University of Alberta

Prehistoric microblade technology in the Oilsands region of northeastern Alberta: A technological analysis of microblade production at archaeological site HiOv-89

by

Angela M. Younie ©

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Arts

Department of Anthropology

Edmonton, Alberta
Fall 2008

Your file Votre référence
ISBN: 978-0-494-46990-3
Our file Notre référence
ISBN: 978-0-494-46990-3

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *Prehistoric microblade technology in the Oilsands region of northeastern Alberta: A technological analysis of microblade production at archaeological site HiOv-89,* submitted by Angela M. Younie in partial fulfillment of the requirements for the degree of Master of Arts.

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Date: September 18, 2008

Abstract

Microblades are a type of small stone artifact that can be hafted to osseous or wooden handles to create composite tools. Until recently they were rarely found in Alberta; however, evidence of microblade production has now been observed in a number of archaeological sites excavated in the boreal forest in the northern portion of the province. This study examines the sequence of microblade production at HiOv-89, a prehistoric lithic workshop in northeastern Alberta, through technological analysis and artifact refitting. The results of this analysis are compared to nearby sites in the Oilsands region of Alberta, and to the extensively documented traditions of microblade production found to the northwest in Alaska and the Yukon. It is proposed that the microcores from HiOv-89 and other sites in northeastern Alberta may be considered a far southeastern expression of the Denali Complex of the far northwest.

Acknowledgments

There are many hard-working, generous, and supportive people who deserve thanks for their assistance and encouragement for this research. First and foremost is my supervisor and mentor, Dr. Raymond Le Blanc, who provided invaluable enthusiasm, knowledge, and experience. Nowhere else is there a person more dedicated to archaeology, and more understanding of missed deadlines and nonsensical typos. Many other faculty and staff of the Department of Anthropology deserve thanks, including Dr. Charles Schweger who helped me to identify some of the lithic materials in my assemblage.

Martina Purdon, Darryl Bereziuk, and Joan Damkjar of the Archaeological Survey of Alberta all generously lent their time to help me access their database and libraries, and to keep me informed of new information relevant to my thesis topic. Thank you to the Archaeological Survey for permission to use images and information gathered from the reports in their libraries, and to all of the Survey staff for helping to provide such thorough and interesting resources.

The artifacts studied for this research project were loaned from the Royal Alberta Museum, with the help of Jack Brink and Petra Reichwein. Thanks also to Robert Dawe of the Royal Alberta Museum, who helped to identify the silicified mudstone portion of the assemblage.

This research was funded by a grant from the Social Sciences and Humanities Research Council of Canada. As well as helping to sponsor this work by providing technical resources and printing services, FMA Heritage Inc. conducted the mitigative excavation of HiOv-89 and facilitated access to the artifact assemblage from the site. Petro-Canada commissioned and funded excavation of the site, and granted permission to the author for use of photographs taken on the Fort Hills Oilsands Lease during the excavation of the site.

A number of parties consented to the use of copyrighted photographs and figures in this thesis, and deserve thanks for their willingness to contribute to academic research and our understanding of the past. These include FMA Heritage Inc., Golder Associates

Ltd., Bison Historical Services Ltd., Petro-Canada, and Archaeology Press. Thank you Robin Woywitka, Martin Magne, D'Arcy Green and Michelle Wickham, for your help not only in acquiring these materials, but also for your ideas, time, and support.

Of course I have to thank all my student colleagues, who helped to pull me through a whirlwind first year. Fellow graduate students Jill Taylor-Hollings and Jo-Ann Marvin, I miss you already. Tanya Roberts, you have been a role model and mentor for me, and tons of fun to hang out with. And Angela Green and Yvonne Pronovost, thanks for the Friday afternoon archaeology discussions.

If not for my parents, I would never have had the courage to transfer into the Arts. Few children are encouraged to do what they want in life, whatever the cost, and certainly I would not be here without the encouragement, love and support of my family.

Finally, thank you Robin Woywitka for being there through nearly every aspect of this work, from pointing out the research value of the site, to helping make maps, to having ridiculous late-night discussions about lithics and glacial lakes. And even more important, thank you for the love and support and understanding that meant everything, and kept me going when the going got hard.

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List of Acronyms

ACCS	Alberta Culture and Community Spirit
APA	American Palaeo-Arctic tradition
ASA	Archaeological Survey of Alberta
ASTt	Arctic Small Tool tradition
BP	Years Before Present (given in uncalibrated radiocarbon years, unless otherwise noted)
BRS	Beaver River Sandstone
FHOSP	Fort Hills Oil Sands Project
FMA	FMA Heritage Incorporated
NANAMt	The Northeast Asian – Northwest American Microblade tradition
NWCMt	Northwest Coast Microblade tradition
NWMt	Northwest Microblade tradition
SM	Silicified Mudstone
SS	Silicified Siltstone

Chapter 1 Introduction

Research Problem

Microblade technology is a widespread and varied approach to stone tool production developed and used across many continents and over tens of thousands of years of prehistory. The numerous variations in production techniques used to create a similar end result - the microblade - have been studied in a variety of contexts in attempts to understand how and why people discovered, learned, and chose between them. The answers to these questions, it is hoped, can lead to further discovery of the prehistoric cultural relationships and lifeways that influenced these discoveries and decisions. Much research has been focused in northwestern North America, where numerous traditions of microblade production have been defined, including the Denali Complex, the Northwest Microblade tradition, the Northwest Coast Microblade tradition, and the Arctic Small Tool tradition. Microblade production in North America is conventionally considered to be restricted to these far northwestern traditions, found in Alaska, the Yukon and western Northwest Territories, and British Columbia (Clark and Gotthardt 1999).

The following research undertakes to expand the current knowledge of these traditions to northern Alberta, where several sites have been recently discovered to contain evidence of microblade production. Artifacts such as microcores, ridge flakes, and core tablets indicate methods of production possibly related to the Denali Complex, as does associated evidence of burin technology. Previously published studies of microblade technology in Alberta, although sparse, provide evidence supporting these associations (Le Blanc and Ives 1986; Sanger 1968a; Magne and Fedje 2007).

The main body of this research involves the technological analysis of the artifact assemblage from HiOv-89, a prehistoric lithic workshop located approximately 80 kilometres north of Fort McMurray in northeastern Alberta. Discovered in 2001, the site produced an assemblage of 935 lithic specimens, 80 of which were found to be related to microblade production. These artifacts are here measured, described, and photographed, and combined with supplementary evidence from the assemblage, including a full debitage analysis and refitting analysis. The results of this study will be used to describe the lithic reduction sequence used to produce microblades at HiOv-89, as well as to gain a basic understanding of related technologies used at the site, and of the site formation processes that may have affected the distribution and composition of the assemblage after it was abandoned.

A secondary component of this research is an overview of possible microblade sites reported in the so-called grey literature of government-mandated archaeological work. This literature comprises a vast body of unpublished documents submitted to the government by privately operated archaeological research companies. Most of the microblade sites reported here have been discovered in the vicinity of modern Oilsands leases, where archaeological surveys are carried out prior to industrial ground disturbance. Abundant lithic material sources and proximity to the Athabasca River seem to have created a dense pattern of prehistoric use of the landscape, resulting in a concentration of archaeological sites located approximately 30 km south of HiOv-89, and yielding significant evidence of microblade production over the last decade. Information gathered about these sites during the overview of the grey literature will be compared to the evidence of microblade technology at HiOv-89, and to the nearby Bezya (HhOv-73) microblade site (Le Blanc and Ives 1986). Finally, the evidence gathered during this study will be incorporated into a discussion of prehistoric patterns of lithic raw material and tool use, and of possible cultural transmission or contact, between northeastern Alberta and the far northwest.

Thesis Outline

This thesis will address the above outlined problem by answering five key questions:

1) What type of microcore reduction sequence characterizes the HiOv-89 assemblage?
2) What supporting information about site formation processes and related lithic reduction technology can be used to facilitate interpretation of this site?
3) How do microblade artifacts from recently discovered Oilsands sites in northeastern Alberta compare to those from HiOv-89?
4) How did the raw materials locally available near Oilsands sites influence decisions made during microblade production?
5) What similarities may be drawn between the Denali Complex and the methods of microblade production seen at HiOv-89 and other Oilsands microblade sites, and might these similarities represent cultural interactions?

These questions will be addressed over eight chapters. The first three chapters will provide background information for this study, including a review of the current literature on microblade technology, and the environmental and archaeological context of HiOv-89. Chapter 4 describes the methods used during the studies conducted for this thesis, including site excavation, laboratory preparation and analysis of artifacts, refitting analysis of artifacts, and the review of unpublished literature and government data from northeastern Alberta. The following two chapters are dedicated to the analysis of the lithic assemblage of HiOv-89. Chapter 5 includes a discussion of the raw materials used at the site, debitage analysis, tool descriptions, and the results of the refitting analysis in terms of artifact distribution and tool production. Chapter 6 describes the microblade component of the assemblage; this includes the description, measurement, and photography of microcores, ridge flakes, and microblades, as well as an evaluation of refitted microblade artifacts. These results are incorporated into a description of the microcore reduction sequence that was used at HiOv-89.

Chapter 7 describes the results of the literature search of Oilsands microblade sites, including the patterns of microblade production that appear to occur in the region, and how these patterns may have been influenced by locally available raw materials. These patterns are compared to those seen in the far northwest, and it is suggested that the Oilsands microblade sites may represent a southern extension of prehistoric microblade technology seen throughout Alaskan and the Yukon. Chapter 8 provides a summary and interpretation of the data, as well as suggestions for future research relating to microblade technology in northern Alberta.

Chapter 2 Microblades and Burins

Definition

Microblade technology is represented archaeologically by the uniquely shaped cores created during microblade production. These artifacts occur in archaeological sites across Europe and Asia, northern Africa, and North America. However, variability in microblade technology - that is, the methods used to produce microblades - has allowed archaeologists to identify specific, related groups of microblade-producing archaeological cultures. The current study refers exclusively to the archaeology of microblades in northwestern North America, where temporal and technological continuities in the archaeological record indicate the possibility of cultural continuities.

Before these cultural relationships are discussed further, the basic components of microblade artifacts, and the methods and theory of using these artifacts to trace cultural relationships, must be outlined. In northwestern North America, the microblade, microcore, and burin are commonly found in association, and seem to be representative of associated technologies, described below.

Microblades

Microblades are small, thin, parallel-sided flakes, removed by pressure-flaking from intentionally shaped cores (Clark 2001:64). Lamellar or "blade-like" flakes, which like microblades are at least twice as long as they are wide and have generally even, parallel sides, may be produced as a natural by-product of any type of flintknapping, especially bipolar reduction. In order to support the identification of these flakes as true microblades, it is desirable to establish the associated presence of other artifacts related to microblade production, such as the small, characteristically-shaped microcore (Sanger 1968b, 1970). Such cores are identifiable by the presence of a fluted face, upon which a series of thin flake scars gives evidence of microblade removal (Figure 2.1).

Microblade technology provides a number of advantages in terms of lithic reduction. Once removed from a core, microblades may be hafted onto a handle or shaft, either by themselves, or in combination with other microblades or tools to create composite points or knives (Sanger 1968b). In this way, each useable flake produced from a microcore increases the workable edge gained from the raw material. Flakes generated during conventional core reduction are often used in a similar way; however, unlike conventionally produced flakes, microblades, when consistently produced, will occur in a standard shape and size. The resulting artifacts are interchangeable and can be replaced once dulled, allowing reuse of a composite tool. Often the proximal or distal ends of microblades are snapped off to control the length and curvature, and to obtain the straightest possible edge (Wyatt 1970). These factors allow microblade technology to be highly conservative of raw material. Core preforms or ideally-sized raw materials are light and easily transported, as are the resulting composite tools. Furthermore, once a core is formed, many microblades can be quickly produced at once and used to replace worn blades in a handle without replacing or remaking an entire tool. These factors allow microblades to be a component of a highly maintainable system of production, where tools could be repaired or modified on short notice (Bleed 2001).

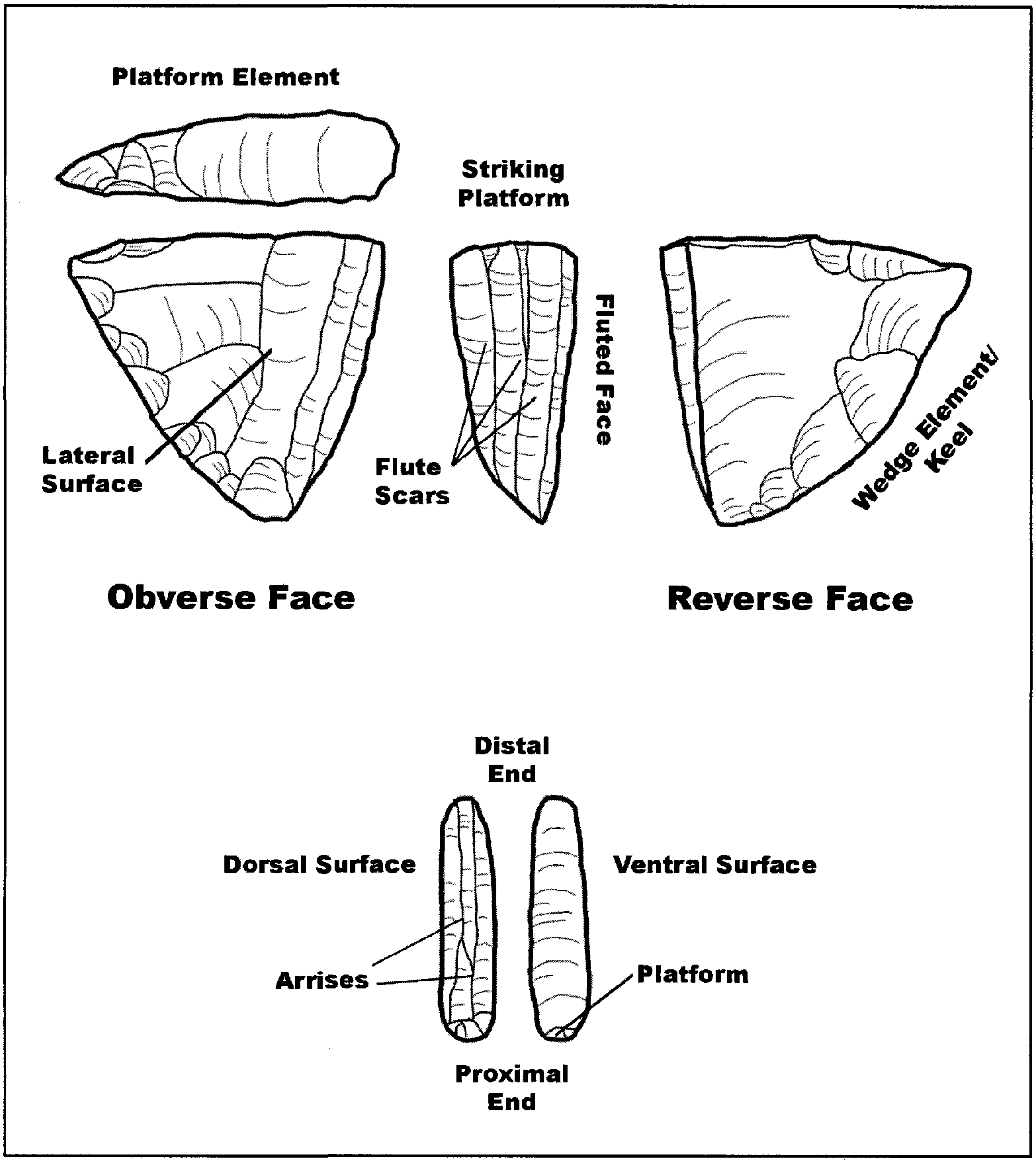

Figure 2.1 Microblade and microcore characteristics

Burins

The burin is a relatively complicated category, alternately defining a tool type – the burin or graver – or a method of flake removal – burination (Burkitt 1920). The burin blow is performed on the edge of a stone tool or flake, struck obliquely on a notched or truncated platform, causing the removal of the edge thus struck as a long, sometimes lamellar flake, called a burin spall. The angle and placing of the blow often cause the spall to terminate in a hinge fracture, creating a J-shaped facet on the burin. A burin is most commonly considered equivalent to a graver, and is defined as a tool type exhibiting a straight sharp edge, or *biseau*, used for engraving. However, burinated surfaces may have served many other purposes, such as cutting, scraping, or planing, while the burin technique may have been used simply as another type of flake removal to shape a tool or core during lithic reduction, or to re-sharpen tools by removing use-worn edges (Tomàškovà 2005:86). Burins may consist of a single burinated surface, or they may be dihedral, with two burin facets originating on the same corner of a tool. The most commonly identified burins are longitudinal, with the burin facet running along the length of the tool, rather than the width, providing a long "handle" for manipulation.

Burin spalls, the flakes removed by a burin blow, may also have been used for finer work, or have been hafted in a manner similar to microblades (Giddings 1956). They tend to be much thicker than microblades, and sometimes exhibit use-wear removed through burination. Due to the heavy force necessary to remove these thick flakes, burin spalls also show distinct bulbs of percussion and ripple marks, and may also be distinctly curved. In the case of the typical burin spall, a hinge fracture, rather than feathered termination, is another distinct sign of this particular type of flake removal.

The core-burin, initially defined at the Dry Creek site (Powers et al., 1983), is a rather obscure category that encompasses the microcore and burin at once. It may be considered a distinct type of thin wedge-shaped core, or alternatively, as a multifaceted burin. Although not widely used, it aptly describes those wedge-shaped cores that tend to be thin, with two or three facets on the fluted face that exhibit evidence of use-wear (Clark 2001). Artifacts of this category may be considered a variety of multi-tool, primarily cores and secondarily burins.

Tracing Cultural Relationships

Technology and Typology

One of the first questions that must be addressed when comparing lithic technologies is whether variation is meaningful in terms of tracing cultural associations. The main typological classification systems for microblades address their production methods, reflected in reduction sequences and microcore shape. It is assumed that methods of production, being systematic, complex, and relatively standardized within sites and even across geographic regions, must be culturally transmitted, passed from flintknapper to flintknapper. If this is true, certain methods of production would be inherited and transmitted within a cultural group, and continuity of production methods between sites should represent cultural continuity. However, tools are created to fill mainly utilitarian functions, and so it has also been argued that continuity of tool types and production methods represents continuity in utilitarian rather than cultural factors. Similarly, variation in toolkits has been argued to be due to functional requirements rather than cultural variation (Tomàškovà 2005:82-85).

The raw material used to create a tool may greatly influence the methods used to knap the stone, and consequently also on the final form of the tool. While chert and obsidian are most often considered ideal for flintknapping, the presence of inclusions and incipient fractures will influence workability. Silicified sandstones and mudstones include a great variety of minerals with a wide range of grain size and fracture patterns, some ideal for fine stone working, and others more marginally useful. Quartzite tends to be unpredictable and difficult to work with, and is not likely to be found among microblade assemblages, although there are exceptions to this rule (cf., Seong 2004 for further discussion). Quartz crystal microblades are less common, but have been found in Labrador (Jordan 1980), the eastern Arctic (Arundale 1980), and on the Northwest Coast (Lepofsky et al., 2000). Often, only fine-grained materials are used in the production of carefully standardized tools such as microblades. However, coarser-grained materials do provide an advantage in that they often require less platform preparation and grinding, since the rough material surface naturally prevents slipping of the billet or hammerstone (Ackerman 1980).

The size of locally available workable pieces may influence the types of tools that can be produced, and the methods that can be used to produce them. Since one of the proposed functions of microblade technology is the conservation of raw material, one should expect to see the greatest production of microblades in areas of lithic scarcity, and less production near areas of abundance. Further, under the assumption that different reduction processes conserve material more than others, variability in production methods and microcore shape could reflect resource availability and the need to conserve material, rather than cultural variation.

Despite these complicating factors, decades of archaeological study have provided a wide body of evidence, allowing archaeologists to propose a number of theories of cultural interaction based on the temporal and spatial distribution of various methods of microblade production in North America. Some theories, such as the tracing of Beringian migrations, are supported by relatively secure dating, strong consistencies in the archaeological record, and supporting interdisciplinary evidence from geological, biological, or linguistic sciences (Goebel et al., 2008). Others, such as the initial inhabitation of the Northwest Coast and protohistoric movements of the Athapaskan language group (Magne and Fedje 2007), still lack secure site dates and a complete archaeological record, but provide probable explanations for prehistoric population movements. The proposed Beringian and Athapaskan migrations, most relevant to the study of HiOv-89, are further addressed below. All dates referred to in this discussion are represented in uncalibrated radiocarbon years, unless otherwise noted. Further information on the inhabitation of the Northwest Coast can be found in Ackerman (1980, 1996) and Erlandson and Moss (1996).

Beringian Migrations

The archaeological study of microblade production has contributed to a suite of evidence suggesting that the Americas were first inhabited by populations migrating out of northern Asia and across Beringia during the late Pleistocene. The strongest evidence is from physical anthropology; modern populations in Asia and the Americas exhibit genetic continuities in mitochondrial DNA and phenotypic expression (Dixon 2001). Geological, archaeological, and linguistic studies have all provided evidence that inhabitation of the Americas began by at least 13 000 BP (calibrated), while some researchers have theorized that humans may have arrived as early as 30 000 to 50 000 BP

(Dixon 2001). These early dates are less well supported, and generally not accepted by the academic community.

Microblades seem to have become widespread in far eastern Siberia by 13 000 BP, with many sites dating to near 11 000 BP (Yesner and Pearson 2002). These sites are grouped within the Dyuktai Culture of microblade production, with wedge-shaped cores possibly being the only core type present before 10 000 BP (Chun 1992). Cores were prepared by bifacial shaping, and ridge flakes (often termed ski-spalls) and core tablets were a standard part of archaeological assemblages, strongly resembling microblade artifacts on the eastern side of Beringia over a similar time range. While a variety of different core shapes and production methods existed in surrounding areas of Japan and northern China, it is the Dyuktai Culture of Eastern Siberia that is considered the most likely source of the Beringian migrations based on both archaeological and geological evidence (Yesner and Pearson 2002).

The earliest confidently dated evidence for microblade production in North America is currently seen at Swan Point in the Tanana River Valley of central Alaska, with microblades found in a layer dating to at least 13 700 calibrated years BP, based on two corresponding AMS radiocarbon dates on charcoal samples (Holmes 2001; Holmes et al., 1996). The Tanana valley contains some of the oldest archaeological sites in North America, many of which appear to exhibit early occupation layers lacking microblades dating between 12 000 and 10 000 BP, and overlying microblade containing layers dating from 10 000 BP and younger (Yesner and Pearson 2002). These archaeological sequences posed some difficulties for the proposition that microblade assemblages represented the earliest migrations into North America. The early presence of microblades at Swan Point, however, and similarly early dates of microblade components at sites such as Dry Creek (uncalibrated radiocarbon dates 9340±195 and 10 690±250 BP; Hoffecker *et al.,* 1996) and Healy Lake (the oldest of 42 uncalibrated radiocarbon dates at the site is 11 410±60 BP; Cook 1996), indicate that sites lacking microblades are instead representative of either a contemporaneous non-microblade using culture, or more likely, seasonal variations in site function (Yesner and Pearson 2002).

Cores from the earliest microblade sites are generally wedge-shaped, and appear to have been produced by methods similar to the Dyuktai method (Ames and Maschner 1999:62). Because of these similarities and apparent temporal continuity, and supporting genetic evidence, it is hypothesized that a group of culturally and biologically related people, originating in eastern Siberia, migrated across Beringia into Alaska, becoming the ancestors of modern indigenous American peoples. The interdisciplinary evidence supporting this theory of Beringian migration also supports, in this case, the validity of using spatial distribution of archaeological materials to represent past population movements.

Proto-Athapaskan Migrations

Following the arrival of humans in western Alaska, migration must have continued steadily southward and eastward, in order to account for archaeological evidence of humans present in Monte Verde in South America before 12 500 BP (Bever 2006). Following the initial population of the Americas, cultural and biological groups did not remain stable, but continued to migrate and interact through trade and kinship networks, political alliances and rivalries, and according to their responses to environmental variables and disasters. Such interactions are much more complicated, and difficult to trace, than the migration of a single population into a previously uninhabited territory. Often a suite of well-preserved, highly distinctive artifacts, showing clear spatial and temporal patterning, is required to trace the movements of a cultural group over time. These studies have been successful in using artwork and housing styles to trace the late Holocene origins of modern cultural groups on the Northwest Coast (for an overview of these studies, and list of references, see Ames and Maschner 1999). Recent efforts have been made to use similar methods to trace Athapaskan origins using the microblade as a diagnostic artifact (Magne and Fedje 2007).

The Na-Dene, or Athapaskan, language family in its historic distribution covers a large portion of western North America, closely mirroring the distribution of currently known microblade sites (Figure 2.2). These sites show distinct temporal patterning, with the oldest sites found in Alaska, younger sites in the Yukon and northern British Columbia, and the youngest spreading outward into the British Columbian Plateau and the Northwest Territories (Magne and Fedje 2007). Furthermore, a number of prehistoric microblade sites have been associated with modern ethnohistoric Athapaskan activity (Magne and Fedje 2007). It has been hypothesized that these sites represent the prehistoric migration of a proto-Athapaskan culture, southwards and eastwards from its origins in western Beringia, into the historically recorded territory of the language group (Borden 1968; Dumond 1969).

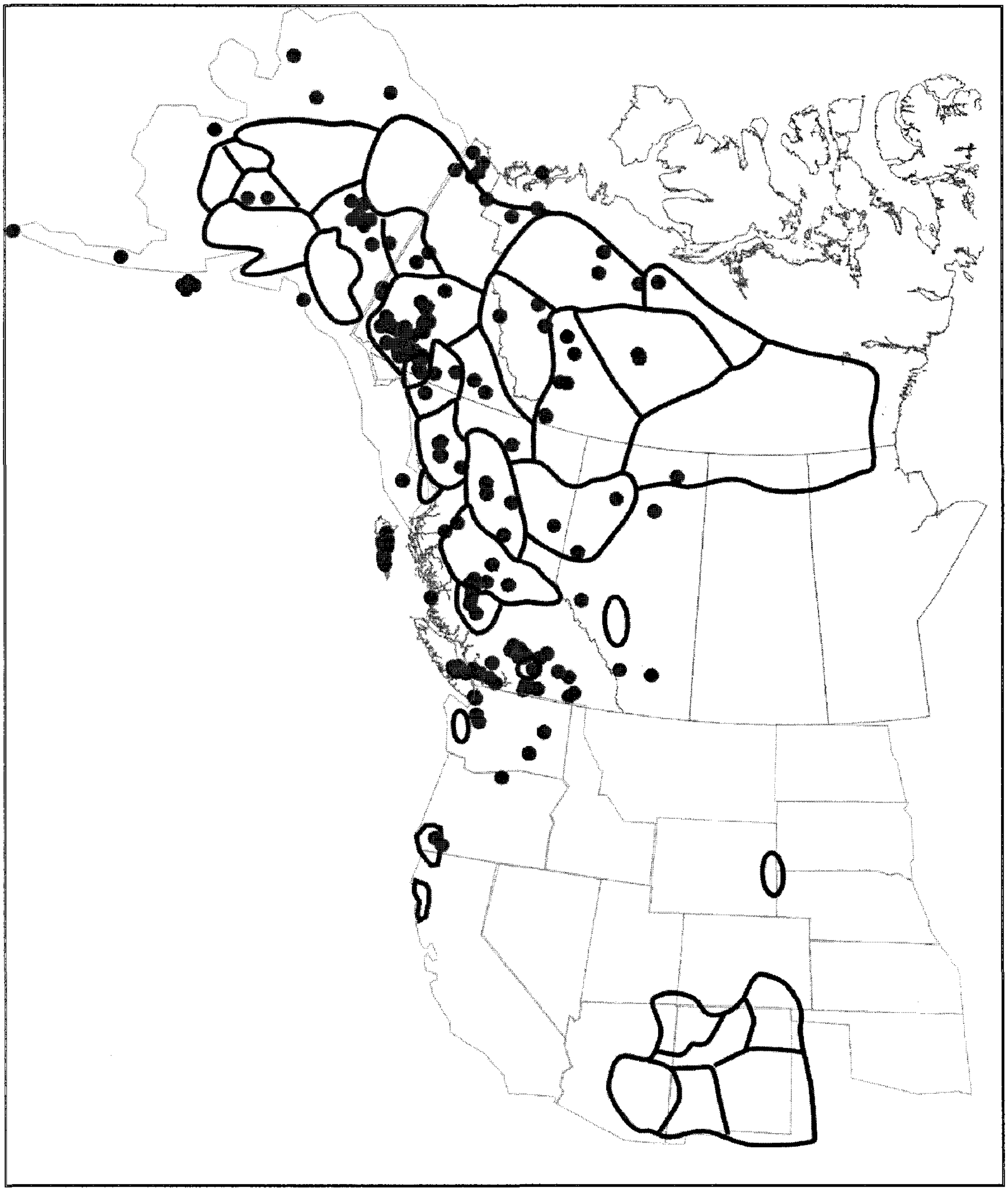

Figure 2.2 Distribution of Northwest Microblade tradition sites and Athapaskan groups at contact. (Sites with >1 microblade;196 sites from Alberta, B.C., Yukon, NWT, and Nunavut databases. American data from published sites only and therefore incomplete). From Magne and Fedje 2007, used with permission from Archeology Press, Simon Fraser University.

While this theory is highly plausible, it must be applied with caution. Although the use of microblades to trace proto-Athapaskan cultural continuity is partially supported by modern linguistic data, this information cannot be used to verify cultural relationships of the past. Linguistic groups and cultural traits were likely very different 10 000 years in the past than in the present, and archaeologists must be careful not to assume that modern Athapaskan cultural traits can be automatically associated with prehistoric sites. Furthermore, the simple presence or absence of microblade sites in a region is not the only factor to be considered. Sites in different regions display differing microcore technologies, indicating many possible cultural distinctions. Comparison of these various traditions of microblade production could be compared with Athapaskan linguistic subgroups, in order to evaluate the validity of using traditions of microblade production to trace cultural relationships. Early evaluations by Dumond (1969), although focusing on temporal rather than technological factors, seem to indicate a continuity between linguistic groups and variations in microcore technology.

The study of microblade sites in relation to proto-Athapaskan cultures may be highly relevant to the archaeological study of HiOv-89 in the Athabasca Oil Sands. The area along the Athabasca River north of Fort McMurray rests on the very edge of Athapaskan territory as recorded at contact, near the borders of a number of Aboriginal cultural groups, most notably the Athabasca Chipewyan to the northeast, the West Woodland Cree to the southeast, and the Athapaskan Beaver and Slavey to the west. All four groups have been recorded in the journals of fur traders in the area, and protohistorically in oral traditions; however, the prehistoric distributions of these culture groups and their ancestors are still unclear (Ives 1993). Archaeological study of the area has also indicated a significant Plains cultural influence on Alberta's subarctic populations during prehistoric times (Ives 1993; McCullough and Wilson 1982). The presence of microblade technology indicates a prehistoric northwestern cultural influence, and the possibility of migration of Athapaskan or proto-Athapaskan groups throughout the area. Evidence for such cultural continuities could be strengthened by the association of microblade sites in Alberta to known traditions of microblade production seen in the far northwest.

Microblade Traditions of Northwestern North America

The following description of microblade traditions in North America is based on a somewhat generalized view of microblade technology and microcore form. Since the first discovery of microblades in the subarctic, archaeologists have proposed many different, often overlapping classification systems, based on microcore forms, production sequences, microblade characteristics such as retouch and hafting marks, and occasional circular methods of definition based more on site dates and geographic location than on actual artifact characteristics. A holistic approach seems most sensible under these circumstances. Since core shape is highly reflective of the production sequence used to create it, and since patterns in production methods over time and space are indicative of cultural distributions, the interpretation of all factors together provides the greatest potential for inference.

Smith (1974a, 1974b) proposed a techno-typological method for classifying microcore types, dividing production into three sequence types; System *A* involved shaping of a biface blank, followed by platform preparation, and finally fluted face shaping and microblade removal (Figure 2.3). System *B* is informal, with the platform removed first from a pebble blank, followed by fluted face shaping and flake removal (Figure 2.4). System *C* is identical to System *A*, with a flake used as a blank rather than a biface. This method was based upon an amalgamation of Morlan's non-metric classisfication system proposed for North American cores (Morlan 1970), and Kobayashi's system proposed to incorporate cores from northeasern Asia and northwesern America (Kobayashi 1970). While Morlan and Smith's systems are both well-known, and there is definite value to the use of production sequence to describe microblade production technology, they are difficult to apply to the current research. Systems *A* and *C* are virtually identical except for more extensive blank preparation in the former, which has been much further elaborated upon, with a number of subsystems. System *C*, however, is common in North America, and in reality shows at least as many variations as System *A*. Variation in the relationship of the blank to the production sequence is also masked in Smith's method, since each system has a predetermined blank form, while in reality the starting material only partially influences the choices made during production. The analysis here will take into account the production sequence of microcores, focusing on the methods used in Systems *A* and *C*, which are common to the Denali Complex (see below); however, Smith's method of classification will not be used.

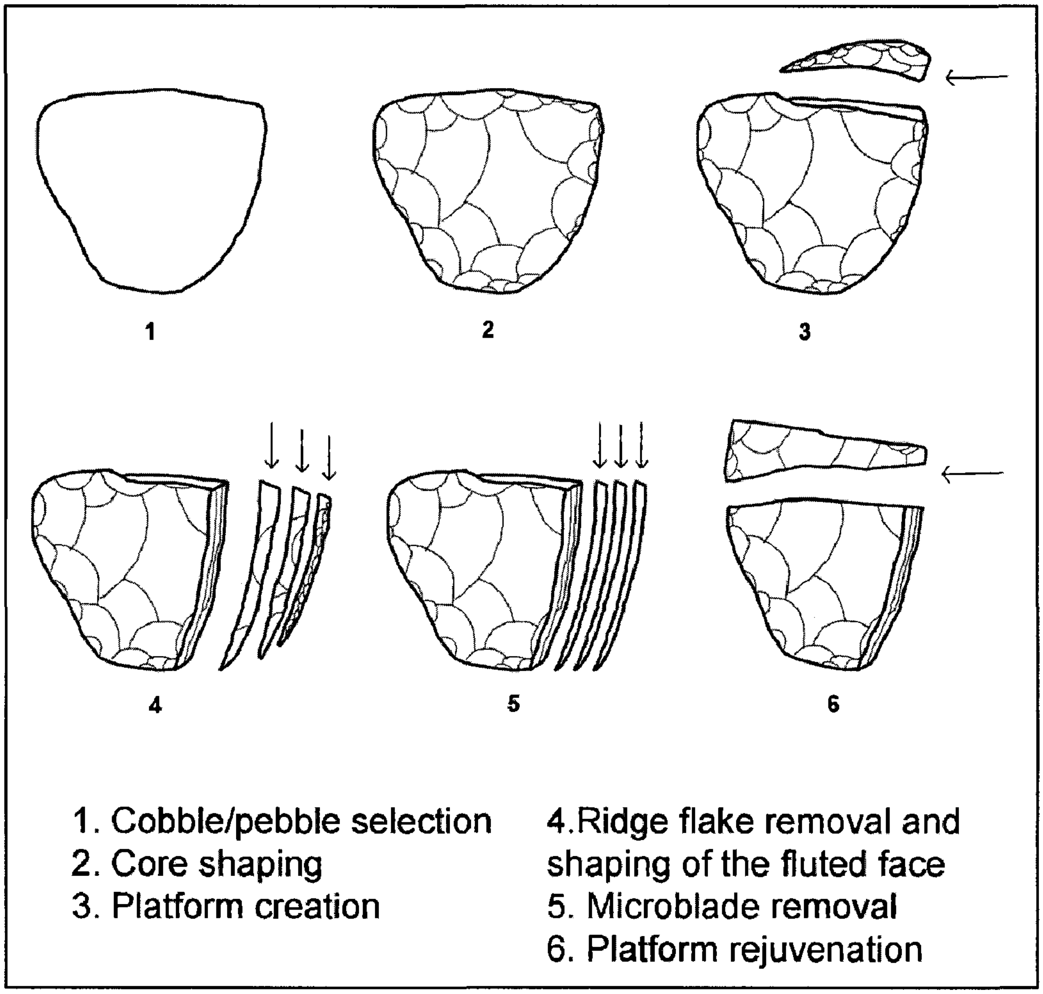

Figure 2.3 System *A* of microcore reduction

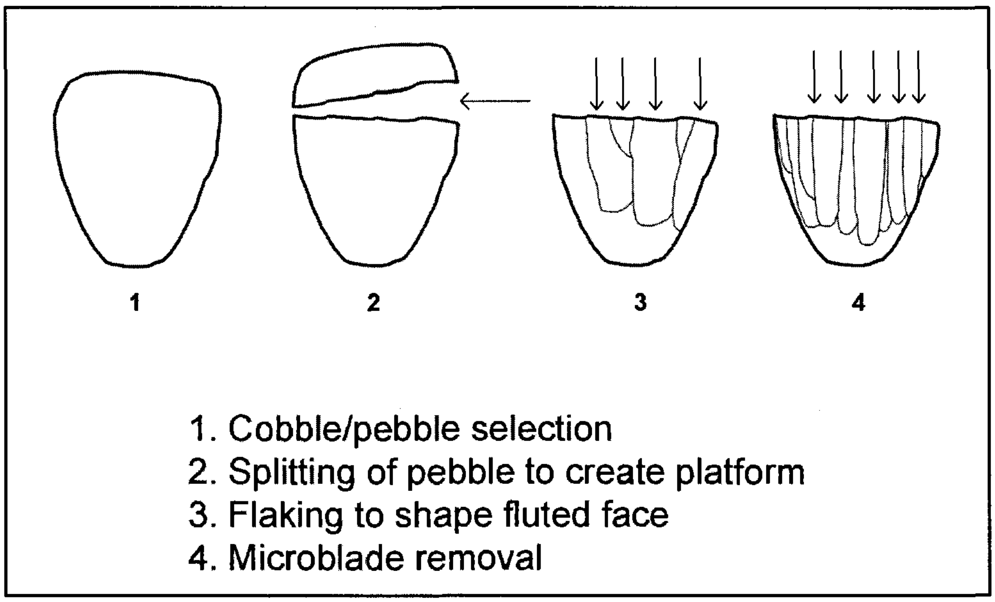

Figure 2.4 System *B* of microcore reduction

The most common method for the archaeological study of microblades focuses on *traditions* of microblade production (Table 2.1; Figure 2.5). Traditions are composed of large regional groups of assemblages exhibiting similarities in microcore form and in the presence or absence of such specialized debitage as ridge flakes and core tablets. Many researchers have proposed smaller, more specialized groups of *complexes* and *industries* within the traditions discussed below, generally referring to single sites or geographically limited groups of sites. While these categories do seem to show consistent variations in the details of production methods, the overall production sequence, and resulting core forms, are the same, and so the details of these groups are not discussed here. As well, when conflicting or overlapping traditions exist, they will be described within a single category. As with the previous discussion, all dates discussed are given in uncalibrated radiocarbon years unless otherwise specified.

NANAMt

The Northeast Asian – Northwest American Microblade tradition (NANAMt), defined by Smith in 1974 (Smith 1974a, 1974b), was proposed to encompass all prehistoric cultures in northeastern Asia and northwestern North America associated with any type of microblade production prior to the development of the Arctic Small Tool tradition in the Canadian Arctic by approximately 4000 BP. All microcore types found in these regions would be included in this tradition, including three distinct microcore reduction sequences. While spatial and temporal patterns of the presence of microblade production do indicate associations, little can be said about such associations at this scale other than an overall relationship between eastern Asian and western North American

Table 2.1 Traditions of microblade production in eastern Asia and northwestern North America

Tradition	Date (BP)	Microcore Shape	Base	Platform Preparation	Platform Rejuvenation	Ridge Flakes	Burins
Dyuktai	15000 - 10000	wedge	biface	spall	tablet or partial tablet	yes	yes
NWMt / Denali / APA	12000 - 3000	wedge	flake/pebble	spall	tablet	yes	yes, and core-burins
Arctic Small Tool	4000 - 1000	conical	pebble/block	variable	variable	rare	yes
Northwest Coast	9000 - 4000	conical, boat, irregular	pebble	flaking/none	rare	no	no
Plateau	7500 - 2000	wedge	pebble	rare	rare	no	no

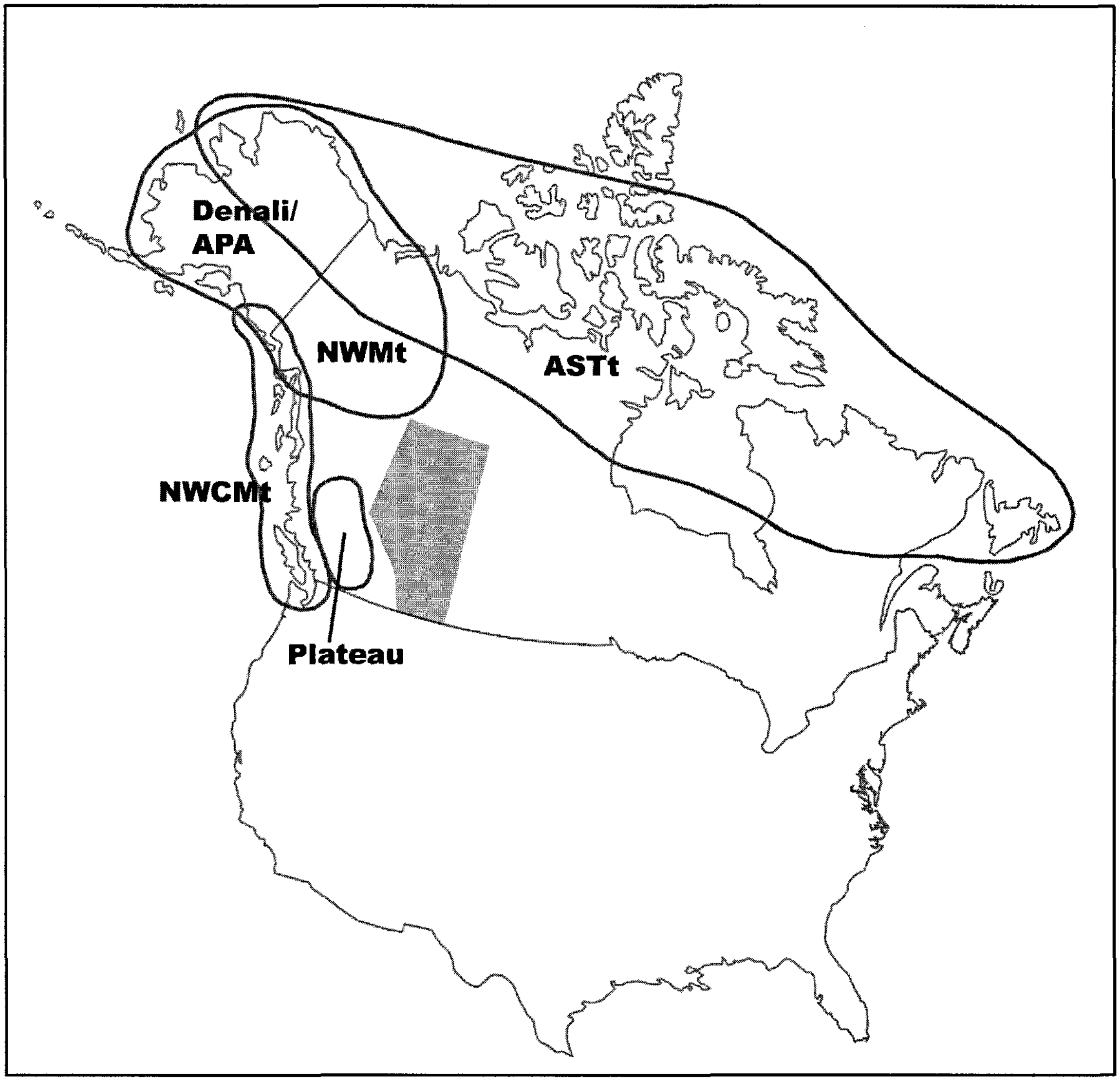

Figure 2.5 Microblade traditions of northwestern North America, in relation to the province of Alberta

cultural groups; this generalization provides little analytic value in terms of cultural relationships *within* western North America. The wide geographic and temporal range proposed for the NANAMt is also much wider than usually considered suitable for the definition of a tradition, and so the NANAMt is rarely used in archaeological study.

The Denali Complex and other Wedge-Shaped Cores

The wedge-shaped core, typified by microcores found at the Campus site in Alaska (Rainey 1939; Mobley 1991), is generally representative of most microblade assemblages in the early to mid-Holocene western Arctic and Subarctic. The most common form is created from a pebble or thick flake, bifacially modified to create a wedge-shaped preform. Further flaking creates a ridge to guide the removal of a series of flakes, creating a fluted face from which microblades are removed. A flat platform is created on the upper surface of the core by the removal of a single spall, usually from the front, and rejuvenation proceeds through further similar spall removals. The *ridge flakes* and *platform tablets* created during this process may be used as evidence of the characteristic "Campus-type" core, also referred to as a "Denali" or "Gobi" core. Variations usually included in this group include cores unifacially modified from naturally wedge-shaped flakes, and those with platforms prepared by transverse flaking of the platform rather than spall removal. These follow the production sequence described by Systems *A* and *C* (Figure 2.3), in which the core blank is shaped first, followed by platform removal and finally fluted face shaping and microblade removal. A certain type of burin, the notched transverse burin, was first noted at the Donnelly site assemblage (Hadleigh-West 1967), but has now been recognized in microblade assemblages across Alaska and the Yukon. The Donnelly burin can be recognized by notching of the platform rather than use of a snapped or flaked edge, and by a transversely oriented burin facet along the width, rather than length, of a flake or tool.

Throughout the northwestern Arctic this technique of microblade production and its associated wedge-shaped microcores is seen from just over 11 000 BP to less than 3000 BP (Clark 2001, Yesner and Pearson 2002). It is less common after 7500 BP in Alaska, and occurs over a slightly later time period in the Yukon and Northwest Territories, with the most common dates ranging from 8000 to 7000 BP. It has been included within a number of overlapping lithic traditions, including the American Palaeo-Arctic Tradition (Anderson 1968, 1988), the Northwest Microblade Tradition (MacNeish 1954), and the Denali Complex (Hadleigh-West 1967). Sites of these traditions contain combinations of wedge-shaped Campus cores, Donnelly burins, core-burins, scrapers, bifacial tools, and lanceolate and notched points.

The Denali Complex originally was seen as existing in Alaska, while the Northwest Microblade Tradition was found to the east in the Yukon (Hadleigh-West 1967). However, it has also been proposed that the same method of microblade and lithic tool production can be seen in both categories, and that the above-named traditions should be considered under a single definition (Clark 2001). I agree with this proposal, and while no consensus has been reached regarding the name of such an overall tradition, I agree with Clark and Gotthardt (1999) in preferring the use of the Denali Complex, as one of the most familiar, commonly used terms, and one that is most strongly associated with microblade technology specifically. Unlike the Northwest Tradition, the Denali Complex also poses no danger of being confused with the Northwest Coast Microblade tradition. Although originally defined as a complex, it has grown to encompass the role of a tradition, and is considered as such for the purposes of the current research. Major sites of the Denali Complex are listed in Table 2.2, and shown in Figure 2.6.

After approximately 7000 BP, northwestern microblade technology became more variable, and less common in securely dated archaeological assemblages (Clark 2001). Cores found in the north after this time include wedge-shaped cores of less standardized production methods, as well as tabular, conical, and cylindrical cores, and irregular cores recognizable only by the presence of blade-like flake scars and absence of bipolar percussion. A resurgence of the Denali method of production is also seen in the northwest after 5000 – 4000 BP, and has been termed the Late Denali (Dixon 1985). Sites such as the Pointed Mountain site (4000 BP to 2200 BP; Millar 1981) exist within this later time range, and are clearly related to Denali technology (Clark and Gotthardt 1999).

The West Coast and Interior Plateau

The Northwest Coast Microblade tradition is a diverse, loosely-defined category encompassing the various core types found on the Northwest Coast after the disappearance of the earliest, Campus-type cores. It was proposed by Ackerman et al. (1985) to describe the Early and Middle Holocene microblade sites throughout the area. Sites of this tradition date from 8500 BP to approximately 4000 BP, and generally include cores fashioned from split pebble preforms, and less commonly, thick, unshaped flakes (Ackerman 1996). It is believed that this method of production was adapted to take advantage of readily locally available beach cobbles and pebbles, whose coarser

Table 2.2 Selected representative sites of the Denali Complex

Site	Date (BP)	Microcore Shape	Base	Platform Preparation	Platform Rejuvenation	Ridge Flakes	Burins	Source
Campus	3500 - 2725	wedge	flake/ biface	spall	tablet, flaking	yes	yes, and core-burins	Mobley 1991
Donnelly Ridge	indeterminate	wedge	pebble/ flake	spall	partial tablet	yes	yes	Hadleigh-West 1967
Dry Creek	10700	wedge	flake	flaking/spall	partial tablet	yes	yes, core-burins	Powers *et al*. 1983
Healy Lake	13500 - 9150	wedge, tabular	variable	flaking	flaking	no	yes	Cook 1996; Holmes 2001
Ice Mountain (Mount Edziza)	5000 - 4000	wedge-like	biface	spall	core rotation	yes	no	Fladmark 1985
Pointed Mountain (Fisherman Lake)	4000 - 2200	wedge, tabular	variable	variable	variable	N/A	yes, and core-burins	MacNeish 1954, Millar 1981
Kelly Creek	indeterminate	wedge	thick flake	flaking/spall	tablet	probable	yes, and core-burins	Clark and Gotthardt 1999
Onion Portage (Kobuk & Akmak)	9500 - 7000	wedge	flake/ pebble	spall/partial spall	tablet	N/A	yes	Anderson 1970, 1988
Otter Falls	4570	wedge	flake	flaking/spall	flaking/ spall	N/A	core-burins	Cook 1968, Workman 1978
Swan Point (Early Component)	Cal 13700	N/A	N/A	N/A	rejuvenation flake	yes	yes	Holmes 2001
High River (Alberta)	indeterminate	wedge	flake	N/A	partial tablet	yes	no	Sanger 1968b
Bezya (Alberta)	4000	wedge	pebble	flaking/partial spall	partial tablet	yes	yes	Le Blanc and Ives 1986

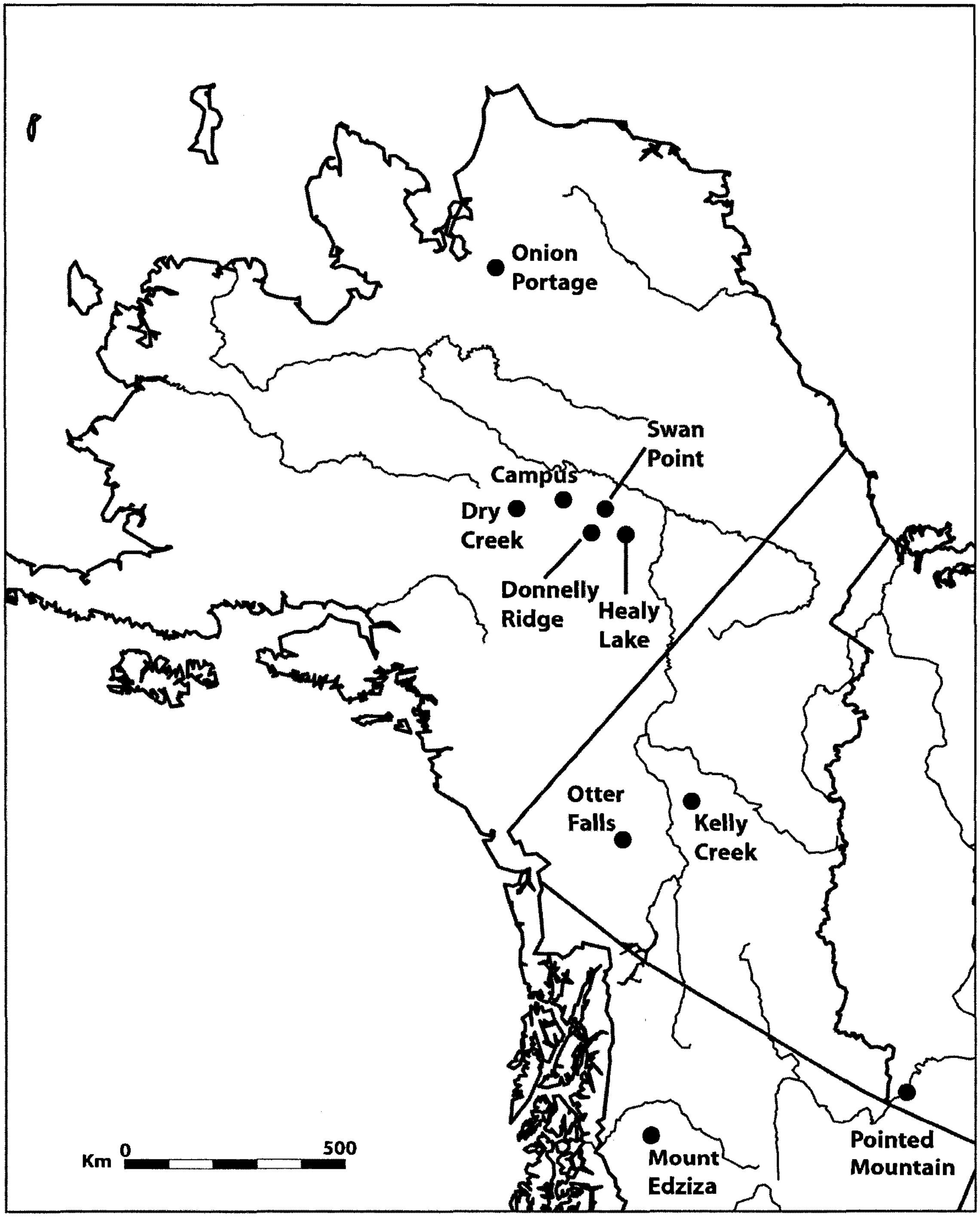

Figure 2.6 Denali Complex sites discussed in text

grain texture made extensive shaping more difficult, and required little preparation to roughen a platform (Ackerman 1980). Conservation of lithic material is obviously less crucial here, and methods of core preparation on the Northwest Coast indeed seem to reflect a more liberal, less systematic approach to lithic reduction.

