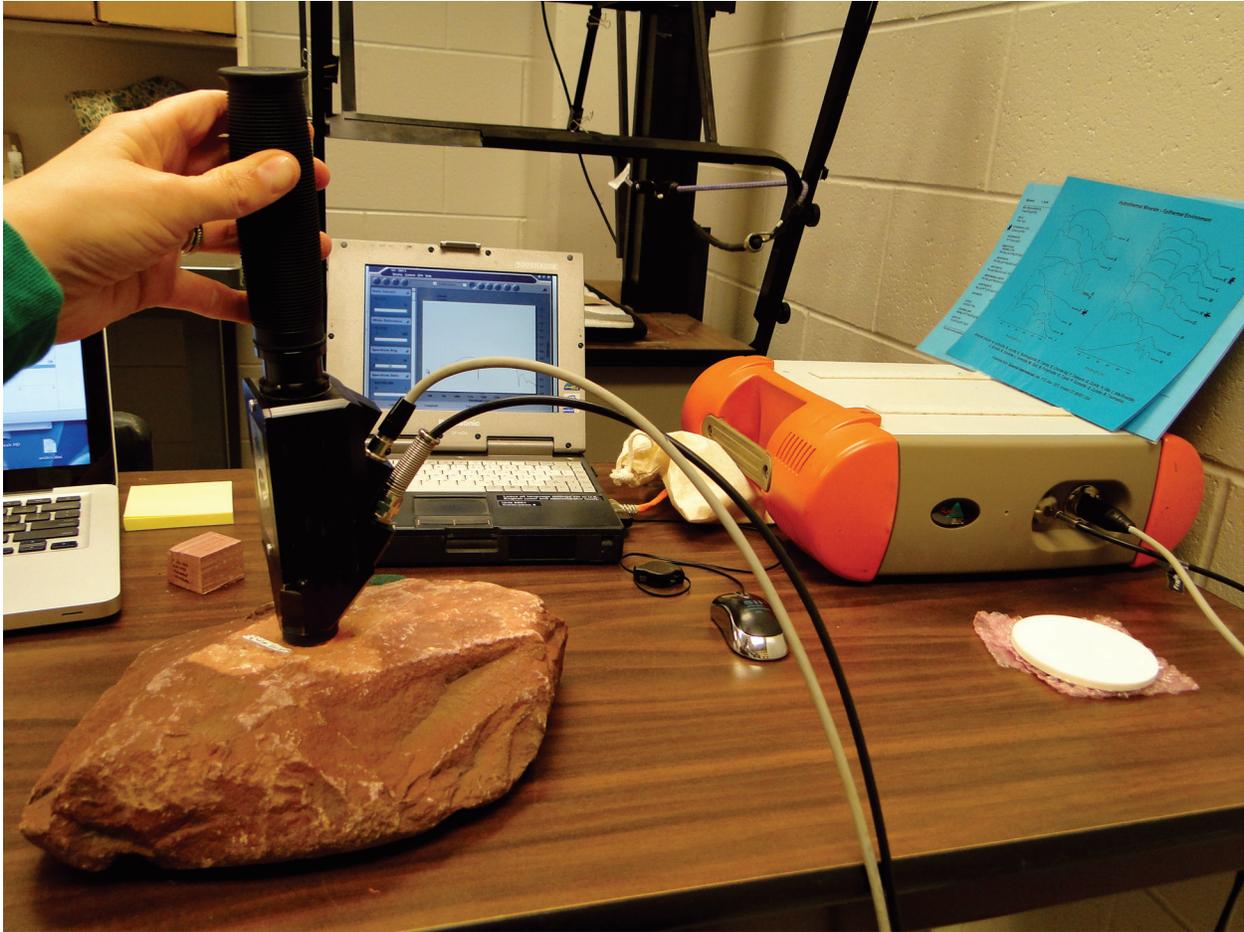


Figure 4.2 Spectrometer taking a reading on a large sample of pipestone from Pipestone National Monument; Photo by A. Hadley courtesy of the Kansas Historical Society (KSHS)

reflected wavelengths of the minerals in the sample and the spectrum is recorded.

The spectrometer used in this research detected three parts of the Electromagnetic spectrum, the visible (400-700 nanometers [nm]), near infrared (700-1300 nm), and short wave infrared (1300-2500 nm). This is different from the portable infrared mineral analyzer (PIMA), which was used to source pipestone at Hopewell and Mississippian sites by archaeologists in Illinois, in that the PIMA only detects the short wave infrared portion of the spectrum. The advantage of the spectrometer used in this research over the PIMA is that the mineral hematite can only be detected in the visible range of the spectrum, which was important in distinguishing pipestone and hematite powder samples (Figure 4.5). All of these pipestones contain hematite, which can be seen as a signature around the 900 nm region of the visible spectrum.

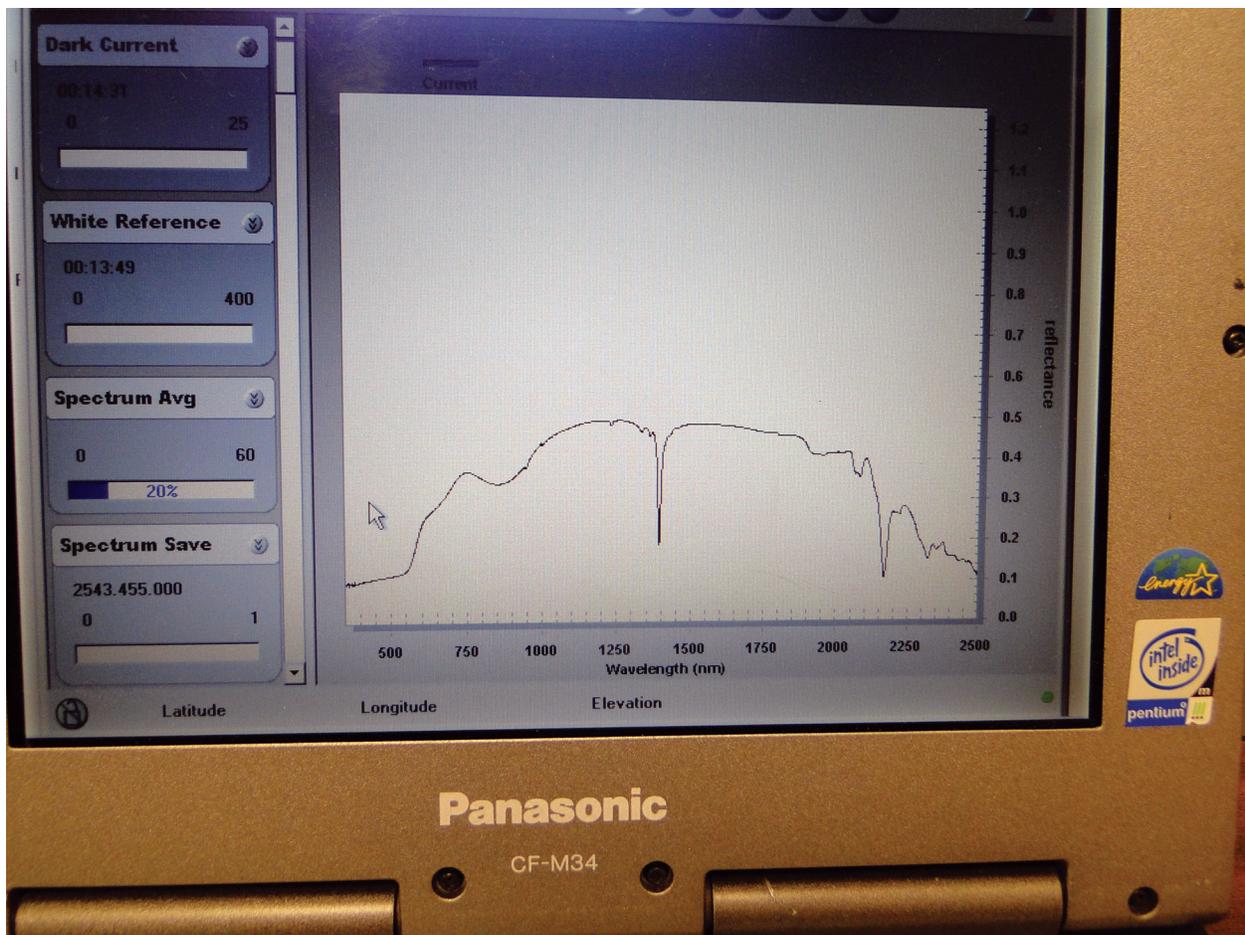


Figure 4.3 Photo of the reflected spectrum from a sample of pipestone from Pipestone National Monument; Photo by A. Hadley courtesy of KSHS

The reflected spectra were then analyzed using software to identify the suite of minerals evident in the sample. The infrared spectrometer is particularly sensitive to clay minerals (Hauff 2005:6.14), which are the main components of the Plains' pipestones and the flint clays that outcrop in Illinois and Missouri (Gundersen 1987; Gundersen and Tiffany 1986; Hughes et al. 1998). Resources that aided in the identification of the distinctive mineralogy of pipestones from different sources included twenty samples from known geological provenances and previous sourcing research (i.e. Emerson and Hughes 2000, 2001; Emerson et al. 2003, 2013; Fishel et al. 2010; Gundersen 1981, 1987, 1988, 2002; Gundersen and O'Shea 1981; Gundersen and Tiffany 1986; Penman and Gundersen 1999; Wisseman et al. 2002, 2010, 2012).

The main pipestones that I encountered from the southern Kansas and northern Oklahoma



Figure 4.4 Powder sample from Malone Site (14RC5) in a petri dish; Photo by A. Hadley
Courtesy of KSHS

sites were KSPS, MNPS, and WIPS/SDPS. The spectrum for KSPS only reflects the presence of the mineral pyrophyllite, which has very sharp signatures at 1390 and 2161 nm regions (Figure 4.6). Although quartz is an important mineral in pipestone, it is only detectable through a water signature at 1900 nm (Hauff 2005) and is not always apparent. Thus, a spectrum where the only minerals detected were pyrophyllite and hematite was deemed KSPS.

Minnesota pipestone differs from KSPS, in that it contains muscovite and diaspore. In some samples both minerals are seen and in others only one of these minerals is detectable. Thus,



Figure 4.5 Hematite carved figurine of a rabbit from the Radio Lane site (KSHS Cat. # 14CO385-425-1); Image also demonstrates the similarities between pipestone and hematite artifacts; Photo by A. Hadley courtesy of KSHS

MNPS contains the pyrophyllite signatures and diaspore is seen in a shoulder at approximately 1801 nm. The muscovite features appear as double features off of the deep pyrophyllite features around 1404 and 2192 nm. Wisconsin and South Dakota pipestone is composed almost entirely of the mineral kaolinite, which has double features between 1393 to 1407 nm and 2154 to 2203 nm.

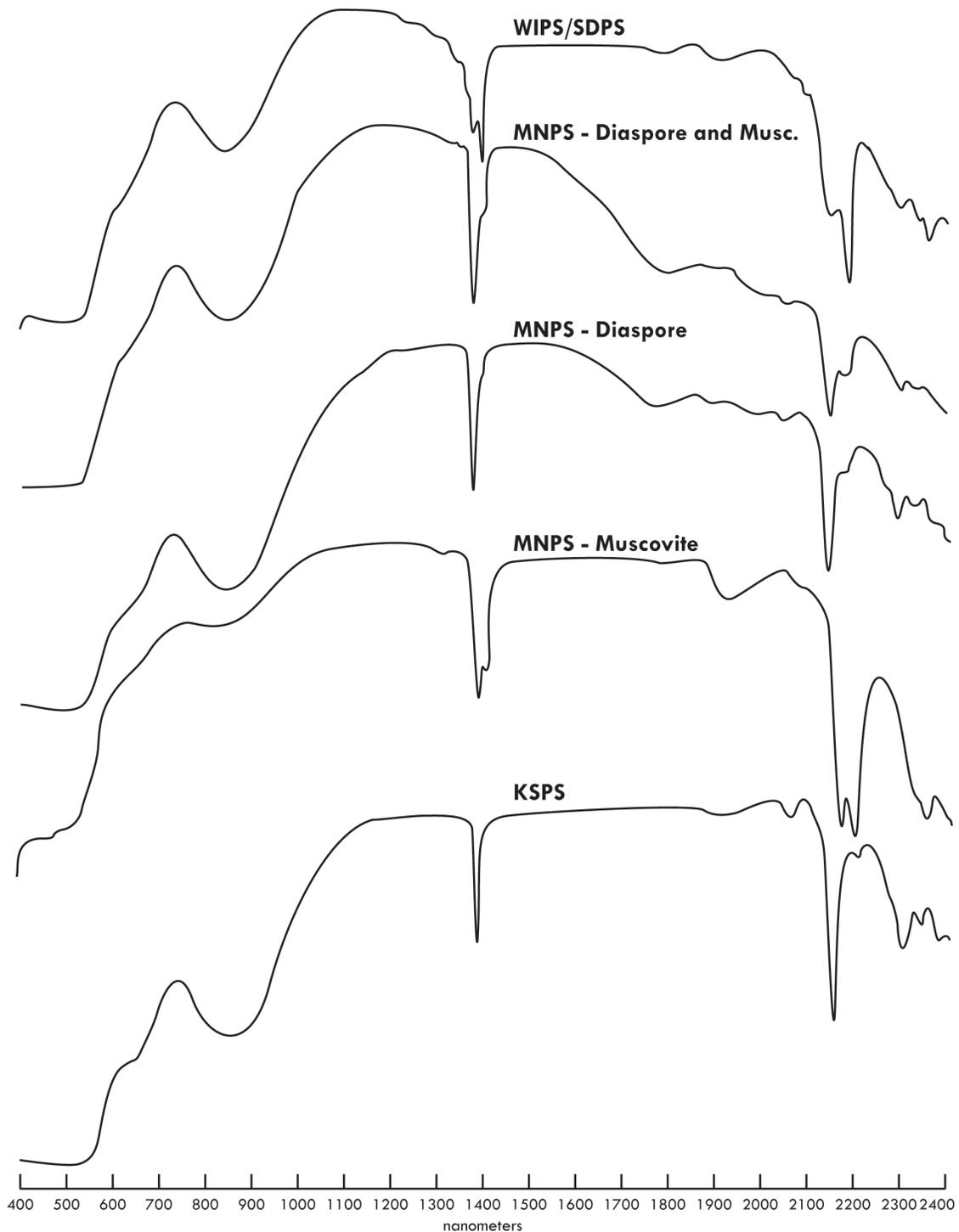


Figure 4.6 Pipestone Spectra: WIPS/SDPS spectrum is from a pipe fragment from the Paint Creek site (KSHS Cat. # 14MP1, 2013.B-136); MNPS-Diaspore and Muscovite spectrum from a pipe fragment from the Longest site (Oklahoma Archaeological Survey [OAS] Cat. # 34JF1, 2007.013.34JF1.001936); MNPS-Diaspore spectrum from a ground and drilled artifact from the Bryson-Paddock site (OAS Cat. # 34KA5, 1007) MNPS-Muscovite spectrum is from a bead preform from the Thompson site (KSHS Cat. # 14RC9 586-36); KSPS spectrum is from a pipe fragment from the Mem site (KSHS Cat. # 14MN328-3587); Graphic by A. Hilburn

SUMMARY OF MINERALOGICAL RESULTS

I analyzed a total of 468 pipestone artifacts: 160 from GBA sites, 18 from protohistoric Wichita sites in Oklahoma, and 290 from two curated assemblages that lack provenience (but represent almost a century worth of private surface collections from Marion, McPherson, and Rice counties). The artifacts found at GBA sites were predominantly KSPS (88 percent; Table 4.2; Figure 4.7). Gundersen (1993:56) previously reported finding KSPS artifacts at GBA sites and he tested 25 percent of the GBA pipestone artifacts analyzed in this research. It was easy to determine if Gundersen had sampled the artifact because it contained an area with modern filing marks where his samples were collected. Samples as large as one gram were removed for XRD. Additionally, the samples were often removed from the broken edges of artifacts, which often obscured manufacture and breakage patterns (Figure 4.8). Although Gundersen widely presented the results of his GBA analysis, the details were never published.

The surface collections that were analyzed were predominantly (87 percent) KSPS (Table 4.3), of which 248 artifacts were from the Robb family's collection. This material was on loan to Donald Blakeslee at Wichita State University (WSU). The pipestone was surface collected by a family of three beginning in 1917 (Odell et al. 2011:4). A few of the artifacts have labels giving county-level proveniences and one is labeled Paint Creek, possibly for the site (14MP1). The corresponding notes indicate the majority of the artifacts are from the GBA sites of Paint Creek and Sharps Creek sites in McPherson County, Kansas (Blakeslee 2012:305).

In the surface collections and the archaeologically excavated GBA contexts, the percentage of MNPS is only 5 percent of the total pipestone sample (Figure 4.9). This is significantly less than the amount of MNPS found in protohistoric Wichita contexts (Table 4.4). At the two protohistoric Wichita sites in Oklahoma, the majority of pipestone was MNPS (94 percent). There are two possible sources for the small amount of MNPS in the GBA assemblages. The MNPS at these sites may represent exotic material that was traded or procured at long-distances in southwestern Minnesota. There is abundant archaeological evidence for the contemporaneous (and earlier) use of pipestone from the Pipestone National Monument (PNM) quarries (Scott et

Table 4.2 Types of Pipestone at Great Bend Aspect sites

Sites	Kansas Pipestone	Minnesota Pipestone	Wisconsin or South Dakota Pipestone	Indeterminate	TOTAL
14CO1	2				2
14CO331	6			3	9
14CO382	2				2
14CO385	8				8
14CO501	2			1	3
14MN308	1				1
14MN326	1				1
14MN328	39	1		1	41
14MP1	6	1	1		8
14MP401	6				6
14MP404	8				8
14MP408	4				4
14MP409	1				1
14RC2	4	1			5
14RC5	19	2			21
14RC8	12	1		3	16
14RC9	9	1		2	12
14RC301	1				1
14RC305	2				2
14RC311	1				1
14RC410	1				1
14RC420	6	1			7
TOTAL	141	8	1	9	160

al. 2006:Table 4). However, because a small percentage of the glacial tills in Nebraska and South Dakota contain a small percentage of MNPS (i.e., Gundersen and O’Shea 1981), the glacial tills cannot be ruled out as the possible source for both KSPS and MNPS. However, it is significant that MNPS dominates the pipestone at the protohistoric Wichita sites in Oklahoma and I think this represents a change in pipestone procurement practices, which has greater social and political implications as discussed below.

WIPS/SDPS has not been identified in the Kansas glacial tills. Only one artifact from the

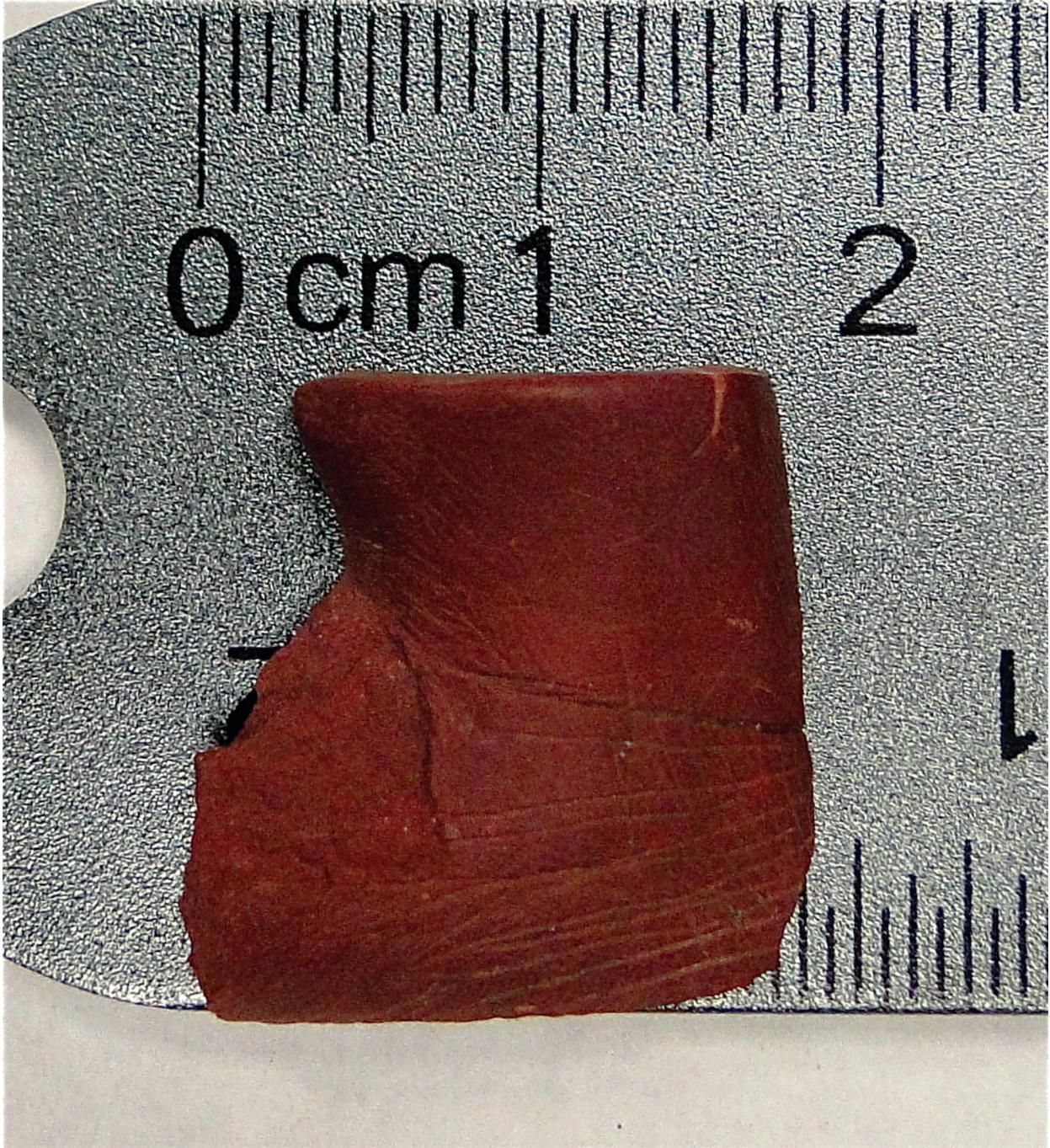


Figure 4.7 Elbow pipe fragment made from Kansas pipestone that is broken in half, from the Mem site (KSHS Cat. # 14MN328-9125); Photo by A. Hadley courtesy of KSHS

GBA archaeological sites was identified as WIPS/SDPS by its high content of kaolinite. This one specimen was found at the Paint Creek site (14MP1) in McPherson County, KS (Figure 4.10). Seven artifacts (2 percent) were identified as WIPS/SDPS in the Robb family and McPherson County Museum surface collections. None of the pipestone artifacts from protohistoric Wichita



Figure 4.8 Broken elbow pipe from the Living the Dream Site demonstrating the removal of modern filings for XRD samples, the flattened area on the break on the inside of the elbow (KSHS Cat. # 14CO382-430-1); This pipe fragment is made of Kansas pipestone; Photo by A. Hadley courtesy of KSHS

sites in Oklahoma were WIPS/SDPS. Possible sources for the WIPS/SDPS artifacts in these assemblages are Wisconsin quarries, South Dakota quarries, or glacial tills in Iowa, South Dakota, Wisconsin, and Minnesota (Gundersen and Tiffany 1986:55; Penman and Gundersen 1999:48). The sourcing data needs to be refined, possibly using more expensive chemical techniques, in order to distinguish pipestones from these sources.

A total of 24 artifacts from GBA sites and the surface collections had unidentifiable sources of pipestone (Table 4.5). Of these artifacts, the majority (63 percent) were burned and/or smoked (Figure 4.11). Significant amount of burning can destroy the mineralogical signatures making it impossible to distinguish the diagnostic mineral suites (Wisseman et al. 2012:2053). For the burned artifacts, the majority showed pyrophyllite in the spectrum, but it was so weak that identification of other mineral signatures was impossible. Thus, distinguishing a KSPS from MNPS in a burned or smoked artifact was not always possible. Although burning and smoking

Table 4.3 Pipestone from the Robb and the McPherson County Museum Collections

Contexts	Kansas Pipestone	Minnesota Pipestone	Wisconsin or South Dakota Pipestone	Indeterminate	TOTAL
Marion Co., KS	2			1	3
Rice Co., KS	3				3
Paint Creek	1				1
Unknown, Robb Family Collection	214	13	5	14	246
Unknown, McPherson Co., Museum	33	2	2		37
TOTAL	253	15	7	15	290

Table 4.4 Types of Pipestone at Protohistoric Wichita sites

Sites	Kansas Pipestone	Minnesota Pipestone	TOTAL
34JF1		12	12
34KA5	1	5	6
TOTAL	1	17	18

Table 4.5 Reasons for Indeterminate Pipestone Designation for GBA, Robb Family, and McPherson County Museum Collections

	GBA	Robb/ McPherson	TOTAL
Burned	5	2	7
Smoked	1	5	6
Burned and Smoked	1	1	2
Blackened/Too Dark	0	2	2
Clerical error	1	4	5
Unknown	1	1	2
TOTAL	9	15	24

could potentially destroy the mineralogical signature, 82 percent of GBA and 85 percent of surface collected artifacts that were burned or smoked were not affected and had identifiable mineral suites. Thus, burning needs to be intensive to destroy the mineral signatures.

Other reasons that it was not possible to determine the type of pipestone were errors in the data and the artifacts that were either too dark or were painted or stained black (Figure 4.12).



Figure 4.9 Pipe lip fragment made of Minnesota pipestone with deeply incised parallel lines from the Paint Creek site (KSHS Cat. # 14MP1-2013.B.178); Photo by A. Hadley courtesy of KSHS

Blakeslee (2012:314) also noted blackening of pipestone artifacts in the Robb Collection, stating that the artifact “was coated with some sort of organic material before being exposed to heat in a reducing atmosphere.” Blakeslee goes on to state that during Gundersen’s analysis of pipestone from a Pawnee site, intentional blackening of pipestone pipes was observed. I also observed this



Figure 4.10 Pipe fragment made of Wisconsin or South Dakota pipestone (primarily kaolinite) from the Paint Creek site (KSHS Cat. # 14MP1-2013.B.136); This image shows the roughly drilled and scraped interior of an unused pipe; Photo by A. Hadley courtesy of KSHS

on several pipestone pipes that I analyzed using the spectrometer at the Pawnee Indian Village (14RP1). Additionally, Ewers (1963), who documented pipe manufacture among the Blackfeet pipe-carvers in the early 1940s, noted that the Blackfeet generally blackened their gray shale and sandstone pipes by covering them in lard and placing them in a smudge pit. In general, the



Figure 4.11 Pipe Fragment made of an indeterminate type of pipestone from the Killdeer site (top, KSHS Cat. # 14CO501-333-1); Also one of the more elaborately decorated pipe fragments with shallow incised rectangles; The interior of the pipe does not contain dottle but has been burned (bottom); Photos by A. Hadley courtesy KSHS

pipestone artifacts at GBA sites are not blackened and this appears to be a trend that developed long after the GBA. This may indicate that some of the Robb collection artifacts are from different time periods.

One important artifact not made of one of the three types of Plains pipestones is the pipestone maul from the Schrope site (14CO331; also reported in detail in Blakeslee et al. 2012). Significantly, the grooved maul appears to be made of pipestone, although it was noted by Blakeslee



Figure 4.12 Pipe fragment that has either been burned or intentionally blackened made from Kansas pipestone, from the Radio Lane site (top, KSHS Cat. # 14CO385-376-1); The interior of the pipe showed thick dottle and the outside burning may also be the result of this pipe's heavy usage (bottom); Photo by A. Hadley courtesy of KSHS

et al. (2012:224) “the maul weighs many times more than the combined weights of all red pipestone recovered during the [Arkansas City] project.” All seven spectra recorded for this maul show a total lack of the diagnostic minerals pyrophyllite and/or kaolinite that characterize the Plains pipestones (KSPS, MNPS, WIPS, and SDPS). There are multiple issues with the grooved maul, including the fact that it was broken into sixteen pieces possibly from thermal shock, it has been glued back together, and it is covered in carbonates (Figure 4.13). All of these factors could affect the spectra, however, other pipestone artifacts with these same issues still had a slight curve of pyrophyllite in their spectra, which was lacking in this case, completely. It is possible that this material is made from Missouri Flint Clay from south of St. Louis area; however, further research is needed to confirm the provenance. Interestingly, the grooved maul was found in a feature with two Caddo sherds (Hoard 2012c:494). The grooved maul is also rare in that it is the only non-pipe GBA artifact made from pipestone. Pipestone used as tools and other non-pipe objects are more common at sites late eighteenth and early nineteenth century Native American sites in Kansas.

In general, the mineralogical analysis strengthened the conclusions made by Gundersen and Blakeslee in previous studies. Their conclusions and the results here are that the majority of GBA pipestone is KSPS. The surprising result that the pipestone at protohistoric Wichita sites was primarily made from MNPS is exciting and will require further research to determine why this shift in pipestone usage occurred among protohistoric Wichita peoples.

CONCLUSIONS

There was a strong pattern of KSPS use at GBA sites, a pattern previously documented by Gundersen (1993) and strengthened with more data here. A quarter of the pipestone artifacts in the GBA collections had modern filing marks from Gundersen’s analysis and in a handful of cases I was able to correlate the results of my mineralogical analysis to Gundersen’s assessment using the inventory notes that are curated with Gundersen’s XRD samples collection at MWAC. The GBA people most likely used the glacial tills of northeastern Kansas for their source of pipe-

Table 4.6 Trends in Pipestone Use at Oklahoma Sites

Cultural Affiliation	Dates	KSPS	MNPS	Indeter- minate	TOTAL
Unknown Plains Village	Approx. AD 700-1500	3		1	4
Fort Coffee and Spiro Phases	AD 1250- 1650	2		1	3
Odessa Phase	AD 1250- 1475	1			1
Unknown Protohistoric or Late Prehistoric	Approx. AD 1450-1750		1		1
Wheeler Phase	AD 1500- 1725	3			3
TOTAL		9	1	2	12

stone.

I also tested 12 pieces of pipestone from Oklahoma sites that were slightly earlier and contemporaneous with the GBA (Table 4.6), the majority (75 percent) of which were KSPS. Three of the KSPS artifacts are from Wheeler Phase sites, which are thought to be one of the Plains Caddoan groups (Drass and Baugh 1997:200). One of the KSPS artifacts is from an Odessa Phase site, and is thought to be ancestral to the Little River Focus (Brosowskie and Bevit 2006:203). Two KSPS elbow pipes are from the Fort Coffee and Spiro Phases, which predate and generally overlap with GBA (Rogers 2006; Rohrbaugh 1984), the occupants of these phases may represent the ancestors of the historic Kitsai, another Caddoan-speaking group (Rohrbaugh 1982). Thus, it is clear that KSPS was the preferred stone for pipes in southern Kansas and northern Oklahoma during a long period of prehistory and protohistory. The use of KSPS appears to be restricted to a specific time frame and may possibly even represent a cultural preference by Caddoan-speaking groups.

Around the time that GBA sites were abandoned (ca., AD 1700), Bryson-Paddock (34KA5) was settled (Vehik 1992, M. Wedel 1981). It is not surprising that the majority of pipestone at the Longest site (34JF1) was MNPS because the protohistoric Wichita moved to the Red River in the mid-eighteenth century, at least in part to gain easier access to French trade (M.



Figure 4.13 Pipestone maul made from an unidentifiable pipestone that has been refitted and glued together and also contains carbonates; from the Schrope site (KSHS Cat. # 14CO331-multiple numbers)

Wedel 1981). The southward move from the GBA homelands to what is now Oklahoma afforded the protohistoric Wichita more frequent access to European trade goods (M. Wedel 1981). Apparently the move to Oklahoma also marked a change in pipestone procurement practices. There are at least three explanations for this changed pattern in pipestone procurement, although there are likely other factors to consider. The first is that the protohistoric Wichita had access to MNPS through the French. Another explanation is that the pressure coming from the Osage, Comanche,

CHAPTER 5: Ground Stone Analysis of Pipestone

INTRODUCTION

This chapter focuses on the groundstone analysis that was conducted on pipestone artifacts. First, provided is a brief summary of the work of two researchers whose contributions are important for this analysis. Next, I summarize ethnographic observations on pipestone manufacturing activities. The results of the groundstone analysis follow with each artifact class discussed separately including mineralogical data. The spatial distributions of pipestone artifacts are then considered. Finally, the overall trend of GBA pipestone manufacture, recycling, and discard patterns are summarized. Also in the conclusion, a comparison of the archaeological and ethnographic research is provided.

PREVIOUS RESEARCH ON GREAT BEND ASPECT PIPESTONE ARTIFACTS

The works of Blakeslee (2012) and Vehik (2002) on GBA pipestone are crucial to this study. Although their relevant research is summarized in the Background chapter, I outline their contributions to understanding pipestone here because these are particularly relevant to my findings from the groundstone analysis. Vehik (2002) analyzed the large GBA assemblages excavated by Wedel (1959) and curated at the Smithsonian Institute, in order to better understand the nature of GBA trade. She found that pipestone manufacturing activities were only found at sites with council circle features (Vehik 2002:54). Vehik interpreted this pattern as evidence for the specialized activities or ritualistic orientation of council circle features.

Blakeslee (2012) made significant contributions to the technological understanding of GBA pipestone artifacts through definition and study of the Windom pipe type, which is a GBA elbow pipe made from pipestone that has a tall bowl and short base (initially identified but not named by W. Wedel 1959:286-288). These pipes are most commonly made from Kansas pipestone (KSPS; Blakeslee 2012:301). Blakeslee (2012:303-304) found Windom pipes at sites that pre-date the GBA, including the Odessa phase [AD 1250-1475] and Pratt complex [AD 1300-1500] [Brosowkie and Bevitt 2006]), and sites that are contemporaneous to GBA (e.g., the Fort

Coffee focus (AD 1450-1650), the Neosho focus (AD 1400-1650, Rohrbaugh 1984), Wheeler phase (AD 1500-1725, Drass and Baugh 1997). Blakeslee used the pipestone artifacts from multiple private surface collections (including the Robb family collection) and assemblages from previous GBA excavations (i.e., Blakeslee et al. 2012) to define the stages of manufacture and recycle of Windom pipes. The stages of manufacture were blank, preform, decoration, shaping of interior passages, use, and dismantling for another use. The research of both Vehik and Blakeslee was key throughout this analysis.

ETHNOGRAPHIC OBSERVATIONS ON PIPESTONE MANUFACTURE

To gain contemporary native perspectives, I interviewed pipestone carvers to gain additional insights on the processes of pipe manufacture. Initially, the goal was to speak with pipestone carvers among the Wichita and Affiliated Tribes in Oklahoma. However, I spoke with a former president on the phone who said he was not aware of tribal members that still carved pipestone pipes. He also stated that research on Wichita pipe carvers may be 20-30 years late. For this reason, I went to Pipestone National Monument to interview pipe carvers. I knew that at the park I would be able to speak with multiple pipestone carvers. After the initial presentation of the results from this research at the Plains Anthropological Conference, I had an opportunity to interview another pipestone carver. In total, I interviewed five carvers, four of which were males and one female, with ages ranging from 45 to 75. Three carvers were members of the Sisseton-Wahpeton Sioux, one was a member of the Ojibwe, and one was a member of the Kiowa Tribe of Oklahoma. Three carvers taught themselves how to carve pipes. Two of the carvers from the Sisseton-Wahpeton Sioux tribe were taught by family members and were fourth and fifth generation carvers.

The main goal of the interviews was to learn about the processes of manufacturing pipestone pipes, in order to better identify these processes in the archaeological record. There were three main insights that I gained from these interviews, which involved the processes of quarrying, stages of manufacture, and the use of the waste products. As for quarrying activities, only

Native American individuals who are registered with a federally recognized tribe are allowed to quarry pipestone at the National Monument. Quarrying was restricted to the summer months because the quarries were too wet and cold in the winter, late fall, and early spring. Quarrying is done in a way similar to how it was done in the early twentieth century, using only hand tools. To access the pipestone, thick layers of the Sioux Quartzite are removed by placing chisels into quartzite cracks and prying and hammering off large pieces. My primary informant at Pipestone National Monument described the quarrying in the following manner.

...I think we talked a little about when you go quarrying and when you are connecting with the earth. You know...and yeah, the reality of the job is backbreaking, swinging hammers, modern tools, sledgehammers and wedges, whatever. But it doesn't matter, it's all a spiritual process. It's not a sacred process; it's a spiritual process. Cause I don't say it's sacred cause I'm not waking that pipe up for somebody, that's their responsibility. So when I carve a pipe its no different from when I'm out there quarrying. So if I'm carving a pipe for one particular person I keep them in mind. That helps me and I'll talk to them and gotten to know them a little bit, and that always helps... you know? It's still just spiritual process it ain't no different than the spiritual process of getting out of bed and making bacon and eggs in the morning. You are feeding the body and the soul and you are enjoying the start of a new day that came forth. It's all spiritual...you know it's not so much that it's not untouchable sacred.

Manufacture was mainly done with tools that are typically used for other crafts and activities. Hacksaws were used to cut out the pipe blank. Multiple different types of files and rasps were used to shape the pipes. Detail work was done with wood chisels and knives. All of the carvers I spoke with used an electric drill for boring out the bowl and base holes in the pipes. Finishing the pipes involved using various grits of sandpaper to remove the file marks. The final stage in the manufacture was to polish the pipe, often using bees wax. I asked my primary informant about how many different tools he used for carving and he said:

I don't know how many different...I usually just tell people about 25 pounds of tools that I carry to carve my pipes that carve you know a wide range of different styles and things and just your own imagination...but the tools that I collect every time I go to a hardware store in a different town, or...in, an arts and crafts store, or whatever. I always check out the carving tools. I even got exacto knives, just in case, you never know how you are gonna use 'em, just in case, I have exacto knives and wood chisels, too.

Significant for an archaeological investigation are the pipe scraps and powder from manufacture. Pieces of manufacture waste were often recycled. One of my informants, a prolific

carver, told me that he gave his small scraps to some of the female carvers in the community who do not have men to quarry for them. These smaller pieces are turned into small turtles, figurines, or jewelry sets. These small, carved items along with pipes and stems are sold in the gift shop owned and operated by the Pipestone Indian Shrine Association and located in Pipestone National Monument. Stone powder was also recycled for use in making red paint, often for Sun Dances. Due to the high clay content of pipestone powder, one of the carvers found the powder useful in sealing cuts on her hands from carving. Pipestone powder and scraps that were not recycled were returned to the quarry and buried with an offering and a prayer. My primary informant explained how a broken pipe was dealt with:

First of all, you examine [the broken pipe] and see if you can get something else out of it. If you can't then, and if the break or the fracture, cause usually that is what we deal with mainly fractures...I just throw it back in the bucket of stuff that is buried down in my quarry, just give it back to the earth mother.

I have drawn three conclusions from the interviews with pipe carvers that may be significant to understanding the archaeological record. I revisit insights from the ethnography of pipe carvers in the conclusions of this chapter. First, pipestone quarrying is only a warm and dry weather activity because significant soil and Sioux Quartzite must be removed to access the pipestone. These deep pits become swimming pools whenever the area receives significant rain or snowfall. It is unknown if quarrying was only conducted during warm months in prehistoric and protohistoric quarrying, but presumably it was. The majority of nineteenth century visits by Americans and Europeans to the quarries occurred during from spring to early fall (Scott et al. 2006). However, quarrying activities were not always documented. Quarrying for KSPS is likely easier than quarrying MNPS because it does not require significant amount of digging. Access to KSPS is from the ground surface and it is also washed out in streams. For this reason, it is possible that KSPS was procurable year round.

A second observation from the interviews with pipe carvers is that none of the tools used for pipestone carving were specifically made for that activity. Tools were informal and unspecialized in contrast to the pipestone objects that were carved, which were imbued with layers of different meanings. In fact, the majority of my interviews focused less on the technological

and more on the spiritual and metaphysical aspects of pipestone. In the early nineteenth century, George Catlin (1975:247) documented the use of multi-purpose tools (i.e., knives, sand, water, and wood drills) that were also used in pipestone carving. Similar observations were made by John C. Ewers (1963) with twentieth century pipe-makers. With such continuity between pipe-carvers over a long time period, expecting to identify tools only used for pipe-carving in the archaeological record may not be realistic.

The last observation of pipestone carving was that very little of the pipestone is wasted. The conservation of every piece of pipestone is in part a function of the difficulty in quarrying and the limited access to the quarries. The administration at PNM informed me that as of early Fall 2013 there were a total of 170 individuals on a waiting list to gain access to the quarries and all individuals must be members of a federally recognized tribe. Documentation of what was done with the scraps is lacking in both ethnographic and historical pipe-making accounts. Thus, it is difficult to surmise what we might expect to see in the archaeological record in terms of recycling and disposing of extra pipestone material. The difficulty in quarrying would be a lesser issue for dealing with pipestone collected in glacial tills.

METHODS OF ANALYSIS

Pipestone artifacts were classified into five broad categories: worked fragments, pipes or pipe fragments, tools, powders, and unmodified pieces. Analysis of each pipestone artifact involved noting multiple attributes, weighing, drawing, and scanning it with an infrared spectrometer. Attributes that were recorded for each pipestone fragment were: type, modifications, Munsell colors, weight, and surface treatment (see Appendix B). Also recorded were the artifact number, provenience, cultural or temporal affiliation of the artifact, collector, date of collection (if the information was available), and the curational facility. A sketch was made of the front and back of the artifact and photos were taken of the unique artifacts.

Pipes and pipe fragments that were nearly complete had many more attributes that were recorded (see Appendix C). The pipe bowl attributes were diameter, height, and the bowl hole di-

iameter. An important note on terminology is the use of base or shank in this research, as opposed to stem. This distinction is made because the pipe stem for the GBA pipes and historic pipes is a separate wooden entity. By referring to the bottom elbow of the pipe (the part that is smoked out of) as the base it avoids confusion with the wooden separate pipe stem. The pipe base had the following attributes that were recorded: length, width, and base hole diameter. The diameter of the neck was measured if the pipe was complete enough. The diameter of the drilled hole at the neck was also measured. The neck hole diameter was possible to measure on many of the broken pipes because it was common to have the pipes broken in half, basically down the center-line of the pipe, exposing the shape and size of the drilled holes. Also recorded were the type of striations visible in the bored holes to better understand the drilling processes and the nature of the drills. The shape of the drilled holes was also recorded. For complete and broken pipes the presence or absence of dottle and its extent and location were noted, in order to identify pipes which had been smoked.

GROUNDSTONE ANALYSIS

The following discussion addresses all of the 468 pipestone artifacts that were analyzed by dividing them into seven categories: unmodified, modified fragments, pipe fragments, identifiable types of pipes, ornaments, tools, and powders. The artifact summaries are separated by GBA sites (Table 5.1), the Robb and McPherson County Museum Collections (Table 5.2), and the protohistoric Wichita sites (Table 5.3). Pipestone artifacts were the focus of this research in order to follow the life cycles of this particular material. However, there are other types of pipes found at GBA sites. Pipes made from limestone, gray siltstone, and steatite have been identified at GBA sites. Additionally, ceramic tubular pipes that are believed to be a Puebloan trade good have been identified at two GBA sites: Thompson (14RC9 and 14RC12; Wedel 1959:309) and Crandall (14RC420; Lees et al. 1989:78). Despite the handful of pipes made from ceramic and other stones at GBA sites, the overwhelming majority of pipes are made from red pipestone.

Table 5.1 Pipestone Artifacts at Great Bend Aspect Sites

Sites	Pipe Frag.	Elbow pipe or Frag.	Ground, cut, incised, or drilled	Ornament or Figurine	Flake	Tools	Powder	Unmodified	TOTAL
14CO1	1			1					2
14CO331*†	7	1				1			9
14CO382	2								2
14CO385*	6			1	1				8
14CO501	1	1	1						3
14MN308		1							1
14MN326		1							1
14MN328* †	8	6	18	2	5			2	41
14MP1	4	1	3						8
14MP401	3		3						6
14MP404	4		3					1	8
14MP408	1		3						4
14MP409			1						1
14RC2	2		3						5
14RC5	14	1	5				1		21
14RC8* †	12	1	2	1					16
14RC9*	6	2	3	1					12
14RC301					1				1
14RC305	2								2
14RC311			1						1
14RC410								1	1
14RC420*	4	2			1				7
TOTAL	77	17	46	6	8	1	1	4	160

* Denotes sites with pipestone that was not analyzed for this study.

† Denotes a site with a chipped stone assemblage that was analyzed in this research.

Table 5.2 Pipestone Artifacts from the Robb Collection and the McPherson County Museum

	Pipes, pipe frag or blank	Elbow pipes or frags	Other Types of Pipes	Ground, cut, in- cised, or drilled	Ornament or Figurine	Unmodified	Total
Marion Co., KS				3			3
Rice Co., KS				3			3
Paint Creek					1		1
Unknown, Robb Family Collection	156	26	1	52	5	6	246
Unknown, McPher- son Co., Museum	2	9	1	20	3	2	37
Total	158	35	2	78	9	8	290

Table 5.3 Pipestone Artifacts from Protohistoric Wichita Sites in Oklahoma

	Pipe frag.	Elbow pipes or frags	Ground, cut, incised, or drilled	Flake	Ornament	Total
34JF1	1	2	8	1		12
34KA5	3	1	1		1	6
Total	4	3	9	1	1	18

Unmodified

Only twelve artifacts in all of the collections (GBA, protohistoric Wichita, Robb, and McPherson assemblages) were unmodified. Five of these unmodified pipestone cobbles had water-worn cortex. The two unmodified fragments from the Mem site (14MN328) were very small with a combined weight of 2.91 grams and the fragment from 14MP404 was 7.85 grams. All but one of the unmodified pieces were made from KSPS. However, a very large cobble weighing 286 grams was made of Wisconsin or South Dakota pipestone (WIPS/SDPS). One of the unmodified fragments, that was KSPS, was the only piece of pipestone analyzed from 14RC410 site. This site has been dated to the 1400s, placing it in the early Little River focus of the GBA (Roper 2011).

Modified

Modified pipestone is a category that varied greatly in the extent of modification. These were either unfinished or finished artifacts that lacked diagnostic pipe features. Diagnostic features of a pipe are minimally the drilled concave interior and the exterior that is ground smooth. Pipe fragments are not included in the modified pipestone group. There were a total of 46 modified pipestone artifacts from GBA sites, 78 from surface collections (Robb collection and McPherson County Museum), and nine from the protohistoric Wichita sites in Oklahoma. The artifacts in the modified category included unfinished pieces which were broken or abandoned, completed artifacts, pieces used to make powder, or samples that were being tested or used to practice pipe-carving techniques.

A cut was distinguished from incised, in that incised was decorative, which was easy to establish because it formed a pattern and was not random. Additionally, cuts were deeper than incisions and were often not clean single cut marks but appeared to have multiple overlapping cuts. Grinding was identified through a flattened area of the stone that exhibited coarse striation marks. The most prevalent modification of pipestone was grinding followed by a combination of grinding and cutting.

Cutting and snapping was distinguished as a separate modification. This process has been previously identified in pipestone manufacture with these same collections as the groove-and-snap technique (Blakeslee 2012:311) or scored and snapped (Lees et al. 1989:78). A similar technique had been identified in GBA bone tool technology as cut or sawed and snapped (Wedel 1959:248, 263-4, 367). Cut and snap was recognizable in that there was a deep cut mark on an edge usually encircling the entire circumference of the stone with an uncut, rough area in the center (Figure 5.1). There were 14 pipestone artifacts that were ground and also cut-and-snapped in the Robb collection. The large amount of cut and snapped pieces in the Robb Collection may be due to the fact that these pieces were on average larger than the archaeological assemblages, with an average weight of 27 grams as opposed to 19 from the entire Robb/McPherson assemblage. It is likely that these larger blocks were easier to spot while surface collecting. This large

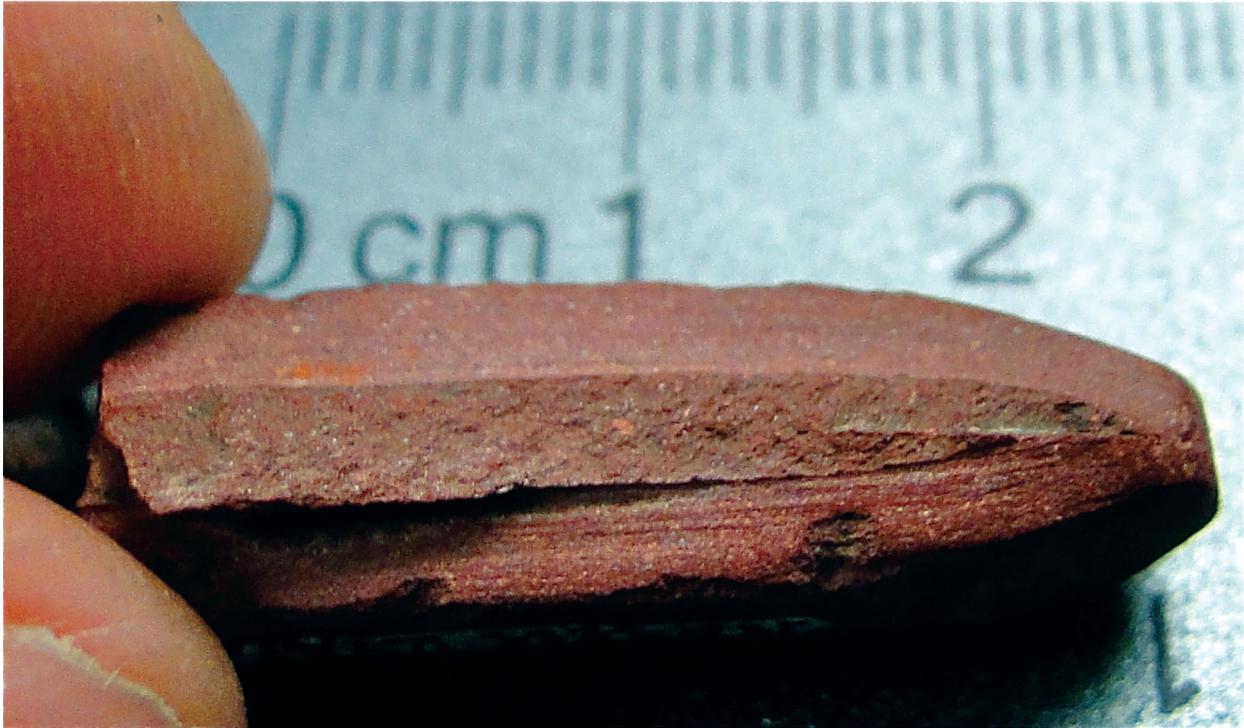


Figure 5.1 A cut and snapped side of an artifact from the Mem site (KSHS Cat. # 14MN328-11488), Photo by A. Hadley courtesy of KSHS

amount may represent the archaeological bias, however, it is possible that the area where the Robb family surface collected was a hub of pipestone carving activities, particularly in breaking down raw blocks to blanks.