Core shapes of this tradition include mainly conical and cylindrical forms, but also reported are blocky, amorphous, and informally wedge-shaped and tabular forms, which are thicker and have much wider fluted faces than their counterparts to the north. Platform preparation is rare, and platform rejuvenation even less common. Cortex is common on the lateral surfaces, and even on the striking platform. A second coastal tradition, the Moresby Tradition, was originally proposed to be specific to Haida Gwaii (Fladmark 1979), but it includes artifacts functionally and typologically equivalent to those of the Northwest Coast Microblade tradition (Ackerman et al., 1985, Fedje and Christensen 1999, Magne 1996).

The Plateau tradition was defined by Sanger (1968a) to describe a method of production consistent throughout the Interior Plateau of British Columbia from 7500 to 2000 BP. Common characteristics are generally wedge-shaped cores with little to no platform preparation, and a single fluted face. Microblades tend to be triangular, with a general absence of ridge flakes, and the materials used are almost entirely locally available (Sanger 1968a, 1970). It is possible that this tradition spread inward from the coast, retaining the lack of ridge flakes and platform preparation seen in the Northwest Coast Microblade tradition, but again changing in form to reflect locally available materials.

Arctic Small Tool Tradition

This tradition is relatively well known, associated with the pre-Dorset and Dorset cultures throughout the northern Canadian Arctic. The Alaskan Denbigh Flint Complex has been grouped within the Arctic Small Tool tradition (Maxwell 1985), associated with the Palaeo-Eskimo culture of the Canadian Arctic. Early sites of this tradition are seen in Alaska, with the tradition becoming widespread across the Canadian Arctic by about 4000 years ago. Once established, the tradition was stable, showing 3000 years of continuity (ibid.). Cores of this tradition are conical or pyramidal, with some wedge-shaped variants, producing specialized non-triangular microblades often found to have been extensively retouched and broken distally (Wyatt 1970). Platform preparation and maintenance are variable, including partial spall removal, random flaking, or no preparation at all (Clark and Gotthardt 1999). Ridge flakes are rare, but have been found among artifacts of the Denbigh Flint Complex component at Onion Portage (Anderson 1970). These characteristics make the Arctic Small Tool tradition distinct from the Denali complex, but knowledge of this tradition is useful for comparative purposes because of its detailed, relatively complete assemblages including not only microblades, cores and burins, but also preserved handles and tools in which microblades were hafted (Maxwell 1985).

Recent Discoveries in Alberta

As can be seen from the traditions described in the previous section, microblade assemblages in North America are conventionally associated with the far northwest.

Until recently, the boreal regions of northern Alberta have been considered too far southeast to be a part of these archaeological and cultural systems, and have instead been associated with plains and parkland assemblages in archaeology, and western boreal Cree cultures in anthropology. Despite the publication of the High River microblade assemblage in southern Alberta in 1968 (Sanger 1968b), and the Bezya assemblage in northern Alberta in 1986 (Le Blanc and Ives 1986), the presence of microblade producing cultures in Alberta has only been addressed in passing, as these two isolated sites have been difficult to place within a regional context. Isolated finds of blade-like flakes and microcores, such as the Fort Vermillion microcore (Pyszczyk 1991), have been sporadically reported since the late 1980s, although most have remained in the unpublished grey literature of government mandated archaeological consulting reports (Figure 2.7; see also Chapter 7 for further discussion). It was not until after the turn of the twenty-first century that consistent finds of microblade assemblages, containing evidence of the full sequence of microblade production, began to appear in the Oilsands of northeastern Alberta, and as yet these assemblages have been sparsely addressed in both the published and unpublished literature.

High River Microblades

The High River microblade assemblage was originally discovered in the 1950s in a blowout a few kilometres east of High River in southwestern Alberta. The original collection included only microblades and ridge flakes, lacking microcores and preventing definitive conclusions about the technology used to create them. However, two cores were discovered between 1981 and 1982 in a site approximately two kilometres to the

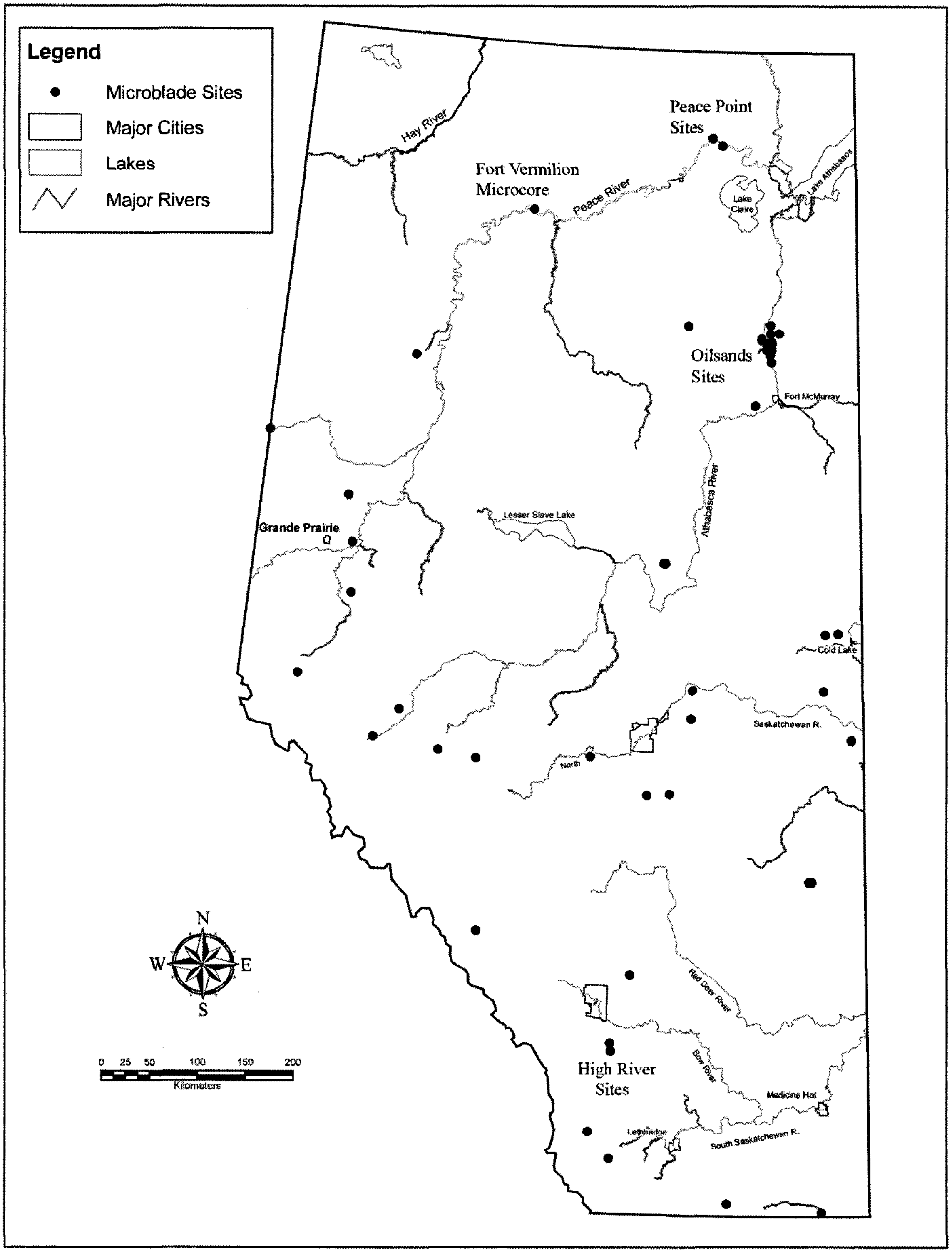

Figure 2.7 **Reported microblade finds in Alberta. Map by Robin Woywitka. Site information and GIS data from the Alberta Archaeological Site Inventory, Archaeological Survey of Alberta, April 2008**

southeast, followed by the discovery two previously collected but unidentified microcores from the same area. The artifacts all seem to display a consistent technology similar to that seen in the Denali Complex, but exhibiting some unique characteristics (Visser et al., 2008). All four cores were created from thick flakes, with ridge flakes used to create both the fluted face and platform. Platform rejuvenation is evident in the form of truncated spalls rather than full platform tablets (ibid.). Cores are tabular to wedge shaped, and although they have been bifacially and unifacially flaked, they lack keels. Fluted faces are thin, composed of two to three blade scars, and the majority of microblades are trapezoidal. The High River microcores are unique in having a distinctly longer fluted face than average for Denali cores (ibid.).

Northeastern Alberta and the Oilsands Region

A number of isolated microblade sites from northern Alberta have been reported in the grey literature of archaeological consulting reports available through the Archaeological Survey of Alberta (ASA); however, only a few have been verified and published. The most significant of these sites, containing five microcores and over 100 microblades, is the Bezya site (HhOv-73, Le Blanc and Ives 1986) within the Oilsands region of northeastern Alberta. The cores from this site are wedge-shaped, created from small chert pebbles with ridge flake preparation and partial platform rejuvenation. They appear much like Denali cores, and Le Blanc and Ives suggest that the site may represent a far eastern extension of the Northwest Microblade Tradition (ibid.: 88-89). A composite radiocarbon date tentatively places the site near 4000 uncalibrated years BP.

A single microcore was found at the Gull Lake prehistoric site, in a ploughed field near Fort Vermilion in far northern Alberta (Pyszczyk 1991). The face is distinctly wedge-shaped and the keel, while not sloping up to the platform, is bifacially shaped (ibid.). The core is relatively large compared to others found in Alberta, and the fluted face contains eight flute scar facets (ibid.). The Gull Lake Site is interpreted to include multiple occupations over thousands of years, and due to the disturbed context of the site, no date or cultural association can be assigned to the artifact (ibid.).

Blade-like cores, microblade-like flakes and microblade-like cores have been reported at the stratified Peace Point site in Wood Buffalo National Park, far northeastern Alberta (Stevenson 1981, 1986). The materials come from a number of different strata in the site, dating 1040 BP and later, up to the protohistoric era (Stevenson 1986). Although they display a similar technology in that cores were shaped and unidirectionally flaked, possibly producing regularly-shaped flakes, these cores are not definitively related to microblade production. They are irregularly shaped, with wide, less regularly placed flake scars on their fluted faces. They have not been widely accepted as microcores (Clark and Gotthardt 1999:151). Microblade-like cores and flakes have also been reported much farther south, at four sites on Calling Lake 200 km north of Edmonton (Gruhn 1981:33, 49, 65). These cores are also somewhat blocky and irregularly shaped compared to the formal microblade cores seen in the far northwest. While they may represent a form of microblade or blade-like technology, they appear to be unrelated to the Denali method of microblade production.

Finally, a number of possible microcores and blade-like flakes have been reported during recent investigations within the Alberta Oilsands region. Like Bezya, these sites have been discovered during archaeological survey and mitigation projects contracted by oil industry developers. Unlike Bezya, however, few of these sites have been thoroughly investigated, and although reports of the sites have been submitted to the Alberta Government, none have been published. At present, the identity of microcores at the majority of these sites has not been verified, and little information yet available allows for the incorporation of such sites into the wider picture of microblade production in northwestern North America. These sites have the potential to expand the currently accepted range of microblade technology, under which the Bezya, Fort Vermilion, and High River microblades and cores are considered something of an anomaly, and not yet representative of strong cultural associations with the subarctic and arctic populations of Alaska and the Yukon. HiOv-89 is one such site, containing a relatively large number of wedge-shaped microcores, ridge flakes, burins, and burin spalls, which has great potential to contribute to our knowledge of microblade technology within Alberta, and its relationship to the established microblade traditions in the far northwest.

Chapter 3 Site Background

Regional Environment

Palaeoenvironment

The landscape along the Athabasca River from Fort McMurray to Lake Athabasca was strongly affected by glacial and periglacial processes during much of the late Pleistocene and early Holocene. Deglaciation of the area occurred approximately 10 500 years BP (Rhine and Smith 1988), resulting in the creation of massive proglacial lakes as meltwater became trapped by glacial landforms and the retreating Laurentide Ice Sheet itself. Glacial Lake Agassiz covered much of northern Saskatchewan to the east, and Glacial Lake McConnell stretched along the Athabasca River, beginning near Fort MacKay and extending over what are now Lake Athabasca and Great Slave Lake.

Unflooded portions of land were likely immediately colonized by cold-adapted vegetation, creating an open steppe-like environment (Lichti-Fedorovich 1970). Pollen core records from Kearl Lake indicate that by 10 250 BP, the region southeast of Glacial Lake McConnell was vegetated by an open spruce, birch, and herb environment (Bouchet-Bert 2002: 64). This environment persisted for three millenia, although becoming more open and dominated by deciduous vegetation around 9800 BP (ibid.: 64). By approximately 8780 BP, the Laurentide Ice sheet had retreated to northeastern Saskatchewan, and the postglacial lakes had drained and separated into their modern locations of Lake Athabasca, Great Slave Lake to the north, and Wasekamio and Turnor Lakes to the east (Rhine and Smith 1988; Smith and Fisher 1993). At 7500 BP, pine appear in the pollen record, and it is hypothesized that the environment had developed into a more closed, mixedwood boreal forest, with peat moss rather than herbaceous ground cover, similar to that seen in northern Alberta today (Bouchet-Bert 2002: 65; Vance 1986) . Despite the presence of peat mosses in the pollen record, more detailed studies indicate that peat growth was initially limited to lake infilling and flooded areas (Hutton et al., 1994). True muskeg bog and fen development through sphagnum peat succession did not begin until at least 6000 years BP, and modern peatland complexes were not fully developed until 4000 to 2000 BP (Hutton et al., 1994; Halsey et al., 1998).

The Fort Hills uplands are a Kame Complex, deposited directly by the melting Laurentide Ice Sheet near the southern limit of its last major glacial advance. HiOv-89 lies directly to the north of these uplands, approximately 6 km east of the Athabasca River near the western edge of the McClelland Lake wetlands. The site sits on the banks of one of numerous small lakes surrounding the wetlands. While their specific origin has not been studied, geological studies of the surrounding area indicate that they are most likely sinkhole lakes. A palaeokarst formation is found throughout much of the Oilsands of northeastern Alberta beneath the Athabasca tar sands deposit (Dembiki and Machel 2006), influencing the geography of the region where the tar sands deposit is thin or absent. Among other sinkhole chains in the region, a chain of large lakes related to karst geology has been documented at the northern edge of the wetlands (Axys Environmental Consulting Ltd., 2005).

The McClelland wetland complex rests on the southern margin of a 4000 km^2 glacial braid delta floodplain that extends along the banks of the Athabasca River to its modern delta at Lake Athabasca (Rhine and Smith 1988). This braid delta was deposited by the Athabasca River at the southern edge of Glacial Lake McConnell between 10 500 and 8780 BP, as glacial meltwater from Lake Agassiz, brought west by the Clearwater and Athabasca Rivers, drained through Lake McConnell northward into the Arctic Ocean (ibid.). Much of this deposition may have occurred during a catastrophic flooding from Lake Agassiz circa 9900 BP, lasting possibly 78 days as the water levels of the massive glacial lake dropped by 46 metres (Smith and Fisher 1993). The floodwaters incised deep channels still visible along the Clearwater and Athabasca Rivers, and dispersed into a fan near Lake McConnell, depositing enough eroded sediment to push the banks of the lake progressively farther north.

While the majority of deposition of the Athabasca braid delta may have occurred during the flood, it is likely that moderate deposition continued until the lakes were fully drained by 8780 BP (Rhine and Smith 1988). This interpretation places vegetation development, and possible human habitation, of the braid delta significantly later in time than for the unflooded areas to the south and within the Fort Hills Uplands. Furthermore, although the majority of the sand dunes on the braid delta are now stabilized, it has not yet been established at what time this occurred, and the time required for stabilization may push the time of possible occupation of HiOv-89 and other sites on the braid delta even closer to the present.

Climate

The area between Fort McMurray and Fort Chipeweyan borders between humid continental and subarctic climate zones, experiencing warm summers and long, cold winters, with average temperatures below 0°C for six months of the year (Environment

Canada 2006a). Modern environmental data cannot be considered entirely representative of past conditions; however, the relatively early stabilization of a boreal forest environment provides some evidence that the climate was likely relatively stable over time as well.

Environmental data have been collected for the Fort Hills region from the Bitumont Fire Tower, located in the south of the Fort Hills uplands (Environment Canada 2006b). As the Fire Tower is only manned during the summer, no winter data are available for the area. The most consistent and thorough climatological records in northeastern Alberta are those for the city of Fort McMurray (Environment Canada 2006a). Average temperatures and rainfall for the summer months from 1961 to 1990 are very similar for the two stations, differing only by a fraction of a degree or a few millimetres, and so the Fort McMurray data may be considered representative here. Temperatures in the region range from extreme highs of 36°C in the summer to extreme lows of -50°C in the winter, with an overall daily average of 0.2°C (ibid.). Average daily temperatures range from 16.6°C in the month of July to -19.8°C in January. Annual precipitation is moderate, averaging 334.5 mm of rain and 172 cm of snow, with snow covering the ground from mid-October to mid-April, reaching depths of 31-32 cm during most of January and February (ibid.).

Vegetation

The majority of northern Alberta, including the study area, is vegetated by boreal mixedwood forest (Beckingham 1996:24). Although often perceived as thick, boggy, and featureless, the boreal forest comprises a surprising diversity of flora, varying in composition according to soil, drainage, and topography. Stands of aspen (*Populus tremuloides*) or poplar (*Populus balsamifera*) with alder (*Alnus crispa*) and wild rose (*Rosa acicularis*) underbrush are most common, and may be found in moderate to well-drained areas (Beckingham 1996: 24). In high, well-drained, sandy areas are expanses of mature open jack pine (*Pinus banksiana*) with reindeer lichen (*Cladina* spp.), club moss (*Lycopodium* spp.), and blueberry bush (*Vaccinium myrtilloides*) undergrowth. In low, wet areas, black spruce (*Picea mariana*), willow (*Salix* spp.), tamarack (*Larix laricina*) and Labrador Tea (*Ledum* spp., colloquial Trapper's tea) surround vast open tracts of muskeg bog and fen, composed of spongy layers of sphagnum moss (*Sphagnum* spp.) (Natural Regions Committee 2006). Various combinations of these groups of vegetation may be found throughout the boreal forest, and may also contain white birch (*Betula papyrifera*), white spruce (*Picea glauca*), a wide variety of berries including wild raspberry (*Rubus idaeus*), cranberry (*Vibernum edule*) and buffalo berry (*Shepherdia canadensis*), and a variety of grasses, mosses, lichens, fungi, and herbs. Boreal forest soil types most commonly include Organics, Grey luvisols, Brunisols, and Gleyosols (Beckingham 1996: 25). Moisture regimes range from sandy, well-drained xeric to boggy poorly-drained mesic.

Distribution of vegetation in the boreal forest varies over time according to forest succession and muskeg development cycles. Forest fires have likely always played a large role in the boreal forest environment, burning off mature, closed forests and established muskeg layers. Continual development of peat layers greatly decreases soil drainage properties and encourages wetland development, while the burning off of muskeg opens up potential habitat for forest growth. It has been hypothesized that prehistoric forests were more open before the modern suppression of natural wildfires and traditional controlled burnings (Lewis 1980). Forest fires may also once have limited muskeg growth by burning off old layers of sphagnum. It may also be noted that boreal flora exhibit great seasonal variation; long winters and deep snow not only limit the growing season of many plant resources, but also limits accessibility to these resources over much of the year.

Fauna

Mammals most notable to the boreal forest ecosystem are moose, beaver, black bear, muskrat, snowshoe hare, and a variety of mice, squirrels, weasels, and deer (Natural Regions Committee 2006). Less common are the grizzly, grey wolf, lynx, fisher, wolverine, woodland caribou, woodland bison, and elk (ibid.). The larger fauna of the boreal forest tend to be solitary, wide-ranging species. Woodland caribou and bison travel in small dispersed herds, and are much more solitary than the gregarious plains bison to the south, or tundra caribou to the north. Although both species are rare at present, they may have been more widespread in prehistory, before historic environmental disruption caused by over-hunting and industrial development. Smaller mammals such as hare, mice, and squirrels are plentiful and widespread. A wide range of birds live in or migrate through northern Alberta, including Canada geese, hawks, grouse, chickadees, magpies, whiskeyjack, and various species of gulls, ducks, owls, and songbirds (Mucklow 2002).

Wetland areas of the boreal forest, including lakeshores, rivers, ponds, swamps and fens, attract the greatest diversity of wildlife, and support a variety of fish species, including northern pike, yellow perch, pickerel, whitefish, lake chub, trout, and various species of suckers and shiners (Natural Regions Committee 2006). They compose one of the few locations where the presence of both floral and faunal resources may be relatively easily predicted, as well as providing breeding grounds for some of Alberta's most famous northern species: the blackfly, mosquito, horsefly and deerfly. Moose, woodland caribou, and a great variety of waterfowl are all most likely to be found near wetlands. Beaver, more commonly found near smaller wetlands associated with ponds and streams, are intimately connected with northern wetlands. The building of beaver dams and lodges not only requires water, but encourages wetland development by impeding drainage systems.

Although diverse and often plentiful, wildlife of the boreal forest have unpredictable population distributions, varying intensely from year to year. The famous cyclical, boom-and-bust snowshoe hare and lynx populations (Ives 1991) may be one of the best examples; as hare populations rise, their predators are able to breed rapidly with a high survival rate, eventually reaching a population level too high to be supported by the hare. As hare populations are devastated by over-hunting, lynx populations also begin to drop, bringing the populations back to their original levels and beginning the cycle over again. These cycles, combined with the solitary nature of the fauna and long winters limiting floral resource availability, can lead to food shortages and famine, especially in the late winter and spring.

Local Environment

Site HiOv-89 was discovered near the northern edge of the Fort Hills Uplands in 2001 during a survey by FMA Heritage Resources Consultants (FMA) for the Fort Hills Oil Sands Project (Unfreed et al., 2001). The site is situated on the south bank of a small dry lake approximately 90 km north of Fort McMurray and six kilometres east of the Athabasca River, on the southern edge of the Athabasca glacial braid delta (Figure 3.1, Plate 3.1). Local topography of the southern portion of the braid delta is composed of stabilized sand dunes, with a local relief less than 15 ft (McPherson and Kathol 1977: 91), and is dominated by open jack pine forest. The McClelland Lake Wetland complex to the east of the site is composed of patterned and unpatterned wooded fens, shrubby open fens, and swamps (Woywitka 2007: 17). The margins of the wetlands are interspersed with patches of dry land, sinkhole lakes, and forested peat plateaus (ibid.: 17).

HiOv-89 sits on a sandy knoll in undulating terrain, forested by open jack pine with a sparse underbrush of alder and blueberry bushes, and ground cover of reindeer lichen and club moss. The banks of the lake, including the northern portion of the site, are covered in thick underbrush of alder, willow, and young aspen, while the bottom of the lake is overgrown with muskeg, grass, and shrubs (Plate 3.2). The soil is massive, unstratified brown sand with a leached grey Ae horizon 0-10 cm below surface, lying over an orange iron-oxide stained Bm horizon extending to 40 cm below surface (Plate 3.3). Near the edge of the lake, thick alder root mats have caused significant bioturbation, as have a number of jack pine scattered throughout the site (Plate 3.4).

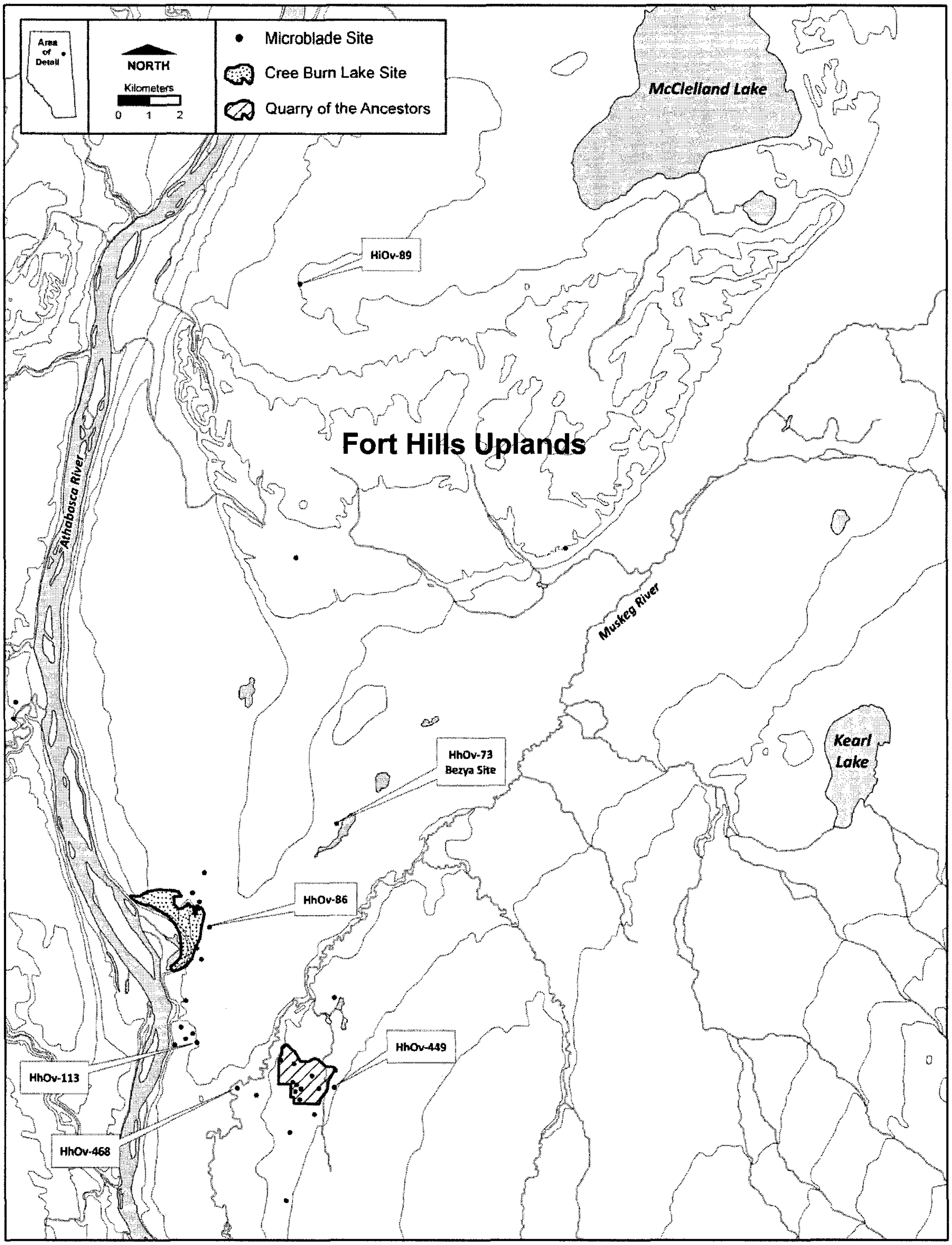

Figure 3.1 **Location of HiOv-89 in relation to other reported microblade sites near the Athabasca River. Labelled sites indicate confirmed microcore finds, while unlabelled sites indicate reported microblade finds. Map by Robin Woywitka. Site information and GIS data from the Alberta Archaeological Site Inventory, Archaeological Survey of Alberta, April 2008**

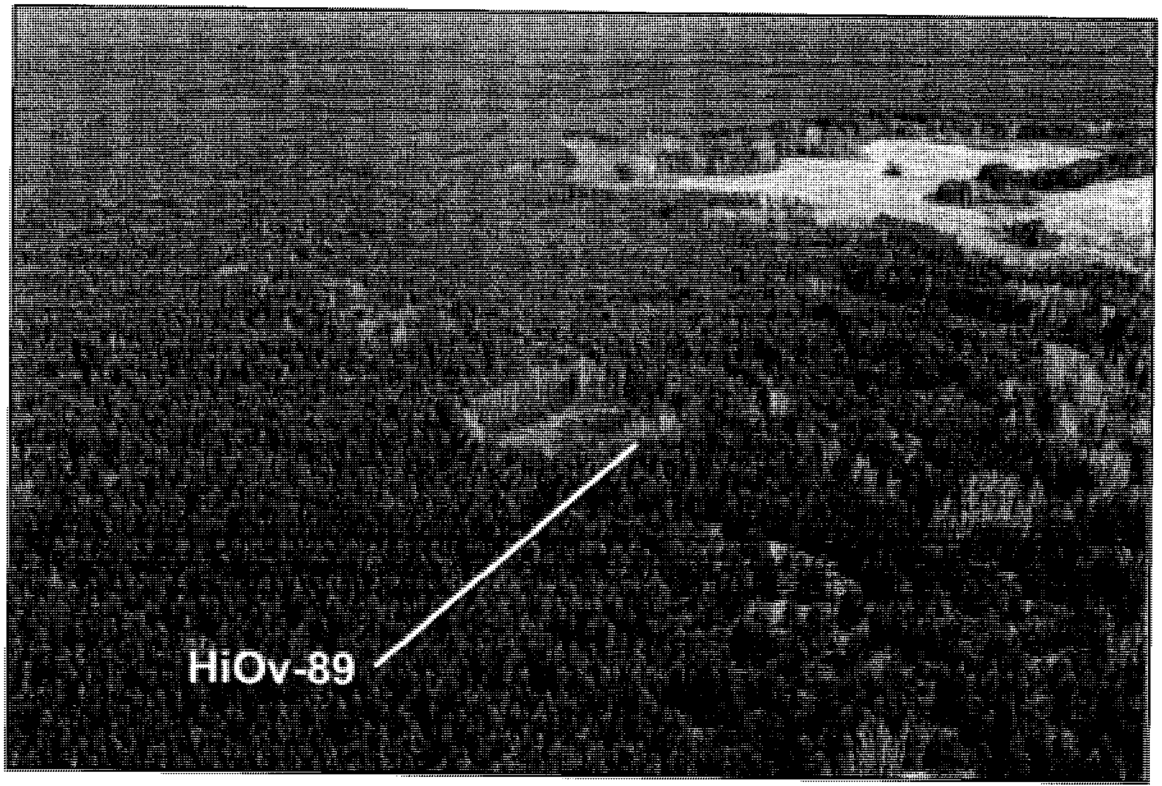

Plate 3.1 Aerial view of the sinkhole lake adjacent to HiOv-89 (modified from Unfreed et al., 2001: 384. Used with permission from FMA, Petro-Canada, and the ASA)

Plate 3.2 View of HiOv-89 facing south from across lake (Used with permission from Petro-Canada)

Regional Culture History

Ethnography and Oral History

The early historic and protohistoric inhabitants of the Athabasca area are well known from the observations and interviews recorded in the journals of fur traders and missionaries. At present, the area is inhabited by Chipewyan Athapaskan and Cree; however, a number of different Aboriginal groups are known to have occupied the lands between Fort McMurray and Lake Athabasca since protohistoric times, including the Beaver, Slavey, and Chipewyan Athapaskans, and the Western Woodland Cree. Some of this apparent cultural mobility may have been caused by the interruptive presence of fur traders, travelling westward along the Clearwater River and then north down the Athabasca River. The mobile, sometimes migratory lifestyle of many subarctic cultures may also contribute to the fluidity of the area's history, and may have been a feature of lifeways far into the region's prehistory.

Some of the earliest historic records of the area are the journals of fur traders who traveled with the Cree, who occupied the area along the eastern Athabasca River during the contact period, and held oral traditions of driving the Slavey and Beaver Indians out of the River basin in the past (MacKenzie 1971, cited in Ives 1993). It is inferred that this population shift was caused by westward expansion of the Woodland Cree, armed with fur traders' rifles and searching for fertile trapping territory, and that the original inhabitants of the region were Slavey or, more likely, Beaver (Ives 1985, 1993). These groups are both boreal-adapted Athapaskan cultures; other northern Athapaskan culture groups traditionally lived at the borders of the boreal forest and the barrenlands, with seasonal rounds strongly tied to both subarctic ecoregions (Janes 1983). Although the

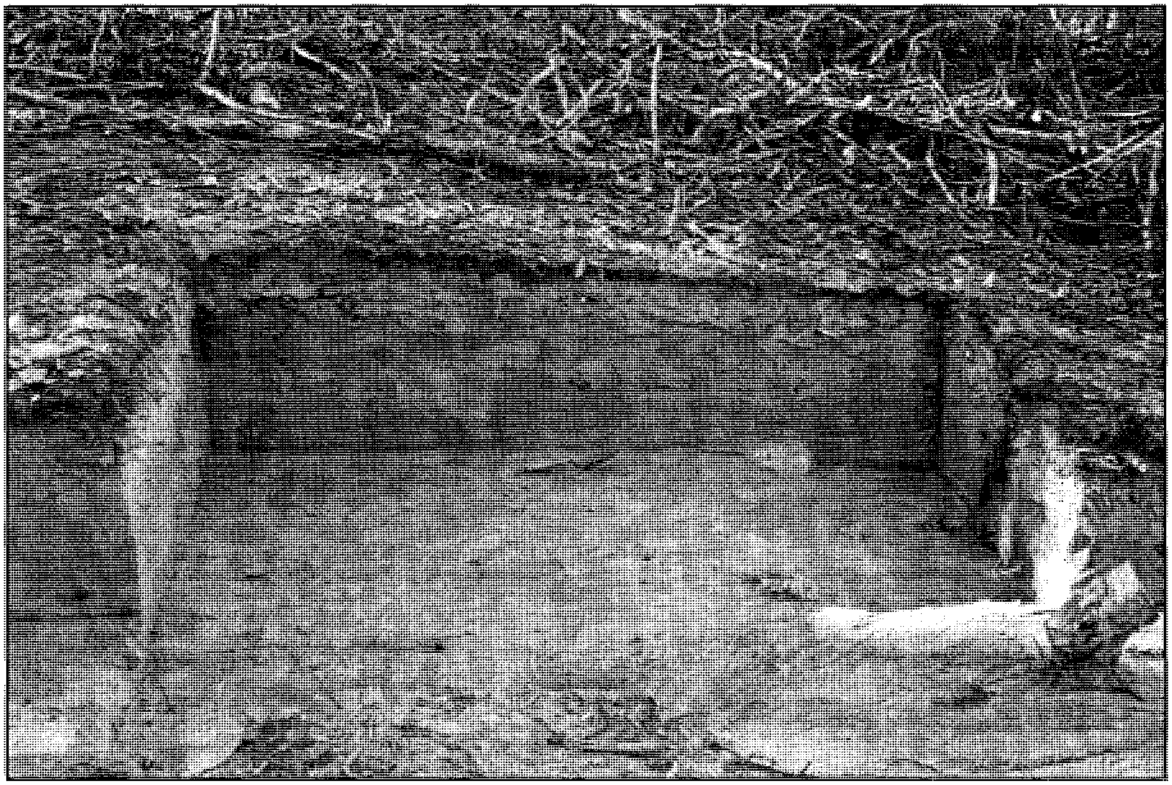
Plate 3.3 Soil profile in Block A1 (Used with permission from Petro-Canada)

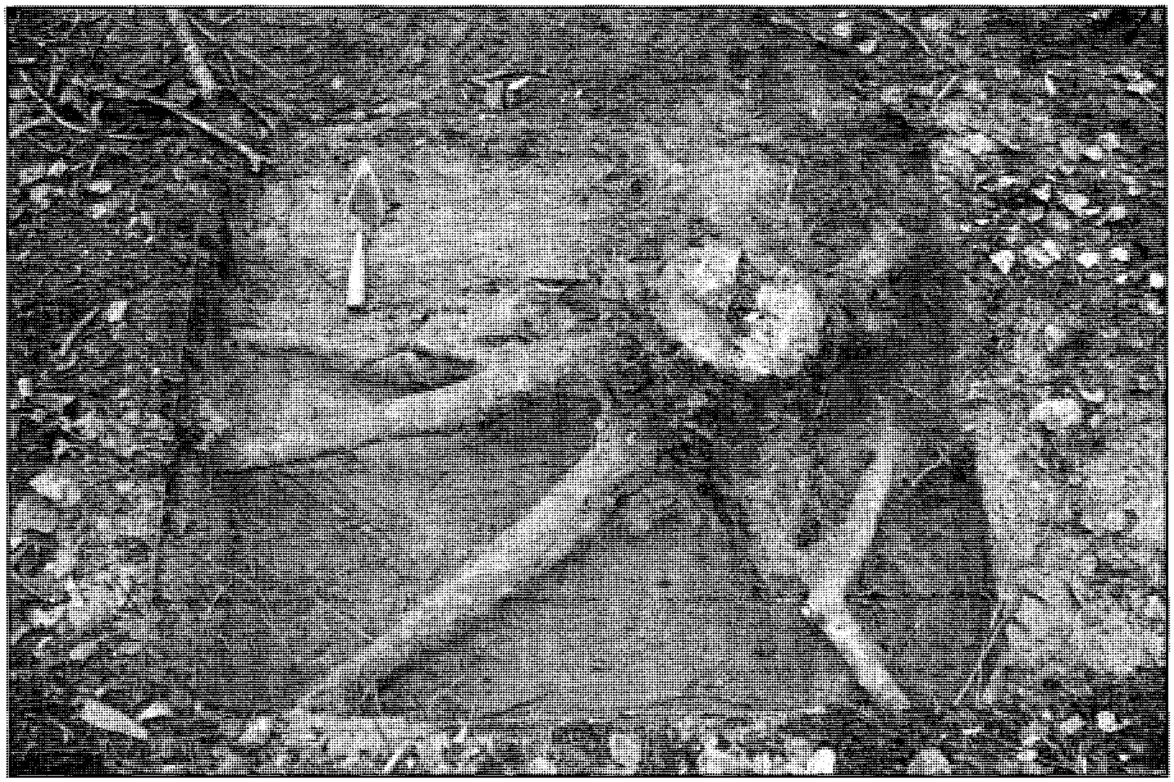
Plate 3.4 Soil disturbance caused by jack pine in Block A1 (Used with permission from Petro-Canada)

Chipewyan are traditionally a barrenland people, their seasonal rounds often extended south into the boreal forest as they followed the migratory routes of their primary source of subsistence, the barrenland caribou (Athabasca Chipewyan First Nation 2003).

It may be that the archaeological record in the Oilsands region does not represent the ancestors of a single aboriginal group but rather interrelated and shifting occupation by the ancestors of many or all of these groups. It must also be considered that prehistoric peoples in the region were possibly only tenuously related to any one of these groups, and while oral traditions and ethnographies of pre- and post- contact Aboriginal lifeways may serve as useful analogies for earlier prehistoric cultures, they must be interpreted with caution. Previous ethnographic research of Athapaskan and Cree cultural groups has been conducted, and a thorough summary of this work is beyond the scope of the current discussion. Perhaps the most exhaustive and well-known collection of such work can be found in Helm (1981), while more focused ethnographic studies of language families (for example, Ives 1990) and hunting practises (for example, Sharp 1977) may also be found in the anthropological literature. A traditional land use study based on interviews and oral history was commissioned and published by the Athabasca Chipewyan First Nation (2003) at Fort Chipewyan, while some further traditional land use studies and interviews have also been conducted in areas affected by Oilsands development as components of environmental and social impact assessments (for example, Mucklow 2002).

A few key aspects of subarctic Athapaskan lifeways may be summarized here. Most notably, these groups were highly mobile, hunting and gathering following seasonal rounds, using light, transportable technology. Snowshoes, sleds, snares, wood and hide houses, and hide clothing were some of the most vital material goods, produced from wood, bark, moss and hide. In the summer, berries, roots, mosses, and plants such as Trapper's tea, wild mint, wild chamomile, cattails, and various mosses and fungi were used for food, tea, dyes, tobacco, medicine, and insect repellent (Mucklow 2002). Availability of animal food and material sources such as hare, fish, and deer could be highly variable from year to year, and so smoking and storing of meat was an important activity. Snares were extremely important, and created in various sizes to trap hare, deer and other prey. Moose and beaver were of primary importance for southern Athapaskan groups such as the Slavey (Ives 1985; VanStone 1974:25).

Northern Athapaskan cultures are characterised by extremely low population densities, often considered to be a result of the harsh conditions of boreal forest living; however, it may simply have been an aspect of the highly mobile, flexible lifestyle enjoyed by these northern societies (Ridington 1978; VanStone 1974:23, 125). Despite the unpredictability of animal populations and the weather, this and many other cultural adaptations seem to have mitigated the apparently uncomfortable living conditions in the north. Family and marriage connections were maintained across great distances, providing insurance against famine or natural disasters by allowing groups to temporarily share more hospitable territory (VanStone 1974:54).

Archaeology

A number of factors conspire to limit our knowledge of northern Alberta prehistory (cf., Wright 1995:405-406 for discussion of the limitations to the interpretation of the archaeological record in the boreal environments of the Middle Northwest

Interior). Thick ground cover, combined with an apparent lack of archaeological features visible above ground level, makes site surveys difficult and labour-intensive, as few natural exposures exist, and sites are typically found only through shovel testing for subsurface materials. Secondly, the boreal forest seems to contain a limited array of archaeologically visible materials, mainly, lithic tools and debris. Although lithic resources likely played a relatively small role in prehistoric life ways compared to floral and faunal resources, they are the most archaeologically visible aspect of prehistoric activities in the Oilsands region today. The sandy, acidic soils along the Athabasca River tend to encourage the decomposition of organic remains, while very few sites have been found in areas of heavy or frequent deposition that would protect the remains of wooden or bone tools, or even hearths, from wind, scavengers, decomposition, and bioturbation of the soft, sandy soil matrix. Because of this, debitage analysis and lithic tool typology have been the main methods of analysing archaeological sites in Alberta's boreal forest.

Early archaeological study in northern Alberta focused on point typology, comparing the rare points found in the boreal forest to a well-developed, well known sequence of Canadian Plains point typology (cf., Saxberg and Reeves 2003 for one of the most recent examples of this approach). Successful comparisons led to the conclusion that cultures in the boreal forest were strongly influenced by plains cultures from the south (Noble 1971; Saxberg and Reeves 2003); this conclusion continues to influence archaeological study despite conflicting interpretations that many of these points also closely resemble Athapaskan Taltheilei points from the Northwest Territories (McCullough and Wilson 1982). Compounded by a paucity of dateable sites, these early theories have prevented the development of a suitable typological sequence for use in northern Alberta. However, a number of more constructive research directions have been recently developed. Most notably, the high number of known sites discovered during Oilsands exploration, studied in conjunction with ethnographic evidence, has allowed for a number of theories to be developed about prehistoric lifeways in Alberta's boreal forests. This research is best summarized by Ives (1991, 1993), and focuses on what archaeological sites in the boreal forest can tell us about aboriginal use of the landscape, including lithic material use, moose hunting, and seasonal selection of site occupation.

The Oilsands lease areas are unique to known archaeological sites in northern Alberta for the ubiquity of a fine-grained, highly workable lithic material known as Beaver River Sandstone, composing 95-100% of excavated materials in the majority of sites in the area. The only apparent outcroppings in Alberta are located along the Athabasca River, in a small area near Fort MacKay (Fenton and Ives 1990). Beaver River Sandstone is common in small percentages in assemblages in the Birch Mountains 70 km to the west and along the Clearwater River to the south (Ives 1993); however, the highest concentrations occur within 30 kilometres of the source, focused in the Cree Burn Lake and Quarry of the Ancestors site localities to the north of Fort MacKay (Figure 3.2).

Cree Burn Lake is a single large, highly significant archaeological site, while Quarry of the Ancestors is a large grouping of sites with extremely dense artifact and debitage concentrations, centred on a possible outcropping of fine-grained Beaver River Sandstone at site HhOv-319 (Saxberg and Reeves 2004). Both localities seem to represent repeated, intensive land use and occupation, possibly over the entirety of the Holocene. In both locations, Beaver River Sandstone debitage composes the

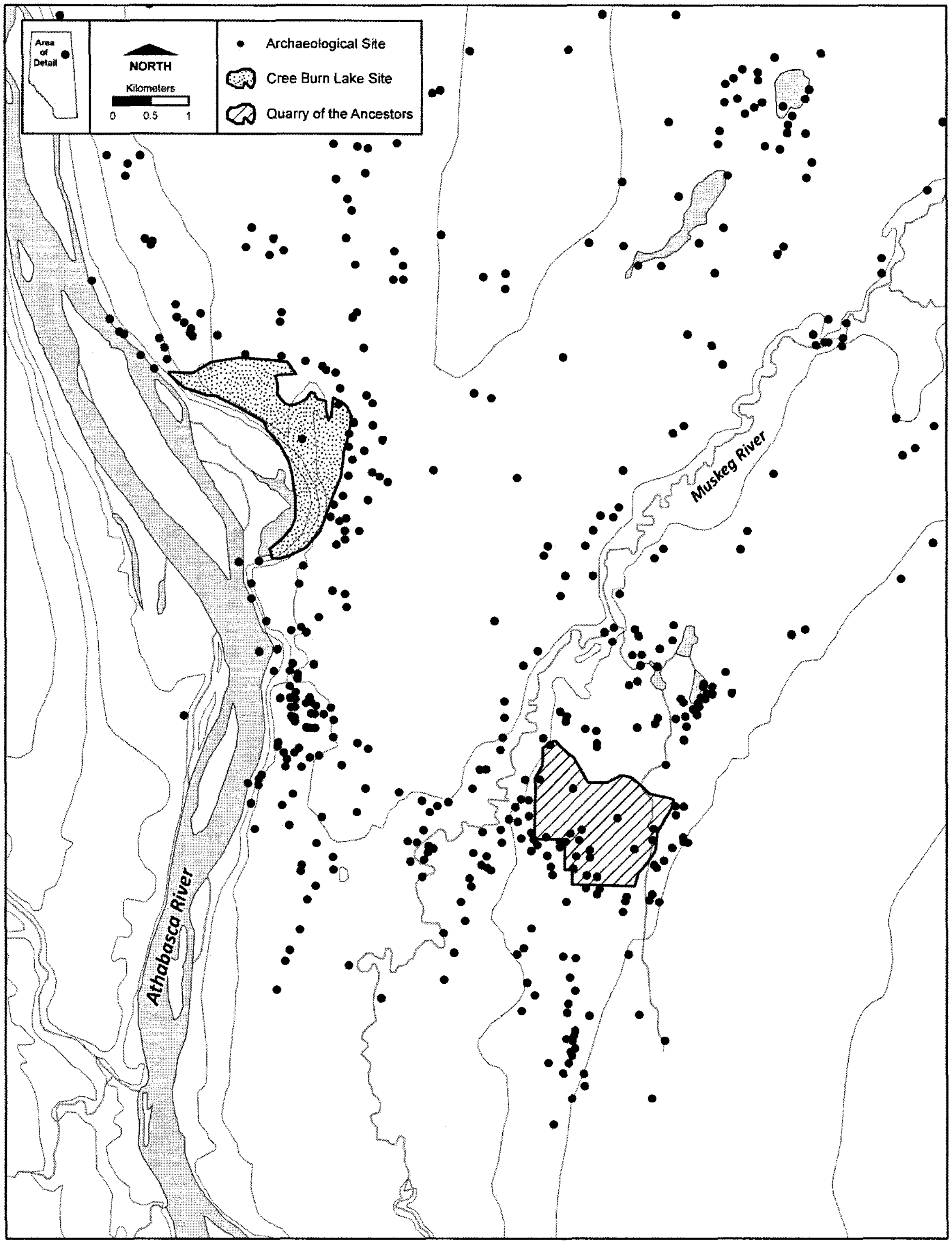

Figure 3.2 **Archaeological sites in the Oilsands region in relation to the Cree Burn Lake and Quarry of the Ancestors Site Localities. Map by Robin Woywitka. Site information and GIS data from the Alberta Archaeological Site Inventory, Archaeological Survey of Alberta, April 2008**

majority of the site assemblages, often numbering in the hundreds of thousands. Tools are comparatively rare. Farther out from these occupation centres, sites become sparser, with lower proportions of Beaver River Sandstone, and higher proportions of tools (Ives 1993).

This site distribution may reflect the seasonal rounds of historic Athapaskan populations, with larger, settled communities in the summer and small mobile hunting groups in the winter. The two site complexes may represent a traditional gathering area for prehistoric populations within the Oilsands region. They are ideally located near a major transportation corridor, near both the Athabasca and Muskeg Rivers, surrounded by many small lakes and wetlands ideal for moose hunting, and centred on a major source of lithic raw material. If this is the case, it can be hypothesized that raw material procurement and initial reduction may have been seasonal, occurring during more sedentary occupation in the summer, when food was more plentiful and more free time remained for material procurement and modification. Tools and preforms taken out on the winter hunting rounds would then be modified, sharpened, and discarded over the winter, to be replaced again during the summer.

Such hypotheses must be approached with caution, since occupation of the large quarry sites may not have been seasonal; the apparent intense occupation of the site complexes may simply represent the accumulation of materials during repeated visits to valuable quarry sites over time rather than larger, long-term occupations. Further, even if seasonality does play a large role, ethnographic evidence indicates that summer hunting parties also ventured far from base camps in search of prey, so that satellite camps far from the major site complexes could also represent summer activities. The apparent greater size of these sites may simply reflect the higher material availability in the area, leading to a focus on lithic reduction, which is overrepresented in the archaeological record due to the low preservation of organic materials. The true distribution of assemblages composed of varying sizes and materials is also not fully represented, as the areas surrounding Quarry of the Ancestors and Cree Burn Lake are located within active Oilsands leases and have been intensively excavated. Site variability at this time may be more indicative of the timing and location of different Oilsands mining projects, resulting in a higher rate of excavation, and therefore the appearance of larger, more complex sites, in areas where mining projects have progressed further in the planning process. However, my own experience from mitigative survey and excavation projects near the Quarry of the Ancestors, and within the Fort Hills Uplands only 20 kilometres to the north, provides evidence that the concentration and composition of sites within these complexes is indeed unique. Despite the presence of high, well-drained terrain, numerous sinkhole lakes, and proximity to a massive wetland complex ideal for moose and waterfowl hunting, sites in the Fort Hills and farther north are relatively few, and generally smaller, with greater variability in raw material usage and a high percentage of isolated finds of less than ten flakes.

The microblade site HiOv-89 has the potential to contribute much information to the current interpretations of site patterning in Alberta's northeastern boreal forest. Located relatively far from the possible main centres of occupation at Cree Burn Lake and Quarry of the Ancestors, and composed of a wide variety of material with a relatively high percentage of specialized lithic artifacts, this site resembles Bezya much more than the typical pattern of sites found in the south. Both of these sites contain evidence of a technology more common to the subarctic regions of Alaska and the Yukon and Northwest Territories. HiOv-89 may represent a small winter camp related to the seasonal rounds described above, or it may represent an occupation by a cultural group unrelated to the majority of activity occurring in the region. Analysis of the material present at the site, the techniques of lithic reduction used by its occupants, and its relationship to techniques used at Bezya and other reported microblade sites in the region, may help to reveal the uses of the site and the relationship of its inhabitants to those in more heavily inhabited areas of the Oilsands region, as well as the relationship of the region itself to subarctic cultures farther to the northwest.

Chapter 4 Study Methods

Field Methods

Survey

HiOv-89 was discovered during a foot survey of the sinkhole lakes and wetlands associated with the McLelland Lake Fen Complex (Unfreed et al., 2001). This survey was performed under Permit 2000-130, issued by the Archaeological Survey of Alberta (ASA) to FMA Heritage Incorporated (FMA), to mitigate possible impacts of industrial development on previously undiscovered archaeological sites in the area of the Fort Hills Oilsands Project (FHOSP). Shovel tests in the site area were spaced 5 to 10 metres apart, with testing focused on the top of the knoll. Upon discovery of cultural materials, four additional tests were placed around each positive test pit in the cardinal directions. Shovel tests measured 40 by 40 cm, and were excavated to approximately 40 cm below surface. Of the eight positive shovel tests discovered during the survey, seven were spread across an area of 15 by 15 metres on the top and middle terraces of the knoll, while the eighth was located at the base of the eastern slope (Unfreed et al., 2001:387). An additional 79 shovel tests on and surrounding the knoll produced no artifacts (Figure 4.1; Unfreed et al., 2001:383).