Flakes

Not included in the modified category of pipestone artifacts are flakes. Pipestone is typically ground and not flaked, however, in the finer-grained pipestone objects the material fractures conchoidally. There were a total of eight flakes from GBA assemblages and one from the Longest site (34JF1, protohistoric Wichita site). Four of these flakes, including the one from the Longest site, were from ground pieces of pipestone. The remaining five flakes were either from unmodified pipestone or from a portion of the stone that was not modified. All of the flakes from GBA sites were made from KSPS and the flake from the Longest site was made of MNPS.

Unidentifiable pipe fragments

Unidentifiable pipe fragments were pieces of pipestone pipes that contained diagnostic pipe traits, such as a concave drilled hole interior and ground exterior. The fragments, however, were too fragmented to determine the type of pipe. Although the vast majority of pipestone pipes from GBA sites are of the elbow style, Wedel (1959) reported tubular and odd-looking T-shaped pipes made from pipestone. Thus, no assumption was made that these pipe fragments were elbow pipes. A total of 77 pipe fragments were from GBA sites, four from the protohistoric Wichita sites, and 158 from the Robb and McPherson collections. Only one of the artifacts from the Robb collection was a fragment of a pipe blank and it was so fragmented that the type of pipe could not be determined. Of these pipe fragments 53 contained evidence having been smoked (18 from GBA sites, one from protohistoric Wichita, and 34 from the Robb/McPherson collections). Additionally, a total of 29 pipe fragments (3 from GBA and 26 from the Robb Collection) contained evidence of modifications (ground, cut, and cut-and-snapped) after the pipe broke.

Elbow Pipes

At GBA sites, there is a predominant type of elbow pipe made from pipestone, the Windom pipe, named by Blakeslee (2012). First, I will describe the attributes and extent of Windom pipes, followed by a discussion of what I observed at the GBA sites, Robb and McPherson collections, and protohistoric Wichita sites. The Windom pipe was first reported by Wedel (1959) at the Tobias site (14RC8).

The prevalent form of pipe was L-shaped, with the bowl exceeding the stem arm in length. The under side of the stem arm and the side of the bowl away from the smoker are characteristically straight, or nearly so, and meet at a right angle. The side of the bowl toward the smoker, on the other hand, is rather markedly convex or bulbous and meets the upper side of the stem arm at an acute angle. Stem and bowl alike are conically bored probably with flint drills; and the walls, from 1 to 3 mm thick, are usually well smoothed. Decoration, to judge from our specimens and a number of others seen in local collections, is comparatively rare and simple; when present, it consists of a slight swelling near the top of the bowl, or of a narrow incised line or lines, or of narrow single or double beading about the outer lip of the bowl (Wedel 1959:286).

The unique characteristic of the Windom pipe, that Wedel aptly described, was that the bowl

is longer than the base. The bowl was identified as having the thickest dottle (Blakeslee 2012; Wedel 1959), particularly compared to the base hole, which can be blackened but rarely has the thick organic coating. Windom pipes are also found in miniature sizes. Blakeslee (2012:301) reported undrilled Windom blanks that were miniature in size, although no specific dimensions were provided. Neither Wedel nor other reports on GBA sites mention miniature pipes. Blakeslee (2012:306) defined these pipes as most commonly made from KSPS. Other stones, such as limestone, gray siltstone, and red sandstone are rarely used (Blakeslee 2012; Wedel 1959). Windom pipes have a restricted temporal distribution from the fifteenth century to late seventeenth centuries (Blakeslee 2012:303-304,321), but have also been identified at sites that are slightly earlier and contemporaneous with GBA (i.e., Pratt Complex, Odessa phase, Fort Coffee, Neosho focus, Wheeler phase sites [Blakeslee 2012:299-300]).

In this research, I assessed whether or not the elbow pipes were Windom pipes. The two important morphological characteristics of the Windom pipe are that it has an elbow of 90° or less. Another criterion is that the bowl is longer than the base (Figure 5.2). Morphology of some broken pieces was used to determine that the pipe was likely a Windom, although some of the evidence was missing. Because some of these pipes were broken and not smoked it was not possible to distinguish the bowl from the base. Elbow pipes were distinguished by evidence of an elbow, but lacking the diagnostic traits of a Windom pipe.

A total of 55 elbow pipes were found in all four of the collections (Table 5.4). There were nine pipes that were complete enough to be identified as Windom pipes and five that were broken or not smoked but were probably Windom pipes. Out of the six elbow blanks from all collections, all but one were complete enough to be called Windom with one blank too broken to distinguish its a type. The majority (56 percent) of the pipes were broken elbow pipes, all of which had part of the elbow in the remaining portion (refer to Figures 4.7 and 4.8).

Two complete pipes were miniature elbow pipes with base lengths of less than 17.5 mm and bowl heights of less than 16 mm. Both of these pipes had bowl and base holes that were coated in dottle. One of the miniature elbow pipes was found at the Mem site (Figure 5.3). The



Figure 5.2 Windom pipe from the Mem site (KSHS Cat. # 14MN328-1724), Photo by A. Hadley courtesy of KSHS

Table 5.4 Elbow Pipes in all Four Assemblages

	Complete Windom Pipes	Windom Pipes, Broken or Not Smoked	Blanks, shaped like Windom Pipes	Broken Elbow Blanks	Broken Elbow Pipes	Mini-Elbow Pipes	Other Type of Elbow Pipes	Total
GBA sites	3	1	1		10	1	1	17
Robb	2	2	3		19			26
McPherson	4	2	1	1	1			9
Protohistoric Wichita					1	1	1	3
Total	9	5	5	1	31	2	2	55

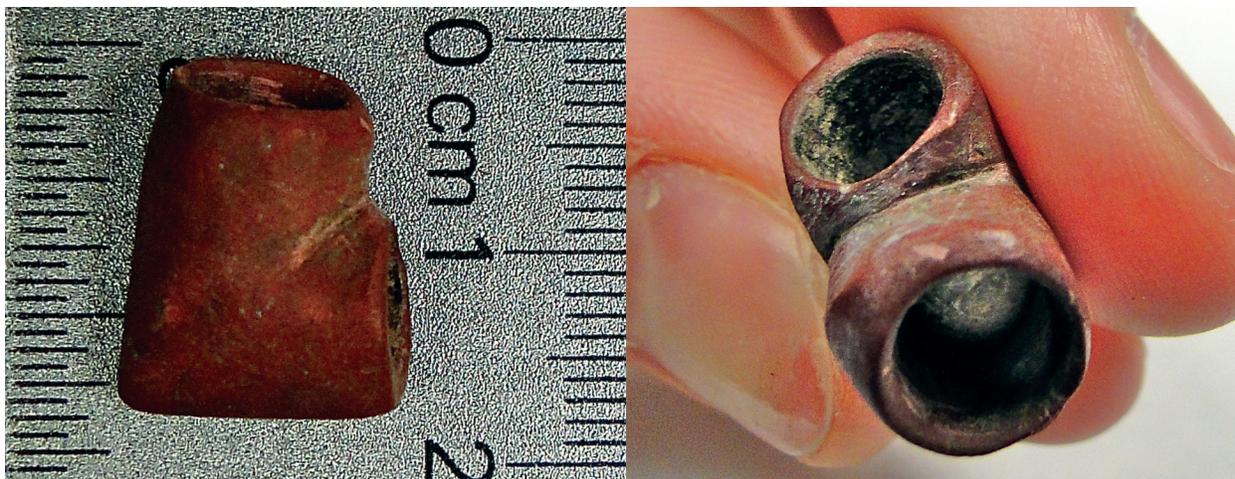


Figure 5.3 The only complete pipe found during the analysis of GBA artifacts; Miniature elbow pipe (left) with dottle demonstrating the pipe's use (right) from the Mem site (KSHS Cat. # 14MN328-1030), Photos by A. Hadley courtesy of KSHS

other miniature elbow pipe was from Burial 7 at the Longest site and had four oblique parallel incised lines from the lip of the base toward the elbow. These miniature pipes were different from the Windom pipes, in that the bowl and base were within millimeters of being equal lengths. However, it is possible that the miniature pipe from the Mem site pipe was initially a Windom pipe that was cut down to a smaller version over time. The Longest site's miniature pipe has a very wide bowl hole and because of this I doubt that the bowl was longer. The major differences between the miniature elbow pipes at the Mem and Longest sites, are that the Longest is made from MNPS and has a decoration that is not common to most GBA pipes. The Mem pipe is not decorated and is made from KSPS.

All but one of the 17 elbow pipes from the GBA sites, were made of KSPS. One elbow fragment from the Mem site was made of MNPS. Twenty-eight of the Robb Family and McPherson County elbow pipes were made from KSPS and two were burned and there was no mineral signature. One of the Windom pipes in the McPherson collection is also made from MNPS. Two broken elbow pipes from the Robb Family Collection were made from MNPS.

Other details about the elbow pipes include decoration, evidence of smoking, and the patterns of breakage. Of the 17 GBA elbow pipes, only three were incised and seven contained definitive evidence of being smoked. Of the 35 elbow pipes from the Robb and McPherson County,

Museum collection, one was incised and 16 contained definitive evidence of being smoked. Of the three elbow pipes from the protohistoric Wichita sites, two were incised and one contained definitive evidence of being smoked.

During the analysis, I noted that many of the elbow pipes were longitudinally broken in half (refer to Figure 4.7 and 4.8). While evidence of a cut and snap type of break were rare, this may be for two reasons. First, for broken pipe fragments the XRD samples were removed from the broken side removing the original characteristics of the break. The pipestone sample was often taken from a broken edge because it was assumed that the finished or complete side was more important. Second, it may be that pipes were broken in half by percussion, because many of them were thin enough to snap with applied pressure. There was one pipe with a thick base that had a deep v-cut around the base revealing that it was likely in the process of being cut in half (Figure 5.4). Blakeslee (2012:317-319) first reported the dissection of pipes for reuse as pendants. However, he described the process as first involving removing the bowl from the base and then dissecting it in half. There were 11 of the 17 GBA elbow pipes that were longitudinally cut. This modification was not observed on the Robb and McPherson County collections or the protohistoric Wichita pipes.

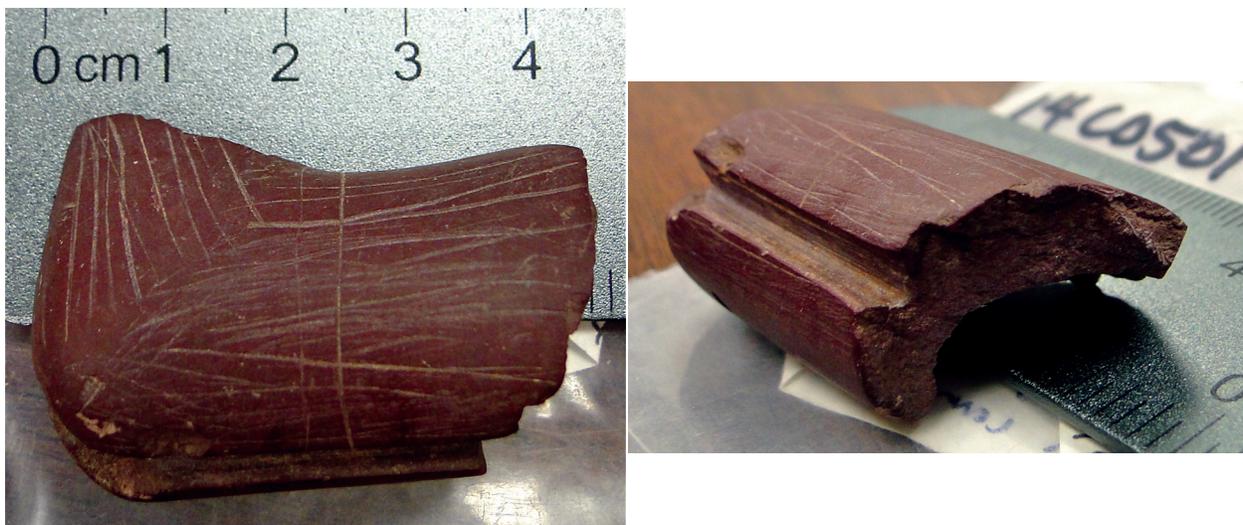


Figure 5.4 Elbow pipe (left) with a cut around the base (right) from the Killdeer Site (KSHS Cat. # 14CO501-506-2), Photos by A. Hadley courtesy of KSHS

A very interesting elbow pipe is an elaborate one compared to the pipes found in Burial 6 at the Longest site. The pipe was made from a spotted variety of MNPS with light pink spots on a dark red background. The bowl was flared and the end of the base contained a thick metal ferrule that was quite fragile. Next to the metal, were deeply incised lines, which contained the remnants of a metal inlay.

Other Pipes

Wedel (1959) observed stone pipes at GBA sites that were T-shaped or tubular. In the collections analyzed in this research, the only other types of pipes that were complete enough to determine they were not elbow pipes were found in the Robb Collection and the McPherson County Museum collection. The pipe from the McPherson County Museum collection is closest to a rough Modified Micmac (Figure 5.5). Modified Micmac pipes are defined by both West (1934) and Ewers (1986) as an acorn-shaped bowl on top of a short, blocky base. These are generally found during historic times and it is believed that traders brought this pipe type west from the Great Lakes region during early historic times (Ewers 1986:50). The reason this pipe is of note is because it is made from either Wisconsin pipestone or South Dakota pipestone, with a spectrum dominated by the mineral kaolinite. The other unusual pipe is a fragment that could be a T-shaped pipe fragment, but it was too broken to determine and could represent a pipe in the process of being recycled. Both of these pipes lack archaeological provenience and may not be from GBA contexts.



Figure 5.5 Photo of a Micmac pipe from the McPherson County Museum Collection; Made from either Wisconsin or South Dakota pipestone; Photo by A. Hadley courtesy of the McPherson County Museum and Don Blakeslee

Ornaments

There were only four ornaments in the GBA assemblages: two pendants, one bead fragment, and one bead preform. One of the pendants is from the Tobias site (14RC8-211-73) and it is oval-shaped with two biconical holes drilled through it and it is broken across one of the holes. There is a shallow groove ground between the two holes. The other pendant is complete and it is from the Mem site (14MN328-3334). This pendant is triangular also with two biconical holes drilled into it. Unlike the careful placement of the drilled holes on the Tobias pendant, the holes in the Mem pendant are offset and appear to be randomly placed on the triangle (Figure 5.6). The bead fragment found at the Larcom-Haggard site (14CO1-217-14) is very small and was identified as a pipe fragment in Blakeslee et al. (2012:218). I identified the artifact as a bead because of its small size; with a maximum width of just 11 mm it is hard to imagine this would have been a pipe. I also think that it was not a miniature pipe because the piece was faceted on three sides and such detail is not seen on the miniature pipes. The artifact broke during the initial stages of drilling with a break that exposes the conical-shaped drill hole (Figure 5.7). The bead preform is from the Thompson site (Figure 5.8). The preform is a cut and ground disc that is identical in form to beads found in the Robb Collection (labeled Paint Creek) and the McPherson County Museum Collection (2004-172-1062 and 2004-172-1063). The only difference is that the preform lacks a drilled hole and still contains rough grinding striations. The ornaments from Tobias, Mem, and Larcom-Haggard were all made of KSPS, but the bead preform from the Thompson site is MNPS.

A total of five ornaments were found in the Robb and McPherson County Museum collections. Four of these are circular beads that have a single drilled biconical hole. The one pendant is oblong shaped with a biconical hole drilled through one end. One of the circular beads is made from MNPS and the other ornaments from Robb and McPherson are KSPS. There was a single ornament from the protohistoric Wichita sites. This was a triangular pendant from the Bryson-Paddock site (34KA5). A single biconical hole was drilled through one of the points, which caused it to break. This piece was made of MNPS.



Figure 5.6 Triangular pendant from the Mem site with biconically drilled holes (KSHS Cat. # 14MN328-3334), Photo by A. Hadley courtesy of KSHS



Figure 5.7 Broken bead blank with a conical drilled hole from the Arkansas City Country Club Site (KSHS Cat. # 14CO1-217-14), Photo by A. Hadley courtesy of KSHS



Figure 5.8 Bead preform from the Thompson site (KSHS Cat. # 14RC9-586-36), Photo by A. Hadley courtesy of KSHS

Figurines

Two artifacts in the GBA assemblages are identified as figurines because they appear to be relatively finished and are carved into particular shapes. These artifacts are also too elaborately carved to be pipes and they may have functioned as a pendant although a hole drilled through the artifact is lacking. The figurine from the Radio Lane site (14CO385-812-1) contains drilling evidence that indicates it was a recycled pipe fragment. The artifact is shaped like a beaver tail with very fine scalloped edges and seven shallow conical holes drilled in a row along the center line (Figure 5.9). The shape resembles figurines from the McPherson County Museum collection (8735) and the Robb collection. The figurine from the McPherson collection has small lines incised on two of the edges but they do not completely encircle the piece unlike the Radio Lane figurine. The Robb collection artifact is similarly shaped but has six incised parallel lines on the end of the “tail.” All three of these beaver tail-shaped figurines are made of KSPS. The other GBA figurine is from the Mem site (14MN328-18574). This artifact has two complete edges that are ground to a right angle with incised lines along its edges, similar to the figurine from the McPherson County Museum and possibly was an incomplete version of the Radio Lane figurine. This artifact was also KSPS.

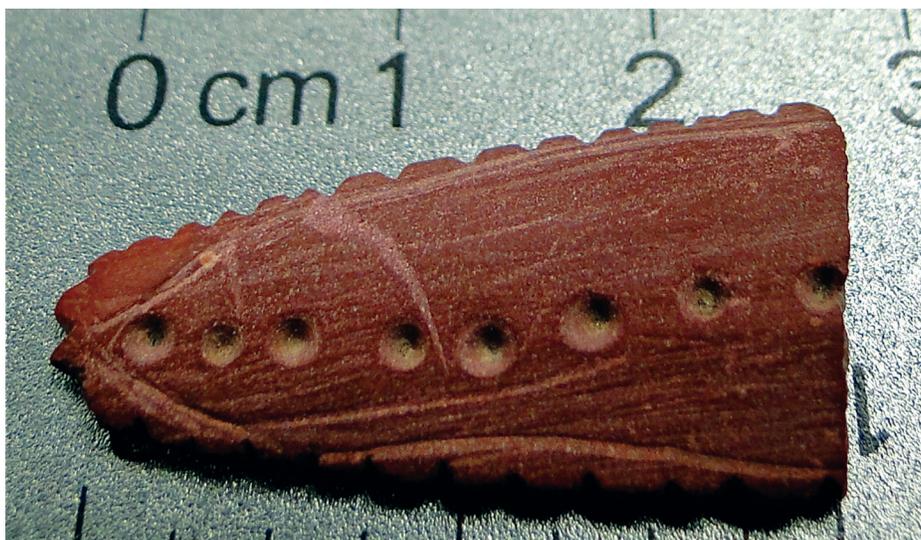


Figure 5.9 Figure from the Radio Lane site (KSHS Cat. # 14CO385-812-1), Photo by A. Hadley courtesy of KSHS

There were a total of four figurines from the Robb and McPherson County Museum collections. Two of these artifacts were the beaver tail-shaped figurine previously mentioned. Another figurine from the Robb collection was similar to the artifact from the Mem site with three ground sides and two corners at right angles. On the longest complete edge there is evidence of two incised lines.

One of the artifacts from the Robb collection is classified as a figurine, but most closely resembles the thunderbird tail found on the base of some Oneota disc pipes (Figure 5.10). Unfortunately, the spectrum from the artifact is inconclusive as to the type of pipestone from which it is made, although its spectrum most closely resembles WIPS/SDPS with only kaolinite and hematite signatures. If the artifact were made from MNPS, that would more closely support that it was an Oneota disc pipe fragment, because from this research I have found that the majority of the Oneota disc pipes that I tested were made from MNPS.



Figure 5.10 Image of an Oneota disc pipe with “thunderbird tail” from the White Rock Site (14JW2), Photo by A. Hadley courtesy of University of Kansas Archaeological Research Center (KUARC)

Tools

The only tool was the hafted pipestone maul, which was discussed above in the sourcing chapter (refer to Figure 4.13). It was ground into shape and then had broken into sixteen pieces. The piece is of note because it clearly was not made from one of the four Plains pipestones. I did analyze multiple pipestone mauls, manos, metates, celts, nutting stones, bannerstones, molds, and an axe all from sites that are within or near the glacial till areas of Kansas, Nebraska, and Missouri. Many of these were from Kansa village sites, but that is the subject of a future research project.

Powder

There was only one sample of pipestone powder that was analyzed for all of the assemblages. This sample was found in a small bag with the Malone site (14RC5) collection. There is no data on the provenience or origin of this powder, beyond the site level. The sample was definitely KSPS. I believe that this is a powder sample collected by or for Gundersen, in order for him to use it for XRD. I interpret Gundersen to have tested half of the pipestone artifacts from the Malone site based on the presence of modern filing marks from his work. During the 1980s and 1990s, Gundersen amassed a large collection of pipestone samples from GBA sites, and this powder sample is small enough that I believe this is likely to be from his work and not powder that was found in an archaeological context. Despite the failure to find powder samples from these sites, I am hopeful that Wedel's collections from GBA sites that are curated at the Smithsonian Institution National Museum of Natural History will yield potential pipestone powder samples that can be tested. According to the Smithsonian's online records, there are a total of 371 red powder samples from GBA sites that need to be tested. I did test powder samples from other archaeological contexts (mainly from the Pawnee Indian Village [14RP1]) and these were all turned out to be hematite. Thus far no pipestone powder sample has been found from an archaeological context.

DISCUSSION OF SPATIAL DISTRIBUTIONS

When considering the distribution of pipestone from various sites, I found that some of the Kansas counties had significantly more pipestone than others. The largest amount of pipestone comes from the nine Rice County sites, totaling 66 artifacts. Marion County has the second most pipestone from its three sites with 43 artifacts, although 95 percent of that is from the Mem site. The five McPherson County sites have 27 artifacts, and the five Cowley County sites had the least amount with 24 pipestone artifacts. Additionally, these data only reflect the pipestone that is currently curated in the state of Kansas, I suspect that the amount of pipestone for Rice County will increase when the pipestone at the Smithsonian, which was excavated by Wedel in the early twentieth century, is included in the totals. There are also more pipestone artifacts from the Crandall site (14RC420), but in this analysis I did not have access to the entire assemblage.

The site with the largest assemblage of pipestone artifacts (41) was the Mem site (14MN328). The majority of the features and units (28) only had a single specimen of pipestone, however, four features had multiple pieces of pipestone (Table 5.5). Feature 146 was a bell-shaped pit that had a grass-lined base (Lees et al. 1989) and it contained a total of four pieces of pipestone. Feature 858 had four pipestone artifacts and Feature 524 had three pipestone artifacts, both were refuse-filled, bell-shaped pits (Lees et al. 1989). Feature 1118 had the one specimen of MNPS at the site, but the feature was not described in publications.

The majority of the pipestone in Rice County comes from four sites: Malone (14RC5), Tobias (14RC8), Thompson (14RC9), and the Max Crandall (14RC410) sites. These sites also contain six of the eight artifacts made from MNPS at the GBA sites. The Malone site (14RC5) had a surprisingly large amount of pipestone with a total of 21 artifacts, but these artifacts lack proveniences within the site. Sixteen pipestone artifacts came from the Tobias site (14RC8). Five of the artifacts came from Mound 1, a refuse-filled mound. The Thompson site (14RC9) had twelve pipestone artifacts, five of which were from Feature 88 and three were from Feature 18. There is no information available on what these features might have been. Seven pipestone artifacts were excavated at the Max Crandall site (14RC420). Four of these artifacts, including one

Table 5.5 Pipestone from the Mem site (14MN328), All Proveniences from Area 861

Provenience	Description	Count
Surface		1
Unit 57		1
Unit 72, 0-10 cm		1
Unit 73, Fea. 578	Refuse-filled, bell-shaped pit	1
Unit 74, 0-10 cm		1
Unit 90, Fea. 348	Small refuse-filled pit	1
Unit 102, 0-10 cm		1
Unit 164, Fea. 1204, 10-20 cm	Refuse-filled pit	1
Unit 237, 10-20 cm		1
Unit 334		1
Unit 337, 10-20 cm		1
Unit 346 or 396(?), 10-20 cm		1
Unit 347, Fea. 1118, 0-10 cm		1
Unit 351		1
Unit 365, 0-10 cm		1
Unit 381, 10-20 cm		1
Unit 381, Fea. 1206		1
Unit 572, 0-10 cm		1
Unit 568, 10-20 cm		1
Fea. 146 (3), 145-147 cm (1)	Bell-shaped pit, grass-lined base	4
Fea. 282		1
Fea. 287, 10-20 cm		1
Fea. 358 (?), Below 60		1
Fea. 524 (2), 1.2 m (1)	Refuse-filled, bell-shaped pit	3
Fea. 650		2
Fea. 887, 40-50 cm	Refuse-filled storage pit	1
Fea. 833, Unit 337, 0-10 cm		1
Fea. 858, 30+cm (1), 60+cm (2), 80 cm (1)	Refuse-filled, bell-shaped pit	4
Fea. 631, Fea. 1034, 50-70 cm	Oval pit-house and assoc. storage pits	1
Fea. 1091, 20-30 cm		1
Fea. 1203, Fea. 631	Oval pit-house and assoc. storage pits	1
14MN328		1
Total		41

piece of MNPS, were found in Feature 50, a refuse-filled bell-shaped pit.

Nine pipestone artifacts are from the Schrope site (14CO331). There was only one feature that had a concentration of pipestone artifacts. Three pipestone artifacts were found in Feature 311 a refuse-filled, bell-shaped pit that also contained a fragment of turquoise or azurite. The hafted maul made of a pipestone that is not from a Plains source was found in Feature 324, a refuse-filled bell-shaped pit that lacked other pipestone artifacts, but contained Caddoan sherds.

Three sites had eight pipestone artifacts each: the Radio Lane site (14CO385), Paint Creek (14MP1), and 14MP404. At the Radio Lane site, there were two features with multiple pipestone artifacts. These features were Feature 315, which was not a sampled feature and Feature 326, which was a refuse-filled bell-shaped pit. It was also reported that this site had a modified tabular fragment of pipestone (14CO385-8-0) that was sourced as Catlinite through XRD Blakeslee et al. (2012:Table 10.12). This artifact was not analyzed for this project. This is a significant artifact because it is the only pipestone from the GBA Cowley County sites that is made of MNPS. The other two sites, Paint Creek and 14MP404 both lack provenience data beyond the site.

The Max Crandall site (14RC420) had additional pipestone artifacts that were not analyzed here, but for this analysis seven pipestone pipes and fragments were available. Four of the pipestone artifacts, including one made of MNPS, were found in Feature 50 a refuse-filled bell-shaped pit. The remaining sites with pipestone either lacked provenience data within the site (14MP401, 14RC2, 14MP408) or had so few pipestone artifacts that there were no concentrations in particular units or features.

DISCUSSION AND CONCLUSION

The assemblages of pipestone are missing a few artifacts from particular sites, however, this sample is the bulk of pipestone artifacts from GBA sites and establishing the organization of pipestone technology is possible with this sample. This section will discuss patterns in GBA and protohistoric Wichita pipestone manufacture, use, recycling, and discard. The archaeological

results are also compared to the ethnographic study of pipestone manufacture, as it is practiced today.

Pipe Manufacture

This analysis strengthens, rather than modifies, Blakeslee's (2012) Windom pipe production trajectory. Blakeslee's (2012) stages were: blank, preform, decoration, shaping of interior passages, use, and dismantling for another use. The difference in this analysis and Blakeslee's is in our definitions of pipe blanks and pipe preforms. I defined a pipe blank as a roughly shaped pipe that lacked drilled holes (Blakeslee's preform). I classified ground and cut pieces shaped into roughly square or rectangular blocks, as ground and cut artifacts, Blakeslee called these blanks (Figure 5.11). Of the 46 modified pipestone artifacts at the GBA sites, only 11 are large enough to have been carved into pipes. Pipe blanks were rare, with only one from the GBA collections (Figure 5.12). This specimen was a Windom pipe blank from the Max Crandall site. When this blank was abandoned the inner elbow was partially ground and both bowl and base holes were not completely drilled. Pipe blanks were much more common from the Robb and McPherson collections, with four Windom pipe blanks and one broken elbow pipe blank.



Figure 5.11 Cut and ground pipestone block from the Mem site (KSHS Cat. # 14MN328-333-3); what Blakeslee (2012) refers to as a blank; Photo by A. Hadley courtesy of KSHS



Figure 5.12 Pipe blank from the Max Crandall site (KSHS Cat. # 14RC420-674); What Blakeslee (2012) refers to as a preform; Photo by A. Hadley courtesy of KSHS

Drilling was one of the last steps (Blakelsee 2012:316-317). Of the seven blanks from the Robb, McPherson, and GBA collections, four had shallow and incomplete drilled holes. In rare cases grinding to refine the pipe was conducted after the pipe was completely drilled. This was observed on two nearly complete and not used pipes (14MN326-123 and 14MN328-19327). In both cases, the grinding went too deep on the bowl portion and exposed the drilled cavity, rendering the pipe useless (Figure 5.13).

Initial drilling was likely conducted with a pipe drill leaving thick striations that are perpendicular to the drilled hole (Figure 5.14). The next stage was to refine the hole and to make it wider. In the finished pipes the long axis of the drilled holes had striations that were parallel to the drilled hole, these were likely from enlarging the already long axis of the drilled cavity (Figure 5.15). This pattern was also observed by Blakeslee (2012).

Decorations of the GBA pipes are consistent with Blakeslee's (2012) description. The decorations on GBA pipes were limited to incised lines, raised beads, or collars encircling the lip of the bowl. Two pipes had perpendicular striations on the lips of the bowl. One pipe had shallow



Figure 5.13 Side of a pipe that was ground into the inner cavities (KSHS Cat. # 14MN326-123), Photo by A. Hadley courtesy of KSHS

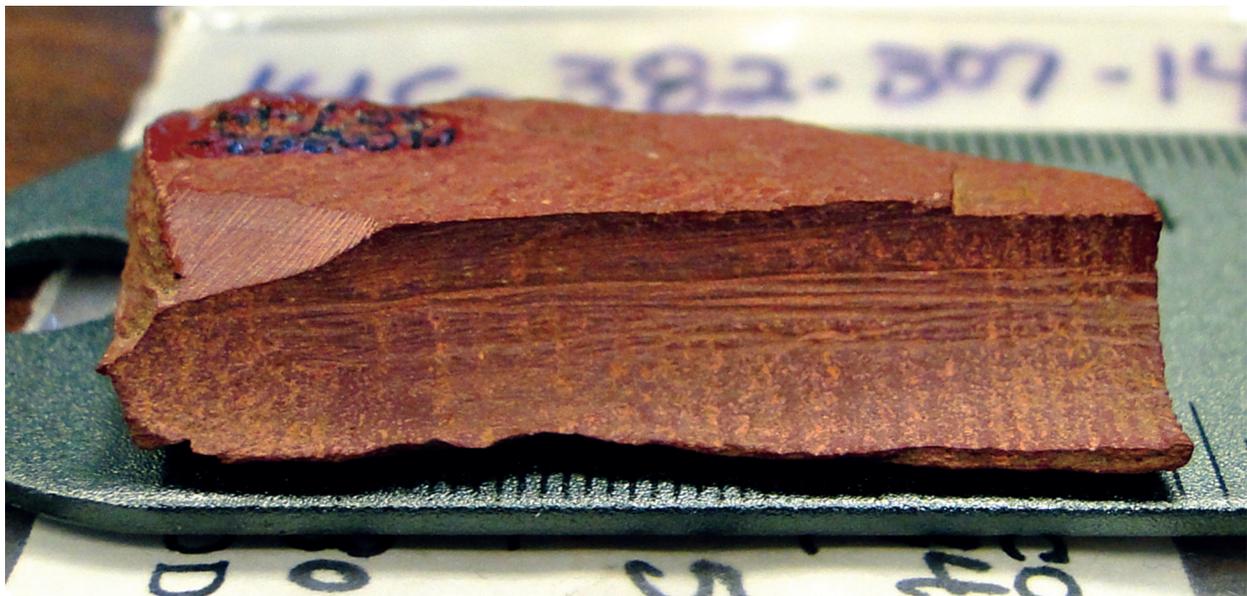


Figure 5.14 Broken pipe from the Living the Dream site, with the exposed rough, perpendicular drilling marks (KSHS Cat. # 14CO382-307-14), Photo by A. Hadley courtesy of KSHS

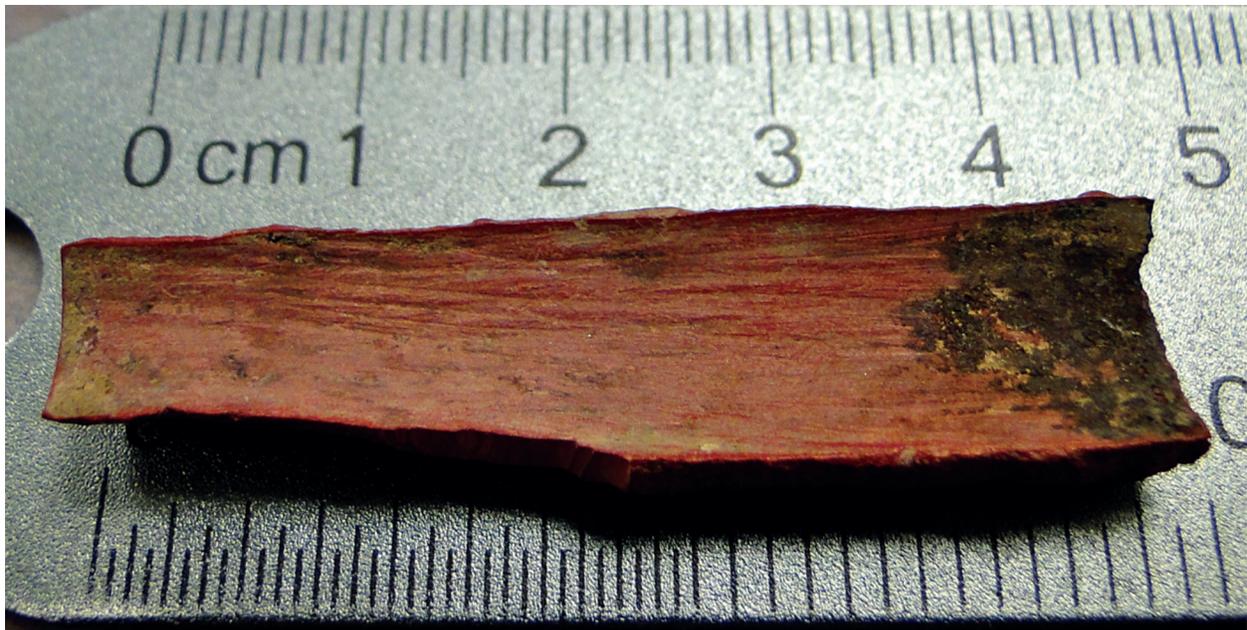


Figure 5.15 Broken pipe from the Radio Lane site, exposing rough parallel marks probably from widening the cavity and dottle (KSHS Cat. # 14CO385-647-1), Photo by A. Hadley courtesy of KSHS

rectangles incised on the side of the bowl (14CO501-333-1; refer to Figure 4.11).

The small amount of pipestone found at the protohistoric Wichita sites is not sufficient to create a production trajectory for pipestone at these sites. The pipestone artifacts at these sites are either very small fragments or large complete pipes. However, a summary can be made about the types of pipes and decorations as compared to the GBA assemblages. The two complete pipes are both elbows, but they are different from the Windom pipe, the typical elbow pipe found at GBA sites. The miniature pipe from the Longest site (2007.013.34JF1.001955) has a pattern of four incised lines that are parallel to each other but are oblique to the lip of the base. The other pipe is dramatically different from GBA pipes in that the base is actually longer than the bowl. The decoration on the second pipe from the Longest site has a metal inlay, a feature not associated with GBA pipes, and most often associated with historical tribes (West 1934:285-187).

The one KSPS artifact from the protohistoric Wichita sites in Oklahoma does not stand out as being different from other pipestone artifacts at the site. The artifact is a pipe fragment that is broken into two pieces, contains dottle, and was square-shaped. The square shape is what distinguishes this pipe fragment from a GBA Windom pipe. The reason for comparing this pipe

fragment to a Windom is because most of the Windom pipes are made of KSPS and one might assume it was a pipe from a previous era passed down over the generations. However, the design of the pipe fragment is consistent with pipe manufacture at these later-occupied protohistoric Wichita sites.

Pipestone manufacture at GBA sites differed from pipestone carvers operating in Pipestone National Monument (PNM) today. While most of the manufacturing steps resemble the protohistoric stages there is one significant difference. My main informant waited until the pipe was complete and decorated before drilling the pipe. All of the drilling was done with an electrical drill with various sized drill bits. Also, because many of the pipestone objects were being sold in gift shops the decorations were quite elaborate. One of my informants told me that you could tell an archaeological pipe from a modern pipe based on the level of finishing. He said that the modern use of sandpaper removes most of the filings marks, whereas, finished archaeological pipes still bore some filing marks. I agree with this assessment, that although the finished GBA and protohistoric Wichita pipes were quite impressive, grinding marks often were visible in the crook of the elbows, near beaded lips, and on the lips themselves. The flexibility of sandpaper allows a modern pipestone carver to smooth out the hard to reach areas of the pipe.

Pipe Use

Pipe use remains the most difficult aspect of a pipe's use-life to understand from the perspective of the archaeological record. I had hoped that the analysis would reveal some patterns with finished pipes, however, the vast majority of pipestone artifacts at the GBA and protohistoric Wichita sites were broken fragments scattered throughout pits filled with other refuse. The two smoked and complete pipes found at the protohistoric Wichita sites were found in burials and the lack of GBA burials may explain the dearth of complete pipes at these sites. Additionally, of the 450 pipe fragments and pipes at the GBA sites and in the Robb and McPherson collections only 17 percent contained evidence of having been smoked. However, this result is likely due to the fragmented nature of the evidence and the fact that pipestone was often recycled after its initial

use. Blakeslee (2012:305) argues that the small size and design of the Windom pipe proves that it was only smoked for ritualistic purposes. Vehik (2002:55) noted that used pipestone pipes were more commonly associated with council circle features, further supporting their ritualistic function. The near lack of complete pipes in the archaeological record supports this claim because these ritualistic pipes were carried off site, interred with their owners, or recycled into beads or pendants.

Pipe Recycling

The breakage patterns for the elbow pipes were very similar. The majority were cut or broken into halves exposing the inner cavities of the pipe. Some of these pipe fragments also had the bowl or base removed. The evidence is consistent with Blakeslee's (2012:318) repurposing trajectory for Windom pipes. Pipe fragments, which were broken for other uses or through manufacture and use, are the most common type of pipestone artifact at the GBA. This differs slightly from the artifacts found at the protohistoric Wichita sites, which were mainly modified fragments with minor amounts of grinding, cutting, and drilling. Although the evidence is very limited, there is currently no supporting evidence for the recycling of pipestone pipes into pendants or beads at the protohistoric Wichita sites.

Despite the large number of broken pipes, few exhibit grinding after they were initially broken and even fewer could be classified as pendants, beads, or objects such as figurines. This could be explained in part due to the fact that only a quarter of a pipe is used to make a pendant. Thus, it can be concluded that the creation of ornaments out of pipes may not have been to economize the material, because the material would be wasted. The purpose may have been to memorialize the pipe's use in an even more personal way. Pipestone recycling with modern pipe makers is dramatically different from what we see at the GBA sites. Due to the commoditization of the material and its highly sacred meaning to Native Americans, every single scrap of pipestone is recycled or ritually discarded, including the powder.

Discard

Pipestone artifacts at GBA sites when broken were typically discarded in storage pits with other refuse. Before this research, there was no recognized pattern or association of pipestone with other artifact types (a Chi-square analysis was conducted in Chapter 7 to test the association of pipestone with other artifact classes in pits at the Arkansas City sites). Although Vehik (2002:55) noted the importance of used pipes in association with council circles, she identified the majority of pipestone fragments were found in pits outside of the council circles and that they were likely “discarded as trash.” Unfortunately, the Robb Collection lacked provenience data for Blakeslee’s (2012) production trajectory, he did note that the lack of GBA mortuary data hinders our understanding of pipe usage and disposal. Thus, as for the archaeological record, pipestone was simply dealt with in the same manner as unwanted or broken lithics, animal remains, and broken pots. This is very different from how modern pipe carvers deal with their leftover material. Modern pipe-makers today take all of the scraps and powder and return it to the quarry, often with an offering and a prayer.

CHAPTER 6: Chipped Stone Tool Analysis

INTRODUCTION

Since Wedel's (1935, 1959) initial definition of the Great Bend Aspect (GBA), research on their stone tools has been diverse ranging from basic descriptions in the early years to a recent detailed use-wear analyses. The following analysis was focused only on the GBA tools that were potentially used in pipestone manufacture. Previous archaeologists that were interested in pipestone use and manufacture conducted detailed lithic analyses that were integral to this research.

The lithic research of Wedel (1959), Blakeslee et al. (2012), and Odell et al. (2011) are important to this research because these studies consider both chipped and groundstone technology. Wedel's (1959) thorough descriptions and illustrations of stone tools in *Introduction to Kansas Archaeology* provides an important basis for understanding the potential variability within the GBA collections. Wedel also lists the proveniences of the artifacts and compared the various Little River sites. The recent detailed lithic analysis (i.e., Blakeslee et al. 2012) of the Lower Walnut focus sites in the Arkansas City area was important for drawing parallels between the assemblages. The Arkansas City report also provided useful details on proveniences, feature descriptions, and associated artifacts (Hoard 2012a). Odell et al.'s (2011) unpublished article on the Robb collection tools and their pipestone use-wear patterns was a primary reference throughout this research. These studies have been previously summarized and are incorporated into the analysis and discussion below.

The following chapter outlines the analysis of GBA chipped stone tools that were determined to be associated with pipestone through use-wear and residue analysis. First, the methods that are employed in the analysis are described. Next, is a summary of the chipped stone tools beginning with those tools that exhibited both pipestone use-wear and residue. This section is followed by a brief summary of the tools with pipestone residue and no use-wear. Then the spatial distribution of the tools is discussed. Finally, the conclusion brings together the results to discuss patterns and their potential for understanding past behaviors.

METHODS

The chipped stone tools that were microscopically analyzed were from the following Great Bend Aspect sites: Tobias (14RC8), Schrope (14CO331), Mem (14MN328), and Lewis (14PA307). Although the Mem and Lewis sites are included in the analysis, they comprise only 10 percent of the chipped stone tools. The Mem site artifacts were on loan to another archaeologist during the time of the analysis and the Lewis site only has a small number of chipped stone tools. Additionally, the Tobias and Schrope sites had very large stone tool assemblages. To provide focus for this study, the tool types previously identified by Odell et al. (2011) as used in pipestone production activities were analyzed. These tools were identified as end scrapers, drills, and unifacial and bifacial tools. Projectile points were also included in the analysis because of the potential to recycle these for use in working pipestone, which was identified in the Tobias assemblage (i.e., Hadley 2014). Additionally, projectile points do not require much time to microscopically analyze because they are small and have edges that are sharp making it easy to quickly scan them for the dramatic crushing and rounding that results from stone against stone use-wear.

There were two steps in the microscopic analysis, using a Nikon Eclipse LV150NL microscope. The first step was to microscopically analyze at 50-power magnification all of the tool types previously identified as used in pipestone manufacture. The next step used the microscope at 100-power to reanalyze those tools identified as having pipestone residue or wear. At this higher magnification, the attributes of the wear and residue were recorded. To systematically record the use-wear and residue patterns, each tool was sketched onto a grid with eight polar coordinates (Odell 1979). Pipestone wear and residue patterns were then documented in the corresponding polar coordinates. This system will allow the results to be tested and replicated in the future.

While recording the data, each tool edge was treated separately, so that the characteristics of wear and residue were understood for each edge. The used tool edges were identified as an employable unit (EU). The EU is defined as the part of the artifact that is one functional, contiguous unit (Knudson 1973:108). Once the used edge was identified, then the polar coordinates were

combined to define the EU. For this research, the EU was identified as an edge with pipestone residue or wear. Employable units were separated if there was an edge, projection, or corner that did not exhibit wear or residue and could have been used in performing a different task.

The use-wear attributes that were recorded were the type of abrasion, rounding and striations, and the location according to the grid. Scarring, its location, and its distribution were also recorded. Scarring is basically the type of flakes that are removed during use of the tool edge. Scars were described as having feather, hinge, step, comminution, or a combination of these termination types. The types of pipestone residue were described with the location and also the distribution on worked and non-worked edges and other surfaces. Basic stone tool attributes were also recorded. These were the tool type, material, presence and extent of retouching, presence of burning, and completeness of the tool.

The experimental collection was used throughout the analysis as a reference to better understand and identify the pipestone use-wear and residue in the archaeological assemblage. The assemblage was particularly important in identifying the characteristics of pipestone residue on non-worn edges. For example, the Undifferentiated Osagean cherts often had faces of the tools that were not used in the pipestone manufacture but were covered in residue powder. This was observed on the archaeological tools and was also confirmed with the experimental assemblage. Additionally, the experimental collection aided in the identification of pipestone residue depending on the color of the chipped stone material. For the darker materials (e.g., brown Smoky Hill Jasper) the dark red residue was harder to identify and on the lighter materials (e.g., Undifferentiated Osagean) the pink powdery residue was more difficult to identify. The experimental collection provided a guideline for the patterns of pipestone use-wear and residue depending on material types, tool types, and tool uses.

SUMMARY OF THE CHIPPED STONE TOOLS AND ATTRIBUTES

A total of 1,304 tools were scanned at 50-power magnification, of which only 151 had evidence of pipestone residue or use-wear and residue (Table 6.1). Only the tools with pipestone

Table 6.1 Total Number of Tools that were Microscopically Analyzed

Sites	Total Analyzed	With Pipestone Residue	With Pipestone Wear and Residue
Tobias	783	41	78
Schrope	397	5	20
Mem	5	1	1
Lewis	119	2	3
Total	1304	49	102

residue or both wear and residue were studied further and recorded during the analysis. The most important lithic material for these tools was Florence chert (36 percent) followed by Smoky Hill Jasper (33 percent) with minor amounts of Alibates (12 percent) and Undifferentiated Osagean (11 percent) tools. Half of the tools with pipestone residue or wear and residue were end scrapers. Thirty-one tools were parallel-sided drills, also known as ensiform pipe drills (c.f., Hadley 2014; Wedel 1959).

Of the 151 tools that were recorded, 49 exhibited pipestone residue, only. The following analysis focuses heavily on the 102 tools that exhibited *both* pipestone residue and wear. The 49 tools with residue only are briefly described in a separate section. There are two reasons for separating the results of the analysis in this way. First, the Tobias site, which had the largest lithic assemblage of the four sites, was curated together in large boxes and bags. Without the tools being individually wrapped and bagged, it is possible that pipestone residue would rub off onto other tools. However, the presence of both pipestone wear and residue confirms that the tool was used on pipestone and not contaminated with pipestone in other ways. The tools from the other sites were also stored together, but in smaller quantities. Second, the residue could be contamination from actual protohistoric practices of storage or use. In either case, methodologically it is best to consider tools with wear and residue separately from the tools that only had pipestone residue. However, below is a brief description of the tools with residue, because there are possible protohistoric behaviors that could have resulted in this pattern.

Tools with Pipestone Use-wear and Residue

There were 102 tools that exhibited pipestone use-wear and residue (Table 6.2). The majority of these were end scrapers, followed by parallel-sided drills, bifaces, reamers, flake tools, expanded base drills, beveled knives, and projectile points. The lithic materials that comprised the largest percentage of tools with residue and wear were made from Florence chert and Smoky Hill Jasper (Table 6.3).