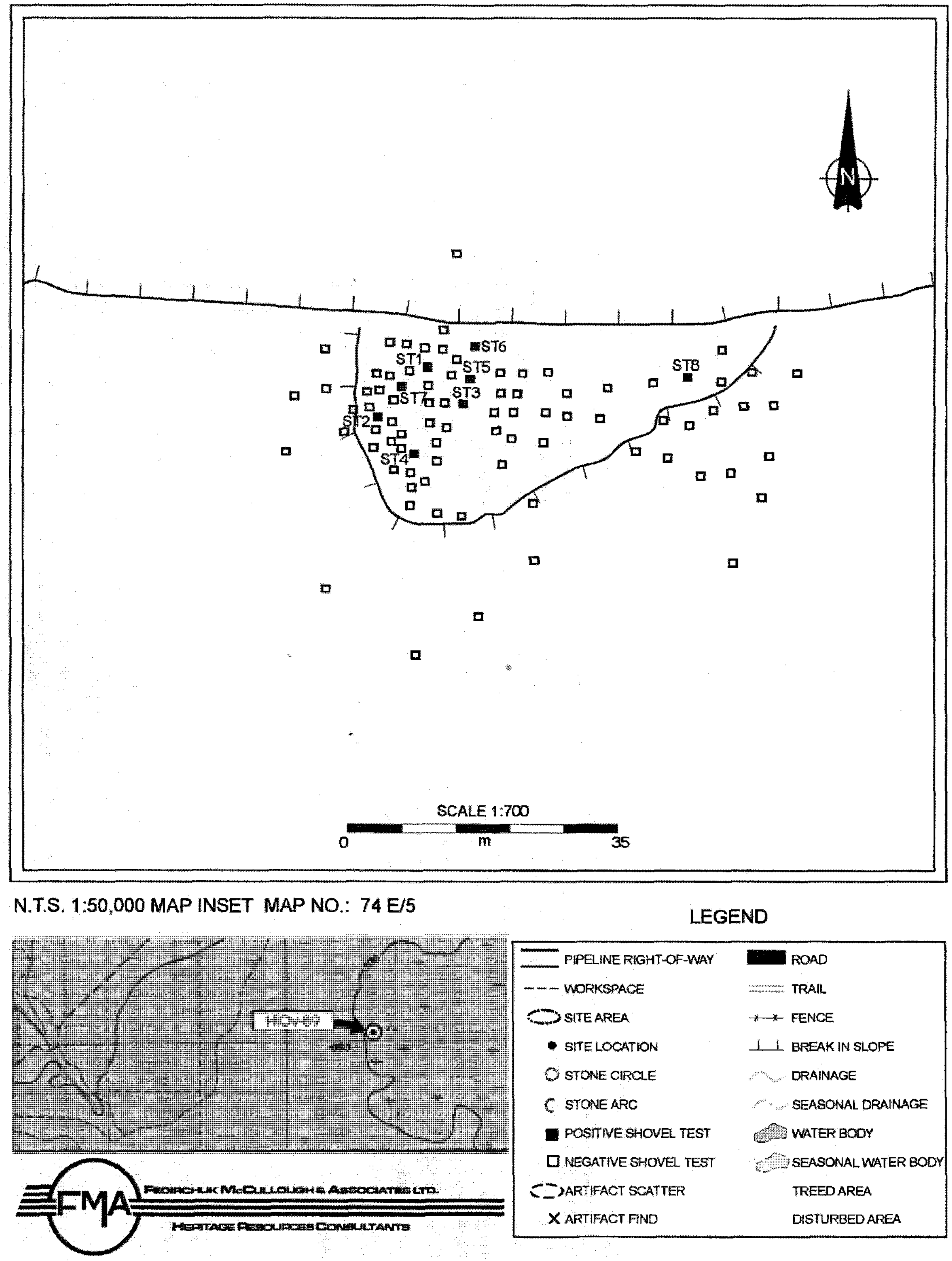

Figure 4.1 **Shovel Testing Program at HiOv-89 (Modified from Unfreed et al., 2001. Used with permission from FMA, Petro-Canada, and the ASA)**

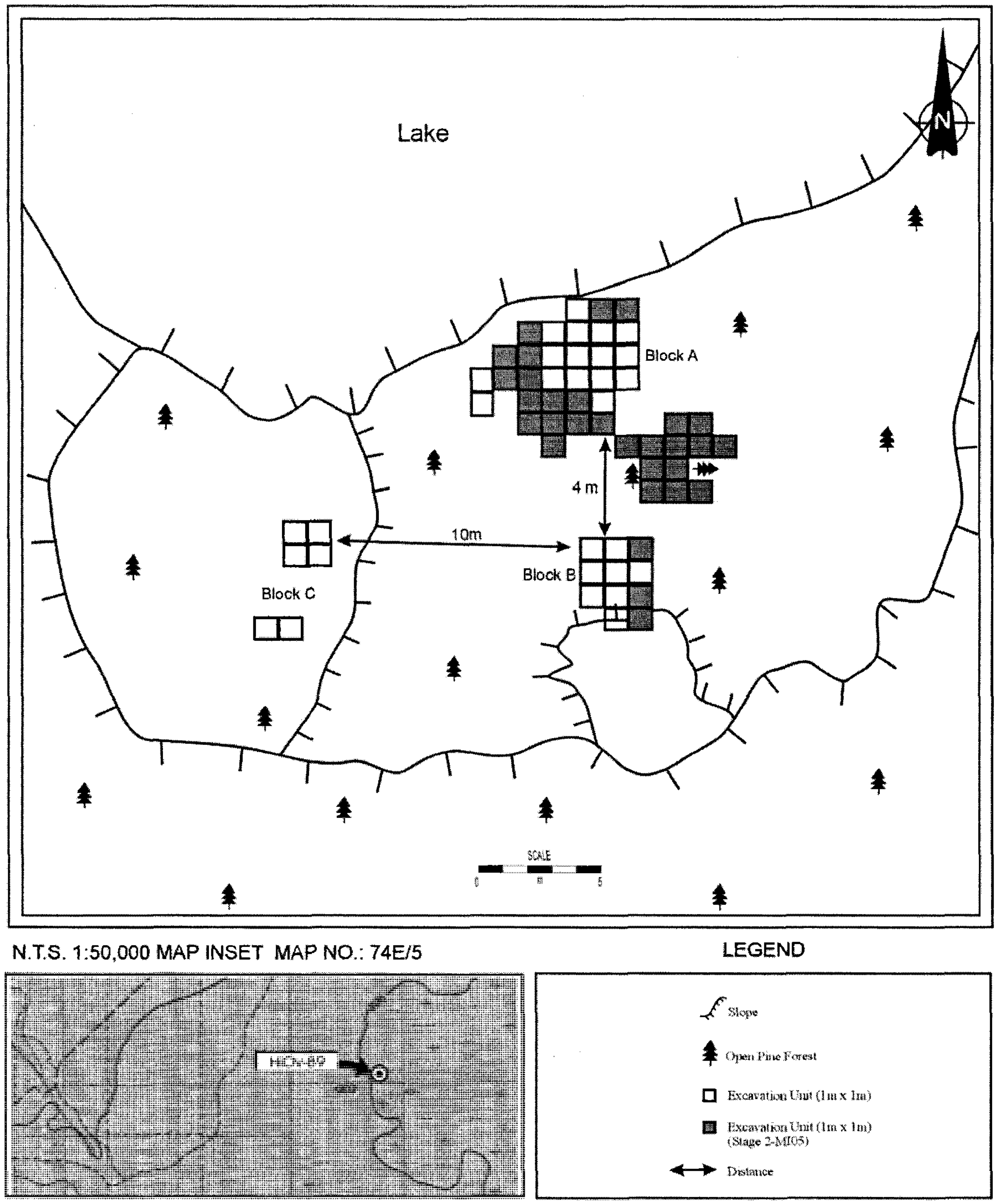

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Figure 4.2 **Excavation Layout at HiOv-89 (Modified from Woywitka and Younie 2008. Used with permission from FMA, Petro-Canada, and the ASA)**

Ten artifacts were recovered during the survey, and although such a number is considered quite low, the site at once merited further attention due to the discovery of two rare artifacts: a proximal microblade fragment and a microcore fragment, both made of a white, chert-like material. Based on the preliminary survey findings, HiOv-89 was concluded to be a subsurface collection of lithic materials, including chert, siltstone, Beaver River Sandstone (BRS), quartzite, and the chert-like material, locally available in the form of river cobbles on the banks of the Athabasca (Unfreed et al., 2001:Appendix II).

Excavation

In 2005, under ASA permit 2005-328, a crew from FMA returned to perform mitigative excavation of HiOv-89, as the site area was slated for forestry clearing and full-scale Oilsands development within the next 10 years (Woywitka and Younie, 2008). Excavation was performed by shovel shaving, with all sediment screened through ¼ inch mesh, and minimum location data recorded to 1x1 m unit and 10 cm arbitrary levels. Depth was measured from the ground surface at each corner of the unit. In areas of high artifact density, units were divided into quadrants and excavated by trowel. Large or distinctive artifacts found in situ were recorded in three-dimensional provenience, with the southwest corner of the unit as a datum point (ibid.). Each unit was excavated to a depth of at least 30 centimetres, and excavation continued until sterile soil was reached, indicated by the excavation of a full 10 cm level without any artifacts. Artifacts were found between the surface and a depth of 50 cm, concentrated at depths between 10 and 30 cm.

Although the archaeologically positive shovels tests from the 2000-130 survey had been marked with flagging tape, they were difficult to relocate after five years of weathering and vegetation regrowth. Because Shovel Test #8 contained little material and was far removed from the remainder of the site, the area surrounding it was further tested prior to establishing excavation units. No further artifacts were found, and so no excavation was conducted in the area. Excavation units were placed over the suspected locations of the remaining seven positive shovel tests, with further units expanding outward in the directions of highest concentrations of material. The placing of these units resulted in three main blocks of excavation (Figure 4.2). Block A consists of two adjacent concentrations, sub-blocks A1 and A2, directly adjacent to the bank of the lake on a large level section of land on the eastern slope of the knoll (Plate 4.1 and Plate 4.2). Block B is a few metres southwest, farther from the lake but on the same level section of land (Plate 4.3), while Block C is located on the highest point of the knoll, ten metres to the west of Block B (Plate 4.4). Mitigation proceeded in two stages of 30 units each, with an intervening period of evaluation and initial material analysis. In total, six units were excavated in Block C, 11 units in Block B, and 43 units in Block A (Woywitka and Younie 2008).

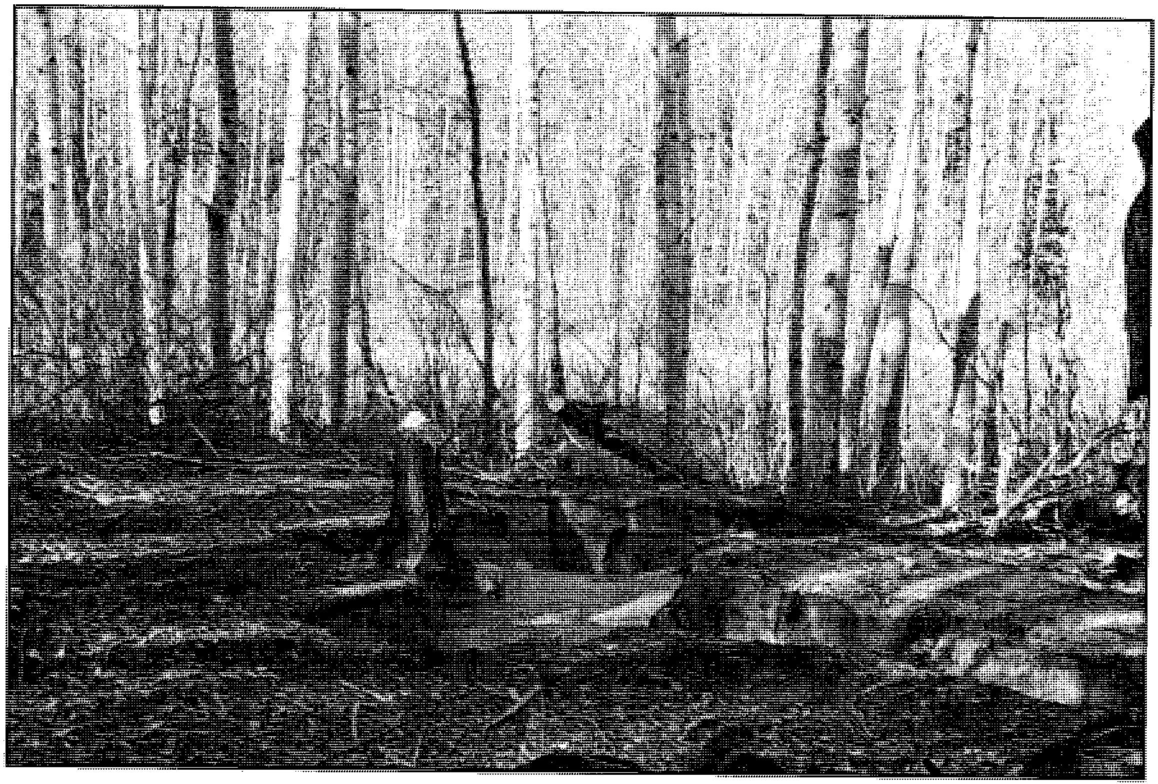


Plate 4.1 View facing northwest of Block A1 and sinkhole lake during Stage II excavation (modified from Woywitka and Younie 2008: 161. Used with permission from FMA, Petro-Canada, and the ASA)

Plate 4.2 View facing southeast of Block A2 (modified from Woywitka and Younie 2008: 160. Used with permission from FMA, Petro-Canada, and the ASA)

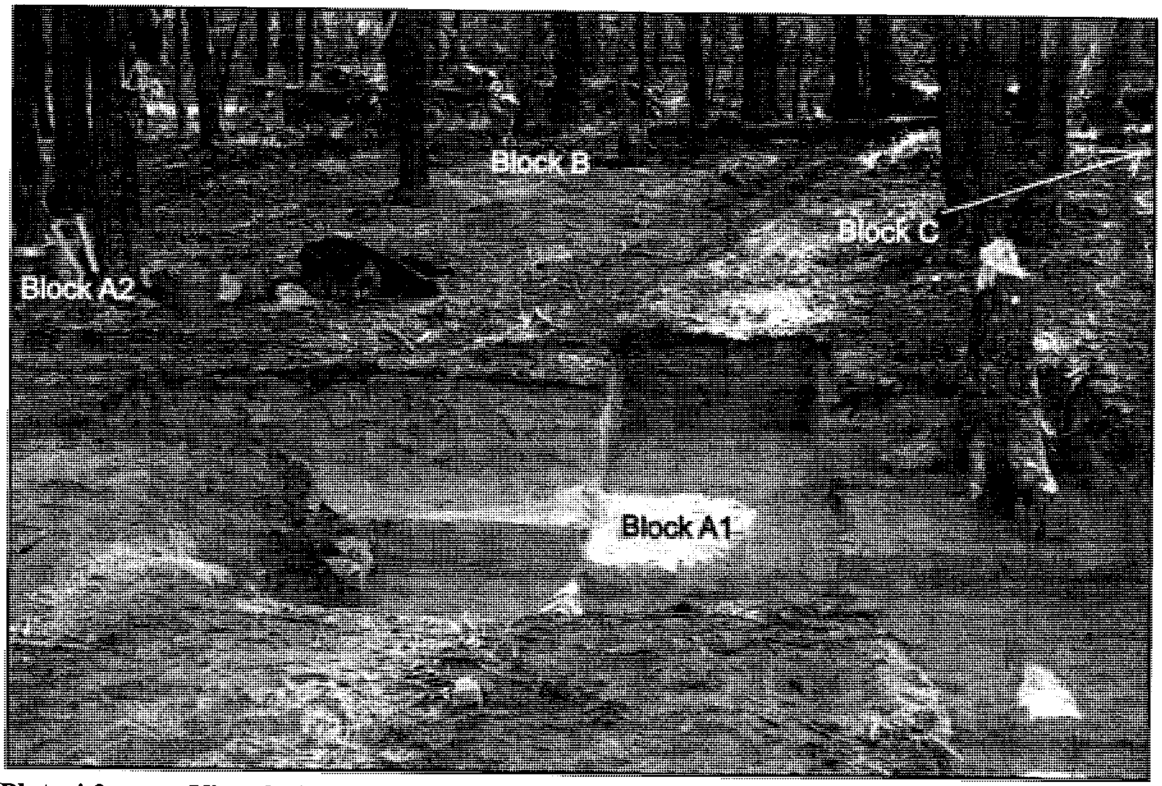


Plate 4.3 View facing south of Block A1, with backfilled Block B visible in the background (Used with permission from Petro-Canada)

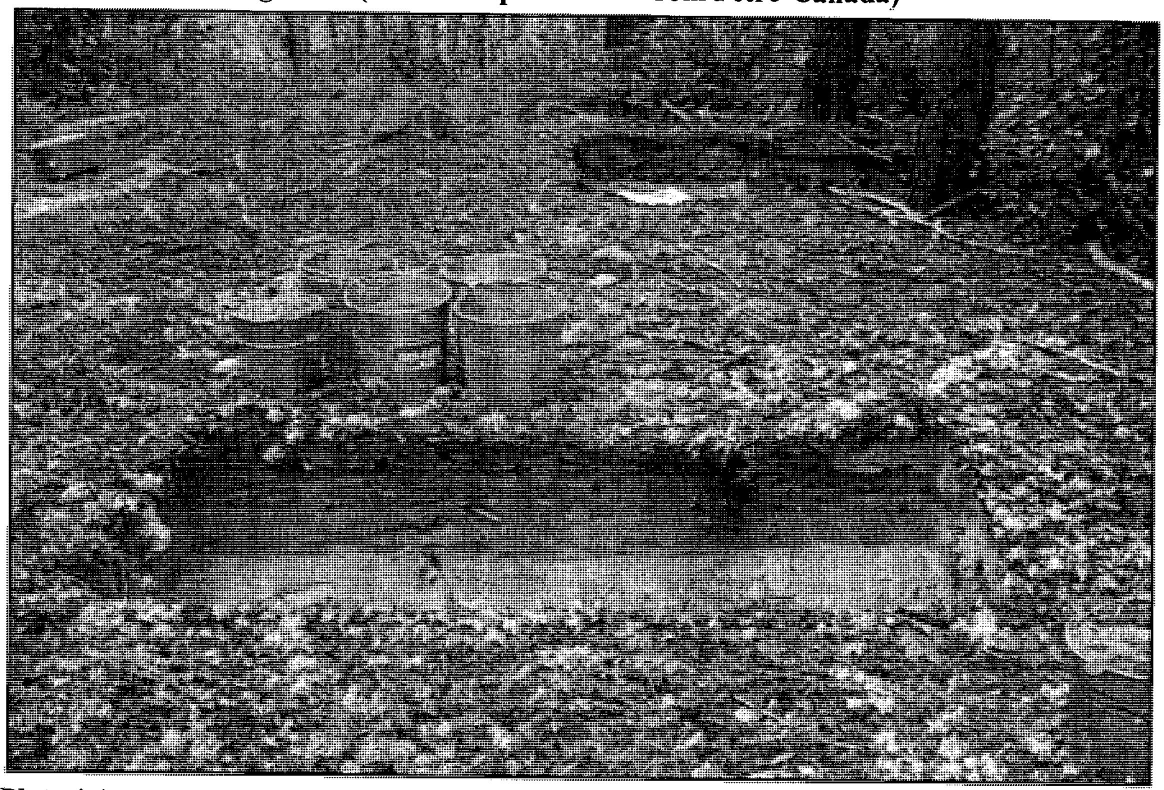


Plate 4.4 View facing north of Block C (from Woywitka and Younie 2008:162. Used with permission from FMA, Petro-Canada, and the ASA)

Laboratory Methods

Previous Laboratory Work and Analysis

Preliminary labwork for the assemblage was carried out by staff at FMA. This work included washing, weighing, sorting of artifact sizes, types and materials, and the creation of a basic artifact catalogue for the site. Artifacts were washed with water and a toothbrush, and once dry were weighed on an electric scale accurate to 0.1 g. Formed tools were measured, photographed, and described, and any microblades and microcores that could be identified were separated in case of future research. An initial analysis of artifact distribution and debitage reduction stage was also performed, finding a high probability that the majority of cultural materials at the site were recovered, and that bioturbation in the soft, sandy soil had significantly affected artifact distribution. Any evidence of possible multiple occupations was indistinguishable due to taphonomic processes at the site, and so the site was treated as a single component. Block A appeared to contain all of the material related to microblade production, as well as a large amount of debitage representing secondary and finishing stages of reduction, and a small amount of highly decomposed faunal material. Block B contained mainly black silicified siltstone flakes representing the finishing stage of lithic reduction, and Block C contained very little cultural material.

Debitage Classification System

For the current study, microcores, ridge flakes, microblades, burins, burin spalls, and formed tools were separated from debitage. Edge-modified flakes are not shaped by flaking, and so full descriptions and detailed measurements are not warranted for the purposes of this study; however, all instances of edge retouch and use-wear were recorded. Because these flakes comprised a large part of the debitage assemblage, both edge-modification and debitage characteristics of the flakes were recorded, and these artifacts are included in the overall debitage analysis for the site.

As the by-product of lithic reduction, debitage may provide many clues to the types of lithic reduction occurring at a site, and so a detailed analysis of debitage from the assemblage was conducted. Debitage was first measured by assigning size categories, providing the measurement of the longest dimension of the artifact to an accuracy of 5.0 mm. Post-depositional modifications such as iron oxide build-up, wind erosion, and temperature spalling were recorded. Debitage was then divided into three main categories: flakes, shatter, and cores. Flakes exhibit a platform where they have been struck from the core, a bulb of percussion, an identifiable dorsal and ventral surface, and an intact distal termination where they were fully removed from the core. Flake fragments must exhibit at least one of these flake features. Shatter is typically blocky and angular, and does not exhibit any identifiable flake characteristics. Cores exhibit the scars of previous flake removals, including inverse bulbs of percussion.

Flakes and flake fragments were further classified according to a number of criteria: flake portion, dorsal cortex cover, dorsal scar count, platform scar count, presence of platform grinding, and presence of edge modification. Flake portion was classified as whole, proximal, medial, or distal. Dorsal cortex cover was divided into four categories: (1) complete coverage, (2) cover of more than half of the dorsal surface, (3) cover of less than half, or (4) no cortex (entire dorsal surface covered with previous flake scars). Dorsal scars are the result of flake removals occurring prior to the removal of the flake under study, and were recorded as 1, 2, 3 or more, or none (complete cortex cover). Like dorsal scars, platform scars reflect previous flake removals from the same core, and multiple scars are most common as a result of alternate flaking and bifacial tool shaping and sharpening. Platform scars can be seen as small facets on the platform surface, and were recorded as 1, 2, 3 or more scars, or none if the flake was struck from a cortex platform. Finally, platform grinding was recorded as present or absent. Platform grinding is used to prepare a platform surface for flake removal, especially when multiple previous flake removals have created a lipped surface, or when a smooth surface must be roughened to prevent a punch or billet from slipping.

Two general types of flakes, reflecting different types of lithic reduction, are commonly found in lithic assemblages. Bifacial reduction flakes are the by-product of artifact shaping, and may in fact reflect bifacial or unifacial shaping or trimming. These flakes have a shallow platform angle, often combined with platform grinding, and strong lipping on the ventral edge of the platform. They tend to exhibit strong curvature, with high dorsal scar and platform scar counts. Core reduction flakes represent a type of reduction in which a core is reduced with the purpose of creating flakes, some of which are collected to be retouched or used as tools, while the core itself is discarded at the end of the reduction process. The flakes have wider platform angles and large bulbs of percussion, with little lipping evident. Curvature varies, depending on the size and shape of the core, but platform and dorsal scar counts are generally low to moderate, depending on the stage of reduction.

The categories described above may provide a number of clues as to the type of lithic reduction occurring at HiOv-89. Most notably, reduction stage may be calculated. Larger flakes with a high presence of cortex, combined with low dorsal scar and platform scar counts, indicate that cobbles of raw material were being prepared for further reduction by the removal of the outer cortex. Cortex is often rough, soft, or easily shattered, and is not ideal for the creation of stone tools. The presence of large, blocky shatter is also indicative of this primary reduction stage. Secondary reduction, the removal of flakes and shaping of tools, is evidenced by the presence of flakes of a variety of sizes, with moderate dorsal and platform scars, and a lower presence of shatter and cortex. The final sharpening, re-sharpening, and reuse of tools occur during the tertiary stage, which is represented by tiny, curved, bifacial reduction flakes with very high dorsal and platform scar counts.

Measurement and Description of Formed Tools

In order to describe and measure tools effectively, a consistent system for orientation must be established. Tools and flakes were oriented in the conventional method (Banning 2002:280): tools are generally oriented to reflect the manner of their use, with the working edge oriented away from the observer (distal), and the dorsal surface, if observable, facing upward. Flakes are oriented to reflect their position during reduction: the platform faces the observer (proximal), with the dorsal surface, the outside core surface prior to flake removal, facing upwards.

Microblades and cores were oriented and described following Morlan (1970, 1976) and Le Blanc and Ives (1986). Microcores are unique in their orientation rules; on a two dimensional page, the platform faces toward the top, away from the observer, with the fluted face to the right, and the keel or wedge element to the left. In this position, the upper surface or lateral face will be the obverse, and the hidden surface the reverse face (Figure 2.1, Chapter 2). In order to be consistent with microcore descriptions, burins are oriented with the platform for burin removal away from the observer and the burin facet to the right. Traditional orientation of microblades reflects standard flake orientation, with the dorsal surface facing upward, and the platform facing proximally (Banning 2002:280). Although many researchers have adopted Sanger's (1968b) method of orienting the platform distally, reflecting the positioning of microcores, I prefer the use of the traditional orientation, reflecting the identity of the microblade as simply a specialized flake. Ridge flakes and burin spalls, having no working edge, are also oriented as flakes.

All tools and specialized debitage (ridge flakes, microcores, and burin spalls) were measured in at least three dimensions using digital vernier callipers, and described in detail. Unless otherwise noted, all measurements represent the maximum value of the artifact for the dimension measured, and are given in millimetres. One exception is the width to thickness ratio for microblades. This represents the mid-point width divided by mid-point thickness. For fragments, the point estimated to be nearest the mid-point of the original piece was used instead; in either case, the width and thickness were measured at the same point for each artifact to ensure validity of the ratio. This measurement was not taken for extremely small proximal or distal fragments. Separate maximum width and thickness measurements were also taken. Length was only measured for whole or wholly refitted microblades, burins, and ridge flakes. Microcore measurements are shown in Figure 4.3. Core length measures the maximum distance between the fluted face and keel of the core; if the platform element represents the longest portion of the core, then the platform length and core length measurements will be equal. The chord length represents the direct distance between the outer edges of the flute scars at the top of the platform.

Flakes and tools were examined under 15X magnification for retouch and use-wear. Retouch was recorded only when obviously intentional, as indicated by the presence of small uniform, parallel flake scars. The intentionality of use-wear is more difficult to determine. Isolated scratches, scars, or edge breakage were most likely the result of trampling, excavation damage, or bag-retouch, and were not recorded.

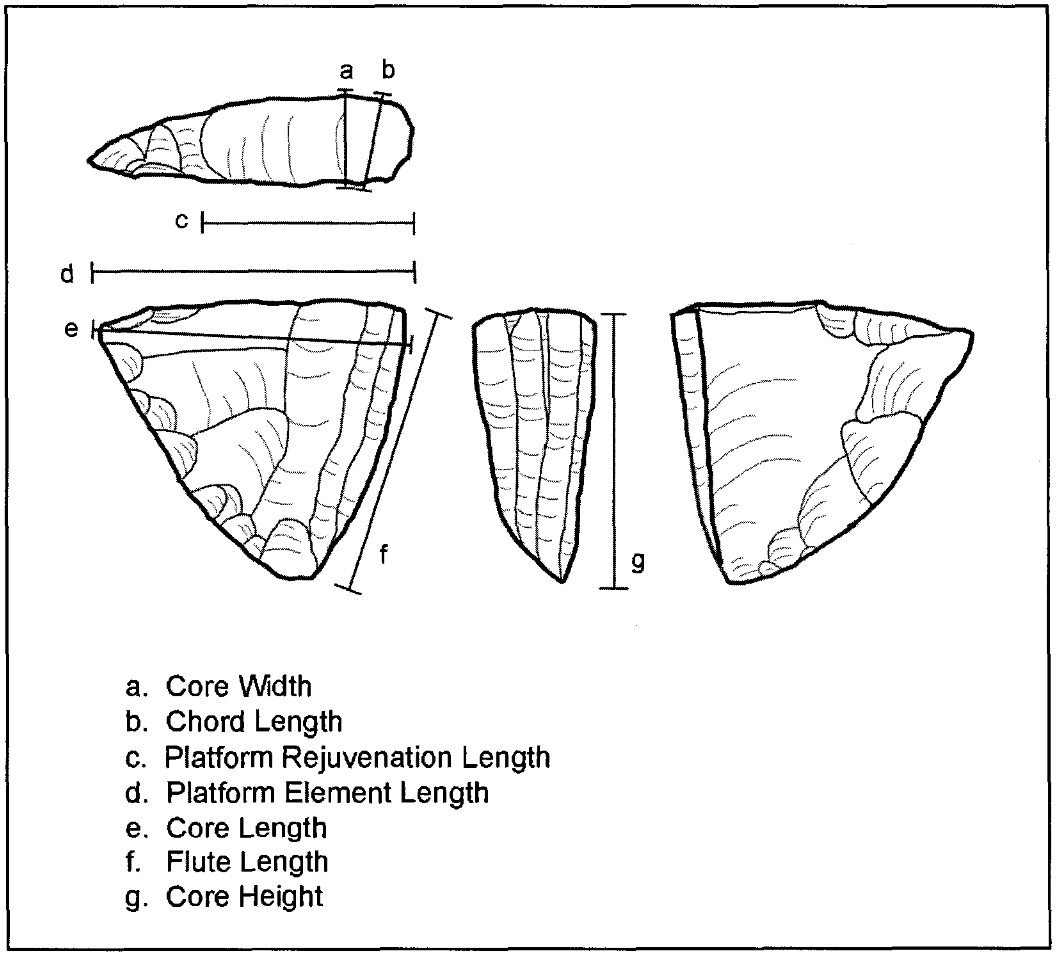


Figure 4.3 Microcore Measurements

Because of the extensive post-depositional wind polishing of some artifacts, edge polish also cannot be considered indicative of use-wear at HiOv-89. In order to ensure that only definite use-wear was recorded as such, a possible use-wear category was incorporated into the analysis, used for irregular or very faint wear. Small flake scars on the dorsal surface of the proximal ends of flakes were considered to be evidence of platform grinding rather than use-wear, unless extending past the surfaces of the platform.

Raw Material Analysis

A raw material classification system was developed for the assemblage (Table 4.1). Consultation with Dr. Charles Schweger of the University of Alberta helped to define 15 material types present at HiOv-89. The chert-like material used for most of the microblade production was identified as a type of silicified mudstone (SM) occurring in three different varieties. During surveys of the FHOSP footprint area, Gryba has found white, grey, brown, and mottled cobbles of this material along the shores of the Athabasca River, pointing to a local source of this fine-grained, highly workable material (Unfreed et al., 2001: Appendix II). Although Gryba describes the material as chert, both Dr. Schweger and Robert Dawe of the Royal Alberta Museum have identified the material as silicified mudstone (Dawe, pers. comm. 2007; Schweger, pers. comm. 2007). The materials dominating Block B of HiOv-89 were identified as silicified siltstone (SS), varying in colour from dark grey to black. A second type of brown SS was coarse and light in density, and occasionally appeared in combination with the SM within a single specimen, indicating this SS type may be related to the SM either as a form of cortex,

Table 4.1 Lithic material classification system

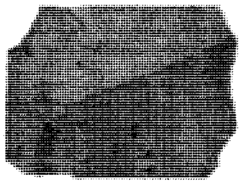
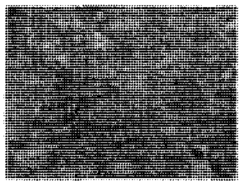
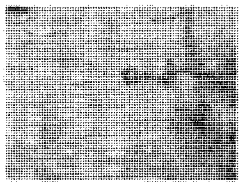
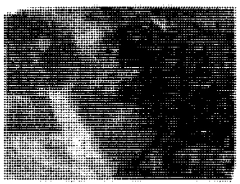
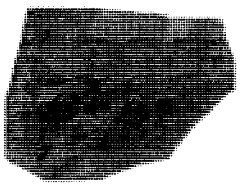
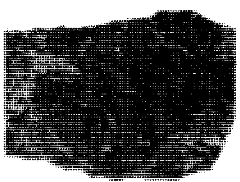
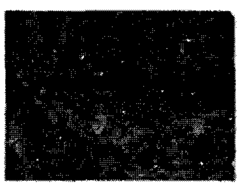
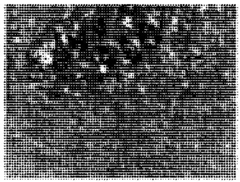
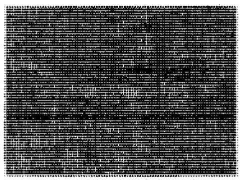
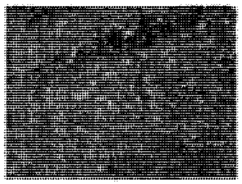
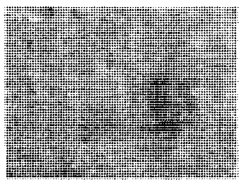
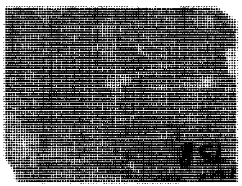
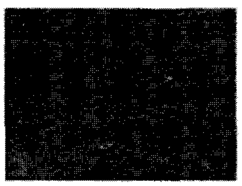
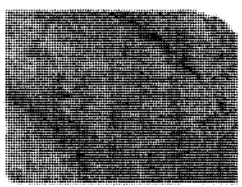
0 cm 1	Code	Material	Description
	BRS 1	Beaver River Sandstone	Fine-grained, highly workable
	BRS 2	Beaver River Sandstone	Coarse-grained, unpredictable fracture
	CH 1	Chert	Creamy white, some fossils present
	CH 2	Chert	Mottled and banded blue and grey, spalled
	CH 3	Chert	Red with some black bands, waxy and coarse-grained
	CH	Chert	Other chert varieties
	GN	Gneiss	Black, banded, possibly not cultural

Table 4.1 Continued

0 cm 1	Code	Material	Description
	NQZ	Northern Quartzite	Smooth, fine-grained and glassy, yellow to pink in colour
	OQZ	Orthoquartzite	Crumbling and highly weathered, brown with quartz crystals
	QZ	Quartzite	Common quartzite varieties, generally purple and coarse
	SM 1	Silicified Mudstone	Fine-grained, highly workable, white to beige in colour
	SM 2	Silicified Mudstone	Fine-grained, highly workable, grey to brown in colour with small white mottles occasionally present
	SM 3	Silicified Mudstone	Fine-grained, highly workable, uneven brownish red colouring and exhibiting post-depositional spalling
	SS 1	Silicified Siltstone	Black, medium-grained with smooth fracture
	SS 2	Silicified Siltstone	Brown, porous. Appears to be de-silicified SM1

or a portion of the material that has been de-silicified post-depositionally. A few crumbling, highly weathered pieces of orthoquartizte also appear to have undergone such a de-silicification process (Schweger, pers. comm. 2007). Three different varieties of chert were found: a creamy white chert containing marine fossils, a mottled and striped bluish grey chert, and a red, waxy-looking chert. Beaver River Sandstone (BRS) was relatively rare in the collection, and occurred in two varieties: the first fine-grained, possibly fire-treated, exhibiting a smooth conchoidal fracture; and the second rough and very coarse-grained, exhibiting an uneven fracture. Some medium-grained, greyish-pink quartzite is present in the assemblage, as well as flakes of fine-grained, glassy yellowish-pink quartzite. This material is a highly workable form of quartzite found throughout northern Alberta and other areas, and is often termed "Northern Quartzite" among archaeologists in Alberta. A few pieces of black, banded gneiss were also collected, although they do not exhibit definitive evidence of cultural modification.

Refitting

Refitting is the process of piecing together information about a site, artifact, or artifact production method by reconnecting previously associated pieces of cultural materials (Cziesla 1990, Cziesla et al. 1990). This may be done by reassembling broken artifacts piece by piece, or reconstructing lithic reduction sequences by placing flakes and debitage sequentially back on to the core from which they were removed. Short sequences of flakes may also indicate reduction types and possible core shapes for cores not present at a site. The distance between broken pieces of a single artifact may be indicative of artifact disposal or post-depositional artifact movement, helping archaeologists to retrace the processes involved in a site's formation.

The small number of artifacts present at HiOv-89, as well as the apparent variety of distinct material types, make HiOv-89 an ideal candidate for refitting analysis. The goal of refitting analysis was to reconstruct the microblade component of the site. If microblades, ridge flakes, core tablets, and shaping flakes could be fitted back to the microcores from which they were struck, they would provide evidence to augment the analysis of production methods based on microcore typology. Over two weeks, a total of 42 hours were spent by the author attempting to find refits, and the collection was also briefly examined by Dr. Le Blanc, coauthor of a refitting study of a similar Oilsands microblade site (Le Blanc and Ives 1986), to ensure that a low number of refits was not due to the inexperience of the author. Since the BRS, quartzite, gneiss, and black SS were not among the materials associated with microblade production, they were excluded from refitting analysis. Chert, SM, and the brown SS were therefore the materials included in the analysis.

Artifacts were first sorted by provenience to guide the refitting, then by material type, and finally by artifact size and shape. These various sorting methods were used to attempt to overcome the unintentional tendency to attempt to refit only pieces that look similar in colour and shape, although post-depositional processes may have greatly altered the appearance of an artifact (Plate 4.5). Refitted artifacts were glued together using water soluble glue, and any composite artifacts created during refitting were identified and measured using the same methods as used for the general assemblage, and recorded in a separate catalogue.

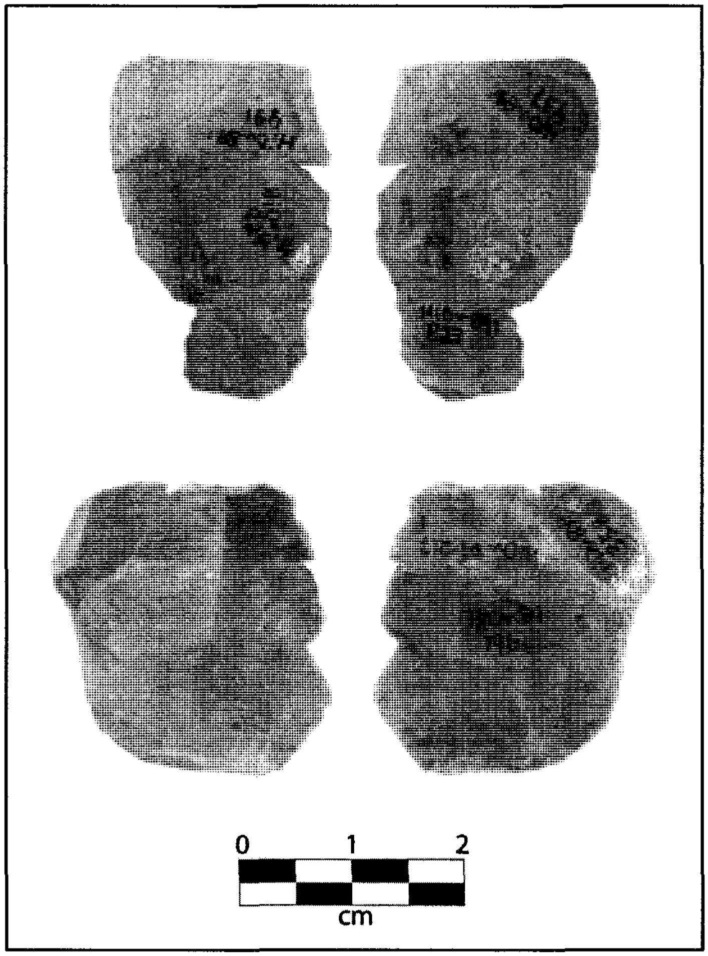


Plate 4.5 Examples of refitted flake fragments of varying appearance

For the purposes of this research, refitted pairs were classified into three categories. The assemblage from HiOv-89 is characterised by highly fragmented artifacts and apparent fluidity in artifact production, with evidence of extensive reuse and resharpening. Cziesla's standard system of refitting classification, distinguishing between breaks, production, and modification (Cziesla 1990), was difficult to apply to this assemblage, as the original tool production sequences could not be confidently separated from sequences relating to re-use and recycling. Instead, refits were classified following Wenban-Smith (1997). Under this system, *breaks* are defined as refitted artifact fragments that were snapped or otherwise broken, while *conjoins* represent the refitting of a reduction or production sequence, and conjoined pairs represent sequential flake removals from a core or tool. A third category was added to this system to account for refitted broken pairs that were pot-lidded post-depositionally due to moisture and temperature fluctuations. These *spalls* were useful in examining the post-depositional processes occurring at HiOv-89.

Review of Unpublished Reports

The final aspect of this study involved a review of sites reported to contain evidence of microblade technology in the Oilsands region. The review was conducted at the Heritage Resources Management Branch of Alberta Culture and Community Spirit (ACCS), located in Edmonton, Alberta, with assistance from ASA staff Darryl Bereziuk, Martina Purdon, and Joan Damjkar. First, the *Alberta Archaeological Site Inventory* database was searched for all site report forms with references to microblades or microcores. The information from the database was then used to locate the Historical Resources Act survey and/or excavation reports associated with these sites. From these site forms and reports, information was gathered about the extent of site excavation, the types of materials found, and descriptions, or photographs, of the artifacts related to microblade technology.

Sites were too numerous for a first-hand analysis of the reported artifacts to be conducted; as such the information gathered during this portion of the study was subject to some limitations. All inferences drawn from these reports must be considered conditional, upon possible misinterpretation of photographs or of the previous authors' descriptions. Furthermore, because many of the sites have been recently discovered, many reports have not yet been submitted to, or approved by, the government, and were not yet available for study. Conversely, many of the older reports were prepared under different reporting requirements, leading to inconsistencies in the level of detail acquired during the literature review. Despite the preliminary nature of this evidence, and cautions that must be taken in its interpretation, it is valuable for such unpublished literature to be synthesized, and it is hoped that the results of this analysis might point to potential topics of future study.

Chapter 5 HiOv-89 Analysis Part I: Assemblage Overview

Introduction

There were 935 pieces of lithic material recovered from HiOv-89, including 10 items recovered during shovel testing, 742 excavated from Block A, 171 from Block B, and five from Block C. The assemblage consists of 797 pieces of debitage, 39 microblades and fragments, 28 burin spalls, 24 microcores and fragments, 17 ridge flakes, 16 burinated tools, and 15 scrapers (Table 5.1 to Table 5.4). Of the 15 material types defined during analysis (see Table 4.1, Chapter 4), 83.9% of the assemblage is composed of varieties of silicified mudstone and siltstone (Table 5.5). Apart from a black silicified siltstone, these materials appear to be variations of a single material, all of which are seen in the microblade and burin component of the site. The remaining material types, including Beaver River Sandstone (BRS) and varieties of chert and quartzite, comprise a small portion of both debitage and scrapers in the assemblage. Fourteen gneiss fragments show no sign of cultural modification, but may have been culturally transported to the site.

Table 5.1 Debitage types found at HiOv-89

Class	Type	Number
Core	Core Fragment	2
Flake	Bifacial Reduction	107
	Bipolar	1
	Core Reduction	215
	Indeterminate	335
Shatter	Shatter	136
Total		*796*

Table 5.2 Materials related to microblade production found at HiOv-89

Class	Type	Number
Microblade	Whole	9
	Proximal	21
	Medial	5
	Distal	4
Subtotal		*39*
Microcore	Microcore	9
	Microcore Fragment	13
	Microcore Preform	1
	Platform Tablet	1
Subtotal		*24*
Ridge Flake	RF, primary	5
	RF, secondary	9
	Platform RF, primary	1
	Platform RF, secondary	2
Subtotal		*17*
Grand Total		*80*

Table 5.3 Materials related to burin production found at HiOv-89

Type	Number
Burin	7
Multi-Tool	9
Burin Spall	28
Total	*44*

Table 5.4 Scrapers and retouched artifacts found at HiOv-89

Type	Number
Scraper/Retouched Flake	6
Side and End Scraper	4
Side Scraper	1
End Scraper	1
Thumbnail Scraper	1
Scraper	2
Total	*15*

Table 5.5: **Frequencies of raw material distributions by block**

Raw Material	Block					Total
	A1	A2	B	C	Shovel Test	
BRS1	5	8	10	1	2	26
BRS2	1		3	2	1	7
CH	2	2				4
CH1	12	2				14
CH2	31	8				39
CH3	2	4				6
GN	8	5			1	14
NQZ	1	16		1	1	19
OQZ		10				10
QZ	2	3	1			6
SM1	258	20			2	280
SM2	106	70				176
SM3	16	1				17
SS1	48	13	159	1	3	224
SS2	89	2	2			93
Total	*581*	*164*	*175*	*5*	*10*	*935*

Twenty-four bone fragments were also recovered from units $51^{N}599^{E}$ and $52^{N}599^{E}$ in Block A of the site, near the highest concentrations of debitage and modified artifacts. They were found between 10 and 30 cm below surface, again placing them within the area of highest artifact density, and providing limited evidence that they may indeed be associated with the lithic artifacts at the site. One bone fragment shows evidence of having been burnt, while the others are highly decomposed and partially calcined. Altogether, the fragments weigh 7.5 g, averaging 0.31 g each, and none measures more than 3.0 cm in length. The species of the fragments could not be identified, nor was radiocarbon dating attempted, at the request of the Royal Alberta Museum to conserve the material.

The following raw material and refitting analyses refer, unless otherwise noted, to the entire lithic assemblage at HiOv-89, including debitage, tools, burins, microcores and microblades, and other specialized debitage. The analysis of edge-modified flakes includes only debitage not related to microblade or burin production, while formed tool analysis includes all scrapers, shaped retouched tools, and burins and burin spalls. The full analysis of microblades and their associated materials will be addressed in Chapter 6.

Debitage Analysis

The diversity of raw material types identified at HiOv-89 must be addressed during the debitage analysis. There appears to be a clustered distribution of raw materials at the site, indicating a possibility for separate uses, or even separate occupations, tied to these raw materials. Further, different raw material types may have been used to create different types of tools. The following section will attempt to take these factors into account by looking at the various roles of the different materials in the collection. Although 15 material types were defined during artifact cataloguing, many of these types are closely related, and it is likely that only five or six distinct raw material sources were used at the site. Furthermore, it seems that the majority of lithic reduction was focused on two of these types. The distinctions between the main lithic groups will be addressed below.

Silicified Mudstone

The most common raw material in the assemblage is silicified mudstone, which occurs in three colours: beige (SM1), greyish-brown (SM2), and mottled grey and reddish-orange (SM3). Although these three types look different, and have been classified separately for cataloguing purposes, mottling of two or all of these colours will often appear within one artifact (for example, burin HiOv-89-279, Plate 5.6c, microcore HiOv-89:873, Plate 6.5,and microblades HiOv-89:648 and 811, Plate 5.11g and i). Variations grading between the main colours are also present, indicating that these differently coloured artifacts are all created from a single type of silicified mudstone. This interpretation is supported by Gryba's raw material survey of the Fort Hills Lease Area (Unfreed et al., 2001: Appendix II), during which he noted that cobbles of what he called brown, white, and grey chert could be found near the Athabasca River. In the survey report for HiOv-89, the silicified mudstone found in the shovel test was classified as this material. Given the smooth, fine-grained, and apparently highly workable qualities of the material, it is not surprising that it was originally classified as chert.

A second material type in this category consists of a brown, coarser-grained silicified sandstone (SS2) that appears to be related to the silicified mudstones. Occasionally the two material types occur together within a single artifact. Specimens of SM1 such as HiOv-89:872 (Plate 6.7 a) and 224 (Plate 6.10 b), in which portions appear very similar to SS2 and are eroded and indistinct, indicate that the material may in fact represent highly weathered and de-silicified portions of the original silicified mudstone artifacts. The material is often slightly crumbling, with platform and dorsal scar characteristics difficult to distinguish. Although catalogued as silicified sandstone, artifacts of this material seem in fact to be cortical or eroded pieces of SM1, and they are accordingly analysed as silicified mudstone.

A further characteristic of this material is the evidence for exposure and intensive weathering on a portion of the artifacts. While many artifacts are well preserved, a significant number have been obscured by the de-silicification described above, as well as by heavy wind polishing and pot-lid fracturing. Wind-polishing is most commonly seen on the SM1 materials, and can be intense enough to completely obscure features such as platforms or dorsal flake scars. Pot-lid fractures are seen almost exclusively on SM2 artifacts, and are likely related to inherent weaknesses in the material.

Silicified mudstone artifacts include scraper tools, burins, multi-tools, microblades and cores, and debitage. Although burin spalls and ridge flakes have been included in the charts within the burin and microblade categories for illustrative purposes, they are in fact simply specialized types of debitage. Under these considerations, tools and microblade artifacts make up 14.3% of the silicified mudstone artifacts at the site, with the remaining 85.7% composed of various types of debitage.

Distribution

All but two of the artifacts composed of silicified mudstone were recovered from Block A (Table 5.5), spread over an area approximately 10 metres north - south by 10 metres east - west. Artifacts were found between 0 and 50 cm below surface, with the majority recovered from level 2 (10 to 20 cm below surface; Table 5.6). Of the formed artifacts and specialized debitage at HiOv-89, all materials related to microblade production, and the vast majority of those related to burins, were composed of silicified mudstone.

Debitage Characteristics

Silicified mudstone debitage seems to represent the intermediate stages of lithic reduction. Shatter accounts for only 10.6% of the debitage (Table 5.6). Flakes are split almost equally between dorsal scar counts of one, two, and more than two, with only 3.1% of flakes having full dorsal cortex cover, and only 20% of flakes exhibiting any cortex at all (Table 5.7). Platform scar counts are low on average; the most common platform scar count is one (Table 5.8). Platform grinding is common, and is seen in roughly half of the silicified mudstone flakes. Edge modification is seen on 22.3% of the debitage as either edge-retouch or use-wear (Table 5.9).

Of those flakes containing platforms and showing identifying characteristics, the vast majority represented core reduction rather than bifacial reduction. Wide platform angles, low platform scar counts, and low curvature were all common traits. Debitage was also very small, with an average weight of 0.46 g and the majority of artifacts measuring between 1.0 and 1.5 cm in maximum dimension. However, given that over two-thirds of silicified mudstone flakes catalogued are fragmentary, these numbers may not be representative of the original flake sizes.

Table 5.6 Frequencies of silicified mudstone artifact types and depths of artifact recovery

Class	Type	Level						Total
		1	2	3	4	5	ST*	
Debitage	Bifacial Reduction Flake	2	46	14	5	0	0	67
	Bipolar Flake	0	1	0	0	0	0	1
	Core Fragment	0	1	0	1	0	0	2
	Core Reduction Flake	3	101	33	10	0	0	147
	Indeterminate Flake	5	94	67	12	1	0	179
	Shatter	0	29	12	6	0	0	47
	Debitage Total	*10*	*272*	*126*	*34*	*1*	*0*	*443*
Tool	Scraper	0	4	1	1	0	0	6
	Burin	0	2	3	1	0	0	6
	Multi-Tool	0	2	4	1	0	0	7
	Burin Spall	0	11	12	1	0	0	24
	Tool Total	*0*	*19*	*20*	*4*	*0*	*0*	*43*
Microblade	Microblade	1	20	11	5	1	1	39
	Microcore	0	12	8	2	1	1	24
	Ridge Flake	0	14	3	0	0	0	17
	MB & Burin Total	*1*	*46*	*22*	*7*	*2*	*2*	*80*
Grand Total		*11*	*337*	*168*	*45*	*3*	*2*	*566*

*ST: Shovel Test

Table 5.7 Dorsal surface characteristics of silicified mudstone flakes

Dorsal Scar Count	Dorsal Cortex Cover				Total
	0%	1-50%	51-99%	100%	
0 (Cortex)	0	0	3	9	12
1	97	19	13	0	129
2	113	18	4	0	135
3 or more	102	11	3	0	116
Total	*312*	*48*	*23*	*9*	*392*

Table 5.8 Platform characteristics of silicified mudstone flakes

Platform Scar Count	Platform Grinding		Total
	Present	Absent	
Cortex	1	6	7
1	65	63	128
2	31	19	50
3 or more	14	11	25
Total	*111*	*99*	*210*

Table 5.9 Edge modification of silicified mudstone debitage

Retouch	Use-Wear			Total
	Present	Possible	Absent	
Present	27	1	26	54
Possible	0	0	7	7
Absent	32	6	344	382
Total	*59*	*7*	*377*	*443*

Silicified Siltstone

A single type of silicified siltstone (SS1) represents the second most common raw material found at HiOv-89. Unlike the silicified mudstone, very few formed tools of this material were found at the site. There is only a single formed tool, a scraper, representing 0.4% of the entire silicified siltstone assemblage. Since the SS1 material was apparently not involved in microblade production, it can also be expected to show different debitage characteristics, and perhaps different distributions, than the silicified mudstone.

Distribution

This material is more equally distributed throughout the site than is the silicified mudstone, being found in every excavation block (Table 5.5). Silicified siltstone also tended to be found slightly deeper, with the majority of artifacts found in level three (20 to 30 cm below surface; Table 5.10). Interestingly, debitage of this material shows different characteristics in different blocks.