Table 6.2 Tool Types with Pipestone Wear and Residue

Sites	Biface	End Scrapers	Beveled Knives	Parallel-shafted Drills	Expanded Base Drills	Reamer	Flake Tool	Projectile Point	Total
Tobias	5	43	2	16	4	5	2	1	78
Schrope	4	13		1			1	1	20
Mem	1								1
Lewis		1		1			1		3
Total	10	57	2	18	4	5	4	2	102

Table 6.3 Material Types for Tools with Pipestone Residue and Wear

Sites	Florence	Smoky Hill Jasper	Alibates	Osagean Undifferentiated	Dakota Quartzite	Unknown	Total
Tobias	32	49	15	14	2	6	78
Schrope	21			2		2	20
Mem	2						1
Lewis		1	3			1	3
Total	55	50	18	16	2	9	102

The most common evidence of pipestone wear was light to heavy rounding of the edges of the tool. Heavy rounding was distinguished from light rounding, in that the major extent of the edge is rounded. Light rounding resulted in only the prominent edges with rounding. Striations were uncommon, particularly when compared to the experimental assemblage.

Scarring involved the detachment of flakes during use. Scars were often on the tool edges or on both faces close to the edge. The scars were variable in their patterning on the edge of tools. The terminations of the scars were combinations of feather, hinge, step, or comminution.

Comminution is basically a crushed edge, which was defined by Odell et al. (2011:5) as “pock-marked surface adjacent to thick overlapping step fractures.”

There were two types of pipestone residue observed during the analysis, and these were observed in the experimentation phase of this research. The residue was described based on both color and texture. The pipestone residues were found in two different colors, a dark red and light pink, and two different textures, powdery and polished. While the pink residue was exclusively associated with a powdery texture, the red residue was found in both powdery and polished forms. The location of pipestone residue was noted and whether it was on a worked on non-worked edge.

The tool classifications below are based on morphological characteristics and do not necessarily reflect the way in which these tools were used on pipestone. Each tool type is discussed as to potential uses based on the experimental data and a comparison to Odell et al.’s (2011) findings of pipestone use-wear in the Robb collection. The Odell et al. (2011) experimental results were compared to an archaeological assemblage. Odell et al.’s tool classifications are primarily based on use-wear evidence and it was noted when a tool was used for other purposes. This research differs from Odell et al. (2011) in that pipestone residue was determined to be as important as the use-wear for finding tools used to work pipestone.

End Scrapers

The end scrapers were the most numerous tool type to contain both wear and residue (56 percent; Figure 6.1). While this association is interesting, it may not be significant in the bigger picture when considering that this was the most common primary tool type that was analyzed. In the Tobias site assemblage, some bags contained more than 100 end scrapers. End scrapers are numerous at all GBA sites (i.e., Blakeslee et al 2012; Lees et al. 1989; Loosle 1991; Wedel 1959) and they are assumed to be related to hide processing. Thus, the proportion of end scrapers used for pipestone manufacture may be the result of a function of their abundance in the archaeological record at GBA sites.



Figure 6.1 End scrapers with pipestone residue and wear from the Tobias site; (top row left to right, KSHS Cat. #: 14RC8-39739, 14RC8-30766, 14RC8-34855, 14RC8-30014 (second row) 14RC8-23199, 14RC8-48076, 14RC8-18136, 14RC8-31942, 14RC8-21258, (bottom row) 14RC8-23199, 14RC8-35038, 14RC8-33412, 14RC8-33411; Photo by A. Hadley courtesy of KSHS

There were a total of 57 end scrapers with residue and wear, three-quarters of which were from the Tobias site. These teardrop-shaped tools are well made, symmetrical, and unifacial, with steep retouch on their distal edges. The end scrapers are also the most durable tools that are used in pipestone manufacture. The majority (79 percent) of end scrapers were complete and 21 percent are the distal ends. There were a total of 30 end scrapers with only one edge used, 21 with two edges used, and six with three edges used (Table 6.4). Additionally, 25 end scrapers with pipestone use-wear had edges that contained residue and not wear. Based on the experimental collection the presence of residue on non-used edges generally indicates the heavy use of the tool in pipestone manufacture because the pipestone powder is so fine it tends to cling to the porous surfaces of the stone. All of the used edges of the end scrapers contained some level of rounding (Figure 6.2). Heavy rounding occurred more often (53 used edges) than light rounding (36 used edges). One used edge of an end scraper had scarring but no rounding and two used edges had rounding and no scarring. The most common types of scarring on end scrapers were two scar combinations: feather, step, and hinge or hinge and step. Scarring occurred more frequently on the lateral edges (50) of the end scrapers than the distal ends (13). Both types of pipestone residue, the red polish residue and pink powdery residue, occurred most frequently on the edges of

Table 6.4 Number of employable units (EUs) or used edges on tools with pipestone wear and residue

Tool Types (Number of Tools)	Number of Employable Units			
	Max. 1	Max. 2	Max. 3	Non-Worked Edges with Residue
Bifaces (10)	6	3	1	5
Beveled Knives (2)	2			
End Scrapers (57)	30	21	6	25
Expanded Base Drills (4)	1	2	1	3
Flake Tools (4)	3	1		3
Plain-Shafted, Parallel-sided Drills (18)	7	11		5
Reamer (5)	3	2		2
Projectile Points (2)		1	1	
TOTAL	52	41	9	43

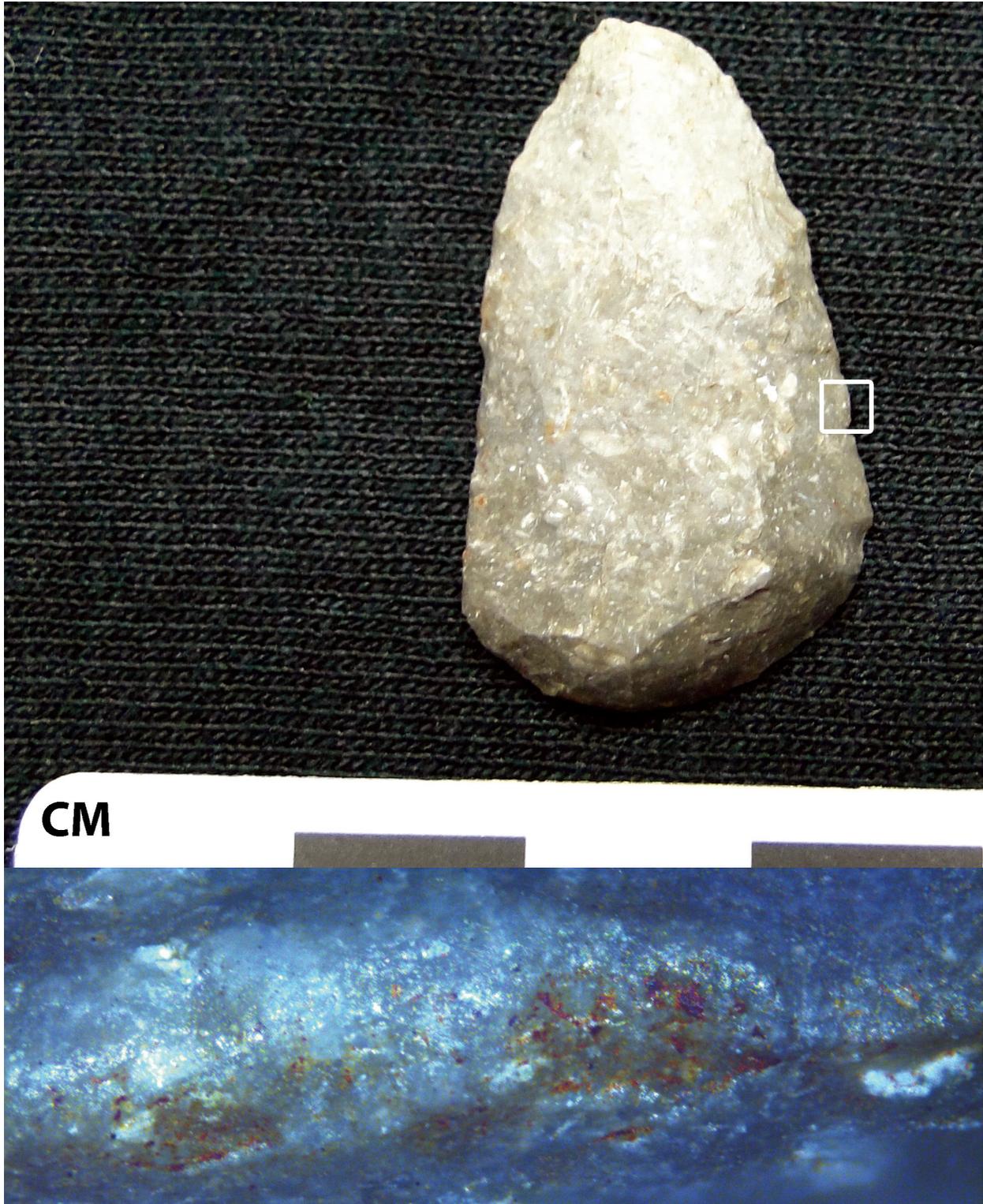


Figure 6.2 End scraper box indicates area of microscopic photo (top); The lateral used edge of the end scraper (at 50-power magnification) with pipestone wear in the form of heavy rounding, step fractures, and dark red residue (bottom, KSHS Cat. #14RC8-33411); Photos by A. Hadley courtesy of KSHS

the end scrapers with use-wear.

Both this study and Odell et al.'s (2011) analysis of the Robb Collection found that the end scrapers were the largest artifact class used on pipestone. Odell et al. also noted that these were likely hand-held tools. Both analyses and a previous assessment by Blakeslee (2012) found that the lateral edges of end scrapers were most commonly used. Of the 57 end scrapers in these assemblages, 47 had lateral use-wear. Additionally, heavy rounding was more commonly observed on the lateral edges and light rounding on the distal edges. Odell et al. also concluded that based on the wear and striations, these end scrapers were used primarily for scraping and secondarily for cutting. Although striations were not observed on end scrapers in this analysis, the heavy rounding of the edges is consistent with the use of these end scrapers as cutting and scraping tools. A small number (n=9) of the end scrapers had use-wear that was restricted to the proximal tip, which is more consistent with their use as a reamer or gouge. It is clear from this analysis that end scrapers were multi-functional tools in pipestone production.

Drills

Parallel-sided drills were the second most common tool with pipestone use-wear and residue, with a total of 18 tools (16 from Tobias and one each from Schrope and Lewis). The Tobias parallel-sided drills were the focus of a pilot study (i.e., Hadley 2014), which was further expanded herein. The parallel-sided drills, also called pipe drills, are long narrow bifaces with fine retouch (Figure 6.3). In cross-section these drills are often diamond or oval shaped and occasion-



Figure 6.3 Parallel-shafted drill from the Tobias site that exhibits pipestone use-wear and both types of pipestone residue (KSHS Cat. # 14RC8-17-13); Photo by A. Hadley courtesy of KSHS

ally exhibit beveling.

In the analysis, I identified more broken parallel-sided pipe drills than complete drills. Eleven of the pipe drills were broken in half with only the distal end remaining, six were medial fragments, and one was complete. The complete pipe drill is from the Schrope site and is impressive due to the large amount of pipestone residue covering the tool. One of the distal pieces from Tobias was broken into three fragments and refitted back together by KSHS and it is notable due to the extreme amount of rounding on the tool edges (Figure 6.4).

In terms of the used edges of the pipe drills, there were two edges and the tip that could be used. Eleven of the pipe drills had both of their edges used, six of which exhibited wear on the tips, and only seven had a single used edge (refer to Table 6.4). Five edges that lacked wear exhibited pipestone residue. While striations were often observed on the experimental tools, it was only observed on one archaeological tool in the GBA assemblages. The tool with striations was a broken pipe drill (Figure 6.5; 14RC8-20831). The striations were observed on an edge that also had heavy rounding. Heavy rounding was observed on 17 edges of pipe drills and light rounding was on 11 edges of pipe drills. The majority of the used edges on the pipe drills had hinge and step scars.

Odell et al. (2011) notes that the pipe drills from the Robb collection were used for drilling, cutting, and scraping. Two of the diagnostic features of wear caused by drilling are tip rounding and striations perpendicular to the long axis (Odell et al. 2011:8-9). The one set of striations that were observed on a pipe drill (14RC8-20831) were identified as perpendicular to the sides. Heavy rounding was also observed on the tips of a total of five pipe drill fragments and one complete drill with use-wear that is consistent with drilling activities. Of the remaining 12 pipe drills, six are medial fragments and are too fragmented to determine their use. The other six pipe drills that had tips that were not rounded may have been used for another purpose or after their initial use they were turned around in the haft and became the proximal tool end. What is for certain is that all 18 pipe drills served in some capacity as a pipestone-working tool.

The other type of drill that was found in the analysis was an expanded base drill, which



Figure 6.4 Drill with box indicating the area where the microscopic image on right was taken (top); A closer view of the lateral edge of the drill with macroscopic rounding and pipestone residue (middle); Used edge with rounding and pink powder residue at 100-power magnification (bottom, KSHS Cat. #14RC8-132-57,58,59); Photos by A. Hadley courtesy of KSHS

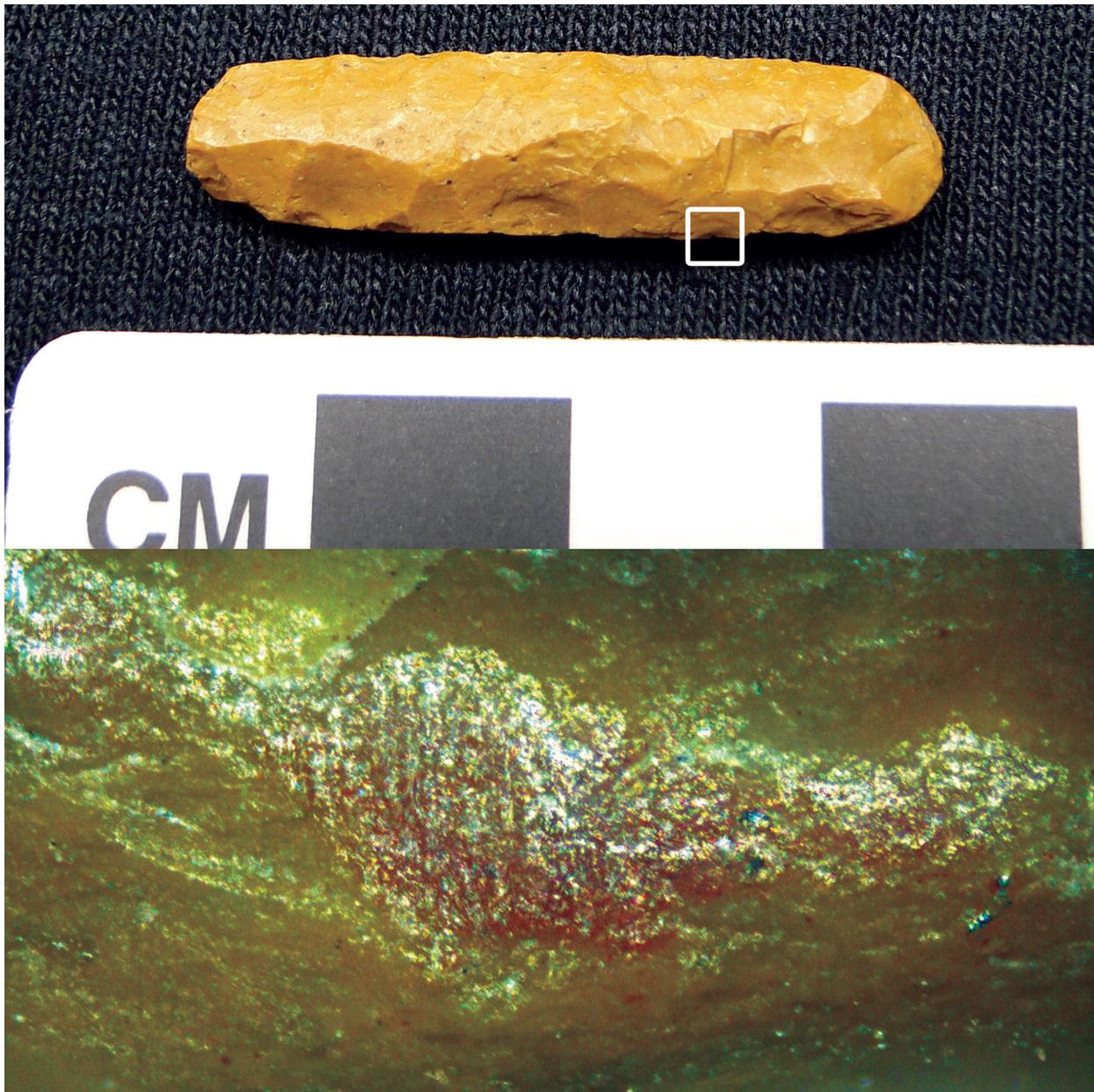


Figure 6.5 Pipe drill fragment with a box indicating the area of the microscopic photo (top); Microscopic image at 100 power of the lateral used edge showing dark red pipestone residue and striations perpendicular to the edge (bottom, KSHS Cat. #14RC8-20831); Photos by A. Hadley courtesy of KSHS

has a bifacial end that resembles the pipe drill with a blocky proximal end exhibiting minimal modifications (Figure 6.6). In the Arkansas City Report, these tools were classified as awls and were assumed to be related to hide processing. These tools are as numerous as end scrapers (Blakeslee et al. 2012:182). There were four expanded base drills that exhibited pipestone use-wear and residue, all of which were from the Tobias site. While an expanded base drill cannot be



Figure 6.6 Expanded base drill that exhibits pipestone use-wear and pink powder residue (KSHS Cat. # 14RC8-211-76); Macroscopic pipestone residue evident near tip; Photo by A. Hadley courtesy of KSHS

misidentified as a pipe drill, because of the distinctive blocky proximal end, many of the distal fragments classified as pipe drills could be broken from an expanded base drill. During this analysis, no attempt was made to refit the artifacts (although refitting was done to some degree with Tobias assemblage). However, in the future targeted efforts to refit the drills may reveal important information about tool usage, discard practices, and site formation processes. All of the expanded base drills were broken, three of which were the proximal end and one a small portion of the base was broken.

The used edges on the expanded base drills varied more than the pipe drills because the expanded base provided additional edges that could be used in manufacturing pipestone objects. One expanded base tool had three used edges, two tools had two used edges, and only one tool had a single used edge (refer to Table 6.4). All of the used edges of the expanded base drills

exhibited light rounding. There was only one combination of scar types found on the expanded base drills, which was hinge and step fractures, which was also the most common on the pipe drills. Expanded base drills were examined in the Robb collection and only one was found to have pipestone wear (Odell et al. 2011:10). Odell et al. found that these tools were used for drilling, scraping, cutting, and shaving but not on pipestone. Only one of the expanded base drills (14RC8-211-76) is complete enough to determine that it was not used for drilling because the tip is not rounded and wear was only observed on one side.

As with the end scrapers, the most common type of pipestone residue on the pipe drills and expanded base drills was both the red polish and pink powder residues. Eleven edges of the pipe drills only exhibited pink powdery residue, this includes six used edges and five un-used edges. The pattern of pipestone residue was similar on the expanded base drills, with five tools exhibiting both residue types and four having only pink residue. Of the four with just pink residue half were used edges and the other half not used edges.

Bifaces

There were a total of ten bifaces that were used in pipestone manufacture. These were tools that were bifacial and did not fit into the other technological categories. The majority of the bifaces were broken, five were distal fragments, one lateral, one medial, and only three were complete. Out of the ten bifaces, six only had a single used edge, three had two used edges, and one tool had a single used edge (refer to Table 6.4). The abrasion observed on the used edges included eight edges with heavy rounding, six with light rounding, and one has scarring but no rounding. The most common type of scarring on the bifaces was a combination of feather, hinge, and step fractures, which is distinctive from the other tool categories (the other tools mostly had step and hinge fractures). Similar to the other tools, the bifaces mostly had a combination of red polish and pink powdery pipestone residue or only the pink pipestone residue. Odell et al. (2011:8) identified the bifaces in the Robb collection as tabular tools and these tools were often used as cutters and scrapers, functioning similarly to end scrapers. Out of the ten bifaces in these

GBA assemblages, all but three have long continuously worn edges that were likely used for scraping and cutting. The other three bifaces (14CO331-367-9, 14CO331-394-2, and 14RC8-60) had very isolated areas of pipestone use-wear indicating their probable uses as reamers or gouges.

The most notable bifaces that were analyzed were from the Mem site. Bifaces were the only set of artifacts analyzed from the Mem site because the collection was on loan and not available. The bag of large bifaces (10 cm or larger) all had distinctive heavy battering marks on the edges. Battered bifaces were also observed in the Arkansas City assemblages, although none of these were from the Schrope site (Blakeslee et al. 2012:184). Half of the bifaces were too large to analyze under the microscope because of the limited working distance (the space between the objective lens and the stage). Five were examined and one had both pipestone wear and residue and one only had residue. The residue was prominent enough on these tools that I observed it macroscopically at KSHS while going through lithic assemblages and selecting out tools for this analysis.

One biface from the Mem site (Figure 6.7) appears to have battering wear (through extremely heavy rounded and crushed edges) and pipestone residue. There were twelve battered bifaces from the Mem site, one of which had pipestone wear and residue and one that just had residue. Blakeslee et al. (2012) surmised that bifaces at GBA sites were used to refinish the surface of manos and metates. The battered biface with pipestone use-wear and residue may have been used to grind the surface of pipestone objects, after all grinding is one of the most common modification seen on GBA pipestone artifacts. The battered bifaces could also have been used to peck pipestone, although of the 160 GBA pipestone artifacts only one was pecked (and it was not a pipe fragment) and pecked artifacts were rarely observed in the Robb and McPherson county museum collections or in the historic Wichita sites in Oklahoma. Pecking was most commonly observed on pipestone artifacts at historic Kansa sites and in those cases it was associated with

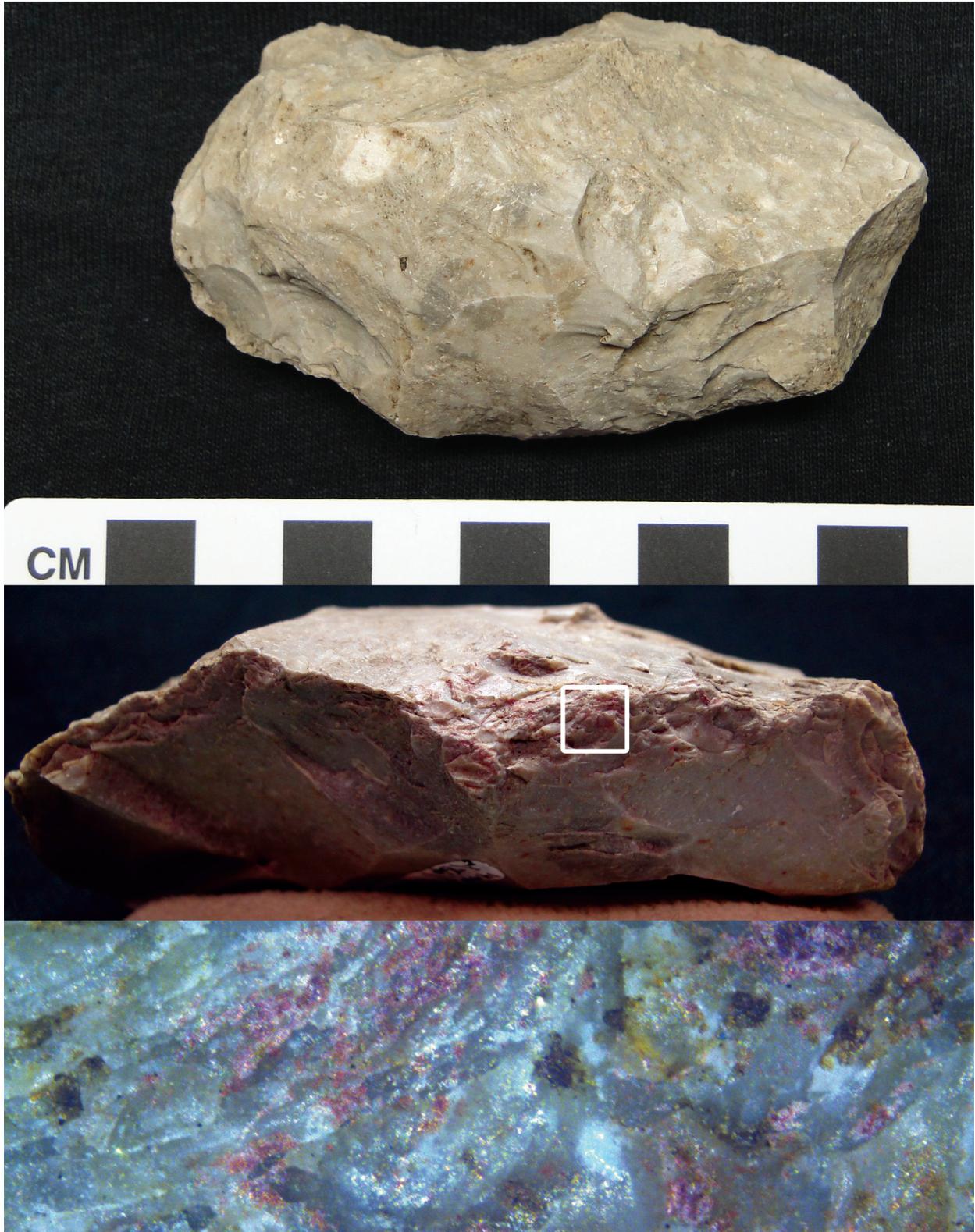


Figure 6.7 Battered biface from the Mem site (14MN328, top); Lateral battered edge with box indicating area of microscopic photo (middle); Crushed edge with pink powder residue at 100 power magnification (bottom, KSHS Cat. # 14MN328-15706); Photos by A. Hadley courtesy of KSHS

pipestone tools.

Reamers

A total of five reamers were identified, all from the Tobias site. The reamers were small, bifacial tools, about the quarter of a size of a complete parallel-sided drill. These tools often had one rounded end and one pointed end. These reamers differed from the reamers described by Odell et al. (2011) and Blakeslee et al. (2012), in that they are not unifacial and the majority had some degree of retouch. In fact, the reamers analyzed from the Tobias site more closely resemble broken distal or proximal ends of parallel-sided drills that were recycled into a reamer. All five of the reamers are complete.

Two of the reamers (14RC8-83-5 and 14RC8-153-4) had use-wear that was isolated on the distal tips and only a small amount was found on the lateral edges directly next to the tips. The other three reamers have the majority of use-wear on their lateral edges, which is more consistent with the use-wear seen on the parallel-sided drills and expanded base drills. However, the reamers are unique in terms of their abrasion, scarring, and residue types as compared to the drills. Heavy rounding was identified on five of the edges and light rounding on two edges. The most common type of scarring was a combination of hinge and step fractures. The pipestone residue on the reamers was also unique in that the most common type of residue was the pink powder (observed on three used edges and two non-worked edges) followed by a combination of red polished, red powder, and pink powder (on two used edges). One used edge had only the red polish and pink powder and another used edge only had pink and red powders. The infrequency of red polish corresponds well with the experimental tools that were used to ream and gouge pipestone. The experimental tools only had a small amount of red polish and more often had the powdery residue.

Reamers that were identified in the Robb collection had been used to gouge the bottom of pipe bowls and ream out the interior passages of the pipes (Odell et al. 2011:9-10). The end of the reamer was worn and the sides had evidence of scraping. The reamers in this analysis had similar wear in that the majority had tip wear and extensive wear on the lateral tool edge and

likely functioned in similar ways.

Flake Tools

Flakes were not systematically analyzed to determine if they were used because there were thousands from the Tobias and Schrope sites. However, when flakes that appeared to have been used were in bags with other tools, they were microscopically analyzed. There were a total of 4 flake tools found in the assemblages with pipestone residue and use-wear. Generally, the flake tools were amorphous unifaces that retained some of their original flake features. These artifacts were complete with heavy rounding on three used edges and light rounding on two used edges. One of the heavily rounded edges did not contain scarring. Scarring on the other used edges was a mixture of different types, although the one type of scarring they all had were hinge fractures. The most common residue type was both the red polish and pink powder. The flake tools likely had a variety of uses in pipestone production from reaming and gouging to cutting and scraping.

Beveled Knives

Beveled knives were also included in this analysis because there were only two few of them that exhibited evidence of pipestone wear (Figure 6.8). The complete beveled knife exhibits a side-notched haft with a long and narrow beveled distal end. The extreme distal end of the tool was the edge that was used on pipestone. This was determined based on the light rounding, hinge and step fractures, and presence of pink powdery residue. Based on this data, it appears that this tool was used to gouge, ream, or incise a very shallow indentation. The other beveled knife is a proximal end with use-wear on the extreme base. This edge also has light rounding, with combination scarring of hinge, step, and feather. The residue on this piece is both red polish and pink powder. Both of the beveled knives have wear that is consistent with uses as reamers or gouges.



Figure 6.8 Beveled knife from the Tobias site that exhibits a small amount of pipestone use-wear and pink powder residue (KSHS Cat. # 14RC8-6304); Photos by A. Hadley courtesy of KSHS

Projectile Points

There were a total of two projectile points that were identified as having pipestone residue and wear (Figure 6.9). One of these points was a Washita point from the Tobias site and was previously described in Hadley (2014). This projectile point, made from dark Smoky Hill Jasper, had light rounding and step and hinge fractures on the extreme distal end of the point. It should also be noted that it appears that this point was reworked after breaking because the blade length is 1 cm long. It is likely that the Washita point was used to gouge, ream, or incise shallow indentations in pipestone. The pipestone residue is also isolated to the extreme used tip, further supporting these uses. The other projectile point is a Fresno point with use-wear and residue on all three edges. The use is characterized by light rounding with two scarring combinations: step and hinge, and hinge and feather. All of the used edges have red polish, red powder, and pink powdery pipestone residue. The Fresno point likely had a different function from the Washita point based on the differences in wear patterns and residue. The Fresno point was probably used as a pipestone scraper or cutting tool based on the extensive wear and residue on all of its edges.

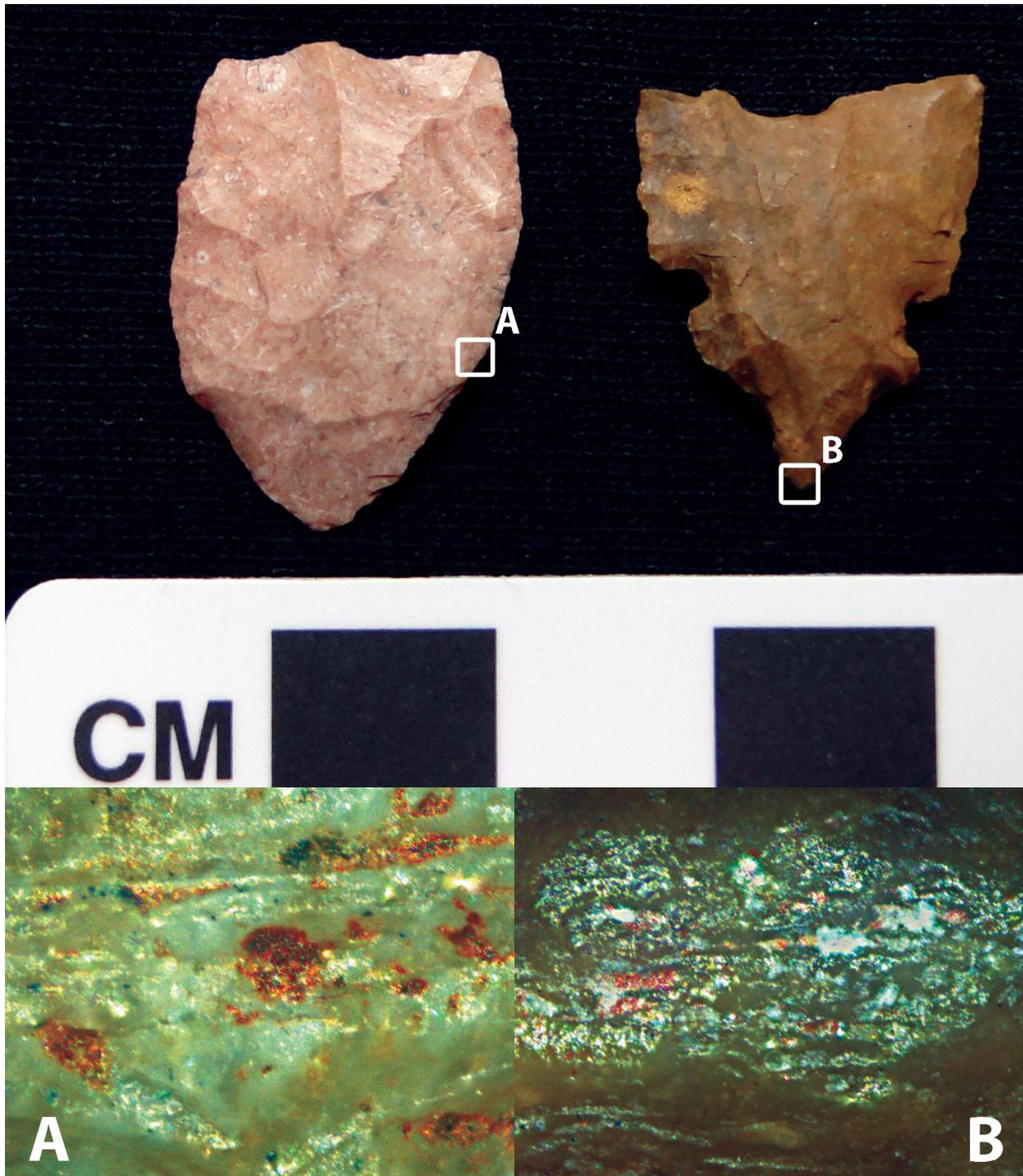


Figure 6.9 Projectile points with pipestone use-wear and residue with boxes indicating area of microscopic photos; Fresno point from the Schrope site (top left, KSHS Cat. # 14CO331-197-1) and Washita point from the Tobias site (top right, 14RC8-32622); Used edge of Fresno point at 100 power magnification with red pipestone residue, rounding, and step fractures (bottom left); Used tip of the Washita point at 100 power magnification showing pink powder residue, rounding, and step fractures (bottom right); Photos by A. Hadley courtesy of KSHS

Tools with Pipestone Residue Only

There were a total of 49 tools that exhibited pipestone residue but not use-wear. The majority of the artifacts were end scrapers, followed by flake tools, parallel-sided drills, beveled knives, bifaces, and expanded base drills, respectively (Table 6.5). Eighty-four percent of these tools only had pink powdery residue. The most common lithic material type for chipped stone tools with residue and lacking use-wear was the dark brown variety of Smoky Hill Jasper (Table 6.6). The majority of the tools were complete, which is skewed by the amount of end scrapers and the fact that they are durable tools.

Table 6.5 Tools with Pipestone Residue

Sites	Biface	End Scrapers	Beveled Knives	Parallel-shafted Drills	Expanded Base Drills	Flake Tool	Projectile Point	Total
Tobias	2	16	4	8	3	8		41
Schrope		2				3		5
Mem	1							1
Lewis		1	1					2
Total	3	19	5	8	3	11		49

Table 6.6 Materials of Tools with Pipestone Residue

Sites	Florence	Smoky Hill Jasper	Alibates	Osagean Undifferentiated	Unknown	Total
Tobias	8	20	4	6	3	41
Schrope	3			1	1	5
Mem	1					1
Lewis		1	1			2
Total	12	21	5	7	4	49

There are multiple explanations as to why these tools exhibit residue and not wear. The first could be contamination from archaeological processing or curation. Older curation techniques involved storing large quantities of stone tools in bags or boxes together. This was particularly the case for the Tobias site, which was excavated a long period of time. In recent decades, the majority of these collections have been updated with tools separated into individual bags. In

addition to storage techniques, it may be possible to introduce a small amount of fine pink pipestone powder to tools through archaeological cleaning practices. In both cases, experiments are needed to determine if contamination is possible and to describe the extent of contamination.

There may also be another explanation for pipestone residue and no use-wear that is not related to archaeological practices. The tools may have initially been used on pipestone but were repurposed for another use, retaining only the residue as evidence of the earlier function. This was clearly observed on three of the 49 tools, two of which were end scrapers (one from Tobias and one from Schrope site) and one was a pipe drill. It was especially clear on the pipe drill because there was a white residue on top of the pipestone residue. White residue and red pipestone residue was also observed on a reamer from Tobias that also had pipestone wear (Figure 6.10). Further experimentation could also aid in the identification of recycled pipestone tools versus those contaminated by archaeological practices.

Despite the fact that these tools contained pipestone residue, in this research it has *not* been deemed significant because of the lack of diagnostic pipestone use-wear. As mentioned above, there are multiple reasons for a tool having residue and not wear, the majority of which may be related to archaeological practices rather than protohistoric behaviors. For this reason, the focus in the discussion and conclusions focuses on the tools with both wear and residue. It is hoped that future experimentation will clarify the significance of pipestone residue on tools with no pipestone use-wear.

DISCUSSION OF SPATIAL DISTRIBUTIONS

The sizes of the assemblages from each site varied dramatically (refer to Table 6.1). The Tobias site had the largest assemblage of stone tools analyzed, with 783 tools, of which only 10 percent of the assemblage had pipestone residue and wear and 5 percent had residue. The Tobias is such a large assemblage because of the many excavations conducted over the years at the site. The size of the Tobias assemblage is almost double the size of the Schrope assemblage, from which 397 tools were analyzed. The 119 tools from the Lewis site is substantial considering the



Figure 6.10 Reamer with a box indicating the area of the microscopic photo (top); Distal end at 50 power magnification with red pipestone residue and a white residue (bottom, KSHS Cat. # 14RC8-153-4); Photos by A. Hadley courtesy of KSHS

limited scale of work conducted at the site and this would be the smallest studied assemblage if not for the lack of access to the chipped stone tools from the Mem site.

At the Schrope site, there were eleven features that contained tools with pipestone residue and wear, of which only five features were sampled for a detailed analysis (Schoen and Garst 2012b:Table 8.2). Two of these features (Features 306 and 324) had serious bioturbation that was noted by the mixture of protohistoric and historic artifacts (Garst et al. 2012:337). Feature 311, a fairly large (184 cm wide at base) and deep (160 cm), refuse-filled bell-shaped pit, had the most tools with wear and residue, with five (Table 6.7). Also present in this pit was a fragment of turquoise or azurite. Feature 306 had three tools and Features 311, 301, and 324 each had two tools with pipestone wear and residue. Of the five sampled features, all but one had an interesting exotic artifact, such as turquoise and Caddo sherds. Interestingly, only three of these features

Table 6.7 Lithic tools from the Schrope site with Pipestone Wear and Residue

Proveniences for 14CO331	Feature Description	Count
Area 951, Fea. 331, 0-20cm	Refuse-filled cylindrical storage pit, With turquoise bead (60-80 cm),	2
Area 952, Fea. 301, 20-40cm (1), 60-80cm (1)		2
Area 952, Fea. 304, Depth 143cm		1
Area 952, Fea. 306, 40-60cm (1), 80-100cm (2)	Refuse-filled cylindrical storage pit, serious bioturbation	3
Area 952, Fea. 311, 10-20cm (1), 60-80cm (2), 80-100cm (1), 100-200cm (1)	Refuse-filled bell-shaped pit, turquoise or azurite present	5
Area 952, Fea. 313, 80-100cm		1
Area 952, Fea. 315, 60-80cm	Refuse-filled bell-shaped cache pit, Caddo sherd 92cm,	1
Area 952, Fea. 316, 40-60cm		1
Area 952, Fea. 324, 120-140 cm	Refuse-filled bell-shaped cache pit, Caddo sherds same level, serious bioturbation	2
Area 952, Fea. 334, 20-40cm		1
Area 952, Fea. 337, 40-60cm		1
Total		20

(Features 311, 313, and 324) also had pipestone artifacts present in the fill.

The majority (77 percent) of tools with pipestone residue and use-wear were from the Tobias site. Twelve of the tools with pipestone residue and wear were found in Mound 1 (Table 6.8), a refuse-filled mound excavated in the summer of 1977 (Witty 1977, 1978:1). Low midden mounds are a diagnostic feature of GBA village sites (Blakeslee and Hawley 2006:167). There were also five pieces of pipestone that were found in Mound 1. Five tools were found in Area

Table 6.8 Lithic tools from the Tobias site with Pipestone Wear and Residue

Provenience	Count
Area 771, Mound 1, Unit 190, 15-30cm	1
Area 771, Mound 1, Units 191-192 Balk, 15-30cm	1
Area 771, Mound 1, N-S Balk wall, Units 208-209, 30-45 cm	1
Area 771, Mound 1, Units 209-210, 30-45 cm	1
Area 771, Mound 1, Unit 210, 15-30cm (1), 18-30cm (1), 30-45cm (1)	3
Area 771, Mound 1, Unit 212, 0-15cm	1
Area 771, Mound 1, Unit 231, 0-15cm (3), 15-30cm (1)	4
Area 771, Pit 4 fill, Fea. 112	1
Area 771, Unit 1069, 15-30cm (1), over 30cm (1)	2
Area 771, Units 189-190 Balk, 30-45cm	1
Area 771, Unit 566, 40-50cm	1
Area 781, Unit 2165, 0-15cm	1
Area 781, Unit 2174 15-30cm (1), no depth (1), Fea. 2280 (1)	3
Area 781, Unit 2284, 0-15cm	1
Area 781, Unit 2343, 15-30cm (1), no depth (1)	2
Area 781, Unit 2344, 15-30cm	1
Area 781, Unit 2370, 15-28cm (1), Fea. 2661 (2)	3
Area 781, Unit 2371, Fea. 2685	1
Area 781, Unit 2372, 0-15 (1), 10-30cm (5), Fea. 2685 (3)	9
Area 781, Unit 2373, 0-15cm (3), Fea. 2423 (1)	4
Area 781, Unit 2374, 15-30cm (3), 30-40cm (1)	4
Area 781, Unit 2375, 15-30cm	1
Area 781, Unit 2401, 0-15cm (1), Fea. 2683 (1)	2
Area 781, Unit 2402, 0-15cm (1), 15-30cm (2)	3
Area 781, Unit 2406, 0-15cm	1
Area 781, Unit 2433, 15-30cm	2
Area 781, Unit 2434, 0-15cm	1
Area 781, Fea. 2083	1
14RC8	21
Total	78

771, an area in the northern part of Tobias site “between the road and the council circle” which was excavated in 1977 (Witty 1977:3). A total of 40 tools with pipestone wear and residue are from Area 781 at the site, which may be the area of the summer 1978 excavations. There is no detailed data on the features and proveniences for the site.

The Lewis site, interpreted as a seasonal hunting camp (Monger 1970), had a total of 119 tools, three of which had pipestone wear and residue and two had pipestone residue. The fact that there are tools at the site that were used in the manufacture of pipestone objects is important because no pipestone objects have been found at the site. A steatite pipe was found in the GBA levels, but no fragments of pipestone were found (Monger 1970:6). There are three possible explanations for the presence of pipestone use-wear and residue on tools at the Lewis site. One, a limited amount of pipestone artifact manufacture or maintenance was happening at the site and because pipestone is a rare commodity, all of the pipestone was carried out of the camp to the permanent residences. Another explanation is that the tools used to manufacture pipestone artifacts at the permanent villages were carried out on the hunt to be recycled for another use. The two tools with pipestone residue and no use-wear may represent this possible explanation. Also, the tools with residue and no wear are a beveled knife and an end scraper, which are more commonly associated with activities other than pipestone manufacture. A third explanation, that is not nearly as satisfying, is that the artifact sample size is too small to appropriately make conclusions about possible protohistoric behaviors at the site. There has been a very limited amount of excavation at the Lewis site and more extensive excavation may uncover pipestone artifacts.

It is unfortunate that the Mem site, which contained the largest amount of pipestone, did not have a larger sample of stone tools available for microscopic analysis. The evidence for the use of battered bifaces in pipestone artifact manufacture is still limited to two artifacts, one with wear and residue and one with residue. However, this limited evidence opens up another class of tools that may reveal another use, even if somewhat marginally used, in pipestone artifact manufacture. Additionally, the bag of battered bifaces from the Mem site was the only sample of large bifaces that were included in the analysis. The other lithic assemblages were so large that before

the analysis, an initial sort removed tools that did not fall into Odell et al.'s (2011) description of tools used in pipestone manufacture or tools previously identified as used in pipestone manufacture (i.e., projectile points in Hadley 2014). Future research may need to target a larger sample of lithics from GBA sites to determine what other types of tools may have been used in pipestone manufacture.

CONCLUSION

For three of the four GBA lithic assemblages analyzed (Tobias, Schrope and Lewis sites), this analysis demonstrates that there are no specialized tools for pipestone manufacture. The most common artifact for use on pipestone, the end scraper, is also the artifact with the highest frequency in the assemblages. I arbitrarily narrowed the field of analysis to the tool types that were previously identified as used in pipestone manufacture as defined by Odell et al. (2011) because I did not have enough time to analyze the entire assemblage of stone tools from the four sites. Additionally, I wanted to compare the tools from multiple sites. However, in the future it may be worthwhile to microscopically analyze all of the stone tools from a site to determine the full range of tools used in pipestone manufacturing activities. This analysis of GBA tools has demonstrated that assuming the function and use of a tool based on its type and morphology is questionable and probably not the most productive tactic. Too often, end scrapers are assumed to be used only on hide-processing. However, the end scraper may be more akin to the Swiss Army knife for the GBA because they were used for cutting, scraping, and reaming or gouging pipestone wood (e.g., for hafts and pipestems) and other materials.

At the outset of this research, it was hoped that the tools and pipestone artifacts would reveal some information about where pipestone manufacture was taking place and perhaps by whom. However, the proveniences associated with the pipestone manufacturing tools at Tobias, Schrope, and Lewis, are not sufficient to be enlightening. The majority of the features were previous storage pits turned into trash receptacles. Mound 1 at the Tobias site, which had a notable concentration of pipestone and tools used on pipestone, was also a thick midden. For both the

mound and storage pits, it appears that the concentration of pipestone-related artifacts was more a function of their size rather than related to the specialized use of an area or pit. This analysis demonstrates a ubiquity of tools used in pipestone manufacture across these sites.

CHAPTER 7: Conclusions

RETROSPECT AND PROSPECT

This chapter combines the data from the previous chapters to examine the overall organization of pipestone pipe technology at GBA sites. This was done by applying two different models and testing the relationship between pipestone and other artifacts. The first model applied is Blakeslee's (2012) pipestone production trajectory model that he made specifically for Windom pipes from GBA sites. This provides significant insight into manufacture and recycling practices. The second model applied is Hayden's (1998) scheme for understanding the design and production of prestige lithic technologies in transegalitarian societies (intermediate between egalitarian and chiefdom). The application of Hayden's model highlights the social and economic constraints that shaped this particular technological system. The chapter concludes with some issues related to data collection, the final thoughts on the organization of pipestone pipe technology at GBA sites, and some future research directions.

SPATIAL RELATIONSHIPS

Pipestone and Other Artifact Classes

In order to test if there was a relationship between pipestone and other artifact classes, I needed detailed data from multiple sites and contexts within those sites. Although I had provenience data for pipestone artifacts at the sites used in this research, I lacked provenience data for the other artifact classes. However, the Arkansas City Report (Hoard 2012a), available on the Digital Archaeological Record (t-DAR), contained downloadable spreadsheets of all of the artifact classes represented in the sampled features. Due to the large number of excavated features from the eight sites, the project managers chose a sample of 90 of the total 698 excavated features for comprehensive analyses (Schoen and Garst 2012b:127). Of the 90 sampled features, 45 were bell-shaped, 14 were cylindrical, and 31 were basin-shaped (Schoen and Garst 2012b:Table 8.2).

To facilitate the statistics, I coded the data for artifact presence or absence. I then used

SPSS chi-square analysis to test if there was a significant relationship between pipestone artifacts (pipes, pendants, and the maul) and the other 49 artifact classes (Table 7.1). There were a total of 22 artifact classes that had significant relationships with pipestone artifacts using a 95% confidence interval. This means that when these artifacts were found in the 90 randomly sampled features, they were also likely to be found with pipestone. Unfortunately, for these results, there were only seven sampled features with pipestone artifacts. A larger sample of pipestone artifacts would likely result in a more robust statistical test.