Table 5.10 Frequencies of silicified siltstone artifact types and depth of artifact recovery

Artifact Class	Artifact Type	Level						Total
		1	2	3	4	5	ST*	
Debitage	Bifacial Reduction Flake	1	6	18	1	0	1	27
	Core Reduction Flake	0	8	32	0	0	0	40
	Indeterminate Flake	1	31	54	1	1	2	90
	Shatter	0	21	40	5	0	0	66
	Debitage Total	*2*	*66*	*144*	*7*	*1*	*3*	*223*
Tool	Scraper	0	0	1	0	0	0	1
	Tool Total	*0*	*0*	*1*	*0*	*0*	*0*	*1*
Grand Total		*2*	*66*	*145*	*7*	*1*	*3*	*224*

ST: Shovel Test

Debitage Characteristics

Silicified siltstone debitage seems to represent the intermediate stages of lithic reduction. Shatter comprises almost one-third of the debitage (Table 5.10). Flakes are split almost equally between dorsal scar counts of one and two, while only 14 flakes (9.2% of all silicified siltstone flakes) show any cortex at all (Table 5.11). As with silicified mudstone, platform scar counts are low on average; however, platform grinding is less common, seen on only 31.3% of flakes with identifiable platforms (Table 5.12). Edge modification is seen on only 13.5% of the debitage; however, all of the artifacts showing distinct evidence of retouch or use-wear are found in Block A (Table 5.13 and

Table 5.14). Only three instances of possible edge modification are found in Block B. Edge modification is seen on 42.9% of the debitage in Block A, compared to only 1.9% of the debitage in Block B.

Of those flakes containing platforms and showing identifying characteristics, a small majority represented core reduction rather than bifacial reduction. Overall, platform angles, curvature, and platform scar counts were variable throughout the SS1 assemblage. It should be noted that many artifacts classified as shatter tended to be small and thin, likely representing flake fragments with no identifiable flake features, rather than traditional blocky shatter as a by-product of early stage flake production. Debitage was also very small, with an average weight of 0.37 g and the majority of artifacts measuring between 0.5 and 1.5 cm in maximum dimension. However, given that over three-quarters of SS1 flakes catalogued were fragmentary, these numbers may not be representative.

Table 5.11 Dorsal surface characteristics of silicified siltstone flakes

Dorsal Scar Count	Dorsal Cortex Cover				Total
	0%	1-50%	51-99%	100%	
1	36	9	1	0	46
2	62	3	1	0	66
3 or more	41	0	0	0	41
Total	*139*	*12*	*2*	*0*	*153*

Table 5.12 Platform characteristics of silicified siltstone flakes

Platform Scar Count	Platform Grinding		Total
	Present	Absent	
Cortex	0	1	1
1	12	21	33
2	4	16	20
3 or more	4	7	11
Total	*20*	*45*	*64*

Table 5.13 Edge-retouch characteristics of silicified siltstone debitage in different excavation blocks

Retouch	Block			Total
	A1	A2	B	
Possible	2	0	1	3
Present	17	3	0	20
Absent	31	10	159	200
Total	*50*	*13*	*160*	*223*

Table 5.14 Use-wear characteristics of silicified siltstone debitage in different excavation blocks

Use-Wear	Block			Total
	A1	A2	B	
Possible	3	1	2	6
Present	14	3	0	17
Absent	33	9	158	200
Total	*50*	*13*	*160*	*223*

Other Material Types

Beaver River Sandstone

Only 33 pieces of BRS were found, accounting for 3.5% of the entire assemblage. Little can be said statistically about such a small assemblage; however, it is noteworthy in itself given the prevalence of Beaver River Sandstone in archaeological sites throughout the region. Three tools of BRS, including two large scrapers and a multi-tool, comprise 9.1% of the BRS found at the site (Table 5.15). The average size range for BRS debitage is between 1.0 and 1.5 cm, however, there is significant variability, with flakes ranging from less than 0.5 cm to almost 4.0 cm. Weights were similarly variable, ranging from less than 0.1 g to 8.3 g, and averaging 1.26 g. Overall, it seems that both the intermediate and finishing stages of lithic reduction are evident in the BRS debitage. Characteristics such as dorsal and platform scars were evenly distributed, with no distinct patterns evident other than an extremely low occurrence of cortex. There are 12 tiny finishing flakes of the fine-grained BRS 1, and all of the flakes showing definite signs of retouch or use-wear (Table 5.16) are also of the fine-grained variety.

Table 5.15 Beaver River Sandstone artifact types

Class	Type	Total
Debitage	Bifacial Reduction Flake	5
	Core Reduction Flake	5
	Indeterminate Flake	20
	Debitage Total	*30*
Tool	Multi-Tool	1
	Scraper	2
	Tool Total	*3*
Grand Total		*33*

Table 5.16 Edge modification of Beaver River Sandstone debitage

Retouch	Use-Wear			Total
	Present	Possible	Absent	
Present	4	0	2	6
Absent	1	1	22	24
Total	*5*	*1*	*24*	*30*

Chert

Chert is slightly more common at HiOv-89, representing 6.7% of the assemblage (Table 5.17); however, some of this prevalence may be due to the similarities between CH 1, CH 2, and the silicified mudstone varieties, which were difficult to distinguish without microscopic analysis. There are few characteristics distinguishing the chert debitage from the remainder of the lithic assemblage, and so there is no evidence available to evaluate the accuracy of this specific material distinction made during cataloguing. As with the other materials in the assemblage, dorsal scar counts and platform scars and grinding are all variable, and cortex is rare. The average size of chert debitage is between 1.0 to 1.5 cm, and the average weight is 0.98 g. Edge modification is seen in similar proportions as in the rest of the assemblage, with evidence of edge-retouch or use-wear visible on 29.6% of the chert debitage (Table 5.18). Burins and scrapers constitute 7.9% of the chert artifacts, while identifiable debitage is dominated by core reduction flakes and shatter. Overall, chert seems to represent intermediate stages of lithic reduction, focused on core reduction.

Table 5.17 Chert artifact types

Class	Type	Total
Debitage	Bifacial Reduction Flake	3
	Core Reduction Flake	17
	Indeterminate Flake	20
	Shatter	14
	Debitage Total	*54*
Tool	Burin	1
	Burin Spall	4
	Multi-Tool	1
	Scraper	3
	Tool Total	*9*
Grand Total		*63*

Table 5.18 Edge modification of chert debitage

Retouch	Use-Wear			Total
	Present	Possible	Absent	
Present	4	0	3	7
Possible	0	1	2	3
Absent	5	1	38	44
Total	*9*	*2*	*43*	*54*

Quartzite

Overall, quartzite artifacts are the largest seen in the lithic assemblage, weighing an average of 2.8 g, with maximum dimensions measuring from 0.5 to 7.0 cm and averaging between 1.5 and 2.0 cm. The assemblage is dominated by shatter (Table 5.19), while those flakes with identifiable characteristics show even distributions of dorsal scars and presence of platform grinding. There is a tendency toward single platform scar counts, and very little cortex is present. Although a few tiny finishing flakes of northern quartzite (see Table 4.1) were found, the majority of flakes represent intermediate stages of lithic reduction. In general, shatter is composed of orthoquartzite, while scrapers, identifiable flakes, and retouched flakes (Table 5.20) were composed of northern quartzite or generic purple quartzite. A total of three quartzite scrapers were found in the assemblage, making up 8.6% of the quartzite artifacts.

Table 5.19 Quartzite artifact types

Class	Type	Total
Debitage	Bifacial Reduction Flake	5
	Core Reduction Flake	6
	Indeterminate Flake	7
	Shatter	14
	Debitage Total	*32*
Tool	Scraper	3
	Tool total	*3*
Grand Total		*35*

Table 5.20 Edge modification of quartzite debitage

Retouch	Use-Wear			Total
	Present	Possible	Absent	
Present	2	0	3	5
Possible	1	0	0	1
Absent	0	1	25	26
Total	*3*	*1*	*28*	*32*

Gneiss

The gneiss found at HiOv-89 is questionable as a cultural material; however, it was found in areas of high lithic concentration in Block A, at the same depths as other lithic artifacts in this block, and may have been transported to the site for reasons unrelated to lithic tool production. All gneiss artifacts were catalogued as either shatter or distal flake fragments; however, much of the shatter bears little evidence of any purposeful modification in the form of recognizable fracture scars. The gneiss artifacts are within the range of other materials at the site, weighing an average of 1.0 g and measuring on average between 01.5 and 2.0 cm.

Refitting Analysis

Refitting analysis at HiOv-89 produced a surprisingly small number of successful refits, with an especially low number of conjoined refitted pairs. Out of an assemblage of 935 artifacts, there were 82 refitted pairs found, including 54 broken artifact pairs, 12 heat or frost-spalled pairs, and 16 conjoined pairs (Table 5.21, see also Chapter 4 for a description of refitting methods and terminology used here). While the majority of refitted broken pairs were debitage fragments, the majority of conjoined and spalled pairs were related to microblades and burins, allowing for some insight into burin tool use and microcore reduction at HiOv-89. These results, and those relating to the measurement and composition of refitted broken microcores, burins, and other tools and specialized debitage, are discussed as a part of the artifact analysis for each artifact type, respectively. The results of debitage refitting are discussed below, as are the spatial distributions of refitted artifacts. Distribution analysis incorporates all artifact pairs in each refitting category, including debitage, tools, and microblade and burin artifacts.

Table 5.21 Artifact types involved in refitted artifact pairs

Refitted Artifact Type	Refit Type			Total
	Break	Conjoin	Spall	
Burin	3	3	0	6
Microblade	3	3	0	6
Microcore	1	0	8	9
Ridge flake	0	4	0	4
Debitage	47	6	4	57
Total	*54*	*16*	*12*	*82*

Because artifacts were measured by depth level and one metre unit, the analysis of spatial distributions is only accurate within 10 centimetres vertically and one metre horizontally. Values for average distances between artifacts are calculated assuming artifact locations at the centre of the unit, and are only accurate to within a metre. The maps illustrating the horizontal distributions of refitted pairs show artifacts scattered from the centre of the unit in order to differentiate the many artifacts that were refitted from a single unit, and do not represent the actual distributions of artifacts within the excavation units. Vertical distribution of refits was only briefly studied, as nearly all artifacts were found in levels 2 and 3. Due to the scale of depth recording during excavation, a separation of a single level is not necessarily significant for this study. A refitted pair with one artifact from the top centimetres of level 3, and the other from the bottom of level 2, may be only a few centimetres apart, and closer together than a pair spread across all ten centimetres of level 2.

Breaks

The refitting of 54 broken artifact pairs produced a total of 45 new artifacts, including 38 pieces of debitage, three burins, three microblades, and a microcore fragment.

Distribution

The distance between refitted pairs of artifacts showed great variation among broken artifacts (Figure 5.1). Pairs differed in depth from a two level distance, to being found in the same level, and averaging 0.4 levels (or 4 cm) in vertical difference. Given the level of precision of measurement, this value is only an approximation with no statistical validity. Horizontal measurements can be assumed to be slightly more relevant, as the distances between artifacts were often more than a few units. Horizontal artifact pairs varied between appearing in the same excavation unit, to being found in units 7.2 m apart, with an average distance of 1.0 m. Two-thirds of the artifact pairs (n=36) were found either in the same unit or only one unit apart, while only 17.0% (n=9) were separated by two or more metres.

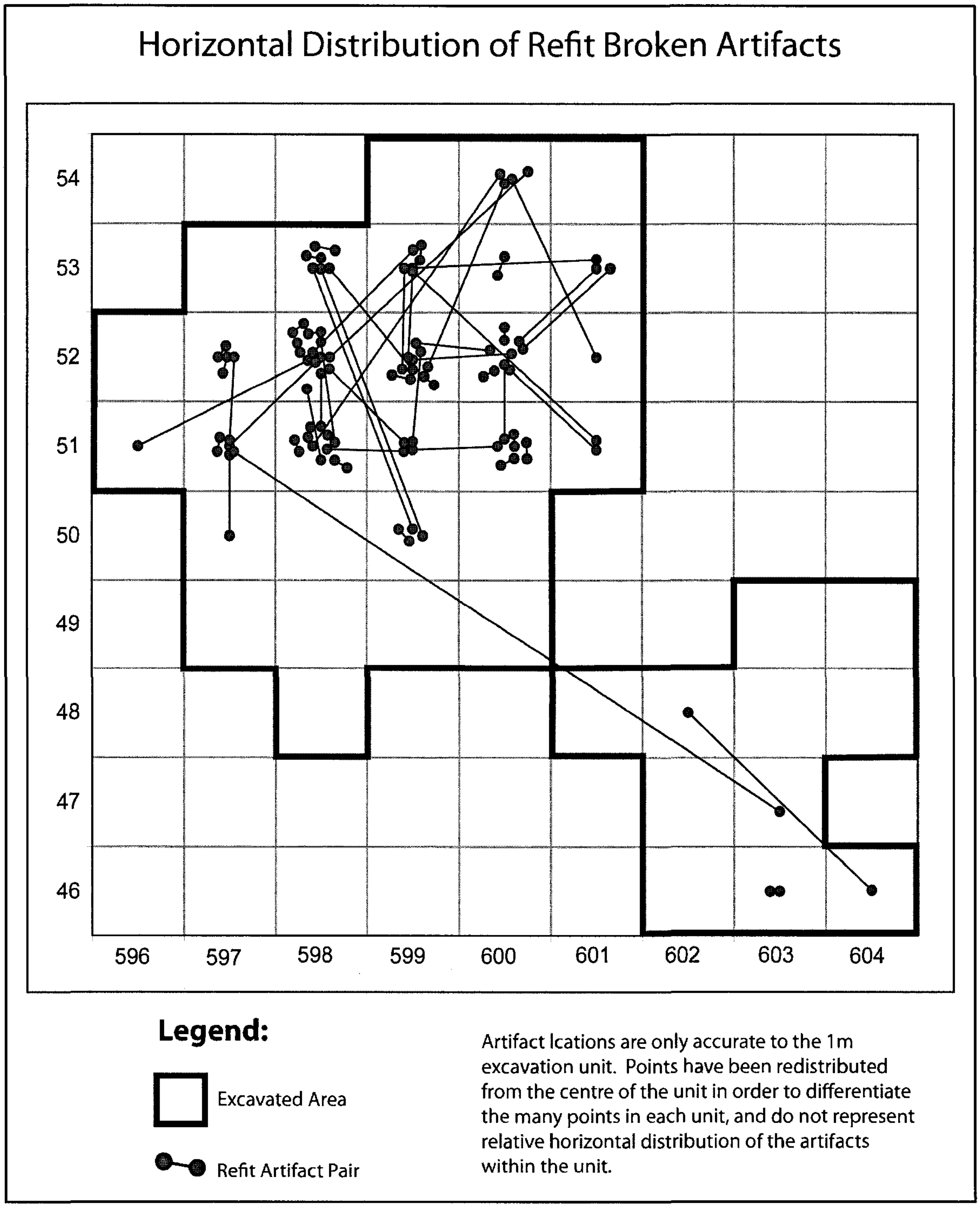


Figure 5.1 Distribution of refitted broken artifacts

Debitage

Refitted broken flakes and shatter could be re-classified as 13 new whole or almost whole flakes, 11 distal flake fragments, four proximal fragments, eight medial or unidentifiable fragments, and two pieces of shatter. Refitted debitage were generally composed of a single refitted pair, but some were composed of three or even four flake fragments. These refitted pieces were much larger than those in the rest of the assemblage, measuring on average between 2.5 and 3.0 cm in maximum dimension, and weighing an average of 1.92 g. Of these 38 new artifacts, 22 showed evidence of retouch or utilization. Retouch was continuous across the fracture on two of these artifacts, while 15 flakes exhibited discontinuous retouch at the fracture points, indicating post-breakage utilization of the flakes. In the remaining three flakes exhibiting retouch, post-depositional edge breakage has obscured evidence of whether retouch was continuous. Such breakage has also obscured evidence of retouch on many of the other refitted flakes. In those refitted artifacts where retouch was visible, all retouch was marginal and extremely fine. Marginal retouch was often used to round out broken flake corners. There are also two flakes exhibiting post-break burination on the surface of the refitted fracture. When horizontal distances between refit pairs are calculated depending on the presence of post-breakage usage, average distances become 1.4 m for those exhibiting evidence of such use, compared to 0.8 m for those lacking evidence for such use.

It should be noted that although refitting analysis was not conducted for the silicified siltstone artifacts in Block B, a number of refitting flake fragments of this material were noted during cataloguing. Many of these fragments showed retouch characteristics similar to those recorded on flakes incorporated into the full refitting analysis.

Spalls

Twelve of the refitted artifact pairs seem to have been broken post-depositionally, due to temperature or moisture fluctuations, and are distinguished from other broken or conjoined pairs by their lack of bulbs of percussion or ripple marks, and the presence of either irregular or pot-lidded fracture patterns. The refitting of these artifacts produced five new artifacts, including a microcore, a partially refitted microcore fragment, a microcore preform, a proximal flake fragment, and a piece of shatter. A small pot-lidded fragment was also refitted into a retouched flake (HiOv-89:204 & 201, Plate 5.4a).

Distribution

The refitted frost or heat-spalled artifacts show a distinctly different spatial pattern than other refitted artifact pairs (Figure 5.2). With the exception of a single pair of refitted microcore fragments (HiOv-89:872 & 370), found approximately 2.8 m apart, all of the refitted pairs of this type occur within the same excavation unit, indicating a maximum possible distance of 1.41 m. The strength of the distribution pattern and the nature of the fracture type makes it tempting to assume that many of the artifacts were in fact found much closer together, possibly even next to each other. While this interpretation cannot be proven, it is supported by the fact that all but one of the refitted pairs in this category involved artifacts found within the same level. While these pairs could still be separated by a possible vertical distance of 10 cm, the consistency in level

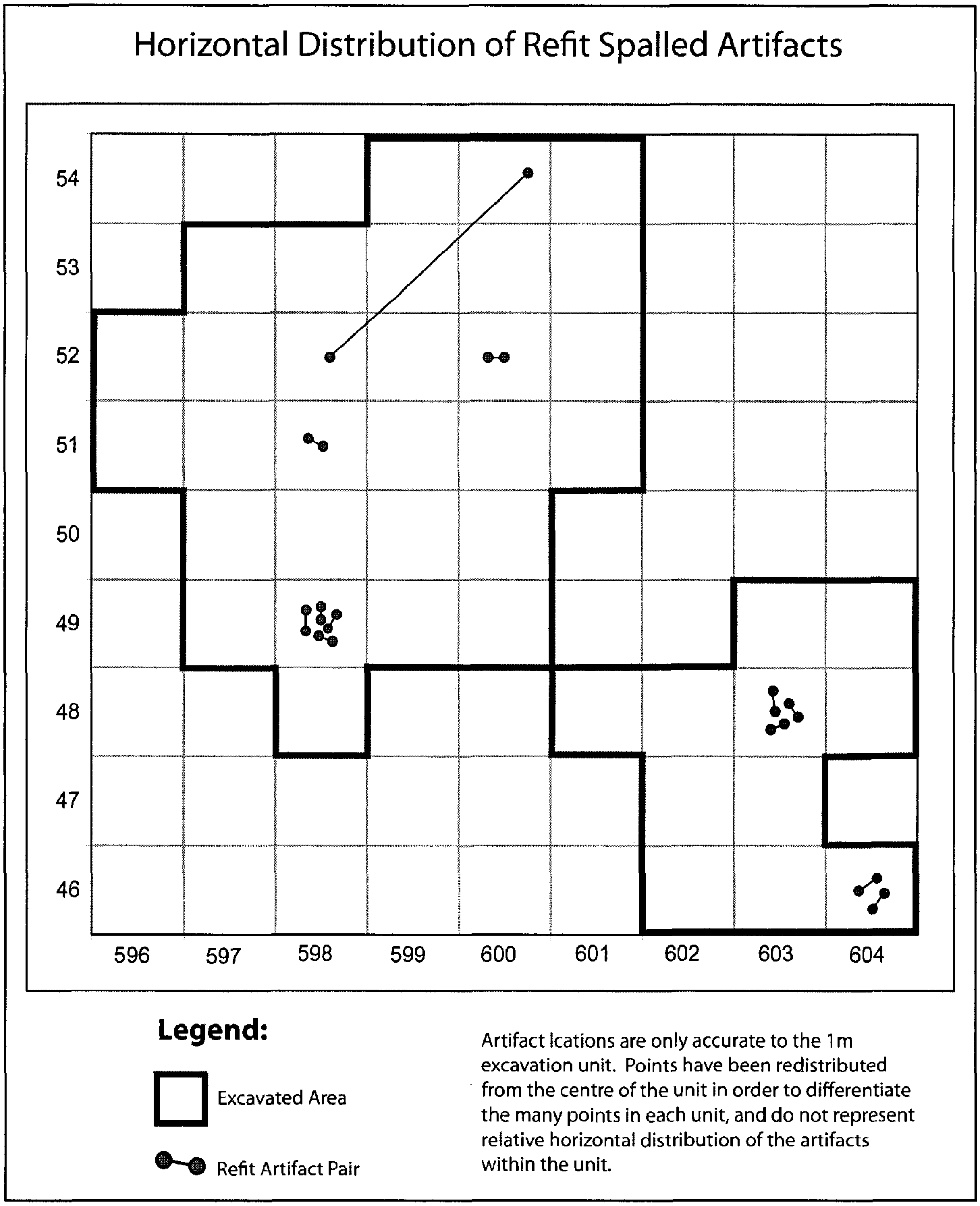


Figure 5.2 Distribution of refitted spalled artifacts

provenience is much stronger than seen in the other refitted types, and indicates the potential for more closely refitted pairs.

Debitage

The low number of debitage refits found in this category precludes any statistical analysis of refitted debitage. The single piece of shatter shows some scraper-like retouch along one edge; however, it is heavily weathered along this edge, and is still too fragmentary to be categorized as a tool. It is composed of three smaller pieces of shatter, weighs 7.4 g, and measures 4.0 to 4.5 cm in maximum dimension. The refitted flake fragment is a small piece of a platform pot-lidded from the original flake.

Conjoins

Of the 16 conjoined artifact pairs, three were burin spall sequences, four were ridge flakes refitted to microblades or cores, three were microblade sequences, and six were flake removal sequences.

Distribution

Conjoined artifacts show a slightly different distribution pattern than the other refitted artifact types (Figure 5.3). The vertical distributions are almost exactly the same as those seen with broken artifact pairs, with artifacts occurring either in the same level or one level apart, and averaging 0.4 levels or 4 cm distance between refitted artifacts. Horizontally, however, artifacts pairs were more significantly separated, ranging from appearing in the same unit to approximately 5 m apart, but with an average of 1.6 m

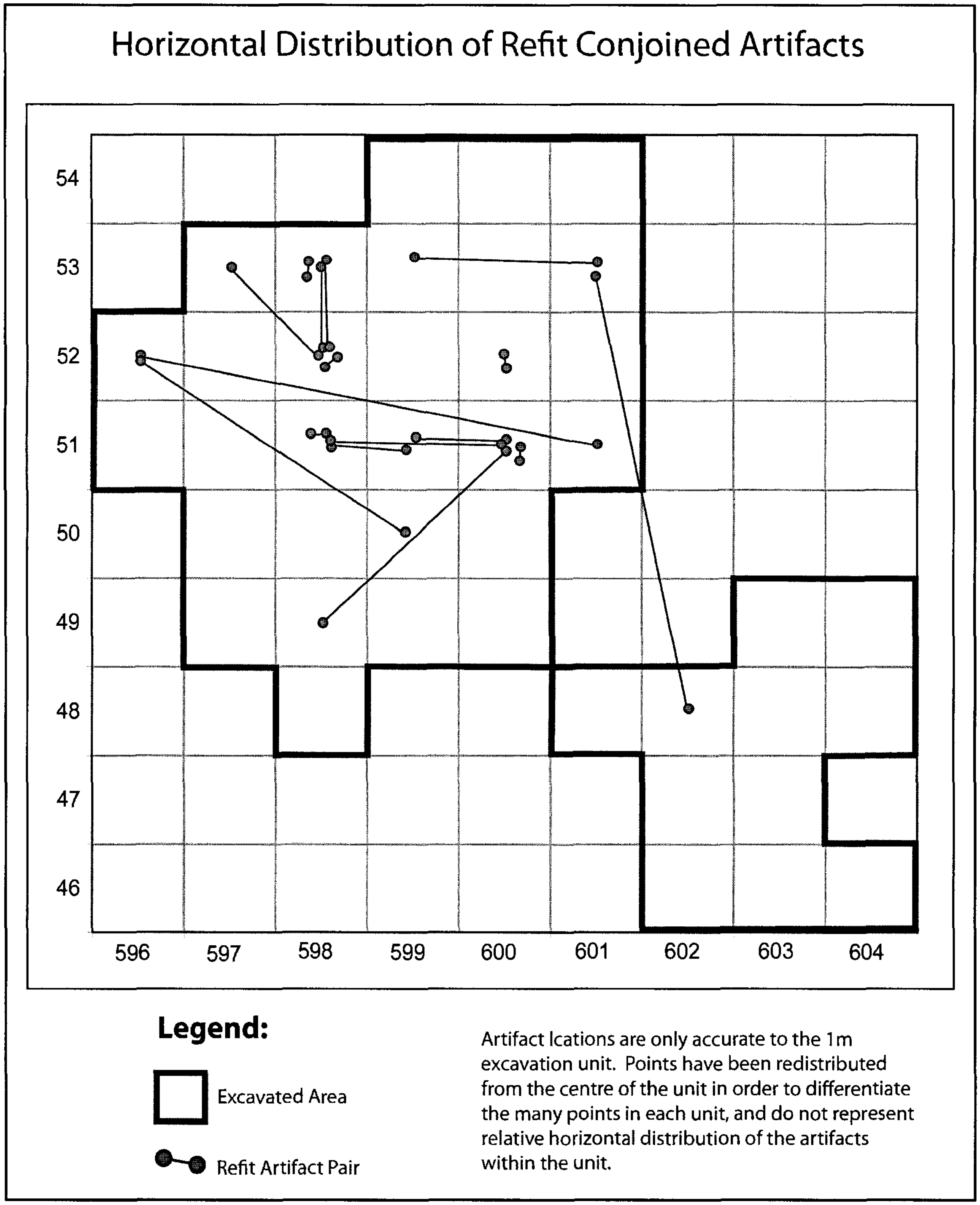


Figure 5.3 Distribution of refitted conjoined artifacts

between artifacts. A greater variation is seen in the distances between refitted pairs among conjoined artifacts compared to broken or spalled artifacts, however, this distance is similar to that seen in broken artifacts with evidence of utilization of one or more fragments after breakage. Just over half (n=9) of the refitted conjoined pairs were within the same unit or 1 m apart, while 37.5% (n=6) were separated by 2 m or more.

Debitage

Of the six refitted flake sequences, three were decortication sequences, two were core reduction sequences, and the sixth involved two core reduction flakes, the dorsal one refitted from two flake fragments, and the ventral one retouched into a scraper (Plate 5.1). Little can be said about debitage reduction sequences based on these few artifacts.

Refitting Summary

Given the nature of the assemblage, a relatively low number of refits were made during refitting analysis. From these few successful refits, however, a number of patterns of spatial distribution are evident. Most notably, spalled artifact pairs were found in close proximity, compared to conjoined artifacts, which were found farthest apart. Most of the refitted artifact pairs were broken pieces of debitage; however, a number of artifact reduction sequence refits were also discovered, most of which related to microblade production. These sequences will be further described as a component of the discussion of the microcore reduction sequence in the following chapter (p.146). The results of the refitting analysis in terms of tool use and spatial distribution are incorporated into the conclusions of the assemblage overview at the end of this chapter.

Tool Descriptions

The tools described in this section include both formed and informal tools not directly related to microblade production. Edge-modified flakes, while showing clear evidence of intentional use or modification after being removed from the core, are considered informal or expedient as they do not require specialized shaping prior to use. Scrapers and other unifacially shaped flakes are considered to be specialized retouched flakes, but may be considered formed tools as they require shaping and more intensive flaking, and generally have more specialized functions. Burination is another specialized form of retouch, and burins are generally expedient in their creation, requiring a single flake removal to produce the working edge. However, burins have a distinctly specialized function and method of production, and platform preparation through notching or flaking is often required prior to burination, and so burins may be considered an intermediate tool type. Scrapers and burins at HiOv-89 are therefore only loosely described as formal tools, more formal than edge-modified flakes but not intricately shaped into symmetrical or fully bifacial tools.

Edge-modified Flakes

There are 159 flakes and debitage in the assemblage showing evidence of edge modification (Table 5.22). This includes 50 artifacts with evidence of retouch, 53 with use-wear, and 56 with both. There were 25 complete flakes among the modified debitage, with the remaining 134 retouched artifacts including distal, medial, and proximal flake fragments, as well as two pieces of retouched shatter. The 26 complete flakes represent only 16.2% of the retouched debitage, while 23.9% of the debitage assemblage for the entire site is composed of complete flakes, indicating either that broken flakes were more commonly selected for edge modification, or that flakes were intentionally snapped before utilization. Refitting of broken flakes showed that edge retouch occurred both before and after snapping or breaking of the artifact, so it could also be that often larger flakes were selected for utilization, which were then more susceptible to post-depositional breakage. This is supported by the observation that edge-modified artifacts have an average weight of 1.1 g and an average size between 2.0 and 2.5 cm, compared to 0.6 g and 1.5 to 2.0 cm overall for debitage in the assemblage.

Table 5.22 Edge modification of debitage

	Use-Wear			
Retouch	**Present**	**Possible**	**Absent**	**Total**
Present	51	2	39	14
Possible	1	2	11	92
Absent	40	13	635	688
Total	*92*	*17*	*685*	*796*

Scrapers and Retouched Flakes

The assemblage at HiOv-89 contains nine scrapers (Plate 5.1, to Plate 5.4; Table A.1, Appendix A) and six retouched flakes (Plate 5.4, Table A.2, Appendix A), found throughout the site but concentrated in Block A (Figure 5.4). All of these artifacts have been rather informally created from flakes, while bifacial core tools are distinctly lacking from the site. Scrapers include four side- and end-scrapers, two side-scrapers, an end-scraper, and a thumbnail-scraper. The retouched flakes at the site show a greater variation in size and shape than the scrapers, without the characteristic steep-angled scraping edge, and do not show intentional overall shaping of the artifact as seen in more elaborate bifacial tools common to Oilsands archaeological sites. These artifacts do, however, show at least some unifacial or bifacial shaping or thinning, and scraper-like use-wear on their working edges. Scrapers and retouched flakes together show some of the greatest variety in material type of any other artifact category at the site, with no one material type dominating the collection, which includes two types of silicified mudstone, black silicified siltstone, quartzite, northern quartzite, BRS, and two types of chert.

While most of the retouched flakes and scrapers are unremarkable in their shape and overall appearance, one specimen (HiOv-89:809; Plate 5.2) displays a wedge shape and shaping method very similar to that displayed by microcores at the site (see Chapter 6). The artifact has been created from a thick decortification flake. The scraper edge strongly resembles the unifacially shaped fluted face ridges seen in refitted ridge flake sequences, while the opposite edge has been partially shaped through small, parallel flake scars and resembles a keel. The distal end of the flake does not end in a typical flake termination or a snap fracture, but appears to have been removed by a burin blow. The burin scar terminates in a slight hinge just before the retouched keel, and strongly resembles a prepared microcore platform. This artifact cannot be confidently identified as an unfinished microcore, however, for two reasons. First and perhaps more importantly, there is no obvious reason why this core may have been abandoned at this stage in reduction. Secondly, the scraping edge does show evidence of use-wear, giving strong evidence for diagnosing the artifact primarily as a scraper. However, two of the refitted ridge flake sequences also show some use-wear on the fluted face preparation ridge. The possible relevance of this artifact for microcore analysis, if it is indeed a microcore, will be discussed in Chapter 6.

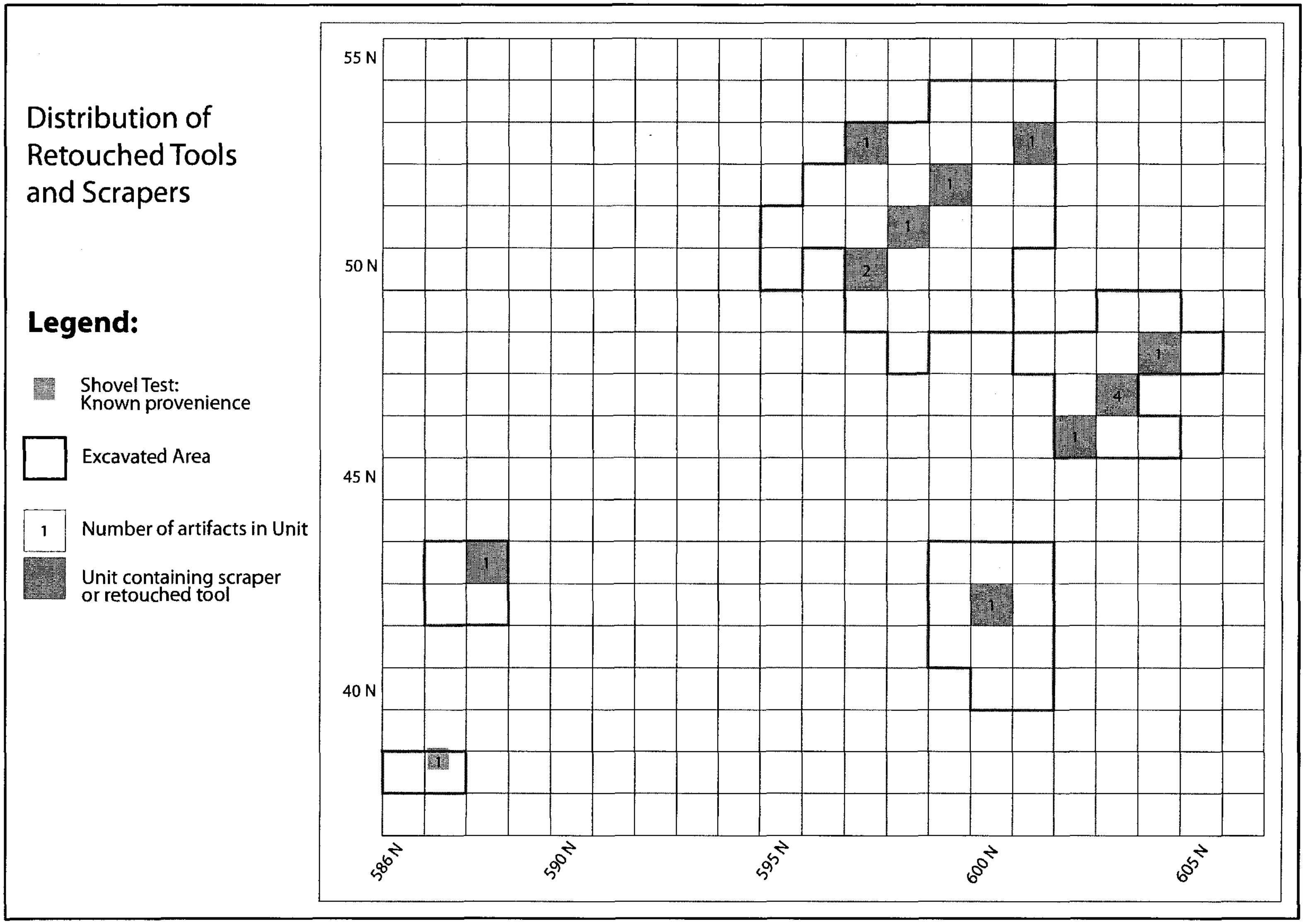


Figure 5.4 Distribution of retouched tools and scrapers

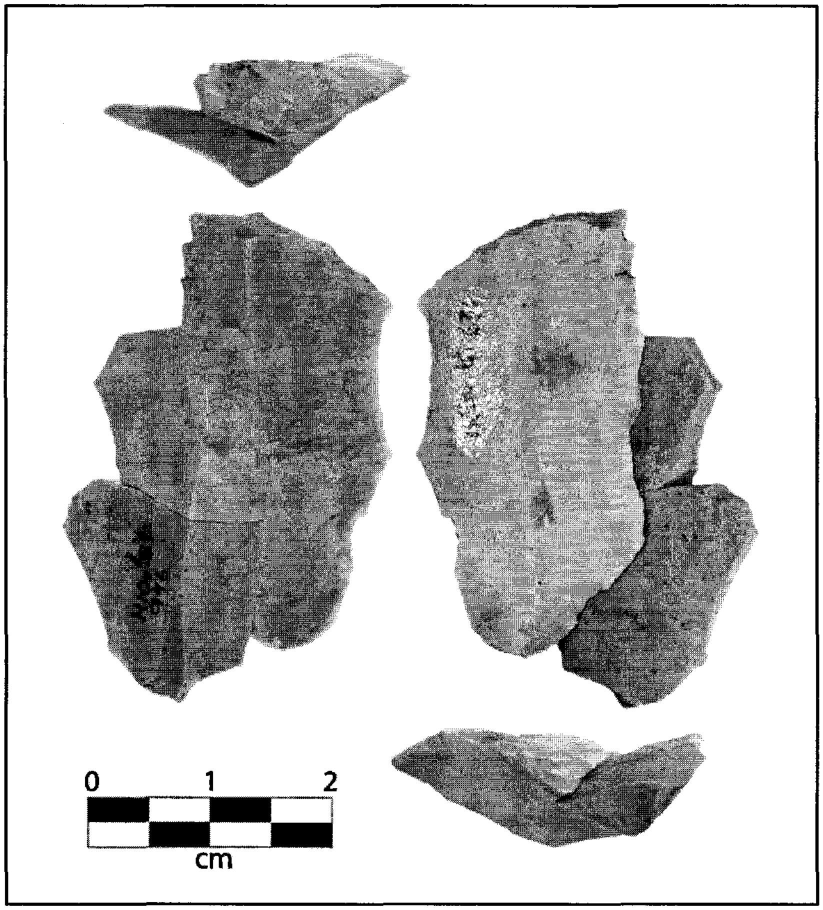


Plate 5.1 Scraper HiOv-89:631 and refitted flake fragments

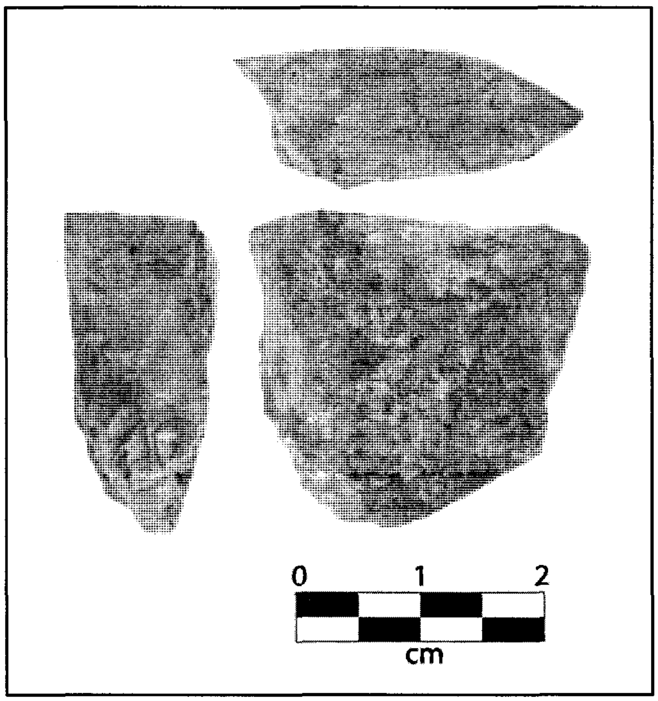


Plate 5.2 Microcore-like scraper HiOv-89:809

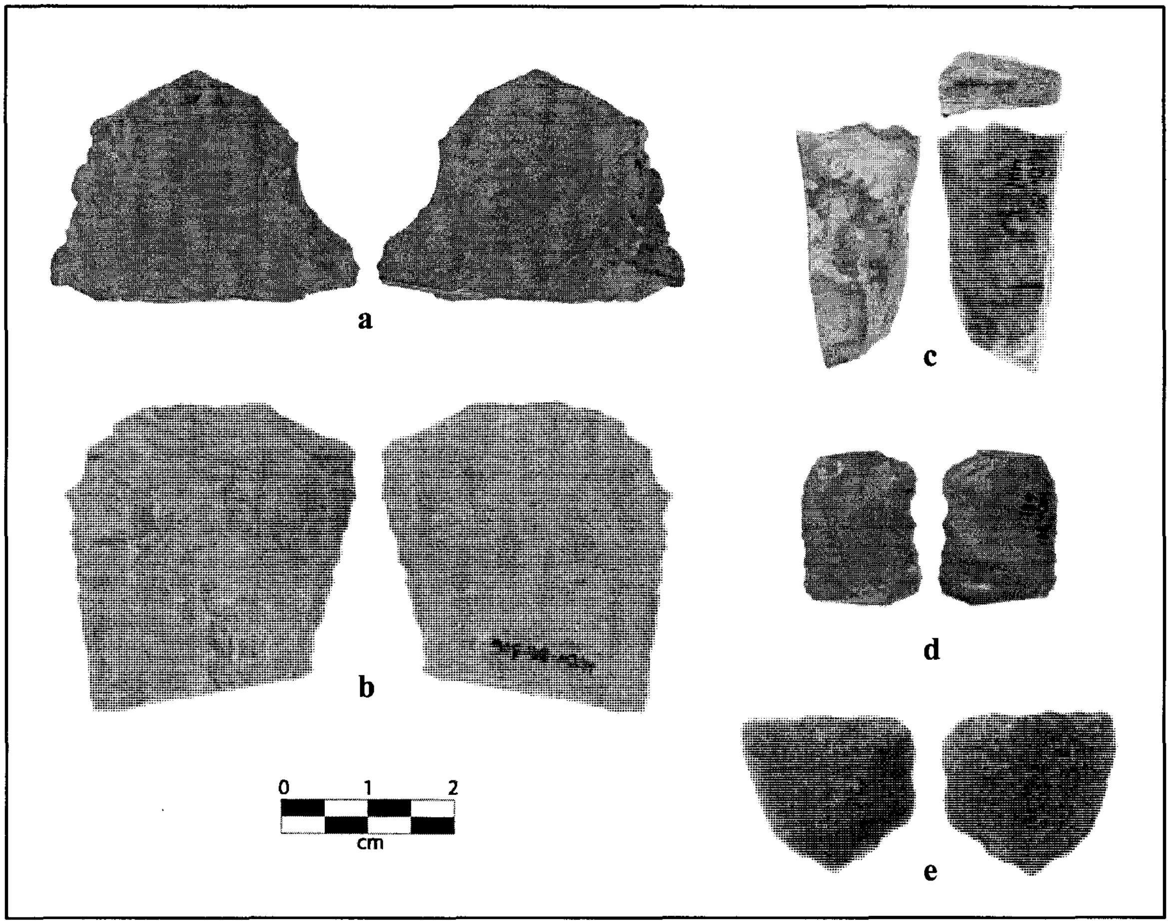


Plate 5.3 Scrapers: (a) HiOv-89:177; (b) HiOv-89:806; (c) HiOv-89:414; (d) HiOv-89:681; (e) HiOv-89:929

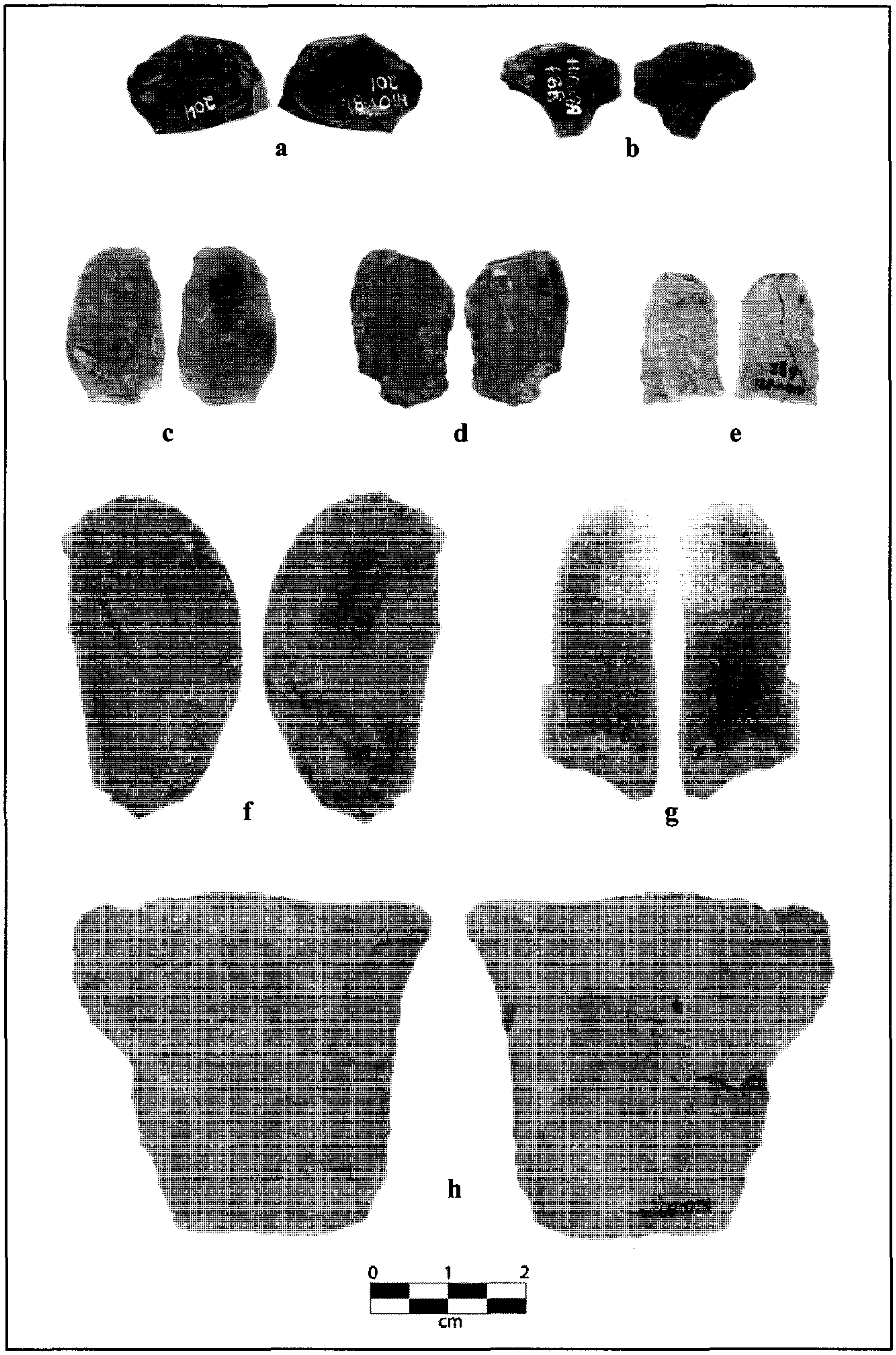


Plate 5.4 Retouched flakes: (a) HiOv-89:204; (b) HiOv-89:688; (c) HiOv-89:684; (d) HiOv-89:758; (e) HiOv-89:642; (f) HiOv-89:161; (g) HiOv-89:864; (h) HiOv-89:002

Burins, Multi-Tools, and Burin Spalls

Burins at HiOv-89 display a wide range of characteristics and methods of production (Plate 5.5 and Plate 5.6; Table A.3 and Table A.4, Appendix A). Among the collection can be found both transverse and longitudinal burins, with platforms on notches, breaks, and sometimes simply on opportunistically selected edges. Burin facets may be single or dihedral, or may occur adjacently along the same flake edge. Burins in the collection vary widely not only in the characteristics described above, but also in width and in overall size. The great variety in burin styles and production methods indicates a flexible, possibly spontaneous and expedient approach to burination. Although notching is present, it is not specifically combined with longitudinal burination, nor is it as wide as that seen in the Donnelly Burins associated with many Denali microblade sites.

Many burinated tools also exhibit retouch, and are referred to here as multi-tools, as they have multiple, often seemingly unrelated, working edges (Plate 5.7 to Plate 5.9; Table A.5 and Table A.6, Appendix A). In general, the multi-tools are created from larger and thicker flakes than the simple burins, and exhibit steep, scraper-like retouch on or adjacent to the burin facets (Plate 5.7a; Plate 5.9). In cases where the retouch occurs on the burin facet itself, the working edge is extremely steep, often right-angled, reflecting the original shape of the burin facet (Plate 5.7b). The prevalence of multi-tools in the assemblage, combined with evidence that burination may have occurred both before and after retouch, is consistent with the flexible approach to burination seen throughout the burin tools in the assemblage.

It is almost certain that the burin spalls found at HiOv-89 represent a biased sample, as there is a significant potential for small, thin artifacts of this type to be lost in the ¼ inch screens used during excavation. Indeed, the spalls in this collection are relatively large and thick (Plate 5.10 and Plate 5.11; Table A.7 to Table A.9, Appendix A). Strong to moderate curvature is common, as are overshot flake terminations, rather than the typical hinge termination associated with burination. This observation may be related to the biased sample of thick burin spalls; the greater force necessary to remove burin spalls from a thick flake, compared to burins on thin flakes, may prevent the early termination of the spall in a hinge. Spalls are equally seen with triangular and trapezoidal cross-sections. Remnant use-wear is common, and is often intense and steep. Modification of burin spalls themselves through retouch is rare, seen in only a few of the artifacts.

As with microblade artifacts, burin tools and spalls were found exclusively in Block A (Figure 5.5). Burination was most commonly performed on silicified mudstone flakes, but not exclusively. A few items of chert and BRS may also be found among the burin artifacts, although these are far less common.