Table 7.1 Artifact classes from sampled features from the Arkansas City sites (Hoard 2012a); Shaded boxes are artifacts that had a significant relationship to pipestone as seen using Chi-square with a p-value ≤ 0.05

Burned Earth	Nodules	Abrader	Nutshell	
Daub	Ceramics	Uniface	Miscellaneous Rock	Bone tool
Burned Sandstone	Modified Flakes	Scraper	Graver	Awl
Unburned Sandstone	Projectile Points	Drill	Nutting Stone	Bone Bead
Burned Limestone	Mussel Shell	Biface	Polished Celt	Bone Needle
Unburned Limestone	Modified Shell	Knife	Perforator	Scapula Hoe
Hematite	Charcoal	Turquoise	Maul	Other Beads
Limonite	Groundstone	Hammerstone	Unmodified Bone, Identifiable	Bone Ornament
Debitage	Metate	Obsidian	Unmodified Bone, Unidentifiable	Historic
Cores	Mano	Corn	Modified Bone	Siltstone Pipe

Based on this preliminary statistical analysis, there does not appear to be a pattern in the types of artifacts found with pipestone. The artifacts with a significant relationship to pipestone include structural debris, tools, and prestige technology objects. However, there are just as many of these types of artifacts that also do not share a significant relationship to pipestone. Specifically less than half of the groundstone objects and the chipped stone tools shared an association with pipestone. Only half of the artifacts defined as prestige technology according to Hayden (1998; definition below) (hematite, limonite, turquoise, obsidian, mussel shell, modified shell, obsidian, bone beads, other beads, and polished celt) were associated with pipestone. The historic artifacts had a significant relationship to pipestone, however, this class included intrusive historic objects and trade goods that are contemporary to GBA occupation. To better understand the relationship between pipestone and historic artifacts, a more refined breakdown of this artifact class is needed. This particular statistical test may be significant in demonstrating that pipestone and other prestige artifacts are eventually relegated to the same fate as utilitarian artifacts, i.e., refuse pits. However, a larger sample from controlled contexts is needed to better define the relationship between pipestone and other artifacts.

DISCUSSION OF PIPESTONE MANUFACTURE

Pipestone Production Trajectory

The original categorization of pipestone artifacts used here was helpful in understanding the basic modifications. However, of greater value to understanding pipestone-manufacturing processes is to identify the stages of these pipestone artifacts within a production trajectory. The best available production trajectory is the model outlined by Blakeslee (2012) for GBA pipestone pipes because each stage is carefully detailed. Blakeslee's seven stages included: blank, preform, decoration, shaping of interior passages, use, dismantling for another use, and discard. Blakeslee (2012:311-312) defined a blank as involving:

...smoothing the surfaces of the pebble, outlining the cuts to be made in the stone, then using a combination of abrasion and grooving-and-snapping to produce a blank that has the approximate dimensions of a pipe but not the elbow shape or finished surfaces. (refer to Figure 5.11)

Blakeslee (2012:313) defined a preform as follows:

...creating a pipe preform from the blank...involved a combination of slicing, whittling, abrasion, and rubbing along with purposeful snapping-off of pieces of stone outlined by deep grooves...Slicing continued to be used during the fashioning of the preform, especially to create the hollow where the stem and bowl join...Abrasion produced striations in parallel sets, with various sets running at slight angles to one another. Finally, rubbing with a soft material erased the abrasion marks, leaving a uniform surface in which the color of the stone was fully expressed. (refer to Figure 5.12)

Blakeslee's (2012:314) third stage was decoration, although he observed that not all of the pipes were decorated before they were drilled. Decoration was relatively simple and uniform, with incised lines and beading occurring near the lips of the bowls and bases. The fourth stage was creating the interior passages of the pipe, which involved

drilling initial openings through the bowl and stem and then increasing their diameter by repeatedly gouging and reaming until the desired wall thickness was achieved. ... bowls were drilled first (Blakeslee 2012:316-317).

Use of the pipe as a smoking device is Blakeslee's fifth stage. The sixth stage is the dissecting of pipes for another use.

Dissection began by cutting a deep groove near the base of the bowl in order to separate it from the stem. At least some of the bowls that survived this procedure intact were then cut into shorter sections and then into four equal parts lengthwise (Blakeslee 2012:318).

The dissected piece was then abraded making the once drilled interior surface flat. These pieces were then made into pendants and beads. His final stage was discard of a pipe.

Underlying Blakeslee's production trajectory is the idea that a pipestone fragment would go through each stage. However, there are many pipe fragments that show no sign of having been smoked but were then dismantled for other uses and some broke during manufacture. Although pipes were made at these sites they were not heavily or exhaustively used. Additionally, there were a few pipestone blanks that had partially drilled holes. Thus, it is important to note that within this trajectory there is more flexibility in the stages than seen in Blakeslee's trajectory.

Despite the likelihood that stages on the trajectory may have been skipped, the primary use of pipestone at GBA sites was to be made into pipes. Pendants, beads, and figurines were generally made from pipe scraps and appear to be secondary uses. There is no evidence that the pipe stage was skipped to make a pendant, bead, or figurine, however, this possibility should be

further explored.

I applied Blakeslee's trajectory to the pipestone artifacts from the GBA sites. However, some changes were made to take into account artifacts that did not fit into his original categories (Table 7.2). I created two stages that preceded Blakeslee's first stage (blank), which were unmodified and modified. Unmodified objects were pipestone objects that showed no signs of grinding, cutting, or drilling. Four of these unmodified pipestone artifacts had flake morphology, but showed no other modifications. Modified objects were pipestone artifacts that showed evidence of grinding, cutting, or drilling. However, modified objects were either too fragmented or unfinished to determine if it was a part of or an early stage of a pipe blank. Modified objects often were minimally ground, cut, or drilled. Based on the evidence so far, it appears that all pipestone was going to be a pipe first, thus modified (and unmodified pipestone) represents the initial stages of pipe production. Modified pipestone objects may also be waste material from early in the manufacturing process.

In my pipestone production trajectory, I defined a blank and preform in the same way that Blakeslee defined these terms. In accordance with Blakeslee's trajectory, I also created a decoration category. The decorated artifacts were objects that had incised lines or beading, but lacked evidence of having been drilled. These artifacts were too either fragmented or small to determine that it had been drilled or it simply had not been drilled when it broke.

For Blakeslee's fourth stage, shaping of the interior passages, I simply labeled it drilled to simplify the terminology. However, I acknowledge that "shaping of the interior passages" is more accurate because it involved more than just drilling. Based on the markings inside the drilled pipes, it was apparent that drilling was an early stage in creating the holes in pipes. Once the holes were established they were often enlarged not by drilling (which results in interior markings that are perpendicular to the long axis of the drilled hole) but by gouging the interior walls (which results in interior marking that are parallel to the long axis of the drilled hole).

Any pipestone artifact that was drilled and was clearly a fragment from a pipe, but showed no evidence of having been smoked was classified in this category. Pipe fragments

Table 7.2 Breakdown of GBA pipestone artifacts in a production trajectory, 1 tool and 1 powder sample not included

Sites	Unmodified	Modified	Blank	Pre-form	Decoration	Drilled	Complete and Used	Used and Broken	Dismantled	Recycled	TOTAL
14CO1									1	1	2
14CO331						7			1		8
14CO382						2					2
14CO385				1		1			5	1	8
14CO501		1							2		3
14MN308						1					1
14MN326						1					1
14MN328	5	11	2	1	2	9	1		8	2	41
14MP1		3				5					8
14MP401		3				2			1		6
14MP404	1	3				4					8
14MP408		3				1					4
14MP409		1									1
14RC2		3				2					5
14RC5		5				12			3		20
14RC8		2				8		1	4	1	16
14RC9		1	2			5		1	2	1	12
14RC301	1										1
14RC305						2					2
14RC311		1									1
14RC410	1										1
14RC420		1	1			2			3		7
TOTAL	8	38	5	2	2	64	1	2	30	6	158

that did not show signs of use through dottle are assumed to be in the process of manufacture. However, my impression from the analysis is that the vast majority of pipe fragments labeled as “drilled” actually represent stages in the process of being dismantled for other uses. This is based on the breakage pattern and the fact that a lack of dottle does not mean that the pipe was not used. In terms of the breakage pattern, pipes were consistently broken so that the base and bowl were separated and the remaining pieces were broken in half. In terms of the dottle, many of these fragments are small enough that unless the dottle was extensive (which was actually

rarely observed on the larger pipe fragments) then the fragments could easily have come from used pipes, which did not show signs of smoking. Further chemical and microscopic analyses are needed to test if these drilled artifacts were indeed smoked.

Determining if the drilled and decorated fragments were smoked or not is significant to the interpretation of the overall pipestone pipe trajectory at GBA sites. If pipestone breaks during the drilling process, then the question remains as to whether or not these pieces are then recycled into pendants or beads. Are pipes significant because of the ceremony in which they were smoked? Or is the pipestone material itself of greater importance and thus, unused pieces are recycled into pendants and beads? Answering this question will help archaeologists to better interpret the significance of pipes and pipestone at GBA sites.

Blakeslee's fifth stage was a complete and used pipe. In my analysis, I divided this category into pipes that were used and either complete or broken. The broken pipes appeared to have been accidentally broken as opposed to the common recycling pattern of dissecting or breaking the pipes in half. Further analysis and experimentation is needed to determine if the common breakage pattern seen in the pipes may have been intentionally cracked open or if they broke from reheating during multiple smoking episodes.

I labeled Blakeslee's pipe dissection stage as "dismantled." Pipe fragments that were classified as dismantled showed signs of having been smoked and were broken. Recycled artifacts were pipestone objects that were not pipes but were pendants, beads, or figurines. Discard, which is Blakeslee's final stage, was not considered in this table because I think that the majority of these artifacts were discarded as refuse based on their highly fragmented nature. Some artifacts may have been lost because of their small size, as is likely the case for the only complete pipe in this sample, the used mini-elbow pipe from Mem. It should also be noted that there are other ways that pipestone artifacts may have been deposited in the archaeological record, such as in burials.

GBA Sites

The categorization of pipestone artifacts into this production trajectory demonstrates the types of pipestone manufacturing activities at sites. The only pipestone at Saxman (14RC301) and 14RC410 was one fragment of unmodified pipestone at each. Drilled pipe fragments were the most common type of pipestone artifact. Four of the drilled pipe fragments broke during manufacture; these were pipes from Mem (14MN328), 374 Quarry Corners (14MN326), and 14MP404. However, the other 60 drilled artifacts were broken fragments, which may or may not reflect used pipes, but the consistency in the breakage patterns, either broken in half (as is the case for 26 artifacts) or into small slivers (as seen in 27 artifacts), supports that these minimally used, if used at all, pipes were in the process of being transformed into other artifact types. According to Blakeslee's production trajectory, a pendant only uses about a quarter of a pipe, thus, these partial pipe fragments are just as likely to represent the waste material from pendant production, as they are to represent pipe fragments that were being dismantled. Thirty drilled artifacts were definitely in the process of being dismantled. This was determined by the breakage, cutting, and grinding patterns, and if the pipe had been smoked. Another indication of the manufacture of pipestone artifacts at these sites can be found in the 38 artifacts that were classified as modified. Generally, the modified class represents an early stage of pipestone production. Interestingly, the majority of this early production stage can be found at Marion, McPherson, and Rice county sites.

The assessment of pipestone artifacts using this production trajectory reveals that pipestone manufacture and recycling occurred unevenly at GBA sites (Table 7.3). Categorizing the production trajectory into stages of manufacture (unmodified, modified, blank, preform, decoration, drilled specimens with manufacture breaks, and used pipes) and stages of recycling (drilled and lacking evidence of a manufacture break, dismantled, and recycled artifacts) some patterns emerge. First, the Cowley County sites have very little evidence (2 artifacts) of manufacturing activities as opposed to recycling evidence (21 artifacts). The large assemblage from the Mem site (14MN328) and the McPherson county sites both contain abundant evidence of both manu-

Table 7.3 GBA sites with pipestone manufacturing and recycling

Sites	Manufacture Activities	Recycling Activities	TOTAL
14CO1		2	2
14CO331		8	8
14CO382		2	2
14CO385	1	7	8
14CO501	1	2	3
14MN308		1	1
14MN326	1		1
14MN328	24	17	41
14MP1	3	5	8
14MP401	3	3	6
14MP404	5	3	8
14MP408	3	1	4
14MP409	1		1
14RC2	3	2	5
14RC5	5	15	20
14RC8	3	13	16
14RC9	4	8	12
14RC301	1		1
14RC305		2	2
14RC311	1		1
14RC410	1		1
14RC420	2	5	7
TOTAL	62	96	158

facturing and recycling activities. At the Rice county sites, with a total of 65 pipestone artifacts, 69 percent represent recycling and 31 percent represent manufacturing activities. Additionally, the three sites that contain council circles have 19 artifacts related to recycling activities and only 9 artifacts related to manufacture. Interestingly, Vehik (2002:Table 5) using the Smithsonian's GBA collections, found the opposite that manufacturing debris was more common at council circle sites. This difference may be accounted for because the data that Vehik was using was excavated primarily from council circles, whereas, the material that I examined came mostly from non-council circle contexts (i.e., pits and trash middens) and only a minor amount came from council circles. This suggests that there may be particular locations within these GBA sites where

pipestone pipe manufacture was occurring.

Robb and McPherson County Museum Collections

In the Robb and McPherson County Museum collections, the drilled artifacts were the most common, with 104 artifacts (Table 7.4). Of these, seven artifacts (2 from the McPherson County Museum and 5 from the Robb collections) clearly broke during manufacture. Dismantled pipes were the second most common artifacts (n=83) followed by the modified (n=70). Further summarizing this data into either manufacture or recycling activities, it is clear that there is more evidence for recycling than manufacture (Table 7.5).

Table 7.4 Robb and McPherson County Museum collections in a production trajectory

Provenience	Unmodified	Modified	Blank	Pre-form	Decoration	Drilled	Complete and Used	Complete and Not Used	Dismantled	Recycled	TOTAL
Marion Co., KS		3									3
Rice Co., KS		2	1								3
Paint Creek										1	1
Unknown, Robb Family Collection	6	52		2	2	102			78	4	246
Unknown, McPherson Co., Museum	1	13	9			2	2	2	5	3	37
Total	7	70	10	2	2	104	2	2	83	8	290

Table 7.5 Pipestone manufacturing and recycling for the Robb and McPherson County Museum collections

Sites	Manufacture Activities	Recycling Activities	TOTAL
Marion Co., KS	3		3
Rice Co., KS	3		3
Paint Creek		1	1
Unknown, Robb Family Collection	67	179	246
Unknown, McPherson Co., Museum	25	12	37
Total	98	192	290

Oklahoma Sites

Less is known about the production of pipestone manufacture at the protohistoric Wichita sites in Oklahoma because the pipestone from these sites has not been the subject of an in-depth research project. For heuristic purposes I categorized the artifacts from these sites into Blakeslee's trajectory (Table 7.6). The same assumptions about the production trajectory that were applied to the GBA artifacts were also applied to the protohistoric Wichita artifacts. Additionally, breakage patterns were not extensively recorded and so are not taken into consideration. There were some notable differences between the protohistoric Wichita and GBA pipestone artifacts. The pipestone at the protohistoric Wichita sites are almost entirely Minnesota pipestone. The types of decorations found on these pipes include types of modifications not seen on GBA pipes. The protohistoric pipes also had faceting and metal inlay. Another difference was that there were six broken pipestone fragments that had either been faceted or polished. However, these pieces also lacked the diagnostic evidence making them clearly identifiable as recycled from pipes. I placed them into the decoration category, but they could represent pipes that were dismantled for other uses. The classification of these decorated artifacts is important to the overall assessment of manufacture versus recycling at the protohistoric Wichita sites. If we assume that these artifacts were being decorated and the next step was drilling, then they should be classified into the manufacturing stage. However, there is no evidence to support this assumption and it is likely they are fragments from pipes, which are being modified into pendants, beads, or figurines. If we assume that decorated artifacts were in the process of being manufactured into pipes, then there appears to be very similar evidence for manufacturing and recycling activities at both sites (Table 7.7). Table 7.7 also shows that more manufacturing activities were being conducted at the Longest site (34JF1) compared to Bryson-Paddock (34KA5). If we assume that the decorated artifacts were from finished pipes, then recycling is the dominant activity at the Longest site (Table 7.8). At Bryson-Paddock recycling dominates the pipestone activities. I learned subsequently that there are more pipestone artifacts from Bryson-Paddock which were not available at the time of my analysis. Thus, with the small assemblages, the paucity of details

Table 7.6 Pipestone Artifacts at the protohistoric Wichita sites in a production trajectory

Sites	Unmodified	Modified	Blank	Pre-form	Decoration	Drilled	Complete and Used	Dismantled	Recycled	TOTAL
34JF1		3			6	1	2			12
34KA5		1				3		1	1	6
Total		4			6	4	2	1	1	18

Table 7.7 Protohistoric Wichita pipestone; Assuming that decorated artifacts were in the stages of manufacture

Sites	Manufacture Activities	Recycling Activities	TOTAL
34JF1	9	3	12
34KA5	1	5	6
Total	10	8	18

Table 7.8 Protohistoric Wichita pipestone; Assuming that decorated artifacts were finished pipes being dismantled for another use

Sites	Manufacture Activities	Recycling Activities	TOTAL
34JF1	3	9	12
34KA5	1	5	6
Total	4	8	18

about breakage patterns, and the limited information about pipestone production trajectories, it is not realistic to interpret the details of pipestone production at these sites.

Summary of Pipestone Manufacture Activities using the Production Trajectory

The production trajectory of pipestone pipe artifacts at GBA sites in Kansas began with the procurement of the material in northeastern Kansas. The material was then taken to a few sites in the northern part of GBA occupied areas, particularly the Mem site, where the pipes were carved. The complete pipes were traded throughout the other GBA sites and contemporaneous sites and smoked. After the pipes were used, they were broken and recycled into pendants, beads, and figurines. The leftover pipestone artifacts were then discarded into pits with other refuse.

The majority of pipestone artifacts found at the GBA sites and in the Robb and McPher-

son County Museum collections, represents pipe fragments that are in the process of being recycled into other objects. Broken pipe fragments dominate the artifacts from these assemblages. It is rare to find whole and undamaged pipestone artifacts. Only the Mem site (14MN328) contains more evidence of manufacture (59 percent) than recycling (41 percent). This is significant because the Mem site in general had the largest assemblage of pipestone compared to all of the other GBA sites. It may also be significant to note that of all of the GBA sites in this list, the Mem site is the closest to the glacial till source area of Kansas pipestone.

The division of pipestone activities as either manufacturing or recycling reveals three conclusions. 1) The spatial extent of pipestone manufacture activities is limited to a few sites. The Mem site in particular appears to be a center for pipe manufacture while this activity is rare at the Cowley county sites. When the Marion and McPherson county sites are combined, it is clear that pipestone manufacturing is more common at sites in these counties when compared with Rice and Cowley counties. 2) Recycling pipestone is an activity that was widely practiced at most of the sites. The thin pipes were often broken, and based on the consistent breakage patterns this may have been done intentionally for ritual reasons, and carved into pendants, beads, or figurines. 3) More research is needed to understand the pipestone production trajectory at proto-historic Wichita sites during the eighteenth century.

PIPESTONE PIPES AS PRESTIGE TECHNOLOGY

Pipestone pipes are assumed to be objects used in ritual contexts, but this presents an interpretation of how they were used but this interpretation does not advance the understanding of the technological system. However, if we consider a GBA pipestone pipe as a prestige technology, we can consider the broader implications. I argue that pipestone pipes are a prestige technology, the goal of which was to “display wealth, success, and power...to solve a social problem or accomplish a social task such as attracting productive mates, labor, and allies or bonding members of social groups together via displays of success” (Hayden 1998:11). Conceptualizing pipestone pipes as prestige items does not necessarily imply that they were used only in ritual

contexts. In fact, there is some ethnographic and ethnohistoric data suggesting that pipes were smoked recreationally among Plains groups (Catlin 1866; Ewers 1963). Additionally, not all ritualistic items may be considered prestige objects, an example of a nonprestige ritual artifacts used by Hayden (1998:15) is of two sticks placed together to make a cross as opposed to a prestige ritual object such as an ornate golden and jeweled cross. A ritual object becomes a prestige item when “special effort has been invested in the procurement or fabrication...” and when its “primary purpose has become to impress the participants or onlooker” (Hayden 1998:15).

For an object to be considered a prestige technology significant labor costs needs to have been invested at some level of its material procurement or manufacture (Hayden 1998:12). Additionally, prestigious objects indicate wealth, success, and power and should display a certain degree of attraction whether from its color, shine, transmission of light, shape, or if it is a food in its richness or sweetness (Hayden 1998:13). There are three implications in the archaeological evidence of GBA pipestone pipes that support the interpretation of these pipes as prestige technology. 1) Pipestone is a brightly colored material, with a bright red color that is rare in nature. When pipestone is polished or the powder is made into paint it creates a bright brick red color while hematite (the most common source for red ochre pigment) is brownish in comparison. 2) Pipestone is exotic to the counties with GBA sites. The Mem site is approximately 96.5 kilometers (60 miles) straight-line distance to the nearest source area for Kansas pipestone. It is important to note that the areas bearing glacial till pipestone were not known hunting grounds for the occupants of GBA sites (Blakeslee and Hawley 2006:Figure 10.1). Kansas pipestone was either procured by specialized trips to the source or through trade. Even though the GBA primarily used Kansas pipestone which is not as far away as the other pipestones, the procurement either directly or through trade would still have been costly. 3) The limited evidence of manufacturing activities at GBA sites suggests that not everybody made their own pipe. If not everyone has the materials or skills to make their own pipe then pipes would have been rare and valued objects. This also suggests that pipe manufacture may have been a specialized activity with pipe-making specialists (e.g., Weltfish 1965) perhaps centered at the Mem site (14MN328).

It has been suggested that red pipestone pipes at GBA sites were used in ceremonies, which were the precursor to the historic calumet ceremony. The ethnographic basis for this assumption is found in Dorsey's (1995:17) mythology of the Wichita Indians, "that [the Wichita] originated this ceremony, and that it was obtained from them by the Skidi, who, in turn, passed it on to the other tribes of the Pawnee." The French recorded the protohistoric Wichita practicing an elaborate calumet ceremony in 1719 (Odell 2002; M. Wedel 1988b). This particular ceremony occurred less than two decades after the abandonment of the GBA sites in Rice, McPherson, and Cowley counties (Hoard 2012b:178). Ethnohistoric and ethnographic data document the role of ritual paraphernalia, such as pipes and pipe stems, in the calumet. The calumet ceremony was widely practiced but at its core it was a ceremony for creating alliances between two groups (Blakeslee 1975). Alliance building was accomplished by showing respect to the leader, gift exchanges, and feasting. Additionally, in the Chaui band of the Pawnee's nineteenth century practice of the calumet ceremony, the host was usually a chief or other prominent individual in the community "who not only had accumulated property, but also had a large following of relatives who could contribute to the store of articles required for these rites" (Fletcher 1996:19). The amount of labor and goods needed to successfully perform the calumet is a fundamental requirement for prestige technologies (Hayden 1998:12). From an anthropological perspective, we can see that the historic calumet ceremony functioned as a display of wealth, power, and success in order to gain and maintain alliances. However, when comparing the GBA sites to the protohistoric Wichita sites there are many differences, not just with the archaeology of pipestone pipes but also in other archaeological features. There is also no archaeological or ethnohistoric evidence, which directly supports a practiced form of the calumet ceremony at GBA sites, other than the pipes themselves. Thus, it cannot be assumed that pipestone pipes at GBA sites were part of a late prehistoric or early protohistoric calumet ceremony as it was witnessed in historic times.

Application of Hayden's Model for the Design and Production of Prestige Stone Technology

The research value of treating red pipestone pipes as prestige technology as opposed to ritual technology is that the goal of prestige has social and economic implications. By applying a prestige technology model to GBA pipestone technology we can explore the broader social and economic contexts. The prestige technology model used in this research is from Hayden (1998:39), who modeled the potential constraints that would affect the design of prestige lithic technologies (Table 7.9). Hayden's discussion focused on lithic technologies and transegalitarian societies, those intermediate between egalitarian and chiefdom societies, which are directly applicable to this research. Design theory takes into consideration the social and economic processes shaping the design and manufacture of material culture and relating the performance of artifacts to particular tasks (Bleed 1986:738). Design theory borrows concepts from design engineers and is heavily influenced by behavioral archaeology's models for technological change (e.g., Schiffer 1972; Schiffer and Skibo 1987, 1997). Design theory has also been compared to organization of technology approaches such as the *chaîne opératoire* and behavioral chains (Hayden 1998:4).

By applying Hayden's model to GBA red pipestone artifacts we can begin to expand our modeling of the technological systems functioning at these sites and importantly, start to consider the social and economic role of the technology. The following discussion partitions the constraints from production to design considerations, and ending with constraints and social aspects. I took this approach as it reflects how the archaeological record is encountered from the material and leading to the interpretations of the social and economic factors affecting those materials.