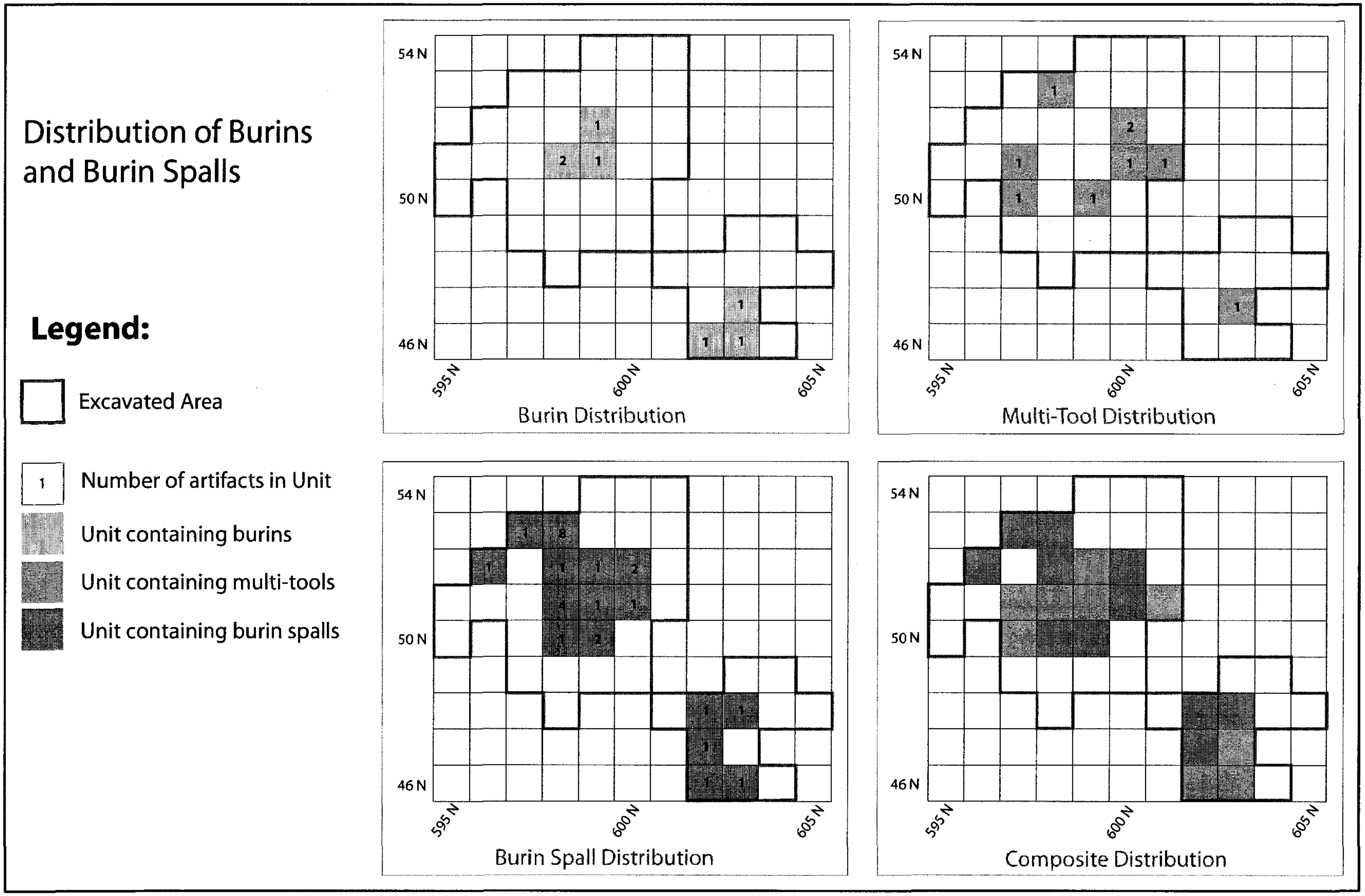


Figure 5.5 **Distribution of burin, mutli-tool, and burin spall artifacts**

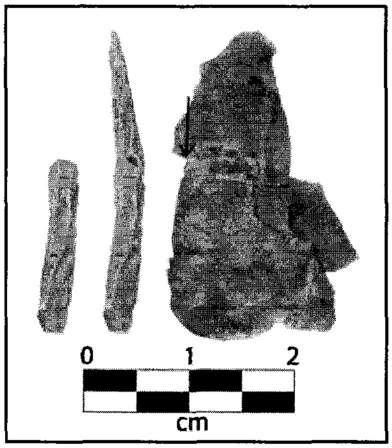


Plate 5.5 Refitted burin on a break (HiOv-89:199 and refitted flake fragment are shown; burin blow occurred after breakage of these fragments)

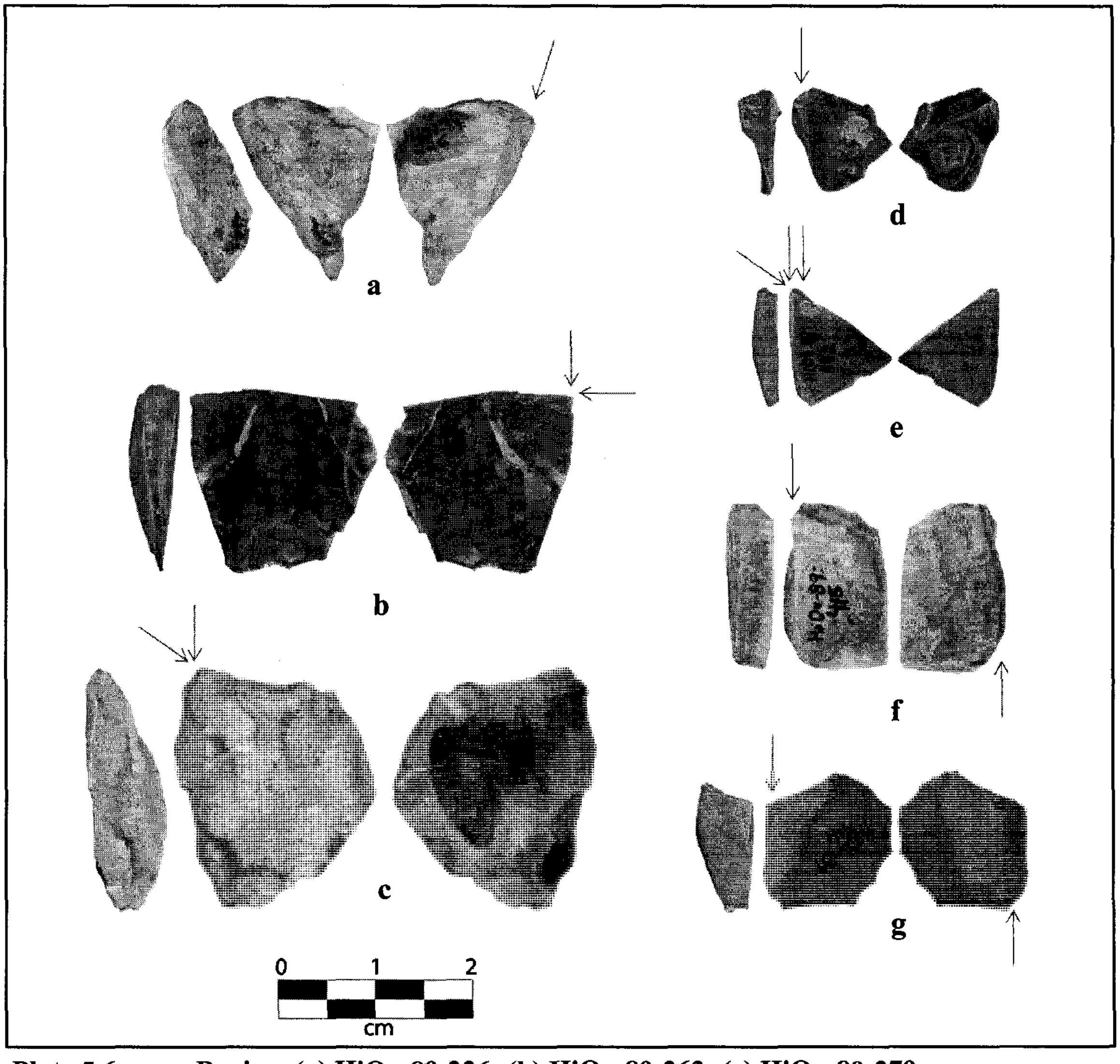


Plate 5.6 Burins: (a) HiOv-89:226; (b) HiOv-89:263; (c) HiOv-89:279; (d) HiOv-89:692; (e) HiOv-89:882; (f) HiOv-89:415; (g) HiOv-89:941

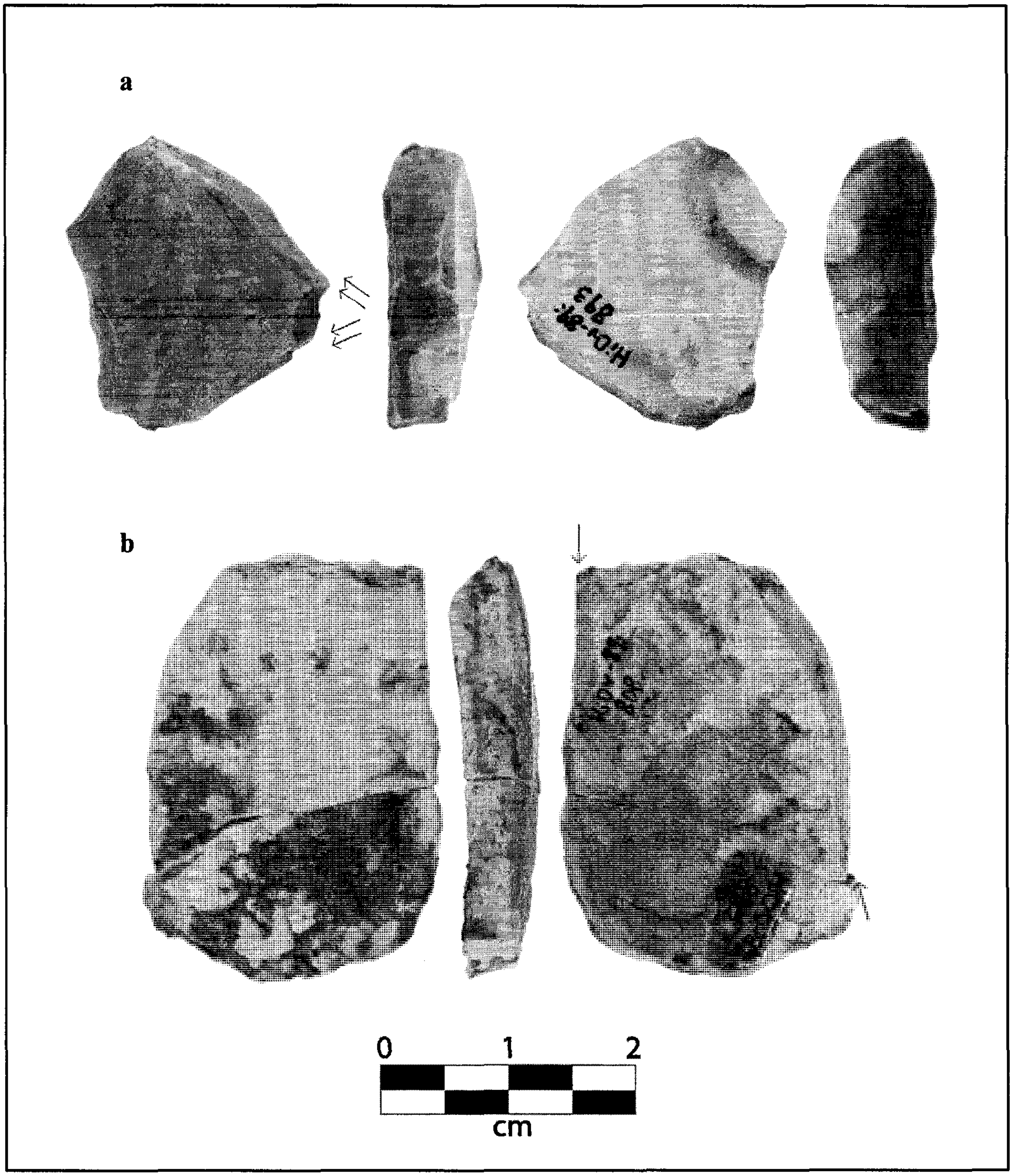


Plate 5.7 Multi-Tools: (a) HiOv-89:893; (b) HiOv-90:808 & 835

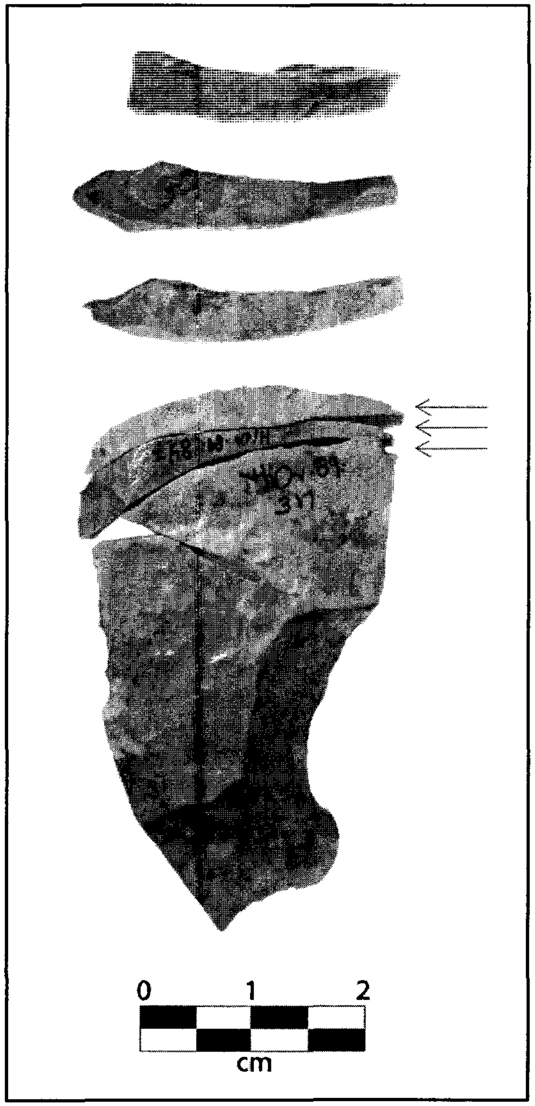


Plate 5.8 Refitted multi-tool and burin spalls

Plate 5.9 Refitted multi-tool with wind abraded burin facet

Plate 5.10 **Whole burin spalls: (a) HiOv-89:935; (b) HiOv-89:670; (c) HiOv-89:655; (d) HiOv-89:894; (e) HiOv-89:535; (f) HiOv-89:657; (g) HiOv-89:884; (h) HiOv-89:891; (i) HiOv-89:886; (j) HiOv-89:534; (k) HiOv-89:478; (l) HiOv-89:520; (m) HiOv-89:739; (n) HiOv-89:675; (o) HiOv-89:711; (p) HiOv-89:386**

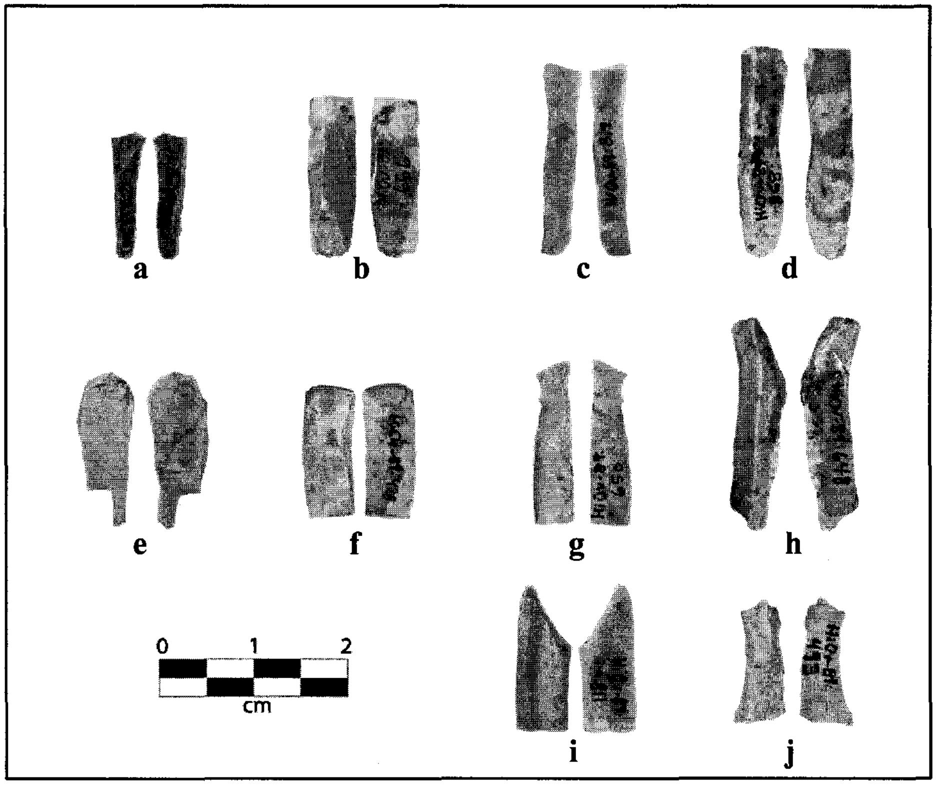


Plate 5.11 Proximal and distal burin spalls: (a) HiOv-89:313; (b) HiOv-89:656; (c) HiOv-89:819; (d) HiOv-89:868; (e) HiOv-89:477; (f) HiOv-89:428; (g) HiOv-89:650; (h) HiOv-89:648; (i) HiOv-89:811; (j) HiOv-89:493

Refitted Burin Spall Sequences

Two pairs of multi-tool fragments (HiOv:89:317 & 470; and HiOv-89:835 & 808) were refitted to form a single useable tool. In both cases, it appears that the tools were shaped and utilized both before and after the fracture occurred; some retouch scars match across the break, while others do not. A cross-mended tool (HiOv-89:317 & 470) has been refitted to two consecutive burin spalls (HiOv-89:820 & 847; Plate 5.8). The burin and both burin spalls show use-wear on the edges of the burin facet, in the same location for each piece. The refitting of these tools, and the use-wear patterns, indicate that the tool was being used and reused on-site, and that burination was used to resharpen tool edges. Although heavy wear is present on the burin spall platforms, it is difficult in this case to distinguish use-wear from intentional platform grinding. The broken pieces of the burin are found within about 2 m of each other, while the burin spalls are separated from each other by 4 m, and the first spall (HiOv-89:820) is separated from the burin fragments by 6 m. This separation of the artifacts indicates the possibility of some mobility within the site between burin sharpening, and possibly more than one episode of use, while the similarity in use-wear indicates that the burin was used for a similar function throughout these episodes, possibly by a single person.

Overview Summary

The artifact analysis presented here is intended to facilitate the analysis of microblade production in the next chapter by answering two salient questions. First, do the artifacts found at the site represent a single occupation, or are some artifacts a part of a second or third component, unrelated to the microblade production? To answer this question requires an understanding of site formation processes at HiOv-89, and an analysis of artifact distributions. Secondly, what patterns of tool production and use can be seen at the site, and might these patterns be similar to, or integrated with, those seen in microblade production? This question requires a more straightforward analysis of debitage and tool characteristics, and patterns of retouch and use-wear.

Artifact Distribution and Site Formation Processes

It is clear that Block A represents the main lithic production and tool use area of the site, while Blocks B and C represent peripheral activity. Block C is particularly anomalous, containing only a few artifacts found close to the surface, and most likely represents artifacts scattered from the main concentration post-occupationally. It could be predicted that further excavation units placed around the borders of the site would likely have uncovered similar sparse scatterings of artifacts. The materials collected from Block B are limited in both raw material and artifact types, dominated by silicified siltstone and with few tools or even edge-modified flakes recovered from the area. Given the low precision of depth measurement, patterns of vertical distribution are much less clear. Possibly the only notable distinction that can be made is the average greater depth of silicified siltstone artifacts compared to silicified mudstone. The differences in both horizontal and vertical distribution, combined with a lack of microblade or burin tools, strongly suggest that the black silicified siltstone found at HiOv-89 may be from a separate, earlier occupation than the microblade component of the site.

Silicified siltstone is also set apart from much of the assemblage by a lack of evidence for post-depositional modification. Wind erosion of silicified mudstone is extensive and clearly post-depositional, often obscuring cultural modifications to artifacts; such modification could only occur if artifacts remained on the surface long after deposition. Such exposure may have also contributed to the pot-lid fracturing of the darker-coloured variety of silicified mudstone. Pot-lid fractured chert and heavily degraded quartzite also occur in the assemblage. Beaver River Sandstone artifacts stand apart in this respect; like silicified siltstone, they lack evidence of surface exposure, and are also relatively common in Block B. These differences in post-depositional effects further support the idea that the silicified siltstone, and possibly also BRS artifacts, were deposited during a separate occupation of the site, and due to differences in seasonality or climate, were not as strongly affected by weathering prior to burial.

Refitting analysis, undertaken for the chert and silicified mudstone artifacts at the site, provides further evidence for understanding the distributions of these materials. Broken artifacts are generally separated by about 1.0 m, while frost-spalled artifacts were found much closer together, and refitted conjoined artifacts the farthest apart. Broken artifacts showing utilization after breakage are separated by greater distances than are unused broken flakes or those only utilized prior to breakage. It seems that those artifacts broken post-depositionally tend to be found relatively close together, while larger distances between broken and conjoined artifacts may reflect transportation of the artifact within the site during reduction and use. Based on these distributions, it can be inferred that only moderate post-depositional movement of artifacts has occurred, and that the modern distributions of artifacts at this site can be considered a relatively accurate representation of their distributions near the time of deposition.

Debitage Characteristics and Tool Use at HiOv-89

Overall, debitage at HiOv-89 represents the intermediate stages of lithic reduction, with a focus on core technology over bifacial technology. This is consistent with the presence of numerous microcores and flake tools, and lack of bifacially modified artifacts. The low number of finishing flakes found at the site is likely related to both the coarse screen size, and to the focus on microblade and burin technology over the production of tools such as bifaces that often require edge sharpening. Decortification flakes are noticeably also lacking at the site, a factor that cannot be attributed to screen size but instead indicates that decortification of the materials used at this site occurred elsewhere, prior to site occupation. Cores other than microcores are also conspicuously absent. A high proportion of the debitage at the site is small and fragmentary. Refitting analysis has shown that average measurements of flake size and weight are unrepresentative, and that many larger flakes originally existed at the site. The larger sized flakes, and the absence of cores, allow for the interpretation that moderately sized, inexhausted cores may have been removed from the site when it was abandoned, to be reused later.

Utilization of lithic materials at HiOv-89 seems to incorporate a flexible, expedient approach to tool production and use. Formal tools including burins, retouched flakes, and scrapers together are far outnumbered by edge-modified flakes, many of which are small and thin, and were used or reused after the flake was broken. Burins are similarly small and thin, while multi-tools and scrapers are only roughly shaped. This is not to say that the lithic technology is unsophisticated; the variation in multi-tools and burins at the site shows instead the knowledge of how to apply a few flaking methods to create a variety of working edges and tools, without resorting to intricate and time-consuming bifacial shaping.

It seems likely that tools created at this site were both used on-site, and carried away for later use or reuse. The low rate of successful refitting, especially of conjoined artifacts, indicates either that artifacts at the site were highly modified and reused to the point that they could not be recognized and refitted, or that many artifacts from various points in the reduction process were removed from the site. Another possibility is that the high rate of breakage and pot-lidding among the artifacts reduced large parts of the assemblage to fragments too small to be recovered during screening, and that those artifacts that were recovered were too fragmentary to be effectively refitted. In either case, extensive reuse and multiple reduction events for flakes and tools are evident, indicating that conservation of material may have been a priority. This is not unlikely, given the rarity and workability of the materials being used.

A number of prehistoric activities are represented by the artifacts at HiOv-89, particularly those of silicified mudstone. Most notably, previously decortified pieces of lithic material were reduced in a specialized lithic workshop, producing microblades, burins, and retouched flake tools. These tools were then utilized, mostly for scraping but also possibly for engraving functions. Combined with the small size of tools and lack of bifaces and projectile points, this observation indicates the performance of domestic activities such as butchering, food processing, and possibly the working of bone, antler, and wood. It is likely that some of these materials were used for the hafting of microblades and other small lithic artifacts produced at the site. Due to the lack of organic preservation, it is unknown whether microblades at this site were hafted into wood, bone, or antler handles or shafts; all materials were likely present at the time of site occupation. However, it is possible that the larger, thicker scrapers may have been used as wedges for splitting wood rather than for more traditionally conceived uses such as scraping of hides, while burins may have been used for engraving small notches for the hafting of microblades.

Chapter 6 HiOv-89 Analysis Part II: Microblade Technology

Artifact Descriptions

The lithic assemblage from HiOv-89 includes 80 artifacts relating to microblade production, all of which are composed of silicified mudstone and were found in Block A (Table 5.02, previous chapter; Figure 6.1). Many clues about production of these artifacts may be found through analysis of artifact shape, remnant flake scars, evidence of use-wear, and platform characteristics. This section provides a detailed description of the entire microblade component at HiOv-89, focusing on the characteristics of three distinct groups of artifact types: microcores, ridge flakes, and microblades.

Microcores (Table A.9 to Table A.12, Appendix A)

The 24 microcores and fragments found at HiOv-89 were refitted to create ten full microcores, three microcore fragments, a microcore preform, and a large rejuvenation tablet. Overall, the microcores are small and wedge-shaped, weighing an average of 6.0 g with an average length of 28.27 mm. Most cores are roughly unifacially shaped, exhibiting various types of platform preparation, but consistently having either two or three flute scars, and showing intensive use-wear on one or more surfaces.

Microcore 209 (Plate 6.1a)

Microcore 209 exhibits a classic Denali shape, although it is difficult to trace the reduction sequence used to produce this core. It has been made from a thick flake, and the keel has been shaped through small, mainly marginal flaking of the obverse surface. Thinning scars are visible near the platform, one originating from the keel and running along the reverse surface just below the platform, and another smaller scar below, originating from the flute element. The platform appears to have been prepared by the detachment of a spall running the entire length of the platform element. There are three flute scars. Heavy use wear is visible on the obverse face of the wedge element, the edge where the fluted face meets the reverse face, and the top of the platform.

Microcore 556 (Plate 6.3b)

Although this core has two fluted faces and no wedge element, only one of the faces seems to have been used for any kind of blade removal, and is considered the true fluted face for core orientation. This face is wedge-shaped in cross-section, but the core itself shows little resemblance to a classic Denali core. Both fluted faces are strongly curved, almost meeting at the centre of the base of the core. The core has been shaped from a flake, with the unaltered ventral surface becoming the obverse face, and a few narrow thinning flakes running transversely across the reverse face, which is heavily patinated. The flake scar serving as the keel of this core exhibits extremely heavy, scraper-like use-wear on the reverse surface, as well as some light use-retouch on the flake scar surface itself at the juncture with the obverse face. Heavy use-wear along the obverse side of the platform has been partially obscured by a short platform rejuvenation scar, originating at the platform and terminating in a hinge. Platform grinding, or possibly use-wear at the platform, is also visible.

Microcore 653 (Plate 6.2a)

This multi-tool appears to have been converted into a small scraper after being exhausted as a microcore. It was formed on a thick flake, with an unmodified ventral surface serving as an obverse face, and the reverse face covered by approximately 40% cortex. The short, wide flake scars on the keel of this face seem to be remnant dorsal flake scars rather than a result of intentional unifacial shaping. The reverse face also exhibits smaller, thinner flake scars near the fluted element that appear to be the result of unifacial shaping of a ridge during fluted face preparation. There are two flute scars on the fluted face, the upper portion of which has been truncated by flaking of the platform into a scraper-like edge; platform preparation and rejuvenation techniques have been obscured by this modification. During refitting, a secondary ridge flake (HiOv-89:644) was found that, while it did not refit to the core, showed flaking and material colourations matching the core and placing it only a few flakes away in a hypothetical reduction sequence, indicating that the core has not been greatly reduced since its original production. Heavy to moderate use-wear is present along the scraper edge of the artifact, as well as at the base of the core.

Microcore 790 (Plate 6.4b)

Little evidence of shaping can be found on this informal, indistinctly wedge-shaped microcore on a thick flake. Much of the reverse face is composed of rough, stepped cortex, with the exception of some flaking near the fluted face, which may be the remnants of ridge flake preparation. A large spall was removed to create the platform of the core, and it appears that at least one rejuvenation was performed through the same burin blow-type method. Three microblade scars on the fluted face all terminate at a step-fracture that appears to have been caused by a weakness in the material. No use-wear is visible, although apparent basal crushing may in fact be isolated retouch and use-wear. It appears that the core was abandoned due to flaws and irregular fracturing of the raw material.

Microcore 812 (Plate 6.4a)

This wedge-shaped core has been roughly formed from a thick, blocky flake. Little intentional shaping is evident; however, unifacial flaking accompanied by moderate use-wear is visible on the obverse of the keel near the base of the core. Bifacial flaking and use-wear are also present on the platform element, originating from the reverse edge. The original platform preparation method is difficult to determine, but the platform has been partially rejuvenated by a spall ending in a hinge. There are four full flute scars on the fluted face, as well as a fifth that ends in a step-fracture not far from the platform. A single, narrow flake scar originating from the base and ending in an irregular step-fracture may have been an attempt to rejuvenate the fluted face. This core is larger than many of the others in the collection, and does not appear to be fully exhausted; it may have been abandoned due to the inability to rejuvenate the fluted face.

Microcore 814 (Plate 6.3a)

Because this core exhibits two fluted faces, it cannot be traditionally oriented, and so the face with the higher number of flute scars is designated as face *A*, and is used to orient the core. Although it is likely that the core has been produced on a flake, analysis is impeded by heavy pot-lid fracturing, obscuring approximately 80% of the reverse face. Part of the obverse face has also been obscured by what appears to be weathering and decomposition of the surface of the raw material. The platform has been either created or rejuvenated by intensive side-blow flaking, originating from the reverse face and accompanied by scraper-like use-wear. Fluted face *A* exhibits three flute scars, two originating from the platform and one apparently from the opposite end, although half of the scar has been obscured by the weathering of the obverse face. Face *B* exhibits two flute scars, both originating from the platform, which exhibits use-wear or platform grinding at the juncture with the fluted face. Use-wear is also visible on the reverse edge of Face *A*, and moderate unifacial retouch with use-wear is visible on the obverse surface at the base, between the fluted faces.

Microcore 830 (Plate 6.2b)

This core is lightly patinated, leaving some traces of flaking and core shaping difficult to detect. It has been produced from a thick flake, with little apparent shaping on the keel, and while it could be classified as wedge-shaped, it is not classically so. The dorsal surface of the flake composes the obverse face of the core, and has been thinned with a number of long flake scars originating from the keel and ending in a hinge near the centre of the obverse face. The wedge element exhibits marginal flaking of the obverse face near the platform, and both faces also exhibit heavy use-wear. The platform appears to have been shaped or rejuvenated by side-blow flaking that originates from the reverse face. The fluted face is relatively narrow, with two flute scars, heavy platform grinding or use-wear at the top edge of the fluted face, and wear along the upper half of reverse edge of the face.

Microcore 873 (Plate 6.5)

This artifact is the only core in the collection created from a bifacial tool. The tool has been shaped into a rough oval through irregularly-placed bifacial thinning flakes, none of which reach the centre of the artifact. More regular bifacial and unifacial marginal retouch are present along most of the edges, as well as moderate use-wear. A platform was prepared by the removal of a short spall ending in a hinge. Two flute scars remain on the wedge-shaped flute element. Light to moderate use-wear is also present on both the obverse and reverse edges of the fluted face (Plate 6.16).

Microcore 892 (Plate 6.1b)

This wedge-shaped core has been produced on a flake. The reverse face of the core is composed of cortex, with the exception of a thinning flake scar just below the platform element. There is no other evidence for shaping of the flake. The platform has been formed by the removal of a spall, originating from the wedge element and leaving a single smooth scar across the platform element. It has also been rejuvenated by the removal of a short spall, beginning at the platform and terminating in a hinge. There are two flute scars, one fully on the fluted face and the other angling onto the reverse face, while the obverse edge of the fluted face exhibits light use-wear. Both flakes removed from the fluted face would have had cortex at their distal ends. Some apparent platform grinding is evident, with no further retouch or use-wear visible elsewhere on the core.

Microcore Fragments 255 & 373 (Plate 6.7b)

These small, thin artifacts were refitted to create what appears to be a broken microcore. When examined together, artifact 373 contains the platform and upper half of the fluted face and wedge elements, while artifact 255 contains the lower half of the fluted face and the base. The lower half of the wedge element is missing. While artifact 373 no longer resembles a microcore, it contains a remnant platform created by flaking and a partial spall removal, and evidence of a spall removal where the fluted face once was. Artifact 255 exhibits a jagged surface at the front of the break, and three remnant flute scars that appear to have existed before the break. It seems as though the knapper was attempting to rejuvenate the fluted face with a burin blow directed downward from the platform, but a flaw in the material caused the spall to end in a ragged step fracture, while the force of the burin blow split the core into pieces. There is evidence of use-wear at the base.

Microcore Fragment 364 (Plate 6.7d)

The body of this core fragment has either broken or frost-spalled away, leaving only portions of the platform and fluted face, with very little of the body remaining. The remnant obverse and reverse faces are moderately patinated, preventing analysis of the flakes scars on these faces. The platform is flat and smooth, suggesting that it was prepared through spall removal, and there are two flute scars on the fluted face. There is significant platform grinding or use-wear where the two surfaces meet, and on the obverse edge of the fluted face (Plate 6.17). Some light use-retouch on one of the broken edges may indicate post-breakage use of the tool, or it may have been caused by post-depositional wear; the retouch scars are parallel, but isolated.

Microcore Fragments 792-796 (Plate 6.6)

Microcore 793 is the only core made from a mottled red and grey silicified mudstone. It has been partially reconstructed from five pot-lidded fragments found within the same one metre excavation unit. It has also been refitted to two ridge flakes, one primary and one secondary, located in units two and three metres away, respectively. The fluted face also bears evidence of an attempted microblade removal, where a flake scar below the refitted secondary ridge flake ends in a step fracture only a few millimetres below the platform. An apparent inclusion or flaw in the material is visible at this point as a white band running transversely across the core, and was likely the impetus for the abandonment of the core at this early stage in reduction. The fragmentary nature of the core prevents analysis of methods used to shape it; however, the refitted ridge flakes show that the fluted face was unifacially shaped by side-blow flaking from the reverse side of the core, followed by the removal of a primary ridge flake running along the reverse edge of the platform element. The secondary ridge flake was removed from directly below the primary flake, as was the truncated flake. Remnant flake scars from the unifacial shaping are still visible on the left side of the flute element, and the ridge of the primary flake also shows evidence of apparent light use-wear retouch. The proximal end of the secondary ridge flake extends past the platform of the core. The platform is currently ragged and seems also to be truncated, perhaps caused by post-depositional spalling of the material, rather than intentional platform rejuvenation or modification. There is little evidence of use-wear or platform grinding on the core itself.

Microcore Fragment 872 (Plate 6.7a)

The majority of this core appears to have been lost due to spalling and decomposition of material, leaving only a fluted face and the remnants of a platform and base. It has been refitted to an irregularly fractured platform rejuvenation spall (HiOv-89:370) that exhibits the distal hinge termination of a previous platform rejuvenation scar. The fluted face contains three flute scars, with moderately heavy grinding or use-wear at the platform. There is also unifacial marginal retouch and moderate use-wear at the base. Remnant flake scars on the obverse surface near the flute element may be residual evidence of ridge flake preparation. The core may have been abandoned due to exhaustion rather than the irregular shape of the platform, since some grinding and flake removals have occurred since the irregular platform rejuvenation.

Microcore Fragment 554 (Plate 6.7c)

The exact nature of this small flake cannot be determined; however, the dorsal surface bears flake scars strongly suggestive of flute scars, indicating that the flake may represent an attempt at side-blow fluted-face removal or rejuvenation. Two individual flute scars are present, with a third surface at the termination of the flake possibly representing one of the lateral faces of the core. The edges of this third surface exhibit moderate use-wear. The left lateral margin of the flake is feathered, while the right margin slightly oversteps the edge of the artifact from which it was removed, possibly representing the base of the core as there is no evidence that this edge was used as a platform. The flake itself is whole, with a single platform scar and no evidence of platform grinding or cortex.

Microcore Preform 729 (Plate 6.8)

This large artifact has been partially refitted from four pot-lidded fragments (HiOv-89:003, 729, 730, and 743). Although clearly a core of some type, it can only be speculated based on its shape to be a microcore preform. It contains a bifacially shaped keel, and a smooth flat platform apparently created by the removal of a large, wide spall. The fluted element is relatively flat, with a number of small flake scars running transversely and longitudinally across the surface, none reaching far past the centre. A portion of the bottom of this face was not refitted, but the remainder exhibits a wedge-shaped outline. It is unknown why this core would have been abandoned at this stage in reduction, although it could be that these fragments spalled from the core during reduction rather than post-depositionally, and that the artifact was abandoned as flawed material. This is not supported by the location of the fragments all within the same unit, which indicates they were deposited very close together. The core is distinctive within the assemblage for its size, method of production, and the abandonment of such a large piece of material with no evidence of attempted reworking.

Core Tablet 614 (Plate 6.9)

The only core tablet found in the assemblage is an excellent example of a Campus-type core rejuvenation tablet. Like the core preform, the platform tablet is unusual for its size and production method; it is, however, too small to refit to the core preform. A remnant bifacially shaped keel is present, as well as the remnant of the original platform, containing six flute scars with platform grinding at their proximal ends. The inferior surface of the tablet exhibits a strong bulb of percussion at the front, indicating rejuvenation by a transverse burin blow.

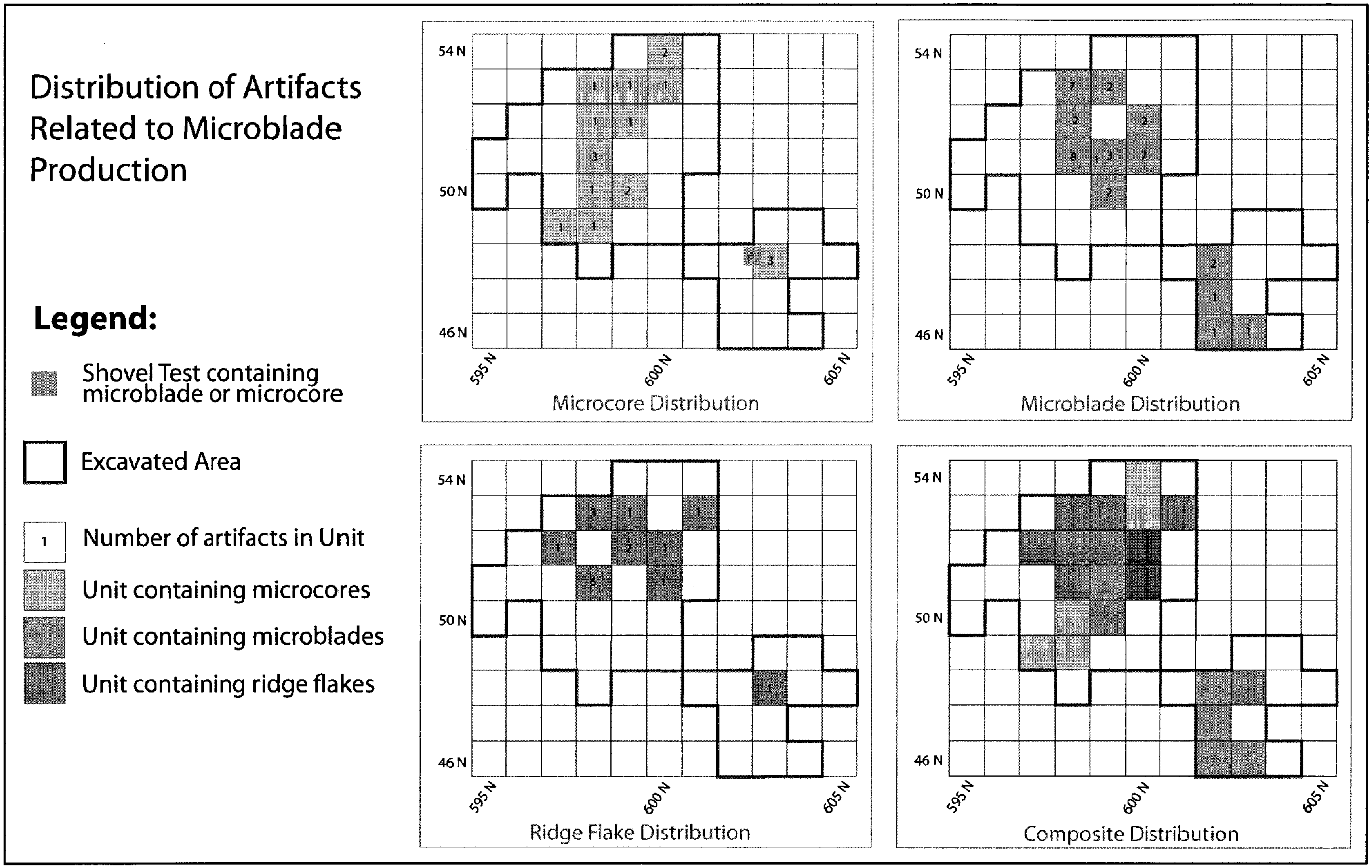


Figure 6.1 **Distribution of artifacts related to microblade production**

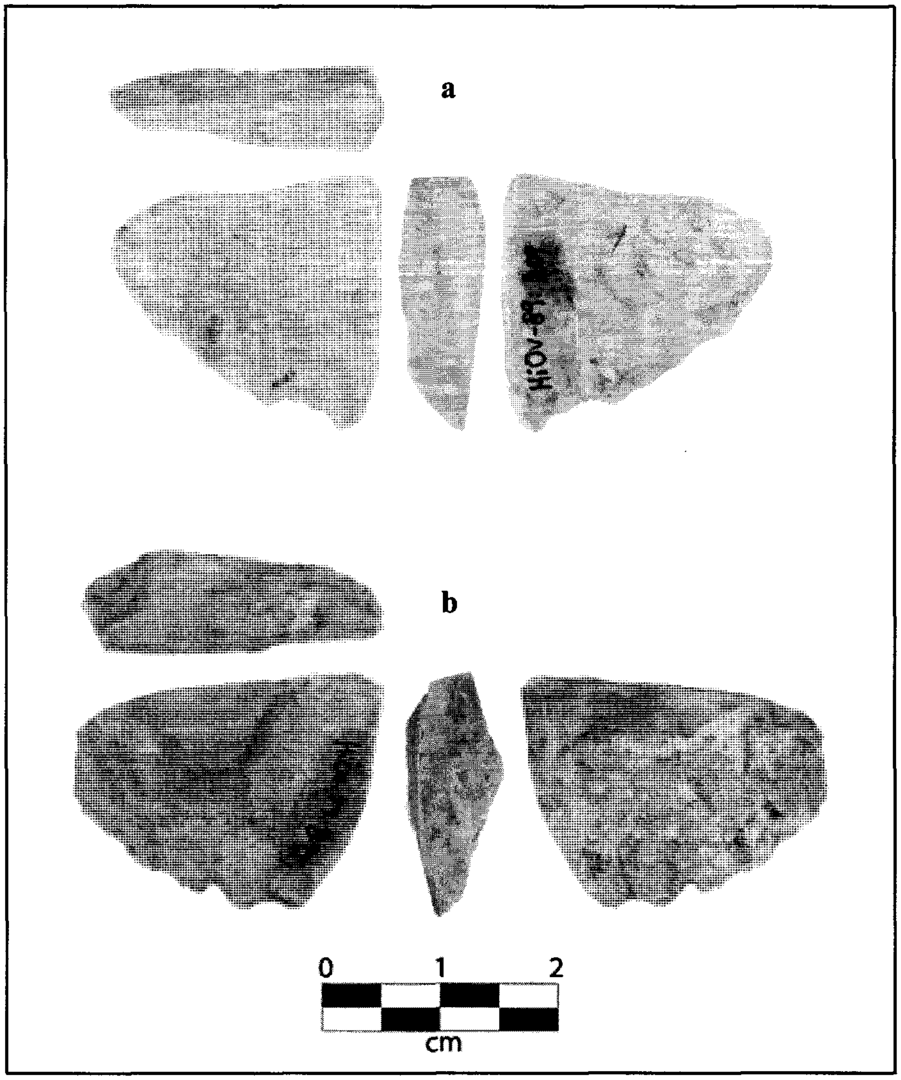


Plate 6.1 Microcores: (a) HiOv-89:209 and (b) HiOv-89:892

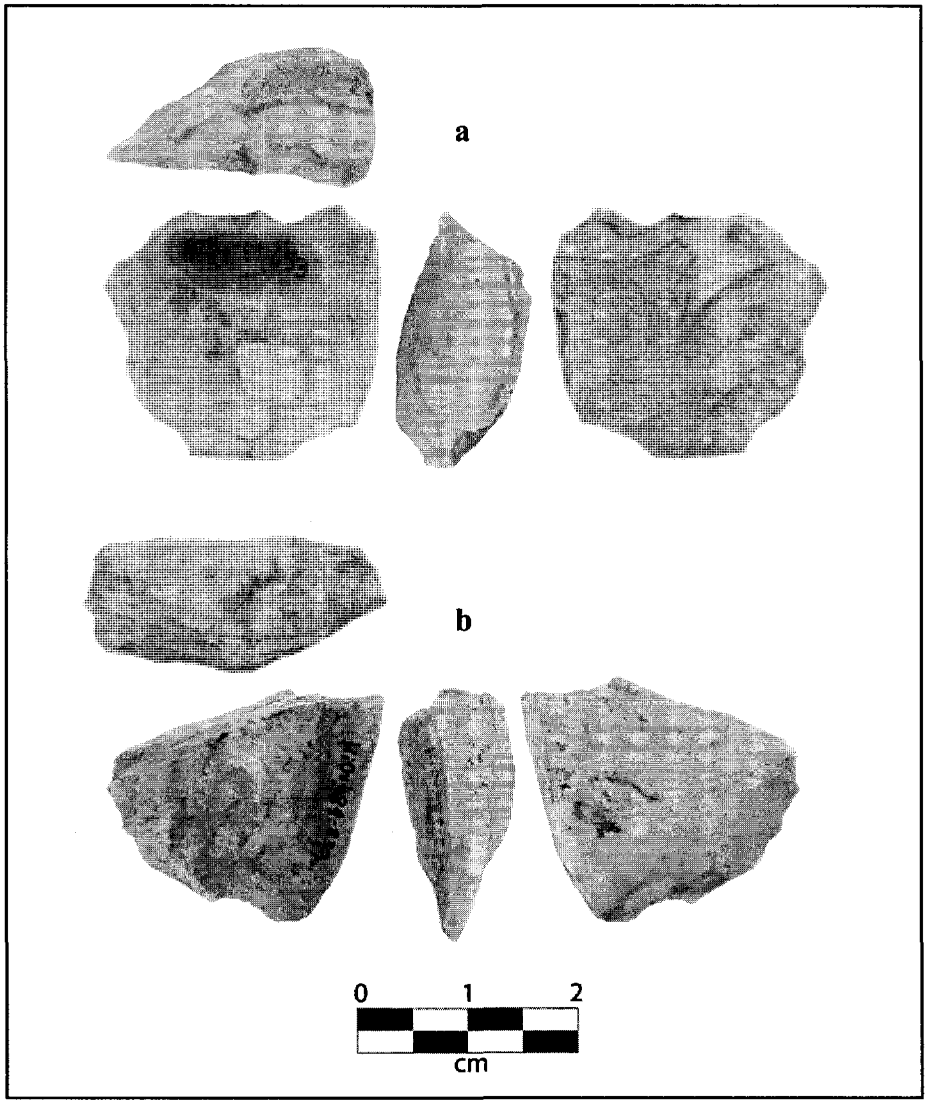


Plate 6.2 Microcores: (a) HiOv-89:653 and (b) HiOv-89:830

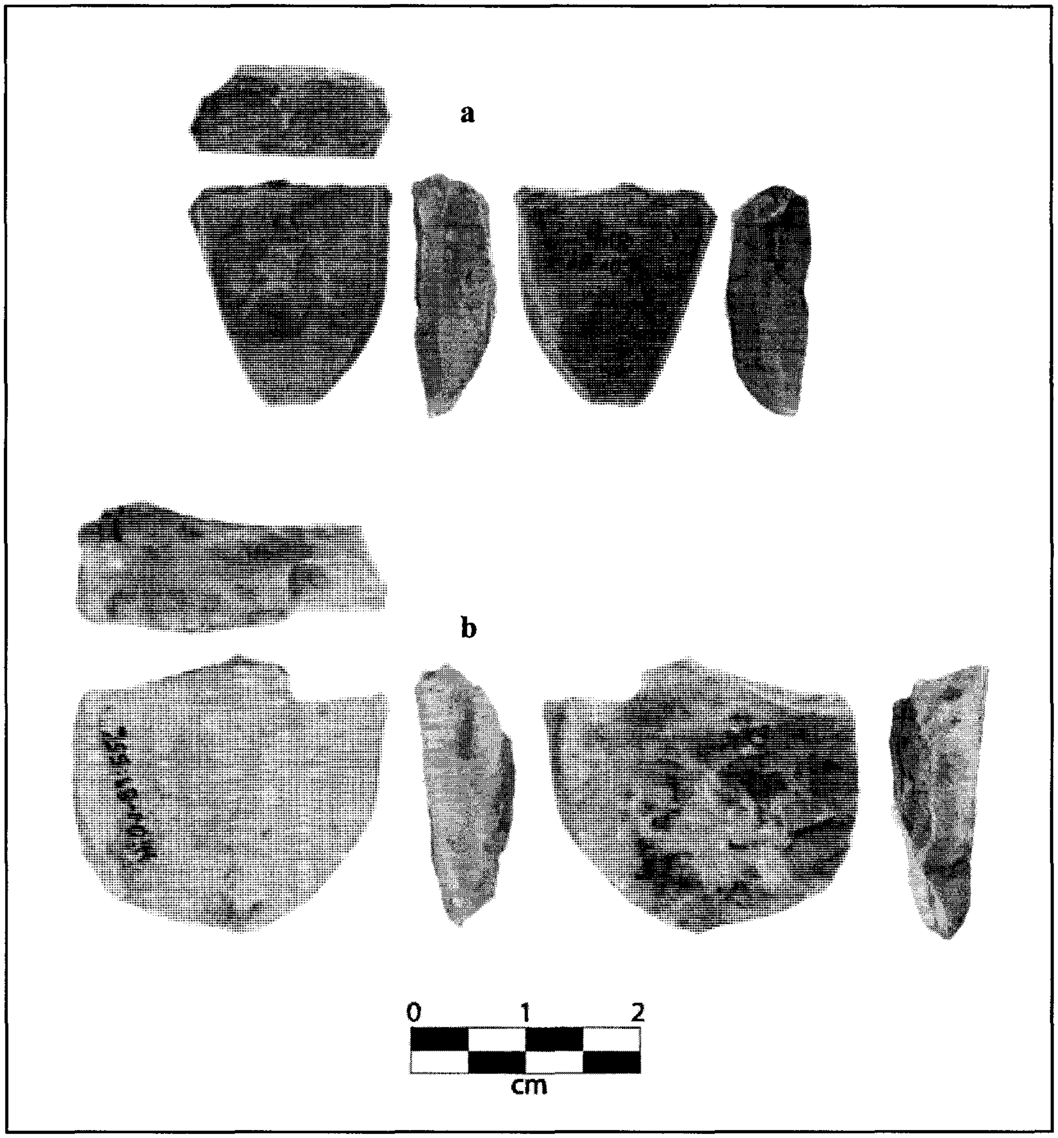


Plate 6.3 **Microcores: (a) HiOv-89:814 and (b) HiOv-89:556**

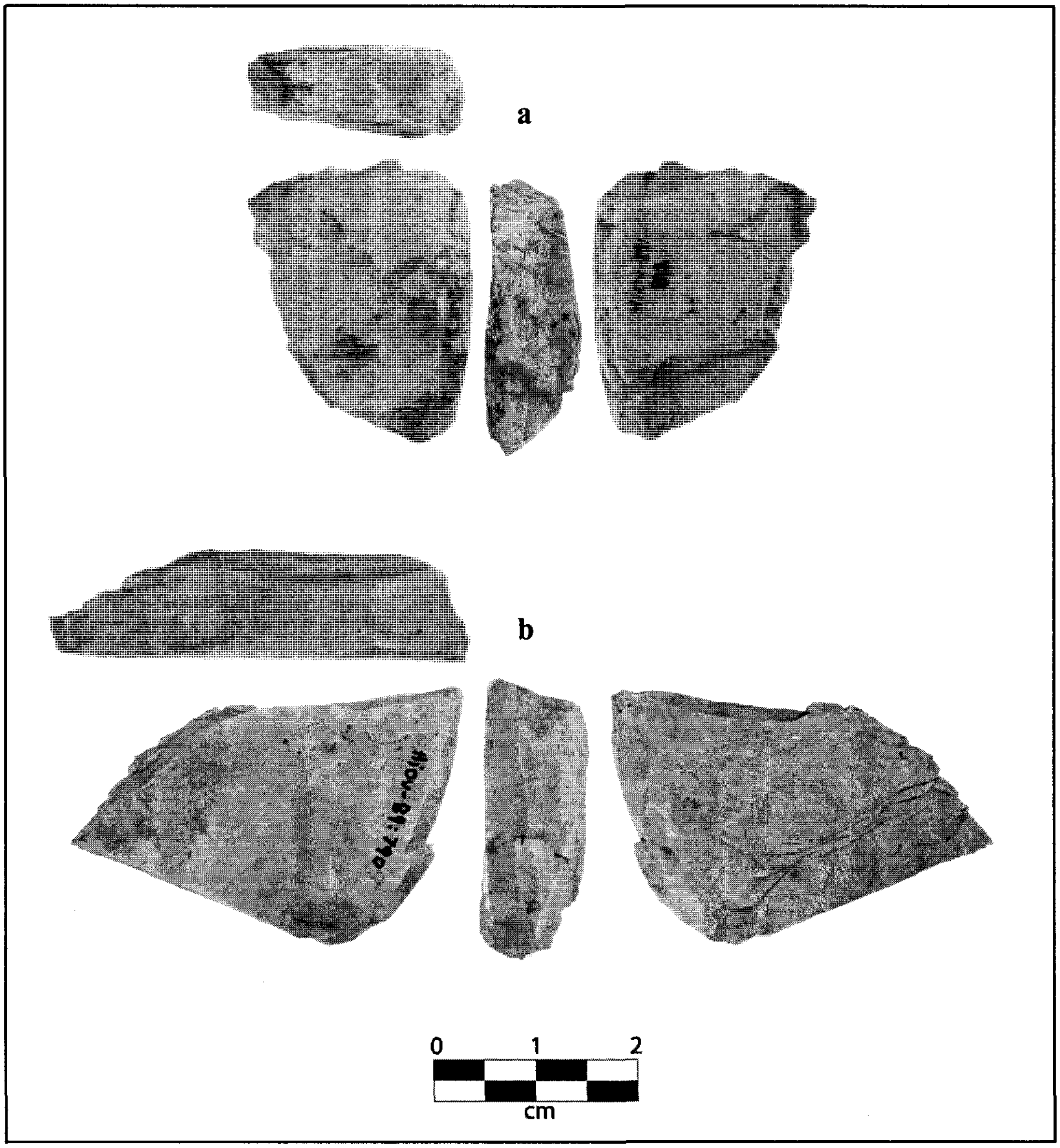


Plate 6.4 Microcores (a) HiOv-89:812 and (b) HiOv-89:790

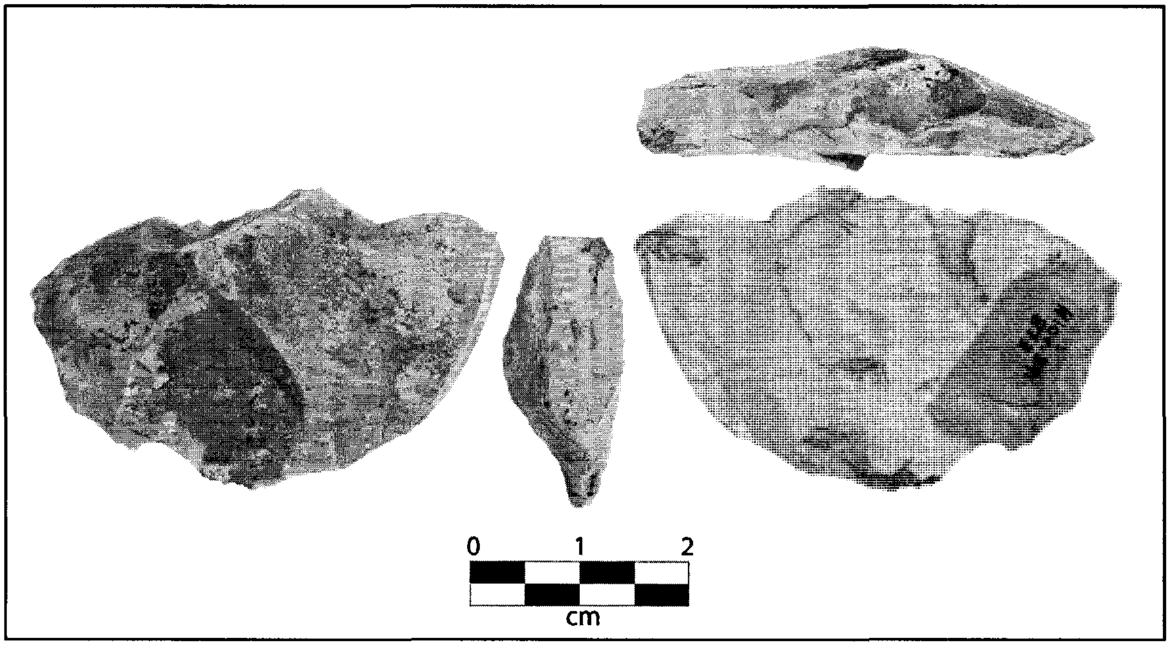


Plate 6.5 Microcore HiOv-89:873

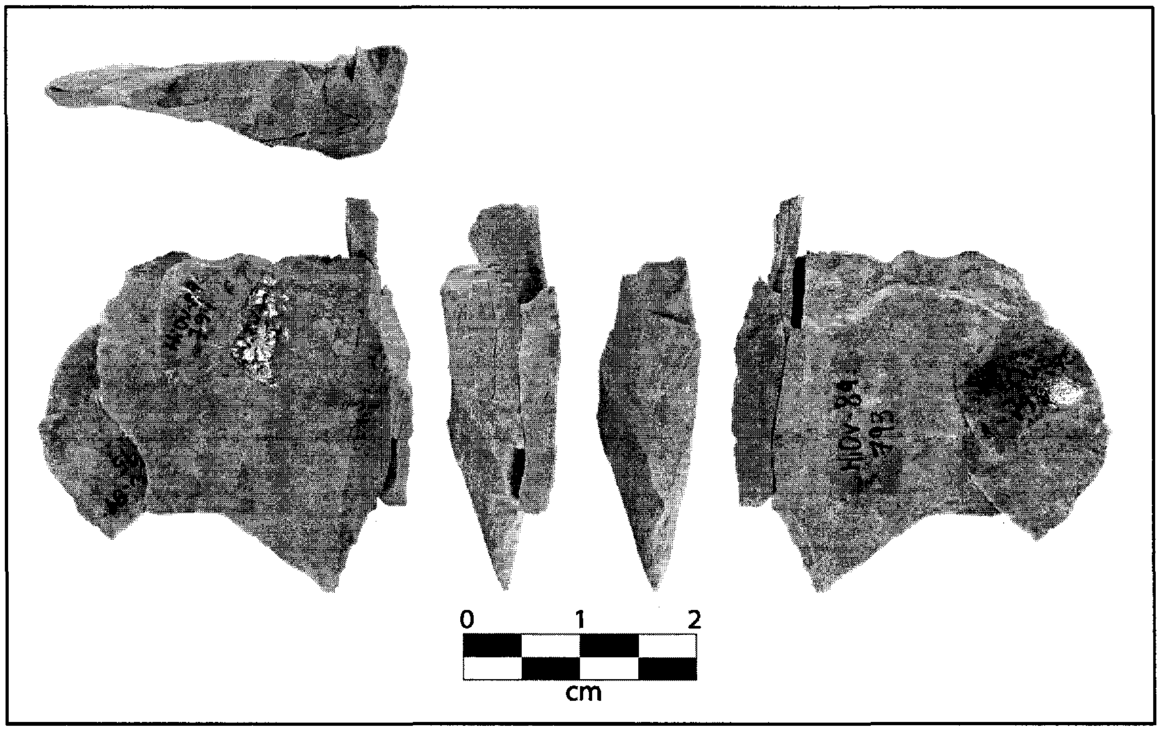


Plate 6.6 Refitted frost-spalled microcore fragments HiOv-89:792-796, showing refitted ridge flake sequence. Middle-right view shows the unrefitted fluted face after ridge spall removal.

Plate 6.7 Microcore fragments: (a) HiOv-89:872; (b) HiOv-89:255 & 373; (c) HiOv-89:554; (d) HiOv-89:364

Plate 6.8 **Microcore preform**

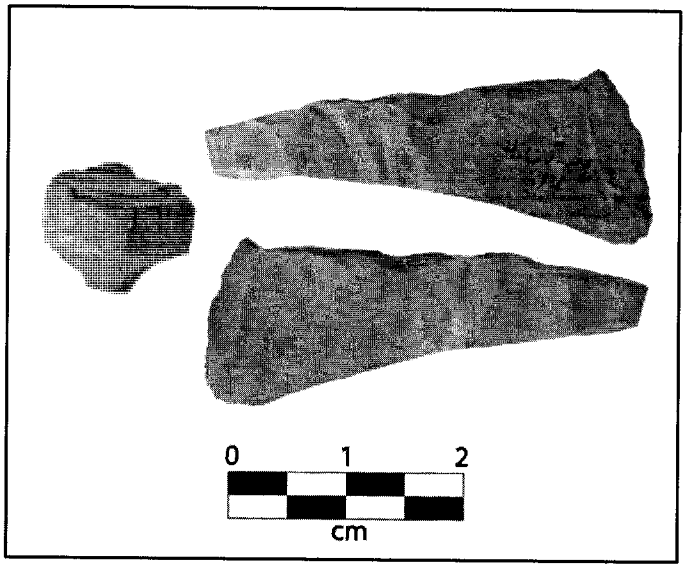


Plate 6.9 **Core tablet**

Ridge Flakes (Table A.13 to Table A.16, Appendix A)

Ridge flakes may be divided into primary and secondary types. Primary ridge flakes are the first to be removed during the transformation of a bifacially shaped ridge into a fluted face; they are long, thin flakes, triangular in cross section, which show remnants of transverse flake scars on either side of a single dorsal ridge. Secondary ridge flakes are subsequently removed to complete the shaping of the fluted face. They exhibit both remnants of the transverse scars, and longitudinal scars from the removal of primary ridge flakes and any previously removed secondary ridge flakes. They may be triangular or trapezoidal in cross section. Ridge flakes may also be used to create the platform surface, such as the striking platform preparation flakes found at the Bezya microblade site HhOv-73 (Le Blanc and Ives, 1986: 72). They are wider and thicker than standard fluted face ridge flakes, with hinge terminations indicating partial platform preparation, as reflected in a number of cores at both HhOv-73 and HiOv-89. Of the ridge flakes present at HiOv-89, the platform ridge flakes also seem to be less carefully shaped, with a central ridge extending only part way down the length of the flake.

Of the 17 ridge flakes present at HiOv-89, three are platform ridge flakes (Plate 6.10). Two of these exhibit a single large flake scar on the dorsal surface, originating from the proximal end, indicating a previous partial ridge flake removal. These flakes are called here secondary platform ridge flakes, and are likely the result of platform rejuvenation, similar in function to the Denali-type platform tablet. The remaining ridge flakes in the assemblage consist of five primary and nine secondary fluted-face ridge flakes (Plate 6.11 and Plate 6.12, respectively). Their ridges have generally been unifacially shaped, with retouch originating equally often from the right and left sides of the ridge, representing the obverse and reverse faces of a microcore, respectively. The only exceptions are two flakes exhibiting bifacial shaping, and two secondary flakes whose ridges have been obscured by previous ridge flake removals. All of the primary ridge flakes are triangular in cross-section, while the secondary flakes are evenly divided between triangular and trapezoidal.

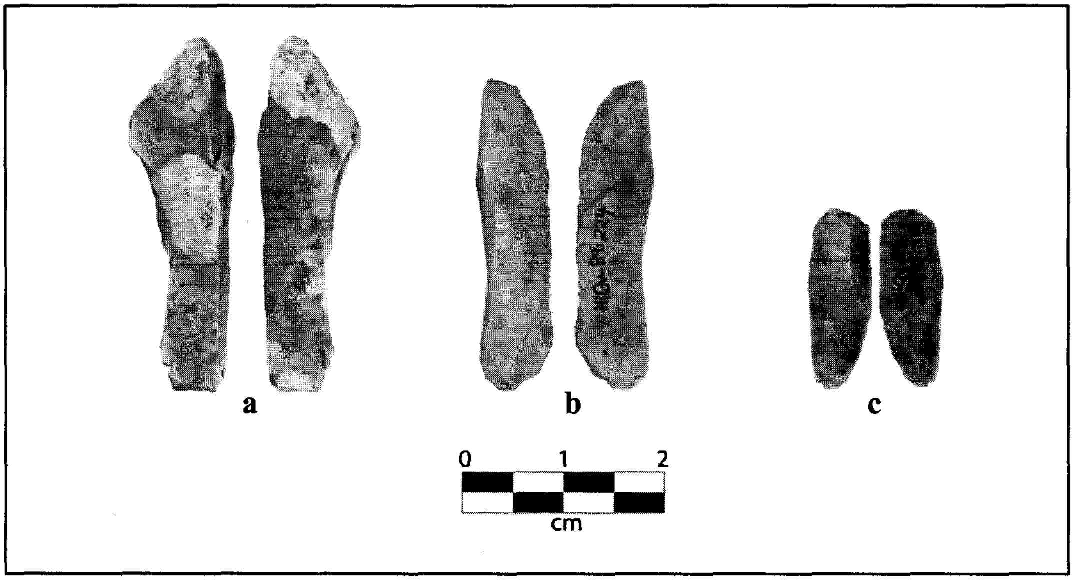


Plate 6.10 **Platform ridge flakes: (a) HiOv-89:413; (b) HiOv-89:224; (c) HiOv-89:889**

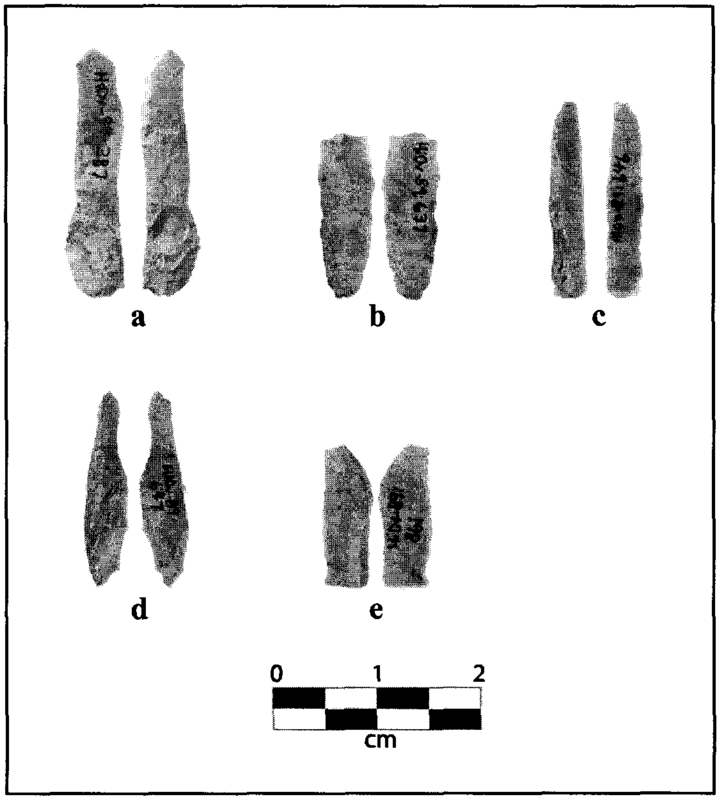


Plate 6.11 **Primary ridge flakes: (a) HiOv-89:387; (b) HiOv-89:637; (c) HiOv-89:646; (d) HiOv-89:647; (e) HiOv-89:861**

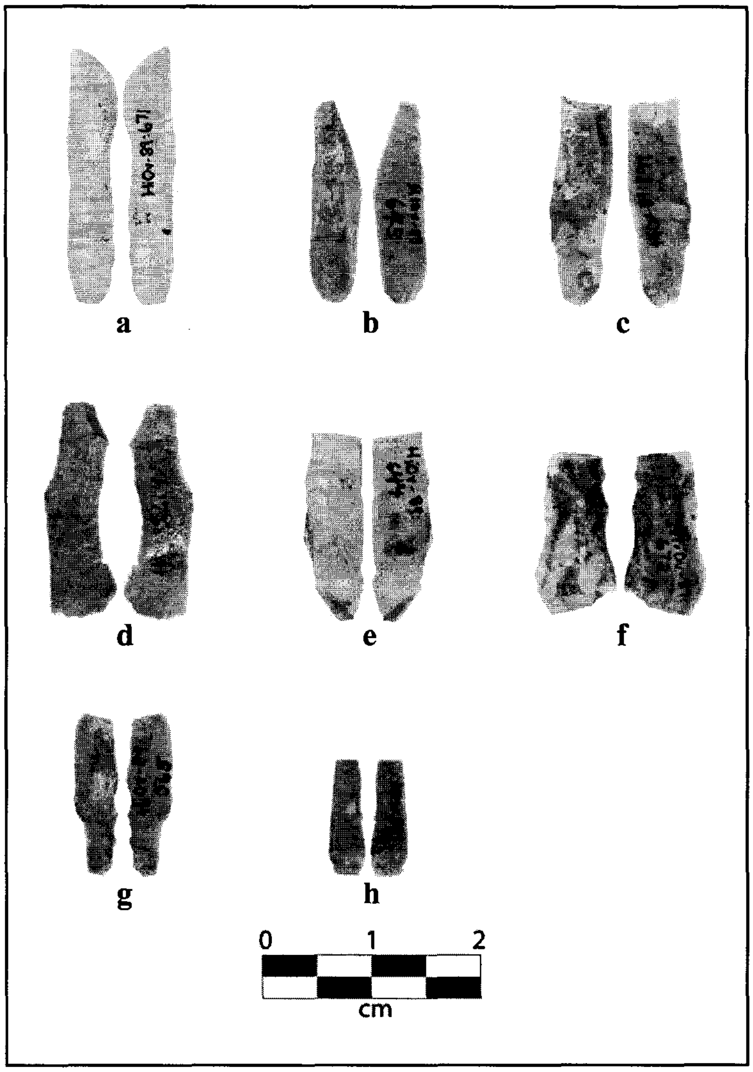


Plate 6.12 **Secondary ridge flakes: (a) HiOv-89:671; (b) HiOv-89:645; (c) HiOv-89:897; (d) HiOv-89:664; (e) HiOv-89:644; (f) HiOv-89:672; (g) HiOv-89:565; (h) HiOv-89:742**

Microblades (Table A.17 and Table A.18, Appendix A)

After refitting, the 36 resulting microblades and fragments were sorted into 10 whole microblades and 20 proximal, three medial, and three distal fragments (Plate 6.13 and Plate 6.14). The microblades at HiO-89 are very small, weighing on average only 0.12 g. Whole microblades range from 13.66 mm to 28.24 mm in length, measuring an average of 20.95 mm. Average mid-point width and thickness measurements are 4.58 mm and 1.46 mm, respectively, creating a width/thickness ratio of 0.333 for the collection. Maximum width and thickness measurements for the microblades are on average only 0.3 mm to 0.4 mm larger than those taken at the midpoint.

Of the 30 microblades with observable platforms, 70.0% (n=21) exhibit evidence of platform grinding in the form of small, clearly visible flake scars on the dorsal surface of the platform. Close to half (n=16) exhibit a single platform scar, while the other half (n=14) exhibit two or more scars. Equal numbers of triangular and trapezoidal microblades were examined, while ten of the artifacts are trapezoidal near the platform but triangular near the distal end where the arrises of overlapping flake scars merge together. The microblades also range widely in thickness; some are flat and thin, and tend to increase in width near the platform, while others are thicker, curved, and more consistent in width. The majority of microblades, however, show slight or no curvature. Use-wear and retouch are both rare, seen on 30.6% (n=11) and 8.3% (n=3) of the microblades, respectively.

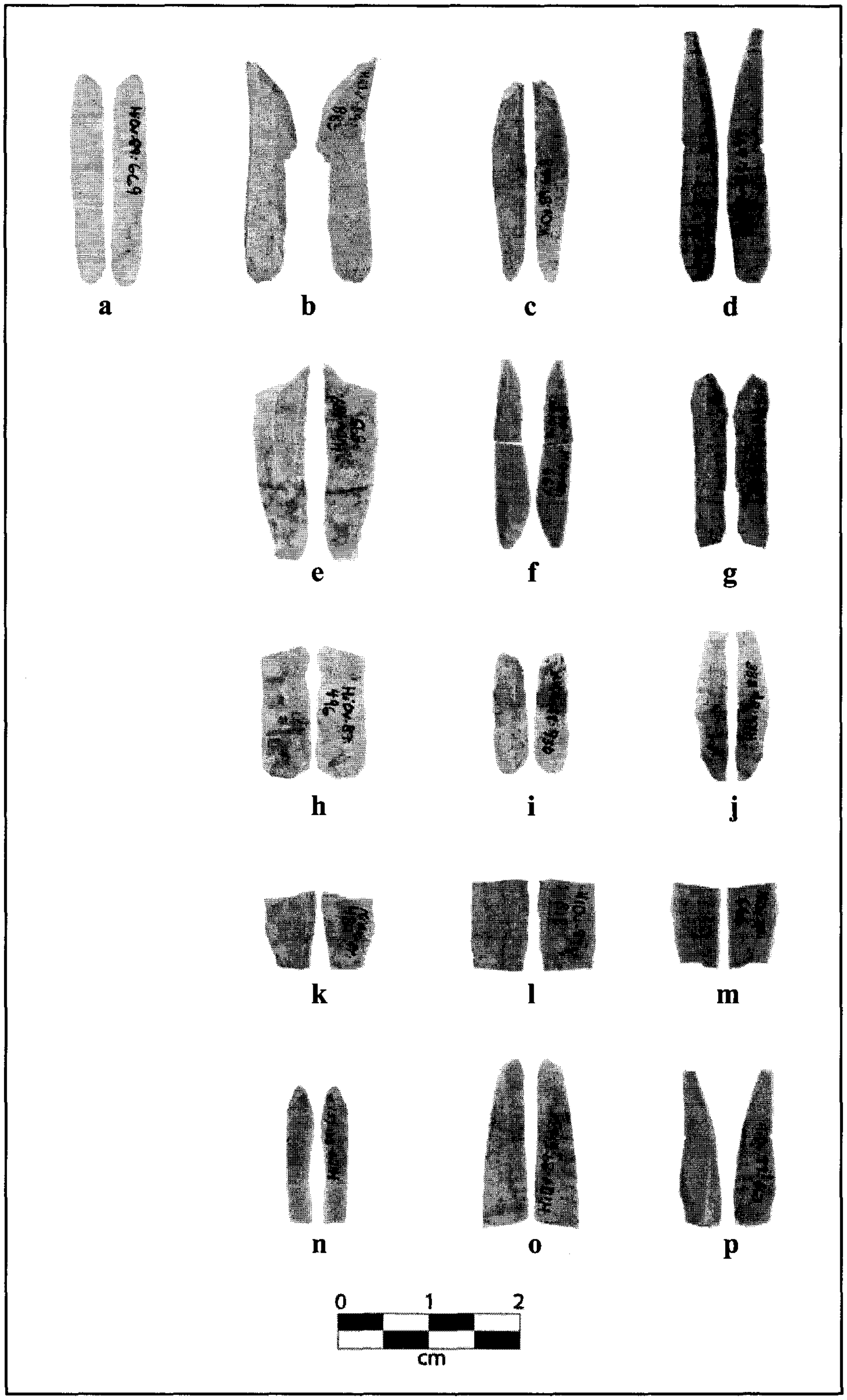


Plate 6.13 **Whole microblades and medial and distal microblade fragments: (a) HiOv-89:669; (b) HiOv-89:883; (c) HiOv-89:668; (d) HiOv-89:691; (e) HiOv-89:895; (f) HiOv-89:665 & 667; (g) HiOv-89:649; (h) HiOv-89:496; (i) HiOv-89:930; (j) HiOv-89:888; (k) HiOv-89:480; (l) HiOv-89:818; (m) HiOv-89:666; (n) HiOv-89:651 & 652; (o) HiOv-89:643; (p) HiOv-89:663**

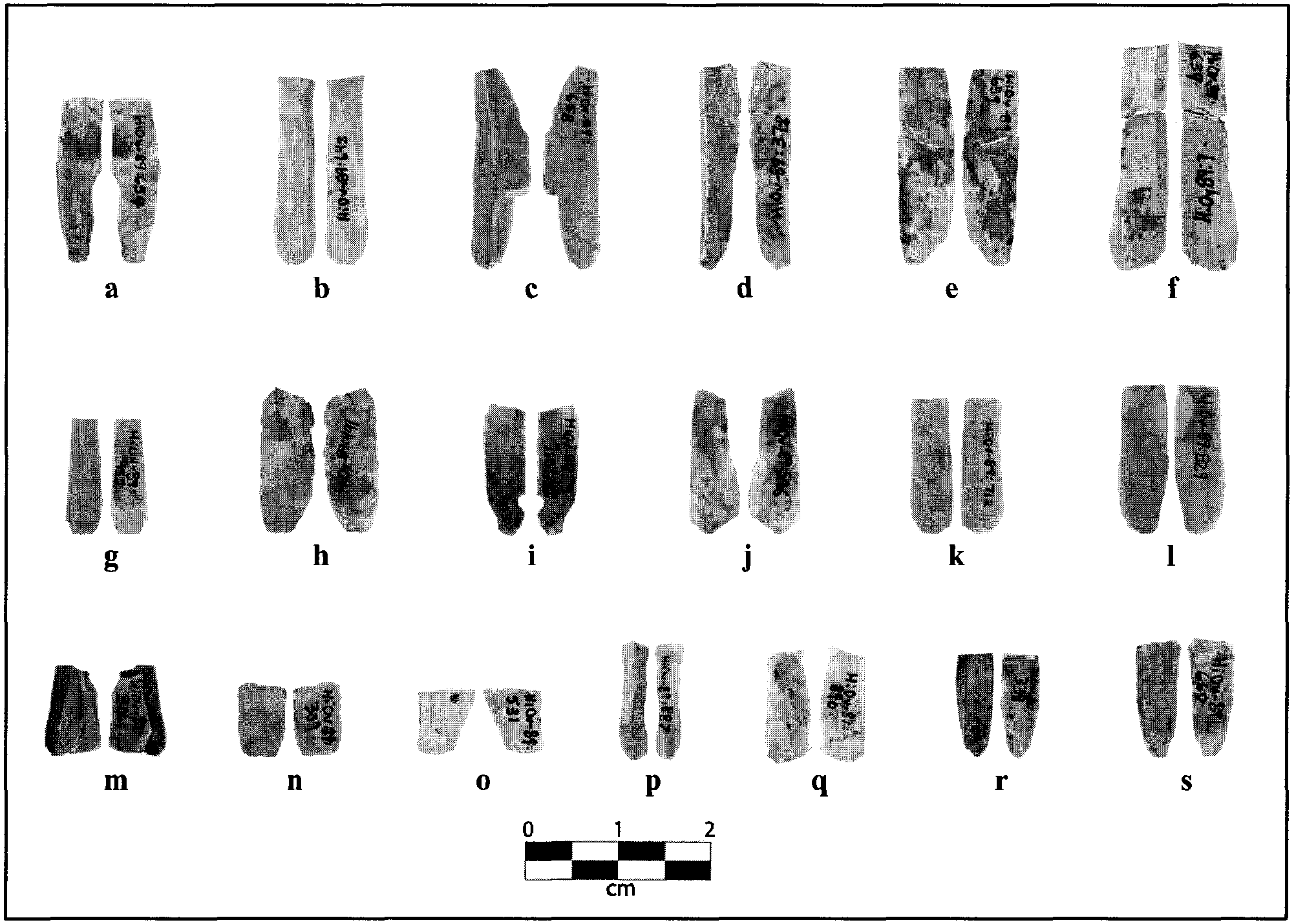


Plate 6.14 **Proximal microblade fragments: (a) HiOv-89:654; (b) HiOv-89:642; (c) HiOv-89:658; (d) HiOv-89:378; (e) HiOv-89:659; (f) HiOv-89: 007 & 639; (g) HiOv-89:952; (h) HiOv-89:441; (i) HiOv-89:710; (j) HiOv-89:596; (k) HiOv-89:712; (l) HiOv-89:829; (m) HiOv-89:301 & 662; (n) HiOv-89:309; (o) HiOv-89:531; (p) HiOv-89:887; (q) HiOv-89:890; (r) HiOv-89:339; (s) HiOv-89:660**

Refitted Ridge Flake and Microblade Sequences

Ridge Flake HiOv-89:644 to microcore 653

The secondary ridge flake HiOv-89:644 (Plate 6.12e) is a thin, triangular proximal fragment with remnant shaping scars along its left edge. Although the two artifacts do not directly refit, microcore HiOv-89:653 (Plate 6.2a) shows remnants of corresponding ridge-shaping scars on its reverse face adjacent to the fluted element. The indirect conjoining of the two artifacts is further supported by a thin purple line of discolouration seen directly below the remnant cortex on the reverse face of the microcore. This purple line has also been exposed on the ridge flake, where it matches the pattern seen on the microcore. Although indirect, this refitting is not without useful information. Most notably, it can be seen that the core has not been intensively reduced since the removal of this ridge flake; there is little evidence that further shaping has occurred, while only a few hypothetical microblades separate the ridge flake from the core. As discussed during the microcore description above, it does appear that reuse of the core, unrelated to microblade production, has also occurred since the last microblades were removed from the core. Assuming that this core would only be recycled after its usefulness for blade removal was exhausted, this indicates that the core was significantly depleted after limited use for microblade production. While this assumption is not necessarily true, it is supported by the small size of the core. It is also an assumption that the ridge flake represents the original shaping of the fluted face rather than a method of rejuvenation; however, the author is unaware of any reported cases of such a method of fluted face rejuvenation. Taking all assumptions into consideration, it seems that microcore HiOv-89:653 was limited in its use as a microcore; after the completion of the shaping process it was quickly reduced, and then reshaped into a new tool rather than being rejuvenated for the further removal of microblades. This conclusion is supported by the presence of remnant cortex and by the irregular shape of the core, indicating that careful, continual shaping of the core was not conducted.

Ridge Flakes HiOv-89:645 & 646 to microblades 663 & 658 (Plate 6.15)

This sequence of four artifacts has been complicated by the fragmentary nature of the artifacts, and by the presence of a partially corrected step-fracture on one of the microblades. HiOv-89:646 (Plate 6.11c) is a medial primary ridge flake fragment, unifacially shaped through tiny, regular flaking originating from the obverse side of the hypothetical microcore. It overlies a small but whole secondary ridge flake (HiOv-89:645, Plate 6.12b) that contains remnant scars from the unifacial shaping. A misshapen and unused proximal microblade fragment (HiOv-89:658, Plate 6.14c) lies directly below the ridge flakes. Midway along the length of the dorsal surface of this microblade, a scar from a previously attempted ridge flake removal ends in a step fracture, leaving the surface of the hypothetical fluted face irregular and lacking a consistent ridge to guide microblade removal. There is a second flake scar on the dorsal surface directly distal to the step fracture, incorporating the step as a platform and partially correcting this error. The secondary ridge flake refits into this flake scar. The final flake in this sequence is a short, triangular distal microblade fragment (HiOv-89:663, Plate 6.13p) lying below the first microblade. This refitted sequence provides a picture of the shaping sequence for

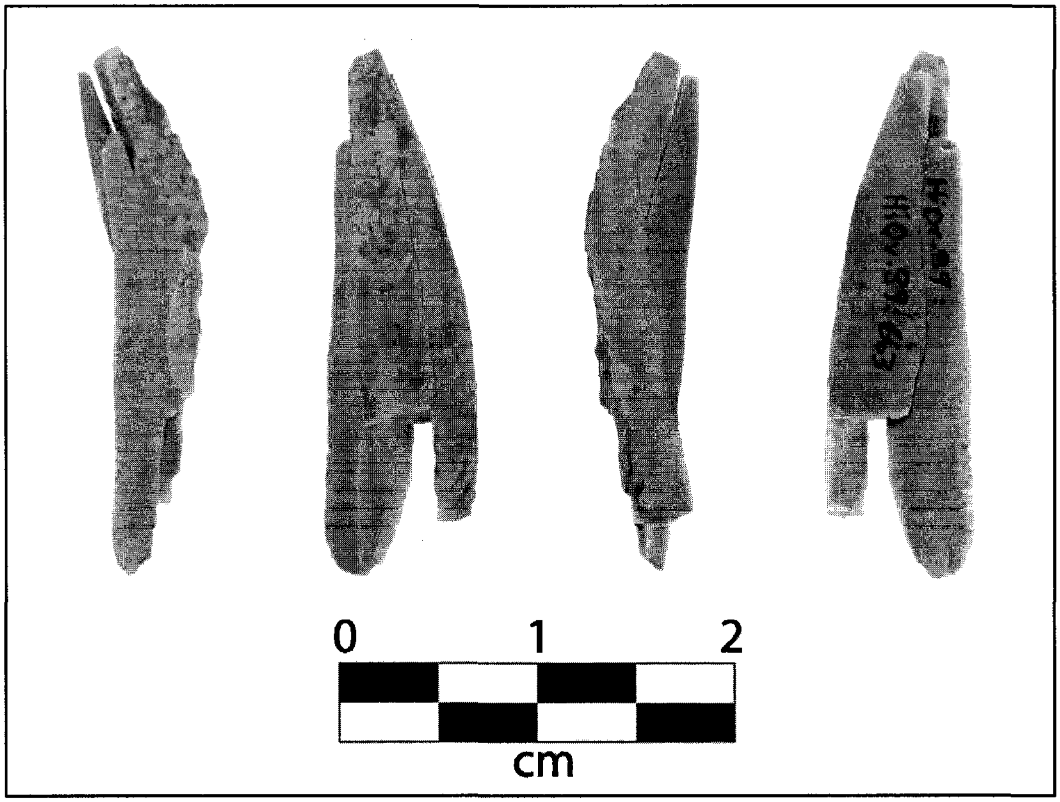


Plate 6.15 **Refitted ridge flake sequence. Ridge Flakes HiOv-89:645 & 646 to microblades HiOv-89:663 & 658**

the fluted element of a hypothetical core that has not been found to refit to these flakes. Measurements of the refitted artifacts together provide a fluted face length of approximately 27.7 mm, and a hypothetical core thickness of approximately 7.5 mm, placing this core well within the quantitative range of the other cores found at the site.

Ridge Flakes HiOv-89:647 & 664 to microcore 793

This short core reduction sequence seems to have been interrupted by flaws in the raw material, preventing the removal of useable microblades. It consists of a primary ridge flake fragment (HiOv-89:647, Plate 6.11d) refitted to a secondary ridge flake (HiOv-89:664, Plate 6.12d), which then refits to a microcore (HiOv-89:793, Plate 6.6).

The primary ridge flake fragment has been shaped by unifacial flaking originating from the obverse face. The secondary flake was removed from directly beneath the primary ridge flake, resulting in a trapezoidal cross-section. The proximal end of this flake extends above the current platform element of the microcore; however, subsequent spalling of the platform makes platform rejuvenation impossible to diagnose. There is evidence of only one further flake removal, which ends in a step fracture on the fluted surface of the microcore just below the platform. The fluted face of the microcore has not yet been fully shaped.

Microblade HiOv-89:669 to Ridge Flake HiOv-89:671

Little information can be gleaned from this refitted pair; however, what information can be inferred may be valuable. Both artifacts are whole, with their platforms lining up almost exactly along a single horizontal plane, indicating that the platform from which they were removed was not rejuvenated or modified by any methods other than grinding between ridge flake and microblade removal. This refitted pair constitutes the only direct evidence in the collection regarding the sequence of microcore shaping, indicating that the platform production occurred before the removal of ridge flakes to shape the fluted face.

The Microblade Reduction Process at HiOv-89

The microcores, ridge flakes, and microblades combine to provide evidence of a consistent method of microblade production at HiOv-89. Although the resulting artifacts are not consistent in shape and size, they share many distinct features indicating that they were created using a formal production sequence. One important characteristic that must be noted throughout the process is a flexible approach to microcore creation and reduction, using similar techniques to create the desired result despite an apparent limitation in the availability and size of the raw materials being used.

The most common starting point in the microcore creation process of this assemblage is the selection of a thick flake. There is little evidence for the reduction and shaping of pebbles or cobbles into microcores, although one large preform indicates that the tool-makers at the site were aware of this possibility. Flakes seem to have been selected for a wedge-like cross section, allowing for minimal reduction to create the desired shape. Such an approach would allow for the efficient use of both time and material. Microcores are most consistent in measurements of thickness and height, with overall length and platform rejuvenation lengths being the least consistent (Table A.10, Appendix A). Given that the latter measurements may vary with the extent of core exhaustion, these differences are not surprising; however, the former measurements also indicate that flakes are most strongly selected for a desired thickness, around 9.0 mm, and height, around 24.0 mm. Given that core height influences flute length, which in turn determines the length of microblades produced from that core, this selection process would allow for the creation of microblades of a standardized length with minimal initial effort.

After flakes were selected, cores were informally shaped through unifacial flaking, equally common on the reverse and obverse faces. Flaking was usually marginal, shaping only the outer edges of the artifact, with the exception of occasional thinning flakes running horizontally across the upper obverse or reverse face of the core. The fluted face was formed through more intensive unifacial shaping of ridges, to be removed as ridge flakes. Platforms were less consistently created; platform ridge flakes, informal spall removals, and side-blow flaking were all used. Although platform preparation methods themselves varied, they generally resulted in similar platforms, extending only partially across the top of the core from the fluted face, with spall removals, when present, typically ending in a hinge termination. The evidence available from the site is not sufficient to determine in what order the different elements of the cores were shaped; however, it may be inferred that the most likely sequence was core shaping, then platform production, and finally creation of the fluted face. The ridge flake to microblade sequence of HiOv-89:669 and 671 supports the idea of the platform being created before the fluted face. Indirect evidence for this sequence can also be observed in that the ridge flake method of shaping the fluted face tends to require a suitable platform for flake removal. The core-like scraper HiOv-89:809, described in Chapter 5 (Plate 5.2), also indirectly supports this argument; if the artifact is indeed a partially finished core, it exhibits a fully prepared platform, but only partially prepared fluted face.

There is evidence that both platform and fluted face rejuvenation occurred during microblade production. Platforms were typically rejuvenated through a spall removal beginning at the juncture of the platform and fluted face, commonly extending only about 30% of the way into the platform element, at which point the spall terminated in a hinge.

Fluted face rejuvenation also occurred, as seen in the sequence of correction for the step-fractured microblade HiOv-89:658, and in the presence of a single flake apparently removed from a fully formed fluted face (HiOv-89:554); however, a number of cores in the collection also appear to have been abandoned due to irregularities and flaws in the material of the fluted face, and so fluted face rejuvenation was not consistent throughout the collection. Many of the microcores at this site do not seem to have undergone long and complicated reduction sequences, but rather were casually shaped and quickly abandoned when they became difficult to work.

Despite this apparently casual approach to core reduction and disposal, many other microcores at HiOv-89 seem to have been used, and reused, to the point of exhaustion. Cores with remaining lengths significantly larger than average, such as HiOv-89:790, 793, and preform 729, seem to have been abandoned due to flaws in the material affecting microblade removal. Microcore HiOv-89:873 is the only exception to this rule; however, this artifact is unique in a number of ways, and seems to represent an exception to most of the processes described here. It must be taken into account that the extremely small, apparently exhausted nature of the microcores may also be a factor of the selection process for working materials; if large flakes were not available for the creation of cores, then cores would naturally be small before microblade removal even began, and would quickly become exhausted. After exhaustion or abandonment as cores, these artifacts were further used as scrapers and burins, with use-wear clearly visible over the flute scars on many of the microcores. Use-wear is also found on the edges of the platforms and keels, and is commonly heavy. Extremely heavy wear is present on the bases of many cores, and moderate wear at the front of the platforms at the margin of the fluted face (Plate 6.16 to Plate 6.18); however, some of these forms of wear may be from use, or simply the result of basal crushing and platform grinding during microblade removal. Heavy wear on the ridges of core preparation flakes (Plate 6.19) may be due to the core shaping process, but could also indicate use-wear deposited prior to microblade removal.

Microcores at HiOv-89 are excellent candidates for the core-burins described by Powers et al. (1983; see also Chapter 2). The low flute scar count, high degree of use-wear, and associated presence of burin-and-scraper multi-tools, all indicate that these cores were not used solely, or possibly even primarily, for microblade production. The presence of some use-wear and retouch on the microblades indicate they were indeed used; however, the sample is too small and fragmentary to determine the specific nature of this use. While these blades were likely hafted and used as parts of composite tools, few utilized specimens remain at the site. It could be that many microblades were produced here, then hafted, and taken away when the site was abandoned. The high proportion of proximal fragments could be interpreted as evidence for this idea, as the medial fragments would be most consistent in form and ideal for hafting; however, proximal flakes may have been most commonly recovered simply because their greater width at the bulb of percussion increased their potential for being caught in the screen. It is likely that many more microblades and small fragments remain at the site, having fallen through the ¼ inch screens used to sift the excavated soil and been neither discovered nor recorded. Because of the large screen size used, the low number of microblades and medial fragments, and lack of retouch, cannot be considered negative evidence about microblade use at the site, and the interpretation of the site must rely on the larger microcores and ridge flakes.

Overall, the analysis of microblade artifacts indicates that conservation of raw material was indeed a key aspect of lithic production at HiOv-89. Continual reuse and recycling of raw materials was facilitated by a flexible approach that allowed for artifacts to be created, used, and recreated as a variety of different tool types. Despite this fluidity, standardized methods such as ridge flake preparation were also being used to create consistently wedge-shaped cores, indicating the presence of a specialized microblade technology. The presence of bifacially and unifacially shaped cores, as well as ridge flakes, burins, and a single platform tablet, all indicate a northwestern influence. It seems that a method of microcore reduction closely related to that seen in the Denali Complex was used at HiOv-89, adapted to a more flexible approach to make use of small fragments of rare raw materials. Variations in the reduction sequence such as side-blow platform preparation and partial rejuvenation may have delayed the exhaustion of microcores. Comparison of these interpretations to a wider view of microblade production in northwestern Alberta has the potential to extend the boundaries of the Denali complex much farther southeast than previously interpreted, and similarly to indicate a more extensive northern influence in the region than current interpretations of the archaeology of northern Alberta allow.

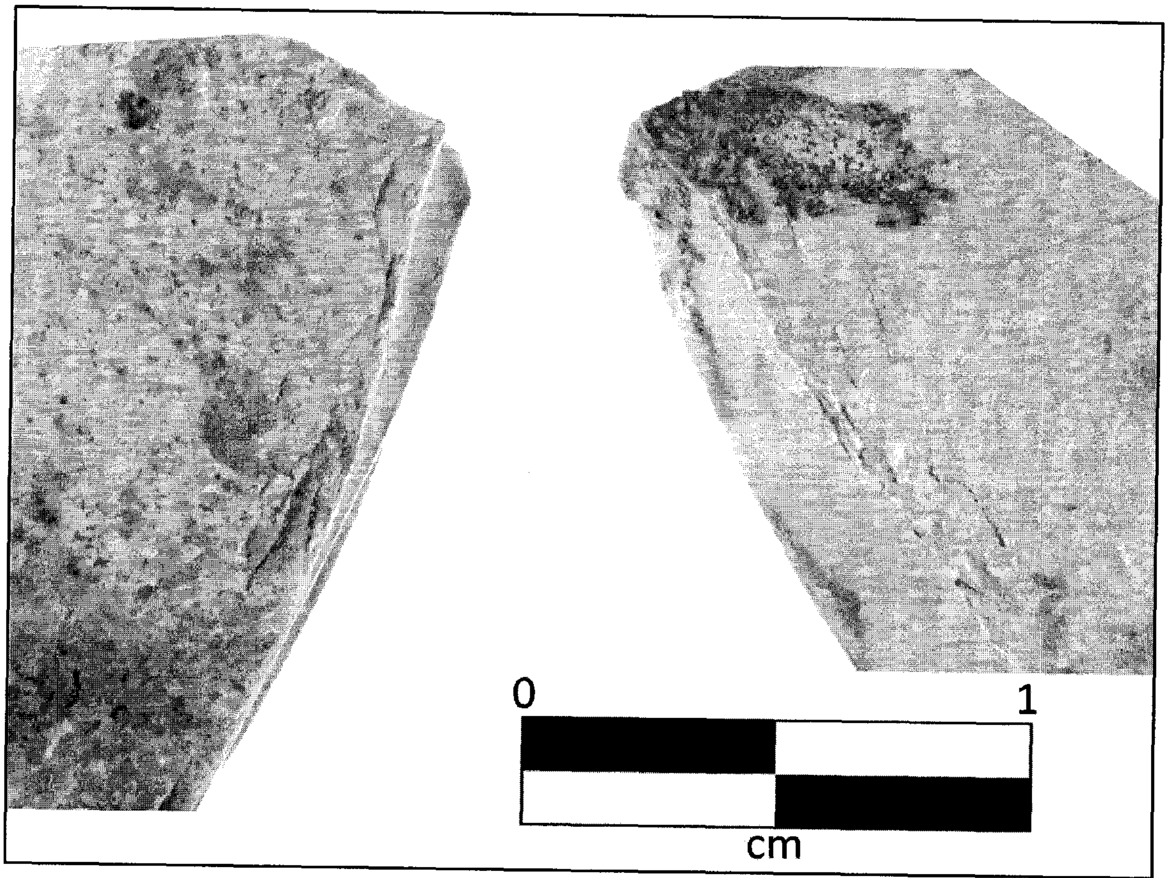


Plate 6.16 **Detail of microcore HiOv-89:873, showing use-wear on the lateral margins of the fluted face**

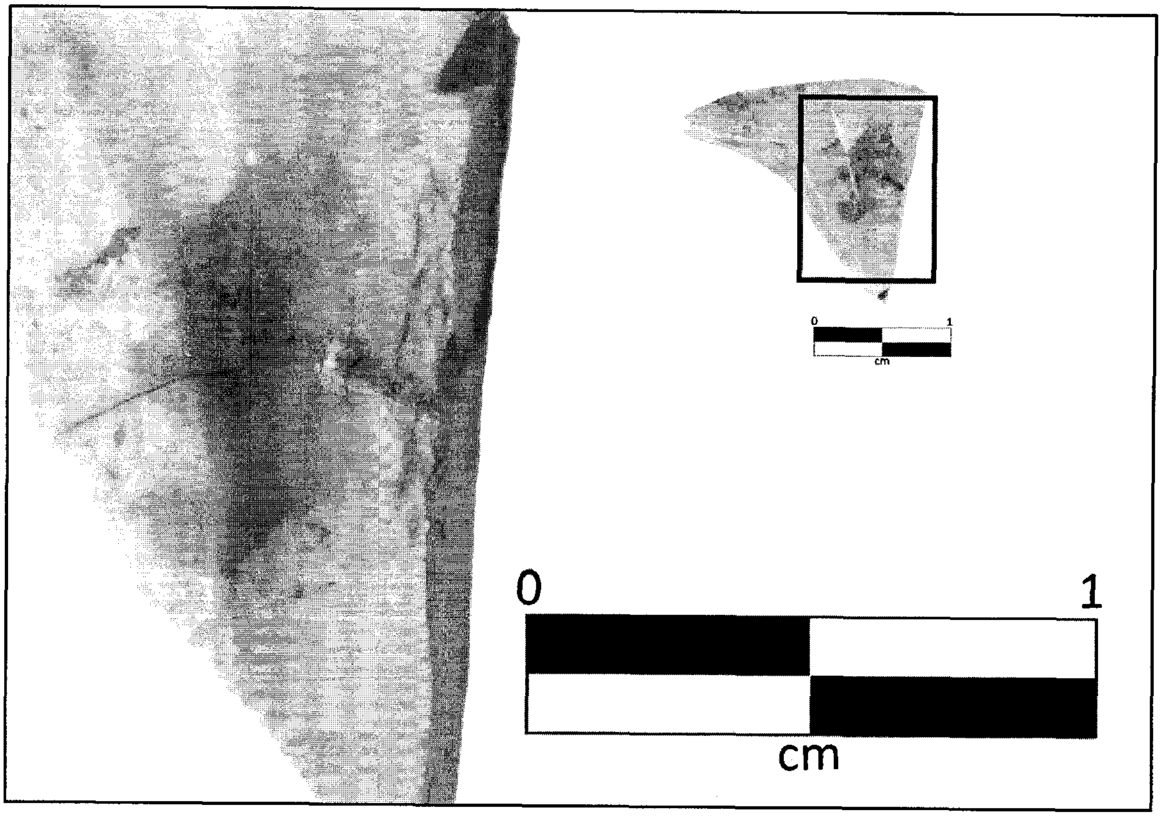


Plate 6.17 Detail of microcore fragment HiOv-89:364, showing retouch on break, and use-wear on the obverse edge of the fluted face

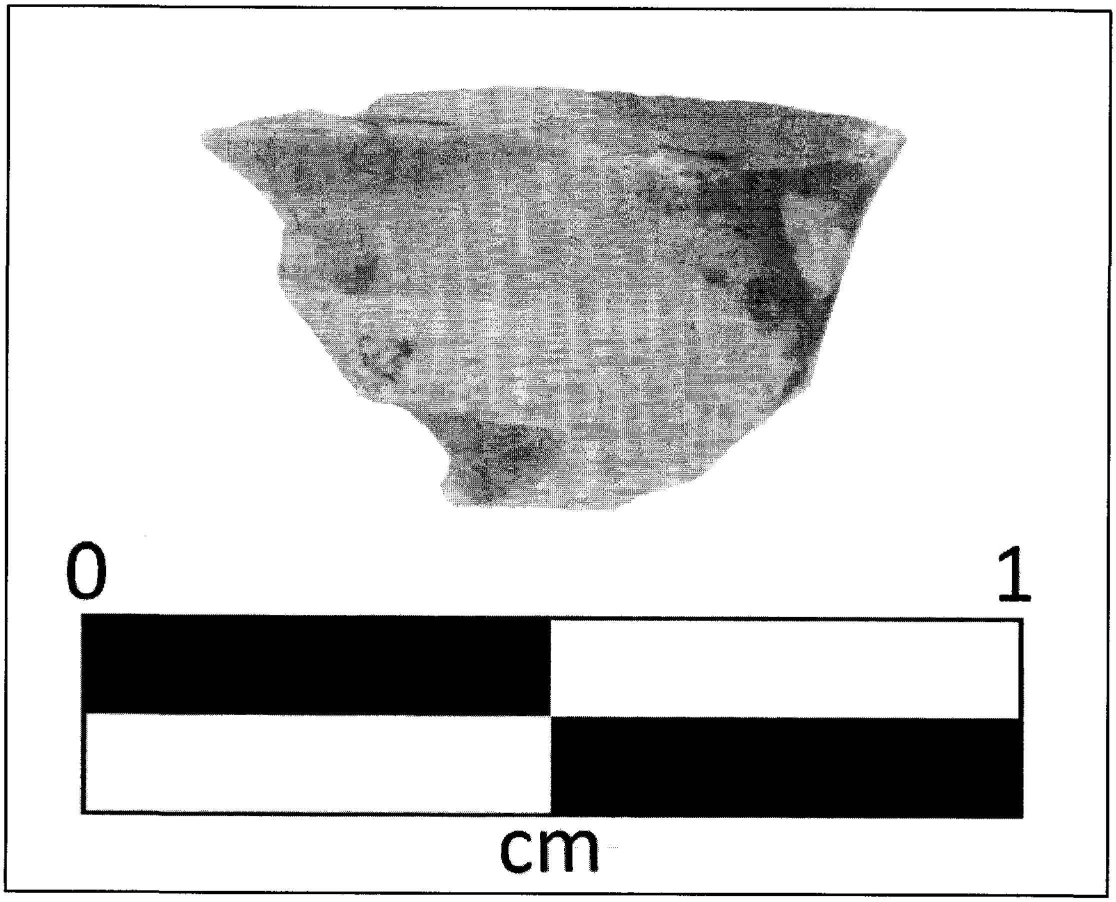


Plate 6.18 **Detail of possible microcore fragment HiOv-89:554**

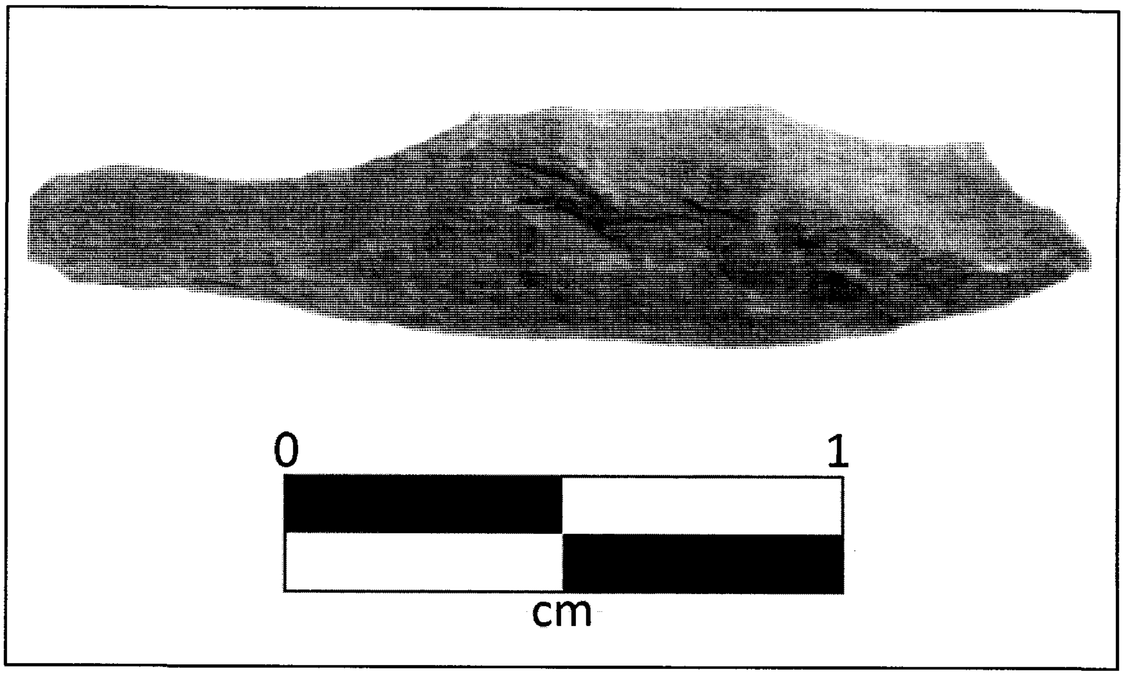


Plate 6.19 **Detail of primary ridge flake HiOv-89:647, showing apparent use-wear on ridge**

Chapter 7 Microblade Production in Northeastern Alberta

Introduction

Over the last few decades, the presence of microblade technology has been noted during a number of mitigative survey and excavation projects in northeastern Alberta. The great majority of these reports relate to work conducted for Oilsands exploration and development, and occur along the eastern side of the Athabasca River between Fort MacKay and the northern extent of the Fort Hills. This region has undergone some of the most intensive Oilsands exploration, and consequently some of the most intensive archaeological survey, in Alberta to date. However, since the 1986 publication of the Bezya site in the Oilsands (Le Blanc and Ives 1986), few published studies have been undertaken describing the microblade materials found in the region. All other written reports of microblade finds occur in the grey literature of unpublished reports and government documents produced by the archaeological consulting industry.

The intention of this chapter is to integrate the data gathered from the HiOv-89 microblade assemblage into the emerging picture of microblade production within the Oilsands region. This will be done through an overview of reported microblade sites within the Oilsands region, with the goal of creating an analytical framework for the study of past and future microblade discoveries. Due to the size and number of sites in the region, this overview occurs at the most basic level of analysis, and is intended only as a starting point for future research. It includes a description of the types of data available through the provincial databases, a basic analysis of microblade technology as currently reported in northern Alberta, and recommendations for further, more detailed study of previously collected assemblages from the Oilsands region. While the level of data available at this preliminary stage of research is somewhat limited, I believe that future study aimed at the direct analysis of field notes and assemblages from previously excavated sites may be able to decipher past reports of possible microcores and blade-like-flakes, and provide deeper insight into patterns of microblade production in northern Alberta.

Alberta Archaeological Site Inventory

Heritage resources in Alberta are monitored and regulated at the provincial level. Archaeological sites may be discovered through academic work, mitigative survey, or may be revealed during farming and ploughing of fields, industrial ground disturbance, or by members of the public by chance. In all cases, the location and characteristics of the archaeological sites are recorded and entered into a provincial database, the Alberta Archaeological Site Inventory, maintained by the ASA through the Heritage Resources Management Branch of ACCS. The ASA monitors academic and mitigative archaeological work through a permitting system, which requires that all artifacts found are catalogued and described in a final report. Further, a standardized site form is filled out, detailing the location of each site discovered, the work conducted at the site, and the artifacts found, and the information on this form is entered into the provincial site database. In order to determine the extent of known microblade technology in northeastern Alberta, this component of research entailed a search of this database for sites containing microblade-like artifacts, and a review of the related final permit reports submitted to ACCS.