Production

The exact way in which pipestone was quarried is not known. Weathered or water-worn cortex was observable on many of the unfinished artifacts. Additionally, the sourcing from this study indicates that the majority of pipestone represented is Kansas pipestone. There are at least two possible ways in which the pipestone was procured, through direct access or trade. Loosle

Table 7.9 The design and production process of prestige lithic technologies, adapted from Hayden (1998:figure 3)

	CONSTRAINTS			
Social Problem	»	»	»	
	<p>Task Constraints Socioeconomic goals</p> <p>Socioeconomic Constraints Surpluses Available (individual, group) Levels of Inequality Context of Display -Size and nature of groups -Purpose of gathering (funeral, marriage, initiation, political feast) Craft Specialization Stability in Hierarchical Succession Mobility, Transport, Storage</p> <p>Material Constraints “Appeal” Characteristics Available Materials and Costs Shaping Potential Decorative Potential Polishing Potential</p> <p>Technological Constraints Production Costs Available Technology</p> <p>Ideological Constraints Meaning of Motifs and Colors Valued Attributes</p>		<p>Design Considerations Apprehendibility (visual, audial) Attractiveness Weight and Size Model of Display (standing alone, worn, held) Prehension of Attachment or Support Fragility Use Life (Single event or Multiple event) Number of Manufacturing steps</p>	<p>Production Quarrying Primary Reduction Secondary Reduction Finishing -grinding -flaking -carving -incising -polishing -decorating Intentional Breaking Recycling</p>

(1991) has argued that based on the pipestone at the Major site (14RC2) and 14RC306, that it is unlikely that the people at these sites had direct access to the source. He based this argument on the lack of evidence for pipestone manufacture that was occurring at these sites. Loosle (1991:169) surmised that at the very least the pipestone was being reduced and finished at other sites, which this study supports. There is evidence of trade between GBA sites and the Lower Loup and possibly Oneota in southeastern Nebraska, both of whom occupied areas with or in the vicinity of Kansas pipestone (Hawley and Vehik 2012:31; Loosle 1991:171; Vehik 2002:56; W. Wedel 1959:617). The evidence of these trade relationships is sparse, but provide possible avenues through which pipestone was procured.

Regardless of how the pipestone was procured, it was not directly transported in unfinished pieces back to the GBA sites. The further away a site is from the glacial tills the more

likely that only finished pipestone artifacts are found. Reduction of the pipes occurred at specialized sites or in specialized areas of sites. Our best evidence so far, for where these pipes are being manufactured are at the Mem site (14MN328) and at the GBA sites in McPherson County. Notably, there may be particular features, such as the council circles, within GBA sites where the pipes are made (Vehik 2002; W. Wedel 1959) and more research is needed to determine further test this possibility.

In addition to Hayden's stages for production, I added intentional breaking and recycling. Both of these steps appear to be an extremely important part of pipestone artifact production at GBA sites. These activities are much more widespread than the original pipe production and were likely happening at a household level. The chipped stone tools with pipestone use-wear and residue are the tools that were used to break and recycle pipes into pendants, beads, and figurines. Some of these tools were found with pipestone objects, while others were not, and a few were identified at the Lewis site, which lacks artifacts made from pipestone. Supporting the unspecialized nature of pipestone pipe recycling is the fact that many of the tools are generally associated with other tasks. Further evidence supporting the unspecialized nature of pipestone pipe recycling are the tools with residue and lacking pipestone use-wear, which during their use-life were used on pipestone and then used for other tasks.

Pipes that were used or minimally used were broken and recycled into pendants, beads, and figurines. Present evidence suggests that pipestone was not initially made into artifacts other than pipes. The breaking and recycling of minimally used pipes may have been a way of commemorating the ritual in which a pipe was originally involved. A modern analog for this type of commemoration is similar to when a basketball team wins a championship. Team members and coaches cut down pieces of the net and often tie them to their hats or jerseys. Recycling pipes into pendants was likely a similar practice. It was a way of capturing the original prestige of that pipe or the ceremony in which the pipe was used and locking it into a piece of jewelry or figurine. This serves to bind or bond the individuals of the group(s) who participated in the ceremony or event.

Design Considerations

It has been argued that red pipestone pipes are attractive objects. Red pipestone pipes' qualities include their color, size, and in the simplicity of design and decoration. As seen with the modern pipestone carvers at Pipestone National Monument (PNM), when pipestone is polished with fat or wax it becomes a deep red color that is unusual in nature. Examples of polished red pipestone were analyzed in the Kansas Historical Society's ethnographic collections, which had an impressive range of shades of red on the Munsell chart, such as pink (5YR 7/3), weak red (7.5R 5/2, 7.5R 5/4), light red (10R 6/6) dusky red (7.5R 3/4, 10R 3/4), dark red (7.5R 3/6), and red (7.5R 4/6, 7.5R 5/6, 7.5R 5/8). Unfinished pipestone is typically a weak red (7.5R 4/2, 7.5R 4/4). Additionally, experiments in making pipestone pigment for this research found that mixing pipestone powder with rendered fat also created a bright red color. Although there is currently no archaeological evidence of pipestone powder use, it was used historically (Weltfish 1965:395) and I found that it is still used in Native American ceremonies. Pipestone powder is an important by-product of production. Finding pipestone powder use in the archaeological record may simply require searching for it. Possibilities include red slips on GBA ceramics such as Geneseo Red (Wedel 1959).

Historically and even today, pipestone from PNM quarries is considered a sacred stone. It is difficult to determine from the archaeological record at GBA sites, if this was also the case in protohistoric times. Today, carvers at PNM take leftover powder and scraps and bury them at the quarry with a prayer and an offering. In contrast, the leftover scraps of pipe recycling were found in pits with other many other artifacts, including practical technologies. Using the ethnographic and archaeological research, it would appear that at GBA sites pipes were considered significant prestige objects worthy of recycling but that association may not have extended to the material itself.

Blakeslee (2012:305) noted the small size of the GBA pipestone pipes and he thinks this indicates their ritualistic use. The bowls of these pipes (which are longer than the base) are rarely longer than 10 cm and are usually shorter. Miniature pipes that were used as well as undrilled

miniatures have been found (Blakeslee 2012:305). The bowls are often drilled and reamed with thin walls making them particularly fragile.

The design and decoration of these GBA pipestone pipes was fairly simple. The design was a basic elbow pipe with a long bowl and short base. The bowl opening constricts slightly on many of the pipes (Blakeslee 2012:301). Decorations were beading or incised lines around the lips of the bowls. While the decorations were not elaborate they were consistent, suggesting a shared view of ritual technology throughout the GBA sites and during the entire duration of occupation of these sites.

Constraints

The next stage of Hayden's model is to consider the multiple constraints shaping the technology. This is an extremely important stage for the discussion of red pipestone pipe technology because the constraints really lead to discussions of the people, society, and economic system within which the pipes were used. Determining the role of pipes within the society is a goal of this research and can only be addressed when the technology is placed in a broader social context.

Task constraints that shape practical technologies, such as the task mechanics, efficiency, resource availability, available time, and consequences of failure (Hayden 1998:5), are not as important for prestige technologies as they are for practical technologies. For prestige technology, the most important constraints according to Hayden (1998) are the socioeconomic goals. Archaeologically we can model these and borrow from ethnohistory in identifying the kinds of socioeconomic goals past people may have had for red pipestone pipes. As a prestige technology, the goal for red pipestone pipes at GBA sites would have been to display wealth, success, or power, however, the exact reason for this display is unknown archaeologically. However, for the display to be successful, labor and/or material investments would have been required to make the pipes a significant representation of wealth, success, or power.

Hayden (1998:Figure 39) refers to multiple socioeconomic constraints, some of which I

view as interconnected, in particular craft specialization; available surplus; and mobility, transport, and storage. Craft specialization has many definitions and applications in anthropology (c.f., Brumfiel and Earle 1987; Clark 1995; Clark and Parry 1990; Costin 1991; Cross 1993; Earle 1987; Hagstrum 1985; Kenoyer et al. 1991; Longacre 1999; Muller 1987; Spielmann 1998, 2002). Craft specialization is often associated with highly stratified societies and narrowly defined as a full-time, elite-sponsored occupation (Childe 1951; Muller 1987). There is very little archaeological evidence to argue that the occupants of GBA sites were a ranked society (Baugh 2008; c.f., Vehik 2002). Archaeologists focusing on technological organization have long recognized that craft specialization comes in many forms. Craft specialization, as it relates to the production of red pipestone pipes, is best defined by Clark and Parry (1990:297) as the “production of alienable, durable goods for nondependent consumption.” This definition allows for craft specialization that is on a continuum of independent to elite-sponsored (also known as attached) and part-time to full-time (Brumfiel and Earle 1987; Costin 1991; Earle 1981). In terms of the part-time to full-time continuum, I think that pipestone pipe manufacture was a part-time endeavor based on the paucity of pipestone at most sites or features within sites, the lack of evidence for workshops (with a possible exception of some council circle features), and because there are not formalized tools employed only for this activity. However, whether or not the production was sponsored by elites, ritual specialists, or was entirely independent remains to be determined (c.f., Spielmann 1998). The uniformity in overall size, shape, design, and decoration suggests that the people at GBA sites had a very specific idea of what this particular prestigious technology should look like. It may be impossible at an archaeological level to identify if this uniformity was the result of standards imposed at an individual or societal level.

Focused labor effort is an integral aspect of both prestige technology (Hayden 1998) and part-time specialization. As Hayden (1998:12) notes this labor may be used in many different ways but it is always used to intensify the value of an object. Hayden considers this labor as “surplus” because the end goal is not subsistence, which is also how Clark and Parry (1990:298) define part-time specialization. Significant time and resources were likely used in procuring pipe-

stone from its glacial till sources, whether through specialized trips or trade. Related to mobility and transport of pipes, the finished pipes were more widely dispersed than manufacture activities. The GBA elbow pipes are found at all GBA sites and at many contemporaneous sites in the Texas panhandle and northern Oklahoma (Blakeslee 2012:303-304). This distribution likely represents the alliances and trade relationships that were built with the people at GBA sites.

Hayden (1998:40) emphasizes societal inequality, the instability of leadership, the nature of the event, and the risks involved as key constraints in the design of prestige technology. Based on the archaeological record and ethnohistoric documentation (but not the bioarchaeological record because we lack pipes from grave contexts), what we know of the occupants of GBA sites were that these people were relatively egalitarian in terms of access to resources. It is possible that they may have had slaves (a practice documented for contemporaneous tribes to the west and southwest and for the protohistoric and historic Wichita [M. Wedel 1982; 1988b]). The council circles are the best archaeological evidence for leadership and specialized activities at these sites. These features have slightly more prestige items in the form of exotic goods than other GBA features (Vehik 2002). The council circles are thought to represent the dwellings for either political or ritual leaders (Vehik 2002; W. Wedel 1967). From limited Spanish documentation, we know that the people of Quivira were led by a chief with copper in his possession (M. Wedel 1982). Documentation of ritual leaders, if there were any that were separate from political leaders, is completely lacking for the GBA. Additionally, the stability of leadership positions is difficult to establish from the archaeological record.

From the archaeological record, it is also difficult to assess the consequences of a pipe failing to properly display prestige. There are other artifacts at GBA sites that could also display wealth, success, or power (e.g., turquoise, copper, marine shell). However, none of these prestigious artifacts also functioned as smoking devices. A finished pipe itself may represent a successful display of prestige and the failure is when an individual is unable to recruit a person to procure the pipestone or carve the pipe (c.f., Hayden 1998:15).

Social Problem

The first stage of Hayden's model for prestige lithic technology is that a past transegalitarian society has a social problem that needs to be solved. Hayden (1998:16) argues that there are two different goals of prestige lithic technologies among transegalitarian groups. These two goals are either 1) for ritual use to impress others and reinforce subsistence alliances, or 2) for surplus-based competition. Hayden (1998:17) theorizes that competitive displays of success developed in resource-rich areas in order to recruit sufficient labor to process these resources.

Specifically, Hayden (1998:17) states:

Labor shortages might be especially acute in the temperate zones where large-scale seasonal migrations of ungulate herds occurred and where large amounts of meat...could not simply be stored by freezing but required more laborious thin filleting and prolonged drying of the fillets over smoky fires. Labor would also have been in short supply for the effort-intensive conversion of animal skins into supple buckskin or clothes or for manufacture of other items that could be exchanged as wealth.

The difference in these two goals is represented in the archaeological record (Hayden 1998:16). Ritual objects used to reinforce subsistence alliances are rarely found archaeologically and are only present at sacred sites not at habitation sites. Artifacts associated with surplus-based competition are found in graves of specific individuals, represent substantial investments of labor, were made by part-time specialists, and are found at habitation sites.

Both of Hayden's goals could be applied to the GBA's use of pipes as prestige technology. However, there was a greater need for labor that would hunt and process bison rather than for subsistence alliances. This assessment is based on the fact that the majority of the GBA trade partners either had the same or similar subsistence economies (Vehik 2002:41), although group-specific availability may have varied by years or season. Therefore, bison meat, hides, and other products such as bone tools may still have been widely traded. It is clear in the archaeological record of GBA sites, that bison represented the largest class of animals exploited (Haury 2008, 2012; Rohn and Emerson 1984; W. Wedel 1959). Ethnohistorical accounts also documented GBA bison hunting and trade (Winship 1896:396). Thus, it is plausible that at GBA sites the supply and demand for bison products exceeded the labor for hunting and processing the bison. Additionally, there may have been other projects (trade expeditions, building projects, etc.) that

required high labor demands for which leaders could have used a pipe-using ceremony in their recruitment. Bison hunting and processing is just one example that is particularly visible in the archaeological record, for which focused labor was likely needed.

The archaeology of pipestone pipes at GBA sites also supports the surplus-based competition model. Pipes are found at habitation sites and although they are not common, they occur more frequently than expected for ritually significant objects. Pipestone artifacts and pipe fragments are also found in pits associated with other types of refuse. The evidence also supports the idea that pipestone pipes were made by part-time specialists and that a significant amount of labor and time was invested in the material procurement and manufacture of the pipes. These specialists may have been ritual specialists that had privileged access to the knowledge of pipe manufacture. We currently lack intact graves at GBA sites (Blakeslee and Hawley 2006:170), which would clarify whether or not pipes are associated with individuals of higher status. The social problem for the GBA may have been the need for individuals to help in a hunt or in processing the materials from the hunt. Competitive displays involving the smoking of red pipestone pipes may have been one of the ways in which people were recruited.

These competitive ritual displays may have been early precursors of the calumet ceremony, which was thought to have originated with the Wichita (Dorsey 1995:19). During Blakeslee's (1981:761) ethnohistorical research on documents from the Spanish Inquisition, he found a calumet-like ceremony performed as early as the 1630s among the Plains Apache. While this ceremony was contemporaneous with the GBA occupations, it does not necessarily mean that the ceremony was also being performed at GBA sites. The Plains Apache were much more actively engaged with the Spaniards at this time as compared to the occupants of GBA sites. The archaeological evidence of a calumet ceremony has also never been defined, beyond a particular type of pipe. The pipe as evidence of the calumet is fairly weak because the pipe was not the most important ritual paraphernalia involved in the historical performance of the ceremony (as seen in Fletcher 1996). It remains that the major difference between the competitive ritual displays and the calumet ceremony are the motivating social problems. However, both rituals used prestige

technology in order to build alliances and during times of rapid change (such as the early eighteenth century at Wichita sites) ritual displays may have been adapted for purposes that differed from their original use at GBA sites.

CONCLUSIONS

Limitations of the Data

Other archaeologists working with GBA data have noted the limitations of working from artifacts almost entirely collected from pits (i.e., Blakeslee 2012; Hoard 2012c; Loosle 1991; Roper 2002; Sundermeyer 2005; Vehik 2007) or surface collections. In this research, I found the same limitations with the GBA data. The structural remains are difficult to identify and the vast majority of artifacts are found in storage and cache pits or general surface contexts. Some of the GBA sites also have mounds that contain refuse. Additionally, some of the shallow basins may have been short-term storage or cache pits. It is difficult to ascertain what these storage and cache pits and midden mounds actually represent. A key to interpreting these GBA sites may be found in historical documentation of the Wichita sweeping clean their house floors (Vehik 2007) and of historical Pawnee using old storage pits for their refuse (Wetfish 1965:297). While some of these pits may represent refuse pits, others may represent forgotten or abandoned storage and cache pits. Another challenge in the excavation of GBA sites is the layout of the villages, houses dispersed among fields. The grass lodges in which these people resided also leave little evidence of the structure and most often the structures identified are arbors. The published information on the archaeological record at these GBA sites provides very little contextual evidence as to activity areas within sites.

Another prominent limitation of the data is the lack of archaeological reports on many of the sites. Archaeological reports of the original excavations are limited to the cultural resource management projects conducted in Marion and Cowley counties. Wedel (1959) described excavations at the Rice and McPherson county GBA sites he excavated, however, these collections are not readily available. There is some grey literature covering the excavations of the Lewis site

that were useful during this analysis. Several theses and dissertations were also useful because they described the assemblages for some of the Rice county sites. The lack of archaeological reports for many of the GBA collections will limit further research endeavors.

Organization of Pipestone Pipe Technology at GBA sites

The archaeological evidence indicates that pipestone pipes were a prestige and possibly a ritual artifact likely used in competitive displays to recruit labor among other purposes. These pipes may have also been used in other ceremonies. Pipes were not, however, exhaustively used based on the rarity of thick dottle coating the interior pipe passages. Many of the broken pipe fragments reflect minimal use. Pipes were made by part-time craft specialists that may have been ritual specialists with a monopoly on the knowledge of pipestone material sources and manufacture. Modern and historic pipe carvers (i.e., Ewers 1963), with all of their advantages of metal tools, power drills, and sandpaper, are still a small specialist group. Modern pipe carving is tedious work and most people would rather pay for that service than do it themselves. Often pipes were and are commissioned and historically were traded for goods as valuable as horses (Ewers 1963). Pipe production was restricted to a few of sites in Marion and McPherson counties. The corresponding tools that would support the craft specialization of pipes at these sites have not been identified through use-wear and residue analyses, rather, only non-specialized tools have been identified in the making of pipes. Artifacts such as pipe drills (i.e., W. Wedel 1959:269) remain enigmatic and were apparently used on pipestone but not always. Finished pipes were then traded throughout GBA occupied sites and even with contemporaneous neighbors.

Interestingly, while pipestone pipe production was a specialized craft, I believe that the breaking down and recycling of old pipes was done by the individuals that owned or last used the pipes and perhaps those that participated in the ceremonies. Pipes were intentionally broken after minimal use and were then recycled into pendants, beads, and figurines. This recycling activity was not restricted to any particular site or areas within the site, but occurred at an individual and household level. This strategy may have been a way for individuals to commemorate the original

prestige associated with the pipe or the ceremony in which the pipe was used. By making the pipe into a bead or pendant this was a way of displaying the prestige associated with that pipe's original use.

The 250 years of GBA occupation in central and southern Kansas do not show variation of this overall pattern of pipestone procurement, manufacture, trade, use, and recycling. The greatest change to GBA lifeways came in the late seventeenth and early eighteenth centuries. For various reasons, the occupants of GBA sites moved to northern Oklahoma on the Arkansas River. These protohistoric Wichita sites were fortified and contained a significant amount of French trade goods. Importantly, this physical move also marked a drastic change in pipestone pipe technology. Currently, I have only limited data on the pipestone at these protohistoric sites, however, present evidence demonstrates that these people no longer had access to the glacial tills of Kansas and had to obtain pipestone from the pipestone quarries in southwestern Minnesota. This change in pipestone procurement may have drastically changed the strategy for pipestone pipe production, use, and recycling. This trade may have been conducted through the French. In 1719, French trading expeditions were coming up from New Orleans in the south as in the case of La Harpe (M. Wedel 1988e) and also from Illinois to the west as in the case of the Dutisné trading expedition (M. Wedel 1988d). Ethnohistorians also note that the calumet ceremony was being performed with French traders at early eighteenth century protohistoric Wichita sites (M. Wedel 1988e).

Future Research Directions

There are multiple productive avenues this research for further work as suggested by this research. Here, I elaborate on a few of them. First, a more inclusive use-wear and residue analysis of stone tools at Marion and McPherson county GBA sites is needed. The pipestone use-wear and residue analysis was not as productive in this research as I had hoped, and this may be due in part to the fact that pipes were only made in limited areas. I would like to find stronger evidence supporting the part-time craft specialization at these sites and potentially define specialized areas

of the site where pipestone production took place.

Another avenue of research that needs to be explored is ritual craft specialization (i.e., Spielmann 1998) and ritual modes of production (i.e., Spielmann 2002; Yerkes 1983). I have only begun to explore this problem. It would be productive to explore the anthropological literature on these subjects and evaluate the data in this research to better understand the organization of the GBA pipe-making technological system. Anthropological and archaeological literature concerning objects recycled into commemorative ornaments needs to be investigated, and holds potential relevance to the pipestone use system.

Another project is to examine in detail the Smithsonian Institution's GBA assemblages. This could be done using the same use-wear and residue analysis on the stone tools and categorizing the pipestone artifacts according to the above trajectory. Vehik (2002:Table 5) examined the exotic artifacts, including pipestone, from the Smithsonian's collections and determined that manufacturing activities were occurring more frequently at sites with council circles. This research did not find the same results. However, the assemblages I examined and the Smithsonian assemblages are from different contexts (14RC12, 14RC13, and 14RC306; from different areas of sites: 14RC2, 14RC5 14RC8, 14RC9). The investigation of these data has the potential to refine the interpretation of where and by whom pipestone pipes were made.

A more complete study of pipestone at the Bryson-Paddock (34KA5) and Deer Creek (34KA3) sites is needed. I think that the changes in pipestone procurement, the added pressure from surrounding enemy tribes, and the increase in European trade goods would have greatly affected pipestone technology. Learning about the changes in the technology can give us an understanding as to the ritual and social changes also occurring at this tumultuous time (M. Wedel 1981, 1988d,e).

The most promising project that remains to be completed is to interpret the thousands of other pipestone artifacts which I analyzed during this study. During my research and sourcing, I analyzed pipestone at the Kansas Historical Society, Oklahoma Archaeological Survey, University of Kansas Archaeological Research Center, Wichita State University, and Kansas State

University. I also spent several days at the Midwestern Archaeological Center in Lincoln, Nebraska, in order to reanalyze some of Gundersen's powder samples. Some of the most interesting pipestone artifacts that I analyzed were from historic Kaw sites along the Kansas River, Oneota sites in Kansas and Nebraska, and from Coalescent Tradition sites in South Dakota. Soon I will begin analyses of these sets of artifacts. The pipestone material from South Dakota sites is a type with which I am not familiar. I need to explore Gundersen's quarry samples from South Dakota to better understand the variations in pipestone in the northern Plains region.

This dissertation opened multiple additional avenues for research that I plan to explore. Overall, the types of analyses were beneficial and in the end led to insights on the organization of pipestone technology at GBA sites and the pipe technology's role in a broader social and economic context. Related to pipestone pipe technology, there remain issues that need to be resolved and more questions that need to be answered. It is my hope that this dissertation is a useful step toward addressing these issues.

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APPENDIX A

Minerals Found in Pipestone from the Plains

Mineral	Chemical Formula	Colors	Mohs Hardness	Description	Citation
Pyrophyllite	$Al_2Si_4O_{10}(OH)_2$	white, pale-blue, yellow and green	1-2, scratch with fingernail	"...a phyllosilicate, meaning it is a silica-bearing mineral with a molecular structure that is sheet-like," Can be a clay mineral or coarse-grained depending on the type of rock (Nesse 2000:184).	Anthony et al. 2001; Nesse 2000
Diaspore	$AlO(OH)$	white, gray, or pale shades of many other colors	6.5-7, scratch with a steel knife or at 7 it can scratch glass	aluminum hydroxide, similar to the softer Boehmite ($AlO(OH)$), white with a Mohs Hardness of 3.5-4 (Nesse 2000:Table18.5).	Nesse 2000
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	colorless, gray, brown, green, yellow, and rose-red	2.5, scratch with copper coin	Also a phyllosilicate, like Pyrophyllite	Anthony et al. 2001; Nesse 2000
Kaolinite	$Al_2Si_2O_5(OH)_4$	white to tan	2-2.5, scratch with fingernail or for 2.5 with copper coin	Phyllosilicate and clay mineral with chlorite, defined as "sheet silicate minerals that occur in the clay-sized (<0.002mm) fraction of soils, sediments, sedimentary rocks, and weathered or altered rocks" (Nesse 2000:252-253).	Anthony et al. 2001; Nesse 2000

APPENDIX B

Pipestone Analysis Form

ART # _____ PROV _____
FAC _____ TYPE _____
MOD _____ CA _____ Color _____
SUR _____ Date _____ Coll _____
WT _____ NOTES _____
FN: _____
Name(s)/Date(s)/Images _____

DRAWING OF ARTIFACT

ART # _____ PROV _____
FAC _____ TYPE _____
MOD _____ CA _____ Color _____
SUR _____ Date _____ Coll _____
WT _____ NOTES _____
FN: _____
Name(s)/Date(s)/Images _____

DRAWING OF ARTIFACT

APPENDIX C

Pipestone Pipe Analysis Form

ART # _____ PROV _____

FAC _____ TYPE _____

MOD _____ CA _____ Color _____

SUR _____ Date _____ Coll _____

WT _____ BD _____ BHD _____ BHT _____ SL _____

SW _____ SHD _____ ND _____ NHD _____ SH _____

DPU _____

NOTES _____

FN: _____

Name(s)/Date(s)/Images _____

DRAWING OF ARTIFACT