A systematic search for microblade sites in Alberta was conducted though the Alberta Archaeological Site Inventory. The categories *[Site] Description*, *Collection Remarks*, and *Further Remarks* were queried for the terms microblade, microcore, bladelet, ridge flake, micro and blade. Over 100 sites were recovered from this database search; however, after ruling out results relating to micro-debitage, knife-blades, and unifacial blades, 70 sites remained. These sites were further reduced to 41 sites found within northeastern Alberta. The majority of the sites were recovered as the result of reporting of blade-like flakes under either the *Description* or *Collection Remarks* categories; however, a number of true microblades and microcores were also reported.

A source of error in the research method described above was noted immediately; seven sites known to contain microcores in northeastern Alberta were not identified during the database search. These sites were instead found with the help of staff at the ASA (Darryl Bereziuk, pers. comm., 2007), and also by searching through permit reports for the microblade sites found during the database search, since many sites are often addressed within a single report. A review of their database entries quickly revealed the source of this error: the presence of microblade materials had not been reported in the database site forms for these sites. In the database, *Collection Remarks* are not always described in detail, and often only temporally diagnostic tools are noted. While the site form provides an entry space for the number of tools, projectile points, cores, and debitage collected, microblades and microcores must be reported under *other*, if at all.

This initial source of error points to an underreporting of microblade sites, in terms of the provincial sites database. Further difficulties were encountered during the review of previously submitted reports. Changes over the last three decades in government requirements for reporting formats have created inconsistencies in the type and detail of information provided. Many older reports simply indicate that microcores or microblades were found at a site, providing no description or illustrations of individual artifacts. When photographs are provided, often only one face of a single representative artifact is depicted. Many photographs from older reports are low in resolution or have been poorly reproduced due to the technology available at the time they were written. A second limitation to this research was the availability of reports for recent excavations of Oilsands sites that have revealed a number of interesting finds related to microblade technology. Many of the reports for sites excavated within the last year are currently undergoing review, and are not yet available for public viewing.

Reported Oilsands Microblade Sites

Including the 41 sites found during the site file search, and seven found through further research, there are 48 possible microblade sites in northeastern Alberta. Of these, 37 are considered to be within the geographic range of the Oilsands area (Figure 7.1). A summary of all 46 sites may be found in Table 7.1 and Table 7.2, but only Oilsands sites are discussed here. Eighteen sites, constituting nearly half of those studied, are reported to contain either microcores, microcore fragments, or possible microcores, as well as one other site reported to contain a ridge flake. The remaining 18 sites, however, contain rather limited evidence of either blade-like flakes, or one or two isolated microblades.

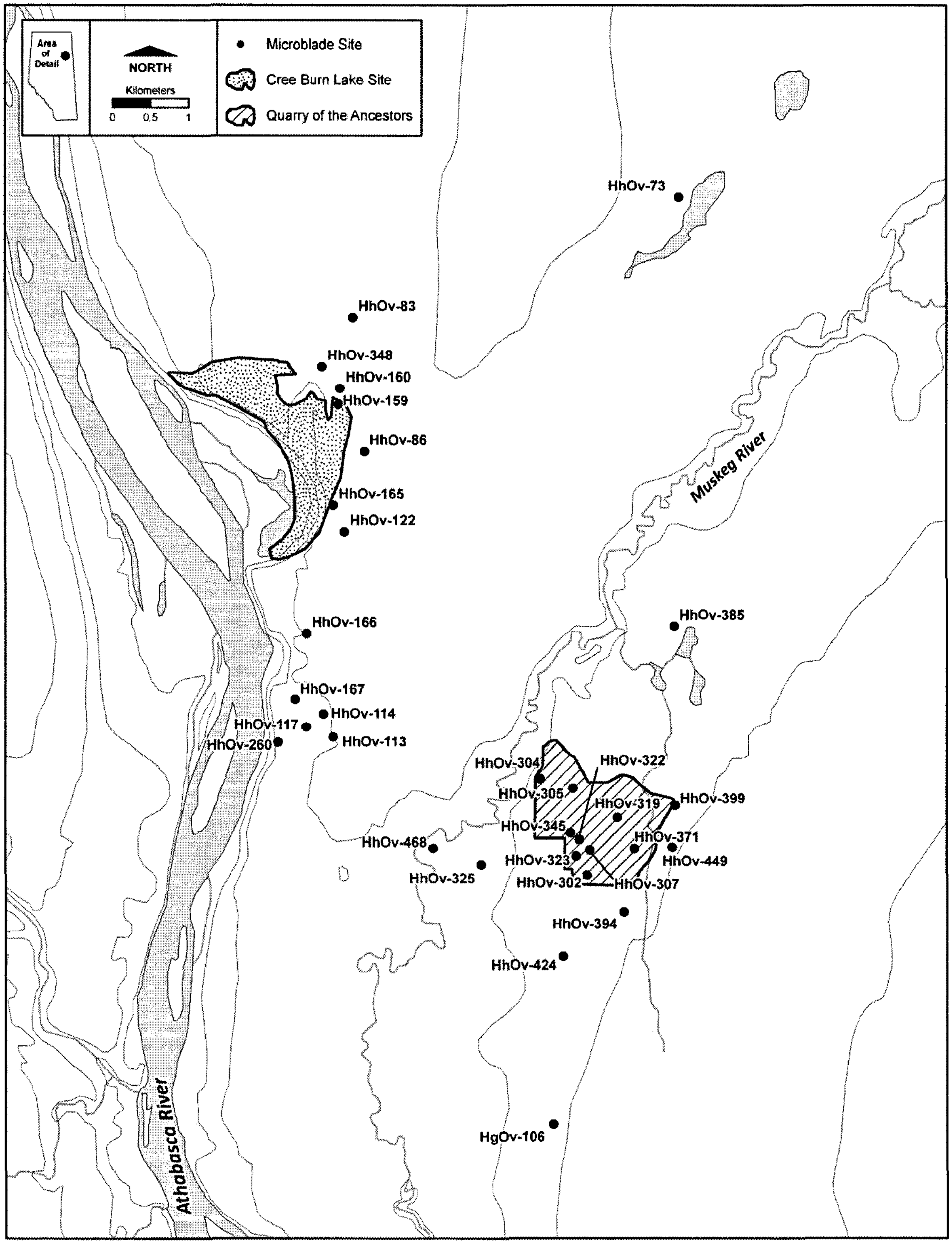


Figure 7.1 **Microblade sites in the Oilsands area: detail of southern site clusters. For a full view of all microblade sites in the Oilsands area, refer to Figure 3.1. Map by Robin Woywitka. Site information and GIS data from the Alberta Archaeological Site Inventory, Archaeological Survey of Alberta, April 2008.**

Table 7.1 **Microblade artifacts from reported microblade sites in northeastern Alberta**

Borden	Research Type	Blade-Like Flakes	Microblades	Microcores
GdOo-31	Survey	1 chert		
GdOp-24	Survey	1 chert		
GhPh-3	Survey/Excavation		6	1
GhPh-4	Survey/Excavation		34	3
GhPh-7	Survey/Excavation		4	1 fragment
GhPh-8	Survey/Excavation		5	
HeOw-1	Survey	1 black pebble chert		
HgOv-45	Survey	3 BRS*		
HgOv-106	Survey			1 prepared ridge flake
HhOv-73	Survey/Excavation		103	5 chert; prepared ridge flakes
HhOv-83	Survey	several		
HhOv-86	Survey/Excavation		26 BRS	4 BRS and 1 chert
HhOv-113	Survey/Excavation		18 BRS	42 BRS
HhOv-114	Survey/Excavation		11 BRS	
HhOv-117	Survey	3 BRS		1 possible BRS
HhOv-122	Survey	1 BRS		
HhOv-159	Survey/Excavation	1 BRS		
HhOv-160	Survey	2 BRS		
HhOv-165	Survey	2 BRS		
HhOv-166	Survey	1 BRS		
HhOv-167	Survey			1 possible
HhOv-260	Survey		1 possible	
HhOv-302	Survey; Excavation report unavailable		11 BRS	1 fragment BRS
HhOv-304	Survey; Excavation report unavailable			1 fragment BRS
HhOv-305	Survey; Excavation report unavailable		17 microblades and fragments	3 possible

Table 7.1 continued

Borden	Research Type	Blade-Like Flakes	Microblades	Microcores
HhOv-307	Survey; Excavation report unavailable		13 microblades BRS	2 core fragments BRS
HhOv-319	Survey; Excavation report unavailable		13; one of black chert	some possible
HhOv-322	Survey; Excavation report unavailable		1	1 fragment BRS
HhOv-323	Survey; Excavation report unavailable		many	1 fragment
HhOv-325	Survey; Excavation report unavailable			some possible
HhOv-345	Survey; Excavation report unavailable	32		1 possible
HhOv-348	Survey	5		
HhOv-371	Survey	several		
HhOv-385	Survey	1 BRS		
HhOv-394	Survey; Excavation report unavailable	several BRS	1 chalcedony	
HhOv-399	Survey	1 BRS		
HhOv-424	Survey		1 BRS	
HhOv-449	Survey; Excavation report unavailable			1 chert
HhOv-468	Survey; Excavation report unavailable			1 preform
HhOw-16	Survey	5 BRS		
HhOw-36	Survey			1 possible
HiOu-68	Survey; Excavation report unavailable		1 BRS	
HiOv-57	Survey/Excavation	1 chert		
HiOv-89	Survey/Excavation		39	23 cores and fragments; 17 ridge flakes
HiPf-1	Survey			1 quartzite
IgPc-2	Survey/Excavation	yes		possible
IhPd-4	Survey/Excavation	yes		
IcQa-11	Surface Collection			1

*BRS: Beaver River Sandstone, see p. 68

Table 7.2 Characteristics of reported microblade sites in northeastern Alberta

Borden	Site Size (m)	Associated Artifacts	Environment	Additional Remarks
GdOo-31	50 x 25	debitage	boreal	
GdOp-24	50 x 20	debitage, shell beads	boreal	also Traditional Use area
GhPh-3	large	points, scrapers, choppers, debitage		Calling Lake
GhPh-4	large	points, scrapers, debitage		Calling Lake
GhPh-7	large	point, scrapers, debitage		Calling Lake. Blades also reported
GhPh-8	large	points, knives, ceramic, debitage, hammerstones		Calling Lake
HeOw-1	10 x 10	debitage	near valley, on sand dunes in mixed forest	
HgOv-45	100	BRS debitage	Saline Lake; mixed forest sandy soil	
HgOv-106	50 x 50	BRS debitage	open pine near black spruce escarpment	
HhOv-73	100 x 40	3 core tablets, burin, burin spalls, edge-modified flakes	rise by small lake, mixed pine and aspen	Bezya Site. Uncalibrated radiocarbon date of 3990±170 BP (Le Blanc and Ives 1986)
HhOv-83	50 x 50	cores, scrapers, bifaces, awl, debitage	knoll, open aspen	Early Nezu Complex
HhOv-86	large	bifaces, drill, scrapers, debitage	series of ridges near a drainage ditch in mixed spruce and aspen	site has been incorporated into HhOv-16, Cree Burn Lake Main Site; original database entry is blank
HhOv-113	200 x 50	points, bifaces, wedges, retouched flakes, hammerstones; chert and quartzite also present. 1 blade also reported	long ridge in mixed aspen forest	cores are cylindrical and wedge-shaped

Table 7.2 Continued

Borden	Site Size (m)	Associated Artifacts	Environment	Additional Remarks
HhOv-114	40 x 26	BRS bifaces, graver, retouched flakes, cores and debitage. 2 blades also reported	short ridge in open jack pine near black spruce bog	
HhOv-117	175 x 100	biface fragments, burin, cores, debitage	high ridge near Athabasca, mixed aspen and jack pine	"microblades" only found during survey, no further materials from excavation; related to Cree Burn Lake
HhOv-122	5 x 5	1 BRS flake	aspen, long sandy ridge near black spruce, red soil	
HhOv-159	120 x 100	Eden tip, bifaces, scrapers, retouched flakes, core, much debitage	low long ridge, sand over bitumen, jack pine	Assigned to the Nezu Complex
HhOv-160	100 x 50	debitage	dune, open jack pine near low land	
HhOv-165	70 x 60	biface, discoidal core, debitage	dune, aspen	
HhOv-166	100 x 80	BRS debitage	dune, aspen near black spruce	
HhOv-167	50 x 40	quartzite points, BRS bifaces, cores, retouched flakes, scrapers, debitage	low dune, aspen	site location has been lost
HhOv-260	5 x 5	flakes, shatter, biface reduction flakes	mixed forest, base of knoll	
HhOv-302	80 x 30	chert point base, knife, uniface, wedge, scrapers, bifaces, mostly BRS	aspen, sandy knoll near wetland	Quarry of the Ancestors site locality
HhOv-304	180 x 75	quartzite Scotsbluff point, BRS gravers, adze, bifaces, awls, many cores, debitage	aspen island in muskeg	Quarry of the Ancestors site locality
HhOv-305	1050 x 315	quartzite, bifaces, gravers, wedges, unifaces	BRS outcrop, rocky and sandy knolls, aspen, near wetlands	Quarry of the Ancestors secondary site

Table 7.2 Continued

Borden	Site Size (m)	Associated Artifacts	Environment	Additional Remarks
HhOv-307	53 x 2	bifaces, points, unifaces, awl, retouched flakes	point on fen, aspen and shrubs	Quarry of the Ancestors site locality
HhOv-319	800 x 480	points, knives, bifaces, scrapers, spokeshaves, wedges, retouched flakes. BRS, chert, quartzite	outcrop by low muskeg surrounded by sandy aspen knolls	Quarry of the Ancestors primary site
HhOv-322	10 x 10	bifaces, scrapers, uniface, cores, spokeshave, mostly BRS	mixed aspen on edge of fen	Quarry of the Ancestors site locality
HhOv-323	60 x 10	bifaces, knives, scrapers, unifaces, awl, gravers, wedges, retouched flakes	mixed aspen on edge of fen	Quarry of the Ancestors site locality: "microblade production evident in all site areas"
HhOv-325	10 x 10	bifaces, scraper, retouched flakes, cores	elevated sandy ridge, jack pine	possible cores are BRS and show long thin scars
HhOv-345	45 x 15	bifaces, scrapers, wedge, retouched flakes	mixed aspen on edge of fen	Quarry of the Ancestors site locality
HhOv-348	150 x 50	uniface, biface core, BRS and quartzite debitage	knoll with aspen and shrub	near Cree Burn Lake
HhOv-371	400 x 100	core, debitage BRS and chert	ridge on dry lake with aspen and shrub	Nominated for inclusion within Quarry of the Ancestors site locality
HhOv-385	5 x 5	cores, scraper, retouched flakes, much cortex, all BRS	ridge with aspen and shrub	
HhOv-394	200 x 50	drill, BRS debitage, biface, multi-directional cores	ridge on drainage with aspen	
HhOv-399	15 x 10	biface, BRS debitage, quartzite flake	knoll on drainage with aspen and shrub	
HhOv-424	10 x 10	scrapers, awl, retouched flakes	ridge, open pine	
HhOv-449	50 x 30	tools, debitage of BRS, chert and quartzite. A hearth and FBR also present	open pine surrounded by low, dry black spruce bog	

Table 7.2 Continued

Borden	Site Size (m)	Associated Artifacts	Environment	Additional Remarks
HhOv-468	5 x 5	projectile points, core, debitage	upland near Muskeg River, open aspen forest	core is bifacially shaped with prepared platform (Wickham, pers. comm. 2008)
HhOw-16	150 x 100	cores, abrader, biface fragments, debitage. BRS, quartzite	Ells River Valley	
HhOw-36	100 x 60	biface preform, BRS and northern quartzite flakes	Ells River Valley, spruce and aspen	possible core is created from a thick BRS flake
HiOu-68	5 x 5	point, cores, wedge, retouched flakes, all BRS	defined ridge in mixed pine and aspen	
HiOv-57	60 x 50	points, bifaces, BRS and chert	high ridge near bog, mixed aspen and pine with moss	Assigned to Late Taltheilei Tradition
HiOv-89	80 x 40	burins, scrapers, utilized flakes	knoll on sinkhole lake in open pine	
HiPf-1	unreported	endscraper, FBR, flakes, all quartzite	low terrace on Legend Lake, open polar and willow	Legend Lake Site
IgPc-2	large	numerous	cliffs on Peace River; open grassland and aspen	Peace Point Site
IhPd-4	large	numerous	high cliff on Peace River, mixed aspen	Peace Point Site
IcQa-11	large	unknown	ploughed field	Fort Vermilion;; core is wedge-shaped (Pyszczyk 1991)

Database Evidence

Most of the reported microblade and microcore finds found in the database were reported during initial site surveys, with less than half of the sites receiving follow up excavation allowing for evaluation of the extent of microblade production activity. Sites originally discovered during mitigative survey may have been avoided by further industrial activity to protect the site, or mitigative excavations may be planned for the near future. Those sites within the Cree Burn Lake locality are protected by provincial designation, and so further mitigative excavation of these sites has not been conducted. Of those sites that have been fully excavated, final excavation reports are available for only seven sites, including Bezya and HiOv-89, with the other 13 sites awaiting final report review at this time.

A few observations may be made from the sample of 37 Oilsands microblade sites taken from the database. These sites range widely in size, from 5 m to over 1000 m in length. Eight of the sites are included within the Quarry of the Ancestors locality. Nearly all occur on well-drained terrain, often in mixed aspen forest near a drainage or water source. All but six occur on prominent landscape features such as knolls, ridges, and high stabilized sand dunes. Some of these factors likely reflect survey testing methods; drainages are generally considered to be ideal locations for archaeological sites, as are elevated features of the landscape. It may also be that larger sites, especially sites within Quarry of the Ancestors, where the highest density of artifacts is often found, are simply more likely to provide blade-like flakes by random chance.

Permit Report Evidence

Permit reports, when available, provided supplemental evidence for the occurrence of microblade technology in the Oilsands region. While artifact descriptions and measurements are most commonly given, artifact photography has the greatest potential to allow other researchers to interpret previously excavated assemblages. It must be noted, again, that all interpretations presented here cannot be considered definitive, as no first-hand analysis of the artifacts was conducted. As observed earlier, the permit reports discussed here were written at different times over three decades, under changing standards of the level of detail required for reporting of artifact analysis and photography. While a lack of detail may be noted in some of the reports discussed here, it is not meant to criticise the authors; rather, the intention is simply to establish the level of evidence used to support any conclusions drawn from this discussion, and to show that these conclusions must be taken tentatively.

Sites HhOv-117 and HhOv-167 are reported to have produced a single possible microcore each during shovel testing studies; photographs provided in the survey report depict a single lateral face of each artifact (Saxberg et al., 1998:236). Based on these illustrations, these cores seem to bear little resemblance to microcores from Bezya and HiOv-89, showing evidence of neither platform preparation nor unifacial or bifacial core shaping. They do, interestingly, show a strong resemblance to each other, each with a vague keel rising out of the base of the core, but in any other aspect they appear to be uniquely shaped bipolar cores. This hypothesis is supported by the artifact descriptions in the text; both cores are described as having seven or eight "long linear flake scars" that "appear to have been removed from two directions" (ibid:26, 29, 130). Later testing at

HhOv-117 produced no further evidence of microblade production technology; however, no controlled excavations have been conducted at the site.

Photographs of a sample of the blade-like flakes from HiOv-117, 122, 159, 160, 166, and 167 are also included in Saxberg et al. (1998:248). Again, only a single face of each artifact is shown, usually the dorsal surface, and any interpretation of these artifacts based on the photographs may be inaccurate. The artifacts are generally described as "blade-like in form" (ibid:28). The artifacts depicted are somewhat irregular, with rough dorsal surfaces and occasionally lacking parallel margins; however, they are blade-like in form, and first-hand investigation of these assemblages could potentially lead to the identification of either a bipolar or blade-like technology at these sites.

An initial survey report is also available covering sites HhOv-302, 304, 305, 307, 319, 322, 323, 325, and 345 (Saxberg and Reeves 2004). Most microblade materials found at these sites were recovered during recent mitigative excavations, and the reports are not yet available. The preliminary survey report provides photographs for two blade-like cores from HhOv-305 (Saxberg and Reeves 2004:268), as well as a description of a blade core fragment from the same site. Again, a single face is shown for each artifact and interpretations are made cautiously; however, no fluted surfaces are visible in the photographs. The third core is described as long and thin, square in cross-section, exhibiting two blade-like scars on one face, and irregular scars on the opposite face, but no illustration is available (Saxberg and Reeves 2004:51). A blade core from HhOv-319 is also described but not illustrated. It is described as a unidirectional blade core, with marginal unifacial flaking and long, blade-like flake scars on the ventral surface (Saxberg and Reeves 2004:83).

A blade-like flake was found at HiOv-57 during survey; however, mitigative excavation of the site produced no further evidence of microblade production (Saxberg et al., 2004:39-41), and it is possible that the blade-like flake was produced by chance. A photograph of a microblade reported during survey of HhOv-424 shows a thick blade-like flake resembling a burin spall (Saxberg and Reeves 2006:206, 209). The same permit report describes a ridge flake recovered from HgOv-106 (Saxberg and Reeves 2006:205, 209), although remnant flake scars could not be identified on the dorsal ridge of the flake show in the accompanying photograph. The site form for HgOv-45 indicates that three blade-like flakes were found among 17 BRS flakes recovered during site survey, but no further information is available in the report (Sims 1976).

The permit report describing HhOv-114 (Green et al., 2006) provides full photographic representation of all the microblades reported to be found at the site. Eighteen microblades of BRS are measured, described, and photographed with a view of the dorsal surfaces of the flakes (Green et al., 2006:Appendix I). All are triangular in cross section, and also relatively wide and thick, with somewhat irregular edges. A few are more suggestive of burin spalls than microblades, indicating that both microblade and burin technologies may be present at the site.

Based on the evidence described above, it is apparent that further study of the reported microblade sites in the Oilsands region is warranted. There is evidence for the presence of both blade and burin technologies, possibly in association at some sites. Further mitigative excavation of sites that produced blade-like flakes during survey may led to the discovery of definitive evidence of microblade technology. It may be noted that the initial survey study of HiOv-89 lead to the discovery of only a possible microcore and a microblade fragment, but upon excavation, the site returned a high density of artifacts related to microblade production. Recent excavations of four sites near Cree Burn Lake and Quarry of the Ancestors have also produced such evidence, in the form of microcores and ridge flakes, which allow for the interpretation of the possible microcore reduction sequences used to produce microblades at the sites.

Recent Discoveries

Aside from Bezya and HiOv-89, a few more recently discovered sites have produced genuine microcores and microblades. Microcores from these sites come from a variety of contexts, formed through various methods, from various materials. While detailed information through a final excavation report is only yet available for half of these sites, a summary of these recent findings may be useful in creating a context through which to study possible future Oilsands discoveries.

HhOv-86

The prehistoric site HhOv-86 was recorded and excavated in 2000, and subsequently incorporated into HhOv-16, the main site of the Cree Burn Lake complex near the Athabasca River. The permit report contains detailed descriptions of five microcores and a brief summary of 26 microblades and ridge flakes, all discovered during mitigative excavation in 2000 (Clarke and Ronaghan 2004: Appendix I). Three of the microcores were created from flakes, while a fourth was made on a utilized unifacial tool, and the fifth is a flake removed from a microcore. The reused uniface was made from chert, while the remaining artifacts are of BRS.

The three complete BRS cores on flakes show little evidence of keel or platform shaping; however, all show between two and three parallel, blade-like scars on a single fluted surface. One of the microcores exhibits conventional flake scars on the remaining surfaces (Clarke and Ronaghan 2004:Appendix I). The remnant platforms of the other two microcores on flakes were reused as the platforms for microblade removal. The chert core has three blade scars, two of which terminate in step-fractures, and a possible burination scar adjacent to the fluted face (Clarke and Ronaghan 2004:Appendix I).

Twenty-six microblades are reported at the site, including twelve ridge flakes. No illustrations are available for further identification of the artifacts. Measurements reported for the artifacts show them to be of similar length, but on average larger in width and thickness than the ridge flakes found at HiOv-89, by approximately 2 mm in each dimension (Clarke and Ronaghan 2004:Table I-1, Appendix I), making them overall much larger and thicker than the HiOv-89 microblades.

HhOv-113

Excavation of HhOv-113 in 2005 led to the discovery of both microcores and microblades in the site assemblage (Green et al., 2006:173). The site is located on a long, sandy ridge in mixed aspen and jack pine forest, approximately one kilometre east of the Athabasca River (ibid.:173). This location places it approximately between the Cree Burn Lake and Quarry of the Ancestors site localities, and far south of both HiOv-89 and Bezya (Figure 7.2). Cores from HhOv-113 are also strikingly different from those found at the two more northerly sites; all 42 examples found at the site have been produced from fine-grained BRS, and are found in two types: wedge-shaped and "cylindrical polyhedral." The actual shapes of the cores vary greatly (Plate 7.1), but they appear to have been manufactured through two relatively consistent methods. Wedge-shaped cores are bifacially shaped, usually with two remnant flute scars on the fluted face (Green et al., 2006:Appendix I). Blades have been removed unidirectionally from the cylindrical cores, most commonly with two to three parallel, rather than overlapping, blade scars on the fluted face. Green et al. (2006:178) compare these to the cores from HhOv-86, which also seem to have been used to produce a small number of microblades per core. Interestingly, from the photograph provided (ibid.:Appendix I), the wedge-shaped core types seem to be close to exhausted, possibly indicating a high number of microblades

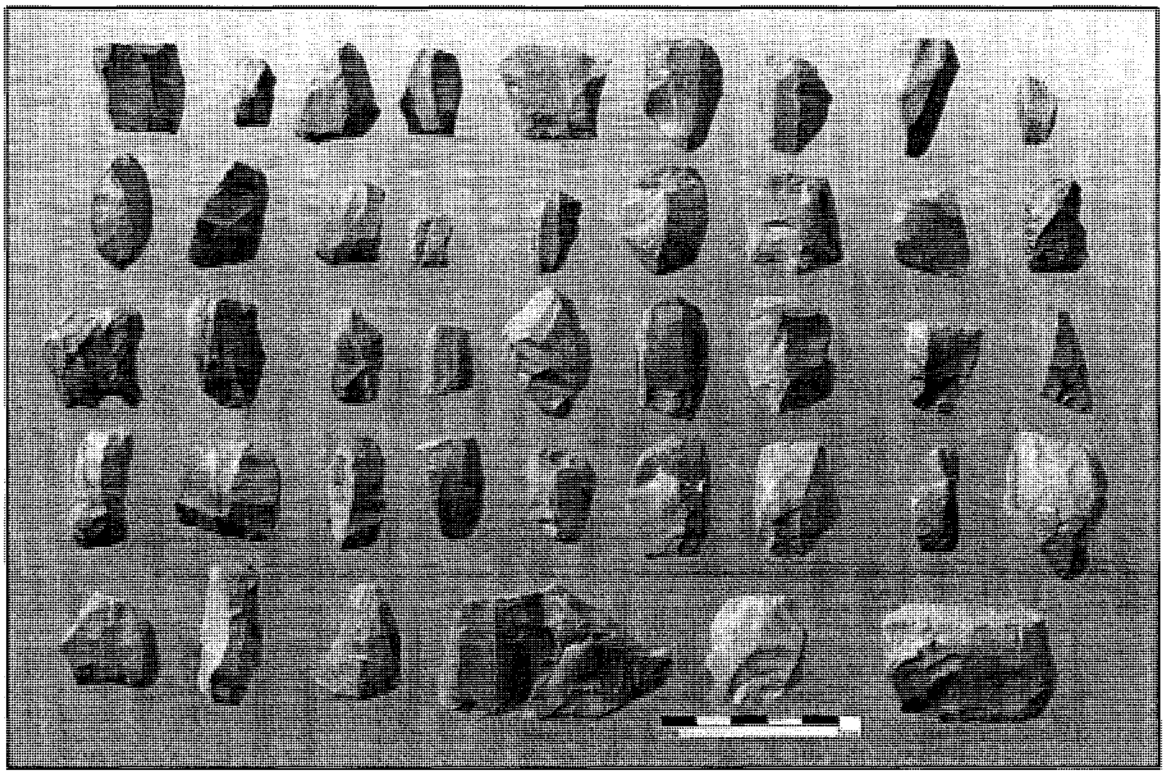


Plate 7.1 Microcores from HhOv-113 (Plate I-40 from Green et al., 2006:Appendix I; used with permission from Golder Associates Ltd. and the ASA)

produced per core. Almost all of the cores show bipolar crushing, which may have occurred if the artifacts were stabilised in a type of vise to facilitate pressure flaking (ibid.:Appendix I).

Eighteen BRS microblades and fragments were also described in the site report, including artifacts both triangular and trapezoidal in cross-section (Green et al., 2006:Appendix I). Based on the photograph included in the report, these artifacts appear to include microblades, blade-like flakes, and possibly burin spalls. The margins of a few of the microblades show limited use-wear, while most others show none (Green et al., 2006:Appendix I).

Other significant artifacts in the assemblage include 22 wedges, bifacial and unifacial tools, scrapers, edge-modified flakes, hammerstones, and an anvil. Most notable are three nearly whole side-notched projectile points, which could be typologically related to a number of different traditions, depending on the system used. Green et al. (2006:179) note a similarity in the bases to Gowen points dating to near 6000 BP, as well as to the tentatively dated, but not widely accepted "Early Beaver River Complex" proposed by Saxberg and Reeves (2003) to range between 7500 BP and 7000 BP. Given the association of microblades to the tentatively dated Bezya site at 3990±130 BP (Le Blanc and Ives 1986), Green et al. (2006:179) propose that HhOv-113 is most likely to have been occupied between 6000 and 4000 BP, although no definite date can be assigned to the assemblage.

HhOv-449

A single microcore was recovered from HhOv-449, a site located just to the east of the Quarry of the Ancestors boundaries. The specimen is thin and wedge-shaped, composed of a pink, fine-grained, chert-like material, with three blade scars on the fluted face (Michelle Wickham, pers. comm., 2008). A fourth scar extends onto one of the lateral surfaces of the core. There is a short, partially prepared platform. (Michelle Wickham, pers. comm., 2008).

HhOv-468

Finally, a single microcore preform was found at HhOv-468. The artifact shows extensive, regular bifacial shaping along two margins, with the edge of one of the shaped margins partially removed through a single, burin-like flake detachment (Michelle Wickham, pers. comm., 2008). The result is an apparent microcore platform, with the adjacent, bifacially shaped fluted face awaiting ridge flake removal. If this artifact is, as is strongly suggested, truly a microcore preform, it can be most closely compared to the Bezya microcores, based on the shaping methods and platform preparation technique (Michelle Wickham, pers. comm., 2008). It is unknown why the preform might have been abandoned at this stage in reduction.

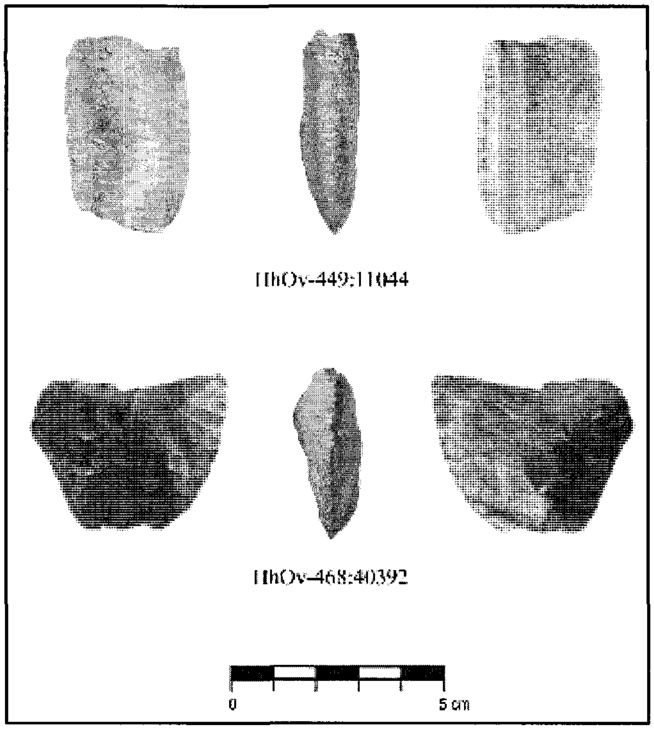


Plate 7.2 **Microcores from HhOv-449 and HhOv-468 (used with permission from Bison Historical Services Inc. and the ASA)**

Summary

At this time, it seems that while a number of cohesive patterns of microcore production appear to exist within the Oilsands region, there is also evidence of variation that cannot yet be explained without further evidence, including more secure site dating. It might also be noted that the apparent localization of microblade production in this portion of northeastern Alberta may be as strongly related to the rate of excavation focused within Oilsands leases as it is to patterns of prehistoric cultural activity. Despite these limitations, many of the patterns seen here are strongly suggestive of those seen in the Denali Complex to the northwest, and may be indicative of a continuity in lithic cultural tradition.

Patterns of Production

The majority of Oilsands microcores seem to be best categorized as wedge-shaped, produced through a relatively uniform reduction sequence with varying degrees of formality. There are two main variants to the system. The first and most formalized sequence is seen at Bezya and on the core preform from HhOv-468, in which a pebble is bifacially reduced to create a core preform. The second pattern is seen at HiOv-89, and seems to be reflected in the cores from HhOv-86, HhOv-449, and the wedge-shaped cores from HhOv-113. Here, core preforms are more casually produced from wedge-shaped flakes, with bifacial or unifacial marginal flaking to shape the keel, and occasional thinning to create a more suitable cross-section. Unifacial or bifacial flaking is also used to shape ridges for creation of the fluted face, and often also the platform. Occasionally, bifacial or unifacial tools are reused, with the shaped edges of the tool serving to provide an ideal starting point for ridge flake removal. HiOv-89 shows possibly the most formally produced cores among this version, while those from HhOv-86 and HhOv-113 are produced much more opportunistically. While the presence of two main variants may simply reflect the fact that only two sites have been formally studied and described, distinction between them is supported by parallel techniques used at HhOv-86, 113, 449 and 468.

In both variants, a number of common reduction methods are used. Ridge flakes and platform ridge flakes are common among Oilsands microblade sites, indicating an association with Denali microblade technology. After shaping of the core preform, the platform is created through a partial spall removal, or occasionally side flaking or the opportunistic selection of an existing ideal surface. Platform preparation is followed by formation of the fluted face, and finally microblade removal. Platform rejuvenation through the use of a burin-type blow seems most common. Fluted faces are generally very thin, most often exhibiting between two and three flute scars, with the occasional core exhibiting up to four or five.

Raw Material Usage

Raw material type seems to have a strong influence on production methods used during microcore reduction. In those sites where less common, more fine-grained materials such as chert and silicified mudstone are used, such as Bezya, HhOv-449, HhOv-468, and HiOv-89, more formal production methods are employed. Where BRS is used, however (HhOv-86 and HhOv-113), microcores seem to have been produced more opportunistically, with little intentional shaping.

These patterns are significant to our understanding of both why and how microblades are produced and used. The fact that microcores were produced not only from rare materials, but also from the omnipresent Beaver River Sandstone, shows that microblades may have been produced not only as a method of conserving raw materials, but perhaps also for some other advantage of the production methods, or for their inherent value as tools. There are a number of possibilities, but the relationship between raw materials and production methods should be taken into account while exploring these possibilities.

While raw material conservation cannot be considered the sole purpose of microblade technology in the Oilsands, there is clear evidence of attempts to conserve the silicified mudstone used at HiOv-89, most notably in the presence of exhausted cores exhibiting extensive use-wear, and occasional reworking as scrapers or burins. It seems that the finer-grained silicified mudstone seen at HiOv-89 was highly desirable for microcore production, allowing for the systematic core reduction patterns evidenced at the site. Because the material was finer-grained than the more common BRS, attempts were made to conserve and re-use the material. However, this practice does not preclude the use of BRS at other sites, to replace worn microblades in composite tools, when no finer-grainer materials were available.

A second line of research regarding raw material use in the Oilsands involves the less formal shaping methods used for the BRS microcores at HhOv-86 and HhOv-113. These cores show a superficial resemblance to those seen on the Northwest Coast, where abundant, relatively coarse-grained beach pebbles were used to produce conical, cylindrical, blocky and amorphous microcores, as well as roughly wedge-shaped cores. Geographic constraints, as well as the current understanding of the culture history of these two regions, make it highly unlikely, although not impossible, that this resemblance can be attributed to some type of cultural connection. At present, the most probable explanation for these similarities is as a response to abundant raw material. In both locations, it can be proposed that locally available materials were incorporated into a previously established tradition of microcore reduction, allowing for less conservative, and therefore less formal, approaches to lithic reduction.

Thus far, this second type of microcore formed from BRS is less commonly seen in the Oilsands than are microcores of chert and silicified mudstone. This observation may be due to factors of raw material selection, and higher desirability of finer-grained materials for microblade production, or it may simply be due to a previous lack of recognition of the more informal BRS cores by archaeologists.

No matter what the influence of raw material in its production, microblade technology presents a number of other characteristics that make it well suited to the mobile prehistoric lifeways of the subarctic. Most notable is the portability of microblade technology, whether in the form of small cores and preforms, or as finished microblades hafted into more lightweight bone or antler composite tools. The role played by microblades as a component of a maintainable toolkit, with interchangeable artifacts allowing for the swift and efficient repair of composite tools (Bleed 2001) also cannot be overlooked. Hafting may have been facilitated by bitumen (D'Arcy Green, pers. comm. 2008), naturally exposed throughout the region near outcrops and the edges of riverbeds. Alternatively, the surrounding boreal vegetation may have provided ample hafting adhesive in the form of pine or spruce resin, as recently discovered in a slotted antler point from the Gladstone Ice Patch in the southern Yukon (Helwig et al., 2008).

Relationships to the Far Northwest of North America

The microcore reduction patterns seen in the Oilsands region have potential correlates in the microblade traditions of far northwestern North America. Most notable is the similarity between the microcores from HhOv-449, HhOv-468, HiOv-89, and Bezya to those of the Denali Complex. These cores share a wedge shape, bifacial and unifacial shaping techniques, and the removal of ridge flakes and platform tablets. The associated presence of burin technology and the use of core-burins are also seen both in the Denali Complex and in the Oilsands. However, cores from the Oilsands do show some trends in production that differ slightly from the Denali types, including the tendency toward partial platform rejuvenation rather than the removal of a full core tablet, and the tendency towards thin fluted faces exhibiting only two or three flute scars. The presence of a large, fully-formed core tablet at HiOv-89 presents, thus far, the only exception to this rule; however, the singularity of the artifact itself presents a number of questions. How the artifact reached the site, and why no other examples of this method of production were found at the site, cannot be easily explained. This artifact, much larger than the majority of microblade artifacts found in the Oilsands, and unique in production characteristics, seems to indicate that further variation in Oilsands microblade production may be present but as yet undiscovered.

The cores from HhOv-86 and HhOv-113 do not show the same strong resemblance to the typical Denali core type; however, they seem to be in keeping with the later forms of microblade production in the Yukon and Northwest Territories, in which greater variation and more casual methods of production are seen after 7000 BP alongside the traditional Denali method (Clark and Gotthardt 1999). As discussed above, they may represent an adaptation of the Denali microcore to locally abundant but coarser-grained raw material, or they may represent transmission of this later northern form to Alberta's boreal forest.

Further study in the Oilsands may help us to determine more securely the origins and relationships of the various approaches to microcore reduction discussed here. For example, it is not yet known whether the microcores from various sites are roughly contemporaneous, or whether they vary sequentially over time. If this variation were found to show similar temporal distribution as that seen in the far north, it would give even stronger evidence for incorporating the microcores from Oilsands sites into the traditions of microblade production found in the far northwest of North America.

Chapter 8 Conclusions

Summary

The questions proposed at the outset of this thesis have now been answered:

1) What type of microcore reduction sequence characterizes the HiOv-89 assemblage?

Microcores at HiOv-89 were created systematically. Most often, a thick wedge-shaped flake was unifacially shaped to create a keel, and ridges for the platform and fluted face elements. These ridges were removed via burin-type blows, creating ridge flakes and platform ridge flakes, and shaping the platform and fluted face. Finally, microblades were removed from the cores, likely through pressure flaking. Occasionally, the platforms of the microcores were rejuvenated through partial burin spall removals, and exhausted cores were often reused as burins and scrapers, leaving use-wear along the ridges of the fluted face and the edges of the platform. Variations are seen within the site; bifacial tools could be used as microcore preforms, and platforms were sometimes formed and rejuvenated by side-blow flaking, or by the removal of core tablets.

2) What supporting information about site formation processes and related lithic reduction technology can be used to facilitate interpretation of this site?

Many of the site formation processes occurring at HiOv-89 limit some aspects of site interpretation. Low organic preservation has led to the decomposition of organic artifacts and hampers radiocarbon dating of the site, while the soft sand matrix, typically lacking palaeosol development, hinders the identification of separate occupation events and the analysis of spatial distribution. However, the associated lithic artifacts provide information about site use and occupation. The extensive number of edge-modified flakes, and the evidence of burins being sharpened and re-used on site, indicate that the site was not just a lithic workshop, but was also inhabited, possibly as a campsite, while other materials were worked. Evidence of scraping indicates that some form of animal or hide processing took place, while the range of use-wear from extremely heavy wear on thick flakes and tools to the use of thin, fragile burins indicates that a range of activities may have taken place.

3) How do recently discovered microblade sites from the Oilsands of northeastern Alberta relate to HiOv-89?

The available evidence from archaeological sites excavated thus far only allows for the drawing of preliminary conclusions regarding patterns of microblade production in the Oilsands. Microcore reduction here shows a number of consistencies, but does appear to have taken two main forms, leading to the creation of two core types.

The first form strongly resembles the pattern seen at HiOv-89: cores are wedge-shaped, and bifacially or unifacially flaked to various degrees, the fluted and platform elements are shaped through ridge flakes, and platform rejuvenation is typically conducted through the removal of a spall ending in a hinge fracture. This form exhibits two variants thus far discovered: first, the bifacial reduction of a cobble to create a core blank; and secondly, the bifacial or unifacial shaping of a thick flake to create the blank. Both variants lead to the creation of a wedge-shaped, Denali-type microcore.

A second form of microcore reduction is more expedient, and seems to rely on the opportunistic selection of flake blanks with little modification prior to microblade removal. In these cases, only a few microblades are removed from each core, and the resulting microcore is informally shaped, resembling the polyhedral cores seen on the Northwest Coast.

4) How did the raw materials locally available near Oilsands sites influence decisions made during microblade production?

Based on the available evidence, it seems that fine-grained materials such as chert and silicified mudstone were preferred for the systematic reduction of microcores. However, use of readily available, slightly coarser-grained Beaver River Sandstone is also evident. Those cores that are made from BRS, however, seem to be more expediently formed. It may be that BRS was only used for microblade production when finer-grained materials were not available, or that BRS did not require careful shaping since loss of a core due to mistakes during reduction would not have been as significant, as more BRS was often available. However, it may be that the differences in approaches to core reduction are due to cultural differences over time or with migration and seasonality. Whether these two types of microcore production are contemporaneous is yet to be determined; such information would certainly influence any interpretation of the reasons for this variability.

5) What similarities may be drawn between the Denali Complex and the methods of microblade production seen at HiOv-89 and other Oilsands microblade sites?

A number of comparisons may be drawn between the microcores from the Oilsands, most notably HiOv-89 and Bezya, and those of the Denali Complex. Cores are typologically similar, having wedge-shaped profiles and exhibiting unifacial and bifacial flaking. Core-burins and cores with use-wear on the platform and fluted face are present in both groups, as are both primary and secondary ridge flakes, and core tablets. The proposed sequences of microcore reduction are also very similar. Minor variations may be noted among the Oilsands cores. Most notable is the prevalence of hinged platform spalls among Oilsands microcores, rather than the full platform tablets more common to Denali cores, although the core tablet at HiOv-89 indicates that such rejuvenation methods were also used in the Oilsands. Secondly, cores from northeastern Alberta tend to be thin, with only two to three scars on the fluted face, and are generally less extensively prepared than typical Denali cores. This less intensive preparation is typified by the microcores created from BRS; however, it can also be seen at HiOv-89, where some flakes appear to have undergone only marginal flaking before being used as microcores.

Based on the answers to these questions, it can be proposed that Oilsands microcores do indeed represent a far southeastern extension of the Denali Complex. As discussed in Chapter 2, it seems appropriate to recommend also that the Denali Complex be promoted, either in name or simply in theory, to the class of Tradition. Whether the production methods used in this tradition were transmitted from the far northwest via migration, trade, intermarriage, or another form of cultural interaction, is much more difficult to determine. The historical evidence for proto-historic Athapaskan occupation of the area lends some credence to migration hypotheses and association of microcores to proto-Athapaskan cultures (Magne and Fedje 2007). However, the many advantages microblade technology must have presented to prehistoric inhabitants of Alberta's boreal forest provides some evidence for diffusion through trade and other forms of intercultural communication, rather than migration of a single cultural group, since such an advantageous technology might have been quickly adopted by neighbouring subarctic cultures. Knowledge of when microcore technology reached northern Alberta could potentially illuminate some possibilities, and the insecure dating of Oilsands sites at this time could be argued to be one of the most limiting factors in this discussion, and one of the most important to be addressed during future study.

Proposals for Future Study

Slightly different, but clearly related sequences of production have now been proposed for Bezya and HiOv-89. Aside from HhOv-113, artifacts from these sites show strong resemblances to other Oilsands microcores, and represent the largest collections of microblade related materials in the region. Given the rapid annual rate of site excavation in the region, it seems likely that any number of sites discovered in the next few years could be equally significant to the study of microblades in northeastern Alberta. Before these sites are addressed, or even excavated, it is becoming imperative that a framework of study be established for the region, in order to promote consistency between permit reports and academic study, and within the provincial sites database. This framework might include a description of the microblade production sequences thus far known in the area, as discussed in Chapter 7, as well as the establishment of common terminology and methods of excavation, cataloguing, analysis and reporting of microblade finds in Alberta.

Mitigative Excavation Methods

It is common for sites in the Yukon and Alaska containing specialized debitage such as microblades and burin spalls to be trowel-excavated, measuring depth by natural levels, with all artifacts measured three dimensionally in-situ, and all back-dirt fine-screened through ⅛" mesh. Standards for mitigative excavation in Alberta, however, include shovel-shaving, with only tools measured in-situ, and back dirt screened through ¼" mesh. While application of the standards described above may result in measurement of excessive detail in the Oilsands, there is a case for incorporating higher standards for excavation in Alberta when a site is known to contain microblade artifacts.

Given the deflated stratigraphy of the majority of Oilsands sites, excavation by natural levels would in most cases lead to the excavation of the entire site as a single level, thereby decreasing the information gained, and would not be recommended. The continued use of arbitrary levels is therefore warranted here. While in-situ, three-dimensional measurements may be useful for refitting studies in other areas, the high level of post-depositional artifact movement in the sandy matrix of most Oilsands sites tends to decrease the information gained through detailed in situ measurements. Because of these factors, shovel-shaving can still be argued to be a useful excavation method in order to save time during mitigative efforts. However, if shovel shaving is to be used, smaller artifacts are even more likely to be missed during excavation, and it is highly recommended that all sediments be fine-screened through ⅛" mesh in such cases. The loss of information due to standard screening methods can be seen at HiOv-89, where the number of recovered microblades, and the percentage of refitted artifacts, were both low; as well, very few small burin spalls were recovered, despite the existence of a number of tiny burins within the assemblage.

In most cases, the current standards of measurements by 50 x 50 centimetre quadrants and 10 centimetre levels could be considered sufficient measurement detail. However, in rare cases where archaeologists might encounter microblades in conjunction with hearths, stratigraphy, or other clues that would facilitate dating or separation of occupation levels, I believe that the full suite of detailed excavation methods described above would be highly desirable, regardless of budgetary or timeline concerns. Collaboration between academic and private consulting concerns would be strongly warranted in such a situation. The wholesale destruction of the Oilsands has led to a cumulative impact on sites in the region, with a great number of sites undergoing mitigative excavation over the last few years. This impact, combined with the apparent concentration of sites within the region, makes very real the possibility that each new microblade site may be the last chance for archaeologists to discover the mysteries of microblade technology in northeastern Alberta.

Mitigative Reporting Methods

Permit report and site form requirements have become increasingly stringent over the past few years, and have already addressed and solved many of the difficulties encountered during the current research. However, some inconsistencies persist in reports and on the provincial sites database. It should be noted that the following suggestions describe an idealised standard of reporting that would in its entirety be difficult both for consulting archaeologists to fulfill, and for administrators to enforce, given the current rate of archaeological excavation across the province. Many characteristics of the current system are already efficient, and have provided much useful information for the current research. Given the time and budgetary freedom, however, I believe that the incorporation of the following suggestions into the reporting of microblade sites would prove highly valuable.

Two misunderstandings that have led to inconsistency are the inaccurate reporting of blade-like flakes as microblades, and the confusion as to whether to include microcores as tools, cores, debitage, or simply other artifacts. These misunderstandings together seem to lead to an over-reporting of microblades, as well as an underreporting of true microcores. While all of the artifacts related to microblade production, including the microblades themselves, could be regarded as debitage, and often are - accurately - described as such in permit reports, this practice disguises their unique and valuable nature. I would argue that microblade materials be included within their own artifact class for the purposes of database reporting.

The opposite is the case for blade-like flakes. In rare instances, blade-like flakes found without supporting evidence of ridge flakes or microcores can still be identified with certainty as microblades. In most other cases, however, these flakes are simply randomly produced, often during bifacial reduction, and are unrelated to microblade production. If a few blade-like flakes are found during survey, it may be that further excavation could lead to the discovery of microcores and other related artifacts, and it is valuable for such artifacts to be reported, and separated from other debitage. However, if only a few such artifacts are found after the site has been excavated, it is most likely that they are simply randomly-produced, and they should be considered simply a normal aspect of the debitage assemblage. Under no circumstances should blade-like flakes by themselves be reported as microblades.

It is proposed that analysis of true microcore and microblade finds take into consideration the Oilsands microblade production sequence described above. One aspect of this analysis would be to look beyond simply the cores and blades themselves, to related artifacts such as ridge flakes and platform rejuvenation flakes or tablets, which seem to be rarely recognized or reported. Related technologies such as burinated tools might also be considered. Another aspect of study could be the analysis not just of the shape and size of the cores, as currently typically reported, but also the methods of reduction. The starting material, flaking methods, platform preparation and rejuvenation methods, and extent of post-exhaustion use-wear on the fluted faces and platforms are all relevant characteristics that can be noted without extensive refitting studies.

Finally, photographic methods could be improved to increase the amount of information accessible to other archaeologists. None of the unpublished reports reviewed for this study provided views of more than one face of each artifact, with views of the fluted faces and platforms significantly lacking. Given that platform preparation techniques are valuable to the study of reduction methods, while the fluted face provides the most genuine evidence for designating an artifact as a microcore, photographic representation of these faces of the core are equally important as the lateral faces. Most microblades are photographed from the dorsal view only, providing limited information on platform and termination characteristics. Again, representation of both faces of the artifact would increase the information available to other researchers. With the increasingly widespread use of digital photography, it has become both physically and financially possible to provide higher quality photography, and such information should be considered a requirement for the reporting of unique artifacts such as microblades.

Possibilities for Future Academic Research

As suggested above, collaborative research between consulting and academic archaeology may provide the most significant route for future study of microblade production in the Oilsands region. It must be remembered that HiOv-89 and Bezya were both discovered through mitigative survey activities, while HiOv-89 was also excavated and recorded by a crew of consultant archaeologists. The excavation notes, permit report, and catalogued assemblage from HiOv-89 provided ample evidence for a full academic analysis of the site, despite modest limitations imposed by the mitigative excavation methods used. In this case, the collaborative effort was not proposed until after excavation had occurred, but if future collaborative effort were planned prior to excavation, fewer such limitations would be encountered.

Unfortunately, the potential to conduct such research is constrained by a number of factors, including the ability to correlate industrial development and academic research timelines and budgets, and the future discovery of microblade assemblages. However, research potential can still be found among the provincial sites database, permit reports, and catalogued assemblages, all of which are archived by the provincial government. The possibility exists that a number of microblade artifacts have been previously excavated, but remain unreported. It is highly likely that many more assemblages exist than were found during the preliminary literature review conducted for this research. Microcores may exist in some previously excavated assemblages that were never recognized or noted during cataloguing. Finally, many older reports give only partial information about the microblade assemblages, most notably in terms of artifact description and photography. Two main research goals could be attempted to address these difficulties, which could be completed separately or combined into a single, large study.

First, the actual assemblages of the sites described here (Table 7.1) could be accessed through the Royal Alberta Museum, with re-analysis of both the specific microblade and microcore artifacts described in the permit reports, as well as a review of the full assemblages to search for related artifacts such as ridge flakes, platform tablets, burins and burin spalls. The results of this review could be used to test the validity of reports of microblade artifacts in the database. If a number of true microcores and microblades are discovered during this search, a peer-reviewed publication of a basic analysis of these artifacts, including more detailed photography and descriptions of possible core reduction methods, would contribute greatly to our knowledge of microblades in the region.

Secondly, a random sampling of excavated sites in the area, whether reported to contain microblade materials or not, could be investigated for evidence of microblade production. The magnitude of such a project would depend on the number of sites sampled, and the intensity of searching within assemblages. Due to the rarity of microblade artifacts within assemblages, a sub-sampling of artifacts within each site would not be recommended; however, it could be used on a portion of the sites to extend the range of study. Another factor would be the inclusiveness of the study; the entire assemblage of each site could be studied, or only the microblade component. If sites were found to contain microblade artifacts that had been previously unreported, this discovery might also provide more evidence as to the reliability of early database entries in terms of microblade study, and the potential for future study of previously excavated sites.

Bibliography

Ackerman, Robert E.

1980 Microblades and Prehistory: Technological and Cultural Considerations for the North Pacific Coast. In *Early Native Americans Prehistoric Demography, Economy, and Technology*, edited by David L. Browman, pp. 189-197. World Anthropology, general editor Sol Tax. Mouton Publishers, The Hague, New York.

1996 Early Maritime Culture Complexes of the Northern Northwest Coast. In *Early Human Occupation of British Columbia*, edited by R. Carlson and L. Dalla Bona, pp. 123-132. University of British Columbia Press, Vancouver.

Ackerman, Robert E., Kenneth C. Reid, James D. Gallison, and Mark. E. Roe

1985 *Archaeology of Heceta Island: A Survey of 16 Timber Harvest Units in the Tongass National Forest, Southeastern Alaska.* Center for Northwest Anthropology, Washington State University, Pullman.

Ames, Kenneth M. and Herbert D. G. Maschner

1999 *Peoples of the Northwest Coast: Their Archaeology and Prehistory.* Thames and Hudson Ltd, London.

Anderson, D.

1968 A Stone Age Campsite at the Gateway to America. *Scientific American* 218(6):24-33.

1970 Microblade Traditions in Northwest Alaska. *Arctic Anthropology* 7(2): 2-16.

1988 *Onion Portage: The Archaeology of a Stratified Site from the Kobuk River, Northwest Alaska.* Anthropological Papers of the University of Alaska, Vol. 22, No. 1-2, Linda Ellanna, general editor. University of Alaska Press, Fairbanks.

Arundale, Wendy Hanford

1980 Functional Analysis of Three Unusual Assemblages from the Cape Dorset Area, Baffin Island. *Arctic* 33: 464-486.

Athabasca Chipewyan First Nation

2003 *Footprints on the Land; Tracing the Path of the Athabasca Chipewyan First Nation.* Athabasca Chipewyan First Nation, Fort Chipewyan, Alberta.

Axys Environmental Consulting Ltd.

2005 Historical Resources, Traditional Land Use and Resource Use Environmental Setting Report, Albian Sands Energy Inc. Muskeg River Mine Expansion Project. Consultant's report, on file at the Canadian Environmental Assessment Agency, Ottawa, Canada.

Banning, Edward B.
2002 *The Archaeologist's Laboratory: The Analysis of Archaeological Data.* Kluwer Academic, New York

Beckingham, J. D.
1996 *Field Guide to Ecosites of Northern Alberta.* Canadian Forestry Service, Edmonton, Alberta.

Bever, Michael R.
2006 Too Little, Too Late? The Radiocarbon Chronology of Alaska and the Peopling of the New World. *American Antiquity* 71(4):595-620.

Bleed, Peter
2001 Cheap, Regular, and Reliable: Implications of Design Variation in Late Pleistocene Japanese Microblade Technology. In *Thinking Small: Global Perspectives on Microlithization,* edited by Robert G. Elston and Steven L. Kuhn, pp. 95-102. Archeological Papers of the American Anthropological Association No. 12, Arlington, Virginia.

Borden, Charles E.
1968 New Evidence of Early Cultural Relations Between Eurasia and Western North America. *Proceedings, International Congress of Anthropological and Ethnological Sciences, Tokyo and Kyoto* 8(3):331-337.

Bouchet-Bert, Luc
2002 When Humans Entered the Northern Forests: An Archaeological and Palaeoenvironmental Perspective. Master's thesis, Department of Archaeology, University of Calgary, Calgary.

Burkitt, Miles C.
1920 Classification of Burins or Gravers. *Proceedings of the Prehistoric Society of East Anglia* 3(2):306-310.

Chun, Chen
1992 A Comparison of Microblade Cores from East Asia and Northwestern North America: Tracing Prehistoric Cultural Relationships. Unpublished PhD dissertation, Department of Anthropology, McGill University, Montréal.

Clark, Donald W.
2001 Microblade-Culture Systematics in the Far Interior Northwest. *Arctic Anthropology* 38(2):64-80.

Clark, Donald W. and Ruth M. Gotthardt
1999 *Microblade Complexes and Traditions in the Interior Northwest as Seen from the Kelly Creek Site, West-Central Yukon.* Occasional Papers in Archaeology No. 6. Yukon Heritage Branch, Whitehorse.

Clarke, Grant M. and Brian M. Ronaghan
2004 Final Report, Historical Resources Impact Assessment and Mitigation Program, Muskeg River Mine Project. Golder Associates Ltd., ASA Permit 2000-087. Consultant's report on file, Alberta Culture and Community Spirit, Historic Resources Management Branch, Old St. Stephen's College, Edmonton.

Cook, John P.
1968 Some Microblade Cores from the Western Boreal Forest. *Arctic Anthropology* 1(1):121-127.

1996 Healy Lake. In *American Beginnings: The Prehistory and Paleoecology of Beringia*, edited by Frederick H. West, pp. 323-327. University of Chicago Press, Chicago.

Cziesla, Erwin
1990 On Refitting of Stone Artifacts. In *The Big Puzzle: International Symposium on Refitting Stone Artefacts*, edited by E. Cziesla, S. Eikhoff, N. Arts, and D. Winter, pp. 9-36. Studies in Modern Archaeology Vol. 1, Holos, Bonn, Germany.

Cziesla, E., S. Eikhoff, N. Arts, and D. Winter (Editors)
1990 *The Big Puzzle: International Symposium on Refitting Stone Artefacts*. Studies in Modern Archaeology Vol. 1. Holos, Bonn, Germany.

Dembiki, Eugene A. and Hans G. Machel
2006 Recognition and delineation of paleokarst zones by the use of wireline logs in the bitumen-saturated Upper Devonian Grosmont Formation of northeastern Alberta, Canada. *AAPG Bulletin* 80(5):695-712.

Dixon, E. James
1985 Cultural Chronology of Central Interior Alaska. *Arctic Anthropology* 22(1):47-66.

2001 Human Colonization of the Americas: Timing, Technology, and Process. *Quaternary Science Reviews* 20:277-299.

Dumond, Don E.
1969 Toward a Prehistory of the Na-Dene, with a General Comment on Population Movements Among Nomadic Hunters. *American Anthropologist* 71: 857-863.

Environment Canada
2006a Canadian Climate Normals 1961-1990, FORT MCMURRAY A. In *National Climate Data and Information Archive*. Electronic Document, http://www.climate.weatheroffice.ec.gc.ca/climate_normals/results_1961_1990_e.html, accessed November 28, 2007.

2006b Canadian Climate Normals 1961-1990, BITUMONT LO. In *National Climate Data and Information Archive*. Electronic Document, http://www.climate.weatheroffice.ec.gc.ca/climate_normals/results_1961_1990_e.html, accessed November 28, 2007.

Erlandson, Jon M. and Madonna L. Moss

1996 The Pleistocene-Holocene Transition Along the Pacific Coast of North America. In *Humans at the End of the Ice Age: The Archaeology of the Pleistocene-Holocene Transition*, edited by Lawrence G. Strauss, Berit V. Eriksen, Jon M. Erlandson, and David R. Yesner, pp. 277-301. Plenum Press, New York.

Fedje, Daryl W. and Tina Christensen

1999 Modelling Palaeoshorelines and Locating Early Holocene Coastal Sites in Haida Gwaii. *American Antiquity* 64(4): 635-652.

Fenton, Mark M. and John W. Ives

1990 Geoarchaeological Studies of the Beaver River Sandstone, Northeastern Alberta. In *Archaeological Geology of North America*, edited by N. P. Lasca and J. Donahue, pp. 123-135. Geological Society of America Special Centennial Volume No. 4, Boulder, Colorado.

Fladmark. Knut R.

1979 The Early Prehistory of the Queen Charlotte Islands. *Archaeology* 32: 38-45.

1985 *Glass and Ice: The Archaeology of Mt. Edziza*. Simon Fraser University Publication No. 14. Department of Archaeology, Simon Fraser University, Burnaby.

Giddings, J. L.

1956 The Burin Spall Artifact. *Arctic* 9:229-237.

Green, D'Arcy, David Blower, Dana Dalmer, and Luc Bouchet-Bert

2006 Final Report, Historical Resources Impact Assessment and Mitigation for Albian Sands Energy's Muskeg River Mine and Shell Canada's Jackpine Mine. Golder Associates Ltd., ASA Permit 2005-355. Consultant's report on file, Alberta Culture and Community Spirit, Historic Resources Management Branch, Old St. Stephen's College, Edmonton.

Goebel, Ted, Michael R. Waters, and Dennis H. O'Rourke

2008 The Late Pleistocene Dispersal of Modern Humans in the Americas. *Science* 319:1497-1502.

Gruhn, Ruth

1981 *Archaeological Research at Calling Lake, Northern Alberta*. National Museum of Man Mercury Series No. 99. Archaeological Survey of Canada, Ottawa.

Hadleigh-West, Frederick
1967 The Donnelly Ridge Site and the Definition of an Early Core and Blade Complex in Central Alaska. *American Antiquity* 32(3):360-382.

Halsey, Linda A., Dale H. Vitt, and Ilka E. Bauer
1998 Peatland Initiation During the Holocene in Continental Western Canada. *Climatic Change* 40:315-342.

Helm, June (editor)
1981 *Subarctic*. Handbook of North American Indians Vol. 6. William C. Sturtevant, general editor. Smithsonian Institution, Washington D. C.

Helwig, Kate, Valery Monahan, and Jennifer Poulin
2008 The Identification of Hafting Adhesive on a Slotted Antler Point from a Southwest Yukon Ice Patch. *American Antiquity* 73(2):279-288.

Hoffecker, J. F., W. R. Powers, and N. H. Bigelow
1996 Dry Creek. In *American Beginnings: The Prehistory and Paleoecology of Beringia*, edited by Frederick H. West, pp. 343-352. University of Chicago Press, Chicago.

Holmes, Charles E.
2001 Tanana River Valley Archaeology Circa 14,000 to 9000 B.P. *Arctic Anthropology* 38(2):154-170.

Holmes, C. E., R. VanderHoek, and T. E. Dilley
1996 Swan Point. In *American Beginnings: The Prehistory and Paleoecology of Beringia.* edited by Frederick H. West, pp. 319-323. University of Chicago Press, Chicago.

Hutton, M. J., G. M. MacDonald, and R. J. Mott
1994 Postglacial Vegetation History of the Mariana Lake Region, Alberta. *Canadian Journal of Earth Sciences* 31: 418-425.

Ives, John W.
1985 *A Spatial Analysis of Artifact Distribution on a Boreal Forest Archaeological Site.* Archaeological Survey of Alberta Manuscript Series No. 5. Archaeological Survey of Alberta, Edmonton, Alberta.

1990 *A Theory of Northern Athapaskan Prehistory.* University of Calgary Press, Calgary, Alberta.

1991 The Prehistory of the Boreal Forest of Northern Alberta. In *Alberta Archaeology: Prospect and Retrospect*, edited by T. A. Moore, pp. 39-58. The Archaeological Society of Alberta, Lethbridge, Alberta.

1993 The Ten Thousand Years Before the Fur Trade in Northeastern Alberta. In *The Uncovered Past: Roots of Northern Alberta Societies*, edited by Patricia A McCormack and R. Geoffrey Ironside, pp. 5-31. Circumpolar Research Series, Number 3. Canadian Circumpolar Institute, Edmonton, Alberta.

Janes, Robert R.
1983 *Archaeological Ethnography Among Mackenzie Basin Dene, Canada.* AINA Technical Paper No. 28. The Arctic Institute of North America, University of Calgary, Calgary, Alberta.

Jordan, Richard H.
1980 Preliminary Results from Archaeological Investigations on Avayalik Island, Extreme Northern Labrador. *Arctic* 33(3):607-627.

Kobayashi, Tatsuo
1970 Microblade Industries in the Japanese Archipelago. *Arctic Anthropology* 7(2):38-58.

Le Blanc, Raymond and John W. Ives
1986 The Bezya Site: A Wedge-Shaped Core Assemblage from Northeastern Alberta. *Canadian Journal of Archaeology* 10:59-98.

Lepofsky, Dana, Michael Blake, Douglas Brown, Sandra Morrison, Nicole Oakes, and Natasha Lyons
2000 The Archaeology of the Scowlitz Site, SW British Columbia. *Journal of Field Archaeology* 27(4):391-416.

Lewis, Henry T.
1980 Indian Fires of Spring. *Natural History* 89:76-80.

Lichti-Federovich, S.
1970 The Pollen Stratigraphy of a Dated Section of Late Pleistocene Lake Sediment from Central Alberta. *Canadian Journal of Earth Sciences* 7(3):938-945.

Mackenzie, Alexander
1971 *Voyages from Montreal on the River St. Lawrence through the Continent of North America to the Frozen and Pacific Oceans in the Years 1789 and 1793.* M. G. Hurtig, Edmonton.

MacNeish, Richard S.
1954 The Pointed Mountain Site near Fort Liard, Northwest Territories, Canada. *American Antiquity* 19(3):234-253.

Magne, Martin P.
1996 Comparative Analysis of Microblade Cores from Haida Gwaii. In *Early Human Occupation of British Columbia*, edited by R. Carlson and L. Dalla Bona, pp. 151-158. University of British Columbia Press, Vancouver.

Magne, Martin P. and Daryl W. Fedje
2007 The Spread of Microblade Technology in Northwestern North America. In *Origin and Spread of Microblade Technology in Northern Asia and North America*, edited by Yaroslav V. Kuzmin, Susan G. Keates, and Chen Shen, pp. 171-188. Publication No. 34, Archaeology Press, Simon Fraser University, Burnaby.

Maxwell, Moreau S.
1985 *Prehistory of the Eastern Arctic.* New World Archaeological Record, James Bennett Griffin, general editor. Academic Press, Inc., Orlando.

McCullough, Edward J. and Michael C. Wilson
1982 A Prehistoric Settlement-Subsistence Model for Northeastern Alberta, Canstar Oil Sands Ltd. Bituminous Sands Leases 33, 92, and 95: A Preliminary Statement. Unpublished environmental monograph prepared for Canstar Oil Sands Ltd., on file at FMA Heritage Resources Consultants Inc., Calgary.

McPherson, Robert A. and C. P. Kathol
1977 Surficial Geology of Potential Mining Areas in the Athabasca Oil Sands Region. Quaternary Geosciences Ltd., Alberta Research Council Open File Report 1977-4, Edmonton, Alberta.

Millar, James F. V.
1981 Interaction Between the MacKenzie and Yukon Basins During the Early Holocene. In *Networks of the Past: Regional Interaction in Archaeology*, edited by F. J. Francis and P. G. Duke, pp. 259-294. Archaeological Association of the University of Calgary, Calgary.

Mobley, Charles M.
1991 *The Campus Site: A Prehistoric Camp at Fairbanks, Alaska.* University of Alaska Press, Fairbanks.

Morlan, Richard E.
1970 Wedge-Shaped Core Technology in Northern North America. *Arctic Anthropology* 7(2):17-37.

1976 Technological Characteristics of Some Wedge-Shaped Cores in Northwestern North America and Northeast Asia. *Asian Perspectives*. 19: 96-106.

Mucklow, Laura
2002 Traditional Land Use Environmental Setting Report for Jackpine Mine Phase 1, Shell Canada Limited. Consultant's report, Golder Associates Ltd., Calgary.

Natural Regions Committee
2006 Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece. Government of Alberta Publication No. T/852. Report available from the Alberta Natural Heritage Information Centre, Edmonton.

Noble, W. C.
1971 Archaeological surveys and sequences in central District of Mackenzie, Northwest Territories. *Arctic Anthropology* 8(1):102-135.

Powers, William R., R. D. Guthrie, and John F. Hoffecker
1983 *Dry Creek: Archeology and Paleoecology of a Late Pleistocene Alaskan Hunting Camp.* University of Alaska, Fairbanks.

Pyszczyk, Heinz W.
1991 A Wedge-Shaped Microblade Core, Fort Vermilion, Alberta. In *Archaeology in Alberta, 1988 and 1989*, compiled by Martin Magne, pp. 199-204. Archaeological Survey of Alberta Occasional Paper No. 33. Archaeological Survey of Alberta, Edmonton.

Rainey, Froelich
1939 Archaeology in Central Alaska. *Anthropological Papers of the American Museum of Natural History* 36:351-405.

Rhine, Janet L. and Derald G. Smith
1988 The Late Pleistocene Athabasca Braid Delta of Northeastern Alberta, Canada: A Paraglacial Drainage System Affected by Aeolian Sand Supply. In *Fan Deltas; Sedimentology and Tectonic Settings*, edited by W. Nemee and R. J. Steel, pp. 158-169. Blackie & Son, Glasgow, UK.

Ridington, Robin
1978 Beaver. In *Subarctic*, edited by June Helm, pp. 350-360. Handbook of North American Indians, Vol. 6, William C. Sturtevant, general editor. Smithsonian Institution, Washington D. C

Sanger, David
1968a Prepared Core and Blade Traditions in the Pacific Northwest. *Arctic Anthropology* 5(1): 92-120.

1968b The High River Microblade Industry, Alberta. *Plains Anthropologist* 13:190-208.

1970 Mid-Latitude Core and Blade Traditions. *Arctic Anthropology* 7(2):106-114.

Saxberg, Nancy and Brian O. K. Reeves
2003 The First 2000 Years of Oilsands History: Ancient Hunters at the Northwest Outlet of Glacial Lake Agassiz. In *Archaeology in Alberta: A View from the New Millennium*, edited by Jack W. Brink and John R. Dormar, pp. 290-322. The Archaeological Society of Alberta, Medicine Hat.

2004 Birch Mountain Resources Ltd. Muskeg Valley Quarry, Historical Resources Impact Assessment, 2003 Field Studies, Final Report. Lifeways of Canada Limited, ASA Permit 2003-249. Consultant's report on file, Alberta Culture and Community Spirit, Historic Resources Management Branch, Old St. Stephen's College, Edmonton.

2006 Birch Mountain Resources Ltd. Hammerstone Project Historical Resources Impact Assessment, 2004 Field Studies. Lifeways of Canada Limited, ASA Permit 2004-235. Consultant's report on file, Alberta Culture and Community Spirit, Historic Resources Management Branch, Old St. Stephen's College, Edmonton.

Saxberg, Nancy, Mack W. Shortt, and Brian O. K. Reeves
1998 Historical Resources Impact Assessment: Aurora Mine North Utility and Access Road Corridors, Final Report. Lifeways of Canada Limited, ASA Permit 1997-043. Consultant's report on file, Alberta Culture and Community Spirit, Historic Resources Management Branch, Old St. Stephen's College, Edmonton.

Saxberg, Nancy, Brad Somer, and Brian O. K. Reeves
2004 Syncrude Aurora Mine North Historical Resources Impact Assessment and Mitigation Studies: 2003 Field Studies. Lifeways of Canada Limited, ASA Permit 2003-279. Consultant's report on file, Alberta Culture and Community Spirit, Historic Resources Management Branch, Old St. Stephen's College, Edmonton.

Seong, Chuntaek
2004 Quartzite and Vein Quartz as Lithic Raw Materials Reconsidered: A View from the Korean Paleolithic. *Asian Perspectives* 43(1):73-91.

Sharp, Henry S.
1977 The Chipeweyan Hunting Unit. *American Ethnologist* 4(2):377-393.

Sims, Cort
1976 Report of an Archaeological Survey of the Athabasca River – 1976. ASA Permit 1976-005. Consultant's report on file, Alberta Culture and Community Spirit, Historic Resources Management Branch, Old St. Stephen's College, Edmonton.

Smith, Jason W.
1974a The Northeast Asian – Northwest American Microblade Tradition and the Ice Mountain Microblade and Core Industry. Unpublished PhD Dissertation, Department of Archaeology, University of Calgary.

1974b The Northeast Asian - Northwest North American Microblade Tradition (NANAMT). *Journal of Field Archaeology* 1(3/4):347-364.

Smith, Derald G. and Timothy G. Fisher
1993 Glacial Lake Agassiz: The Northwestern Outlet and Palaeoflood. *Geology* 21:9-12.

Stevenson, Marc G.
1981 *Peace Point - A Stratified Prehistoric Campsite Complex in Wood Buffalo National Park, Alberta.* Parks Canada Research Bulletin No. 158. Department of Indian and Northern Affairs & Parks Canada, Ottawa.

1986 *Window on the Past Archaeological Assessment of the Peace Point Site, Wood Buffalo National Park, Alberta.* Studies in Archaeology, Architecture and History. Parks Canada, Ottawa.

Tomàškovà, Silvia
2005 What is a Burin? Typology, Technology, and Interregional Comparison. *Journal of Archaeological Method and Theory* 12(2):79-115.

Unfreed, W. J, G. J. Fedirchuk, and E. G. Gryba
2001 Historical Resources Impact Assessment, True North Energy L.P. Fort Hills Oil Sands Project Final Report. FMA Heritage Resources Consultants Inc, ASA Permit 2000-130. Consultant's report on file, Alberta Culture and Community Spirit, Historic Resources Management Branch, Edmonton.

Vance, R. E.
1986 Pollen Stratigraphy of Eaglenest Lake, Northeastern Alberta. *Canadian Journal of Earth Sciences* 23(1): 11-20.

VanStone, James W.
1974 *Athapaskan Adaptations: Hunters and Fishers of the Subarctic Forests.* Aldine Publishing Company, Chicago.

Visser, John P., Martin Magne, and Michael C. Wilson
2008 Early Period Microblade Cores from High River, Alberta. Paper presented to the Archaeological Society of Alberta, Calgary, February 2008.

Wenban-Smith, Francis
1997 Refitting of Lithic Artifacts. In *Klithi: Palaeolithic Settlement and Quaternary Landscapes in Northwest Greece, Vol. I: Excavation and Intra-Site Analysis at Klithi,*edited by G. N. Bailey, pp. 95-104. McDonald Institute for Archaeological Research, Cambridge.

West, Frederick H. (editor)
1996 *American Beginnings The Prehistory and Palaeoecology of Beringia.* The University of Chicago Press, Chicago.

Workman, William B.
1978 *Prehistory of the Aishihik-Kluane Area, Southwest Yukon Territory*. National Museum of Man Mercury Series No. 47. Archaeological Survey of Canada, Ottawa.

Woywitka, Robin J.
2007 Historical Resources Impact Mitigation, Fort Hills Energy Corporation. Fort Hills Oil Sands Project; Lease 437/438 Final Report. FMA Heritage Resources Consultants Inc, ASA Permit 2005-328. Consultant's report on file, Alberta Tourism, Parks Recreation and Culture, Historic Resources Management Branch, Edmonton.

Woywitka, Robin J. and Angela M. Younie
2008 Historical Resources Impact Mitigation, Fort Hills Energy Corporation. Fort Hills Oil Sands Project; Stage I & Stage II Historical Resources Impact Mitigation HiOv 44, HiOv 47, HiOv 49, HiOv 50, HiOv 52, HiOv 87, HiOv 89, HiOv 104, HiOv 115 and HiOv 124. FMA Heritage Resources Consultants Inc, ASA Permit 2005-328. Consultant's report on file, Alberta Culture and Community Spirit, Historic Resources Management Branch, Edmonton.

Wright, J. V.
1995 *A History of the Native People of Canada Volume I (10,000 – 1,000 B.C.)*. Archaeological Survey of Canada Mercury Series Paper 152. Canadian Museum of Civilization, Hull, Quebec.

Wyatt, David
1970 Microblade Attribute Patterning: A Statistical Examination. *Arctic Anthropology* 7(2):97-105.

Yesner, David R. and Georges Pearson
2002 Microblades and Migrations: Ethnic and Economic Models in the Peopling of the Americas. In *Thinking Small: Global Perspectives on Microlithization*, edited by Robert G. Elston and Steven L. Kuhn, pp. 133-161. Archeological Papers of the American Anthropological Association No. 12, Arlington, Virginia.

Appendix A: Summary Tables of Burin and Microblade Artifact Measurements and Descriptions

Table A.1 Measurements and characteristics of scraper tools

Catalogue Number	Tool Type	Weight	Maximum Length	Maximum Width	Maximum Thickness	Material	Retouch	Level
631	Side & End Scraper	5.6	37.39	18.99	7.51	SM1	Extremely steep unifacial	3
681	Side & End Scraper	1.4	18.85	14.36	3.58	SM2	Unifacial	2
806	Side & End Scraper	11.6	35.00	34.84	8.35	BRS1	Unifacial	3
177	Side Scraper	8.6	28.24	37.76	6.49	SS1	Rough unifacial	3
809	Side Scraper	10.6	29.29	25.96	11.52	SM1	Unifacial	4
414	End Scraper	4.6	29.90	14.69	9.37	SM1	Steep unifacial	2
929	Thumbnail Scraper	2.5	20.59	19.68	5.85	NQZ	Unifacial	2
Average Measurement		*6.4*	*28.5*	*23.8*	*7.5*			
Minimum Measurement		*1.4*	*18.9*	*14.4*	*3.6*			
Maximum Measurement		*11.6*	*37.4*	*37.8*	*11.5*			

Table A.2 Measurements and characteristics of retouched flake tools

Catalogue Number	Tool Type	Weight	Maximum Length	Maximum Width	Maximum Thickness	Material	Retouch	Level
002	Retouched Flake	20.8	47.11	48.22	9.36	BRS2	Unifacial and bifacial	N/A
131	Retouched Flake	10.7	42.20	22.99	9.68	QZ	Unifacial	2
201	Retouched Flake	1.1	12.98	18.44	4.21	CH	Unifacial	2
682	Retouched Flake	0.7	17.71	11.60	3.36	CH2	Unifacial, one edge is denticulate	2
684	Retouched Flake	1.0	21.59	13.27	3.62	CH3	Unifacial and bifacial	2
688	Retouched Flake	0.5	16.39	13.30	2.51	CH3	Bifacial	3
758	Retouched Flake	1.1	19.91	14.25	3.58	SM2	Unifacial and bifacial	2
864	Retouched Flake	3.8	38.33	15.80	7.40	QZ	Unifacial	2
Average Measurement		*5.0*	*27.0*	*19.7*	*5.5*			
Minimum Measurement		*0.5*	*13.0*	*11.6*	*2.5*			
Maximum Measurement		*20.8*	*47.1*	*48.2*	*9.7*			

Table A.3 Measurements of burin artifacts

Catalogue Number	Weight	Maximum Length	Maximum Width	Maximum Thickness	Level
199	1.1	16.45	18.51	3.05	2
226	1.7	21.79	14.15	8.72	3
263	1.6	19.32	19.00	4.54	3
279	2.1	25.70	19.98	4.09	3
415	1.2	17.78	10.80	4.53	2
882	0.3	12.53	10.48	2.81	3
941	0.7	14.44	13.44	3.42	4
692	N/A	N/A	N/A	N/A	3
Average Value	*1.2*	*18.29*	*15.19*	*4.45*	
Minimum Value	*0.3*	*12.53*	*10.48*	*2.81*	
Maximum Value	*2.1*	*25.70*	*19.98*	*8.72*	

Table A.4 Characteristics of burin artifacts

Catalogue	Material	Burination
199	SM1	Burin on a break, ending in a step fracture. Previous stepped scar below
226	SM1	Two adjacent facets, from opposite ends
279	SM1	Two burin facets facing the dorsal surface. Notching
263	CH3	Dihedral microburination on a break
415	SM1	Two adjacent facets
882	SM2	Two adjacent burinations on one edge, dihedral to a third burination
941	SM2	Two adjacent facets, from opposite ends. Both are on breaks.
692	SM2	Possible burination. Heavy spalling has obscured the majority of the artifact

Table A.5 Measurements of multi-tool artifacts

Catalogue Number	Weight	Maximum Length	Maximum Width	Maximum Thickness	Level
317&470	6.4	43.71	25.69	5.65	3
439	16.6	47.26	35.6	10.46	2
683	0.6	17.61	10.9	2.78	2
808	3.8	25.78	23.25	6.18	3
828	5.3	33.56	21.78	7.45	4
835	1.9	24.65	13.24	5.14	2
893	3.9	21.04	20.43	7.4	2
Average Value	*5.5*	*30.52*	*21.56*	*6.44*	
Minimum Value	*0.6*	*17.61*	*10.90*	*2.78*	
Maximum Value	*16.6*	*47.26*	*35.6*	*10.46*	

Table A.6 Characteristics of multi-tool artifacts

Catalogue Number	Material	Burination	Retouch	Description
317&470	SM1	Two burin facets. One ends in a hinge	Steep unifacial retouch	Refitted fragments of a dihedral burin. Some utilization after break, but little apparent shaping.
439	BRS1	Single burination and notch	Some bifacial retouch	notched burin, retouched and utilized flake
683	Chert	Microburination on break	Unifacial retouch on lateral margins	
808	SM1	Two burin facets	Steep bifacial retouch between burin facets, and on distal edge. Unifacial retouch on ventral surface of proximal edge.	Longitudinal burin and retouched flake. Refits to HiOv-89:835; Refitted Measurements: Length: 33.98; Width: 23.60; Thickness: 6.18; Weight: 5.7g
828	SM1	Dihedral burin	Unifacial retouch	Burin and retouched flake/scraper
835	SM1	Yes	Steep unifacial retouch	Transverse burin and retouched flake/scraper
893	SM1	Dihedral burin, with both sides having two adjacent burin facets, and notching in the centre	The third edge of the tool has steep, scraper-like retouch	Burin and utilized flake. Triangular in shape

Table A.7 Measurements of burin spalls

Catalogue Number	Portion	Weight	Length	Midpoint Width	Midpoint Thickness	Maximum Width	Maximum Thickness	Level
386	Whole	0.2	16.83	6.20	2.38	6.57	2.95	2
478	Whole	<0.1	9.40	3.45	1.51	3.71	1.94	3
520	Whole	<0.1	13.78	3.65	2.28	4.59	2.52	2
534	Whole	0.8	20.61	5.74	5.55	5.82	5.55	2
535	Whole	1.1	29.16	6.32	4.41	6.94	6.16	2
655	Whole	0.6	25.08	6.25	3.68	6.25	4.47	3
657	Whole	0.2	16.87	5.25	2.19	5.27	2.66	2
670	Whole	0.1	22.96	5.32	2.94	5.71	3.54	2
675	Whole	0.2	13.95	4.15	2.66	6.25	3.73	3
711	Whole	0.1	15.99	4.62	1.65	6.48	2.00	3
739	Whole	0.2	13.11	4.21	2.53	5.48	2.65	2
820	Whole	0.6	28.82	5.15	3.74	6.62	3.74	3
847	Whole	0.8	29.03	4.47	3.89	5.76	5.06	3
884	Whole	0.2	17.87	5.72	2.71	5.81	2.71	4
886	Whole	0.4	18.97	6.28	3.08	7.06	3.10	1
891	Whole	0.3	19.05	4.90	3.07	6.20	3.07	2
894	Whole	0.5	25.62	6.18	3.18	6.82	3.23	3
935	Whole	0.2	21.12	5.75	2.44	6.79	2.47	3
313	Proximal	0.1	N/A	2.50	2.12	3.89	2.48	4
656	Proximal	0.3	N/A	5.02	2.36	5.39	2.47	3
819	Proximal	0.1	N/A	3.56	1.94	4.40	2.13	3
868	Proximal	0.3	N/A	4.81	3.23	4.81	3.25	3
493	Medial	0.2	N/A	N/A	N/A	N/A	N/A	1
811	Medial	0.3	N/A	5.89	2.09	6.19	2.54	3
428	Distal	0.2	N/A	5.36	2.80	5.65	3.24	2
477	Distal	0.5	N/A	N/A	N/A	6.19	5.15	3
648	Distal	0.5	N/A	5.01	4.97	5.31	5.00	2
650	Distal	0.2	N/A	4.39	2.25	4.49	2.27	2
Average Measurement		*0.33*	*19.90*	*5.01*	*2.91*	*5.72*	*3.34*	
Minimum Measurement		*<0.1*	*9.40*	*2.50*	*1.51*	*3.71*	*1.94*	
Maximum Measurement		*1.10*	*29.16*	*6.32*	*5.55*	*7.06*	*6.16*	

Table A.8 Basic descriptions of burin spalls

Cat. No.	Portion	Platform Scars	Platform Grinding	Curvature	Arrises	Cross-Section
386	Whole	Obscured	N/A	Moderate	1	Both
478	Whole	1	None	None	1	Triangular
520	Whole	1	None	Moderate	1	Triangular
534	Whole	1	Yes	Very light	3	Trapezoidal, blocky
535	Whole	1	N/A	Moderate	2	Trapezoidal, blocky
655	Whole	2	None	Moderate	N/A	Triangular, blocky
657	Whole	3	Present	Moderate	2	Trapezoidal
670	Whole	2	None	Strong	3	Trapezoidal
675	Whole	2	Light	Strong	1	Triangular
711	Whole	3	None	Moderate	3	Trapezoidal
739	Whole	1	N/A	Moderate	1	Triangular
820	Whole	1	Present	Strong	N/A	Trapezoidal, square
847	Whole	1	Present	Strong	N/A	Trapezoidal
884	Whole	1	None	Moderate	1	Triangular
886	Whole	Battered	Heavy	None	N/A	Trapezoidal
891	Whole	1	Present	Moderate	2	Both
894	Whole	1	None	Strong	1.5	Triangular
935	Whole	1	None	Moderate	1	Triangular
313	Proximal	1	Light	None	1	Triangular
656	Proximal	3	Present	None	2	Triangular
819	Proximal	1	Light	None	2	Both
868	Proximal	1	Present	Very light	1	Triangular
493	Medial	N/A	N/A	Strong	N/A	Trapezoidal
811	Medial	N/A	N/A	Moderate	1	Trapezoidal
428	Distal	N/A	N/A	Light	2	Trapezoidal
477	Distal	N/A	N/A	Light	N/A	Trapezoidal, square
648	Distal	N/A	N/A	Strong	1	Triangular
650	Distal	N/A	N/A	Light	2	Trapezoidal

Table A.9 Detailed descriptions of burin spalls

Cat. No.	Termination	Retouch	Use-wear	Material	Comments
386	Feathered	Edge	Moderate on ridges	SM1	
478	Hinged	None	None	SM1	
520	Slightly overshot	None	None	SM1	
534	Hinged	None	Heavy on edges	SM1	
535	Slightly overshot	None	Moderate on platform, ridges, light on edges	SM1	Possibly an unshaped platform tablet
655	Slightly overshot	None	Heavy on ridge	CH2	Possible core rejuvenation flake
657	Retouched	Platform	Moderate on ridges	SM2	
670	Slightly overshot	Possible	None	SM1	Possible rejuvenation of fluted face
675	Overshot	Edge	Heavy on ridge	SM2	
711	Overshot	None	Moderate on ridge, light on edges	SM2	Possible rejuvenation of fluted face
739	Retouched	Distal shaping into scraper-like edge	Moderate at distal edge	SM2	
820	Slightly overshot	Remnant bifacial shaping at distal end	Heavy on platform and edges	SM1	
847	Overshot	Remnant bifacial shaping at distal end	Heavy on platform and edges	SM1	Secondary spall
884	Feathered	None	None	CH2	
886	Slightly hinged	Platform	Extremely heavy on edge	CH1	
891	Hinged	None	None	SM1	

Table A.9 Continued

Cat. No.	Termination	Retouch	Use-wear	Material	Comments
894	Overshot	None	Heavy on ridges	SM1	
935	Hinged	None	Light on ridges	SM1	
313	Snapped	None	Heavy on ridge	SM2	
656	Snapped	None	None	SM1	
819	Snapped	None	Heavy on side, moderate on ridges	SM1	
868	Snapped	None	Light on ridge	SM1	
493	Snapped	None	None	CH2	
811	Snapped	None	Light on edge	SM1	
428	Slightly overshot	Possible	None	SM1	
477	Overshot	None	Moderate at distal tip	SM1	
648	Slightly overshot	None	Moderate along ridge	SM1	
650	Slightly overshot	Edge	None	SM1	

Table A.10 Microcore measurements

Catalogue Number	Portion	Weight	Height	Length	Thickness	Platform Element Length	Platform Scar/ Rejuvenation Length	Chord Length	Flute Length	Level
209	Core	3.7	21.86	23.02	7.45	21.70	21.70	5.45	21.81	2
556	Core	5.9	23.98	27.52	8.35	26.74	7.96	5.48	19.56	2
653	Core	4.5	22.53	24.28	8.68	19.16	N/A	6.31	18.12	2
790	Core	11.4	28.55	41.10	10.56	41.10	26.57	10.79	27.91	4
792-796	Refitted Core	5.2	29.52	30.56	8.57	21.50	N/A	6.67	29.05	3
812	Core	5.7	28.22	21.55	9.46	21.82	6.35	7.37	24.70	5
814a	Core	3.0	19.73	17.93	7.00	17.93	17.93	6.89	18.96	2
814b	Core	-	-	-	-	-	-	6.22	19.89	-
830	Core	4.4	21.74	26.53	9.83	25.81	7.17	5.39	22.15	4
873	Core	11.3	26.56	43.81	12.24	43.74	12.25	5.57	22.18	2
892	Core	4.6	19.85	26.40	9.29	26.34	6.23	4.41	20.63	2
Average Measurement		*6.0*	*24.25*	*28.27*	*9.14*	*26.58*	*13.27*	*6.41*	*22.27*	
Minimum Measurement		*3.0*	*19.73*	*17.93*	*7.00*	*17.93*	*6.23*	*4.41*	*18.12*	
Maximum Measurement		*11.4*	*29.52*	*43.81*	*12.24*	*43.74*	*26.57*	*10.79*	*29.05*	
255 & 373	Core Fragment	3.4	31.89	24.34	6.97	20.63	9.59	8.27	30.51	2/3
364	Core Fragment	1.6	N/A	N/A	N/A	N/A	N/A	5.08	N/A	2
872	Core Fragment	2.6	25.65	N/A	7.58	N/A	N/A	6.01	24.61	2
554	Core Fragment	0.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2
003, 729, 730 & 743	Core Preform	56.9	47.25	45.00	25.03	45.00	N/A	23.45	N/A	2
614	Platform Tablet	5.0	15.25	36.12	13.22	36.12	N/A	13.22	N/A	3

Table A.11 Shape and fluted face characteristics of microcores

Catalogue Number	Portion	Base	Shape	Remnant Flutes	Shaping Methods
209	Core	Flake	Wedge	3	Unifacial, some thinning
556	Core	Flake	Informal	2	Rough, some thinning
653	Core	Flake	Wedge	2	Unifacial flaking
790	Core	Thick flake	Wedge	3	Rough
812	Core	Flake	Wedge	4.5	Rough
814a	Core	Unknown	Wedge	3	Unknown
814b	Core	-	-	2	-
830	Core	Flake	Wedge	2	Unifacial thinning
873	Core	Biface Tool	Wedge	2	Bifacial flaking
892	Core	Flake	Wedge	2	Rough, some thinning
255 & 373	Core Fragment	N/A	Wedge	3	N/A
364	Core Fragment	N/A	N/A	2	N/A
792-796	Core Fragment	N/A	Wedge	1	N/A
872	Core Fragment	N/A	Wedge	3	N/A
003, 729, 730 & 743	Core Preform	Core	Wedge	N/A	Bifacial flaking
614	Platform Tablet	N/A	N/A	6	Bifacial flaking

Table A.12 **Platform and use-wear characteristics of microcores**

Catalogue Number	Platform Preparation	Platform Rejuvenation	Use-Wear	Platform Grinding	Basal Crushing
209	Full spall	Unknown	Keel, reverse edge of fluted face	Yes	No
556	Unknown	Partial spall	Keel, obverse of platform	Possible	Light
653	Unknown	Unknown	Obverse edge of platform, notching at base	No	Yes
790	Full spall	Full spall	No	Yes	Yes
812	Unknown, probably flaking	Partial spall	Reverse edge of platform, obverse of keel	Yes	Yes
814a	Unknown	Side Flaking	Reverse edge of fluted face, base	No	-
814b	Unknown	Side Flaking	Platform	No	Yes
830	Side flaking	Side Flaking	Reverse edge of fluted face	Yes	No
873	Partial spall	None	Both edges of fluted face, and all margins	Yes	No
892	Full spall	Partial spall	Obverse edge of fluted face	No	No
255 & 373	Side flaking	Partial spall	Base	N/A	Yes
364	Spall	N/A	Obverse edge of fluted face	Yes	N/A
792-796	N/A	N/A	Reverse edge of fluted face	N/A	N/A
872	N/A	Partial spall	Platform, Base	Yes	Yes
003, 729, 730 & 743	Spall	N/A	No	N/A	No
614	Full spall	Full tablet	N/A	Yes	N/A

Table A.13 Ridge flake measurements

Catalogue Number	Artifact Type	Portion	Weight	Length	Mid-Point Width	Mid-Point Thickness	Maximum Width	Maximum Thickness	Level
387	Ridge flake, primary	Whole	0.4	24.13	4.31	3.20	5.79	3.20	2
637	Ridge flake, primary	Proximal	0.1	N/A	5.73	7.55	5.77	7.71	2
646	Ridge flake, primary	Medial	0.1	N/A	3.79	2.01	3.79	2.04	2
647	Ridge flake, primary	Distal	0.2	N/A	4.68	3.27	4.72	3.27	2
861	Ridge flake, primary	Distal	0.1	N/A	4.70	2.09	5.20	2.41	3
645	Ridge flake, secondary	Whole	0.2	18.99	4.80	2.86	5.19	2.86	2
671	Ridge flake, secondary	Whole	0.3	23.89	4.21	3.27	4.65	3.31	2
897	Ridge flake, secondary	Whole	0.2	19.87	5.56	2.29	5.83	2.29	3
644	Ridge flake, secondary	Proximal	0.1	N/A	5.32	1.93	5.67	1.93	2
664	Ridge flake, secondary	Proximal	0.1	N/A	4.97	1.87	6.67	2.00	3
672	Ridge flake, secondary	Proximal	0.1	N/A	5.67	2.15	7.50	2.25	2
742	Ridge flake, secondary	Proximal	0.1	N/A	2.77	0.77	3.51	0.97	2
565	Ridge flake, secondary	Medial	0.1	N/A	4.42	2.24	4.42	3.09	2
440	Ridge flake, secondary	Distal	0.2	N/A	5.04	2.29	5.40	2.63	2
Average Measurement			*0.2*	*21.7*	*4.7*	*2.7*	*5.3*	*2.9*	
Minimum Measurement			*0.1*	*19.0*	*2.8*	*0.8*	*3.5*	*1.0*	
Maximum Measurement			*0.4*	*24.1*	*5.7*	*7.6*	*7.5*	*7.7*	

Table A.14 Platform ridge flake measurements

Cat. Number	Artifact Type	Portion	Weight	Length	Mid-point Width	Mid-point Thickness	Maximum Width	Maximum Thickness	Level
413	Platform ridge flake, primary	Whole	2.7	36.02	7.50	7.57	8.74	8.72	2
224	Platform ridge flake, secondary	Whole	1.7	31.61	7.11	6.50	7.36	6.61	2
889	Platform ridge flake, secondary	Whole	0.3	18.50	6.65	3.08	6.65	3.08	2
Average Measurement			*1.6*	*28.7*	*7.1*	*5.7*	*7.6*	*6.1*	

Table A.15 Shape and platform characteristics of ridge flakes

Cat Number	Artifact Type	Portion	Platform Scars	Platform Grinding	Cross-Section
387	Ridge flake, primary	Whole	1	Yes	Triangular
637	Ridge flake, primary	Proximal	2	N/A	Triangular
646	Ridge flake, primary	Medial	N/A	N/A	Triangular
647	Ridge flake, primary	Distal	N/A	N/A	Triangular
861	Ridge flake, primary	Distal	N/A	N/A	Triangular
645	Ridge flake, secondary	Whole	1	No	Trapezoidal
671	Ridge flake, secondary	Whole	2	Yes	Trapezoidal blocky
897	Ridge flake, secondary	Whole	1	Yes	Trapezoidal
644	Ridge flake, secondary	Proximal	1	No	Triangular
664	Ridge flake, secondary	Proximal	2	Yes	Triangular
672	Ridge flake, secondary	Proximal	1	Yes	Triangular
742	Ridge flake, secondary	Proximal	1	Light	Trapezoidal
565	Ridge flake, secondary	Medial	N/A	N/A	Triangular
440	Ridge flake, secondary	Distal	N/A	N/A	Triangular
413	Platform ridge flake, primary	Whole	1	Possible	Square
224	Platform ridge flake, secondary	Whole	1	No	Trapezoidal to triangular
889	Platform ridge flake, secondary	Whole	2	Yes	Triangular

Table A.16 Production and use-wear characteristics of ridge flakes

Cat Number	Ridge Shaping	Use-wear	Material	Refitting Sequence/Comments
387	Unifacial from right	Heavy on ridge	SM1	
637	Unifacial and bifacial	None	SM1	
646	Unifacial from left	Heavy on ridge	SM2	
647	Unifacial from right	Moderate on ridge	SM3	
861	Bifacial	None	SM1	
645	Unifacial from right	Ridge grinding	SM2	Refits on top of microblade HiOv-89:658. Ends in a step fracture
671	Bifacial	Heavy on ridge	SM1	One previous ridge flake. Refits with microblade HiOv-89:669
897	Unifacial from right	None	SM1	One previous ridge flake scar
644	Unifacial from left	Moderate on lateral edge	SM1	One previous ridge flake scar on right side
664	Unifacial from left	Possible	SM3	One previous ridge flake scar
672	Unifacial from right	None	SM1	
742	Unidentifiable	None	SM2	
565	Unidentifiable	Possible	SM1	
440	Unifacial from left	Light on break	SM1	Two previous ridge flake scars
413	Bifacial	Moderate, dorsal and ventral	SM1	
224	Unifacial	Light on ridge	SM1	One previous ridge flake scar measuring 14.90mm from proximal end. Possible previous flute scar visible on platform
889	Unifacial from right	None	SM1	Hinge termination

Table A.17 Measurements of microblades

Cat Number	Portion	Wgt	Length	Mid-Point W	Mid-Point T	T/ W Ratio	Max W	Max T	Level
496	Whole	0.1	14.83	5.46	1.46	0.27	5.64	1.47	2
641	Whole	0.2	28.24	4.14	1.90	0.46	4.72	2.08	2
649	Whole	0.1	19.81	3.61	1.44	0.40	4.26	2.15	2
665& 667	Whole	<0.1	21.45	3.37	0.99	0.29	3.98	1.37	4
668	Whole	0.1	22.57	3.79	2.20	0.58	3.86	2.22	1
669	Whole	0.1	23.52	3.72	2.16	0.58	3.75	2.26	2
883	Whole	0.3	25.18	4.46	1.78	0.40	5.42	4.34	3
888	Whole	<0.1	16.97	3.79	1.03	0.27	3.79	1.14	2
895	Whole	0.3	23.24	5.63	2.17	0.39	6.43	2.28	2
930	Whole	0.1	13.66	3.88	1.13	0.29	3.94	1.32	2
301	Proximal	<0.1	N/A	N/A	N/A	N/A	4.8	1.16	4
309	Proximal	<0.1	N/A	5.50	0.87	0.16	5.50	1.12	4
339	Proximal	0.1	N/A	4.30	1.93	0.45	4.50	2.07	2
378	Proximal	0.2	N/A	4.12	2.08	0.50	4.77	2.10	2
441	Proximal	0.2	N/A	6.19	1.49	0.24	6.19	1.49	2
531	Proximal	<0.1	N/A	N/A	N/A	N/A	N/A	N/A	2
596	Proximal	0.1	N/A	4.13	1.04	0.25	5.18	1.80	3
642	Proximal	0.1	N/A	4.30	1.25	0.29	4.82	1.56	2
654	Proximal	0.2	N/A	4.86	1.64	0.34	5.37	2.26	3
658	Proximal	0.3	N/A	6.19	2.13	0.34	6.80	2.37	3
659	Proximal	0.2	N/A	6.20	2.03	0.33	6.33	2.16	3
660	Proximal	<0.1	N/A	5.11	1.19	0.23	5.11	1.19	3
662	Proximal	<0.1	N/A	4.26	1.38	0.32	4.46	1.40	3
710	Proximal	0.1	N/A	4.66	0.66	0.14	4.66	1.36	3
712	Proximal	0.1	N/A	4.11	0.91	0.22	4.56	1.30	3
829	Proximal	0.1	N/A	5.19	1.14	0.22	5.71	1.18	5
887	Proximal	<0.1	N/A	2.52	0.98	0.39	3.16	1.43	2
890	Proximal	<0.1	N/A	4.10	1.75	0.43	5.19	1.84	2
952	Proximal	0.1	N/A	3.29	1.26	0.38	4.28	1.26	2
007&639	Proximal	0.2	N/A	5.09	1.82	0.36	6.56	1.82	2
480	Medial	<0.1	N/A	5.91	1.41	0.24	5.91	1.41	3
666	Medial	0	N/A	5.75	1.35	0.23	5.75	1.35	4
818	Medial	0.1	N/A	6.49	1.17	0.18	6.49	1.17	2
643	Distal	0.1	N/A	4.63	1.23	0.27	5.13	1.69	2
651&652	Distal	0.1	N/A	2.55	1.35	0.53	3.07	1.58	2
663	Distal	0.2	N/A	4.33	2.60	0.60	4.95	2.84	3
Average Measurement		0.12	20.95	4.58	1.46	0.33	5.00	1.73	
Minimum Measurement		<0.1	13.66	2.52	0.66	0.14	3.07	1.12	
Maximum Measurement		0.30	28.24	6.49	2.20	0.58	6.80	4.34	

Table A.18 Microblade characteristics

Catalogue Number	Portion	Platform Scars	Platform Grinding	Curvature	Arrises	Cross-Section	Termination	Retouch	Use-wear	Mat.
496	Whole	1	Present	None	2	Trapezoidal, flat	Hinged	None	None	SM1
641	Whole	1	Present	Moderate distal	3	Both	Slightly hinged	None	None	SM3
649	Whole	1	None	Moderate distal	2	Both	Overshot	None	None	SM3
665&667	Whole	1	None	Light	2	Triangular	Slightly feathered	None	None	SM2
668	Whole	2	Light	Heavy	2.5	Trapezoidal	Cortex, indeterminate	None	None	SM3
669	Whole	2	Present	Moderate	2	Trapezoidal	Hinged	None	None	SM1
883	Whole	2	Light	Moderate distal	2	Trapezoidal	Strong overshot	Moderate	None	SM1
888	Whole	1	None	Light	2	Both	Feathered	None	None	SM1
895	Whole	1	Heavy	Moderate	2	Trapezoidal, thick	Slightly overshot	None	None	SM1
930	Whole	battered	Present	None	2	Trapezoidal, flat	Slightly feathered	None	None	SM1
007&639	Proximal	4	Light	Light	3	Both	Snapped	None	Light	SM1
301	Proximal	1	Light	N/A	1	Triangular	Snapped	None	None	SM2
309	Proximal	2	None	Light	2	Triangular, flat	Snapped	None	None	SM3
339	Proximal	1	None	None	2	Triangular	Snapped	None	None	SM1
378	Proximal	1	Present	None	1	Triangular	Snapped	None	None	SM1
441	Proximal	1	None	Light	2.5	Trapezoidal, flat	Snapped	Light	Moderate	SM1
531	Proximal	3	None	None	1	Triangular	Snapped	None	None	SM1
596	Proximal	2	Heavy	Very light	1	Triangular	Snapped	None	Light	SM1
642	Proximal	1	Present	None	2	Both, flat	Snapped	None	None	SM1
654	Proximal	1	Present	Very light	2	Both	Snapped	None	Heavy	SM1
658	Proximal	1	Present	Light	1	Triangular	Snapped	None	None	SM2
659	Proximal	2	None	None	2	Both	Snapped	Moderate	Light	SM1
660	Proximal	1	Light	None	2	Trapezoidal	Snapped	None	None	SM1
662	Proximal	1	Light	Light	1	Trapezoidal	Snapped	None	None	SM2
710	Proximal	2	Light	Very light	1	Triangular, flat	Snapped	None	None	SM3
712	Proximal	2	None	Very light	2	Trapezoidal, flat	Snapped	None	Light	SM2
829	Proximal	3	Light	Very light	2	Both	Snapped	None	Heavy	SM2
887	Proximal	1	Light	Light	2	Both	Snapped	None	None	SM1
890	Proximal	3	Heavy	None	2	Both	Snapped	None	None	SM1
952	Proximal	2	Present	None	2	Trapezoidal	Snapped	None	None	SM1

Table A.18 Continued

Catalogue Number	Portion	Platform Scars	Platform Grinding	Curvature	Arrises	Cross-Section	Termination	Retouch	Use-wear	Mat.
480	Medial	N/A	N/A	None	2	Trapezoidal, flat	Snapped	None	Light	SM1
666	Medial	N/A	N/A	None	1	Triangular	Snapped	None	None	SM2
818	Medial	N/A	N/A	None	1	Triangular	Snapped	None	Moderate	SM1
643	Distal	N/A	N/A	Light	2	Trapezoidal	Slightly overshot	None	Light	SM1
651&652	Distal	N/A	N/A	Light	1	Triangular	Slightly overshot	None	None	SM2
663	Distal	N/A	N/A	Light	2	Triangular	Slightly feathered	None	Light	SM2